Long catheter foam sclerotherapy combined with phlebectomy

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Introduction
Varicose vein (VV) treatment has evolved towards a tailored approach, based on a surgery “a la carte”, or on endovenous ablative treatments. Among all the possible interventional treatments, ultrasound-guided foam sclerotherapy (UGFS) and hook-phlebectomy (HP) have had a growing diffusion within the scientific community in the last years.

On one side HP, if it is performed as a single procedure, may result in interesting outcomes at mid-term, on the other side HP may produce caliber reduction and reflux disappearance of saphenous stem/junction in the vast majority of the cases. Anyway literature data about mid/long-term follow-up of HP show the necessity of an adjuvant treatment for the saphenous stem in many cases.

Results of UGFS are generally worse in larger varices and overall long term outcomes seem to be slightly inferior to Surgery, Radiofrequency (RF) and Endovenous Laser Treatment. Similarly it is arguable that the inclusion of HP in foam sclerotherapy may mimic the laser and RF procedures, which commonly include HP for varicose tributaries.

With reference to sclerosant foam injection, the usage of long catheters has been proposed in the last years, as an alternative to UGFS. In fact long catheter foam sclerotherapy (LCFS) may allow a more homogenous distribution of the sclerosant foam, as well as fluid tumescence in the saphenous compartment may induce a significant minimisation of the saphenous calibre and of the inflow from tributaries and perforators, prior to foam delivery.

Design and Aims
A prospective clinical series (observational cohort study) has been planned to assess the short-mid term efficacy and safety of the association between HP of the varicose and concomitant LCFS of the great, small and anterior accessory saphenous vein (GSV, SSV and AASV respectively). Primary end-points were VV clinical recurrence, duplex-based saphenous stem occlusion/haemodynamic changes and finally symptoms change; secondary end-point was side effects and complication rate.

Patients and Methods
Since 2007 seventy-three patients (52 females, 21 males), for a total of 81 limbs, affected by primary VV related to saphenous vein incompetence were enrolled on an intention-to-treat basis; the patients were submitted in local anaesthesia to mini-incision HP of the varicose tributaries and concomitant LCFS of the incompetent tract of the GSV or SSV or AASV trunk. Mean patients’ age and BMI were 51,5 years and 27.9 (S.D.±5,6) respectively; distribution of C of CEAP was the following C2 63%, C3 25%, C4 9%, C5 2%, C6 1%. The subdivision of vein incompetence was as follows: 59% GSV, 32% AASV, 9% SSV and mean saphenous calibre 3 cms below the saphenous junction was 7.5 mm (SD ± 2.2). Terminal valve of sapheno-femoral junction or of sapheno-popliteal junction was competent in 67/81 cases. Clinical and colour-duplex investigation (CDI) were performed postoperatively and the follow-up duration varied according to the inclusion time; more in details 81 limbs were reviewed at 40 days and 6 months, 69 limbs at 12 months, 51 limbs at 24 months and 41 limbs at 30 months (mean follow-up time 16,8 months SD ± 8.1). The percentage of limbs which were lost at follow-up controls was 12% at 12 months, 30% at 24 months and 28% at 30 months. Visual analogue scale (VAS) assessment for main symptoms was performed during follow-up, with a 0(absence)) to 10(highest intensity) scale. Sclerosant foam was formed through Tessari method, using a gas mixture made of CO2 70% + O2 30% and no silicon syringes; as to sclerosant drugs sodiumtetradecylsulfate (STS) 3% was used in the vast majority of the cases, more rarely Polidocanol (POL) 3% or STS 1,5-2% were chosen. An average of 5,2. mls (SD ± 1.7) of sclerosant foam (higher doses for GSV and lower doses for SSV and AASV) were injected through an intrasaphenous 4-F long catheter in the incompetent saphenous tract. Bandage or 35 mmHg elastic stocking + pads were used as post-operative compression for 7 days 24 hours a day, then a 20-30 mmHg elastic stocking was worn by patients in daytime in the following 40 days. Ambulation was allowed 30-60 minutes after the operation and the patients were discharged 1-2 hours afterwards. One single injection of low molecular weigh heparin at prophylactic dose was administered pre-operatively. Eight limbs were submitted to one additional session of UGFS on tributaries 40-60 days after the original procedure.
Results
A significant VAS improvement was reported for the symptoms: pain mean value decreased from 4.4 to 0.8, heaviness from 5.7 to 1.4 and cramps/paraesthesias had pre/post-op mean value of 2.6 and 0.5 respectively. The clinical recurrence of VV and the CDI-based occlusion rate of the saphenous trunks were respectively: 2% and 95% at 40 days, 3% and 87% at 6 months, 3% and 83% at 12 months, 4% and 88% at 24 months, 2% and 88% at 30 months. The CDI-based cumulative outcomes at the longest follow-up assessment for each limb were the following: a) mean diameter of the patent residual saphenous veins 2.7 mm (SD:+/- 1.5); b) 82% vein occlusion rate, with 95% mean occlusion length percentage; c) antegrade flow in 2% of the cases, d) reflux< 1 sec. in 6% and reflux> 1 sec. in 10% of the limbs. As to post-operative complications, no cerebral or pulmonary embolic event was recorded, while minor complications included one gastrocnemius vein thrombosis, two superficial thrombophlebites and four transient pigmentation; no intraoperative ECG or digital oximetry abnormalities were recorded. Since April 2008 fluid tumescence (60-150 ml of Klein’s solution per intervention) infiltration of the saphenous compartment was included in the procedure, with significantly improved results (70% vs 59% saphenous occlusion rate with and without tumescence respectively). All the lost-to-follow-up patients had a telephone interview and they referred the absence of visible VV in the treated limb in all cases.

Discussion
In agreement with previously published data, our preliminary results from this clinical series show that the inclusion of HP to foam sclerotherapy, together with the usage of long catheter and fluid tumescence in the saphenous compartment, produce very promising results at short/mid-term. The presence of a learning curve, together with the lack of tumescence infiltration in the first 18 months experience, negatively influenced the cumulative outcomes of this clinical series, as the patients included at a later stage have obtained overall better clinical and CDI results. The significant drop-off rate at 12 and 24 months, limits the analysis of the results at longer term, though. This method can overcome the natural limit of foam sclerotherapy and of HP, being applicable also to larger calibre saphenous veins; the reported low clinical and CDI-based recurrence rate and the extremely low complication rate are finally combined with the low costs of this procedure, which can favourably affect its cost/benefit ratio.

Conclusions
The combination of LCFS and HP proved to be a cheap, effective and safe procedure, which results in a low recurrence rate, in a significant improvement of symptoms and in remarkable duplex-based outcomes, also in later stages of VV disease. Longer follow-up data and larger numbers of patients are awaited to validate this combined treatment in VV disease of the lower limbs.
Endovenous laser ablation of the great saphenous vein using a bare fiber versus a tulip fiber. A randomized clinical trial.

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Introduction
Endovenous laser ablation (EVLA) is a very popular technique in the treatment of the great saphenous vein. Nevertheless still some inconveniences such as postoperative ecchymosis, bruising and pain jeopardise the recovery. Some of these side-effects can be due to the direct contact between the fiber tip and the vein wall. From a technical point of view EVLA also has some imperfections: the bare fiber used for EVLA is a rigid fiber. When this fiber is introduced in a saphenous vein, which usually has some small tortuositues and turnings, the fiber has always a tendency to stretch. As a consequence of this stretching, the fiber tip frequently hits the vessel wall (1). Examining the fiber location on per-operative ultrasound control, we can see the fiber tip most frequently situated in a very eccentric position in the vein, the tip touching the vein wall.

Tumescent anaesthesia induces spasm of the vein around the fibre and can diminish this effect. But even then, especially in larger veins, the fiber tip stays in an eccentric position. When in such a situation the energy is delivered at the fiber tip, a direct contact between the fiber tip and the vessel wall results in a destruction and ulceration or perforation of the vein. A consequence of this is a very uneven application of light energy (2,3). When a specimen of vein, which has been treated with EVLA, is examined histologically, a line of damaged vessel wall is seen with carbonised vein wall and ulcerations and perforations, while the rest of the vessel wall stays unaffected. These perforations cause the post-operative appearance of ecchymosis, bruising and pain (4). A histological study showed that avoiding the direct contact between the fiber tip and the vein wall, and centring the fiber-tip intraluminal, results in a more homogenous vein wall destruction, less vein wall perforations and less perivenous tissue destruction (5).

A new safety fiber has been designed: the tulip-shaped, self-expandable distal end at the fiber tip expands within the vein lumen and pushes away the vein wall, thus avoiding this direct contact.

Purpose
The aim of this randomized clinical trial was to evaluate the clinical use of this tulip fiber. We studied the occlusion rate and possible side-effects.

Methods
Between February and December 2010, 174 patients with an unilateral incompetence of the great saphenous vein have been treated in two hospitals: Sint-Andriesziekenhuis Tielt and the University Hospital Gasthuisberg Leuven, Belgium. Inclusion criteria were patients with insufficiency of the great saphenous vein with functional and/or aesthetic inconvenience. In all patients, the diagnosis of venous insufficiency was made by clinical evaluation and Duplex studies. Only unilateral treatments were included. Patients with concomitant insufficiency of the short and/or anterior saphenous vein were excluded. Other reasons for exclusion were deep venous insufficiency, patients with venous diameter exceeding 15mm and cross-dilatation with more than two incompetent side-branches, therapeutical anticoagulation or hypocoagulopathy, hypercoagulopathy or thrombophilia, occlusive peripheral arterial disease (ankle-brachial index<0.85) and pregnancy. All included patients had a minimum age of 18 years. Approval was obtained from the ethics committee of the university hospital Gasthuisberg (Leuven) and the local research committee of the Sint-Andries hospital (Tielt) and the research was performed according to the guidelines of the Declaration of Helsinki. A total of 215 patients fulfilled inclusion and exclusion criteria and 174 of them were randomized after signing an informed consent form. 87 patients have been treated using a Tulip-fibre, the remnant 87 were treated with a bare fibre. We used a 1500nm diode laser (Inter-medic, Barcelona, Spain). Randomization was done using numbered and sealed envelopes. The patients were classified using the CEAP (clinical, etiology, anatomy, pathophysiology) clinical classification.

Description of the Tulip Fiber
This safety fiber (5) consist of a bare fiber with a hollow tube, fixed at the distal end of the fiber. This tube has tulip-shaped, self-expandable blades at its distal end (around the fiber). The tube is folded into an outer guiding catheter, which permits easy access to the vein undergoing treatment. When the outer guiding catheter is with-
drawn (pullback), the tulip-shaped blades at the distal end of this tube expand and push away the vein wall (figure 1).

This expansion centers the fiber tip intraluminal and thus avoids the direct contact between the fiber tip and the vein wall. It also prevents pushing the fiber further intraluminal into the deep system. The tube is made of stainless steel, which has excellent mechanical and chemical resistance to high temperatures.

**Technique**
Access to the saphenous vein was obtained by puncture under ultrasound guidance, and this at the most distal part of reflux. The laser fiber was positioned 1.5cm distal to the SFJ. Before laser ablation tumescent anaesthetic was injected profusely around the saphenous vein, under ultrasound control. At least 300 ml of fluid was injected around the target vein. All patients were treated in the Trendelenburg position.

All saphenous vein ablations were accompanied by a Muller phlebectomy. Phlebectomies were not performed in the immediate vicinity of the treated GSV, in order not to interfere with the measurement of ecchymosis resulting from the EVLA.

**Postoperative care and follow-up**
Compression stockings (class 2) were applied for 3 weeks postoperatively. All patients were treated in an outpatient setting and were encouraged to return to normal activities as soon as possible. All 174 patients were given a prescription for diclofenac on discharge with the instruction to take them only when they became aware of pain or inflammation in the treated leg and then to take two capsules daily. Only patients at risk (history of DVT or superficial thrombophlebitis, morbid obesity BMI>35) for DVT received prophylactic low molecular weight heparine (Enoxiparine 40 mg) for 10 days (thrombophilia was one of the exclusion criteria). A clinical follow-up was scheduled at five days, one month and six months postoperatively. Several clinical scores were used: level of analgetic intake, a visual analogue pain score (VAS), a postoperative Quality of Life score, an ecchymosis score, and the patient satisfaction rate.

The construction and validation of a quality of life questionnaire (CIVIQ), originally designed to analyze changes in quality of life (QoL) caused by venous insufficiency, was used to analyze the two-week postoperative morbidity caused by the treatment. This 20-item questionnaire(CIVIQ2) provides a profile on four QoL dimensions (psychological, pain, physical and social) specific to venous derangement of the lower limb. The CIVIQ2 has been demonstrated to be a valid, reliable, stable and sensitive scale. The quality of life questionnaire had to be completed on the 14th postoperative day and to be returned at the one month postoperative control. To evaluate ecchymosis, we developed a scale in which the postoperative ecchymosis around the ablated vein was expressed in square centimetres (cm²), and this measured surface was divided by the length of the treated vein. Ecchymosis measurement was performed at the 5th postoperative day.

**Results**
The average ages of the patient groups were 52.3 (Bare fiber) and 51.4 years (Tulip fiber) and there was no difference between the two groups (p=0.67). There was no difference in the measured vein diameters, length of the treated vein segments and gender between the two groups (table 1).

The used energy in the patient group treated with a bare fibre was somewhat higher compared to the patient group treated with a Tulip-fiber (63.4J/cm versus 59.7J/cm, p=0.007). Patients treated with a bare fiber also had on average a higher BMI compared to patients treated with a Tulip fiber (26.8 versus 25.4). For this reason we added a corrected analysis based on a general linear model. This regression analysis showed that these differences in patient characteristics had no influence on the measured outcome factors.

The total occlusion rate at one month was 97.6% and there was no significant difference between both groups (p=0.309). Occlusion rates at six months will be aval-
lable in December. Patients treated with a tulip fibre had significant less postoperative ecchymosis (0.11 vs 0.47; p<0.001), pain (5th day) (1.13 vs 2.31; p <0.001) and had a better postoperative quality of life (29.74 vs 33.42; p =0.025). There was no difference in analgetics intake (p=0.59) and patient satisfaction rate(p=0.655). (Table 2)

Table 1: patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>BARE</th>
<th>Tulip</th>
<th>T-test</th>
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<tbody>
<tr>
<td>n</td>
<td>87</td>
<td>87</td>
<td></td>
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<tr>
<td>Age</td>
<td>51.41 (SD:13.4)</td>
<td>52.29 (SD:13.2)</td>
<td>p=0.66</td>
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<tr>
<td>BMI</td>
<td>25.36 (SD:3.7)</td>
<td>26.81 (SD:5.06)</td>
<td>p=0.038</td>
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<tr>
<td>Max Diam</td>
<td>7.4mm (SD:2.7)</td>
<td>7.5 (SD:2.8)</td>
<td>p=0.73</td>
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<td>Mean Diam</td>
<td>5.7mm (SD:1.8)</td>
<td>5.9 mm (SD:2.1)</td>
<td>p=0.50</td>
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<tr>
<td>Length</td>
<td>36.3 cm (SD:8.4)</td>
<td>34.16 cm (SD:10.9)</td>
<td>p=0.14</td>
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<tr>
<td>LEED</td>
<td>59.6 J/cm (SD:8.04)</td>
<td>63.4 J/cm (SD:9.92)</td>
<td>p=0.07</td>
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<tr>
<td>Fluence</td>
<td>36.6 J/cm (SD:10.3)</td>
<td>37.8 J/cm (SD:12.5)</td>
<td>p=0.30</td>
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<td>Gender (female)</td>
<td>78%</td>
<td>73%</td>
<td>p=0.50</td>
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</table>

Table 2: Patients outcome parameters

<table>
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<th>BARE</th>
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<tr>
<td>Factor</td>
<td>25% Median 75%</td>
<td>25% Median 75%</td>
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<tr>
<td>Echymosis Score</td>
<td>0.08 0.21 0.66</td>
<td>0.00 0.04 0.14</td>
<td>0.000</td>
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<tr>
<td>Painscore d5-</td>
<td>1.00 2.00 3.50</td>
<td>0.00 1.00 2.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Painscore 2 weeks</td>
<td>1.00 2.00 3.00</td>
<td>1.00 2.00 3.00</td>
<td>0.180</td>
</tr>
<tr>
<td>Analgetics, days</td>
<td>0.00 1.00 2.00</td>
<td>0.00 1.00 1.00</td>
<td>0.111</td>
</tr>
<tr>
<td>Analgetics, total number</td>
<td>0.00 1.00 2.50</td>
<td>0.00 0.00 2.00</td>
<td>0.119</td>
</tr>
<tr>
<td>QOL (0-100)</td>
<td>24 32 40 23 27 34</td>
<td>29 32 39 23 27 34</td>
<td>0.023</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>9.00 10.00 10.00 8.00 9.50 10.00</td>
<td>9.00 10.00 10.00 8.00 9.50 10.00</td>
<td>0.564</td>
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<tr>
<td>Incapacity work</td>
<td>1.00 8.00 15.00</td>
<td>1.00 2.00 10.50</td>
<td>0.012</td>
</tr>
<tr>
<td>Occlusion rate 1 month</td>
<td>85/87 (97.7%)</td>
<td>83/86 (96.5%)</td>
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</table>

**Conclusion**

Using a Tulip fibre for EVLA of the great saphenous vein results, compared with the use of a bare fibre, in equal occlusion rates at one month and six months, but provokes less postoperative ecchymosis and pain. Patients treated with a tulip fiber seem to have a better postoperative quality of life.

**References**

Peroperative foam sclerotherapy with short catheter in REVAS

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The Foam sclerotherapy could be used peroperatively especially for the treatment of recurrences. This can replace surgical elements of the operation when these elements are impossible, too dangerous or too aggressive. Pre-operative anatomical assessment by Duplex is mandatory to define the strategy and the ideal location of where the foam will be injected. The foam used is made by 1% polidocanol mixed with 4 times its volume of air according to Tessari method. The technique of introduction of the foam depends on the location of the network to be treated:

- The injection of the inguinal neovascularisation is performed downwards under visual control through the inguinal incision or at distance from below by a percutaneous echo-guided puncture or by an injection through a catheter.

- Recanalizations of venous pathways in the shape of tortuous and dystrophic networks are sclerosed by direct echo-guided puncture.

- Sclerosis of a residual saphenous trunk is carried out by inserting a catheter or by direct echo-guided puncture.

- Perforator injection is carried out either directly by puncture or indirectly through a catheter.

We have studied retrospectively 129 recurrences treated in this way (100 great saphenous (GSV), 29 small saphenous veins (SSV)). The 100 GSV were 28 trunks directly connected with the femoral vein, 28 connected with a lymphoganglionic network, 11 connected with perforators and 33 isolated trunks. The 29 SSV, were 4 trunks directly connected with the popliteal vein, 7 not connected 15 popliteal perforators and 3 recanalizations after SSV stripping. All operations included phlebectomies. Twenty re-flush ligations in the groin and 4 in popliteal fossa were carried out. All were carried out under local anesthesia in an ambulatory setting. All patients were assessed clinically and by color Duplex at 3-day follow-up, 115 only were assessed at 40-days. 120 patients (93%) showed complete obliteration. The 9 incomplete obliterations were 3 venous recanalizations in the SSV compartment and 6 perforators (4 popliteal and 2 femoral). Two asymptomatic deep venous thromboses were detected by color Duplex 3-day after operation.

The disadvantage is that the vein puncture during the operation is more difficult than when it is carried out postoperatively. Thromboembolic risk appears to be increased when the sclerosis is performed per-operatively (1.7%). The advantage of the operating room is that we have a large number of different devices to introduce the foam. The efficiency is higher probably because the patient stays immobile for a long time, the segments of treated veins are surgically disconnected and without any flow.

Even with only a 93% obliteration rate at 40 days and a slow decreasing of the percentage as time goes by, the peroperative sclerotherapy should enhance surgical results, since the varices or veins treated peroperatively by sclerotherapy are surgically inaccessible and not excisable.
Vein obliteration with off the shelf devices

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Introduction
Endovenous techniques now have a proven record of efficiency and safety. Unfortunately, in most countries the cost of the single use catheters needed restricts their availability to patients who can afford to pay for this expense. We have been using cheaper solutions to widen the application of these techniques.

Material and methods
Chemical and thermal techniques can benefit from this approach.

Since 2001 we have used Alpha Technique: Ambulatory Bloodless Catheter Delivered Endovenous Foam in Great and Small saphenous trunks.

A Cook® F5 straight angiographic catheter (cost 12 €) is introduced under echo guidance and local anesthesia through a Vygon F5 Desilet® Seldinger kit (30 €).

It is positioned under the junction and 20 cc of tumescent solution are injected to compress the vein proximally.

A short stretch sterile bandage is applied over the thigh. 4 to 6 cc of 2% Polidocanol Foam are injected while removing the catheter.

The bandage is left for 60 min then removed and the patient leaves the clinic.

Steam thermal obliteration is usually performed with a specific catheter.

But through a Luer connector, we saw that the dilator of the Vygon Desilet Kit could be adapted to the hand piece. As it is 20 cm long, it is long enough to treat a Small Saphenous vein.

We puncture the vein with a Seldinger needle, introduce the guidewire then the dilator up to the point where the saphenous trunk bends down in the popliteal fossa.

Tumescent solution is injected around the vein.

3 pulses per centimeter are sent every cm, compression of the proximal trunk with the Ultrasound probe prevents steam entering the popliteal vein.

Results
A comparative study at 5 years was performed between Alpha, Closure Plus and 940 nm bare fiber laser in obliteration of Great Saphenous Veins of 7.5 mm mean Diameters. Rate of obliteration were identical for Alpha and Radio-frequency at 85% while laser had only 70% of the veins still closed.

20 Small Saphenous veins were treated with the Vygon device for injecting steam. All were closed at 3 months and 17 of 18 follow up at 1 year.

Conclusion
Use of mass produced catheters may decrease the cost of endovenous procedures without decreasing the long term efficiency of these methods.
Endovenous procedures in humanitarian medicine

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International humanitarian mission with phlebologic interest in Ecuador (2008-2010).

This mission stemmed from a collaboration between “Amigos de Salud – Morrison Foundation” and an Ecuadorian foundation “el cielo para los ninos”. It took place in military hospitals in different areas of Ecuador for many years.

The objective of the mission was to help a population facing strong economical difficulties preventing them from accessing treatment for their venous insufficiency. Each team, brought its own equipments and its knowledge. A massive queue of patients came every day from all the country and each volunteer was tasked order to take care of more than 100 patients a day. Techniques available were Radiofrequency Closure FAST, LASER 810nm, Steam Vein Sclerosis (SVS), ambulatory phlebectomy, and Ultrasound Guided Foam Sclerotherapy (UGFS).

During one week the teams manned with thirty volunteers were able to screen, map, treat and give compression stockings for more than 600 patients: 143 thermal ablations, about 425 UGFS. No serious side effect was noticed.

Phlebology as a speciality, is well suited to humanitarian missions because of need for screening with clinical examination, mapping the varicose vein with doppler ultrasound for every clinical stage (C2 to C6 of the CEAP classification) and treatment of the main varicose veins can be performed in a single session. Among the different treatments of varicose veins, the thermal and chemical ablations are the most appropriate procedures to treat a large number of patients in short time with few side effects. More over we can combine them to treat extensive or bilateral varicose veins with large diameter or ectasia. The follow up of the treatment should be possible every two years.

Endovenous procedures using thermal or chemical ablation are ideal for humanitarian missions because they are efficient, safe with very few side effects and able to treat a large number of patients in a short time. Sponsoring by medical device companies is necessary to the success of these missions, we express our thanks to them.

Key words: humanitarian medicine, endovenous procedures
Ruptured AAA. Evidence for EVAR, are we guilty when not offering this option?

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Ruptured abdominal aortic aneurysms (RAAAs) are being treated by endovascular aneurysm repair (EVAR) and other endovascular techniques with increasing frequency. The endovascular procedures offer many potential advantages over open repair (OR). They are less invasive, eliminate damage to periaortic and abdominal structures, decrease bleeding from surgical dissection, minimize hypothermia and lessen the requirement for deep anesthesia.

Because of these advantages, EVAR has been used extensively to treat RAAAs by several groups who have achieved good results (1-8). In contrast, some other groups have been unable to demonstrate superiority of EVAR over OR in the RAAA setting (9-10). In this article we will describe some of the strategies, techniques and adjuncts which facilitate the endovascular treatment of RAAAs. We believe that these all contribute to improved outcomes in terms of enhanced survival with this difficult group of patients.

Strategies, techniques and adjuncts - top tips

1. **Standard Approach or Protocol.** These allow the most effective decision-making and treatment of these patients in what are often confusing and stressful circumstances (6.7). They are also important to facilitate education in and recognition of RAAAs by generalists, emergency room personnel and others to enable early diagnosis and mobilization of the specialized care givers best trained to optimize treatment.

2. **Fluid Restriction (Hypotensive Hemostasis).** Fluid resuscitation should be restricted even if the patient becomes hypotensive. Experience has shown that systolic arterial pressures of 50-70 mm Hg are well tolerated for short periods and limit internal bleeding and its associated loss of platelets and clotting factors (2,3,7,11). Whether or not pharmacological lowering of blood pressure is beneficial remains to be conclusively shown (6.7).

3. **Treatment Site.** EVAR procedures are optimally performed in a site equipped for excellent fluoroscopic imaging and open surgery since some patients will require OR or open adjuncts to their EVAR.

4. **Anesthesia and Catheter-Guidewire Placement.** The latter should be obtained percutaneously under local anesthesia. This permits arteriography to define aortic and arterial anatomy, facilitates large sheath and supraceliac balloon placement if needed, and prevents circulatory collapse caused by the induction of general anesthesia. Whether general anesthesia is used later to eliminate motion and improve fluoroscopic imaging to permit precise graft deployment remains controversial. One group has successfully used local anesthesia supplemented by sedation throughout as an alternative (1.3,7).

5. **Supraceliac Aortic Sheath Placement And Balloon Control.** Most experienced groups favor their use only when there is severe circulatory collapse. In such cases, deflation of the balloon before sealing of the rupture site will result in immediate recurrence of the circulatory collapse. Therefore, techniques have been developed to maintain continuous aortic control until the endograft has sealed the leak (2,3,7,12,13). These techniques use multiple balloons to minimize renal and visceral ischemia by placing secondary balloons within the endograft as the supraceliac balloon is deflated and removed through its supporting sheath.

6. **Endograft Type And Configuration.** Both bifurcated and aortouniliac (or femoral) grafts can be used successfully, although some patients have unilateral iliac disease which mandates a unilateral configuration. Modular and unibody grafts have been used successfully in both configurations. An appropriate inventory of suitable grafts and accessories must be stocked sterile in the treatment site and be available for the procedure and unexpected contingencies.

7. **Abdominal Compartment Syndrome** is a major cause of morbidity and mortality after EVAR for RAAA. It is advantageous to keep a high index of suspicion for this entity. Laparotomy and hematoma evacuation have alleviated the hypotension, high ventilatory compliance and oliguria that occurs with the full blown syndrome. Monitoring bladder pressure has been helpful in the early detection of the syndrome (3,7), and early laparotomy with open abdomen treatment (OAT) and suction/sponge (VAC) dressings may decrease mortality and allow survival in otherwise hopeless circumstances when small bowel and mesenteric edema cause loss of domain for the abdominal viscera (7,14).

8. **EVAR For Worst Risk Patients.** It is probable that EVAR is most beneficial in augmenting survival when it is used in the worst risk patients who are unlikely to survive an OR. Patients with hemodynamic instability and profound circulatory collapse, a hostile abdomen, or those unable to receive transfusion would fall in this cate-
gory. If such patients, particularly those that are hemodynamically unstable, are excluded from EVAR, it is likely that the improved survival that can accrue from this form of treatment will be diminished (8).

Discussion

It is clear that several centers, in which the physicians and surgeons are enthusiastic about EVAR treatment for RAAAs, attempted to perform the procedure preferentially in every AAA patients with suitable anatomy (8). This includes patients who are hypotensive and hemodynamically unstable as well as those with frank hemorrhagic shock. These centers have achieved favorable results with EVAR for RAAAs in these unstable patients and believe that it is precisely these high-risk unstable hypotensive patients in whom EVAR offers the greatest survival benefit over open repair. In these centers, between 28% and 79% (Mean 49.1%) of all RAAA patients were treated by EVAR. In addition the proportion of patients treated by EVAR increased with time as devices and skills improved and enthusiasm for the procedure increased, and it is likely that the proportion will increase further as new devices and techniques are introduced. All these centers that are enthusiastic about EVAR treatment of RAAAs emphasize several key factors that are important in achieving favorable outcomes in these patients. Proper use of aortic balloon control, adequate recognition and treatment of abdominal compartment syndrome and the establishment of a structured system and protocol for the treatment of RAAA patients all contribute importantly to improved survival outcomes in patients with this diagnosis. Although there may be other ways to deal with these and other factors and still achieve good outcomes with EVAR in the RAAA setting, the strategies, techniques and adjuncts outlined in this chapter are one way of doing so that has proven to be effective.

References

EVAR for non-fitted AAA. Is the chimney technique a durable option and when to use it?


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Introduction

With short infrarenal necks (<10mm), the chimney endograft technique allows deployment and fixation of the main aortic stent-graft in a more proximal, healthy part of the aorta. Originally, maintenance of blood flow to the covered renal arteries was achieved by using bare stents that were deployed partially inside the renal vessels and partially extending to the suprarenal aortic lumen (1). This technique was standardized by Thomas Larzon as the «top-fenestrated technique» (2). The chimney endograft technique, a recent refinement of this method is based on using small diameter stent-grafts instead of bare stents. This allows treatment of abdominal aortic aneurysms (AAAs) involving the renal arteries without compromising aneurysm sealing (2-5). Finally, a top-down configuration, the so called “periscope endograft”, which is introduced transfemorally, has been used in combination with chimney endografts to treat AAA extending to the diaphragm and involving all the renovisceral vessels (6). This report will review the literature as well as our experience and address the questions regarding durability and indications.

Methods and results

Chimney and Periscope Technique

A left sided transbrachial approach, to avoid crossing the aortic arch, is generally used for the “Chimney” technique, whereas a transfemoral access is necessary for the “Periscope” technique. In cases requiring multiple chimneys and therefore multiples sheaths, a more proximal access site as the axillary artery might be necessary. The chimney or periscope stent-graft(s) is(are) positioned in the target artery (arteries) and deployed with the distal end inserted about 1-2 into the target vessel and the proximal end ending above (chimney graft) or below (periscope graft) the aortic stent-graft. The latter endograft can be implanted before or after the chimney/periscope endograft(s) is(are) deployed. A kissing balloon technique completes the procedure by achieving full expansion of the different stent-grafts used (aortic and chimneys and/or periscopes). The chimney/periscope endografts are usually oversized by 1mm, whereas the aortic stent-graft is generously oversized by about 20%. Treating extensive aortic aneurysms might require very long (>30cm) chimney/periscope grafts. As an alternative to long chimney/periscope grafts, and especially when the aneurysm extends beyond the aortic bifurcation (Crawford II), the chromneys or periscopes can be deployed as a slice of ham in a sandwich, in-between two aortic stentgrafts (5).

Results

Chimney/Periscope endograft: Literature review

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Pt: patients; E/U: emergent/urgent repair; n C/P: number of chimney/periscope endografts; FU: follow-up; M: months; Mort: mortality; Morb: morbidity; d: days; EL I @6 M: endoleak type I at 6 months follow-up; SG: nb of patients treated with at least one stent graft used as chimney/periscope. *: unpublished
Discussion
A short or challenging infrarenal aortic neck is one of the most frequent limitations to endovascular aneurysm repair (EVAR). In patients in whom achieving a more appropriate landing zone would involve coverage of the renal arteries, maintenance of blood flow to the encroached renal arteries can be achieved by using bare stents or stent-grafts extending cranially to the SMA. The latter devices allow addressing AAAs involving the renal arteries.

A major drawback of the chimney/periscope endografting technique are gutter endoleaks, the incidence of which remains unclear both at implantation and thereafter. Primary type Ia endoleaks can mostly be avoided by oversizing the aortic stent-graft generously (up to 20%), having a long length of overlap between the 2 grafts and the aortic wall (3-5 cm), and limiting the method to patients requiring maximally two chimney endografts. Type III endoleaks originating from the chimney/aortic stent-graft/aortic wall interfaces can be avoided by using stent-grafts instead of bare stents to construct the chimney. Huge or high-flow primary type I/III endoleaks should be corrected at the original procedure, whereas we have noted that low-flow endoleaks type I/III usually seal spontaneously. Secondary type I/III endoleaks should be treated aggressively, especially in cases where the aneurysm sac does grow. The chimney technique requires generally one or several remote access(es) through the supra-aortic trunk(s) and carries therefore a high stroke risk in patients presenting with severe atherosclerotic disease of the supra-aortic vessels and/or the aortic arch [7]. In such cases, a transfemoral approach for the chimney technique can be used [8] (figure 1). Severe disease of the target artery might lead to embolization and in some instances critical organ function restriction. Finally, the target artery (arteries) should not be smaller than 4 mm as most stent-grafts are >5mm in size and because a too generous over-sizing could lead to in-folding and occlusion of the chimney/periscope graft.

Based on the published literature, two clinical entities seem to be well managed with the chimney and/or periscope endografting technique. Most authors report using a single chimney endograft, indicating that the technique was usually used to extend cranially a renal artery originating more caudally than the opposite renal artery and with a short landing zone in regard to the lowest renal artery (figures 2 & 3). The technical success rate in this group of patients is high and periprocedural mortality as low as 3%. The other population that seems to benefit from the chimney technique is the group of patients presenting aortic aneurysm rupture. In our experience of 10 patients with aortic aneurysm rupture, 30-day mortality was as low as 10%. Patients requiring >2 chimney/periscope endografts are infrequent and no conclusion can be drawn out of that data. Mean follow-up of 12 months after the chimney procedure is short and therefore caution is still mandatory. But, looking at the series with longest follow-up, in total 104 patients (58% of all published...
cases) followed for a mean of 16 months, there are no events reported indicating this technique isn’t durable.

**Conclusions**

The chimney endograft technique is an advanced endovascular method facilitating EVAR of AAA extending to or involving the renovisceral branches. So far, 30-day mortality is very low and mid-term results are encouraging, indicating that this technique could be a valuable and durable option, at least in patients not fit for fenestrated/branched stentgrafts or open repair. More experience and longer follow-up are still necessary to identify more accurately in which patients this option might be most appropriate.

**Bibliography**

Fenestrated stent graft is the best option for neckless AAA. Technique and outcomes.

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Fenestrated stent-grafts were originally developed as a minimally invasive alternative to open repair to treat complex aneurysm morphology in patients considered to be unfit or at high risk for open surgery. The criteria for treatment with a fenestrated device are in evolution as the safety and efficacy of available devices and techniques are determined. Generally accepted high-risk characteristics include old age, severe medical comorbidities, prior aortic reconstruction, and the need for suprarenal aortic cross-clamping. Currently, there are no FDA approved fenestrated devices approved for general use in the US however they are available in other regions of the world. Device customization currently requires a 4 to 8-week waiting period, which has led to advances in techniques for surgeon-customized fenestrated stent-grafts. This technique is utilized primarily for patients who would not be eligible to enroll in one of the prospective trials or who need urgent or emergent repair of their aneurysm and cannot safely undergo standard open repair.

Techniques

The most important component of successful fenestrated aneurysm repair is careful and accurate advance planning of the procedure. Computed tomography (CT) angiography allows measurements critical values to allow for successful implantation of a fenestrated endoprosthesis. The centerline measurement from the top of the landing zone to the center of the target vessel origin is recorded, as are the clock position, orientation, and diameter of each target vessel origin. The device configuration can consist of single or multiple fenestrations, depending on patient characteristics in order to obtain a sealing neck length of approximately 20 mm.

Regardless of the presence of a gap between the graft and the aortic wall, all fenestrations are bridged with a balloon-expandable stent or stent graft to reduce any misalignment between the fenestration and the vessel origin. In situations where no gap is present between the device and the aortic wall a bare stent may be inserted and no endoleak is expected when at least 4 mm of neck length is present below the inferior most aspect of the target vessel. When the gap is being bridged with a stent-graft to avoid an endoleak, the device is considered to be a fenestrated branched device. Prior to commencing any fenestrated endovascular aneurysm repair, it is imperative that the surgeon has access to excellent imaging equipment and a complete endovascular inventory. A wide range of catheters, wires, sheaths, stents, and stent grafts may be required to safely and effectively complete this procedure. Graft implantation generally requires bilateral femoral and sometimes left brachial arterial access. The larger femoral artery is generally used for main body device implantation and the contralateral femoral artery is used for the target vessels. A large sheath is introduced via the contralateral femoral artery, and the sheath valve is accessed with multiple 5-French sheaths. These sheaths are used for selective catheterization of the renal and mesenteric arteries. The main stent graft is oriented and introduced via the femoral artery. Via the contralateral sheath, a balloon-expandable stent or stent graft is introduced into each target vessel after it has been selectively catheterized through the fenestration. Once all bridging stents are in place, the main body stent graft is fully deployed. The balloon-expandable stent grafts are then deployed to profile and flared proximally with a balloon.

A high level of endovascular surgical expertise is required to safely perform fenestrated procedures. It is imperative that the surgeon be facile with salvage or “bail out” maneuvers that may be required for device design or deployment errors. Access to the target vessel cannot always be regained when significant misalignment occurs. Use of microcatheters, microwires, and a variety of catheter shapes may be necessary.

Outcomes

No randomized controlled trial has compared fenestrated/branched endovascular aneurysm repair with conventional open repair. However, multiple case series and cohort studies have documented the safety and efficacy of the technique. In a recent review, Nordon and associates analyzed 8 studies with a total of 368 cases of FEVAR and compared them with 12 studies representing 1164 open repairs of juxtarenal aneurysms. Cumulative mortality was similar in the two groups. There was statistically significant increase in transient renal failure in the open group compared with the FEVAR group, however there was no difference in the rate of dialysis requirement in the two groups (1.4% in both). Multiple case series from different institutions, both internationally and in the United States have been published. These series routinely document target vessel patency rates in excess of 96%. No patients experienced aneurysm rupture or increase in aneurysm size during documented follow-up.
Future directions

Endovascular repair of aneurysms involving the visceral aorta has become a reality. More than 3000 cases have been performed worldwide with midterm results that demonstrate safety and success. Continued success with fenestrated endografting will require continued appropriate patient selection, high-resolution imaging, proper device design, and technical expertise on the part of the endovascular surgeon. However, as technology and techniques evolve, the endovascular treatment of juxtarenal aneurysms is certain to become more widespread. The continued efforts to provide safe, prefabricated devices available to more patients will certainly allow greater ease of treating patients and has begun early phase I implantations around the world. Finally, surgeon-customization of devices should only be performed in certain urgent or emergent settings for patients with unusual anatomy when standard open surgical repair is of prohibitive risk. These customized repairs should not be attempted unless significant training and experience has been obtained.
Stenosis and thrombosis of endografts: is it preventable?

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Nîmes, France

It is a quite unfrequent complication from 2. 3 to 7.2% (1, 2, 3, 4), but the rate of stenosed or king King limb endografts treated before the occurrence of thrombosis is unknown. All authors underline that this complication occurs before 3 months and mostly in the first month (2, 4).

The factors determining the early thrombosis are:
1. King King of the limb is the most frequent and is facilitated by unsupported portion of the endograft and angulation of the native common iliac more than 90°.
2. The bad applying of the distal part of the limb created by the stiffness of the limb in a tortuous common iliac artery.
3. Lesions of the external iliac arteries: atheromatous stenosis, calcified plaques, dissection linked to the ascent of the graft; all facilitated by narrow artery less than 6 mm (for the newest endografts).

Do the conception of the endograft matters?
In the literature there no statistical difference between any kind of endograft; in the UK evar trial, the comparison between the talent (Medtronic®) 1.8% of thrombosed limb VS the Zenith (Cook®). 3.5% of thrombosed limb was not statistically different (5) at the contrary there was a clear statistical difference between first generation endografts VS second generation.
The new types of endografts endurant (Medtronic®) or Zflex (Cook®) do not afford a real improvement in term of rate of early thrombosis.

How to prevent this complication:
1. The King King, stenosed limb; bad applying and remaining stenosis or dissection of the external iliac artery have to be detected intraoperatively; the graft must be checked without contrast to detect limb stenosis and the final angio must be completed without super stiff guidewire. In case of doubt a two plane angio is realized.
To treat the problem a self expandable bare stent is used at the external iliac level and at the junction endograft-artery if a relining is necessary. In case of limb King King or stenosis a balloon expandable bare stent is more often used. Is had been showed (6) that using a bare stent to prevent complication is good policy.
2. The choice of the endograft according to iliac anatomy is crucial:
- In case of iliac angulation or tortuosity stiff endograft like talent or Zenith must be avoided. The new brand by Medtronic® (endurant) or Cook® (Zflex) affords better compliance with iliac tortuosity but there is still thrombosed limb in the pilot studies.
- In case of bad iliac anatomy the choice of a flexible limb is mandatory (anaconda or excluder gore but no suprarenal fixation for these devices).
- It is possible to mix endografts using a suprarenal fixation graft plus a flexible limb from other company.
- The companies have anticipated this problem and Abbruzzese (6) demonstrated that following the IFU the rate of limb thrombosis was 0.3% and outside IFU rate was 2.3 % and that rate was independent from the type of the graft: Gore®, Medtronic® or Cook®.
- In case of bad External Iliac artery on one side the choice of an Aorto Mono Iliac graft may resolve the problem and in case of bad Iliac artery on both side one have to consider classical surgery as the first line strategy.

In case of thrombosed limb:
If acute thrombotony + stenting could be an option but the risk of disconnection of the component of the graft exist. Fibrinolysis seems to be more dangerous and less effective. Completion of a surgical fem fem is often the most effective choice.

In conclusion:
The study of the literature and our own experience demonstrate that thrombosis of an endograft limb is linked with a perioperative error:
- Or in the strategic choice (aorto bi VS Aorto Mono).
- Or in the graft choice (stiff VS flexible).
- Or because a perfectible error had not been detected and corrected during the procedure (King King, stenosis, bad applying, external iliac dissection or stenosis).
Thus the careful reading of the preop CT scan by the operator itself to determine strategy and endograft choice and a perop angio control without stiff guide wire may avoid this unfrequent complication.
References
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Retrograde hybrid treatment of TAAA, techniques & outcomes

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Introduction
The repair of extensive thoraco-abdominal aortic aneurysms (TAAAs) remains a formidable challenge to vascular surgeons. Despite significant advances in surgical techniques, perioperative adjuncts and critical care, the traditional open repair is still associated with a substantial morbidity and mortality even at centres with extensive experience. A total endovascular approach to treating these challenging cases is somewhat limited by the arch vessels proximally or the visceral and renal vessels distally, which frequently have concomitant occlusive or aneurysmal disease. However, by first revascularising and/or debranching these segments, one can subsequently complete aneurysm exclusion by thoracoabdominal aortic endo-grafting. The less invasive nature of this approach represents a viable treatment alternative to patients that may have previously been deemed high-risk for open surgery.

Technique
The patient is placed in the supine position under general anaesthesia. Cerebrospinal fluid drainage is routinely used along with cell salvage techniques. Arterial and central venous lines, urethral catheterization, and transoesophageal echocardiography are all mandatory perioperative invasive monitoring measures. A midline laparotomy allows for adequate exposure of the abdominal aorta, the origins of the renal arteries, the coeliac axis, and the superior mesenteric artery (SMA). The in-flow site for retrograde visceral bypass grafting is determined by the distal extent of the aneurysmal disease and previous abdominal surgery. If a previous infrarenal repair has been undertaken, the bypass grafts may be anastomosed in an end-to-side fashion to the existing infrarenal aortic graft. In cases where the infrarenal aorta is not diseased, an arteriotomy is performed and the bypass grafts anastomosed in an end-to-side fashion to the native aorta. With aneurysms extending if the aneurysm to the bifurcation, a distal common iliac or proximal external iliac artery may provide the in-flow to the bypass grafts.

Two inverted (14 by 7mm or 16 by 8mm) Dacron® trouser-grafts can function as conduits. Otherwise, a single trouser-graft is used with additional side-limbs sutured in an end-to-side manner. This four-limbed “spaghetti graft” is constructed in a bespoke fashion during the procedure. The limb to the coeliac axis is tunneled in front of the renal vein through the loose areolar tissue behind the pancreas, and the anastomosis is performed to the inferior aspect of the confluence between the hepatic and left gastric arteries. The graft to the SMA is placed in a “lazy C’’ configuration. The renal arteries are sequentially anastomosed in an end-to-side fashion. Separate grafts to each target vessel are used rather than a sequential graft technique, as graft patency remains a concern. If Doppler signals are satisfactory in each limb with the origins of the native vessel clamped, the latter are subsequently suture-ligated to prevent retrograde flow into the aneurysm sac and therefore type II endoleaks. The grafts are then excluded in the retroperitoneum by primary closure or, if that is not possible, by use of an omental flap to prevent bowel adhesion and fistulae.

Following successful visceral and renal bypass, a suitable access site is chosen for endovascular stent deployment. A dedicated conduit attached to the confluence of the visceral grafts, the common iliac artery or the abdominal aorta may be used, but native vessels may also be suitable provided they are of adequate calibre. Our preferred approach is via an iliac conduit in preference to a femoral approach for deployment of stent-grafts because access vessel tortuosity can be an issue. An angiographic catheter is introduced on the contralateral side and the stents are deployed in a sequential fashion from the proximal landing zone through the thoracic aorta to the distal landing zone. Completion angiography after adjunctive procedures (extension cuff, giant Palmaz stent, balloon molding) is routinely performed to confirm exclusion of the aneurysm.

Combined or staged?
In the combined approach, the aorto-iliac segment is promptly available for stent-graft insertion. The visceral grafts can be protected from embolic sequelae during stenting and assessed immediately thereafter for patency. Two-staged enthusiasts argue that reduced operative time is associated with lower complication rates. The endovascular stage of the procedure can then be performed in a haemodynamically stable patient, not subjected to hypothermia, major blood loss, coagulation disorders and with a stable spinal cord. Moreover, the risk of renal injury from contrast nephrotoxicity may be reduced as the kidneys have recovered from the ischaemic insult during revascularisation. Also, the endovascular component of the procedure...
may be performed in an endovascular suite with superior quality imaging, for those centres without a dedicated hybrid operating theatre suite.

Disadvantages of the two-stage approach include potential rupture of the anastomotic site, embolic events into graft branches, graft occlusion during stent-graft insertion and the need for additional femoral access. The main drawback of the staged procedure, however, is the risk of interval rupture (1-2). In a recent study that included hybrid patients from three institutions, including our own (3), 3/21 patients that underwent a staged procedure ruptured whilst awaiting stenting. The authors, therefore, favour the combined approach.

The st mary’s experience
In 1999, Quinones-Baldrich et al (4) were the first to report a combined endovascular and open surgical approach for a type IV TAAA. Rimmer et al. in 2003 (5), at St Mary’s, reported a similar technique of retrograde visceral/renal revascularisation with TAAA endo-grafting for a 49-year old patient with a 9 cm aneurysm of native aorta occurring between previous infrarenal abdominal and upper descending thoracic aortic aneurysm repairs. Three years later, Black et al (6) from St Mary’s reported the largest published series of these repairs describing a total of 29 attempted visceral hybrid procedures. Initially, hybrid procedures were reserved for patients not considered suitable for open TAAA repair. As our experience has evolved, the results have encouraged us to use this method of repair as the treatment of choice for patients with type I, II and III TAAAs unsuitable for endovascular treatment. In patients with type IV TAAAs without previous aortic surgery, open repair is still preferred, due to its low morbidity and mortality as well as paraplegia rates. Moreover, open repair of a type IV aneurysm is undoubtedly less time consuming and technically less demanding than the hybrid approach with a complete visceral and renal revascularization.

In our institution, from 2002 to date, a consecutive series of 117 patients (57 males) with a mean age of 66 years (range 25-81) were included in a prospectively collected database. Of these patients, 91 were elective procedures whereas 26 were operated on in an emergency setting. Patients were classified ASA-III or above in 98 cases. Aneurysm morphology was distributed as follows: Crawford type-I: n=15; type-II: n= 42; Type-III: n=43; type IV: n=1; unclassified: n=8. The elective 30-day mortality rate was 11%. Other complications included paraplegia (10%), prolonged respiratory support (>5 days) (32%), myocardial infarction (7%), stroke (1%), renal impairment requiring temporary haemofiltration (30%) and permanent dialysis (6%). Median blood loss was 4 litres (IQR 2.5-6.7) and mean ischaemia times were 15 min (12-18) for the SMA and coeliac arteries and 16 min (13-20) for the renal arteries. Median hospital stay was 30 days (16-84). At a median follow-up of 26 months (1-56), 94% of the visceral and renal grafts remain patent. There were 32 endoleaks occurring in 27 patients. These included 6 type-1a (requiring ballooning, proximal stent extension +/- extra-anatomical bypass), 5 type-1b in patients with aortic dissection (requiring coiling/onyx, or surveillance), 14 type-2 (1-coiled, 10-under surveillance) and 7 type-3 (successfully re-stented).

Several other centres have published their individual unit experiences of hybrid approaches to TAAA repair, with two systematic reviews to date (7, 8); the overall in-hospital mortality rate reaches 17.7% and permanent paraplegia or paraparesis is seen in 7.5% of cases. Studies evaluating the mid-term and long-term durability of hybrid procedures are scarce. Patel et al (9) reported a one year actuarial survival of 68 +/- 12% whilst Böckler et al (10) reported an overall mortality rate of 30% after a mean follow-up time of 22 months. These results compare favourably with those of traditional open repair. In a retrospective study of 1010 TAAA patients treated by open repair, Rigberg et al (11) noted an overall mortality of 19% at 1 year, reaching 40% in patients over 75 yrs of age.

Considerations
Important factors to consider in terms of the long-term durability of the visceral hybrid procedures include endoleaks, visceral / renal graft patency and potential enteric erosion or fistulation. In our experience, all bypasses are performed with prosthetic grafts, which may lack the durability of vein as a conduit; however, the reported results of the primary graft patency rates are very encouraging. Treatment of type I endoleaks by proximal extension may be challenging, particularly if debranching of the supra-aortic vessels is required; on completion angiography, if a type I endoleak is seen, our usual approach is to intervene immediately. Type II endoleaks on the other hand, are managed conservatively unless there is definite sac enlargement on surveillance postoperative CT scanning. We treat type III endoleaks by relining existing stent-grafts. Given the necessary extra-anatomical route of the visceral retrograde grafts, the possibility of enteric erosion or fistula exists, although we have not experienced this complication. The risk may be reduced by careful closure of the retroperitoneum or the use of an omental flap.

Paraplegia is perhaps the most devastating complication of TAAA repair. The potential benefit of hybrid procedures in reducing the risk spinal cord ischemia has been suggested, as reported in our early hybrid series (6) where no paraplegia was seen.
The visceral hybrid does eliminate the need for aortic cross-clamping, and can therefore provide better cardiovascular stability avoiding reperfusion injuries with postoperative cord oedema. However, the use of endovascular stent-grafts necessitates occlusion of vital aortic side branches. As time has progressed and our experience has grown, we have experienced a more expected paraplegia rate\(^3\).

**Conclusions**

As endovascular techniques and technology are constantly improving and evolving, the full impact of fenestrated stents and branched grafts on TAAA repair is yet to be realized. However, in the meantime, the visceral hybrid repair is a versatile operation and will remain a robust and adaptable method of treating this complex and life-threatening disease process, particularly in high-risk patients unfit for the open repair or who have unfavourable anatomy for fenestrated/branched stent grafting.

**References**

Antegrade hybrid treatment of TAAA, advantages & outcomes

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Introduction
Thoracoabdominal aneurysms (TAAAs) represent an extremely demanding surgical entity for the vascular surgeon. Their surgical approach mandates an incision that involves both thoracic and abdominal cavities. The morbidity and mortality rates, even in centers of excellence, remain high. Mortality accounts around 10% in the best institutional series while systemic complications like cardiac, respiratory, renal and neurological, present in large numbers (1-4).

An alternative therapeutic method is the endovascular repair, with the use of branched endografts. These devices are custom made and their availability is still quite limited while few centers have experience of their use (5). Hybrid operations represent an alternative treatment and combine both surgical and endovascular techniques. They were first reported in 1999 (6). They consist of visceral debranching and revascularization of the abdominal aorta, followed by endovascular relining of the entire aneurysm.

In the present study we report the technical aspects of the “Total Antegrade Debranching” technique and our series in patients judged high-risk to withstand a conventional TAAA repair.

Material and Method
We retrospectively analyzed the records of 9 patients treated with the hybrid technique for TAAAs during the period 2005-2010. Six of the patients presented with type II and 3 with type IV aneurysms. They were all atherosclerotic in nature. For the evaluation of their cardiac function they underwent a stress ECHO and heart ultrasound. Their ejection fractions (EF) were between 30 -35%, while all of them suffered from coronary heart disease (CHD). They were all more than 70 years old and on final evaluation by the anesthesiologists were judged to be ASA 3 and one patient ASA 4, according to the physical status classification system (age> 70, FEV1< 75%, EF< 40%).

Due to the increased risk of death and peri-interventional complications from total aortic cross clamping, the possibility of left heart by-pass and the inevitable blood loss during conventional repair, an antegrade aortic debranching procedure was decided upon, followed by endovascular exclusion of the entire aneurysm. In all of the cases, the ascending aorta was used as an inflow site for the revascularization of the visceral arteries (figure 1).

The technique consists of median sternotomy, with pericardial opening and surgical exposure of the ascending aorta. A side clamp is applied on a healthy part of the aorta at its lateral wall without interruption of the circulation (figure 2).

A mid- upper laparotomy, together with partial division of the upper anterior portion of the diaphragm is performed for the routing of the grafts to the abdominal cavity (figure 3). The grafts are anastomosed to the splanchnic arteries in an end to end fashion, with suture ligation of their origin. The graft to the superior mesenteric artery is routed behind the stomach after caudal traction of it, in front of the head of the pancreas to the superior mesenteric artery. The left renal artery, which is more difficult to access, may benefit from a clampless anastomosis according to the VORTEC/STAT (Viabahn Open Revascularization Technique/ Sutureless Telescopic Anastomotic Technique) described by La-chat (7). This technique was used in 4 of our patients, while in one of them both renal arteries were revascularized by the same manner. Parti-cularly for patients with deep localization of the left renal artery we use the retropancreatic route to facilitate the VORTEC/STAT anastomosis. At the end of the procedure the upper part of the diaphragm was sutured and the pericardium was left open, in cases of grafts compromise. A final angiography was routinely performed to assess the patency of the grafts.
This represents the first stage of the hybrid repair which is followed by an endovascular stage with relining of the entire aneurysmal aorta (figure 4). The transfemoral route was used in all of the cases. The most appropriate femoral artery was exposed for the routing of the endografts. Six Zenith TX2 (COOK IRELAND LTD) (proximal diameter 38mm n=4, 36mm n=2), 6 Gore TAG thoracic endoprostheses (Flagstaff, AZ) (proximal diameter 37mm n=3) and 5 TALENT (Medtronic Inc. Santa Rosa) (proximal diameter 40mm, n=2 and distal 38mm, n=3) were used for the endovascular procedures. In 3 cases of the type II TAAAs there was appropriate length of proximal landing zone, without the need of subclavian artery transposition. For the rest 3 patients we had to perform a carotid-subclavian bypass prior to the procedure in order to create a sufficient landing zone for our endograft. All of the endografts were properly deployed and no endoleaks were revealed on final angiography.

The second stage of the procedure can be performed, either in the same session, or some days following the open part. It is our preference to separately perform the repair. Our patients were treated during the first post-operative month. The disadvantage of this “delay” is the risk of aneurysm rupture during the waiting period.

**Results**

There was no perioperative mortality. No paraplegia was reported or permanent renal failure. Four patients presented a transient deterioration of the renal function (1.8mg/dl< Serum Creatinine< 6mg/dl) that restored after adequate hydration and urine alkalinization without the need for renal dialysis. One patient suffered a minor stroke following the open stage of the procedure, in the form of left hemiparesis, which regressed during the postoperative period. All of the endografts were successfully deployed with no signs of endoleaks on final angiography. One patient developed a pancreatic fistula, which delayed his hospital discharge and oral feeding. The patient stayed under parenteral fluid feeding for 30 days and the fistula regressed, because it was a low flow pancreatic fistula.

The patients following the first stage of the procedure stayed in the intensive care unit for 48 hours with close monitoring of their organ function and neurologic status. They were extubated the afternoon of the same day. None of them developed delayed neurological complications. They were discharged from the hospital, on average, on the 10th day (9-14 days), except for the patient with the pancreatic fistula and were scheduled for the second stage of the technique, within the first postoperative month. Following the endovascular procedure we had no complications and all of the patients were discharged after 5 days of hospitalization.

The mean follow-up of the patients was 28 (range: 8-50) months. In the follow-up period we closely examined the patients following a surveillance protocol consisting of CTA every six months on the first year and annually thereafter (figure 5). All of the patients are alive with good patency of the Dacron and endovascular grafts. One patient developed a persistent type II endoleak, which is under surveillance having not increased the aneurysm diameter.

**Discussion**

Thoracoabdominal aneurysm repair represents an extremely challenging clinical entity for the vascular surgeon. Perioperative morbidity and mortality remains high, even in high volume centers with marked experience. Conventional repair is performed under partial cardio pulmonary...
Another basic disadvantage of conventional repair is the risk of paraplegia due to ischemic injury of the spinal cord. There is a 16% neurological injury rate following total replacement of the aorta. The possibility of this serious complication accounts for type II TAAAs, we covered long aortic segments. A possible explanation could be that the left subclavian artery and both internal iliac arteries were not covered in any case. The authors also quoted about the use of spinal cord drainage. Spinal cord protection is an intervention which may complicate with infection of the central nervous system, or with bleeding and epidural hematoma at the site of puncture. For this reason we kept this measure as a secondary option in the case of delayed neurologic deficits.

Since the presentation of the first branched endograft for TAAA repair by Chuter in 2001, technology has evolved, promising a decrease in the aforementioned figures. The configuration and commercial production of these endografts, is high-time consuming since they are custom-made. This delay, which is more than 6 months, is not easily tolerated by most of the patients, especially in symptomatic or growing aneurysms. Only a few centers around the world with increased experience and proficiency of endovascular grattling, can offer good results with these devices. But these are not results that can be reproduced in every day clinical practice. Another limitation of the endovascular approach of TAAAs is the prolonged operating time which can be more than 10 hours, with duration of radiation exposure of more than 1 hour.

Hybrid repair of TAAAs represents a method which can efficiently decrease morbidity and mortality when compared with conventional repair and can be adopted by high-volume vascular units around the world that can recognize and deal with possible complications. Most of the series described in the literature favor the retrograde approach for the revascularization of the visceral arteries with mortality rates between 9-23% and paraplegia around 9%. Significant systemic complications like renal function impairment, prolonged respiratory support and transient neurologic deficits are described, while the main concern remains the routing of the grafts and their length, especially the one to the superior mesenteric artery, elements which are proportional to their future patency.

In our practice we prefer the antegrade route. The ascending aorta is an excellent site for anastomosis that is easily accessible. Aneurysmal dilatation and atherosclerotic disease are rare pathologies making it an ideal inflow site, when compared with the common iliac arteries. Although the antegrade approach premises the opening of two body cavities, the chest and abdomen, contrary to the retrograde one, we still believe that the superior long-term results, of graft patency and systemic complications, justify its use. Over and above, median sternotomy with minimal dissection of the ascending aorta at the site of the anastomosis, can be very well tolerated by the patient if it is not complicated with pneumothorax from opening of the visceral pleura, or hemorrhage.

A special attention must be given to the routing of the graft for the anastomosis to the left renal artery. We favor the retropancreatic tunneling in difficult cases of obese patients and we don’t use retractors to mobilize the pancreatic tissue, as in the case of the patient with the subsequent pancreatic fistula. Finger dissection is used to create the retropancreatic passage, while thick elastic band or a vesical catheter can be used for the upward and downward traction of the pancreas.

The thoracic aorta was also reported, as an inflow site for the hybrid procedures. This can only be adopted in type IV TAAAs, anastomotic and pararenal aneurysms. Current results of hybrid surgery for type IV TAAA are disappointing with surgical mortality more than 15% due to the retrograde revascularization from the iliac arteries. In our practice we believe that type IV aneurysms, can be treated surgically with excellent results in terms of durability and morbidity. In this series we treated 3 patients with type IV aneurysms, who could not tolerate a conventional repair due to their medical condition.

During the hybrid operations there is no need for CPB or other organ protection measures. Renal insufficiency following thoracoabdominal aneurysm repair, remains an issue of great importance, due to the lack of specific supporting measures to eliminate this complication, at the moment. Renal insufficiency can reach up to 38%, which poses a serious medical problem, especially in patients with various comorbidities, increasing the rate of early mortality. Patients with preexisting renal function impairment are susceptible to acute renal failure increasing the risk of permanent hemodialysis. Hybrid repair can decrease the rates of this lethal complication through several mechanisms like the lack of aortic cross clamping which reduces renal ischemic time, the hemodynamic stability of the patient during the operation...
and the decrease of intraoperative blood loss with the subsequent systemic inflammatory damage to the kidney.

For type II TAAA, early results of hybrid repair are very encouraging (28, 31), according to the few case series reported in the literature, giving an operative mortality around 8% and paraplegia approaching the results of those following endovascular exclusion of thoracic aneurysms, from 0% to 16%. For proximal extension of a type II aneurysm, beyond the left subclavian artery, or for arch aneurysms the ascending aorta can be used in the same manner for debranching of the arch vessels.

A particular attention must be given to the clamping of the ascending aorta. The use of an atraumatic clamp is mandatory together with that of Teflon felts (figures 5, 6). Teflon reinforces the anastomotic line preventing from dissection and helps in hemostasis. Antegrade splanchic debranching is less invasive, avoids aortic cross clamping and reduces the paraplegia risk. Although 9 patients with type II and type IV TAAAs, is a small series from which firm conclusions cannot be drawn, we have used the same technique to treat other aortic pathologies successfully. Our perioperative results and those from follow-up of our patients, reinforce the use of hybrid repair in patients increased open risk repair and may also prove to be efficient in fit patients, if compared with conventional surgery.

Conclusion
Taking into account our results and those of other similar series (16, 24, 25) we believe that hybrid repair of thoracoabdominal aneurysms is a useful tool in the armamentarium of the vascular surgeon for the treatment of high risk patients and can serve as a bridging method until technology will provide us with the ideal endograft for total endovascular exclusion.

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Endurant registries instead of RCT (Randomized Clinical Trials)

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Objective
Global results of EVAR are well documented in the literature. Usually, the results from the major trials (DREAM, EVAR, OVER, ACE) are presented, but it remains doubtful of these results can be extrapolated to the general population, as these trials are performed in a strictly controlled setting. Otherwise, EVAR results are presented from relatively small studies from centers of excellence. Here also, it is unclear whether extrapolation of these results to “real-world” practice is justified. With this in mind, a closely monitored registry may actually reveal much more reliable results of EVAR, as real-world patients are included from real-world practices. The ENGAGE registry was undertaken to quantify the real world outcome after endovascular AAA repair with the Endurant Stent Graft in a large, contemporary, global series of patients.

Methods
From March 2009 to November 2010, 1200 AAA patients were enrolled from 77 clinical sites in 30 countries and treated with an Endurant stent graft. Results are described following the reporting standards for EVAR. Follow-up data was tabulated for all 1200 patients at 30 days and for the first 350 patients at one-year follow-up.

Results
This study included 1200 patients (89.8% men), with a mean age of 73.3 ± 8.1 years, range 43-93. The mean AAA diameter was 60±12mm. The AAA was symptomatic in 15.4%, 52.8% of patients were classified American Society of Anesthesiologists class III or IV. During EVAR procedure 62% of patients received general anesthesia, 28% received regional anesthesia, and 10% received local anesthesia. Intraoperative technical and clinical success was achieved in 99.1% and 97.7% of cases, respectively, with a mean procedure time of 100 ± 45 minutes. Within 30 days, one or more major adverse events were reported in 4.1%, with a 1.3% mortality rate. Type I, II, or III endoleaks were identified in 1.2%, 9.2%, and 0.2% respectively. At one year, AAA-related mortality was 1.8%; each of the deaths were related to complications of the procedure and not the device. Secondary surgical interventions within one year were performed in 4.9% of cases. There were no instances of graft migration or aneurysm rupture. One year Kaplan-Meier estimates for overall survival was 91.0% (SE .016), with a one-year aneurysm related mortality rate of 1.8% (SE .007). At one year, aneurysm size was stable or decreased ≥ 5 mm in 97% of cases.

Conclusion
The ENGAGE registry will supply us with a wealth of data on real-world outcome after endovascular AAA repair in a contemporary, global series of patients. Results up to one year are exceptionally good, but more important long-term results have to be awaited. As the scheduled follow-up period of this registry is very long, this information will be available in the years to come. It is debatable whether randomized trials should stay “the gold standard” for evaluating treatment results.
When is open surgery the best option in patients with TAAA?

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Introduction
Since several years, the debate on open versus endovascular repair in TAAA patients is still going on. It is obvious that during the last decades, open surgical repair was the only option and therefore the gold standard for thoraco abdominal aortic aneurysms (TAAA). The initial high morbidity and mortality rates have gradually improved, mainly due to the introduction of adjunctive procedures including extra corporeal circulation, spinal cord protection and neuromonitoring systems. However, despite these measures, severe morbidity remains a main issue and includes renal failure, paraplegia, pulmonary complications and cardiac problems.

After the introduction of endovascular techniques and subsequent idea of hybrid procedures, many have started performing these alternative techniques. In the aortic arch region, these procedures seem to offer adequate outcome, especially in elderly patients. In TAAA repair, the role of hybrid procedures is still unclear. It must be emphasized that hybrid procedures are also very time consuming but the main advantage is that only one cavity is opened (the chest or the abdomen). This summary describes some considerations why open repair remains the procedure of choice in sub-groups of patients with TAAA.

Indications for open TAAA repair

Connective tissue diseases
In patients suffering from connective tissue disease like Marfan, Ehlers-Danlos or Loeys Dietz syndromes, distinct fear concerns the interaction of the stentgraft with the fragile aortic wall. Furthermore, these patients with connective tissue diseases are (relatively) young and the question arises whether endovascular technology in thoraco abdominal aortic repair is advisable in these patients. We therefore analyzed the clinical outcome of open thoracic and thoracoabdominal aortic repair in patients suffering from Marfan syndrome and assessed short- and mid term survival. The results show excellent surgical outcome, both at short and long-term. The main advantage is the young age and relatively strong physical condition of these patients. Therefore we consider open surgery still the gold standard in patients with TAAA on the base of connective tissue disease. However, the majority of patients with connective tissue disease present with previous aortic procedures including aortic root and/or ascending arch repair, total arch reconstruction or descending and abdominal aortic operations. In these redo procedures, especially in the chest, we also choose for endovascular or hybrid techniques in order to reduce the consequences of extensive surgical trauma.

Post dissection aneurysms
Non-aneurysmatic chronic type B aortic dissections can gradually develop aneurysm sizes that require repair in order to avoid rupture. Several issues play an important role. First, the most proximal part of the dissection often lies in the distal aortic arch, opposite the left subclavian or carotid artery. Second, the septum has become so fibrous and rigid that the endografts cannot adequately deploy and automatically cause a type I endoleak. This can obviously also occur at the distal side of the endograft. Third, in chronic dissections, the majority of intercostal arteries are still patent and covering these segmental vessels comprises an increased risk for paraplegia. Fourth, the dissection most often affects the aortic side branches that in some cases are difficult to handle by endovascular means.

We have performed numerous conversions for persisting type I endoleaks, despite proximal and distal extensions, with or without necessary debranching. The main reason was indeed failing apposition of the septum against the wall of the false lumen. In patients suffering from type A aortic dissection the emergency procedure consists of aortic root or ascending repair, with or without aortic valve replacement. If necessary and feasible, a total aortic arch repair is performed as well. However, in many cases, only a small part of the ascending aorta is replaced with a tube graft, leaving remaining dissection in the arch, descending and abdominal aorta. In patients who gradually develop aneurysmal dilatation in the arch and/or thoraco abdominal aorta, a hybrid procedure with proximal debranching is not feasible due to the short ascending graft; this graft is too short to serve as a donor site for grafts to the supra aortic arteries. In these cases, open repair remains the only option for aneurysm repair.

Aorto bronchial and aorto esophageal fistulae
Primary fistulae between the thoracic aorta and bronchus or esophagus can be caused by trauma and local aneurysms. Post TEVAR complications also include aortic bronchial or aorto esophageal fistulae. Fortunately, these complications are rare
but when occurring they pose a difficult treatment dilemma. In general, symptomatic aortic bronchial fistulae require emergency treatment since patients can bleed to death. In such cases, repeat TEVAR is a valuable option. However, if the fistula reoccurs or bleeding persists, conversion to open surgery has to be considered. Aorto esophageal fistulae after TEVAR are even worse since reinfection rates after repeat TEVAR are extremely high. Repeat TEVAR is more a bridging procedure since the only effective treatment consists of endograft and esophagus resection.

Failed thoracic endovascular aneurysm repair
In contrast to endovascular abdominal aortic repair (EVAR), less is known about complications and conversions after thoracic endovascular aortic repair (TEVAR). Depending on the different aortic pathologies, procedure related complications frequently occur. Serious complications include primary or secondary type I endoleak, retrograde type A dissection, stent collapse, and rupture with subsequent death. Series involving stent grafting of TAAAs have shown that endoleaks occur in 3% to 29% and about 50% of these are life threatening type I endoleaks with unchanged pressurized aneurysm sack. The risk of retrograde type A dissection after TEVAR is approximately 6.8%, with a procedure-related mortality of 40%. Incomplete or total collapsed endografts in the thoracic aorta have only been published in case reports. Fortunately, most of the described complications can be managed by means of additional endovascular interventions. However, patients will remain in whom repeat endovascular techniques will not be feasible owing to inadequate landing zones that do not allow extension devices, inappropriate apposition, and progressive dissection or aneurismal disease. Since we are a referral center for aortic pathology, we have received many patients with failed or inadequate TEVAR procedures. The main reasons for these failures include type I endoleaks with persistent aneurysm sack growth, aortic-bronchial fistula, aortic-esophageal fistula, aortic perforation and infection. The most common cause of type I endoleaks was chronic aortic dissection in which the proximal or distal part of the endograft could not deploy completely because of the rigid septum. Normally, these problems can be solved with extension of the endograft, sometimes requiring additional debranching in the arch or at the level of the visceral vessels.

However, in some patients these limits have been reached, as in our series, and conversion to open repair is necessary. Using our standard protocol for open TAAA repair including extracorporeal circulation, spinal cord protection and neuromonitoring, we were able to achieve good surgical outcome.

Summary
Endovascular repair of thoraco abdominal aortic aneurysms is not only feasible but is also the modern and future treatment of choice for TAAA. At present, TEVAR is our method of choice in traumatic aortic rupture, acute symptomatic type B dissection, descending aortic aneurysms, elective thoraco abdominal aortic aneurysms in elderly patients or patients at higher risk, penetrating aortic ulcers, and aortic bronchial fistulae. Open repair remains our treatment of choice in young patients with TAAA, patients with connective tissue disease who did not undergo previous thoracic aortic procedures, TAAA in chronic type B dissections not suitable for endografting and patients with failed TEVAR. Obviously these open procedures should only be performed in high volume hospitals in which the infrastructure with extracorporeal circulation, spinal cord protection, neuromonitoring, intensive care medicine and perfect teamwork is available.
Treatment of chronic thoracic aortic dissection with branched stent graft, is it feasible?

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Introduction
Type B dissections are usually classified into acute (within 2 weeks from the onset of symptoms) and chronic (more than 2 weeks from the onset of symptoms). Complicated Type B dissections do need urgent treatment. Indications for treatment are: rupture, abdominal end-organ ischemia (such as liver, bowel or kidneys), and although rare also spinal ischemia. Retrograde Type A dissection usually is also regarded an indication for urgent surgery. Pleural effusion as a precursor to rupture and persistent thoracic pain are more and more also considered an indication for treatment. Uncomplicated Type B dissections can be treated medically but it seems appealing to cover the entry tear with a stent-graft in order to promote thrombosis of the false lumen, and subsequent remodelling of the aorta. The natural history of uncomplicated Type B dissection may indicate that treatment in all cases is unnecessary. Estrera et al. reported an early mortality in medically treated uncomplicated Type B dissection of only 1.2% (2). Winnerkivist et al. reported the long term outcome in 66 patients who were all treated conservatively at the time of onset (2). Over a 10 years period, 82% remained free of dissection related death. Only 15% of patients had a chronic dissection aneurysm exceeding 6 cm in diameter. A randomized controlled trial (ADSORB) has addressed whether acute uncomplicated type B dissections would benefit from preventive endovascular treatment, and the results are awaited soon.

Technical difficulties in the treatment of chronic type B dissections with fenestrated or branched grafts
Grafts including fenestrations are used for complex abdominal aortic aneurysms, i.e., short-necked, juxtarenal, and suprarenal aneurysms. The fenestrations should be positioned close to the aortic wall and the ostium of the target vessel, and the graft needs to be repositioned to allow for catheterization of each target vessel. The longer the distance between the fenestration and the ostium of the target vessel, the more unstable the connection becomes between the bridging covered stent and the nitinol-reinforced fenestration. Branched grafts are grafts with incorporated branches and are used in thoraco-abdominal aneurysms, where the distance between graft and target vessel is too long to use a fenestration. Branches provide a better fixation and sealing with the bridging covered stents. Downwards facing branches are obviously very suited in combination with visceral arteries pointing downwards at their origin (e.g., the celiac artery). In chronic dissections, the four visceral branches of the aorta are usually involved. One specific feature in this pathology is the narrow true lumen (figure 1). Due to this narrow true lumen, a fenestrated graft might be more suitable than a branched graft.

Treatment indication for chronic Type B dissection
The main indication to treat a chronic Type B dissection is aneurismal degeneration. This aneurismal enlargement usually occurs over years and not within a couple of weeks. All other potential indications for treatment after the initial acute Type B dissection are relatively rare (late malperfusion, impending rupture or pleural effusion, persistent pain). In addition they occur rather soon after initial onset of symptoms. Therefore, it might be wise to add a category of sub-acute Type B dissection to fill the gap between the acute dissection and the chronic dissection.

If one accepts that treating a chronic Type B dissection is treating a post-dissection aneurysm, it logically means that the treatment should aim at excluding the aneurysm, either by open or by endovascular techniques. Most post-dissection aneurysms do not have a suitable distal neck above the celiac trunk, and are therefore to be regarded as thoraco-abdominal aneurysms. Thus the only option for complete endovascular treatment would be using fenestrated and branched grafts in order to spare the visceral branches of the aorta.
Downwards facing branches, as mentioned above, can be needed when the take-off angle of the visceral artery makes it necessary to catheterize the vessel from above. These branches, however, do require extra room both for correct deployment and for catheterization. Creating this room can be achieved by using a tube graft first with a distal landing zone a few cm above the visceral branches of the aorta. Figure 2 demonstrates a case with a narrow small true lumen (figure 2a), where a tube graft was used to carefully widen the true lumen (figure 2b), and the aneurysm excluded with a graft including a branch for the superior mesenteric artery and two fenestrations for the renal arteries. (figures 2c and 2d)

Another specific feature in chronic Type B dissections is that the aortic visceral branches do not always originate from the same lumen. Especially the left renal artery is often originating from the false lumen with the other three vessels arising from the true lumen. Using a fenestrated graft then means using a technique to perforate the dissection flap in order to switch from one lumen to the other. This can be achieved by puncturing the dissection flap with a needle (e.g., TIPPS needle) or the stiffer back side of a wire. After ballooning, the channel can be used to insert and deploy a bridging covered stent.

Initial experience
Experience is growing after a few initial successes, because more patients do present with post-dissection aneurysms. The grafts used are usually fenestrated grafts with an incidental downwards facing branch for the celiac artery. In some cases the celiac artery was deliberately sacrificed because of a high grade stenosis. This allows using a triple fenestration graft with three fenestrations for the superior mesenteric artery and the two renal arteries. This design only needs a double femoral approach and no upper approach. In the first six patients, the technique was successful, with a good clinical outcome. No mortality or major morbidity was noted. However, endoleaks were seen in four patients.

Not surprisingly, type II endoleaks are probably to be expected as the graft fills the true lumen and compresses the false lumen only slightly. Indeed, the chronic dissection flap is usually fairly thick and stiff and will not allow for complete obliteration of the false lumen. Whether a type II endoleak in the false lumen of a chronic dissection aneurysm is persistent and requires additional treatment in the future remains to be determined. The type II endoleak may even contribute to the collateral flow of the spine and prevent paraplegia. Obviously type I endoleaks at the level of the target vessels are also an inherent risk, as it is sometimes difficult to gauge the length of the covered stent needed. In one case the length of the bridging covered stent proved too short, resulting in a type I endoleak. (figure 3a) This was treated interventionally with a longer bridging covered stent. (figure 3b)

Interestingly, five out of the six patients had been treated with a stent-graft in the acute setting of the Type B dissection. In all of them, the proximal entry tear was well taken care of, with a good sealing in the proximal descending aorta. Nevertheless, the lack of distal sealing had resulted in a growing aneurysm, now requiring treat-
ment. The advantage of the already present stent-graft was the availability of a proximal neck. The distal landing zones varied between the distal abdominal aorta, to the common iliac arteries, or even to the external iliac arteries.

Figure 3: Angiography of left renal artery bridging covered stent showing incomplete sealing. (Figure 3a) After insertion of a longer bridging covered stent, the endoleak was sealed. (Figure 3b)

Conclusion
Longer follow-up is needed, but fenestrated and branched stent-grafts are feasible and will likely play a role in the treatment of chronic post-dissection aneurysms.

References
Hybrid treatment for TAD

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Introduction
The incidence of Thoracic Aortic Dissections (TAD) is estimated at 2-4 cases/100,000/year and the prevalence at necropsy is approximately 1.1 - 1.5%. Additionally, 21% of patients with acute aortic dissections die prior to arriving at a hospital. Uncomplicated type B aortic dissections are managed with medical therapy, owing to the lower rate of morbidity and mortality compared to surgery. Early treatment with either surgical or endovascular methods is reserved for those patients who develop vascular complications such as persistent or recurrent pain, rapid aortic expansion, rupture or malperfusion syndrome. However, this is not a benign approach as failures and dilatation of the false channel do occur in 20 to 40% of the patients who survive the acute phase. In chronic dissections, the approach of overstenting the proximal entry tear as well as any significant distal thoracic communications is often an effective procedure with the expected results of false lumen thrombosis, thoracic aneurysm shrinkage and absence of abdominal aortic dilatation. But some cases do not have this fortunate outcome because double channel patency at visceral vessels and abdominal aorta levels is the rule, and the abdominal false channel may dilate. Lastly, after years of medical therapy, patients are observed to develop a thoracoabdominal aneurysmal disease. In spite of impressive results in centers of excellence, graft replacement of such extensive disease in other centers carries a high morbidity and mortality rate. We have adopted a multi-staged approach consisting of a three-step planned procedure combining extra-anatomic proximal reconstruction, endovascular grafting and standard open surgical techniques.

Methods
In our experience of more than two hundred cases of thoracic aorta pathologies treated, we had to deal with extensive TAD frequently. We preferred endovascular treatment in most cases. Unfortunately, proximal and distal landing zones are seldom not easy to obtain. In such cases, hybrid technique is performed. Extra-thoracic revascularization was obtained via left subclavian artery transposition or bypass in case of landing in zone II, carotid-carotid-subclavian bypass in case of landing in zone I. Nowadays we perform this kind of intervention in a standardized fashion, with a bypass from the right carotid artery to the left subclavian artery and performing a direct re-implantation of the left carotid artery on the graft (figure 1). When the proximal landing zone is the zone 0, different approaches are possible.

Intra-thoracic bypass from the ascending aorta has becoming a common practice in many centres. Nonetheless some patients are considered unfit for this technique, because of previous sternotomy, diseased ascending aorta, higher risk and urgency. In these cases, alternative solutions are possible such as branched or fenestrated endograft, in situ fenestration and double barrel technique. The double barrel technique is an appealing option to treat these patients avoiding sternotomy. We performed our first cases as a bail-out for unintentional covering of the innominate artery. To restore cerebral perfusion, we positioned a parallel stent into the innominate artery via right brachial artery. This patient, treated in 2002, has now a good patency of the stent and complete thrombosis of the false channel.

More recently we applied this technique in several patients more. In eight cases of type B aortic dissection, we had to deal with a distal aneurysm at visceral and abdominal aorta level. Some patients had previously undergone endovascular repair of a chronic type B dissection with thoracic stent-grafts and others were admitted for a pre-existing aneurysmal dilatation of the thoracic as well as the abdominal aorta. Staged hybrid treatment was utilized for management. The first step was the transposition of supra-aortic trunks to provide a suitable proximal neck with either a carotid-subclavian transposition/bypass or retropharyngeal carotid-carotid/carotid-subclavian bypass to provide adequate proximal neck length longer than 2 cm.

The second step involved endovascular exclusion of the thoracic dissection with an endograft which ended 5 to 10 centimetres above the celiac trunk. Lastly, surgical re-
pair of a type IV thoraco-abdominal aortic aneurysm via a thoraco-phreno-laparotomy through the seventh or eighth intercostal space was conducted. During this last phase, the aorta at the level of the diaphragm was replaced by a standard Dacron graft, with a proximal end-to-end anastomosis with the stent-graft (figure 2). Reimplantation of visceral arteries was accomplished with a visceral inclusion patch and reimplantation of the left renal artery via Carrel technique. Routine femoro-femoral bypass and spinal fluid drainage was used, allowing for lower extremities and visceral arteries perfusion during the proximal anastomosis.

Discussion
TAD involving the aortic arch, which is one of the most frequent sites of aneurysmal dilatation of the thoracic aorta, were often excluded from the indications to endovascular treatment because of problems of vascularization of the above-aortic trunks. The surgical technique of transposition, resulting in the lengthening of the proximal anchoring zone, is an effective strategy for extending the indications. The evaluation of surgical risk seems to be a key criterion, since we have not yet availability of long-term results. It seems logical to treat with traditional technique, patients at low surgical risk. The long term outcome of aortic dissections remains somewhat poorly defined. Unfortunately, surviving the initial presentation of an aortic dissection does not guarantee freedom from subsequent aortic events such as aortic aneurysm formation, rupture and extension of dissection that may lead to end-organ ischemia. Even patients successfully submitted to open interposition aortic repair are not immune from possible long term complications.

Endovascular repair of proximal descending thoracic aortic dissections usually promote an aortic remodelling (false lumen thrombosis, true lumen expansion, thoracic aneurysm sac shrinkage). However, the distal thoracic aorta remains untreated and, in some cases, this approach fails to induce thrombosis of the celiac and abdominal false lumen, which may dilate. Proximal thoracic stent-grafting fails to abolish the false lumen in about 15-25% of patients suggesting that perhaps it may not be a definitive solution for all type B aortic dissections. In spite of the impressive results in centers of excellence, graft replacement of such extensive disease across most hospitals carries a high mortality rate, thereby motivating the desire to develop other less invasive methods. We adopted a multi-staged approach consisting of a three-step planned combination of extra-anatomic proximal reconstruction, endovascular grafting and again classic open surgery procedure. This approach appears feasible and safe, albeit remains a major operation. We believe this approach results in a definitive repair with a much lower thoracotomy, leading to lesser pulmonary compromise and avoidance of barotrauma from left lung isolation. In some cases it may even require only abdominal access. One criticism may be the potential risk of paraplegia since it remains very difficult to reimplant patient critical intercostal arteries. In this subgroup of patients we had two cases of paraplegia; one after endograft thoracic exclusion that completely regressed after 3 months and the second after the thoraco-abdominal procedure with an incomplete recovery. In the last case the etiology was probably multi-factorial rather than linked solely to intercostal or lumbar artery occlusion. In fact, in this patient the clamp time was longer and the intraoperative bleeding was more than expected. This corresponds to the theory that neurological complications after thoracic open surgery are more closely related to the aortic cross-clamp time, concomitant mesenteric ischemia and reduced spinal cord perfusion. While lifelong surveillance is still needed, this technique provides a less invasive alternative in this difficult patient population. Longer follow-up and larger series are needed to confirm its usefulness in the armamentarium of the vascular specialist for treating type B aortic dissections.

References
Identification of the Abdominal Aortic Aneurysm (AAA) at risk by functional imaging

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The size of abdominal aortic aneurysms (AAA) is neither sensitive nor specific as the sole determinant for the risk of rupture. However, the rate of expansion of the vessel precedes fissuration and rupture of a certain number of AAA independently of their size (6). The process of expansion preceding fissuration and rupture seems to depend upon the release of matrix metalloproteinases (MMP) produced and/or activated by inflammatory cells (9), causing degradation of elastin and collagen in the aneurysmal walls (7). Elastin degradation and collagen remodeling depend on the activity of a variety of enzymes including some elastases, plasminogen activators (PA), and matrix metalloproteinases (MMPs) (10). There is some evidence that aneurysms with a high inflammatory cell infiltrate and an increased expression of metalloproteinase activity are prone to rapid expansion and rupture (11). A positive correlation between plasma’s MMP-9 and large size and/or expansion of AAA has been reported (6,12). The activity of MMP, and MMP, has been determined in the wall of asymptomatic and ruptured AAA. A higher proteolytic activity is observed at the site of rupture (19). Despite the importance of the aneurysmal size in clinical decision making, small AAA may also rupture. The question therefore arises: could functional imaging techniques such as positron emission tomography (PET) be useful to monitor the development and risk of AAA independently of their size? Conventional imaging of the vascular tree using ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI) and contrast angiography, gives us anatomical and morphological information about localised vascular disease. However, recently available imaging techniques can provide a molecular and cellular assessment of atherothrombosis and can identify the metabolic activity at the level of the arterial wall. PET imaging was developed in the mid 1970s; like any nuclear medicine imaging technique, it is based on the detection of photons emitted by the patient after administration of a radio-labeled tracer. Several physical characteristics of PET constitute a major advantage over monochromatic scintigraphy. Most importantly, the tracers are labeled with positron-emitting radionuclides. The two photons resulting from the disintegration of the positron are emitted in opposite directions (i.e. at 180° from each other) and recorded in coincidence by the detectors surrounding the subject. In short, PET imaging increases the count rate (that is, the number of photons that are detected) and improves the spatial resolution, i.e. lesion detectability. In addition, the images can be fully corrected, in particular for attenuation, which allows for an accurate and reproducible quantitation of tracer distribution. Depending on the radiotracer, a wide variety of physiological and pathological processes can be studied at the molecular level using this technique. However, in routine clinical practice, the vast majority of PET studies are performed using 18-F-Fluorodeoxyglucose (FDG), which reflects glucose uptake and metabolism resulting from cellular activity. FDG is a glucose analogue, transported into cells using glucose transporters. Once inside the cells, FDG is phosphorylated to FDG-6-phosphate, which is not a substrate for the enzymes of the glycolytic chain and hence FDG-6-phosphate accumulates within the cell. FDG-PET recognizes increased metabolic activity and is mainly used for cancer imaging. Indeed cell glucose metabolism is significantly increased in most types of cancer (14), due to increased expression of membrane transporters, increased hexokinase activity, or both. Nevertheless, FDG uptake is not specific for tumors. Increased uptake is observed in many non-neoplastic physiological and pathological conditions (15). Usually, the level of FDG uptake by inflammatory cells in the resting state is low in comparison with tumor cells. However, when activated, these cells may show significant increases in glucose uptake and metabolism. This has been evaluated in various experimental settings, including skin transplantation, turpentine-induced inflammation, concavalin-A activation of T lymphocytes in bacterial abscesses or in B-lymphocytes after viral infection. The lack of specificity for tumors provides a powerful tool for using PET to evaluate inflammatory and infectious diseases as well as during the monitoring of vascular graft infection (16-18). It should be noted, however, that FDG uptake is often seen in the arterial wall, in the absence of any known inflammatory vascular disease. Yun et al evaluated two series of patients who underwent PET imaging for oncological or other indications. They found that the rate of positive vessel uptake approached 50%, and increased with age (19). They also showed that hypercholesterolemia and age were the only parameters correlated with the presence of such uptake, among all major risk factors for atherosclerosis. With the advent of modern PET/CT, the procedure has been considerably shortened and simplified. Usually, patients are asked to fast for six hours prior to injecting FDG, which is of particular importance when investigating inflammatory processes, as glucose loading significantly decreases glucose transporter expression (and FDG uptake) in inflammatory lesions (20). Modern hybrid scanners are coupled with computerized tomography (CT) for attenuation correction and anatomical mapping. Attenuation correction is usually performed using data from continuous enhanced low dose body CT from skull base to the thighs. Intravenous contrast enhancement can be used with limited effects on attenuation correction and uptake quantification, in order to provide additional information on the thrombus, surrounding tissues and vessels. Using autoradiographic techniques, Rudd et al showed increased tracer accumulation in the regions of the plaque with the highest density of macrophages.
Indeed, enhanced uptake has been reported in various inflammatory diseases involving the large vessels. Giant cell arteritis and Takayasu arteritis both show significantly increased glucose metabolism in the wall of the affected arteries (i.e. aorta, subclavian arteries or carotid arteries) [17]. Furthermore, FDG uptake has been found in large arteries in the presence of active atheromatous plaques [18,19]. In a pilot study Sakalihasan et al. observed an association between 18F-FDG uptake by the aneurysm wall and rapid expansion of the aneurysm in some cases [20]. Indeed, five of the nine operations on patients with positive PET imaging were performed on an urgent basis. In the 16 PET-negative patients, aneurysmectomy was delayed for the convenience of the patient from one to several months. None of these patients developed aneurysm-related symptoms in the interval. FDG uptake in the aneurysm wall reflects the presence of increased metabolic activity, probably associated with a high density of inflammatory cells (macrophages, lymphocytes) in the adventitia, as previously described [20]. These preliminary observations have been confirmed recently in a study by Reeps et al. [22], where they observed a correlation between increased FDG uptake and patients with a very high macrophage activity and symptomatic AAA. However, in agreement with earlier reports [23], Reeps et al. failed to find a correlation between maximum standard uptake value (SUV) and maximum cross-sectional infrarenal AAA diameter [20]. These studies could suggest a possible correlation between increased FDG uptake by the aneurysm wall and inflammatory cell biology leading to rupture. Therefore, PET scanning with FDG uptake offers a new tool for exploring adventitial immuno-inflammatory responses in atherosclerosis and AAA.

References
The potential of endostapling in EVAR

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Objective
One of the major limitations of endovascular aneurysm repair (EVAR) is the occurrence of distal migration, especially in angulated and/or short proximal landing zones, which might lead to proximal type I endoleaks and/or migration. The use of endostaples might:
1. Prevent endograft migration and the occurrence of proximal type I endoleaks after initial graft implantation.
2. Address proximal type I endoleaks in EVAR revision surgery.

Methods
In a 1-year period the following patients were eligible for inclusion in this feasibility study:
1. Patients undergoing primary EVAR with short (<8 mm) and large (31-32 mm) infra-renal necks,
2. Patients with proximal migrated endografts and/or proximal type I endoleaks post-EVAR, due to distal migration. All patients were treated with endostaples (Aptus Endosystems, Inc, Sunnyvale, CA, USA) to fixate the primary endograft to the aortic wall, with or without the use of additional proximal extender cuffs. In case of the use of extender cuffs these cuffs were also fixated with endostaples to the primary endograft and the aortic wall. Computed tomography (CT) scans were performed 6-months post-procedurally.

Results
A total of 13 patients (11 men, age 74 ± 8 years) were included in this study, of which 3 underwent primary fixation of an abdominal endograft with challenging proximal landing zone, 9 underwent secondary fixation of a migrated endograft because of distal migration or proximal type I endoleaks post-EVAR, and 1 because of endograft component separation leading to type III and distal type I endoleaks due to complete migration of the primary endograft limbs. In all patients, the primary endografts were secured to the aortic wall with a minimum of 4 endostaples. In case of the use of extender cuffs or bridging grafts these were also fixated with 4 endostaples to the primary endograft and/or aortic wall. One endostaple migrated during implantation but could be successfully snared and taken out. At completion angiography 1 patient with a primary huge proximal type I endoleak still suffered from this leak and an additional juxtarenal self expandable bare stent had to be implanted. At 6-months CT-scans no proximal type I or type III endoleaks were seen, nor migration of the endografts or cuffs. No endostapling related complications occurred.

Conclusions
The use of Aptus endostaples to prevent migration and to treat proximal type I endoleaks due to migration of endografts could be safely performed in this series. During short-term follow-up, (persistent) migration was prevented and proximal type I endoleaks could be treated successfully. Use of this technique may obviate the need for more complex endovascular or open revision surgery after failed EVAR.
Mid term results of side branch endograft for endovascular treatment of Aorto-iliac aneurysm after more than 100 cases

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Background
Iliac branch endograft device (IBD) has been recently introduced as an appealing and effective solution to avoid the wide range of complications occurring during repair of aortoiliac aneurysm with extensive iliac involvement. Nevertheless, the performance of IBD over time is unknown. Aim of this study was to analyze safety and long-term efficacy of IBD in a consecutive series of patients.

Methods
Between 2006 and 2011, 100 consecutive patients were enrolled in a prospective database on IBD. Indications included unilateral or bilateral common iliac artery aneurysms combined or not with abdominal aneurysms. Patients were routinely followed with Computed Tomography.

Results
There were 96 males, mean age 74.1 years. Preoperative mean common iliac aneurysm diameter was 39.75mm (range 27-68mm). Sixty-seven patients had abdominal aortic aneurysm > 35mm (range 35-84mm) associated with iliac aneurysm. Eleven patients presented hypogastric aneurysm. Twelve patients underwent isolated iliac repair with IBD and 88 patients received associated endovascular aortic repair. Periprocedural technical success rate was 95%, with no mortality. Two patient experienced external iliac occlusion in the first month. At a mean follow-up of 21.7 months (range 1-61) aneurysm growth >3mm was detected in 4 iliac (4%). Iliac endoleak developed in 3 patients and buttock claudication in 4 patients. KM estimated patency of internal iliac branch was 91.4% at 1 and 5 years. KM freedom from any reintervention was 90% at 1 year and 81.4% at 5 years. No late ruptures occurred.

Conclusions
Long-term results show that IBD use can ensure persistent iliac aneurysm exclusion at 5 years, with low risk of reintervention. This technique can be considered as a first option in patients with extensive iliac aneurysm disease with favorable anatomy.
Endovascular treatment of the ascending aorta

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Introduction
Endovascular techniques have revolutionized the treatment of pathology affecting the descending thoracic aorta (TEVR), with demonstrable reduction in both mortality and morbidity in conditions with diverse pathologies. It may be argued that endovascular repair of the thoracic aorta is now the first line therapy for complicated acute Type B dissections, descending thoracic aneurysms and thoracic transactions.

With the success of TEVR, new applications have been sought for this technology. One area of potential interest is the ascending aorta. Several pathologies may be candidates for endovascular treatment including isolated ascending aortic aneurysms, cannulation site false aneurysms, intramural haematoma and some Type A dissections. The anatomical and physiological challenges to endovascular therapy of the ascending aorta remain formidable and include:
- Proximal fixation close to the aortic valve and coronary ostia
- Distal fixation which may impinge on the innominate artery
- Curvature of the distal ascending aorta
- Sizing discrepancies in pathological conditions
- Haemodynamic forces in this arterial segment
- Potential for fatal retrograde dissection

Pathologies Suitable for Treatment
Type A Aortic Dissection
Despite these difficulties, endovascular development may offer a therapeutic modality for cases of surgically untreatable Type A dissection. Selective studies have demonstrated that up to 30% of patients with Type A dissection are unable to undergo surgical treatment (1). The mortality in these cases is high (60-80%), and endovascular therapy may be a possible alternative. Two recent studies have ascertained the suitability of Type A dissection for treatment with an endovascular stent graft. In a study from Stephan Haulon’s group (2) 102 patients with Type A were studied. An endovascular repair with a tubular stentgraft was deemed feasible in 45 patients (with 8 requiring a carotid-carotid bypass). An arch-branched endograft could have been used in 13 patients to exclude an entry tear located in the arch.

A similar study was performed by Greenberg’s Group at the Cleveland Clinic (3). In this study of 162 patients, 77% of scans were suitable for analysis. The primary entry tear was visible in only 41% of the studies. Thirty two percent of patients were anatomically amenable to such a repair (absence of valvular involvement, appropriate length and diameter of proximal sealing regions, avoidance of coronary ostia). The most common reason for an inability to perform endovascular repair was absence of a proximal landing zone.

At present the literature regarding endovascular therapy for ascending dissections is limited to case reports and case series but does appear promising. In perhaps the biggest series to date, Ye et al. (4) reported a series of 45 patients with Type A dissection. Many had a primary tear in the aortic arch and descending thoracic aorta, but 10 patients had a tear in the ascending aorta. The overall success rate of the cohort was 98% with a mortality of 6.7%.

Ascending Aortic Aneurysm
Ascending aortic aneurysms are another potential target for therapy. Kolvenbach reported a significant experience of treating these lesions in patients who were unsuitable for conventional therapy (5). In this experience only 25% of patients with ascending aneurysms were candidates for endovascular therapy with the proximal landing zone being the main reason for inability to treat. The combined mortality/morbidity in the 11 patients was 18% with one death from left ventricular perforation and one stroke. Clearly this study is one of feasibility but does seem to confirm proof of concept.

SGVI Experience
Ascending aortic repair is only performed in our institution for patients who have no conventional surgical option. This has included therapy for cannulation site aneurysms and a case of Type A dissection.

In the last 2 years a graft has been developed (Cook Medical) for compassionate use in the ascending aorta. The nitinol based stent graft has features specifically designed for use in this challenging anatomy:
A delivery system capable of delivering the stent to the ascending aorta from a femoral route
- A tip capable of atraumatic entry to the left ventricle
- Stable delivery with accurate placement
- Length and diameter compatible with the ascending aorta

Early experimental data will be presented to illustrate the deployment system. At the time of writing, the system has been used in one compassionate case (6). A 68-year old woman with a history of hypertension and current smoking was admitted with sudden onset chest pain. Her CXR, ECG, serum troponin and d-dimer tests were normal, but over the following 72 hours she developed acute renal failure, requiring haemofiltration, a pericardial and bilateral pleural effusions.

Four days after the patient’s initial presentation, a trans-thoracic echocardiogram and Computed Tomography (CT) Pulmonary Angiogram revealed significant Type A intramural haematoma; contrast extravasation in the ascending aorta from an intimal tear with haematoma in the aortic wall. The patient was unfit for open repair, but consented to an endovascular approach with a custom-designed graft.

Under general anaesthesia, the right brachial artery was punctured percutaneously and the left common femoral artery (CFA) exposed. Angiography identified the position of the coronary and innominate arteries. Via the CFA a 34mm diameter Zenith Ascend® ‘custom made ascending aortic stent’ (Cook Medical, Cook Medical, Bjaeverskov, Denmark) was positioned across the aortic valve over an extra stiff guidewire (Lunderquist, Cook Medical, Bjaeverskov, Denmark). With overdrive pacing induced hypotension, the stent was deployed in the ascending aorta (Figure) (Transesophageal image). Angiography confirmed exclusion of the false lumen with patency of both coronary and innominate arteries. Following surgery, the patient was extubated within 24 hours. A CT scan confirmed coverage of the aortic leak and the patient made a successful recovery.

References

Figures: Illustration of an ascending aortic endograft after placement for a Type A dissection
Open surgery for ascending and arch aneurysms

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Profound hypothermia with circulatory arrest is the principle method of cerebral protection during ascending and aortic arch repair. Refinements in surgical techniques have led to improved mortality and stroke rates. With the increasing use of endovascular repair over the last ten years, there are increasing attempts to treat proximal thoracic aortic segments with stent-grafts. Prior to widespread application of endovascular techniques in the proximal aorta, it is important to establish benchmarks for acceptable outcomes. We review our experience with open repair and emphasize cerebral protection strategies.

The anatomic difficulty in treating the aortic arch stems from the need to provide nutritive flow to the brain. Early aortic arch repairs used extra-anatomic bypass to the cerebral arteries. Griep and colleagues simplified arch repair by using profound hypothermic circulatory arrest (PHCA) (1). This allowed surgeons to operate in a relatively bloodless field without the need for cumbersome extra-anatomic bypasses. The group reported their updated experience in 1994 in 200 patients (2). Stroke occurred in 11% but with 19% suffering temporary neurologic deficits and 15% in-hospital mortality. Embolism and long circulatory arrest times were associated with worse neurologic outcomes (3). Animal and clinical studies suggested that retrograde cerebral perfusion through the superior vena cava provides sufficient nutritive flow and reduces intraoperative atheromatous embolism (4,5). Most groups use antegrade cerebral perfusion (ACP) through an axillary cannula or selective balloon-tipped cannulation of the arch vessels from the operative field. While both methods are efficacious, we primarily adopted RCP. Integrating ACP during aortic arch repair did not improve the arch vessels from the operative field. While both methods are efficacious, we primarily adopted RCP. Integrating ACP during aortic arch repair did not improve the arch vessels from the operative field. When the electroencephalogram is isoelectric, we halt cardiopulmonary bypass to arrest the circulation. High opening pressures are often needed to initiate RCP but subsequent vena caval pressures are kept at less than 25 mm Hg. We provide continuous retrograde cold blood cardioplegia via a coronary sinus catheter. Intermittent antegrade coronary perfusion is given during PHCA and after the aortic lumen is opened. The diseased arch is resected leaving an island for cerebral and subclavian artery reattachment. Individual bypasses to each of the cerebral and subclavian arteries are made only when the arch vessels are diseased, e.g., aneurysmal. In cases of descending thoracic or thoracoabdominal aneurysms, an elephant trunk technique is used. Once the arch is repaired and the distal anastomosis completed, antegrade perfusion is started through a side-arm graft attached to the main graft. We then resect the tubular portion of the ascending aorta and perform the proximal anastomosis. The patient is rewarmed and the patient is weaned off of cardiopulmonary bypass.

Univariate risks for early death included age greater than 72 years, coronary artery disease, acute aortic pathologies, and renal dysfunction (7). The overall 30-day mortality, including cases of acute type A dissection and ruptures, was 9.3%. However, in patients with normal renal function (>80 mL/min/1.73m2) the mortality was 5.0%. We did not segregate temporary and permanent brain injury and classified either as stroke based on neurologic consultation and brain imaging. The overall stroke rate in over 1000 patients with RCP was 2.8%. On multiple logistic regression analysis, age greater than 62 years and emergency cases were risk factors for stroke. Chronic dissection was not a risk for either death or stroke.

The durability of open repair is excellent. Kulik and colleagues reported aortic arch branch patency rates approaching 100% (mean follow-up 2.6 years) and 71% 5-year survival (8). The 5-year freedom from reoperation was over 90%. In our own patients, actuarial survival was 72% at 5 years and 71% at 10 years after surgery (9). We are also selectively using endovascular repair for pathologies of the descending thoracic aorta and the distal aortic arch. Our group has shown short-term benefit in cases of traumatic aortic injury (10,11). For cases requiring exclusion of the proximal aortic arch (zones 0 and 1), extra-anatomic bypasses are required to maintain flow to the brain and upper extremities. It is ironic that circulatory arrest techniques were developed nearly 40 years ago so that extra-anatomic reconstructions could be avoided.

Nevertheless, cervical bypasses are well-tolerated with good long-term patency rates. The mortality is usually less than 1% with stroke rates between 1.4-3.8% (12-14). However, it is difficult to determine the outcomes of endovascular arch repair since many authors include endograft exclusion of the left subclavian artery origin alone (zone 2) with cases involving exclusion of the left common carotid (zone 1) and innominate arteries (zone 0). Such repairs require multiple cervical bypasses, e.g., caro-
tid-carotid and carotid-subclavian. Total endovascular arch repair (zone 0) generally requires a mini-sternotomy and aorto-innominate bypass. Total arch debranching is associated with a mortality of 3-11% with stroke occurring in 3-8% (15,16). By mixing single cervical bypass cases with more extensive proximal arch cases, defining the actual outcomes of aortic arch debranching becomes muddled.

To the complications of aortic arch debranching must be added the morbidity and mortality of endograft deployment. Most case series include less than 50 patients and report early mortality in 4-11% and neurologic complications in 4-19% (15-20). Branched and fenestrated endograft techniques may improve these outcomes but durability remains questionable.

In patients with good renal function, elective open ascending and aortic arch repair with RCP has low mortality (5.0%) and few neurologic complications (2.8%). Durability is excellent with good long-term survival and low re-intervention rates. Additional research is required to define high-risk patients that might benefit from alternative therapies. Long-term results from branched and fenestrated aortic arch endografting are still pending.

References
Hybrid treatment of aortic arch aneurysms

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Background
Despite technical and technological improvements, open repair of aortic arch pathologies is still associated with high mortality and morbidity rates, mainly related to deep hypothermic circulatory arrest and cerebral ischemia. Moreover, the presence of various preoperative comorbidities has been associated with poor outcomes in both univariate and multivariate analyses. Patients ineligible for traditional open surgery might benefit from an alternative approach, such as arch endovascular aortic repair. Progress with branched endografts that allow a total endovascular approach has been slow. Therefore, to provide a less invasive treatment for patients unfit for conventional surgery, a hybrid approach consisting of aortic arch debranching with rerouting of the supra-aortic trunks and exclusion of the pathological portion of the aortic arch employing straight endografts remains advisable.

We report the outcomes of our experience with aortic arch aneurysm repair using the hybrid approach.

Patients and methods
Between ‘98 and ‘11, 445 patients underwent TEVAR for thoracic aortic pathologies in our Center. Among this group, 143 patients with aortic arch aneurysm were treated by means of hybrid repair. Most of these patients had been refused by cardiac surgeons as considered “high-risk” for severe comorbidities.

The feasibility of the endovascular intervention, sizing of endografts, and implant strategy were determined using 16- or 64-row multislice computed tomography (CT) with multiplanar reconstructions. Anatomical exclusion criteria for hybrid repair of the aortic arch were proximal or distal landing zone maximum diameter >38 mm or >46 in cases of planned aortic banding; proximal or distal landing zone length <20 mm; circumferential calcifications or thrombus of the proximal or distal landing zone; inverted funnel-shaped proximal neck with >3 mm increase in diameter from the proximal landing zone; prohibitive occlusive disease, tortuosity, or calcification of intended access vessels or in the region of the intended fixation sites; and angulation in the aortic arch or thoracoabdominal aorta that would preclude advancement of the introduction system. After the orthogonal maximal diameter of the lumen was measured from outer wall to outer wall at the landing zone, the endograft was chosen using 10% to 15% oversizing depending upon the endografts used.

For zone 0, the operation was performed through a median sternotomy. The pericardium was opened and the ascending aorta exposed. Isolation of the proximal right subclavian artery and the common carotid artery (CCA) was performed just distal to the brachiocephalic bifurcation. Use of a tailored “Y” graft with a smaller tubular graft was preferred instead of a commercially available standard bifurcated Dacron graft to reduce retrosternal bulging and extrinsic compression of the left brachiocephalic vein. After systemic administration of heparin under continuous electroencephalographic monitoring and arterial controlled hypotension, the ascending aorta was side-clamped, and a longitudinal arteriotomy was performed. The proximal end of the graft was anastomosed to the ascending aorta using a 4-0 Prolene running suture. The graft was tunneled beneath the left brachiocephalic vein. The innominate artery was clamped distally and transected near its terminus. The innominate artery was anastomosed to an 8- to 10-mm Dacron branch in end-to-end fashion with a 5-0 Prolene running suture.

The absolute indications for left subclavian artery (LSA) revascularization in zones 0 and 1 aneurysms at our Institution were coronary circulation supplied by the LSA through the left internal mammary, inadequate contralateral vertebral artery, young patients, left-handed professionals, and high risk for spinal cord ischemia.

For zone 1, two anterolateral incisions were employed running parallel to the medial border of the sternocleidomastoid muscle at the base of the neck. The CCAs were exposed in the usual fashion, performing a carotid endarterectomy. For this debbranching procedure, a 6- or 8-mm expanded polytetrafluoroethylene ring-armed graft was tunneled in the anterior subcutaneous position. Clamps were applied to the donor carotid vessel, and the proximal anastomosis was completed in an end-to-side fashion with a 5-0 Prolene running suture. The recipient anastomosis was performed in end-to-end fashion with CCA ligation to prevent type II endoleak.
For zone 2 patients treated early in our experience, the LSA was revascularized only in selected cases; in our more recent cases, LSA revascularization has been performed routinely, reserving coverage without revascularization to urgent cases.

For the endovascular component, the common femoral artery at the level of the groin was the preferred access route, although abdominal aortic or iliac access was used in case of inadequate femoral access. Under roadmapping guidance supplied by a portable digital C-arm image intensifier, the common femoral artery was surgically exposed and cannulated with a standard J-tipped guidewire, which was advanced into the ascending aorta and then exchanged with a superstiff Lunderquist pre-curved guidewire (Cook, Inc., Bloomington, IN, USA). The endograft was gently advanced into the aortic arch. Moderate hypotension (systolic blood pressure <80 mmHg) was induced to reduce the risk of endograft migration during deployment. After deployment of the endograft, completion angiography was performed to ensure complete aneurysm sac exclusion, no evidence of endoleaks, and patency of all supra-aortic vessels. Careful balloon molding of the endograft was used only in the presence of incomplete expansion of the endograft or type I endoleak.

The preferred timing of procedure was simultaneous for several reasons: a single general anesthesia is required, which provides the advantage of easy aortoiliac access when needed; and proximal aortic neck reshaping or banding may also be performed, or more proximal ligature of supraaortic stumps to facilitate and optimize the endovascular fixation of the graft, reducing the risk of postoperative type I endoleaks. Patients were evaluated in follow-up with chest radiography and contrast CT scans at 1, 6, and 12 months and yearly thereafter. Angiograms were obtained in selected cases (i.e., endoleaks). Clinical follow-up was also performed at regular 6-month intervals.

**Results**

120 atherosclerotic and 23 dissecting aneurysms, were categorized according to Ishimaru’s classification as 32 zones 0, 34 zones 1, and 77 zones 2. Mainly a simultaneous procedure was performed always using commercially available thoracic endografts. The initial clinical success in zone 0 was 84.3%, with a 30-day mortality of 9.4% due to intraoperative stroke in all the cases. The initial clinical success was 85.3% and 90.9%, with a 30-day mortality of 2.9% and 2.6% respectively in zone 1 and 2. The overall rate of endoleak was 7.7%. Two patients (1.4%) developed spinal cord ischemia. At follow-up (mean 24.5±18 months) the overall survival rate was 89.6%. Two patients treated for zone 1 aneurysm died because of aneurysm rupture. During follow up we observed 4 cases of acute retrograde DeBakey type II dissection: 3 cases were successfully treated with ascending aorta and arch open repair under hypotermic circulatory arrest, one patient died at onset of dissection for stroke.

**Conclusions**

In selected patients with arch disease, early and midterm outcomes of hybrid repair are promising although mortality, especially in zone 0, is still significant and the risk of retrograde dissection has to be assessed. These results may have practical implications for the ongoing evolution of the hybrid repair as well as for patients fit for traditional surgery.
Chronic arch aneurysm: prevention and management

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Introduction
Thoracic aneurysms may involve one or more aortic segments (aortic root, ascending aorta, aortic arc or descending aorta). The etiology, natural history and treatment of thoracic aneurysms differ for each of these segments.

Etiology and natural history
There are several possible risk factors in the etiology and pathogenesis of ascending and aortic arch aneurysms. Aneurysms of the ascending thoracic aorta and of the aortic arch most often result from cystic medial degeneration which appears histologically as smooth muscle cell dropout and elastic fiber degeneration which leads to weakening of the aortic wall, which in turn results in aortic dilatation and aneurysm formation. Cystic medial degeneration occurs normally to some extent with aging but the process is accelerated by hypertension. In young patients cystic medial degeneration is classically associated with Marfan syndrome or with less common connective-tissue disorders such as Ehlers-Danlos Syndrome or Loeys Dietz syndrome. In these syndromes there is an autosomal dominant inheritance with variable penetrance and expression. For several other genetic syndromes with thoracic aortic aneurysm formation gene identification has been made which has lead to an increased knowledge of pathogenesis and treatment. Genetic counseling can therefore be of help in screening first degree relatives of young patients with thoracic aortic aneurysms, in guiding therapeutic options since in some of these disorders such as vascular Ehlers-Danlos syndrome surgical outcome is bad and medical treatment seems to have promising results. However much further research is needed before any therapeutic implications can be drawn.

Prevention and medical treatment
Medical therapies available to slow the growth of thoracic aortic aneurysms and reduce the risk of rupture are quite limited. Treatment with beta blocker results in a significant reduction of aortic dilatation, fewer aortic events and lower mortality in Marfan patients but whether these benefits can be truly extrapolated to the non-Marfan population with thoracic aneurysms remains unknown. There is some early experimental evidence that oxidative stress may play a role in the pathogenesis of atherosclerotic thoracic aortic aneurysms and that statin therapy and angiotensine II receptor blocker therapy may potentially have a protective effect. However much further research is needed before any therapeutic implications can be drawn.

Surgical treatment
Open surgical treatment
Surgical treatment of aortic arch aneurysms is particularly challenging and carries a significant risk of neurological damage from embolization of atherosclerotic debris.
or from global ischemic injury during circulatory arrest. To replace the dilated arch with a prosthetic tube graft, the brachiocephalic vessels must be removed from the arch before its resection and reimplanted into the tube graft arch after its interposition. Traditionally, this involved removing and then reimplanting the brachiocephalic vessels en bloc during hypothermic circulatory arrest. Many surgeons have now adopted a newer surgical technique by using a multi limb prostatic arch graft, to which each vessel is in turn anastomosed individually, which reduces the duration of hypothermic circulatory arrest and the frequency of embolic events.

To improve outcome the surgeon should perform the most extensive therapy possible by using e.g. elephant trunk techniques

Early outcome of total arch replacement depends not only upon the surgeon’s skill but also on the techniques of cerebral protection employed. Three methods of cerebral protection have been used for aortic arch surgery.

The traditional method had been the use of profound hypothermic circulatory arrest with arrest of cerebral perfusion. Subsequently retrograde cerebral perfusion via a superior vena cava cannula was introduced as an adjunct for cerebral protection during hypothermic arrest. It was believed that this technique would improve outcomes by providing nutrients and oxygen to the brain and flushing out particulate matter from the cerebral and carotid arteries that would otherwise embolize. However, systemic studies of retrograde cerebral perfusion have shown no improvement in outcomes.

More recently, the technique of selective antegrade cerebral perfusion was introduced. With this method perfusion cannulas are inserted into the cerebral vessels to perfuse the brain during all but brief periods of surgery, which significantly reduces the incidence of permanent and temporary neurological dysfunction.

To avoid the potential devastating side effects associated with deep hypothermic circulatory arrest and myocardial stunning several authors propose total arch replacement with moderate circulatory arrest and even under normo-thermic beating heart surgery.

Morbidity and mortality as well as early clinical outcomes and survival for total aortic arch repair have improved significantly during the last two decades. The mortality rate for total arch replacement has declined from 35% with profound hypothermia and circulatory arrest to 22% with retrograde cerebral perfusion and to 6% with selective antegrade cerebral perfusion and even to 3% in elective cases.

Open surgical arch replacement represents the gold standard for treatment of aortic arch for suitable operative candidates but it remains a high risk procedure. Furthermore many patients are sometimes denied surgical intervention secondary to their significant co-morbidities.

Endovascular surgical treatment and hybrid procedures

The emergence of new endovascular technologies for treating the abdominal and descending aortic aneurysms has led to the development of new less invasive techniques for addressing complex diseases of the aortic arch. Complete endovascular aortic arch replacement techniques require a proximal “landing zone” in a non-dilated area of the aortic arch which compromises the perfusion of the major aortic arch vessels. Perfusion of these vessels can be obtained using fenestrated grafts or “chimney” techniques.

Endovascular exclusion of aortic arch pathologies combined with an open surgical component effectively called « hybrid » have been introduced recently in an attempt to reduce morbidity and mortality in high risk patients. Short term outcomes are comparable with traditional open surgical repair techniques. Staging the debranching portion several weeks prior to the endovascular portion lower the rates of paraplegia.

Hybrid procedure may reduce early morbidity and yield similar late survival even in high risk patients. However, long term patency of debranching remains unknown.

Recently some concern has been raised over late outcome after endovascular repair of aortic aneurysms: In a multicenter observational study compliance with EVAR device guidelines for treatment of abdominal aortic aneurysms was low and post-EVAR aneurysm sac enlargement was high, raising concern for long-term risk of aneurysm rupture.

There seems to be a catch-up aneurysm-related mortality after six years in the EVAR 1 and 2 study with better performance of open repair versus endovascular repair at later stages. Patients should therefore be followed up with serial imaging studies for surveillance, at discharge after six months and then annually to thoroughly look for endoleaks and aggressively treat them when present. It is obvious that EVAR only works when there is a seal; once this seal is lost, there is an increased risk of rupture.

Conclusion

Endovascular therapy seems to be an attractive alternative for the classic surgical open repair but their results have to be measured against contemporary surgical series. There is a need to justify the long-term durability from endovascular aortic aneurysm repair since there has been some recent concern in the outcome of endo-prosthesis used in the treatment of abdominal aortic aneurysms.

Patients should therefore be followed up with serial imaging studies for surveillance after six months and then annually.
Total endovascular arch repair

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Three different techniques have been attempted so far to overcome the challenges associated with repair of the aortic arch by endovascular means alone with varying degrees of success:

1. ‘chimney’ endografts,
2. in-situ fenestration and
3. branched arch devices.

Of these the latest iterations of branched devices hold the greatest promise of displacing open surgery and hybrid procedures as the method of choice. The other two will be dealt with only briefly.

The first branched arch device to be applied clinically was inserted into the aorta via the right common carotid artery. It was bifurcated; a smaller diameter limb engaging in the innominate artery and a larger diameter limb extending distally into the arch to be accessed by a second endograft inserted from the groin to complete the repair. An extra-anatomic carotid/carotid/subclavian bypass was necessary to safeguard cerebral perfusion. A large sheath had to be introduced into the right common carotid artery following this adjuvant procedure with potential to compromise blood flow to both sides of the brain. Although there were a number of successes a third of the patients suffered strokes and this type of device has been abandoned in favour of the next generation of branched arch devices.

The current design of branched arch device is delivered by the transfemoral route. There is only one commercially available, manufactured by Cook Medical Inc, as a customised version of their TX2 proform thoracic endograft. It incorporates two internalised sleeves for the left common carotid and innominate arteries with wide funnel-shaped openings to facilitate retrograde cannulation.

The endograft is mounted on a precurved cannula within a precurved sheath and is prevented from rotating during insertion by a spiral trigger wire that fixes it to the central cannula. By this means the endograft reliably orients itself within the arch with the funnels on the outer curve. A system of radio-opaque markers assists longitudinal alignment of the funnels with the orifices of the target vessels. Withdrawal of trigger wires deploys the first two sealing stents, while the diameter of the funnel-bearing portion of the stentgraft remains restricted by a diameter-reducing wire. This allows continued perfusion of the supra-aortic branches via the funnels.

Prior to insertion of the stent-graft a surgical conduit is placed onto the right subclavian artery and a left carotid to subclavian bypass is performed. A sheath with a radio-opaque tip is inserted to mark the orifice of the innominate artery. The device is unsheathed under rapid pacing to ensure accurate positioning. The funnels, identified by their markers, are positioned slightly proximal to the orifices of the target vessels to facilitate cannulation. Bridging stents inserted retrograde via the funnels engage with the internal sleeves to complete the repair.

Less than ten of these procedures have been undertaken worldwide and each device has had some unique feature. Therefore, it is impossible to say whether or not this is the future of arch replacement but the anecdotal evidence is promising. An alternative to what has been tried so far is transapical access via a mini-thoracotomy to permit antegrade cannulation and stenting of the supra-aortic branches thereby avoiding the necessity for surgical exposure and manipulation of the neck vessels.
Where are we on in situ fenestrations on arch stent grafts

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Conventional surgical repair of aortic arch pathology is an invasive procedure necessitating cardiopulmonary bypass and deep hypothermic circulatory arrest. Despite advances in surgical technique, anesthesia, and intensive care management, total arch replacement still carries a perioperative death or stroke rate approaching 15%, even in centers with great experience. Improvements in the design of endografts and technical innovations with fenestrations, branches, and hybrid procedures have increased the number of aortic arch pathologies that can be successfully treated with endovascular approaches. It is clear, however, that there remain high complication rates and late failure mainly associated with the morphological and physiological challenges of the aortic arch. Endovascular aortic arch reconstruction provides an attractive alternative for treating aortic arch diseases in high-risk patients who would otherwise be unsuitable for open repair. More recently, repair of aortic arch aneurysms has been accomplished using both hybrid (open and endovascular) and totally endovascular techniques. Exclusion of the aneurysm sac, maintenance of cerebral perfusion, and avoidance of emboli are the primary intraoperative objectives in endovascular aortic arch repair. Important supraaortic vessels, such as the carotid and vertebral arteries or coronary bypasses arising from the internal mammary artery, must remain perfused. In addition, excessive manipulation of catheters, wires, and intravascular devices should be avoided within the confines of the aortic arch to avoid cerebral embolization with subsequent stroke or vessel wall injury, which could result in thrombus formation and dissection. These issues are particularly important for the new generation of side-branched prostheses.

The aim of our experimental animal study is to evaluate the feasibility of endovascular repair of the complete aortic arch by using novel fenestration devices and off the shelf products with simultaneous support of the cerebral circulation. The study designed to have three stages: cadaver, acute and chronic animal studies. After having satisfactory results from cadaver and acute animal studies which had proven the feasibility of the technique, Five Yorkshire pigs were used for the chronic experiments. In order to support the cerebral circulation at five chronic animal study, right femoral artery to right distal carotid artery bypass circuit was achieved during the stent graft deployment, fenestration and conduit fixation procedures. Commercially available Valiant Thoracic Stent Grafts, covered stents, steerable guiding catheters and dilatation balloons were also used during the procedure. Among the commercially available covered stents iCast had chosen because of its perfect response for proximal flaring. Medtronic Research and Development Department produced two prototype of fenestration devices, radio frequency (RF) plasma electrode catheter was chosen to create fenestrations at chronic study while balloon-centered needle-dilator catheter had the risk of perforation during manipulation of sharp angulated arteries. All animals survived during the stent graft implantation, fenestration conduit implantation procedures and following 28 days. Necropsy revealed secure fixation and sealing of the conduits into the fenestrated segments of the stent graft. There were neither fractures or infoldings, proximal or distal migrations or endoleaks depending on Valiant stent graft nor collapse, crush, detachment or stenos of covered stents. No treatment related embolic findings revealed at macroscopic and microscopic evaluation of the brain. Endovascular repair of the total aortic arch via in situ fenestration of the stent graft using cerebral circulatory support seems to be feasible and safe. Further studies are required to complete this technique to become perfect and easy to apply complicated aortic pathologies in a short time with minimal complications. Further studies should be focused on development of off the shelf RF plasma fenestration devices and creating necessary hole diameter and than can be used as a guide wire which over self flaring conduits can be implanted at one step are required before clinical adoption of this procedure.

In situ fenestration for arch vessels has also been reported. It is feasible and can be done with devices available in most endovascular centers. Initial reports described endograft placement at the distal aortic arch with additional in situ fenestration to maintain blood flow into the left subclavian artery (LSA). Fenestrations were performed using different methods (the back end of a 0.018-inch guide wire, a precurved sheath and a needle or a laser catheter). The hole was enlarged by using a series of high pressure balloons and/or cutting balloons and finally, the fenestration was stented with a balloon-expandable stent. More recently, Sonesson et al. reported a total aortic arch debranching with in situ fenestrations for the innominate and left carotid arteries (LCAs). Antegrade cerebral perfusion was maintained using a temporary bypass from the left femoral artery to both carotids. However, although immediate (up to 1 month) technical feasibility is demonstrated, the long-term durability associated with this technique remains unknown. Fenestrating an endograft in situ is not without po-
tential pitfalls, including possible graft tears and loss of integrity at the stent–endograft interface in the long term, given the constant movement of the arch and the lack of an intercomponent overlap. Definitively, we need long-term surveillance of these endografts—intended to remain in place for decades when placed in younger patients—before recommending their widespread use.

Chimney grafts have been proposed to extend the proximal fixation zone in the aortic arch during thoracic endovascular aortic repair (TEVAR). They have the advantage of using standard, off-the-shelf materials and being technically less demanding. Recently, Sugiura et al. have reported their initial experience of 11 chimney grafts in the aortic arch during urgent TEVAR. No supraaortic branch vessels occluded during a 20-month follow-up, and there was no postoperative expansion of the sac. Baldwin et al. have also reported elective stenting of the innominate artery combined with bypass surgery or vessel transposition in 3 cases and stenting of the LSA in 1 patient. TEVAR using a double-barrel stent was technically successful. On follow-up of 2 to 18 months, all double-barrel branch stents and aortic endografts remained patent without endoleak, migration, or loss of device integrity. Although initial outcomes are encouraging, long-term durability remains unknown. Until more patients and longer follow-up are available, chimney grafts should only be considered in emergency patients who are poor candidates for open repair or in cases of preoperative inadvertent coverage of the supraaortic trunks.

Hybrid repair of aortic arch disease has evolved as an alternative treatment option for patients who are at high surgical risk for conventional repair. Supraaortic debranching is performed to provide an appropriate landing zone for the stent graft and to preserve perfusion to the supraaortic trunks followed by stent graft deployment in the thoracic aorta. Hybrid procedures avoid the need for cardiopulmonary bypass, aortic cross-clamping, or hypothermic circulatory arrest. By minimizing the procedural invasiveness, it is expected that morbidity and mortality outcomes can be improved, including the potential to offer therapy to patients who are not candidates for conventional open repair. A recent systematic literature review and analysis reported data of 195 patients who had hybrid aortic arch procedures (63% of them had complete arch repair). The overall technical success rate was 86%, and the most common reason for technical failure was endoleak (9%). The mean perioperative stroke/death rate after open surgical repair (17.5%) reported in recently published studies of large series. Direct comparisons between conventional open and hybrid repairs are difficult, however, because high-risk surgical patients with significant comorbidities are usually excluded from open repair. Of importance, the longest mean follow-up period reported was 23 months, and no long-term data supporting the durability of this method exist. Therefore, conclusions about the long-term efficacy of this treatment cannot be reached. Despite avoiding cardiopulmonary bypass and hypothermic circulatory arrest, total arch debranching is a more invasive procedure compared with hemiarch debranching with extraanatomical revascularization.

Initial experience with branched stent grafts was reported by Inoue and colleagues. Using a unibody custom-designed branched stent graft, they were able to demonstrate the technical feasibility of the method. However, the primary success rate was only 60%, with failures attributed to endoleaks and access site issues, and major complications were caused by multiple cerebral emboli in the vertebral artery and occlusion of the LCA. A recent report by this group noted promising results after single-branched stent graft implantation in aortic aneurysms and dissections involving the LSA. In general, branched stent graft delivery from a transfemoral access site into the aortic arch may be challenging because of the length and tortuosity of the route. Alternatively, device implantation through the ascending aorta has been performed. However, this procedure is not free of risks, especially in a diseased ascending aorta.
Status of arch branched stent grafts

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As more members of western societies achieve great old age, we face the twin problems of an increasing prevalence of aortic disease and an increasingly frail patient group. While the endovascular approach to the treatment of aortic disease has proved successful in the descending thoracic and abdominal aorta, the extension of the strategy to the ascending aorta and arch poses new challenges. At a minimum, the use of endovascular devices designed for relatively straight, dynamically stable aortic segments characterised by few or unimportant branches is self-evidently inappropriate.

Novel innovations including the provision of fenestrated and branched devices invite their application in the proximal aorta in order to preserve blood-flow to vital areas. In addition, it is hoped that pre-formed devices to accommodate the curvature of the arch will result in better device-to-aorta apposition and therefore, fewer endoleaks. Devices with short atraumatic nose cones that are less threatening to the aortic valve and left ventricle also exist. However, these features alone do not solve the problems that bedevil the endovascular treatment of aneurysms of the ascending aorta and arch.

As is the case in all endovascular aneurysm repairs (EVAR), accurate pre-operative planning is key to success. In the case of the most proximal aorta, this requires an acute understanding of the morbid anatomy, together with an appreciation of the anatomic variation and stresses that occur across the cardiac cycle. This is the subject of our presentation.
Endovascular treatment of type a dissection

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Surgical treatment is the first choice for type A acute aortic dissection (grade A recommendation), nevertheless older patients have a mortality risk round 60% when surgically treated (1) and there is a similar risk with medical therapy (2,3). Endovascular treatment is a recent option which can be used in very selected cases. The first case, a jatrogenic dissection, was treated by Parodi in 1995 (4) but the first spontaneous acute dissection was treated by Wang only eight years later (5). At the moment there are only few reports in Literature with short follow up supporting feasibility but there is an increasing interest for this procedure (6).

During the last 30 months we have treated endovascularly 4 cases of type A dissection. All the patients came with acute symptoms and were deemed at high risk for open surgery by the cardiac surgeons (mean age 73, poor nutritional state in one case, severe COPD in one case, 2 previous sternotomy for cardiac surgery). In 2 cases the dissection was limited to the ascending aorta, in one patient previously treated for aortic valve replacement the dissection occurred 6 months later and involved all the thoraco-abdominal aorta but there was a huge entry-tear in the ascending aorta. The forth case has been previously treated for a type A dissection with a short graft and came to observation with a residual dissection in the ascending aorta, an aneurysm of the innominate trunk and a dissection of the right common carotid artery.

All the procedure were done with cardiologist’s collaboration for trans-esophageal echocardiography and cardiac pacing and cardiac surgeon stand-by.

In the 2 cases with limited dissection the graft used was a standard cook TX2 81 mm in length, the deployment done with the tip of the graft across the aortic valve; in the patient previously treated for the ascending aorta, we performed a reversed left-carotid right-carotid and subclavian bypass via retropharyngeal route, to treat the dissection we used a custom made cook TX2 73 cm in length with short tip and we embolized the aneurysm of the innominate trunk with an amplatzer. In the last treated case, with previous valve replacement, we used two custom made cook 38-54 with short tip (2 cm).

All the procedures were successful with complete symptom’s relief despite a residual false lumen perfusion in the last treated case probably due to the severe angulation between the replaced aortic valve and the ascending aorta.

During follow-up serial CT scans confirmed the good position of the grafts, true lumen expansion and false lumen thrombosis (except for the most recent case).

Successful treatment of type A dissection implies aortic valve competence, the presence of an adequate proximal landing zone above the coronary ostia, and distal landing zone to preserve supra-aortic branch vessel perfusion; according to two different CT based study recently published approximately one third of patients (32% and 31.3% respectively) fit these criteria; the possibility to associate some kind of hybrid procedure with reversed debranching or chimney could increase the feasibility to 39.2% (7,8).

Other problems are related to the diameter and curvature of the ascending aorta and to the proximity of the heart which forces to park a stiff wire in the left ventricle. Specific device are needed with long and flexible shaft, short a-traumatic tip, and appropriate graft diameter and length to fit this complex anatomy.

Some tricks are essential to overcome the risk of dislodgment during deployment (i.e. cardiac pacing, temporary cardiac arrest, intra-caval balloon).

In our experience patients unfit for cardiac surgery can be treated in selected cases by endovascular stent graft with good immediate and mid-term result.

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Outcome of patients with open and endovascular repair in acute complicated type B aortic dissection: an updated systematic review and meta-analysis of case series and comparative studies

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Aim
Acute complicated type B aortic dissection is a life-threatening condition. During the last decade, the endovascular reconstruction of the true lumen by the use of stentgrafts has gained increasing attention as the first line therapy in this disease entity. We summarized all published studies for TEVAR among patients with acute complicated type B aortic dissection (TBAD) with respect to clinical success, complications, and outcomes. Furthermore, we determined whether TEVAR reduces death and morbidity compared with open repair for TBAD.

Methods
Studies were identified from a literature search using various databases, and included studies when 3 or more patients were reported and at least in-hospital mortality was reported. Data from comparative studies of TEVAR versus open repair of the descending aorta in TBAD were combined through meta-analysis.

Results
94 observational studies involving 5982 patients were included in the present meta-analysis. In-hospital mortality was 10.6% and other major complications (i.e., stroke (5.9%), paraplegia (5.1%), occurred less frequently. Long-term follow-up was limited to a mean of 23.3 months. During this time late aortic rupture was calculated for 4.3% of cases. A complete false lumen thrombosis was estimated to occur in 77.4% of cases. Late mortality reached 10.8%.

In comparative studies, 30-day / in-hospital mortality and paraplegia / paraparesis were significantly reduced for TEVAR versus open repair. There was no significant difference between TEVAR and open repair in patients with acute complicated TBAD for the following outcomes: late mortality, and stroke rate.

Conclusion
This summary analysis suggests that endovascular treatment of complicated acute type B aortic dissection produces favourable initial outcomes and would seem to be a great addition to the treatment options for this condition. Further study of long-term outcomes is required.
Management of acute thoracic aortic syndrome

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Introduction
Acute thoracic aortic syndrome is a collection of pathologies which is associated with a significant risk of rupture of the thoracic aorta. Originally this term was applied only to variants of aortic dissection such as acute dissection, intramural haematoma and penetrating aortic ulcer. Recently symptomatic and ruptured aneurysms together with traumatic transection have been added to the list of pathologies encompassed by the term. Endovascular treatment is an attractive alternative to open surgery but there is little evidence in the literature about its efficacy in acute aortic syndrome.

Methods
A consecutive cohort of 110 patients with acute thoracic aortic syndrome were treated with endovascular thoracic devices between 2000-2011. There were 75 men and 35 women with a median age of 68 (range 57-76) years. 35 patients had acute complicated dissection, 29 symptomatic aneurysm, 18 infected aneurysm, 12 transection and 9 chronic dissection, 3 vasculitis, 3 penetrating ulcer and one intramural haematoma.

Results
Endovascular repair was performed within 24 hours in 85.5% and the technical success was 98.0%. In hospital mortality was 12.7%. The causes of death were mainly related to the cardiovascular system with four patients suffering myocardial infarction, four aortic rupture and three patients having a stroke. Three patients developed multisystem organ failure as a consequence of massive blood loss. Overall stroke affected 7.3% of patients and a further 6.4% were paraplegic. The two factors which predicted early death were haemodynamic instability and the use of general anaesthetic. The majority of patients in this series had loco-regional anaesthesia but about 20% had general anaesthetic. The one year survival was 81% and the five year survival 63%. Secondary procedures were required in 13 (11.8%) patients. Three patients had stent grafts explanted. Seven patients had further devices inserted for endoleak. Two patients had aortic banding for persistent endoleak and one patient had a cerebrospinal fluid drain inserted for paraplegia associated with a myocardial infarction. Factors associated with late death included the presence of an aortic fistula, long operation time, coronary artery disease and age. Patients with mycotic aneurysms related to fistulas had the worst long-term outcome.

Conclusion
Endovascular repair of acute thoracic aortic syndrome has become established as the first line treatment at our institution with good in-hospital results. At one year 81% of patients were alive. However, medium term mortality is significant with only 63% of patients alive at 5 years. Continued surveillance is essential as secondary procedures and aortic related deaths occurred throughout the follow up period.

Bibliography
Aortic dissection has one of the highest mortality rates of all cardiovascular diseases, and the complexities of management remain a challenge. Medical management with aggressive anti-hypertensive and anti-impulse therapy is the accepted standard of treatment for uncomplicated type B dissection, and most patients have a favourable early prognosis without surgical intervention although some patients suffer late complications and long-term survival remains poor. Complications such as rupture, visceral ischemia, spinal ischemia, and/or limb ischemia usually warrant intervention, while intractable pain and refractory hypertension are indicative for high-risk of worse prognosis with medical therapy alone (1). Surgical resection and interposition of a vascular graft has long been considered the standard treatment for complicated type B dissection, despite the substantial risk of severe complications from its invasive approach (2). During the 1990’s thoracic endovascular aortic repair (TEVAR) emerged as a new treatment modality, stimulated by the need to find a less invasive option to treat often elderly patients with severe co-morbidities. Following the first publications describing the use of TEVAR for type B aortic dissection, the subsequent use of TEVAR for this indication had grown without comprehensive evaluation of the evidence for its benefits and risks. To date, only one randomized trial of TEVAR versus medical management for chronic type B dissection has been performed (3). No randomized trials of TEVAR versus open surgical repair for acute or chronic type B dissection have been performed. Most published reports describing TEVAR for type B dissection consist of uncontrolled prospective or retrospective cohorts or case series.

With rapid technical evolution and wider availability of aortic stent-grafts, immediate emergency treatment of complicated type B dissection is available in many centers. Literature data show a substantial survival benefit for TEVAR in acute complicated type B dissection in comparison with open surgery (8.6% vs. 23.5% respectively), which is also in alignment with the results in the first 125 patients included in the Multicenter Registry of IRAD (4). The International Registry of Acute Aortic Dissection (IRAD) is a multinational registry of 24 referral centers in 12 countries designed to provide an unbiased representative population of patients with acute aortic dissection. Data were obtained from hospital records of patients enrolled in IRAD with acute aortic dissection between 1996 and 2010. 1114 of who were classified as type B aortic dissection. In-hospital mortality was significantly higher after open surgery (33.9%) than after endovascular treatment (10.6%, p=0.002). After propensity and multivariable adjustment open surgical repair was associated with an independent increased risk of in-hospital mortality (odds ratio 3.41, 95% CI 1.00-11.67, p=0.05)

567 patients were discharged alive with documented clinical follow-up data. Survival estimates at one year post-discharge was 6.8% in patients previously treated with endovascular stent graft and 8.1% for patients with medical therapy alone. Kaplan-Meier survival estimates at 5-years showed that patients subjected to endovascular treatment had a lower death rate (16.3% versus 31.2%, p=0.028). These data, collecting from different centers in Europe, Asia and USA may be considered representative of the clinical real word scenario and seem to confirm ever a long-term benefit of endovascular repair over medical management alone, despite an initial higher risk category of TEVAR patients who were complicated at admission.

References
Aortic arch reinforcement for a safer landing zone

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Introduction
Aortic arch aneurysm surgery remains an invasive surgical procedure that requires hypothermic circulatory arrest with a mean reported mortality of 13% and a mean reported neurologic injury of 8%. Despite the introduction of new surgical procedures that have improved outcomes, surgery of the aortic arch remains a challenge. Following the advent of endovascular stent grafting (ESG), a combined vascular and endovascular approach has been proposed for the treatment of aortic arch disease. This ‘hybrid’ technique consists of supra-aortic debranching followed by ESG to exclude the aneurysm. This procedure has reduced the incidence of neurologic events and mortality, particularly in high-risk patients, but the reported incidence of endoleak, especially type I endoleak, varies from 5% to 30%. In the current report, we describe our experience with hybrid treatment of aortic arch diseases focusing techniques and results to avoid type I endoleak.

Surgical technique
Under general anaesthesia, after median sternotomy, the ascending aorta and the supra-aortic vessels are mobilised. Systemic heparinisation is initiated. After reaching a mean blood pressure of 80 mmHg, the ascending aorta is tangentially clamped with a side-biting clamp and the proximal part of a bi- or trifurcated Dacron vascular prosthesis (Uni-Graft K-DV; Aesculap, Tuttlingen, Germany) is sutured end-to-side to the aorta (the third limb is handsewn end-to-side to the bifurcated prosthesis). The position of the proximal anastomosis on the ascending aorta is determined by the preoperative CT scan and by the trans-oesophageal echocardiography aiming to obtain an adequate landing zone for the ESG and to avoid atherosclerotic plaques. The side-biting clamp is removed and, if possible, the first limb is anastomosed directly end-to-end to the proximal left subclavian artery (LSA). If this is not possible secondary to aneurysmal involvement or displacement, the first limb is tunnelled to the mid-portion of the subclavian artery and an end-to-side anastomosis is performed through a 4-cm subclavicle incision. The second limb is anastomosed end-to-end to the left common carotid artery; then, the third limb of the prosthesis is anastomosed to the innominate artery, in the same fashion. Non-invasive monitoring of cerebral oxygen saturation by near-infrared spectroscopy is used for cerebral monitoring during the debranching. We complete the procedure by reinforcing the proximal aorta, immediately after the origin of the main trunk of the new supra-aortic vessels, with a 4-cm-long Dacron tube graft opened longitudinally and then wrapped around the aorta. This location is chosen where the proximal part of the future ESG is intended to be deployed. To better visualise the proximal and distal parts of the reinforcement (the landing zone of the future ESG) during the endovascular step, we mark each end of the reinforcement with radio-opaque thread markers passed around and fixed on to the reinforcement.

Endovascular technique
The ESG deployment is usually done as a second-stage procedure after full recovery from the first surgical step. Occasionally, if there is the need for a slave conduit via the common iliac artery, the ESG is done a few days after the first one. A new CT scan is always performed after the first stage to estimate the diameter of the new landing zone of the ESG; the diameter of the ESG is usually 10-20% oversized above the outer diameter of the reinforced proximal neck. The ESG is deployed under general anaesthesia, in the interventional cardiology suite, after surgical exposition of the femoral artery or of the slave conduit. Stentgraft deployment is routinely performed under hypotensive conditions (80 mmHg systolic pressure). The proximal landing zone is easily localised by identifying the two radiopaque markers at either end of the reinforcement. The main trunk of the newly created supra-aortic vessels is also easily recognised by a circle radio-opaque marker positioned at its origin from the ascending aorta; this precautionary measure avoids the possibility of covering the main trunk of supra-aortic vessels with the ESG. The proximal part of the implanted ESG is always expanded with an occlusion balloon (Equalizer; Boston Scientific, USA), to conform the ESG to the aorta; overinflation is routinely performed and the aortic reinforcement protects against aortic rupture or dissection. As a precautionary measure, in cases of prior abdominal aortic aneurysm repair or nontransposed LSA, cerebrospinal fluid (CSF) drainage catheter is performed prior to ESG implantation.

Discussion
Surgery of aortic arch aneurysm is technically challenging, requiring deep hypothermic circulatory arrest with selective cerebral perfusion. Despite recent improvements in surgical outcomes, even in expert high-volume centres, it carries a perioperative
mortality ranging from 4% to 28% and an adverse neurologic event rate ranging from 1% to 10%. The ‘hybrid’ technique of supra-aortic debranching followed by ESG, initially developed to treat only high-risk patients and patients not suitable for cardiopulmonary bypass, has reported encouraging low incidence of mortality and neurologic events, respectively, ranging from 0% to 4% and 0% to 3%. However, the Achilles’ heel of the hybrid technique is the endoleak. The reported incidence of endoleak ranges from 5% to 30%, particularly for type I. We reported on a previous series of 16 patients a 0% endoleak rate.

We think that our good results are due to the following:

1. In planning for the surgical step, we focus on creating a safe long proximal landing zone for the ESG. Thus, to have a longer landing zone, we prefer complete debranching, positioning the main trunk of the new supra-aortic vessels in the proximal part of the ascending aorta. This allows the proximal landing zone to start from the mid-portion of the ascending aorta, thereby allowing ESG deployment in a straight vessel, achieving a better seal than in a curved aortic arch.

2. We reinforce the aorta at the intended landing zone for the ESG. This offers two advantages for proximal ESG sealing. First, it creates a non-expandable zone, providing a long (4.5 cm), linear, cylindrical neck next to the aneurysm; second, the radio-opaque markers easily point out the proximal landing zone for accurate deployment of ESG. The reinforcement can also prevent further dilatation of the aorta, particularly in this patient population, which is prone to aneurysms, thus avoiding future type I endoleaks. This non-expandable zone allows for safe oversize of the ESG and protects against balloon over-dilatation of the ESG for optimal proximal ESG sealing.

The reinforcement of the dilated aorta has been losing popularity because of the poor results associated with sporadic cases of aortic wall atrophy; however, in our technique described above, we reinforce, without diminishing the diameter of the vessel, a non-dilated aorta to prevent further dilatation. The reinforcement usually covers the resected origins of the epi-aortic vessels, avoiding the little ‘cul de sac’; these advantages allow a better conformation of the ESG preventing type I endoleak. Our complete debranching, instead of carotid-carotid or carotid-LSA bypass, includes the proximal complete disjunction of the supra-aortic vessels from the aortic arch. This avoids the possibility of a type 2 endoleak and prevents the possibility of cerebral embolisation during ESG navigation through the aortic arch and deployment. Despite the avoidance of cardiopulmonary bypass and hypothermic circulatory arrest, debranching surgery is still highly invasive requiring a median sternotomy. We usually start the debranching with LSA revascularisation to assure blood flow to the ipsilateral vertebral artery during left carotid debranching. LSA debranching is also crucial for avoiding paraplegia/paraparesis, particularly in patients with previous repaired abdominal aortic aneurysm; preservation of major collaterals of the vertebral artery that contribute to spinal blood flow protects against spinal cord ischaemia when multiple intercostal vessels are covered during thoracic endovascular repair.

In summary, hybrid treatment for aortic arch disease with debranching of the supra-aortic vessel followed by ESG appears safe and effective; the early results are promising and, if confirmed, this technique will not only be suitable for high-risk patients but it would also represent alternative to conventional surgical therapy. The reinforcement of the aorta associated with a complete debranching ensures a long and safe landing zone for the ESG, reducing the risk of endoleak. However, a longer follow-up is mandatory to verify the promising early results. The systematic revascularisation of the debranched LSA and a two-staged approach provide better haemodynamic stability to maintain perfusion of the central nervous system.
Graft replacement of abdominal aortic aneurysm, is one of the operations vascular surgeons are proud of. Introduced by Charles Dubost in 1951, the operation was one of the most common performed in vascular surgery practice. Long term results are excellent and Emeric Szilagi proved that the operation extended the life of patients harboring an aneurysm. Aortic graft replacement of aneurysm is, however, an extensive operation with significant morbidity and mortality in patient with co-morbid conditions. Many patients have a long recovery and some of them never recover the pre-operative status. As aneurysms are seen predominantly in old persons often debilitated and affected by cardiac, pulmonary and renal conditions, it becomes a priority to minimize trauma to the patient.

In 1976 I was a surgical resident at the Cleveland Clinic, I was living the intensity of an experience of treating patients with abdominal aortic aneurysms, and many of them were very sick and debilitated. The quality of care was probably one of the best at that time. In spite of that, bad outcomes were seen in some occasions. I had the opportunity to see two consecutive patients suffering severe complications related to co-morbid conditions. That experience motivated me to think about a less aggressive, less traumatic procedure to treat those complex patients.

In 1976 I was learning catheter techniques to do selective arteriograms. An interventional radiologist hired from the Massachusetts General Hospital was a great teacher when few people were attracted by catheter techniques. We were using the common femoral approach applying the Seldinger technique. I was delighted being able to cannulate visceral arteries and supra-aortic trunks. All of the sudden, I found myself thinking on compressing a thin Dacron graft and placing it into a bigger catheter and introducing it, in a retrograde fashion, in the abdominal aorta. In relation to fixing and sealing it I envisioned a metal “cage” with barbs. The name of stent, derived from a dentist’s name, was not in use at that time. In summary the idea was to construct a thin graft combined with a metal frame, compress it into a sheath and release it at the level of the neck of the aneurysm proximally and distally.

Guided with fluoroscopy the procedure could be done under local anesthesia from the groin. I was very excited with the idea and shared it with Edwin Beven, chief of Vascular Surgery and Carlos Ferrario chief of the Research Department. The response from them was not what I was expecting. At that time I was performing experiences with dogs related to intestinal ischemia. I was performing acute experiments measuring pressure in the lumen of the bowel, pressure in the superior mesenteric artery and vein after the injection of Prostigmin which increased smooth muscle contraction, increased vascular resistance and finally producing necrosis of the mucosa. After finishing each experiment I asked permission to try my new idea using pieces of Dacron which were discharged from the operating room and pieces of elastic stainless steel welded in the engineering department. Pieces of plastic became sheaths. After many failures I learn that a pusher should be a “holder” instead of pusher. Retrieving the sheath holding the pusher still showed me that the idea was viable.

It is obvious that the first experiments were very primitive, in spite of that, I felt that the idea had potential.

In 1976 I went back to Buenos Aires to continue my practice. But the idea of creating a less aggressive treatment of aneurysms was incorporated to my future plans. In spite of my wishes of continuing my experiments I found that lack of funds and time restricted my experiments.

In 1979 I went back to the Cleveland Clinic as a research fellow. My protocol of research was related to detection of carotid ulcers using radio-active labeled platelets. During my stay I came with the idea to use the “Dacron covered cage” to treat type B aortic dissections. Edwin Beven helped me to contact Toby Cosgrove who was a cardiac surgeon and today is the President of the Clinic. I presented my idea to him, I should say that he was very nice at me but at the same time did not see any value on the idea. I was disappointed thinking that patients would benefit better with the ”cage” in position to occlude the entry site instead of having a segmental resection of the aorta. Time will tell… I thought to myself. I met Toby many years afterwards and he had no recollection of the meeting.

Back in Argentina I put the idea back in my mind and continue with my practice. I was using the extra-peritoneal approach for aneurysms and learnt that patients tolerated the procedure better than the transperitoneal approach probably related to the lack of ileus after surgery.

Charles Dotter, the genius, who developed so many things for interventionists, described vascular stents. Later on Julio Palmaz developed the balloon-expandable stent.
In 1987 I was assisting to a meeting in Washington DC organized by Marty Leon. The meeting was taking place at Georgetown University. One of the presenters was Julio Palmaz. Soon I learnt that he was from La Plata, a university town near Buenos Aires. Julio was presenting his initial experience with his stent in iliac arteries. I approached him after his presentation and mentioned my plans and experiences. All of the sudden I reactivated my ideas, now using his stent instead of my primitive “cage”. Julio did not show any interest but was kind enough to giving me a sample of his stent. Back in Buenos Aires I went to an institution that belonged to the Army and was producing missiles to Irak during its war with Iran. I had a long conversation with Carlos Sommer, the head engineer, and tried to convince him to help people instead of producing weapons. I was successful and Mr Sommer started to produce stents for me, he continued however producing missiles at the same time.

Hector Barone was a biochemist whose family company was producing vascular grafts. He started to collaborate with my project.

The animal experiment was designed. Barone produced tube grafts with the shape of an aneurysm and I replaced infra-renal aortas in dogs with it. After a month, animals received a stent graft combination through a small incision over the common femoral artery. Using fluoroscopy the stent was placed proximally to the aneurismal graft and deployed by balloon inflation. The stent was attached to a tubular graft. Once the proximal stent was deployed, the graft was distended with the balloon. A distal gold mark indicated the end of the graft. A second stent was then placed attaching and sealing the distal end of the graft. After 3 months dogs were euthanized and specimens studied. Fifty six dogs were studied. Proximal and distal ends of the endograft were covered by myointimal hyperplasia, the rest of the graft was free of tissue. Solid thrombus was found regularly outside the endograft and inside the fabric artificial aneurysm.

The Palmaz stent was re-designed in order to reach 30 mm in diameter if necessary. The fabric graft was a knitted Dacron tube. The proximal and distal ends of the graft were radially expandable. In this way the device had only one size. Variations in diameters were obtained by balloons of different sizes.

A second animal study was done in San Antonio, Texas by my group together with Julio Palmaz.

In 1990 the device was ready for the first patient. The president of Argentina called me and presented a patient with a large abdominal aortic aneurysm who was a friend of him, the patient had a severe COPD which precluded him to have the standard surgical procedure. I met the patient and his family, examined him and informed him and his family about the procedure. The patient and his family were impressed by the extensive previous experience with the procedure but became disappointed when they learnt that X-Rays and Ct scans were from dogs.

I invited Julio Palmaz to be part of the first case. We reviewed the CT scan measuring diameters and lengths. Defined the diameter needed we selected the appropriate balloon. We used a valvuloplasty balloon.

On September 7, 1990 we performed the procedure under epidural anesthesia. The right common femoral artery was exposed, the artery punctured with a needle and a soft-tip guide-wire advanced up to the thoracic aorta. A pigtail catheter was advanced and the initial arteriogram performed. Renal and iliac arteries were drawn on the screen as we did not have road-mapping capabilities. The 24 Fr sheath was advanced over a stiff guide-wire using the balloon as a nosecone after injecting few cc of saline in it.

Balloon was inflated with saline, balloon was kept inflated for 30 seconds. Balloon was deflated and moved caudally into the graft which was distended with the balloon.

Only one stent was implanted in the first case since animal experiences indicated that results were similar with one or two stents. Practice was soon changed and two stents, one at each end were used.

Final arteriogram showed a patent graft and no endoleaks, arteriotomy was closed and the procedure concluded.

After having dinner with Julio we went back to see the patient. Patient was ready to have dinner. The second patient who was treated the same day and received the standard resection and graft replacement was still intubated. I told Julio: if we can repeat this, and the treatment results durable, this method will revolutionize our field. We continued doing cases and sharing our experience with everybody in the world. We presented our successful cases and our failures; we analyzed our complications and proposed solutions. I wrote the initial report of five patients and sent the manuscript to John Mannick who was part of the Editorial Board of the Journal of Vascular Surgery. He disregarded the article.
Finally in November of 1991 our experience was published in the Annals of Vascular Surgery with a commentary of John Bergan which anticipated the future. In 2010 the market size for endografts worldwide was almost 1.6 billion dollars, reflecting the great expansion of the method. We still have to work for the achievement of good results for the very long term. Endografts are still primitive in many ways and we should expect further developments. If human beings were able to build the international space-station with its complexity, we can expect to replace the vascular suture by a reliable and durable endograft. Today in academic centers endografts are used in more than 70% of patients harboring abdominal aortic aneurysms. With the advent of fenestrated and branched endografts proportion of cases treated with endografts will further increase.
History of interventional radiology: a review of the work of many doctors, the majority my personal friends, who have contributed enormously to the development of the modern vascular therapy

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Arterial vascular imaging in the clinical practice began in Portugal in 1927 with the first carotid angiogram: “Direct Puncture of the Common Carotid Artery and injection of Thorotrast into the artery: Encefalografia Arterial” performed by ANTONIO EGAS MONIZ, Nobel Prize winner in 1949 for Medicine. The following year, 1928, always in Lisbon Prof REYNALDO dos SANTOS performed the first translumbar aortogram. While performing a sympathetic chain block entered the lumbar aorta and injected CM. The Translumbar Aortogram became the only modality for imaging of the abdominal aorta and peripheral arteries until the advent of percutaneous arteriography. Robb and Steinberg, 1936 in New York performed the first translumbar aortogram. While performing a sympathetic chain block entered the lumbar aorta and injected CM. The following year, 1928, always in Lisbon Prof REYNALDO dos SANTOS performed the first translumbar aortogram. While performing a sympathetic chain block entered the lumbar aorta and injected CM. The Translumbar Aortogram became the only modality for imaging of the abdominal aorta and peripheral arteries until the advent of percutaneous arteriography. Robb and Steinberg, 1936 in New York performed the first Cardioangiogram by “the intravenous injection of large volume of CM into both antecubital veins to visualize right and left heart”.

In 1952 Lucio di Guglielmo et al. wrote the first book on “a Roentgenologic Study of the Coronary artery in the living”. Using the transbrachial or transfemoral (cut down) Root aortic injection of Contrast Medium after injection of Acetyilcholine for cardiac arrest. The filming was done using a biplane Schonander rapid-film exchanger. The important revolution in vascular imaging occurred in 1953 when SVEN IVAR SELDINGER published the paper on “CATHETER REPLACEMENT OF THE NEEDLE IN PERCUTANEOUS ARTERIOGRAPHY” also helped by the development of radiopaque catheters KPA by PER ODMAN which were made from a roll of tubing with the help of a flame and hot water for shaping it. The roll of tubing had a different color for each size. The technique of percutaneous arteriography became very spread throughout the world and permitted the development of many selective arterial visualization for the evaluation of the visceral organs and coronary arteries. Arteriography therefore evolved considerably in the following years always as a diagnostic imaging modality until 1964 when the first Percutaneous Angioplasty was performed by CHARLES T. DOTTER, a doctor from Oregon USA, who was a genius and inventor “A Cardiac catheter can be more than a tool for passive means for diagnostic obser-vation; used with imagination it can become an important surgical instrument” 1963 “It’s a gross simplification of course, but it means that if a plumber can do it to pipes we can do it to blood vessels” – C.T.Dotter. Coaxial catheters were used for the first femoral dilatation in 1964 with great success. Interventional Radiology was then born. In the mid 60’s arterial embolization was suggested by French neuroradiologist René Djişjian as a possible technical modality to treat Arterio-Venous malformations of the spinal cord with good results. Also detachable balloons were developed by Russian doctors for the same purpose.

ALEX MARGULIS in 1967 suggested the name of “Interventional Radiology” to indicate a growing body of manipulative procedures performed by a physician skilled in radiologic techniques and experience in clinical problems” In 1967 the first closure of a Patent Ductus in human was performed by a German Radiologist Dr. Porstman who also developed the Corset balloon in 1973 for arterial dilatation made of rubber balloon protected by a cage made of a silt Teflon catheter. N. Nusbaum and S. Baum in 1968 made the first attempt to treat variceal bleeding by injection of PITRESSIN into the SMA to induce a vasospasm of the intestinal arteries and decreases the blood flow to the portal system in the attempt to control the bleeding. Arterial Bleeding control then became a routine modality for GI and Traumatic not controllable bleeding using the technique of arterial embolisation with Particle, Coils, Glue and some time blood clots. Dr. Josef Rosch in 1970, one of the pioneers of Interventional Radiology, published his first case of arterial control from the gastro-duodenal artery using blood clots. Many interventional devices were then developed and the work of Cesar Gianturco and Kurt Amplatz definitely was of great help to the interventional radiologist in performing special procedures, at time very complicated.

In 1974 A.Grunzig performed a femoral artery dilatation with home-made balloon catheter of polyethylene (very similar to modern balloon catheter) with great success which was followed in 1976 by the first Coronary artery Dilation and the first Renal PTA. In 1985 the first balloon-expandable stent was presented first in an experimental study and later in Human cases by Dr. Julius Palmaz. This stent was the beginning of a new era and finally in 1991 the aortic stent-graft for AAA repair initiated by Dr Juan Parodi followed soon after by the Thoracic aneurysm repair by Dr. Mike Dake.

Now all this new innovative techniques are part of the great specialty of Endovascular Treatment which comprise Endovascular surgery, Interventional Radiology and Interventional Cardiology.
The spinning or misinterpretation of crest and the aha guidelines: what impact should they have on practice

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Introduction
There have been many randomized controlled trials (RCTs) comparing carotid stenting (CAS) to carotid endarterectomy (CEA) in symptomatic patients with carotid stenosis (CS). One important recent trial is CREST (Carotid Revascularization Endarterectomy versus Stent Trial), which has been claimed to show equivalent outcomes for the 2 procedures and to justify CAS in low and moderate risk patients. This presentation will analyze the CREST’s data and flaws and show how CREST has been misinterpreted to render it misleading.

Methods and Results
CREST was designed to compare CEA and CAS only in symptomatic patients. However inability to recruit adequate numbers of these forced the trialists to add asymptomatic patients with a different pathology and natural history, decreasing the power of some findings. The primary endpoint in CREST was a combination of death, stroke and myocardial infarction (MI). CAS and CEA treated patients had no significant difference in this combined end point up to 4 years (7.2% for CAS vs. 6.8% for CEA, p=0.51). However, the incidence of total strokes (52 vs 29, p=.01), major strokes (11 vs 4, p=.09), minor stroke (37 vs. 17, p=.01), and death (9 vs. 4, p=.18) was approximately 2X greater after CAS than after CEA. Some of these differences were not statistically significant because of the study’s reduced power. Only when minor MIs (14 vs. 28, p=.03) were included were the combined outcomes similar.

Other issues and flaws in CREST include:
1. Focus on the composite end-point – minor MIs are not the equivalent of even minor strokes and long-term disability was worse after strokes than MIs in CREST patients;
2. The CAS patients in CREST received more intensive antiplatelet treatment than the CEA patients – possibly accounting for the lower MI rate after CAS;
3. CAS operators in CREST were so good that they are not representative of CAS operators at large – so CREST results may not be representative of CAS throughout the US – this is supported by worse results in all population based studies and meta-analyses;
4. Although the higher incidence of stroke in CAS patients in CREST was similar to other recent randomized trials like ICSS, no evaluation of diffusion weighted MRI cerebral defects was performed in contrast to ICSS which revealed a much higher incidence of such defects (silent strokes) after CAS than CEA;
5. Recent improvements in CAS (like flow reversal and cessation) and improved patient selection were not employed in CREST.

One conclusion of the recent AHA Guideline on carotid and vertebral artery disease was that CAS is an alternative to CEA for symptomatic CS. This conclusion was based largely on the CREST findings and ignored the ICSS results. This conclusion plus other findings of CREST are being widely misinterpreted to show the equivalence of CAS and CEA for both symptomatic and asymptomatic CS patients of standard or low risk. However, the AHA Guideline recognizes that the annual stroke risk of asymptomatic CS has fallen since 1985 from about 4-6% to <1% - probably due to statins and other improvements in medical treatment.

Conclusion
CREST was a well-designed and well conducted randomized trial that showed that both CEA and CAS could be performed with low adverse event rates. However, CREST has its flaws and is subject to misinterpretation. Because CAS causes more strokes than CEA, CAS is currently inferior to CEA and CAS should not be considered an alternative or equivalent to CEA in most symptomatic patients. CREST does not justify CAS or CEA for most asymptomatic CS patients, in most of whom medical treatment is probably a better alternative, although this must be proven by appropriate randomized trials.
Evolution of treatment for critical limb ischemia from amputation to bypass to endovascular treatment

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Critical lower limb ischemia may be defined as sufficiently poor arterial blood supply to pose a threat to the viability of the lower extremity and to require some form of limb salvage techniques. Manifestations of critical ischemia are rest pain, ulceration and gangrene. These manifestations typically occur because of arteriosclerotic occlusive disease of large, medium-sized and/or small arteries, although other etiologies may produce or contribute to these manifestations. For example, many non-vascular causes may cause rest pain, infection may cause or contribute to gangrene, and trauma and decreased sensation may produce ulceration. Although thrombo-embolism and other etiologies can produce acute critical limb ischemia, this presentation will only deal with chronic lower extremity ischemia due to obliterative arteriosclerosis. Over the last 3 decades, it has become increasingly apparent that limbs that are threatened by this process almost always have multilevel occlusive disease which often includes occlusions of arteries in the leg and foot.

Twenty years ago, the treatment of critical limb ischemia consisted of arterial revascularization primarily by open bypass procedures supplemented by endovascular catheter based treatments in 15-20% of cases. Since then, treatment has evolved to a point where the initial therapy in most cases is catheter based with open surgical bypasses or thrombectomies being reserved for special circumstances or endovascular treatment failures.

Endovascular techniques in use currently are primarily those involving balloon angioplasty. The technology for performing these procedures especially below the knee are constantly improving with lower profile (.018 and .014 inch) systems, longer balloons and better specialized guidewires. Drug eluting balloons are showing great promise for lessening intimal hyperplasia and improving mid-term outcomes. Newer techniques for distal access and lesion crossing are also making longer and more complex below knee lesions amenable to endovascular treatment. Techniques are also being developed for accessing and treating endovascularly occlusive lesions in the distal third of the leg and the foot. These techniques include angioplasty with small caliber balloons via approaches through the pedal arches and collateral vessels. Improved self-expanding and balloon expandable stents and even drug eluting stents show great promise for improving the outcomes of endovascular treatment of lower extremity and below-knee arterial occlusive lesions. Nevertheless the exact indications, efficacy and durability of all these improved devices remain to be defined. In addition, other technologies like laser and atherectomy are undergoing improvement and may in the future have an increasing role in the treatment of lower extremity arterial occlusive disease. The role of cryoplasty, phototherapy, brachytherapy, bone marrow cell and gene therapy have also been explored but have thus far not gained wide acceptance, although this may change in the future. As with all other endovascular treatments for lower extremity occlusive disease, cost and durability remain important considerations, and there is a pressing need for long-term studies of comparative efficacy.

At present, the proportion of critical ischemia patients who currently require an open procedure at some point in their course ranges between 20 and 40%. However, this proportion may decrease since endovascular techniques, skills and tools for treating lower extremity ischemia are currently evolving and improving at a rapid pace. Nevertheless open procedures are and will always represent an important part, albeit small, of the care of patients with limbs threatened because of gangrene, ulceration or true ischemic rest pain.

Open surgical options for chronic critical lower limb ischemia include local amputations of toes and other portions of the foot, a variety of debriding procedures including open amputations of portions of the foot to control infection, and a variety of traditional surgical revascularization procedures primarily vein and prosthetic arterial bypasses above or below the inguinal ligament, including those to tibial and pedal target arteries. The latter should only be performed if good autologous vein is available, although these very distal bypasses (short vein bypasses) may originate from the below-knee popliteal or even tibial arteries. These may on occasion be supplemented with localized more proximal endarterectomies or patch angioplasties, although these operations have largely fallen into disfavor and are rarely enough alone to save a severely ischemic limb.

The bottom line of all these treatment efforts for critical ischemia is that everything possible should be done to salvage the threatened foot in these elderly, sick patients.
who do not walk well after one major amputation and certainly do not do so after bilateral amputations, which 25% of this population may otherwise require at some point in their course. Although the endovascular and open surgical methods needed to save limbs initially and maintain this salvage may be time consuming and technically demanding and although they require continuing commitment and often redo procedures by the surgeon or interventional care giver, they are gratifying to those that carry them out effectively and are rewarding in maintaining an acceptable lifestyle in this group of patients with advanced atherosclerosis.
Indications of operative treatment of arterial disease in the diabetic patient

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The adverse macrovascular consequences of diabetes mellitus (DM) are well recognized, as is the accompanying accelerated rate of atherosclerosis that predisposes patients to multilevel occlusive arterial disease, either coronary (CHD), or cerebrovascular (CVD) or peripheral (PAD). Patients with DM are prone to a diffuse and rapidly progressive form of atherosclerosis, which increases their likelihood of requiring revascularization. Strategies for revascularization must take into account the higher risk for restenosis and graft occlusion, as well as the comorbid sequelae that complicate interventions in diabetic patients [1, 2].

Coronary Disease
Improving long-term survival and preventing myocardial infarction in patients with diabetes and established CHD should focus primarily on reducing the incidence of acute thrombotic events and the development of ventricular dysfunction. The BARI 2D trial demonstrated that optimal medical therapy rather than any intervention is an excellent first-line strategy for patients with CHD and DM. Revascularization can be applied when drug therapy does not adequately control symptoms without incurring an increased risk of MI or cardiac death [3, 4]. In patients requiring intervention after optimization of medical therapy there is no obvious survival advantage for either a percutaneous intervention (PCI) or coronary bypass (CABG), but there is a significantly higher risk of repeat revascularizations with PCI. Although drug-eluting-stents (DES) reduce restenosis in comparison with bare-metal stents in patients with diabetes [5], DES studies have consistently shown higher repeat revascularization rates after PCI compared with surgical revascularization [6, 7].

Cerebrovascular Disease
DM seems to represent a predictor for the development of vulnerable carotid plaques irrespective of the degree of stenosis and other risk factors. Overall, diabetic patients are at greater risk for perioperative stroke and death [8-10]. DM is a risk factor for periprocedural events both for CEA & CAS. Particularly for CAS, DM is among the strongest patient-related predictors for adverse outcomes as reported in the Siena CAS Score [11].

Aortic Disease
Diabetes may be among the factors that confer protection for AAA disease, however, it has a negative impact on periprocedural outcomes following open AAA repair. In endovascular AAA procedures, diabetes predisposes to adverse EVAR in respect of vascular access difficulties.

Peripheral Disease
Diabetic angiopathy on a microvascular level has been conclusively disproved. The clinically important arterial changes in lower extremity occur at the macrovascular level: Infrapopliteal > superior femoral artery > aortoiliac. Plantar Arch Interruption is Found in most Cases so that even with a patent fem-distal bypass or a successful infrapopliteal angioplasty, major amputation may result, if the artery feeding the wound is not directly reperfused. It has been, thus proposed that surgical or interventional revascularization to restore pulsatile blood flow, ideally to the artery feeding the wound, is of utmost importance [12-13]. The new TASC IIb guidelines are set to recommend an endovascular first strategy for all lesions, lacking though meaningful Grade A data [14].

Conclusion
Diabetes markedly increases the risk of coronary, cerebral, and peripheral atherosclerosis and the clinical consequences of myocardial infarction, stroke, limb ischemia and death. The selection of percutaneous or open surgical procedures depends on many factors, including the specific clinical occurrence, comorbidities, circulatory region involved, and technical feasibility. Cardiovascular physicians should be aware of the important relationship between diabetes and atherosclerosis and be prepared to institute appropriate medical and interventional treatments to reduce disability and death in these patients [1, 2].
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Retrograde percutaneous digital artery access: pushing forward limits and indications for foot revascularization

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Today endovascular treatment for critical limb ischemia (CLI) is an established treatment option, especially in cases in which surgical treatment is not feasible or recommended because of high surgical risk or contraindications. Recent advances in endovascular technologies have lead to an increasing use of interventional techniques for blood restoration, with high rates of technical success and limb salvage, pushing the interventionist and the materials to the limit. In daily clinical practice particularly challenging cases force us to seek new technical options and solutions to achieve revascularisation, reaching both technical and clinical success.
The Japanese art of crossing SFA / BTK – CTO

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Endovascular therapy (EVT) utilizing percutaneous transluminal angioplasty has become a standard technique to re-establish sufficient blood flow in ischemic limbs of patients with peripheral arterial disease (PAD). Long chronic total occlusion (CTO) remains one of the challenging lesions in the field of EVT for PAD patients, despite the recent introduction of many dedicated interventional devices such as high-performance guidewires and re-entry devices. Although antegrade wiring is the standard technique for the treatment of CTO lesions, its use to recanalize long CTOs remains unsuccessful in up to 10 - 30% of cases, which has prompted the introduction of several wiring techniques to improve the initial success rate of EVT procedure in this setting. Bi-directional wiring technique is one of such techniques. In the cases of SFA-CTO, popliteal artery, dorsalis pedis and distal posterior tibial artery have been used for the puncture points to introduce retrograde guidewire. And, in the case of BTK-CTO, the latter two puncture points have been used.

In this article, we report a novel wiring technique, trans-collateral angioplasty (TCA), to improve the outcome of EVT for long SFA-CTO and BTK-CTO lesions, and yet another technique, direct puncture of distal SFA (DDS), to introduce retrograde guidewire beyond the long SFA-CTO. I present several representative cases, and describe the technical tips and appropriate device selection criteria for the TCA and DDS procedure. The outcomes of these new wiring techniques performed last year at my institution also are summarized and discussed.
Interactions between the kidney and the sympathetic nervous system play a major role in regulating blood pressure. Efferent and afferent renal nerves assure the communication between the kidney and the sympathetic nervous system. Those fibers are located in the adventitia of the renal arteries in a mash-type pattern. By innervating vascular, tubular and glomerular structures they modulate renal functions as well as blood pressure parameters (1).

A continuously elevated sympathetic tone leads to arterial hypertension (1). In those cases antihypertensive drugs fail to lower the blood pressure to a target level permanently.

An alternative treatment option in therapy-resistant hypertension is lowering the (elevated) sympathetic tone by disrupting the interaction between the kidney and the sympathetic nervous system.

This goal can be reached by renal denervation. In this concept an endovascular access to the sympathetic efferent and afferent nerves is assured by placing a radiofrequency catheter into the renal artery and applying energy impulses. Due to anatomy and pathology of the renal artery, a femoral access to the vascular system is chosen. Further, the catheter is advanced into the abdominal aorta and then guided into the renal artery. To ensure an adequate location of the radiofrequency impulse, wall contact is monitored by continuously impedance measurements, before applying radiofrequency energy for a duration of 2 minutes. Those impulses are highly energetic but do not irritate or destroy the surrounding tissue. Once interrupted, the sympathetic efferent and afferent nerves cannot maintain the sympathetic tone on a continuously high level. In the randomized Simplicity HTN-1 trial, we could achieve a mean reduction in systolic blood pressure of 32/12 mmHg after 6 months compared to no change in the control group (2). Benefits of renal denervation can also be expected in other diseases with elevated sympathetic drive like diabetes (3) or heart failure.

In conclusion, renal denervation is a novel, low risk treatment option in therapy-resistant hypertension.

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4F total leg treatment: is this the future?

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One of the more recent treatment options for femoro-popliteal, atherosclerotic lesions, is the application of self-expanding Nitinol stents. Addressing safety and efficacy aspects of the femoro-popliteal stent treatment, recent clinical trials (i.e. Absolute, Durability) have shown promising results for this category of stents in Europe. Both Biotronik’s Astron Pulsar and Pulsar-18, an advancement of the Astron Pulsar for treatment of lesions beyond 100 mm, belong to this category of stents. Nitinol stents for the treatment of atherosclerotic lesions in the SFA and PPA have recently been approved by the FDA (e.g. February 2009, LifeStent FlexStar (Bard Peripheral Vascular, Inc, Tempe, AZ), de novo or restenotic lesions in the SFA and/or PPA). Besides regular Nitinol stents, also self-expanding nitinol stents have recently been approved by the FDA for the treatment of iliac, atherosclerotic lesions. E.g. the first two stent system approvals, the SMART stent (Cordis Corp., Miami Lakes, FL) and IntraStent DoubleStrut stent (eV3, Plymouth, MN).

Access site complications are not a negligible factor during endovascular treatment, and they increase with sheath size. Several types of vascular closure devices have been introduced as an alternative to manual compression, intended to obtain maximum patient comfort, facilitate rapid ambulation and decrease complication rates. Yet, although the safety profile of closure devices is comparable to manual compression, literature review does not show superiority of any particular device. Major complication rates up to 10 % associated with vascular closure devices can be found in the literature. 4F small-diameter endovascular systems may reduce the amount of access-site related complications. Studies comparing the results obtained with 4F and 6F catheters during coronary angiography via femoral approach, state less access complications, lower contrast use, decreased mortality and reduced hospitalization as the most important advantages of 4F systems.

Although there are clear indications of the benefits of 4F devices for peripheral applications, scientific evidence to support this thesis is still lacking today. It is the aim of the 4-EVER study to be the first to investigate long-term results (up to 24 months) in patients presenting with intermittent claudication or critical limb ischemia treated with the Biotronik 4F portfolio of products. The results from this study will be compared to those of prior studies or published literature.

The objective of 4EVER study is to evaluate puncture site complication rate as well as the short- and long-term (up to 24 months) outcome of treatment by means of Astron Pulsar / Astron Pulsar-18 stent implantation in symptomatic (Rutherford 2-4) femoro-popliteal arterial stenotic or occlusive lesions, using 4F compatible devices and without the use of a closure device. The primary endpoint of the study is primary patency at 12 months, defined as absence of hemodynamically significant stenosis on duplex ultrasound (systolic velocity ratio no greater than 2.5) at the target vessel and without TLR within 12 months.

Between June 2010 and May 2011, 120 patients presenting with symptomatic femoro-popliteal lesions were treated according to the 4EVER protocol. Average age was 71 (46-89) years and 84 (70%) were of the male gender. Pre-operative symptomatic assessment, reported a total number of claudicants of 101 (85%), versus 18 (15%) CLI patients. Average lesion length was 70mm (10-370mm). In total, 140 stents were used (86 Astron pulsar and 54 Pulsar-18). Contralateral femoral access was performed in 99 (82.50%) patients and ipsilateral femoral access in 21 (17.50%). Access site closure was obtained by manual compression in all patients. Preliminary 6-month data on 70 patients will be presented at the MEET congress.
The angiosomes concept and its possible implementation in CLI revascularizations

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Taylor and Palmer first pioneered the angiosome model of perfusion in the plastic reconstructive surgery field in 1987. The concept delineates the human body into three-dimensional blocks of tissue, fed by specific arterial and venous sources named "angiosomes". Inasmuch this circulatory network provides a remarkable "rescue system" to ischemic injuries in non-atherosclerotic patients, it appears dramatically hindered in CLI subjects witnessing miscellaneous systemic arterial disease and specific loss of collaterals. It has been suggested that distal limb ischemic wounds may rely on specific bundles of arterial supply that strongly influences tissue regeneration and limb preservation.

The angiosome concept provides useful information on the human vascular anatomy and related pathology, allowing peculiar applications in surgical and vascular interventional therapies for limb salvage. Focusing specifically on CLI, this model may help the clinician to better refine vessel selection, vascular accesses and specific strategies in revascularization. This knowledge may also allow the vascular interventionist to deliberately frame arterial reconstruction from a topographical perspective, in specific ischemic areas of the foot exhibiting tissue loss.

The implementation of the angiosome strategy in infragenicular revascularization for Rutherford grade III CLI patients, may afford encouraging wound healing and limb preservation rates for both, bypass and endovascular techniques. For the latter, it was emphasized their potential advantage to add the avail to simultaneously treat multiple tibial or foot arteries in specific "wound-guided" approaches.

A review of the recent publications in this field is corroborated in this presentation with practical points while applying the angiosome principle in the daily vascular practice.

The implementation of the angiosome concept in contemporary strategies for CLI revascularization might be useful, although comparative and prospective data are further mandatory to cast any pertinent assertion pro-, or against this concept.
Results of ultrasound enhanced thrombolysis for acute peripheral arterial obstructions

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Background
During last decade, percutaneous catheter-directed thrombolysis has become the preferred treatment modality for acute peripheral arterial obstructions. However, hemorrhagic complications during thrombolysis can still be substantial (up to 10%), and are related to the total amount of thrombolytics. One of the promising modern thrombolysis techniques to improve efficiency is ultrasound (US)-accelerated thrombolysis, which combines delivery of low-intensity US and a thrombolytic agent into a thrombosed native artery or bypass graft. In vitro and in vivo studies have demonstrated that low-intensity US can accelerate thrombolysis, thereby increasing delivery of thrombolytics into the thrombus.

Study results
In all studies the EKOS EndoWave system (EKOS Corporation, Bothell, WA, USA) has been used. The system consists of a 5.2F multilumen drug delivery catheter with variable working lengths, a matching US coaxial core wire, and a portable control unit. After positioning of the drug delivery catheter the guidewire must be replaced by the US coaxial core wire. During treatment, the multilumen drug delivery catheter allows dispersion of the thrombolytic agent and a central lumen accommodates the US core wire. The multiple side holes of the drug delivery catheter correspond to the miniature US transducers for the delivery of low-intensity (2.2 MHz) high-frequency US over the entire working zone of the US core wire. It is most important to pass the entire arterial obstruction with the guidewire and thus with the multilumen drug delivery catheter at the start of treatment to facilitate flow to reduce heating and reduce US power.

In 2007 Wissgott et al. published a prospective series of 25 patients undergoing US-accelerated thrombolysis for acute peripheral arterial occlusions of the lower extremities (1). Technical success rate was 100%, and complete lysis was achieved in 88%. One hemorrhagic complication occurred due to dislocation of the introducer sheath, necessitating surgical intervention. At the 30-day follow-up, 2 recurrences had occurred. The same author group published another study comparing US-accelerated thrombolysis with a mechanical thrombectomy device (Rotarex®, Straub, Wangs, Switzerland) in 2008 (2). Technical success rate was again 100% in the thrombolysis group, but a part of these 20 patients had been described in their manuscript of 2007. During the 30-day follow-up, 1 recurrence occurred. Motarjeme and co-workers retrospectively studied 24 patients with subacute arterial occlusions of the lower extremity treated by US-enhanced thrombolysis. Technical success was 100%, and complete lysis was achieved in 96% of the patients, without major hemorrhagic complications. The majority of patients had successful intervention within 24 hours after start of thrombolysis (3). Similar promising results have been described in 29 patients by Raabe et al. (4) In 27 of 29 patients uncomplicated thrombolysis was achieved with 30-day patency rate of 80%. Recently, also Schrijver and colleagues published a feasibility study on the safety and efficacy of US-accelerated thrombolysis in 21 patients with thromboembolic occlusions of the aortofemoral area. They didn’t include acute occlusions, but only obstructions which existed for at least 1 week. Technical success was high (95%) and radiologic success was 90%, without major hemorrhagic complications. Median thrombolysis time was 27 hours (range, 9-72 hours) (5). The largest study so far included 57 Dutch patients with 62 episodes of acute arterial peripheral obstructions of the lower extremities (6). Initial technical success rate was 97%, radiologic success was 82%, and overall clinical success was 77%. Median thrombolysis time was 21 hours (IQR, 15-24). In 38 of 51 procedures with successful lysis (75%) complete lysis was achieved within 24 hours. Major haemorrhage occurred in 2 procedures (3%), and distal embolization in 2 procedures (3%). The 30-day patency rate was 81%, without additional mortality.

Discussion and conclusion
In the clinical studies so far ultrasound enhanced thrombolysis for acute peripheral arterial obstructions, seems a promising technique which has been repeatedly associated with successful revascularization of the major part of patients <24 hours after start of intervention. The incidence of hemorrhagic complications and distal embolization are low. It is important to minimize the length of thrombolytic exposure because most of the complications (haemorrhage, stroke, and renal insufficiency due to repeated angiographies) are related to the length of treatment. However, a few limitations have to be noted. So far, no randomized controlled trials have compared standard catheter-directed thrombolysis to US-accelerated throm-
bolysis for peripheral arterial thromboembolic disease. Recently a randomized trial was initiated in the Netherlands that will compare both thrombolytic strategies in patients with recent thromboembolic occlusions of infrainguinal native arteries and bypass grafts (Current Controlled Trials, ISRCTN72676102) (7). Moreover, it seems important to study the longer term results of thrombolytic therapy in terms of reocclusion and limb salvage. In the series of 62 treated lower extremities by Schrijver and colleagues, 9 reinterventions had to be performed as well as 2 major amputations, during a median 6-month (range, 2-14) follow-up. A possible explanation for the occurrence of reocclusions might be related to ineffective anticoagulant therapy in combination with the large thrombogenic surface of the treated arterial segment or bypass graft after thrombolysis. All patients had been treated with coumarin derivatives for 3 months. Since 10 of 12 reocclusions in the study population occurred after 3 months, perhaps the duration of anticoagulant therapy should be prolonged and dual antiplatelet regimen should be initiated post-thrombolysis. Second, follow-up must be continued at regular intervals. One could advocate routine duplex scanning or MRA at 6 months and 1 year to identify and treat any lesion that could precipitate an occlusion. This intensified follow-up schedule is similar to the protocol which has been advocated post remote endarterectomy of the superficial femoral artery to prevent occlusions during 1-year follow-up. These procedures are also characterised by a large thrombogenic surface post-procedurally.

References
Approaching long superficial femoral artery occlusions: comparison between atherectomy, stenting and Drug Eluting Balloons.

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Peripheral arterial disease (PAD) affects approximately 18% of the population aged 60-90 years old, with an age adjusted prevalence of 3-18.2% and increasing up to 29% with the presence of cardiovascular risk factors (1). Endovascular revascularization has developed rapidly during the past decade, and a great number of patients can now be offered less invasive treatment options (2). Percutaneous transluminal angioplasty (PTA) is favored due to reduced morbidity and mortality, as compared with vascular surgery (1). Nevertheless, even if the evolution of endovascular therapies led to an ongoing debate over the “pros and cons” of various therapies, it must be pointed out that the initial technical success rate is thwarted from the mid- to late-term clinical failure. Thus, to date, choice among endovascular revascularization therapy for PAD remains still controversial, as a consequence of the higher restenosis rate offsetting different recanalization options (2).

In patients with symptomatic PAD, the superficial femoral artery (SFA) is a common place for atherosclerosis. Advances in PTA techniques provided new options for the treatment of this arterial segment, despite sustained recanalization remains an important concern. The primary patency after SFA conventional-balloon angioplasty is greatest for lesions in the common iliac artery and decreases distally, with length increasing, multiple and diffuse lesions, poor-quality run-off, diabetes, and renal failure, which are frequent comorbid conditions in patients with severe SFA disease (2). Endovascular stenting for SFA avoids the problems of early elastic recoil, residual stenosis and flow limiting dissection after conventional angioplasty and can be used for treatment of long calcified lesions. Clinical studies have shown stenting superiority over conventional angioplasty, especially in long SFA lesions (2). Nevertheless, since SFA is subject to longitudinal stretching, external compression, torsion and flexion, stent fractures and restenosis frequently occur especially with first-generation scaffolds (6). In this respect, SFA stents should generally be avoided in bending areas (knee joint) and in segments suitable as a landing zone for a potential bypass (1). Self-expandable nitinol stents have drastically changed the endovascular treatment scenario for SFA disease and they can be now recommended as the first-line treatment for intermediate length superficial femoral artery lesions; this in view of the increasing number of randomized studies reporting of at least mid-term patency improvement (1). The restenosis rate after 1–2 years is 20–30% lower after primary stenting compared with conventional-balloon angioplasty (3-5). Unfortunately, in-stent restenosis is the major drawback even in case of nitinol-stent implantation with no impact of stent designs on neointima proliferation. After initial controversial data (6), drug-eluting stents for SFA disease recently reported encouraging results in terms of primary patency (7), even at long-term follow-up (6), despite the overall patients number enrolled in these trials do not allow firm conclusions. To preserve SFA flow in patients suffering from atherosclerotic disease, additional approaches have been investigated. A recent pilot study suggests a benefit of drug-coated balloon angioplasty (i.e. paclitaxel-eluting balloon, PEB) for PTA of femoropopliteal disease with significant reductions in late lumen loss and target-lesion revascularization (9).

Consistently, removal of plaque material may result beneficial in preventing restenosis: first studies using excisional atherectomy device show feasibility in the treatment of SFA lesions, with low target vessel revascularization rates (10,11), despite the benefit was limited to de novo lesions (12). However, there are some concerns regarding the risk of distal embolization with these devices. In this respect, new combine rotational-aspiration atherectomy systems seem interesting even in high-risk patients’ subgroups (13), and at long-term follow-up (14).

As a matter of fact, no randomized study evaluated the efficacy of atherectomy as compared to stenting (drug-eluting or bare-nitinol) with or without PEB in reducing restenosis of SFA lesions. In this respect an ongoing randomized, active-controlled trial was designed and conducted at Deutsches Herzzentrum Klinik an der Technischen Universität, München: the Intravascular Stenting and Angiographic Results: Randomized Comparison of Stenting, Stenting after Paclitaxel eluting balloon and ATherectomy in patients with symptomatic Peripheral Artery Disease (PAD) (ISAR-STATH - GE IDE No. B00101; NCT00986752). This trial has been designed to assess the effects of atherectomy and stenting after PEB as compared to stenting after conventional PTA on SFA restenosis in patients with symptomatic PAD. We hope that trial results will help interventionalists to solve an existing conundrum regarding the best revascularization strategy in SFA recanalization.
References
Introduction: latest data on the way to consensus (CREST)

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Abbreviations used in this abstract
ACST-2, Asymptomatic Carotid Surgery Trial; ACT-1, Carotid Stenting vs Surgery for Severe Carotid Artery Disease and Stroke Prevention in Asymptomatic Patients; CAS, carotid artery stenting; CEA, carotid endarterectomy; CK-MB, creatinine kinase-MB fraction; CREST, Carotid Revascularization with Endarterectomy versus Stenting Trial; cTn, cardiac troponin; ECG, electrocardiogram; EVA-3S, Endarterectomy versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis; ICSS, International Carotid Stenting Study; MI, myocardial infarction; QOL, quality-of-life, SAPPHIRE; Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy; SPACE, Stent-Protected Angioplasty versus Carotid Endarterectomy; TACIT, Transatlantic Asymptomatic Carotid Intervention Trial.

Recent results from the Carotid Revascularization with Endarterectomy versus Stenting Trial (CREST) showed no difference between carotid endarterectomy (CEA) and carotid artery stenting (CAS) in the primary endpoints of periprocedural stroke, myocardial infarction (MI), or death, and the postprocedural rate of ipsilateral stroke up to 4 years (1). However, the risk of periprocedural stroke was found to be higher with CAS, and the risk of periprocedural MI was higher with CEA. In CREST, periprocedural strokes translated into a significant influence on quality-of-life (QOL), and the effect was found to be much worse than that of periprocedural MI. On the basis of these QOL analyses, the investigators concluded that stroke had a greater adverse effect on health than MI. Nevertheless, this view remains controversial and is frequently challenged because many studies have shown an association between perioperative MI and future mortality in a variety of procedures (2-4).

MI/cardiocellular marker elevation and mortality in cardiac, vascular, and nonvascular interventions
In a meta-analysis of 20 studies with 15581 patients who underwent percutaneous coronary interventions, troponin elevation was associated with increased mortality (4). Oscarsson et al. (5) showed a 15-fold increase in mortality at 1 year with a postoperative cardiac troponin elevation in 546 elderly patients who underwent non-cardiac surgical procedures. Landesberg et al. (6) in a study of 447 patients who underwent major vascular procedures, showed that both creatinine kinase-MB fraction (CK-MB) and cardiac troponin-I (cTn-I) elevation and/or cardiac troponin-T (cTn-T) elevation, independently predicted 4-fold and 2-fold increases in long-term mortality. However, these studies were not conducted in the setting of carotid interventions, and it is unclear whether such findings can be extrapolated to patients undergoing CEA or CAS.

Significance of periprocedural MI in carotid intervention
To address the effect of periprocedural MI on mortality of patients undergoing carotid intervention, the CREST investigators performed a post hoc analysis to explore the prognostic significance of MI among patients undergoing either CAS or CEA (6). In CREST, an electrocardiogram (ECG) and cardiac biomarker (a mixture of troponin-I or -T, CK, and CK-MB) measurements were obtained routinely before and after the carotid revascularization procedure. MI was defined as biomarker elevation plus either chest pain or ECG evidence of ischemia. An additional category of biomarker elevation-only without symptoms or ECG changes was prespecified. Crude and risk-adjusted mortality rates were obtained and compared for patients with and without MI or biomarker elevation-only. Among 2502 patients, 14 MIs occurred in the CAS group and 28 MIs in the CEA group. An additional 8 CAS and 12 CEA patients had biomarker elevation-only. Compared with patients without biomarker elevation-only or MI, mortality was higher over 4 years for those with MI (hazard ratio=3.40, p<0.001) or biomarker elevation-only (hazard ratio=3.57, p<0.005). After adjustment for baseline risk factors, the mortality of patients with perioperative MI or biomarker elevation-only remained significantly higher (hazard ratios of 3.67, p=0.001 and 2.87, p=0.023, respectively). In other words, patients with MI or biomarker elevation-only were 3-4 times more likely to die during the follow-up period than those with no evidence of MI (clinical or subclinical), even after adjustment for important baseline characteristics (including age, diabetes, and history of cardiovascular disease).
On the other hand, unlike MI and biomarker-only elevation, per-protocol CREST analysis showed a lack of association between minor strokes and long-term mortality (p=0.34) (7). Compared with a minor stroke, MI was associated with a 5.2 times risk of long-term mortality (p=0.02). Thus, a patient who suffered a postprocedural MI has a 4-year survival rate of only 75%, compared with a 95% 4-year survival rate after a minor stroke. Clearly, on the basis of the above analyses of MI-associated mortality, the effect of MI post-carotid intervention needs to given strong consideration.
Incorporation of MI as a primary endpoint in carotid trials

In the past, MI was not included in the primary endpoint composite of several large randomized controlled trials comparing CAS and CEA, such as Endarterectomy versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis (EVA-3S) (8) and Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) (9). On the contrary, studies that included MI as a primary outcome, such as the Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (SAPPHIRE) trial (10), received heavy criticism because MI had never been included in any large carotid trials as a primary endpoint up to that point. Even when MI was included as part of the primary endpoint, cardiac biomarkers were not routinely obtained; consequently, the incidence of MI was under-reported. For example, the rate of MI was 0.4% for CAS and 0.8% for CEA in EVA-3S, 0.4% for CAS and 0.6% for CEA in the International Carotid Stenting Study (ICSS) (11), and 0% for both in SPACE. In comparison, CREST reported a 2.5% rate of MI or positive biomarkers; and in SAPPHIRE, the rate of MI was 5.9% for CEA patients and 2.4% for CAS patients. As the effect of MI on long-term mortality becomes increasingly evident, all future trials of carotid intervention must not only incorporate MI into their primary outcome composite but also include a protocol-driven routine collection of cardiac biomarkers to capture all patients with perioperative MI and biomarker positivity only.

Emphasis of MI in carotid disease management can certainly be observed in ongoing large randomized controlled trials. The Asymptomatic Carotid Surgery Trial (ACST-2) (12), the Carotid Stenting vs Surgery for Severe Carotid Artery Disease and Stroke Prevention in Asymptomatic Patients (ACT-1) (13), and the Transatlantic Asymptomatic Carotid Intervention Trial (TACIT) (14) all include periprocedural MI, in addition to stroke and death, as a primary outcome measure. Standardization of the definition of MI (e.g., by use of the universal definition of MI (15)) in future trials would enhance uniformity and allow comparison of different trials with respect to the incidence of MI after carotid intervention. Regarding the cardiac biomarkers collected, measurement of the less-specific CK and CK-MB levels (without cardiac troponin levels), as in SAPPHIRE, (10) should be discouraged to minimize false-positive results in the CEA group from CK and CK-MB released from skeletal muscle during surgery. In future trials, the timing of postprocedural cardiac biomarker assessment should also be extended to 48 hours (as opposed to 6-8) for both CEA and CAS as peak detection rate of postsurgical cardiac biomarkers for major surgical procedures is reported to be between 24 and 48 hours after surgery (16).

Although CREST is the largest carotid trial to date, it only represents one set of data on the incidence of stroke and MI after carotid interventions. For consensus to be reached by the medical community on the importance of periprocedural MI, especially in relation to strokes, future trials should continue to define the true incidence of MI after carotid interventions and the degree of association between MI or positive cardiac biomarkers to mortality, as shown in the CREST post hoc analysis. Perhaps similar post hoc analyses of MI and mortality can be performed for other large carotid trials with long-term follow-up, such as SAPPHIRE, ICSS, EVA-3S, and SPACE. Moreover, the effect of both perioperative MI and stroke on QOL should be studied in future trials with longer follow-up (as opposed to 1 year in CREST) as patients with minor strokes often make a complete recovery. Certainly, the QOL of these patients at 1 year after a minor stroke would not be the same at 4 years.

Conclusion

Carotid artery disease and coronary artery disease are inherently intertwined conditions. With medical advances, patients with coronary artery disease will continue to live longer. Thus, periprocedural MI is likely to become a more frequent concern for patients undergoing carotid revascularization procedures. (17) Although the relative importance of periprocedural stroke versus MI is still a point of contention, the CREST data presented by Blackshear et al. (6) have proven periprocedural MI to be a relevant issue in carotid revascularization trials.

References

18F and above Access Management - EVAR, TAVI, TEVAR: Artery Access Requirements

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It is still common clinical practice to perform an arteriotomy to gain access for large bore introducer sheaths. Since 1997 we use the Prostar XL Percutaneous Vascular Surgical (PVS) device.

Pre implantation screening of the vessels should be done via CT or angiogram. Pay attention to: vessel diameter, calcifications, tortuosity, aneurysms, and if curves in the iliac vessels can be straightened out by a stiff wire. The vessel diameter is acceptable if it is less than 10% smaller than the intended sheath (OD). The actual procedure starts by puncture of the artery, usually under fluoro guidance. The needle entry into the vessel should be just below the center of the femoral head. The skin incision should not be too short (1 cm). The subcutaneous channel should be enlarged with a clamp. Thereafter, the Prostar device is introduced and the needles are placed. After the procedure and removal of the sheath the sutures are tightened pairwise (Fisherknot) and placed on the vessel wall with a knot pusher. To be able to react quickly to possible bleeding you should leave a cross over wire in place. If that is not possible you can introduce a 4F sheath below the big sheath. Iliac ruptures can be treated via prolonged ballooning or covered stents. Occlusions can be treated by PTA or stenting. Bleeding at the puncture site can be treated by prolonged ballooning, implanting a covered stent or surgical repair of the vessel.

347 of our patients (age 36-99, mean 76.3) with iliacal (n=1), thoracic (n=28) or infra-renal (n=145) aneurysms as well as aortic valve stenosis (n=163) required a sheath size ≥ 18 F. In total we used Perclosure devices to close 410 access sites >= 18F. 340 patients were treated in local anaesthesia and 7 in general anaesthesia. All patients were anticoagulated with a minimum of 5000 units Heparin. All patients underwent post interventional clinical controls and were followed regularly by ultrasound, MRT or CT scan. To achieve haemostasis additional pressure dressing due to bleeding of the puncture site was necessary in 8 cases. In 11 cases compression by ballooning was performed. The following complications occurred: 16 false aneurysms, 17 secondary haemorrhages and 4 ruptured sutures. 3/347 (0.9%) needed surgical repair, 1 patients died from vascular complications.

Our experience shows that percutaneous closure devices can be used on a regular basis to achieve haemostasis while using large bore introducer sheaths.
18F and above access management. Appropriate sizing and evaluation of iliac arteries

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Increasing number of endovascular procedure using devices of 18F and over require adequate size and anatomy of common femoral and iliac arteries. Reported serious complications of EVAR and TEVAR refer mainly to jatrogenic lesions of these vessels. Access to femoral arteries can be achieved by percutaneous puncture or artery cut down. Angio CT is very important in estimating vessel calcium component and its location on artery wall. Anterior calcifications should contraindicate the use of Prostar X, the only device used for percutaneous access. Possible discrete iliac stenosis should be dilated but not stented before introduction of large introducers. Diffuse calcifications and or stenosis should be approached with Solo-path introducers, these new devices require a 5-6 mm lumen an can be expanded up to 22F; this is an alternative to crack & pave technique proposed by Martin Malina. It is important to check the status of an artery access every time when a difficult approach was done. Possible dissection should be treated with deployment of a self-expandable stent up to femoral level. Vessel rupture should be treated with a Viaban graft or a covered stent. An angio CT scan should be done to check the retroperitoneal status. When surgery is needed for repair, balloon clamping above rupture is the best way to give the surgeon a clear field and an easier a safer procedure.
Stent grafts or percutaneous valve repair have open a new area where access is essential, most interventions are conducted from the groin or transapical. In the majority of cases devices needing 18 Fr hole are successful but in some patients groin access is impossible due to small iliac arteries, calcifications or tortuosities. The transapical approach has been used in this situation for TEVAR or TAVI. This transapical approach is not without complications, and mortality has been reported mainly due to the fragility of myocardium in elderly. Alternative accesses have been developed. They are: from the top:
The axillary artery access, most commonly know as subclavian access and the common carotid artery access.
The first one is the safest as it does not compromise the cerebral vascularisation. Access to the subclavian artery is not recommended as the artery is not easy to reach by a supra clavícula approach, the vessel is deeply located and very fragile, the axillary artery which is some centimetres distal is much more easy to reach after division for the Pectoralis minor muscle, more over the axillary artery is less fragile and any vascular complication much more easy to repair. The common carotid artery (CCA) has been used but its implication in the cerebral artery makes it more hazardous and so it is not recommended as first option.

From the bottom when the groin is not the good access, we recommend to use an iliac conduit easy to perform on the common iliac artery (CIA) reach by extra peritoneal access.
In some more complex situations, where the iliacs are too calcified, the distal abdominal aorta an also been approached in a trans or extra peritoneal way. Having said that these are all the more common possibilities but only performed in a surgical suite. The axillary artery is the safest way from the top, and the iliac conduit the safest way from below.
How to manage the percutaneous access – From 4F to 18F and above

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When the Swedish radiologist Sven Ivar SELDINGER (1921-1998) introduced the technique of percutaneous catheterization in 1953 nobody could foresee the enormous development of diagnostic and therapeutic angiography (1). The technique enabled physicians to perform angiograms of the vascular system in all parts of the body without open exposure of the artery at the access site. The percutaneous approach became the standard technique of choice for selective and super-selective angiography, for embolization treatment and angioplasty. Diagnostic catheters had originally a profile of 9-Fr. Hematoma formation after angiography was encountered in 5 to 10% of the patients. Improvement of devices led to smaller profiles of catheters from 7-Fr to 4-Fr which reduced the risk of after-bleeding considerably.

Figure 1: Double wall puncture and tangential puncture of the femoral artery should be avoided to reduce the risk of hematoma formation.

Puncture of the access artery is mainly carried out with palpation of the pulse. Usually, only the anterior wall of the artery is punctured. In the original Seldinger technique the anterior and posterior wall of the artery was punctured to avoid dissections, but the bleeding risk is unnecessarily increased with double wall puncture (figure 1). In patients with peripheral arterial disease sometimes pulseless arteries must be punctured. Some arteries can be palpated and punctured without a pulse, especially in slim patients. In obese patients the femoral pulse is sometimes difficult to palpate.

Puncture of the femoral artery requires a good pulse amplitude and a long needle track in these patients. Often several punctures are needed to hit the artery. Also compression of the puncture site after the intervention is less safe with a higher rate of hematoma formation and false aneurysms.

In patients without a pulse and a non-palpable artery other techniques must be used. The first consideration may be to look for an alternative access from the contralateral femoral, the brachial or radial arteries. On the angiographic table fluoroscopy may depict arterial calcifications of the common femoral artery and allow a puncture under visual control. Ultrasound controlled puncture is an alternative. The localization of the artery can be revealed with B-image scanning. Special needles are available which have integrated a Doppler ultrasound element. The Doppler signal intensity grows when the needle tip approaches the artery. Nevertheless, experience with this technique is necessary because the needle may hit the artery only tangentially or not at all.

Closure of the puncture hole needed only manual compression and a compression bandage in the past. The bleeding and hematoma rate was in the range of 3 to 8%. Retroperitoneal bleeding with fatal outcome occurred in 0.1 to 0.3% of the cases.

Diagnostic imaging with 4-Fr catheters still needs only manual compression for several minutes after the procedure. With the application of thrombolysis and treatment with platelet inhibitors new devices were introduced in the 1990’s to reduce the bleeding risk. They can be used with device profiles from 5-Fr to 8-Fr. Numerous devices are available (2,3). Closure devices use different technical principles like fluids, plugs and clips. Fluids are risky because their injection may be complicated by a partly intra-arterial injection, followed by extended peripheral arterial thrombosis, severe ischemia and even amputation. Plugs are made from collagen or polyethylene glycol, should be used in appropriate sizes and should not be stuffed into the artery. Devices using a sandwich technique with an intra-arterial anchor should be used only after angiographic control of the artery. A plaque at the puncture site might be cut open by the anchor and cause thrombus formation and arterial occlusion (Angio-seal™). Otherwise Angioseal™ is an efficient closure device which we use routinely. In cases with plaque burden in the common femoral artery a clip (Starclose™) or outer plug (Exoseal™) should be the preferred closure technique. With all devices a manual compression should be applied for a short time (1-3 minutes).

For endovascular repair of aortic aneurysms (EVAR, TEVAR) and for percutaneous replacement of aortic valves (TAVI) the access may be crucial. The profile of these devices range from 14 to 24 Fr and therefore need a sufficient arterial diameter. CTA evaluation of the thoracic or abdominal aneurysm should include the iliac and common femoral arteries with the intention to determine the vessel diameters, detect stenotic lesions, arterial elongation and kinks, and to locate the femoral bifurcation. For TAVI patients we measure both, the distance of the aortic valve to the coronary
artery ostium and the diameter of the femoral and iliac arteries. Usually, an inner diameter of the access arteries of 7 to 8 mm is necessary for introduction of aortic endografts and aortic valve prostheses.

CTA also serves to depict arterial calcifications at the puncture site, the amount and the distribution of the calcifications. The puncture site can be varied to a certain degree with this additional knowledge not only to facilitate the access and introduction of devices, but also to close the puncture hole at the end of the intervention. Suture based closure devices (Perclose ProGlide™, Prostar™) require a straight passage of needles through the arterial wall. Calcified plaques may hinder the needles on their way from inside out. It may be impossible for the needles to cross the plaque. They may deviate from the correct direction, may buckle and end somewhere in the vessel wall or the subcutaneous tissue (Figure 2). The threads of the suture based closure devices do not dissolve.

Even with a normal diameter of the femoral artery it may be difficult to close an introduction hole of 24-Fr. The closure device is normally placed first before a large bore device is inserted. We prepare the puncture channel down to the arterial wall with the intention to push the nods at the end of the procedure not only somewhere in the subcutaneous tissue, but properly to the level of the arterial wall. Two Prostar XL™ systems can be used with the second system turned 45° in regard to the first system. Tears in the vessel wall, which happen during the device introduction, may reach the threads. The threads are not anchored in the vascular tissue any more and closure of the femoral artery hole fails (Figure 3). For that reason we leave a soft guide wire in position when we push the nods down to the vessel wall.

In case of a closure failure we can insert a new closure device or place a balloon catheter to block the artery until surgical correction is performed.

After successful closure with the Prostar XL™, which is licensed up to 24-Fr, monitoring is necessary. Patients may develop a false aneurysm. Our patients are routinely checked 24 hours after the intervention with an ultrasound examination of the groin. Aneurysms which are smaller than 3 mm are left alone. They disappear spontaneously within a few days. Larger aneurysms up to 20 mm are compressed under visual control with the ultrasound probe. Additional injection of saline adjacent to the basis of the aneurysm narrows its neck and accelerates its occlusion. When that procedure is insufficient to achieve a thrombotic occlusion thrombin is injected into the aneurysm sack and compression is repeated (Figure 4). Surgical revision of the groin is seldom required with this proceeding.

In our own series of 621 EVAR and TEVAR procedures with percutaneous approach we had 11 patients (2%) who needed surgical revision of the common femoral artery due to a complete failure of the closure device or the development of a false aneurysm which did not occlude with ultrasound controlled compression, saline and thrombin injection. These figures underline the fact that EVAR and TEVAR can safely be performed in appropriate patients with a percutaneous technique when the diameter of the common femoral artery and the amount of calcification at the puncture site are respected.

Figure 2a: A needle of the Prostar XL system deviates from its proper course due to femoral artery calcifications. The needle sticks in the subcutaneous tissue.

Figure 2b: Cross sectional sketch of needle deviation.

Figure 3: The introduction of large devices cause tears in the arterial wall which may reach the threads. The threads are not anchored in the vascular tissue any more and closure of the femoral artery hole fails.

Figure 4: Ultrasound controlled compression of a false aneurysm is combined with saline injection at the neck of the aneurysm and thrombin injection into the aneurysm.
References
Femoral artery access management for sheaths 18 F and above: imaging and evaluation before endovascular repair

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Owing to the widespread success of closure devices for standard percutaneous Common Femoral Artery (CFA) closure following diagnostic or interventional vascular procedures, and due to the concern for potential surgical wound access complications in endovascular Abdominal Aneurysm repair (EVAR), Thoracic Endovascular Aortic repair (TEVAR) and percutaneous aortic valve replacement (TAVI) many physicians have sought to expand a percutaneous approach to these procedures involving larger diameter sheaths. Two commonly used suture-mediated closure devices, ProGlide® and Prostar XL® (Abbott Vascular, Inc., Redwood City, CA) have been extensively used for CFA percutaneous repair for access sites of 18F and larger. As such, broadening the application of these devices to use in CFA closure with larger sheaths requires a modified approach wherein one or two closure devices are deployed in the CFA prior to sheath introduction (i.e., ‘pre-close technique’). Prostar XL® has been already approved for several years in EU for large bore CFA access site repair in a ‘pre-close’ fashion. Until now, more than 20 publications report the single-center outcomes of EVAR, TEVAR and TAVI using the ProGlide or Prostar XL closure devices with various devices. Most of these reports suggested that the procedures were shorter, with less loss of blood loss and need for blood transfusion, earlier ambulation and shorter hospital stay than after the conventional surgical CFA repair and general anesthesia. When attempting to directly compare a broadly accepted vascular surgical approach to totally percutaneous access, it is important to carefully consider the risk to benefit profile for each individual patient. A multicenter randomized trial is currently undergoing in the US to determine the risks and benefits of this approach during EVAR.

Pertinent Pre-procedural Evaluations
Proper pre-procedural evaluation and the patient screening are essential to achieve a good outcome with percutaneous CFA repair. There are several challenges that can be encountered during CFA access and repair. To reduce the occurrence of access site complications preprocedural imaging of the access site with non-contrast and contrast computerized tomography (CT) is mandatory to assess the size of the artery, the extent of calcification and the distance from the skin to the access site. Most noteworthy of these challenges are CFA calcification, groin scarring/recent catheterization, small access vessels and severe obesity. Specifically, CFA calcification that completely engulfs the anterior CFA wall, or when present circumferentially throughout the targeted segment poses a problem for the percutaneous repair technique with current suture mediated closure devices. At the time of the procedure, ultrasound guided access is the safest method. The use of micropuncture kit is also very useful technique. The angiography through the micropuncture needle and sheath offers one to remove the kit components when the access is not in a desirable location without significant risk of bleeding. In addition, significant ipsilateral groin scarring and morbid obesity are also exclusionary conditions for most of the operators. The majority of published studies also identified morbid obesity as contributory to pre-close failure using either the ProGlide or Prostar XL closure device. Several studies have associated increasing sheath size with reduced pre-close success. To reduce the potential for failures related to CFA puncture errors, intraoperative arteriography is useful to verify proper CFA puncture prior to proceeding with closure device introduction. Therefore, not every patient is a good candidate for percutaneous CFA access and repair with current generation closure devices. As one expands his experience with this approach the indications for percutaneous approach tend to increase as well as the success of the repair.
Complications of large caliber groin access for EVAR

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Despite advances in stent-graft technology, access-related problems continue to occur during endovascular aortic repair, and are a leading cause of conversion to open repair, and significantly contribute to morbidity and mortality.

The devices employed in endovascular abdominal aneurysm repair (EVAR) and thoracic endovascular aneurysm repair (TEVAR) frequently require large sized delivery sheaths traditionally placed through the femoral arteries. Iliac and femoral artery size, tortuosity, and calcification should be carefully evaluated prior to endovascular aortic intervention to identify potential issues that may require adjunctive techniques to facilitate access. Newer, lower profile aortic devices and percutaneous closure techniques are allowing more challenging patients with aortic pathology to be treated endovascularly.

Patient related factors important in planning and the choice of devices and access vessels will be discussed as well as the attendant difficulties and complications most commonly encountered. Thereafter, techniques and strategies will be discussed in relation to avoiding and managing access complications.

Patient (Access vessel) related factors

Accurate preoperative imaging is essential for delineating the arterial anatomy to successfully size and design a stent-graft for delivery. Multi-sliced, helical computed tomographic angiography (CTA)(1,2) is the imaging modality of choice for proper patient selection and accurate preoperative endograft sizing. Others have advocated MRI(2) or IVUS(4,5) for planning. Whatever method used, accurate assessment of the diameter of iliac and femoral arteries and presence of tortuosity and extensive (circumferential) calcification and stenotic disease should be obtained.

The reported incidence of unfavourable iliofemoral anatomy varies in the literature. Earlier studies revealed approximately 25% of patients with aortic aneurysm had significant iliac occlusive disease, albeit a smaller number have disease severe enough to preclude device delivery(6). With more flexible, lower profile hydrophilic devices available today, there appears to be a 10-15% incidence of challenging iliac artery anatomy that would necessitate ancillary measures or change of access site of choice(7,8). Identification of aorto-iliac tortuosity or occlusive disease may result in adjunctive measures such as aorto-iliac angioplasty +/- stent placement or placement of iliac conduit (required in around 12% of cases) that will circumvent these problems(9).

There appears to be a gender bias in terms of anatomy of access related issues. For example women more often tortuous or calcified iliac arteries(10) requiring an iliac conduit to facilitate device delivery (28.6% vs. 1.2%(11), and 24.4% vs. 6%(12) compared to men, reflecting reduced iliac artery size. They also more likely to exhibit more dilation and proximal angulation of the aortic neck(13,14).

Iliac related complications include disruption, dissection, or puncture leading to formation of retroperitoneal haematoma. The EUROSTAR registry reported access complications in 13% of patients selected for EVAR, which along with migration was the leading cause for conversion to open aneurysm repair(16). Million and colleagues have reported their open conversion rate at 2.1%(17) with iliac rupture as the most common reason, itself reported by Criado and colleagues to have an incidence of 1.5%(18).

Other series have reported incidences of access complications ranging from 5%-28% depending on whether subclinical or manifest access complications are quoted(19,20). Tillich et al. demonstrated a high incidence of subclinical dissection occurring when endografts are delivered via a tortuous iliac system(20). Fernandez et al. recently looked at their experience with endovascular management of iliac rupture during EVAR/TEVAR and encountered a 3% incidence of rupture during EVAR and 9% incidence of rupture during TEVAR(20).

Black et al. commented that the most common early complication following 417 IRAAA EVARs in their series was acute leg ischaemia secondary to iliac stent limb occlusion; this occurred within 3 months in 16 patients (3.8 per cent). In the majority of patients this was secondary to iliac limb kinking in a tortuous iliac artery(21).

The complications associated with open femoral arterial exposure for aortic aneurysm repair are infection, arterial dissection, arterial thrombosis, pseudoaneurysm...
formation, groin hematoma lymphoceles and femoral nerve injury, which occur in 1%-14% of patients (20,25-27). A midterm analysis study of EVAR in 186 patients showed an 8% wound infection rate; a 6.5% rate of local wound complications, including wound necrosis and dehiscence; and a 4.8% rate of lymphocele formation. Complications have also been reported in the literature. A study of 186 patients showed an 8% wound infection rate; a 6.5% rate of local wound complications, including wound necrosis and dehiscence; and a 4.8% rate of lymphocele formation (20,25-27).

Device Related Factors
The most notable advance in endograft technology has undoubtedly been the reduction in device profile. Based on today’s endovascular devices, stent-graft systems measure from 18- to 24-F for the abdominal and from 21- to 28-F for the thoracic aorta. The concept that larger caliber devices are associated with higher access vessel complications is borne out by results of some studies. Matsagkas reported that 12% of their access related complications were directly attributable to bulky (24F) devices in their thoracic stenting experience (29). Increasing device calibre significantly correlated with technical failure in 3 studies of percutaneous EVAR particularly with sheath sizes greater than 20F (30) and 22F (31) (resulting in technical failures in 22% and 36% of cases respectively). Increased sheath sizes have also been associated with higher incidence of access complications (32). Others however, have claimed that there is no relation between larger profile stents and incidence of such complications (33).

Many of the modern devices today also have a variety of features such as hydrophilic stents to increase trackability, delivery sheaths equipped with ballooned exchange ports to minimize blood loss, and tapered nose cones to minimize vessel injury.

Exposure related factors

Percutaneous EVAR (P-EVAR) vs. Open access EVAR (O-EVAR)
Arterial closure devices were initially developed for use with 6- to 8-F sheaths predominantly for coronary diagnostic and therapeutic angiography. Larger arteriotomies (>10F) performed during endovascular aneurysm repair can be closed using a suture-mediated device such as Prostar Plus or Prostar XL (Abbott Vascular, Redwood City, CA). Description of their use has been extensively published (34-36). Most of the evidence regarding their use in vascular surgery is from single-center experiences in EVAR. These have demonstrated closure rates ranging 57%-100% (37,38) with weighted average success rates (from the studies, which provided data specifically for the Prostar XL), has been calculated as 91% (87% - 95%; CI) (39). Only one study has looked at mid term results of closure devices in EVAR identifying 3/156 (1.9%) late complications rate that included a common femoral artery dissection and two femoral artery pseudoaneurysms that required operative repair (40).

In a recent systematic review of the published literature on P-EVAR, Malkawi et al. identified that the overall access related complications were 4.5% in P-EVAR pts. In studies that directly compared P-EVAR vs. O-EVAR, the former had lower such complications compared to the latter with a relative risk of 0.47 (0.28-0.78, 95% CI), p=0.004 (41). However, published meta-analyses since this review have suggested no significant difference between P-EVAR and O-EVAR with regard to complications rates although a trend towards reduced events has been noted (39,42). This is in keeping with the results of the only randomized controlled trial in the subject by Torsello and colleagues comparing Prostar XL with open cut down. They found similar complication rates (3.5% O-EVAR vs. 7.4% P-EVAR; ns) that included one arterial thrombosis in each group. The patient numbers were small (15 in each group); however, they did demonstrate shorter mean operative time (87 minutes vs. 108 minutes, P<0.05), and mean time to ambulation (20 hours vs. 33 hours, P<0.001) in the P-EVAR group (36).

As most of these studies are not controlled there is a potential for selection bias. Presence of features predicting adverse access vessel outcome may persuade the surgeon to perform O-EVAR. In fact, increased iliac vessel tortuosity, excessive calcification (43,44) or stenosis or similar problems affecting the CFA, previous scarring (34,45), or increased groin adiposity (46) are reported exclusion criteria for the use of these devices.

Complications related to the percutaneous closure of the access site for the treatment of aortic aneurysms are bleeding, groin or retroperitoneal hematomas, arterial dissection in the femoral or iliac arteries, pseudoaneurysm formation, compromised distal flow, and problems related to the closure device, such as entrapment of the needles, thrombosis due to narrowing or severe intimal dissection of the artery. The reported incidence of these are 0.9%-9.4% in publications from centres of interest (31,34-36,47,48).
There is some evidence for the use of ultrasound guidance for puncture of the access vessel in the treatment of aortic aneurysms. One study suggested access site complications were significantly reduced using this technique when using P-EVAR compared to the group undergoing O-EVAR\(^{(50)}\). Similarly, Oguzkurt et al. noted only a 2% conversion rate from P-EVAR to O-EVAR in their series of 55 patients. They attribute this to their use of ultrasound guided puncture which facilitated their learning curve in P-EVAR\(^{(50)}\).

**Femoral Fascial Closure**

This technique which was first described by Deithrich\(^{(49)}\) and more recently by Larzon et al.\(^{(51)}\) involves a modification of the percutaneous technique without the use of expensive closure devices. After percutaneous access is obtained and completion of the endovascular procedure, the introducer, dilator, and guidewire are left in place. A small transverse incision between 4cm and 8 cm is made and dissection is carried down to but not through the cribiform fascia. A longitudinal U-stitch with a monofilament 2-0 polypropelene suture is placed in the cribiform fascia with careful attention to not involve the arterial wall. The suture is then tightened with a sliding knot and similar results have been noted in a smaller series by Harrison and co-workers\(^{(51)}\).

**Adjunctive / Salvage measures in management of access complications**

As devices improve with technology, more challenging cases and anatomy previously beyond the remit of endovascular therapy is being considered for endo-techniques. Concomitant with this, increasing technical tips and bail out strategies are described to meet the unusual scenarios encountered in these patients so as to reduce incidence of, or safely manage, their potential complications.

**Iliac Tortuosity**

Stiff wires available to straighten out the vessels include the Amplatz Super Stiff (Cook Inc, Indianapolis, IN), the Meier Wire (Boston Scientific, Natick, MA) and the Lunderquist wire (Cook Inc, Indianapolis, IN). The Lunderquist is the stiffest of the three and allows for greater trackability in a tortuous environment.

“Buddy wire” technique may be used in situations where a stiff wire may not advance. In these cases, a stiff Glidewire (Terumo, Somerset, NJ) can be passed through a catheter which will usually track easily. Leaving the stiff Glidewire within the catheter, a second wire, typically another Glidewire can be placed within the sheath and into the descending thoracic aorta. A second catheter is then advanced over this Glidewire and then this Glidewire is removed. With the stiff Glidewire and first catheter still in place, a stiffer wire can be more easily advanced through the second catheter. The device can then be deployed over this stiffer wire. Brachial artery catheterization has been used as an adjunct to maximize successful device delivery. This antegrade access allows establishment of a brachial-femoral wire, which can “body-floss” the aortoiliac anatomy, stabilizing the route and advancement of the delivery sheath\(^{(52)}\).

For extremely tortuous external iliacs, straightening and redundant excision can be performed in, the “pull-down” technique, first described by Parodi\(^{(53)}\). The success of this maneuver then hinges on ligating the inferior epigastric and deep circumflex arteries which would then allow for the tortuous iliac arterial segment to be straightened by gentle caudal traction on the external iliac artery which has been exposed under the inguinal ligament.

**Iliac stenosis**

The most commonly reported iliac intervention is angioplasty +/- stenting (usually with a 10-12 mm stent) to allow passage of the delivery device\(^{(5)}\). Angioplasty combined with placement of covered stent grafts in the narrowed iliac arteries with subsequent dilation is termed “cracking & paving”\(^{(54)}\). This stent relining with balloononing produces a “controlled rupture” of the iliac system through which the main body of the endograft can be inserted and easily deployed in the standard fashion. Peterson and Matsumura described a similar technique, using a 14 cm long iliac limb which they termed an “internal endoconduit”\(^{(55)}\). One clear disadvantage of these techniques is that they prevent antegrade flow into the ipsilateral iliac artery which may be significant if contralateral flow is suboptimal.

Another technique where tortuosity and/or stenosis exist, involves the use of an iliac conduit which can be fashioned by retroperitoneal exposure of the iliac system and placement of a 10 mm dacron graft onto the common iliac artery (CIA) at its bifurcation. Once the endovascular procedure is complete, the conduit remnant can be easily oversewn or, in the setting of severe iliofemoral occlusive disease, the conduit can be anastomosed to the ipsilateral common, superficial or deep femoral artery as a bypass. In an attempt to minimize retroperitoneal dissection, Carpenter described direct endovascular sheath placement into the iliac artery. The CIA was identified through a small retroperitoneal flank incision, and arterial control was achieved utilizing 2 concentric purse string sutures. After the procedure, the inner suture is tied
while an assistant keeps tension on the outer suture, and then the outer suture is tied. This technique makes circumferential control of the artery or the development of proximal and distal clamp sites unnecessary. In their report, the endograft sheaths were introduced via an arteriotomy for 10 thoracic and 8 abdominal deployments, with no site related access problems (56).

Non-iliofemoral approaches
Some have advocated alternate access sites such as abdominal aorta (54,57) or common carotid artery (58) as direct access routes in challenging iliofemoral anatomy.

The above described double purse string technique may be used for direct aortic access in situations where there is extensive iliofemoral disease and a TEVAR is planned. In a variation of this technique, called the “Surgiclose” minimal surgical exposure of the anterior wall of the access vessel is made, four preliminary, transmural 5-0 polypropylene sutures are then placed in the horizontal plane (2 on either side of the proposed entry point). The vessel is then accessed via an open Seldinger technique in the midline between the four sutures. At the end of the procedure, each of the sutures is tied sequentially. Mayer and co-workers used this technique for 536 accesses over a 4-year period that included 500 common femoral arteries, 32 iliac arteries, and 4 abdominal aortas with up to 24F sheaths introduced. They report no access related early complications (57).

First described by May and colleagues, and several groups since, the use of common carotid artery as the access vessel for endograft placement has been described (59-61). The left CCA is the often favored side (58,61) compared to the right CCA (60), as it provides the more expedient angle of entry to the distal aorta. This approach clearly mandates disease-free carotid arteries bilaterally to minimize stroke risk which is estimated to be around 1.6% (62).

Iliac rupture
The key issue during an iliac rupture is to maintain guidewire access. In doing so, one could quickly pursue an endovascular solution whereas if wire control is lost, the case would likely have to be converted to an emergent open operation. If an iliac rupture is noticed while guidewire access is maintained, a sheath can be reinserted followed by placement of a compliant balloon such as a Coda (Cook, Indianapolis, IN) or Reliant (Medtronic, Minneapolis, MN). The balloon should be placed into the distal aorta via the side of rupture and inflated. Next, a similar balloon should be placed via the contra-lateral side, so the ipsilateral balloon on the side of the rupture can be removed over a stiff wire and a covered stent graft placed, or operative repair performed. This emergency balloon maneuver can also be a vital temporizing measure during emergency treatment of ruptured aortic aneurysms (63).

Completion dictats
Upon case completion, it is important that all junctions are ballooned as indicated by pathology and manufacturer’s guidelines in modular devices and thereafter, biplanar completion angiography obtained before declaring success as potential complications or endoleaks could easily be missed if viewed only in one plane (64).

In O-EVAR cases meticulous attention should be paid to access vessel closure as intimal injuries are frequent especially in diseased, calcified femoral arteries. If necessary, an endarterectomy should be performed if extensive intimal injury has occurred in order to avoid femoral dissection and limb ischemia. Adequate interrogation of access vessel integrity should be made post closure by pulse examination, assessment of limb vascularity and supplemented by Doppler examination or completion angiography especially in P-EVAR cases. Hingorani et al. found clinically undetectable, but haemodynamically significant intimal flaps in 14% of their femoral access cases as assessed by intraoperative duplex scan post completion (65).

Conclusion
Thorough planning is critical to the success of endovascular repair of aorta. Perhaps the most crucial component of this is a detailed appreciation of the morphological characteristics of the aorto-ilio-femoral tree unique to each patient as this is by far the most commonly used route through to the area of pathology. Modern imaging modalities allow a detailed appraisal of anatomy vital to endograft choice and sizing as well as the potential pitfalls such as tortuous iliac anatomy or stenotic femorals.

A successful endo-strategy is underpinned by choosing the endograft which best suits the patient’s anatomy and employing the most optimal route for delivery. This can often be facilitated by the array of open and endoluminal tactics currently at the disposal of the vascular interventionalist.

The increasing use of closure devices have facilitated the growth in number of aortic interventions that can now be performed by P-EVAR. Proponents of this method advocate the lower rate of local wound complications, and the “minimally invasive” nature of it being consistent with the “minimally invasive” nature of EVAR.
With the advent of P-EVAR and increasing operator familiarity with their use, we can expect to see comparable access related complications compared to the more “traditional” Open access EVAR (O-EVAR). It is of note that although there may be a trend towards reduced groin complications with lower profile devices and utilization of P-EVAR, the results are by enlarge from relatively small non controlled series from centres with enthusiasm for these (P-EVAR) techniques. It is of note also that the pattern of complications may also be changing. Whereas with O-EVAR there may be increased likelihood of groin infection, lymph leaks, or femoral N injuries, the set of adverse groin outcomes with P-EVAR seem to be mainly haemorrhagic (haematoma, false aneurysm) or ischaemic (femoral artery occlusion, stenosis, or dissection) leading to the need for open conversion.

Finally, any clinician or team of clinicians engaged in the endovascular treatment of aortic pathology should be well versed in the array of open or endoluminal techniques and maneuvers described to circumvent or deal with the multitude of access related issues that may occur during the course of these procedures.

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Current indications of cardiatis stents & results

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The cardiatis multilayer stent is a self expandable device with a mesh made of cobalt alloy wires interconnected in multiple layers. The system is working on re-arrangement of direction of forces exerted by blood flow on arterial wall and aneurysm sac. Particularly in aneurysms the stent inverts the flow breaking down the velocity and inducing the thrombosis. Its effect on side-branches by flow recirculation allows the persistence of patency of parent vessels at the time of thrombosis within the aneurysm. All this makes this new device ideal when in an aneurysm it is important to keep open side-branches that are vital to end-organs. The Italian experience on 54 cases has shown a technical success in 92% of pts. Complete aneurysm thrombosis was achieved in over 90% of cases at F-U of 1 to 6 mo. Shrinkage of aneurysm sac was recorded at 6 mo in an average of 24% of pts. Collateral branches flow was recorded open in 100% of cases.
Endovascular repair of common femoral artery and concomitant lesions

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Purpose
Indication to treat peripheral arterial disease by endovascular repair is enlarging. However, open repair is still considered as the treatment of choice for common femoral (CFA) atherosclerotic lesions. Here we report the perioperative and the 1-year outcomes after endovascular repair of the CFA in a single center.

Methods:
Between 2006 and 2008, 36 patients were treated by endovascular repair for occlusive lesions of the CFA. Common femoral artery lesions were classified into four types: in type I, lesions were located at the iliac external artery and were extended to the CFA; in type II, lesions were limited to the CFA; in type III, lesions were located at the CFA and its bifurcation; type IV represented restenosis bypass anastomosis. A primary stenting strategy was performed in all cases. Postoperatively, patients were prospectively followed on an outpatient basis. The main endpoint was the primary sustained clinical improvement. Follow-up included clinical, duplex ultrasound examinations and biplane X-ray at 1, 6 and 12 months and yearly thereafter. A computerized data base was used to record demographic, clinical, and follow-up data.

Results
Forty limbs were treated. The mean age was 67.3 years. Most of the patients were scored 3 (61%) according to the American Society of Anesthesiologists. Indications for intervention included 28 limbs (70%) for claudication and 12 limbs (30%) for critical limb ischaemia. We classified CFA occlusive lesions into four groups. According to the classification described above, we treated 20% of type I, 42.5% of type 2, 25% of type 3 and 12.5% of type 4. Local anaesthesia was used in 91.6% of the cases. The over the bifurcation approach was performed in 67.5% of the cases. Forty-three stents were implanted. Concomitant endovascular treatment was performed in 24 cases (60%): in 15 cases to improve inflow and in nine cases to improve outflow. The mean length of hospital stay was 2.9 days (range 1-15 days). Three patients were hospitalised in the context of day-case vascular procedure. An arterial femoral closure device (Angioseal 6F, St Jude Medical) was used to allow early discharge. Complete follow-up data were obtained for all limbs at 12 months. Mean follow up was 22 months. At 12 months of follow-up, primary and secondary sustained clinical improvement were 80% and 90%, respectively. At 12 months, we observed eight cases of in-stent restenosis (20%). During this study, one stent fracture was noted at 6 months and classified as a type 3. At 1 year, target lesion revascularization and target extremity revascularization were 85% and 80%, respectively.

Conclusion
At 1 year, clinical and angiographic outcomes show that endovascular repair of CFA is a safe and efficient technique of revascularisation. However, a longer follow up is required to confirm these results. Currently, a French randomised and controlled trial is ongoing to compare open and endovascular procedures for the treatment of CFA atherosclerotic lesions.
Is DEB useful in below the knee endovascular treatment? Preliminary results of a RCT (DEBATE BTK Study)


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Background
Drug-eluting balloon showed positive results in terms of restenosis reduction in peripheral intervention (PTA). The aim of the study is to investigate in a randomized fashion the efficacy and safety of Paclitaxel-eluting balloon (PEB) (In.Pact Amphirion, Medtronic-Invatec) versus non drug-eluting balloon (NEB) (Amphirion deep, Medtronic-Invatec) in diabetic patients with Critical Limb Ischemia (CLI) undergoing PTA of below-the-knee (BTK) vessels.

Methods
The study, randomized, single center, planned to enroll 150 BTK lesions, 75 lesions in PEB and 75 in NEB group, assuming the 50% absolute reduction of 1-Year angiographic restenosis of the culprit lesion, the primary endpoint, in the PEB group.

Results
At the moment, 84 patients with 110 lesions treated are enrolled in the study and 1-year follow-up is available for 66 lesions in 51 patients, 30 lesions in the PEB and 33 lesions in the conventional balloon group. No significant differences were observed in terms of Rutherford Class, clinical and procedural characteristics among the two groups. Mean age was 71±19 years in PEB vs 77±10 years in NEB (p=0.09), lesion length 107±76mm vs 128±68mm respectively (p=0.2), occlusions in 82% vs 83% (p=0.9) respectively, sub-intimal recanalization in 12.1% vs 14.5% respectively (p=0.5). Restenosis - assessed by angiography in 53 lesions (83% in PEB vs 77% in NEB, p=0.2) and by Duplex Ultrasound in 10 lesions - occurred in 9(30%) PEB vs 23(69%) NEB lesions (p=0.01). Re-occlusion was present in 6(20%)PEB vs 17(51%)NEB lesions (p=0.02). No Major amputation occurred.

Conclusion
By provisional study results, PEB seems to provide better results in terms of 1-year restenosis compared to NEB in the treatment of BTK lesions in CLI patients.
Aorto-Iliac reconstructions of chronic total occlusive lesions with Atrium AdvantaTM V12 covered stent

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Aim
To evaluate the feasibility of treating Aorto-Iliac Chronic Total Occlusive (CTO) lesions using covered stents by various endovascular recanalizing techniques.

Introduction
Endovascular interventions have supplanted conventional open surgical bypasses or Endarterectomies for Aortic and Iliac stenosis. Although endovascular stenting of chronic total occlusions of Iliac arteries have been done, endovascular reconstructions of aortic and Iliac total occlusions have been viewed as lesions more suitable for Aorto-Iliac/Femoral bypasses.

Although thrombolysis with endovascular stenting for total occlusions of Aorto-iliac segment can be an alternative, re-stenosis is often a problem. The COBEST Trial has shown superiority of covered stents in the Iliac region.

Aorto-Iliac endovascular reconstruction with covered stents appear to be an extension of lessons learnt from the COBEST Trial and extended to the aortic segment as well.

Materials and Methods
A retrospective analysis of a single surgeon experience of treating chronic total occlusions of the Aorto-Iliac segment was carried out over a period of 3 years (January 2008-March 2011).

47 patients were evaluated for symptomatic Aorto-Iliac chronic total occlusions. 13 patients has distal PAOD beyond the Aorto-Iliac segment. All patients presented with severe disabling claudication with a mean claudication distance of 65±3.7 metres. 16 patients had tissue loss (3 toe gangrenes, 13 leg/foot ulcers).

27 patients underwent endovascular recanalization. Procedural success rate was 23/27 (85.18%) of which 11 patients underwent reconstructions with Atrium V12 Advanta TM covered stents. 21 patients underwent Aorto-bi Iliac or BiFemoral Bypasses. 2 patients had Axillo-biFemoral Bypass and 1 patient opted for conservative management.

V12 Advanta covered stents were chosen for its properties of low profile, easy deployment, flexibility of diameter adaptability to higher sizes, anchorability, good radial force for total occlusions and moldability to Aorto-Iliac anatomy configuration. All patients were followed-up with a CT Angio at 3 months. This was followed by 3 monthly ABIs, Duplex Scanning and a further CT angio at 1 year.

Results
After a minimum follow-up of 3 -30 months the cumulative patency rate in the V12 group is 100 %. Mean ABI was improved by 3±0.14. Mean claudication distance improvement was 900 metres. Ulcer healing in this group was 100%.

Techniques
V12 Advanta Covered stent can be deployed in 2 ways to create a Neo- Aorto Iliac Segment.

1. “Double Barrel” Technique:
In this technique one V12 covered stent is deployed in each Iliac Artery (Diameters 9-12 mm) by Kissing Balloon technique and the proximal end of the covered stent extends 1cm above the occlusion.

Total Occlusion of Abdominal Aorta Double Barrel Technique Final Result
2. "Double Barrel in a Drum" technique:

Drum in Aorta Advanta V12 16x41mm

Double Barrel in Iliacs Advanta V12 10x41mm

**Conclusion**

Endovascular reconstruction of Aorto-Iliac CTO is a viable alternative for Aorto-biFemoral Bypass with superior short and medium-term outcomes.
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Treatment of complex aortoiliac aneurysms with retrograde endovascular hypogastric artery preservation

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Purpose
The challenge of achieving distal sealing in the treatment of complex aortoiliac aneurysms (AIAs) has stimulated development of new endovascular techniques. One such technique is retrograde hypogastric artery preservation (REHAP). Use of this technique, during which pelvic perfusion is maintained by inserting an aorto-monoliliac endograft on the ipsilateral side with a crossover bypass and linking the contralateral hypogastric artery (HA) and external iliac arteries (EIA) with a covered stent, may allow the morphological limitations faced in AIA treatment to be overcome.

Materials and Methods
The perioperative and long-term outcomes of 12 patients (median age 77, range 64–86) who had undergone elective endovascular repair of AIA employing aorto-uniliac endografting and REHAP were examined for evidence of success and/or complications.

After the femoral arteries were exposed an Apollo endograft (Nano Endoluminal, Florianópolis, Brazil) aorto-uniliac device was inserted. The contralateral HA was cannulated and Viabahn device was advanced and positioned under roadmapping from the EIA into the HA. Finally, a femorofemoral bypass was constructed using a 8-mm dacron graft.

Results
Technical success, defined as device placement in the intended position and cannulation, had been achieved in all cases. No patients presented with endoleak related to the viabahn device, occlusion of the implanted components, hip and/or buttock claudication, or colon or spinal cord ischemia during follow-up. One patient presented with type Ib endoleak related to the aorto-moniliac device 360 weeks after implantation and 3 presented with type II endoleak.

Conclusion
Analysis of the outcomes of employment of REHAP in the contra-lateral HA indicates the technique’s promising prospects in AIA treatment. Longer follow-up of the outcomes of REHAP employment and its comparison with related techniques are required to determine its ultimate role in AIA management and treatment.
Contrast Enhanced Aortic Duplex UltraSonography Scanning (CEADUSS)

A laboratory model phantom to compare and determine the limitations of enhanced and unenhanced ultrasonography scanning for post-operative surveillance of EndoVascular abdominal Aortic aneurysm Repair (EVAR)

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Objectives
The long-term durability of EVAR techniques are still being assessed. Experience to date has revealed that up to a quarter of patients undergoing endovascular aortic aneurysm repair will require subsequent interventions to ensure aneurysm sac regression. To detect this subgroup of patients, currently all patients undergoing endovascular treatments enter a programme of surveillance, usually with regular CT scan follow-up. Thus these EVAR procedures will produce a large financial burden for the NHS and will also impact on diagnostic provisions, so a solution to lighten the load is required. The literature contains a number of studies that demonstrate unenhanced ultrasound to have a mixed sensitivity and specificity. Some report ultrasound, especially with contrast to pick up most of the endoleaks picked up by CT and others report a gross inferiority. Contrast enhanced aortic duplex ultrasound (CEADUSS) is safe, well tolerated, cheap and involves the use of no radiation and the contrast agent is less potent than radiological contrast on the renal system (non-nephrotoxic) when compared to CTA.

We propose ultrasound may be suitable non-invasive follow-up investigation and we aimed to determine the absolute limitations of ultrasound in detecting low flow endoleaks and compare the effects of the addition of microbubble contrast enhancement.

Methods
We constructed an EVAR-simulation-phantom with endoleak represented by a smaller lumen with variable flow alongside the fixed stent. The phantom comprised of agar-tissue-mimicking material and blood consisted of a commercially available Doppler testing fluid. Distances between the two vessels was varied by viewing from set positions and flows were viewed from anterior, posterior or lateral to the stent. Subjects consisted of six ultrasonographers (1 gold standard and 5 subjects), examining the phantom over a number of geometric parameters, flow rates and positions (36 in total). These measurements were tested using colour Doppler imaging then repeated using CEADUSS.

Results
Anterior endoleaks were detected more frequently than lateral then posterior positioned leaks were the most difficult to detect. The addition of contrast improved anterior leak detection from 76.4% to 98.6% (P<0.001) and also lateral endoleaks from 59.7% to 77.8% (P<0.05). However, posterior endoleak detection was not significantly improved (62.5% to 61.1%). Endoleaks positioned further from the main aortic flow were more likely to be detected than those positioned near or even superimposed on the stent. Increasing flow rates in posterior endoleaks increased their detection, but this difference was not significant.

The agreement with the gold standard was increased in all 5 subjects by using contrast and the proportion of uncertainty was reduced in all subjects.

Conclusion
We have demonstrated that anterior and lateral endoleak detection is improved significantly by using microbubble contrast. Also we have demonstrated that user variability and detection certainty is improved with contrast enhancement. We believe that ultrasound EVAR surveillance can be made more accurate and reliable by using contrast enhancement. Our results suggest ultrasound should be considered an adjunct to CT for routine EVAR surveillance.
Embolization of internal iliac arteries aneurysms (IIAA): technical consideration and results

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Objectives
Embolization technics of IIAA are not standardized and results in long-term prevention of rupture are unknown. We retrospectively evaluated in a multicentre study technics and the results of IIAA embolization.

Methods
IIAA was defined by an external artery diameter over 25 mm. Morphological characters and technics were reviewed. Technical success was defined by an immediate aneurysm occlusion. The follow-up was achieved every year by CT imaging or ultrasonography. L’IIAA was described as stable if the diameter’s variation was less than 5mm. The aneurysm rupture, diameter’s increase, endoleaks or buttock claudication were registered.

Results
Between 2001 and 2010, 37 male patients with 40 IIAA were treated, the average age was 77 years. Mean size of IIAA at diagnosis was 41mm. 9 aneurysms showed a proximal neck bigger or equal to 15mm and 10 a distal one. Technical success rate was 67%. Two complications were represented by a résolutive acute renal failure and a early death at 9 days. None colic ischemia was observed. Average follow up was 27 month. 9 patients died without relation with rupture of IIAA. Mean decrease of aneurysm diameter was 5,2mm. 5IIAA presented a diameter’s increase, 20 IIAA a decrease and 15 cases were stable. 10 endoleaks were find whose 3 were proximal and 7 distal by the ilio-lombar artery. 9 patients had a buttock pain. No statistic différence was observed for the major criteria between patients who had a combined embolization of IIA distal branch, aneurysm and proximal occlusion by stenting, plug or surgical ligature, and those who had an aneurysm embolization with or without proximal occlusion.

Conclusions
These results suggest that endovascular treatment of IIAA remain complex. Ilio-lombar arteries endoleaks seems to be a serious problem of managing. Nevertheless, no secondary rupture was observed.
Endovascular tip locking device for pulling vascular devices into anatomic position

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The Seldinger technique allows covered stent grafts to be pushed into place to treat arterial aneurysms. Extreme vessel tortuosity and stenosis can be dangerous in the placement of ever larger devices into arteries. Stiffer guide wires and special "lubricious" coatings do allow for safer placement, but the art is still to "push."

A new and safer "pulling" system is proposed, which avoids the dangers associated with pushing vascular devices against narrow or angulated vessels. This new concept of pulling a device into place by using a "body floss" technique and subsequent tip lock of the wire will allow for simpler, safer placement of endovascular devices. After "body floss" from the brachial to the femoral, addition of a "slick" braided sheath over the wire extending from the tip of the device would prevent damage to vessels. The guide wire can be locked in the dilator tip with a Lead Locking Device. This stylet has a "reverse Chinese finger trap" mesh that can be deployed or retracted as needed. Using a 0.018" guide wire allows for adequate room to insert the LLD as a locking buddy wire.

 Challenges
By pulling only the tip, it is possible for the device to be inadvertently delivered. The proximal lock and tip lock should be separate. This allows the tip to be anchored during deployment of the graft as the protecting sheath is removed.

Bench Data
We have tested this hypothesis with two commercial abdominal endograft devices. The LLD provided adequate braking of the central wire to allow a tip pull of the device. The LLD can be tightened allowing for the wire to move freely and redeployed to lock it again.

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Introduction
The aneurysmatic degenerations are well known arterial homograft complications. We reported a case of an endovascular treatment of an iliac branch of an aorto-bifemoral homograft aneurysm recurring in the follow-up.

Case report
A 77 year-old man, with hypertension, hyperlipidemia, ischemic heart disease and chronic obstructive pulmonary disease, in 2000, underwent a dacron aorto-bifemoral by-pass for Leriche Syndrome.

In 2002 the patient was subjected to aorto-bifemoral graft removal for graft infection associated with aorto-enteric fistula; an arterial homograft aorto-bifemoral by-pass was performed and enteric lesion was treated with duodenal suture and gatro-entero anastomosis.

In 2004 for the homograft rupture, a bifurcated dacron graft (18x16mm) was composed with iuxta-renal proximal anastomosis and distal anastomosis on homograft iliac carrefour.

After six months follow-up, for the presence of a right iliac homograft leg aneurysm (5 cm) associated with a symptomatic (rest pain) proximal dacron graft occlusion, we performed an endovascular obstruction recanalization with an autoexpandible stent (Biotronik-Philon,12x40) which, determining an extrinsic compression of left iliac branch, corrected with kissing-stent technique through another autoexpandible stent (Biotronik-Astron,9x60); pseudo-aneurysm was coverage with Excluder endoprothesis (16-12x100).

The patient had an uncomplicated 32 months follow-up when developed an anastomotic left inguinal pseudo-aneurysm treated with retroperitoneal silver-coated Dacron by-pass between aorto-femoral homograft and deep femoral artery.

During the same period in the right axis the residual segment of homograft, between stent and endograft and in the homograft above endograft we found two aneurysm treated with another endovascular treatment with the position of two sequential Excluder endograft.

The patient died in 2010 for a lung cancer with a good patency of aorto-bisiliac axis without any aneurysmatic lesion at ultrasound controls.

Conclusions
Endovascular treatment of arterial homografts aneurysmatic degenerations is feasible, safe and efficacy; however it requires a careful instrumental follow-up.
Endovascular abdominal aneurysm repair using the Cook Zenith graft.
A single center experience.

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Introduction
Benefits of endovascular aneurysm repair have been published in several reports. The Zenith endograft is a third-generation device that is widely used for EVAR.

Objective
The aim of this study is to present our single-center results of the Cook Zenith endograft after a mean follow-up of 66.4 months.

Material and Methodology
Between September 1998 and October 2003, 143 patients underwent elective endovascular aneurysm repair using the Cook Zenith endograft. Data from these patients were reviewed from a prospective database in October 2008. Primary outcome measures were overall survival, intervention-free survival, and freedom from aneurysm rupture. Secondary outcome measures were early and late postoperative complications, including endoleaks.

Results of the study
Mean follow-up was 66.4 months. Overall survival was 72.1% at 5 years and 63.8% at 8 years. There were no reinterventions-related deaths. Six patients had late aneurysm rupture, which was fatal in three. Freedom from aneurysm rupture was 98.1% at 5 years and 91.0% at 8 years. Late complications occurred throughout the follow-up period, with a tendency for aneurysm rupture and surgical conversion to occur at a later stage in follow-up period. Aneurysm sac enlargement during follow-up was associated with late aneurysm rupture and with need for reintervention.

Conclusion of the study
Elective EVAR using the Cook Zenith endograft provides excellent results through a mean follow-up of >5 years. There is a low aneurysm-related mortality and an acceptable rate of postoperative complications and reinterventions. The occurrence of late complications throughout the follow-up period stresses the need for continued postoperative surveillance in EVAR patients. (J Vasc Surg 2011 Jul;54(1)).
Endovascular repair of idiopathic celiac artery dissection in a patient with suspected cholecystitis

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Introduction
Isolated presentation of celiac artery dissection is a rare phenomenon in the absence of trauma, associated aortic dissection or iatrogenic injury secondary to intervention. The most common initial manifestation is an acute abdominal pain.

Report
We would like to report a case of an isolated idiopathic case of celiac artery dissection in a 44-year-old female with suspected acute cholecystitis. Following a normal ultrasound scan, CT angiogram revealed 22.7 mm length dissection at the origin of celiac artery. The patient underwent successful endovascular repair with two overlapping Palmaz™ Bare Metal Stents (Cordis Endovascular - a division of J&J) Final angiogram revealed successful repair of the dissection with minor flow in the false lumen. Follow up CT angiogram in 3 months showed complete obliteration of false lumen with good technical results.

Discussion
Isolated spontaneous celiac artery dissection should be considered in the differential diagnosis of acute abdominal pain, especially in middle-aged women. CT angiogram is the imaging modality of choice for establishing the diagnosis. Although non-operative treatment with close observation is an acceptable strategy in the management of uncomplicated isolated dissection of celiac artery. Endovascular intervention offers a safe alternative to surgical therapy with good technical success for patients with persistent symptoms and unstable haemodynamics.
The innovation trial: experience with a new customizable, ultra-low profile AAA Stent Graft System

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Background
A variety of devices are approved for abdominal aortic endovascular aneurysm repair (EVAR), but even with technological advancements there is still room for improvement. The new customizable, ultra-low profile INCRAFT AAA stent-graft is designed to address the durability issues of older generation devices, with the customizability to adapt to a broad range of patient anatomies.

Methods
The INNOVATION multicenter, non-randomized study was designed evaluate the performance of the INCRAFT device at 6 centers throughout Italy and Germany. Criteria for entry included AAA diameter ≥4.5 cm in women or ≥5 cm in men, a proximal neck length ≥15 mm and 20-27 in diameter, and an iliac landing zone ≥10mm. The primary endpoints included successful device deployment and absence of Endoleaks (type I, III, or IV) at the end of the procedure and absence of device or procedure related major adverse events at 30 days post procedure.

Results
A total of 60 patients were enrolled at participating centers and have completed 30-day follow up. Preliminary analysis shows a mean age of 74.5±6.9 and 95% of patients were male. The mean aneurysm neck length was 26.9±11.3, proximal neck diameter 22.3±2.2, and aneurysm maximum diameter was 52.60±9.20. Procedural and 30-day follow-up results with all 60 patients will be available at time of presentation.

Conclusions
Despite advances in stent-graft technology, there is still room for improvement with current EVAR devices. Initial experience with the INCRAFT device is encouraging.
Endovascular stenting for palliation in malignant superior vena cava syndrome

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Superior vena cava obstruction can occur in late or progressive stages of various tumor disease involving the mediastinum. To assess feasibility, short and long term efficacy and complication rate of interventional therapy, i.e. recanalisation, PTA and stenting of such lesions we analysed 16 consecutive patients with cancer related superior vena cava syndrome. Clinical follow up was performed every 3 months up to 52 months. Cancer driven mean survival time after PTA/stenting was 10.2 months (8 days - 52 months). Immediate technical success rate and acute clinical success rate was 100%; NYHA class improved from 3.31 (+/-0,60) to 1.8 (+/-0.75). Especially those in class 4 benefitted most and improved to class 2. Symptom relief was reached within 24hrs. All patients remained free from restenoses or recurrent superior vena cava syndrome for the entire follow up or for their remaining life span. We did not have any acute or chronic complication (stent migration, penetration, bleeding). Patients were discharged the other day, mainly on aspirin and clopidogrel, in some cases on low molecular heparin or vitamin K antagonists.

Thus, interventional recanalisation, PTA and stenting of superior vena cava syndrome is technically safe, clinically efficient for rapid and long term symptom relief for palliation in progressive cancer disease representing. It should be considered as first choice treatment.
Management of iliac vein obstruction and reflux: what should be done?

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Aim
To outline the pattern of iliac vein obstructive disease in patients presenting with C5 and C6 venous disease of lower limbs and to ascertain the value of various treatment modalities in their treatment.

Materials and Methods
375 patients (483 limbs) presenting with C5 and C6 disease over a period of 2005 – 2010 were retrospectively analysed according to clinical presentation using CEAP classification. Duplex findings before and after treatment, MR/CT Venography and treatment modalities were recorded with a minimal follow-up of 6 months. A clinical history of DVT was seen only in 59 (15.73%) patients. 289 limbs (59.8%) were identified on duplex scanning, CT / MR and Digital Subtraction ascending / descending Venography as having obstructive Iliac ± femoral venous disease, 103 limbs (21.3%) with purely reflexive disease and 92 limbs (18.85%) combined deep venous reflux in Femoral / popliteal veins with Iliac / Femoro – popliteal vein obstruction / stenosis. In the combined reflux and obstruction group (n=92), Iliac Vein Stenting was performed in 90 cases and Femoral Vein stenting in 6 patients (absent profundization). Absence of ulcer healing 3 months post-stenting lead to additional procedures in 52 limbs (57.7%) (33 Trapdoor Internal Valvuloplasty and 19 Axillo-Femoral / Popliteal Valve Transplants)

Results
Procedural success rate of stenting was 83/90(92.2%). Primary Patency of stents for Iliac / Femoral Veins was 100 % at 3 months to 65/83(78.31%) at a maximum follow up of 3 years. Secondary patency at 3 years follow up was 68/83 (81%). Ulcer Healing following stenting was seen in 38(45.7%) and 36(43.3%) limbs at 3 months. Internal Valvuloplasty patients showed 25/33(75.7%), ulcer healing within 3 months and that stayed up to 23/33(69.7%) at 3 years. Valve Transplants showed an actuarial ulcer healing of 12/19(63.1%) and 9/19(47.3%) at 3 months and 3 years respectively.

Clearly in the combined obstruction and reflux groups there seems to be two groups of patients. One where there is extensive deep venous thrombotic disease in Iliac and Femoral segments where distal valve incompetence is due to thrombo-sclerotic disease: these patients may get only modest improvements in their venous ulcer healing. The other group is one where there is proximal DVT in Iliac segments and the distal valve incompetence is due to severe functional reflux secondary to venous outflow hypertension: These patients remarkably benefit from distal valve repairs.

Conclusion
Although Iliac and Femoral Stenting provide excellent results in cases of isolated venous obstruction, they perform averagely in combined lesions of venous obstruction and severe reflux. Addition of time tested techniques to repair refluxive valves may improve outcomes in the treatment of recalcitrant Venous Leg Ulcers.
Endovascular treatment of tumour-related obstruction of the superior vena cava using a self-expanding Nitinol stent

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Introduction
In patients with upper venous congestion due to a tumour-related, rapidly progressive obstruction of the superior vena cava, an endovascular stent was implanted in response to an oncological emergency after interdisciplinary consultation regarding therapy. The aim of our study was to evaluate the efficacy and safety of the application of self-expanding Nitinol stents in the superior vena cava to alleviate upper venous congestion.

Material and Methods
In 22 patients (15 men; 7 women), a tumour-related compression of the superior vena cava was diagnosed by spiral-CT after intravenous application of contrast medium. Clinically, acute superior vena cava syndrome was found in all patients. Histologically, a bronchial carcinoma was present in 14/22, a lymphoma in 6/22, and mediastinal lymph-node metastases (1 breast carcinoma, 1 malignant melanoma) in 2/22. After a transfemoral approach, cavography was initially performed. The degree of stenosis was classified according to the Stanford classification. In accordance with the degree of stenosis, a self-expanding Nitinol stent (Sinus XL, Optimed) was placed. In the area of stenosis, residual constrictions were post-dilated with a balloon. On the following day, a renewed chest CT was performed to check the postinterventional outcome. Further CT checks were planned after 3, 6, 12 and 24 months, but this algorithm was abandoned in the event of renewed clinical deterioration.

Results
The endovascular stent implantation was conducted without complications in all patients. In all cases, additional dilation was necessary in the area of stenosis by balloon angioplasty. A marked improvement in acute symptoms was observed clinically within 24 hours in all patients. In the follow-up period up to 2 years, there were no cases of stent migration. In 7/22 patients, the CT checks revealed tumour progression (3/7 after 3 months, 2/7 after 6 months and 2/7 after 12 months) with evidence of residual stenosis caused by tumour growth through the stent mesh. 15/22 patients died during the follow-up period.

Conclusion
Self-expanding Nitinol stents provide endovascular therapy of superior vena cava syndrome with a tool with high radial expansion force that effectively frees the patients from their state of distress. As a result of the postinterventional clinical improvement, the patients can then be considered for specific additional oncological therapy.
Temporary non-retrievable IVC filter: insight from the NOVEL registry


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Background
IVC filtration is a safe and effective method to prevent PE in high risks patients with DVT(1). Currently available IVC filters are either permanent or retrievable and both carry risks of complications such as tilting, fracture and migration(2). Recently in our hospital two patients required a sternotomy and open retrieval of migrated IVC filters from the right ventricle on CPBP. The Novate IVC Filter is designed with a bioabsorbable filament which holds the filter arms in a temporary filtering configuration for up to 60 days after implantation. After that the filter arms will open and retract to the IVC wall. The Novate IVC Filter is currently enrolling patients in a multi center, international investigational study.

Methods
The purpose of the Novel registry is to evaluate the device in a first-in-man study, reporting on technical success, complications, PE and IVC occlusion rates. Patients are selected following specific inclusion and exclusion criteria. All patients have pre-procedure lower limbs US combined with CT venogram and a formal DS venogram at implantation. Follow-up includes: an US of the IVC at 5 days, a CTV or venogram at 45 days, an abdominal biplanar x-ray at 60, 120 and 180 days (the latter combined with IVC US) and an office visit at 1 year.

Results
So far 13 filters have been implanted in 6 hospitals worldwide. One patient reached the 1 year follow-up and the filter opened in the 120-180 days interval. Two patients have reached the 120 days follow-up and the filter arms have begun to retract to the IVC wall. Nine patients are awaiting the 45 days follow-up and one patient died of cancer during the follow-up. No morbidity or mortality related to filter implantation has been recorded.

Conclusion
Preliminary results from the Novel registry are encouraging. The Novate IVC filter has so far provided adequate filtration up to 60 days in 3 patients in absence of any adverse event.

References
Three phases of endovenous laser ablation

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Objective
In 2002 the theory of stream bubbles influence on vein wall was offered as the main mechanism of endovenous laser ablation (EVLA). Nevertheless, the exact mechanism of action is still under debate.

Methods
In the process of tumescent anesthesia, the vein is collapsed around the fiber and its lumen is becoming close to the fiber diameter (up to 1 mm). Because of that, as a vein model a glass capillary was used, the inner diameter of it was 1 mm. Capillary was filled with heparinised blood; laser fiber was put into it. Energy parameters were 5, 7, 10, 12, 20 J in one impulse for 1030 nm laser, and 1, 3, 5, 12 J – for 1470 nm laser. In the next series of experiences, we simulated the endovenous laser ablation ex vivo. The great saphenous vein was filled with heparinised blood and put into transparent heat-shrinkable tube. Around the vein the imitation of tumescent anesthesia was created by a gelatin.

Results
Complete vaporization of blood from the capillary and carbonization with heating of fiber tip occurred at energy density 10 J/sm for 1470 nm laser and 70 J/sm for the 1030 nm laser. These values of energy density in real EVLA are threshold. After that, the vein was filled by transparent gas (not vapor stream) and direct influence of laser radiation on venous wall is occurred.

Conclusions
The mechanism EVLA can be nominally divided in three phases:
1. Vaporization of blood and carbonization of fiber tip.
2. After complete vaporization, the direct influence of laser radiation on venous wall is occurred. From our point of view, the direct laser influence on vein wall is the main factor in mechanism of EVLA.
3. If there is no traction of fiber or it is too slow, the overheated fiber tip damaged the vein wall. This mechanism is universal and independent from the wavelength.
Combined Angioplasty and Thrombolytic therapy in Buerger’s disease

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Buerger’s disease (thromboangiitis obliterans) is a disorder affecting medium-sized arteries, as well as occasionally involving the venous system. It occurs predominantly in young male patients who are heavy smokers. Acute limb ischemia in Buerger’s disease is a critical situation, often resulting in limb amputation. Fourteen patients with addictive smoking pattern, normal blood serology, normal proximal pulses, and provokable Raynaud’s phenomenon in the other extremities were all compatible with the later-established diagnosis of Buerger’s disease were included in the study. CT angiography revealed Irregularities, focal occlusions, and collateral reopacification of some digital arteries suggested underlying arteritis. Eight patients had dorsal foot ischemic ulcers and six patients presented with digital gangrene. Patients were given a variable periods of ceasing smoking, long courses of antibiotics for periods ranging form 1 to 6 years. All patients were approached through an antegrade femoral puncture, 0.14 steerable guide wire, 1.25 mm coronary balloon for digital arteries and 2 mm balloon for arch and tibial arteries. Thrombolytic therapy was given through the sheath at the end of the procedure and maintained for 6 hours afterward. Technical and radiological success was evident in 80%, however clinical success was achieved in 95% with healing of the ulcers, amelioration of rest pain, and reversal of the color changes of the toes.

Conclusions
1. The clinical improvement which is far greater than the radiological recanalization could be explained by the effect of balloon dilatation on the digital periarterial sympathetic chain.
2. Thrombolytic therapy is mandatory at the end of the procedure to alleviate the effect of stasis induced by tedious dilatation of small sized digital vessels by ultrasmall short balloon.
3. This procedure should be tried as early in the course of the disease as possible before significant tissue loss ensues.
Can the interwoven nitinol Supera Veritas stent give a solution in the treatment of extensive femoropopliteal disease?

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Introduction
In the endovascular treatment of extensive peripheral arterial disease in the distal superficial femoral and popliteal level, you can encounter flow limiting problems, where stent placement is needed after balloon angioplasty. At the moment most of the standard bare nitinol stents will encounter difficulties in these areas. With the introduction of the Supera Veritas stent (IDEV Technologies, Inc., Texas, US) we may have an answer in treating those problematic lesions.

Methods
Because of the new design with 6 interwoven nitinol wires, this stent has extraordinary characteristics: very flexible, kink, fracture and crush resistant together with great radial force. We have treated the last year more than 40 patients with extensive femoropopliteal disease (TASC II C & D) or chronic limb ischaemia with heavy calcifications, occlusions, recurrent disease, stent fractures etc. These lesions, especially in the area of the distal superficial femoral and popliteal artery, that not responded to balloon angioplasty and that needed stent placement were at treated with placement of Supera Veritas stents. Technical success rate was up till now 100 %.

Follow-up & Results
Three patients died of non-interventional causes. Follow-up was done with ultrasound, in case of doubt CT angiography. There was postoperatively no need for major amputation. Three patients had an occlusion due to progressive distal peripheral arterial disease.

Conclusions
The Supera Veritas stent can be a solution in cases when the use of a “classic” nitinol stent is not indicated, especially in the treatment of extensive peripheral arterial disease and chronic limb ischaemia in the femoropopliteal area.

This stent system can be a necessary complement in your tool box if balloon angioplasty alone is not sufficient enough.

In areas where the placement of traditional self-expandable bare nitinol stents is not favourable, the Supera Veritas stent can be deployed.
Is the creation of a “new” aortic bifurcation with covered stents a benefit for treating extensive aortoiliac occlusive disease: follow-up, tips & tricks

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Introduction
We developed a new Covered Endovascular Reconstruction of Aortic Bifurcation or CERAB-technique for extensive and/or recurrent aortoiliac occlusive disease using covered balloon expandable stents to rebuild the aortic bifurcation.

Methods / Technique
Endovascular recanalisation of the aortoiliac axes, with bifemoral (with or without brachial access); placement and expansion of a 12 mm Advanta V12 Large stent-graft (Atrium Europe BV) in the distal aorta (trough a 9 Fr introducer). Pick up of the already expanded V12 stent with a large balloon whose adapted to the aortic diameter. The balloon is so positioned that the distal marker is about 15 mm proximal to the distal stent margin. After optimal positioning (+/- 20 mm above the bifurcation) and complete expansion, the distal stent part becomes funnel-shaped. Two iliac covered stent-grafts are then placed in this conic segment, in a “kissing-stent” configuration and simultaneous inflated. Both stents are now making a very tight combination with the aortic stent, as were they moulded together.

Results
We treated more then 20 patients with acute, chronic or recurrent aortoiliac occlusive disease (being TASC II C & D lesions). Technical success rate up till now was 100%. Minimum follow-up is 6 months. Three patients died of non-interventional causes. Follow-up was done by ultrasound and CT-angiography. Three patients re-occluded (1 completely) due to progressive distal peripheral illness or haematological disorders. They received successfully thrombolysis or mechanical thrombectomy and treatment of the outflow problems. A classic thrombectomy is feasible without damaging the reconstruction. The other patients showed no complications, four of them received later additional endovascular treatment for progressive distal disease.

Conclusions
The technique can be performed completely percutaneous, because of the access diameter of 9 Fr, it is safe and feasible.
A larger population and longer follow-up is needed to compare to bare stents, but the mid-term results are very encouraging.
Distal peripheral outflow need to be sufficient enough to maintain the arterial flow in the aortoiliac reconstruction and if needed, it has to be improved.
It can be combined with other revascularisation types as a “hybrid” procedure.
CERAB can be used for the treatment of recurrent or in-stent disease at the level of the aortic bifurcation.
Patient-specific simulated rehearsal for the carotid artery stenting procedure: from virtual to vascular reality

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Objective
Recent advancements in endovascular simulation permit patient-specific rehearsal (PsR) of CAS procedures by incorporation of patient-specific CT data. This study aimed to establish if PsR can predict real interventions and to assess its utility as a preoperative rehearsal and planning tool for both the interventionalist and individual team members.

Materials and methods
All patients deemed candidates for CAS with suitable CT imagery were enrolled. All team members were involved in rehearsals conducted in the Laboratory, Simulated Operating Suite (SOS) or Angiosuite environment before the real case. Dexterity, qualitative metrics and non-technical performance metrics were recorded. Subjective questionnaires used a Likert scale from 1 (poor) to 5 (excellent).

Results
Eighteen patients were enrolled. Three dropouts were the results of a technical simulator problem, an inadequate CT scan and a patient no longer deemed a candidate for CAS. Seven rehearsals were carried out in the Lab, 6 in the Angiosuite and 2 in the SOS. In 11/15 and 13/15 patients respectively, endovascular material and fluoroscopy angles were identical. In 4/15 and 5/15 respectively, the simulator did not adequately predict cannulation difficulties of the stenotic internal carotid lesion or common carotid arteries. The realism of the simulations and angiographies were rated highly by each team member (4/5), as its utility to evaluate the case (4/5), increase efficiency in tool use (4/5), potential to increase communication (4/5), confidence (4/5) and team performance (4/5).

Conclusion
PsR permits creation of realistic case studies, rated highly for both face and content validity. Although certain biomechanical vessel properties seem to be replicated to a lesser degree, endovascular material use, access strategy and angiography imagery is effectively replicated. As such PsR constitutes a unique tool that may help tailor endovascular material choice for individual patients and enhance patient safety, procedural efficiency and clinical cost-effectiveness.
Endovascular revascularization for frostbite-induced chronic hand ischaemia: a case report

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Chronic upper limb ischaemia is a very rare condition and it is usually due to arterial atherosclerotic occlusion, chronic arterial compression, iatrogenic or acute arterial trauma.

We describe a case of delayed symptoms presentation of frostbite-induced chronic hand ischemia successfully treated with endovascular recanalization.

A 56 years old man, with a previous history of right hand fingers ulceration after exposure at freezing temperature after a car accident, was admitted to our Hospital with a 3 months history of ulceration of the second finger and pain of the right hand. He presented other cardiovascular risk factors such as heavy-smoking and hypertension; no pro-coagulant risk factors were found and the basic coagulation parameters were normal. The Duplex Scan (DS) performed at the admission to our Hospital showed the presence of obstruction of both radial and ulnar artery at the right wrist.

We performed endovascular treatment (PTA) of the arterial obstructions obtaining recanalization and patency of the right radial artery, with good runoff in the palmar arch and in the digital arteries. At fifth month follow-up, the patient was admitted to our Hospital because of the recurrence of the painful symptoms of the right hand due to re-obstruction of the right radial artery. A re-PTA of the right radial artery has been performed, obtaining the recanalization of the radial artery with the presence of good run-off. At 6 months follow-up the patient was asymptomatic for chronic upper limb ischemia with complete healing of the finger’s lesions. The DS confirmed the patency of the radial artery and the presence of good run-off in the palmar arch.

This case represent a successful endovascular treatment of chronic upper limbs occlusive disease due to traumatic injuries.
Purpose
Demonstrate the safety and efficacy of duplex guided retrograde popliteal access for subintimal recanalization of SFA and evaluate the patency of SFA.

Methods
From February 2008 to July 2011, 45 limbs were treated in 38 patients (mean age 61 years old) with chronic SFA occlusion underwent duplex guided percutaneous subintimal recanalization from a retrograde popliteal access. Once the SFA was recanalized, the procedure was completed with angioplasty and stenting was performed on selective basis.

Results
Technical success (puncture of the popliteal artery and SFA recanalization) was achieved in 43 cases. No arteriovenous fistula, dissection or thrombosis of the popliteal artery was observed. Recanalization rate was 97.5%. CO2 and/or duplex scan were used during recanalization in three patients. The meantime to hospital stay was 2.7 days. Stenting was used in 12 limbs because of recoil and dissection. One occlusion was identified on the first day. No complications in the puncture site (neurological and vascular) occurred. The meantime for follow-up was 17.6 months. No one died in the first month. No major amputation was noticed. Reintervention was necessary in 12 limbs.

Conclusions
The duplex guided retrograde popliteal access position can be considered a «first choice» method for safe and effective SFA recanalization, especially in difficult anterograde or contralateral access, e.g., iliac tortuosity, tandem lesions, obesity.
Atherosclerotic plaque inflammation synchronize with inflammatory activity of visceral fat


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Background
Visceral adipose tissue is thought to confer increased cardiovascular risk through leukocyte infiltration and increased adipose macrophage activity. Previous positron emission tomography (PET) studies using fluorodeoxyglucose (FDG) demonstrated that increased FDG uptake could reflect the severity of inflammation in atherosclerotic plaque. We hypothesized that active atherosclerotic change in the major arteries would accompany increased inflammation within visceral fat and it could be detected in humans using combined FDG PET/computed tomography (CT).

Methods
We observed 44 consecutive subjects with cardiovascular disease. For all of them, an one-hour PET/CT (from brain to foot) was performed after injection of FDG (370-555 MBq). FDG uptake in the aorta or its major branches was evaluated visually and semiquantitatively. Maximal standard uptake values (SUV) of the highest regions of interest were calculated in the subcutaneous fat and visceral fat area, separately.

Results
Significant FDG uptake in the arterial wall was noted in 21 patients (plaque positive; PP group), all of whom have experienced acute cardiovascular events (acute coronary syndrome or ischemic stroke) within a week. The other 23 patients (plaque negative; PN group) had chronic stable angina or asymptomatic carotid stenosis. Visceral fat SUV was significantly higher as compared to subcutaneous fat SUV (0.49±0.15 vs. 0.15±0.05, p<0.001) in PP group, whereas there was no significant difference in PN group (0.18±0.07 vs. 0.16±0.03, p=0.622). When we compared two groups, PP group showed higher visceral fat SUV than PN group (p<0.001). In terms of subcutaneous fat SUV, the results were similar in two groups (p=0.773).

Conclusions
We demonstrated that atherosclerotic plaque inflammation was associated with increased inflammation within visceral fat. Our results need to be confirmed by comparison with histologic or other imaging findings. Further evaluation to determine whether metabolic activity of visceral adipose tissue is a marker or mediator of vascular inflammation is also needed.
Video motion analysis for objective assessment in catheter-based endovascular intervention


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Introduction
Wider uptake and increasing case complexity in endovascular intervention mandates proficiency in guide-wire/catheter manipulation. Objective motion analysis has been comparatively unexplored in this field. This study assesses its feasibility and its role for evaluation of technical skill and technology benefit.

Materials and methods
A semi-automated motion tracking software was developed, utilizing CT-calibrated and noise-corrected cumulative translational motion between frame-by-frame fluoroscopic video coordinates to calculate the 2D catheter-tip path-length (PL) with visual representation in an AP projection. Motion analysis was performed for 64 simulated endovascular procedures involving 20 experienced operators. Subjects cannulated aortic arch and visceral branches within CT-reconstructed pulsatile silicon phantoms in the angiography suite, using robotic versus conventional catheter techniques.

Results
Median PL was significantly reduced using robotic catheterisation techniques: 2093mm IQR(1471-3554) versus 1352mm (1111-1668) in the arch (P = 0.001); 2340mm (1860-3754) versus 572mm (474-767) in the visceral segment (P = 0.001). PL was significantly shorter for the less angulated aortic branches with conventional cannulation techniques (p<0.02). Further analysis revealed statistically significant correlations between PL and total procedure times (Spearman’s rho = 0.749, P < 0.001), catheter movements (rho = 0.7, P < 0.001) and vessel wall-hits (rho = 0.468, P = 0.005). An inverse correlation between PL and qualitative procedure scores was also found to be statistically significant (rho = -0.662, P < 0.001).

Conclusions
Endovascular instrument video motion analysis is feasible, and may act as a useful tool to assess endovascular skill and technology benefit. With further refinement and extraction of other descriptive metrics in addition to PL, it may provide an attractive platform for objective evaluation of endovascular performance.
Design and validation of an error capture tool for quality evaluation in the vascular and endovascular surgical theatre


Imperial College London, United Kingdom

Introduction
The unique and complex vascular/endovascular theatre environment is associated with significant risks of patient harm and procedural inefficiency. Evaluation is crucial to improve quality. This study attempted to design an efficient, reproducible tool for observers or teams to identify/categorise errors.

Method
Relevant published literature and previously collected ethnographic field notes from over 250 hours of complex arterial surgery were analysed. A comprehensive log of vascular procedural errors was compiled and twelve vascular experts graded each error for the potential to disrupt procedural flow and cause harm. Using this multimodal approach, the Imperial College Error CAPture (ICECAP) tool was developed. The tool was validated (21 consecutive arterial cases-52hrs operating-time) as an observer-led error capture record (two observers) and as a prompt for surgical teams to determine the feasibility of error self-reporting.

Results
Six primary categories (communication, equipment, procedure independent pressures, technical, safety awareness and patient related) and 20 error sub-categories were determined as the most frequent and important vascular procedural errors. Using the ICECAP, the number of errors detected correlated well between observers (Spearman rho=0.984, p<0.001). Both observers correctly identified all moderate or severe errors and categorised all errors identically. Self-reporting of errors without prompting identified 24.4% of all recorded errors, whereas surgical teams reported 69.7% of errors when ICECAP error-category prompts were used.

Conclusion
The ICECAP tool may be useful for capturing and categorising errors that occur during vascular/endovascular procedures. ICECAP may also have a role as an error recall prompt for self-reporting of errors by vascular surgical teams.
Fully immersive simulated catheter-lab technology for technical and non-technical skills acquisition and assessment


Imperial College London, United Kingdom

Introduction
ORCAMP is a simulated cath-lab room integrated with a VR-simulator, giving teams the opportunity to train to reduce technical, team and system based errors, in standard/crisis situations.
This study explores the role of the world’s first fully immersive catheter-lab simulator, in training technical and non-technical skills.

Method
The ORCAMP lab was set-up to simulate a fully functioning cath-lab and detailed scenarios developed. Following induction and practice cases, the ‘live’ case was performed by an experienced cardiology team. Post-test questionnaires and filmed debriefing interviews were conducted. Recordings of the procedure were reviewed by experienced clinicians to establish the feasibility of technical (Objective Structural Assessment Tool for Surgery and Imperial College Complex Cannulation Scoring Tool) and non-technical skills assessment (NOn-TEChnical Skills and Obsevational Team-work Assessment for Surgery assessments) using a Likert scale (1-not assessable to 5-assessable 100% of the time).

Results
The ‘live’ simulation was completed successfully. Team members felt aspects of cardiologist, nursing and radiographer training could be facilitated in ORCAMP (mean scores>4/5). The face validity was good for VR-simulator and case content aspects (scores>4/5), however realism of the C-arm (1.6/5) and table movement (2.2/5) were poor (under modification). The external raters graded the ORCAMP suite as a useful environment to assess individual aspects of technical and non-technical skills-75%-100% of the time.

Conclusion
This preliminary assessment suggests ORCAMP may be an excellent platform of which to safely assess and improve technical and non-technical skills of the entire multi-disciplinary team and be used as a clinical proxy where novel team-working and technical modifications may be developed.
Innominate artery stenting: a single centre experience

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Hypothesis
Endovascular interventions have revolutionized the contemporary treatment of peripheral vascular atherosclerotic disease. Innominate artery lesions have traditionally been treated with surgical extra-anatomic bypass via a cervical approach or median sternotomy. Percutaneous transluminal angioplasty (PTA) with stenting may be a viable alternative to traditional open by-pass.

Design and Purpose of the study
To analyze retrospectively the procedures of PTA with stenting of the innominate artery lesions performed in our Centre.

Methods
Between January 2002 and March 2009, 6 patients affected by innominate artery lesions (1 occlusion and 5 stenoses) were treated with PTA and stent using a humeral artery approach. All patients were symptomatic (previous transient ischemic attack, vertebrobasilar insufficiency, upper right limb claudicatio). Short and mid term follow-up included: physical examination, comparative blood pressure measurement on both arms and eco-Doppler examination of the supra-aortic trunks.

Results
In all cases we obtained a successful immediate angiographic result. No major complication (death, stroke) occurred during the immediate perioperative period and throughout all the follow up. Minor complications included puncture site hematoma (1 patient) and acute renal insufficiency (1 patient with known chronic renal insufficiency). Symptoms improved in all patients. Throughout follow up there have been no cases of restenosis detected by routine eco-Doppler examinations and all patients have remained symptoms free.

Conclusions
Percutaneous transluminal angioplasty with stenting may be a viable, effective and safety alternative to traditional surgical treatment of the innominate artery stenosis and occlusions.
Endovascular repair with cardiatis stent of symptomatic persistent sciatic artery aneurysm


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Introduction

A Persistent Sciatic Artery (PSA) is a rare congenital anomaly, usually associated with hypoplasia of the iliofemoral system. In most cases, the sciatic artery is the main dominant inflow vessel to the lower extremity. Persistent Sciatic Artery is associated with aneurismal disease. Aneurysm formation complicates 40% to 60% of the PSA cases brought to medical attention. There are a variety of presentations, including pressure symptoms from sciatic nerve compression and lower extremity ischemia for thromboembolic event or thrombosis aneurysm.

We report a case of a 53 year old man with the lower extremity severe pain due to compression of sciatic nerve secondary to voluminous aneurysm (50x56 mm) of the PSA.

The patient was submitted to a CARDIATIS Stent with axillary artery with surgical access. On the second postoperative day, the patient was discharged asymptomatic, without left buttock pain. Ultrasound color Doppler showed the thrombosis aneurysm sac and patency of the PSA. About 6 months after procedure, the patient remained asymptomatic and normal left pedal pulses. He was submitted to a CT angiography (CTA) which demonstrated the patency of CARDIATIS stent and the sciatic artery without stenosis, and the complete thrombosis sac aneurysm with reduction diameter. The popliteal and distal arteries continued normal.

The CARDIATIS Stent is likely a valid option for stent graft in the treatment endovascular of Symptomatic Persistent Sciatic Aneurysm.
A health promotion program to prevent problems related to diabetic foot (HPPDF) in Brazil

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Diabetes, a diet related non-communicable chronic disease affects approximately 12% of Brazilian population. The aim of this study was to determine the impact of a HPPDF focused to diabetic foot patients on glycaemia levels and the prevention of diabetic foot problems. This is a pre-test-post-test study design of unique cohort. From the total population of 143 diabetic patients who attended to the Basic Unit of Health (BUH) of Ladario County, Mato Grosso do Sul, Brazil during 2004, 30 of them had the complications of the diabetic foot and participated in the HPPDF. This was developed three times per week by a multiprofessional team (physicians, nutritionists, psychologists, pedicurists and physical trainers) between February (pre-test) and December 2004 with three post-test periods, May (post-test 1), September (post-test 2) and December (post-test 3). During the pre-test and the post-test periods, glycaemia levels and the status of diabetic foot were assessed. Data analysis included Wilcoxon-Mann-Whitney test and Pearson correlation coefficients and were processed by means of the Statistical Analysis System (SAS). Results showed that glycaemia significantly decreased from 234.7 mg/dl to 196.7 mg/dl between the pre-test and the post-test 3 periods (p < 0.001), respectively. Younger patients had a greater HPPDF acceptance as well as health improving since an inversely and significantly correlation was observed between age and glycaemia levels. The quality of the diabetic foot improved between pre-test and post-test 3 periods. These findings point out the significant impact of HPPDF on glycaemia and the status of diabetic foot and may be useful as a model for diabetes prevention.
Achieving hemostasis by using a percutaneous suture-mediated closure system after transfemoral approaches

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Introduction
The safety and effectiveness of a percutaneous suture-mediated closure system for achieving haemostasis after a transarterial femoral approach were investigated.

Materials and Methods
A percutaneous suture closure system (Perclose/Proglide, Abbott Vascular) was used in 2200 patients (average age 67.5 ± 12.5 years) who had undergone an angiographic intervention. Vascular access sites with a sheath size of between 6F and 8F were closed. Platelet aggregation was inhibited with 100 mg/d of ASA and all of the patients additionally received 5000 IU heparin perinterventionally. After application of the suture-mediated closure system and achievement of sufficient haemostasis, a light compression bandage was applied to all patients and 6 hours of bed rests was recommended. Postinterventionally (following day and after 6 weeks), the puncture site of all patients was checked using colour-coded duplex sonography.

Results
Immediate haemostasis was achieved in 2103/2200 patients (95.6%). In the remaining 97/2200 cases, a correct development of the suture was not possible, because of calcifications. In such cases, haemostasis was achieved by manual compression. Major complications involved 3 infections that required vascular surgical debridement with the use of an interposition graft. In addition, there were 5 cases of secondary bleeding requiring transfusion. Minor complications involved 3 (0.14%) pseudoaneurysms, 256 (11.6%) groin haematoma (up to max. 3 cm) and 85 (3.9%) palpable suture granulomas.

Conclusion
At puncture size of 6-8F, safe and effective haemostasis is possible with the percutaneous suture-mediated closure system. Insufficient suture closure is to be expected in the case of strongly calcified vessels.

Exclusion of thoracic aortic aneurysm using the Amplatzer Thoracic Graft: preclinical evaluation in a large swine model

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Purpose
The Amplatzer Thoracic Graft (ATG) features low profile delivery, repositionability, recapturability and integration into the aortic wall. The purpose of this study was to evaluate the exclusion of aneurysms in a swine model with ATG under Good Laboratory Practice (GLP) conditions.

Material and Methods
Thoracic Aortic Aneurysms (TAA) were surgically created in 18 swine (58.2-87.6 kg) using a fusiform Dacron graft. ATG is a self-expanding tubular prosthesis consisting of two nitinol and two polyester layers of braid. It was mounted into a delivery catheter with a lock mechanism allowing full recapture and repositioning of the graft during implant. The graft has a continuous folded nitinol braid design at the proximal end to enhance the stability and anchoring of the device in the proximal landing zone. The graft was implanted using 12F sheath. Animals were followed up at 1 week, 1 month, 3 months and 6 months, and afterwards euthanized for pathology examination.

Results
The maximal diameter of the aneurysm was 30-36 mm (32.3±1.7 mm). The diameter of the aorta proximal to the aneurysm was 15-19 mm (16.8±1.3 mm). The diameter of the grafts used in this study was 18-21 mm (18.9±1.1 mm). Graft implantation was technically successful in all 18 cases. Aneurysm exclusion rates by angiography and ultrasound were 83.3% after implant, 94.4% at 1 week, and 100% at 1 month, 3 months and 6 months. All implanted grafts remained stable in the implanted position throughout the course of the study. Pathology demonstrated generally optimal healing of the grafted aorta and aneurysm characterized by inclusion of the graft in organized, maturing and stable neointima. All the aneurysms were full excluded and filled by organized thrombus.

Conclusion
Endovascular exclusion of TAA was achieved using a novel metal/fabric hybrid graft in an animal model. The ATG offers the advantages of low-profile introduction, reposition / recapturability and incorporation into aortic wall with neointimal coverage of the graft surface for aneurysm exclusion.
Catastrophic events after endovascular aortic aneurysms repair (EVAR). Personal experience, treatment and results.

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Purpose
EVAR deeply impacted on aortic aneurysm repair. We retrospectively analyse our catastrophic events during ten years follow-up. How can we consider these events? Anecdotal nor significant clinical data? The primary endpoint is to record sac rupture, endo-graft infection, spinal cord ischemia, neurological deficits and aorta-enteric fistulae.

Method
From January 1998 to June 2011 we have performed 725 EVAR, 626 planned and 99 emergency one that is 55% of treated aneurysms. Almost all commercial stent-graft deployed. All of 684 patients leaving alive the hospital undergone follow-up surveillance and we account for 90% program adherence. We have observed 12 aneurysm ruptures (1.65%), 5 endo-graft infections (0.69%), 3 aorta-enteric fistulae (0.4%), 2 spinal cord ischemia and 2 neurological events (0.55%). Treatment concerning rupture has been open in 3 cases and redo-evar in 8; about infections 2 medical approach and 2 graft explants; aorta-enteric fistulae have been managed with 1 endo-graft associated to duodenum repair and 2 graft removal and duodenum repair; spinal cord ischemia and neurological deficits have been medically treated.

Results
Considering aneurysm rupture 66% mortality for open and 25% for redo-evar; 100% mortality for aorta-enteric fistula; analysing infections 50% mortality after graft removal (bacteria was staphylococcus aureus) and 0% related mortality in patients medically treated (bacteria was salmonella group: 1 long term antibacterial drug and 1 percutaneous drainage); about central nervous system 33% mortality and 66% permanent deficits.

Conclusion
Endovascular aortic repair should be considered as the last 10 years most important vascular surgery innovation; however we cannot underestimate some potential catastrophic events related to the procedure: Incidence of infections, aorta-enteric fistulae and major neurological events seem comparable to open aortic repair while sac aneurysm rupture is more frequent after EVAR in our case history so surveillance should be continued lifelong.

Emergency endovascular treatment of descending thoracic aorta injuries. Incidence and outcome among our intensive care unit population

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Background
To review incidence and endovascular treatment for thoracic aorta injuries at our Intensive Care Unit considering the Emilia –Romagna “Hub and Spoke” trauma network system and the Margherita 2 Registry. To analyse the outcome of severely injured patient with thoracic aorta disruption. To discuss appropriate treatment and timing.

Methods
Emilia-Romagna Region (Italy) is divided into three Hub and Spoke trauma areas. The 85% of multiple injured patients get our I.C.U just after Emergency Unit admission. The Margherita 2 Registry allow us to consider demographical data, injury severity score, main treatments, GCS score, surgical procedures and a lot of others parameters. We are reviewing 916 patients from January 2002 to December 2010, 60% aged 15 to 65. First five admission pathologies are cerebral lesions 70%, bone fractures 55%, thoracic trauma 50%, intracranial bleeding 33%, lung contusion 26%. Average GCS 9.8. The 50% undergone to one or more emergency surgical procedures. We have observed 10 thoracic aorta disruption, 8 of them undergone endovascular procedure within 4 and 12 hours since admission. Five patients have had surgical synchronous procedures.

Results
One patient died during eleven postoperative day, one at first day. One surgical conversion for type 1 endoleak. No cerebral nor spinal damage due to the procedure. No late complications. No procedure related mortality. The I.C.U. general mortality 22.8%, in hospital general mortality 24%, SAPS II expected mortality 28.6%. Mortality in patients with aortic lesion 20%. The two patients treated with conservative therapy are under Ct scan surveillance. The survived patients after endovascular repair are going well and get a MRA nor CT scan follow-up.

Conclusion
The incidence of thoracic aorta disruption, in patients getting alive the ICU, is near 1%, in accordance with the literature. Endovascular approach offers an excellent option for such multiple injured patients. However we need for take care to aortic diameter during shock, to the break bird and infolding behaviour due to endo-graft mismatching in angulated neck, to the left subclavian artery management and a long follow-up. Appropriate treatment and right timing should to be carefully discussed with all specialists.
Occlusion of the distal aorta and the aortic bifurcation: endovascular treatment

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Introduction
Extensive aortoiliac occlusive disease, defined as TransAtlantic Intersociety Consensus (TASC) C or D, is still mainly considered an indication for surgical revascularisation. Although highly effective in terms of graft patency, surgical repair is associated with substantial mortality and morbidity rates. Endovascular therapy as a less invasive alternative treatment of these lesions is challenging.

Methods
A smoker, diabetic and hypertensive sixty-year-old woman presented with a painful ulcer in the first toe of the right foot. Physical examination demonstrated absent femoral, popliteal and pedal pulses bilaterally. Ankle-brachial index was 0.3 bilaterally. She had a hostile abdomen due to gynecologic surgery over ten years ago. Computed tomography angiography showed occlusion of the distal aorta and the aortic bifurcation.

Results
Fully endovascular therapy was performed. Recanalisation of the iliac occlusions was achieved with 0.014 guidewire over bilateral femoral accesses. For the occlusion of the distal aorta, a covered balloon-expandable stent (Palmaz Genesis, 12mm x 38mm) was implanted. For the aortoiliac bifurcation, covered balloon-expandable stents (Advanta V12, 8mm x 38mm) were placed using the kissing stent technique. Closure was achieved with Anglo-Seal vascular closure device. After the procedure, femoral, popliteal and distal pulses were palpable. There were no complications in the puncture sites. She was discharged from hospital on postoperative day two. Three months later, the patient is asymptomatic, distal pulses remain palpable and ankle-brachial index is one.

Conclusion
Extensive aortoiliac occlusive disease can be well managed with endovascular treatment.

Crawford type IV thoraco-abdominal aortic aneurysm: fully endovascular repair with branched stent graft

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Introduction
Thoraco-abdominal aortic aneurysms are mostly treated with conventional open surgery. Total endovascular repair with branched stent grafts represents an innovative approach but requires advanced endovascular skills.

Methods
We present a case of a smoker, hypertensive and dislipemic fifty-five-year-old man. He had been operated from morbid obesity two years ago, suffering postoperative complications with suture dehiscence and intraabdominal abscesses. Ever since, he has a low-output enterocutaneous fistula. During follow-up, computed tomography incidentally diagnosed a 65-mm-diameter thoraco-abdominal aortic aneurysm (Crawford type IV).

Results
Fully endovascular treatment was performed. A thoraco-abdominal branched endograft and a distal bifurcated stent graft were implanted over bilateral femoral punctures. Branches for all four visceral vessels were accessed from left axillary artery. Covered self-expanding stents (Fluency, 7mm x 80mm and 10mm x 60mm) were used to bridge the branches of the stent-graft to the target vessels. Additional support to prevent kinking was achieved with a second non-covered self-expanding stent (Smart, same sizes as covered stents). Lumbar drainage of cerebrospinal fluid was used during the procedure to prevent paraplegia. Technical success was achieved. He didn’t experience any complications apart from a surgical wound hematoma which didn’t need reintervention. Postoperative computed tomography confirmed patency of all target vessels but showed a type II endoleak through the superior mesenteric artery. He was discharged home on postoperative day six.

Conclusion
Endovascular repair of thoraco-abdominal aneurysms is an alternative treatment to conventional open surgery.
Stanford type B aortic dissection: complex hybrid repair

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A forty-four-year-old man with severe hypertension presented with thoracic pain and was diagnosed of Stanford type B aortic dissection. Computed tomography showed an aortic dissection from the origin of the left subclavian artery to the inferior mesenteric artery. The false lumen perfused the right renal artery and the true lumen perfused the superior mesenteric artery and the left renal artery. The coeliac trunk was perfused by the two lumens. A 46-mm-diameter left common iliac artery aneu-rysm was also detected.

Right-to-left carotid crossover bypass was carried out prior to thoracic endovascular aortic repair. A Zenith TX2 Cook stent graft (34mm x 202mm) was implanted to seal the proximal tear. The proximal seal zone covered the origins of the left carotid and subclavian arteries. In the postoperative period, computed tomography demonstrated correct sealing of the intimal tear but retrograde perfusion of the false lumen. A Zenith TX2 Cook endoprosthesis (36mm x 152mm) was placed for distal extension of the previously implanted stent graft. Post-procedural revascularisation of the occluded left subclavian artery was undertaken. As definite treatment of aortic dissection, left iliac artery aneurysm was excluded by an ilio-iliac bypass and a debranching was performed consisting of a bypass from right iliac artery to right renal artery and bypasses from ilio-iliac bypass to left renal artery, superior mesenteric artery and coeliac trunk. To end up, endovascular stent grafting of the abdominal aorta was performed with two Medtronic Valiant stent grafts distally (32 mm x 28 mm and 36mm x 32mm) and a Zenith TX2 Cook 36mm x 152 mm proximally. In the same procedure, a stenosis of the thoracic endoprosthesis was treated with the deployment of an autoexpandable stent Sinus Optimed 32mm x 40 mm.

Two months later, the patient is asymptomatic and computed tomography shows inactive aortic dissection with good end-organ perfusion.

Open versus endovascular treatment of mesenteric vascular disease. A contemporary indian experience

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Aim
To report the spectrum of mesenteric vascular disease presenting in our practice and to compare their open surgical and endovascular options.

Materials and Methods
A prospective analysis of all mesenteric arterial vascular disease presenting to our institute was carried out over the last 30 months (January 2009-June 2011). 39 patients were evaluated for symptomatic mesenteric arterial disease. 12 were atherosclerotic mesenteric artery stenosis/occlusion, 7 mesenteric ischaemia due to aortic dissection, 2 FMD, 2 mesenteric artery embolism, 4 post stent occlusions, 9 aortoarteritis and 3 mesenteric/coeliac aneurysms.

17 patients underwent endovascular revascularization and 20 patients underwent open repair. 2 patients underwent Hybrid repair. The decision pathway for treatment was decided by treating surgeon (RKT) based on pathology, endovascular outcomes and cost affordability of patients. Of the 17 patients, 19 interventions were performed (PTA 2 lesions; PTA + Stent 17 lesions). Among the endovascular interventions 6 patients had stent occlusions of which 4 had open surgical revascularization; the other 2 patients remained asymptomatic and were not intervened. Stents used were Palmaz Blue(7 lesions), Herculink(6) and Racer(6).

All patients were followed-up with a Duplex scans and CT Angio at 3 months. This was followed by 3 monthly Duplex Scanning and a further CT angio at 1 year.
Challenging TEVAR in a complicated acute Type B aortic dissection in a patient with prior EVAR treatment


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Objectives
Case study of early and late outcome of a thoracic endovascular repair (TEVAR) of an acute complicated type B aortic dissection in a patient operated in the past for A.A.A with EVAR.

Methods and Materials
A female, overweight patient, aging 72 years old, who had been operated 8 years ago for AAA with EVAR, was urgently admitted in the I.C.U. for an acute type B aortic dissection. Despite Best Medical Treatment (BMT), she suffered a persisting intensive back pain. Importantly, CT angiography revealed that the arterial perfusion of the celiac trunk and SMA was on the false lumen. The patient underwent operation under epidural anesthesia, 11 days after admission, due to the persisting back pain and the occurrence of aorta enlargement. As the entry point was not sealed after the landing of the stent graft in great proximity to the LSA, it was necessary to cover the LSA with a second stent graft. The perfusion of the celiac trunk and SMA still remained on the false lumen via a new entry point.

Results
The patient tolerated well TEVAR, with no arm claudication and neurological deficits (stroke or paraplegia) or malperfusion and end organ complications. After two years under BMT, the patient is well, and no further complications have emerged.

Conclusions
TEVAR, along with left subclavian artery coverage without revascularization, even in patients with preexisting EVAR is a safe repair approach, especially when the lack of alternatives in urgent cases dictate it, although one should always bear in mind the risk of stroke, paraplegia or malperfusion.
Technical success rates of subfascial endoscopic surgery, foam sclerotherapy and endovenous laser for occlusion of calf perforating veins

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The role of perforating veins (PV) in the pathogenesis of chronic venous insufficiency (CVI) of lower limbs remains uncertain. Nevertheless, in selected cases of advanced CVI minimally-invasive interruption of PV seems to bring clinical benefits. The aim of study was to assess the technical success rates of subfascial endoscopic perforator surgery (SEPS), ultrasound-guided foam sclerotherapy (UGFS) and endovenous laser treatment (EVLT) for occlusion of calf PV.

After clinical and duplex ultrasound examination all patients met the criteria C4-6,Ep,As,p,Pr (CEAP). Incompetent PV were marked and data concerning their diameter and location were recorded. Occlusion of PV was accomplished by means of SEPS (16 limbs/56 PV), UGFS (18 limbs/59 PV) or EVLT (10 limbs/32 PV). SEPS was performed using the two-port technique, standard laparoscopic equipment and carbon dioxide insufflation. Foam was prepared by mixing sodium tetradecyl sulfate with air (1:4). For EVLT was used bare-tipped 600-nm laser fiber. Duplex ultrasound follow-up was performed at one month after treatment.

All PV were virtually occluded during UGFS and EVLT, but 4 (7.14%) PV from SEPS-group, placed at 11-13 cm from the sole of the foot, were not accessible. No major intra- and postprocedural complications were noted in all groups. Unconsidering inaccessible PV, duplex ultrasound follow-up revealed 100% occlusion rate in SEPS-group. PV occlusion rate was 91.52% in UGFS-group and 87.5% in EVLT-group. In both UGFS- and EVLT-groups preprocedural mean diameter of remaining patent PV was higher than that of occluded PV – 5.14±0.22 mm vs 4.26±0.07 mm (p<0.001) and 5.05±0.34 mm vs 4.24±0.07 mm (P=0.026), respectively.

SEPS, UGFS and EVLT are feasible and safe techniques that allows a high initial occlusion rate of PV. Technical success of PV occlusion may be influenced by their location and diameter, that are rational to be taken into consideration during the selection of appropriate method of perforator reflux interruption.

Deep venous thrombosis after orthopedic interventions

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Introduction
Common cases in physiatrists practice are the patients with leg edema which was not verified before the patient’s coming to rehabilitation. Deep venous thrombosis (DVT) is one of the most common causes of leg edema after fractures, long-lasting immobilization or operative cure (implantation endoprosthesis in a hip or a knee or some osteosynthesis material). The edema is at the same time the condition which is bound to life jeopardy and great disability if it not diagnosed and cured on time.

The aim
To establish that DVT is the common cause of the edema in posttraumatic conditions. Bearing in mind the fact that the clinical sight is not characteristic in diagnosing of DVT, we wanted to emphasize the diagnostic guidelines for DVT.

Method
Prospective clinical research of the patients sent to rehabilitation in our institution, after orthopedic interventions, included patients suffering from unilateral leg edema which was verified after the first clinical examination. All the patients from the group were treated as follows: Wells score was taken and ultrasonography vein examination was run.

Results
From January 2008 to April 2011, in 130 patients out of 130 suffering from edema Wells score was ≥ 2 and diagnostic DVT of various level of obstruction and degree of localization was diagnosed by ultrasonography.

Conclusion
Following the algorithms for DVT in patients with leg edema we can exclude or verify TDU which is of great importance for further treatment therapy and preventing from possible complications (embolism pulmonary, post-thrombotic consequences). TDU is as well a contraindication for the application of physical procedures which can result in re-thrombosis or thrombus fragmenting.

Key words
Leg edema, deep venous thrombosis, orthopedic interventions
Postthrombophlebitic syndrome - diagnostic and physical therapy

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Postthrombophlebitic syndrome is the commonest form of the chronic vein insufficiency.

The aim
The importance of physical therapy in vein slowdown curing and in preventing from disease progression and invalidity.

Method and Subjects
82 patients suffering from postthrombophlebitic syndrome and showing clinical gradation of changes according to CEAP classification C2-C3-C4-C5-C6 were treated from 01.01.2010. till 31.12.2010. by physical agents. Diagnostic evaluation of morphological and chemodynamic occurrences was performed by colour duplex scanning. From pathoanatomic point of view, the varicose stem of the saphena magna vein with the mouth dilatation, with thrombotic varicositates of the vein crural segment was detected in 67 patients. Two of them had a thrombus at the mouth of the saphena magna vein, and 12 of them had postthrombophlebitic sequele on the phemoral segment of the saphena magna vein. 6 patients suffered from the complete thrombosis of the stem of the saphena vein. Dilated and insufficient perforated veins were reported in 75% of the patients. Balneophysical agents were applied in postthrombophlebitic syndrome: They are thermomineral water of the indifferent temperature in strictly selected patients, vacusac, vasculator, kinetic, electro and magnetic therapy.

Results
Leg oedema was reduced, dermatophlebosclerotic plates were reduced, trophic changes were reduced, the appearance of vein ulcers was prevented. These were achieved by the influence of the physical agents on the improving of vein drainage, by reducing of vein hypertension, by improving of microcirculating metabolic processes.

Conclusion
Curing of postthrombophlebotic syndrome pose an overwhelming problem in clinical experience and physical therapy performs a part of complex measures in its curing in improving the quality of living and in preventing from invalidity.
Percutaneous closure with the StarClose device: an alternative technique in treating inadvertent subclavian artery catheterisation lesions

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Introduction
We want to report the technique of percutaneous closure with the Abbott StarClose device of inadvertent subclavian artery catheterization lesion during central venous access procedure.

Methods
From 2007 up till now, we had 12 patients with an accidentally catheterized subclavian artery with a 7 Fr. triple lumen catheter. All patients were critically ill requiring systemic anticoagulation therapy or had acute coagulation dysfunction. Because manual compression or surgical intervention was not a first option, we removed the catheter and closed the puncture lesion with a StarClose device (Abbott Laboratories, Redwood CA).

Technique
First we prepare a retrograde brachial access as a bail-out system in case of failure of percutaneous closure. Then we place a 0.35 wire in the brachial artery and one in the misplaced catheter of subclavian artery. Catheter is removed and the split introducer of the StarClose device is inserted over the wire which is then removed. Lesion in the subclavian artery is closed with a StarClose device (normal percutaneous closure procedure).

Results
Eleven procedures went all well and we encountered no problems. Control angiography showed no leaking or haemorrhage of the lesion / closure site in the subclavian artery. In one patient the closing failed because the catheter had also perforated a side branch, this was treated with the placement of a covered stent. Follow-up showed no neurological complications, no bleeding or haematoma after one week. Two patients died less then 30 days post procedure, not intervention related.

Conclusion
Using a StarClose closing device (Abbott Laboratories, Redwood CA), can be a safe alternative for the traditional therapies like compression, surgical intervention, covered stent placement or other endovascular treatment for a subclavian artery catheterization lesion. This type of percutaneous closure is furthermore cost reducing, less invasive and can lower the high morbidity and mortality of this complication.

Embolic Capture Angioplasty (ECA) with the Proteus balloon: balloon angioplasty and distal embolic protection: all in one device

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Introduction
Because endovascular therapy is now the first treatment option of most arterial lesions (even the most complex) the risk of complications is inevitable higher. One of these adverse events is distal embolization of atherosclerotic or thrombotic debris that can lead to devastating consequences.

Methods
We use in high risk patients the Proteus balloon (7 Fr.,Angioslide, Inc., Minneapolis, MN, US) to prevent distal embolization. This unique device combines the opportunities of performing a balloon angioplasty and concurrently capturing released debris in to the balloon when it folds in.

Results
We treated patients with in-stent stenosis and occlusions; long subocclusive lesions; lesions with irregular plaque; post-thrombolytic rest lesions in the femoropopliteal area with the Proteus balloon. The results of the angioplasty were comparable with these of our regularly used balloons. In al cases we retrieved - captured an amount of atherothrombotic material that normally would be flushed into the distal arteries. No patients suffered from distal embolization (controlled by angiography post procedure and with clinic examination-ultrasound later on). We encountered no additional severe complications (occlusion, large dissections, etc.). Overall technical success was more then 90 %.

Conclusion
The Proteus device combines the ability to perform “classic” balloon angioplasty and to give simultaneously protection against distal embolization. It is cost-saving in the treatment of high risk patients: no additional material or hospital costs for the prevention or treatment of distal embolization. The device can decrease the time of thrombolytic therapy in removing remaining thrombus material and can consequently restore faster arterial flow. Further follow-up with a larger population is needed to describe better the efficacy, the benefits and indications of Angioslides Proteus balloon.
Optimizing carotid artery stenting: validation of the scoring system for anatomic suitability for cas with simulated procedure rehearsal

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Objective
Carotid artery stenting (CAS) is a complex procedure which carries the risk of periprocedural strokes. A scoring system based on anatomic criteria, developed by experts, facilitates appropriate patient selection for CAS. Technical advancements in simulation science also allow case evaluation through patient-specific rehearsal (PsR) on an endovascular simulator, by incorporation of DICOM datasets into the simulation software. This study aimed to validate the anatomic scoring system using the PsR technology.

Materials and methods
Three patient cases were selected according to the scoring system (maximum score of 9) and incorporated into the simulation software. One case was considered easy (score < 4.9), one intermediate (5.0-5.9) and one difficult (> 7.0). Twenty novice interventionalists, pretrained in the CAS procedure, performed the CAS cases on the simulator in a random order. Performance was assessed by dexterity metrics (procedure/fluoroscopy time, contrast use and number of angiographies) and by qualitative metrics (generic and procedure specific rating scales for CAS).

Results
The interventionalists took significantly more time to perform the difficult CAS case (median 31.6 vs. 19.7 vs. 14.6min, p<0.0001) in comparison to the intermediate and easy case; more fluoroscopy (20.7 vs. 12.1 vs. 8.2min, p<0.0001), contrast volume (56.5 vs. 51.5 vs. 50.0ml, p=0.0060) and roadmaps were used (10 vs. 9 vs. 9, p=0.0040).

The quality of the performance, as measured by expert-based ratings, declined significantly as the cases became more difficult (score 24 vs. 22 vs. 19, p<0.0001).

Conclusion
The anatomic scoring system for CAS can adequately predict the complexity of a specific CAS procedure as measured by PsR. It exhibits the necessary fidelity to differentiate easy, intermediate and difficult cases. This scoring system, with or without the additional use of PsR, can guide novice interventionalists in selecting appropriate patients for CAS. This may reduce the perioperative stroke risk and improve patient safety.
Radiation-induced carotid artery stenosis: a case of tandem carotid lesions treated with hybrid procedure

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Carotid artery stenosis is one of the most common complication after external neck irradiation (radiotherapy, RT). The tandem lesions (proximal common carotid artery and internal carotid artery) increase the risk of complications during carotid artery stenting (CAS). We describe a case of radiation-induced tandem carotid artery stenosis treated with a hybrid approach.

A 59 years-old man, which 8 years before was subjected to laryngectomy followed by 34 RT sessions in the neck district, presented an asymptomatic 80% internal carotid artery stenosis associated with an ostial 90% common carotid artery stenosis. Both carotid artery plaque, evaluated by Dupplex Scan (DS), were defined as “complicated plaque” because of the low echolucency and the surface morphology. The tandem lesions were treated with internal carotid endarterectomy associated with common carotid artery stenting performed with retrograde approach. The post-operative period was free from cardiological and neurological complications and the patient was discharged at 2nd postoperative day. The patient did not report any neurological complication or restenosis during the 28 months follow-up.

The hybrid procedure could be proposed as a safe therapeutic option in treatment of radiation-induced tandem common and internal carotid arteries stenosis at high risk for CAS.

Pericardial fat inflammation in patients with acute coronary syndrome identified by F-18 fluoro-deoxyglucose positron emission tomography


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Background
We investigated whether pericardial fat inflammation could be related to coronary plaque instability using 18F- FDG PET.

Methods
In 50 (male 14, 48.1 +/− 7.7 years) patients who were newly diagnosed as acute coronary syndrome (28 patients, male 6, 46.8 +/− 7.9 years) or stable angina (22 patients, male 13, 49.5 +/−9.8), the co-registration of PET and contrast enhanced computed tomography (CT) images was performed within 1 week after percutaneous coronary intervention. Regional (chest) PET/CT imaging at 1h after 555 MBq of 18F-FDG injection and the multislice CT angiogram were acquired at 180 min on the Philips GEMINI TF scanner with 16 slice CT. The maximum standardized uptake values (SUVs) were measured in individual plaques.

Results
In patients with ACS, F-18 FDG uptake of pericardial fat was increased the fused PET/CT images. Age and gender- adjusted SUV of FDG was significantly higher in the pericardial fat of patients with acute coronary syndrome than those of patients with stable angina (mean 1.89 0.24 (1.65–2.13) vs. 0.71 0.13 (0.57–0.84), p < 0.0001). There were no differences of risk factors between two groups.

Conclusions
The patients presenting with acute coronary syndrome show higher inflammatory activity of pericardial fat. The findings of our study may also be helpful for understanding a regarding a potential role of the pericardial fat inflammation associated with acute coronary syndrome.
Paramédical / Paramedica
Trattamento endovascolare delle stenosi carotidi: aspetti assistenziali e tecnici

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Durante gli ultimi 10 anni lo sviluppo delle tecniche chirurgiche e i progressi tecnologici hanno prodotto un incremento esponenziale delle procedure mininvasive del trattamento delle stenosi carotidi. Conseguentemente a tali progressi, anche le competenze infermieristiche sono state sviluppate e implementate sia sotto l’aspetto teorico-tecnico che per quanto concerne la sfera relazionale con il paziente. Nel descrivere la nostra esperienza abbiamo voluto illustrare le varie fasi dell’assistenza infermieristica durante la procedura interventistica, dall’accoglienza del paziente in sala operatoria al suo trasferimento presso l’unità operativa di destinazione.

The role of MRA in carotid plaque stadiation and endovascular treatment

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In Italia l’ictus è la terza causa di morte dopo le malattie cardiovascolari e le neoplasie, causando il 10-12% di tutti i decessi per anno, e rappresenta la principale causa di invalidità (1). La prevalenza aumenta in relazione all’età, e ciò è confermato da vari studi internazionali. L’aterosclerosi carotidea viene considerata un importante marcatore di quella coronaria. È stato calcolato che nel soggetto asintomatico con stenosi carotidea il rischio annuale di infarto miocardico è del 5%-9%, e quindi addirittura superiore a quello annuale di ictus ipsilaterale. L’incidenza, come la prevalenza, aumenta esponenzialmente con l’aumentare dell’età, raggiungendo il massimo negli ultraottantacinquenni. Risulta pertanto che il 75% degli ictus colpisce l’età geriatrica (dal 65 anni in poi). Negli anziani di 85 anni ed oltre l’incidenza è tra 20/000 e 35/000 circa, con prognosi peggiore in termini di mortalità rispetto ai soggetti più giovani. La coronarografia è indicata nei pazienti ad alto rischio per la presenza di angina e/o ischemia a bassa soglia al test ergometrico, estesi difetti reversibili di perfusione alla scintigrafia miocardica, multiple aree di asinergia segmentaria all’ecocardiografia da stress. Lesioni coronariche gravi sono riscontrabili nel 65% della popolazione globale dei pazienti con malattia cerebrovascolare extracranica e nel 40% di quelli senza sintomi di cardiopatia ischemica. La stenosi carotidea rimane la causa più frequente di eventi ischemici acuti cerebrovascolari.

La morbilità correlata alla malattia cerebrovascolare è più invalidante di quella provocata da altri eventi ischemici, incluso l’infarto del miocardio. Le sequele neurologiche correlate a un evento ischemico cerebrale vanno dall’afasia alla paralisi, dalla cecità all’estrema debolezza portando a una perdita dell’autonomia e a un’incapacità nello svolgimento delle normali attività quotidiane con enormi costi per il sistema sanitario nazionale. Da ciò deriva la grande importanza che ricopre la prevenzione nella malattia cerebrovascolare e, in particolar modo, il trattamento delle stenosi carotidi del tratto extracranico nella nostra società.

L’incidenza di stroke (ictus ischemico) è dello 0,2% all’anno nella popolazione generale ma sale significativamente in concomitanza alla presenza di più fattori di rischio. Circa l’80% di tutti gli stroke hanno eziologia ischemica mentre i rimanenti sono causati da un evento emorragico; la causa principale della sintomatologia emorragica è da imputare a lesioni steno-ostervative della carotide extracranica che sono res-
Implementazione delle competenze infermieristiche nella chirurgia endovascolare: metodologia di apprendimento e formazione continua sul campo

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Lo sviluppo continuo della tecnologia e le sempre più raffinate tecniche chirurgiche come la costante collaborazione con altre figure professionali hanno imposto anche agli infermieri un’adeguamento delle proprie competenze e professionalità. La formazione universitaria di base e post base non soddisfano ancora tale esigenza di nuove conoscenze e abilità: la formazione continua effettuata sul campo resta a tutt’oggi lo strumento di crescita professionale più efficiente in nostro possesso.

La figura del tutor formativo diventa importante nell’affiancamento e nella guida all’apprendimento di tutto il personale che deve incrementare le competenze di alta specialità che sono essenziali nell’assistenza ad alta complessità come la chirurgia endovascolare.

Bibliografia
Pianificazione assistenziale per i pazienti sottoposti ad intervento di angioplastica e/o stenting per il trattamento delle arteriopatie periferiche

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Nella pianificazione assistenziale degli interventi di ricanalizzazione, ha una rilevante importanza l’approccio multimediale dell’equipe. La collaborazione tra le varie figure professionale facilita e velocizza la procedura: la via d’accesso, la posizione delle apparecchiature radiologiche e la preparazione del campo operatorio sono strettamente connesse tra loro.

L’assistenza al paziente viene svolta ponendo particolare attenzione alla posizione, al monitoraggio dei parametri e alla collaborazione con il resto dell’equipe ma non meno importante sono gli aspetti psico-relazionali a cui si deve dare il giusto rilievo in considerazione delle condizioni generali già molto compromesse del paziente.

CT-SCAN64: Il post-processing dell’imaging radiologico nella terapia endovascolare dell’aorta

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L’esame TC con apparecchiature multidetettore di ultima generazione rappresenta, in questo momento, la tecnica di imaging più evoluta e veloce per l’acquisizione di immagini ad elevata risoluzione spaziale e temporale. Tale tecnica radiologica, con l’ausilio di software dedicati alla ricostruzione di immagini 2D, 3D, MPR, MPR Curved, consente la pianificazione dei trattamenti endovascolari dell’Aorta Toraco-Addominale. Nei pazienti che possiedono un ritmo cardiaco stabile e non elevato la nuova tecnologia applicata alla tomografia computerizzata ci ha permesso, attraverso la cardiosincronizzazione, di visualizzare immagini statiche di un organo in movimento come il cuore e l’aorta durante la sua pulsazione. Nel follow-up dei trattamenti endovascolari toraco-addominali, la cardiosincronizzazione, è risultata valida nello studio dei rapporti tra le endoprotesi implantate in aorta toraco-addominale e i territori anatomici circostanti durante il movimento del muscolo cardiaco e della pulsazione aortica. Nella relazione mostreremo tre casi di procedure endovascolari in cui l’utilizzo della TCMD 64 è stato fondamentale per la pianificazione, l’esecuzione ed il controllo degli interventi. L’elaborazione post-processing delle imaging TC ha fornito un importante supporto nella scelta delle giuste proiezioni radiologiche durante il trattamento al fine di ottimizzare i tempi delle procedure di intervento operatorio con conseguente risparmio della dose radiante erogata al paziente ed agli operatori.

I casi mostrati sono i seguenti:
1. trattamento endovascolare di aneurisma di tipo A dell’arco aortico con Chimney technique (elaborazioni MPR, 3D)
2. trattamento endovascolare di coartazione dell’aorta toracica (elaborazioni MPR, 3D, Navigazione virtuale)
3. trattamento di dissezione e rotture dell’arco aortico (elaborazioni MPR, 3D, TC torace cardiosincronizzata)

Nell’ultimo decennio le procedure di trattamento endovascolare delle patologie dell’aorta toracica hanno subito un incremento esponenziale ed il rapporto di collaborazione tra TSRM e specialista medico è divenuto sempre più assiduo, tutto ciò ha portato ad una profonda rivisitazione dei ruoli all’interno dell’equipè operatoria.

Il ruolo del Tecnico Radiologo all’interno del teamwork risulta utile per le conoscenze in ambito di radioesposizione, di anatomia radiologica e delle tecniche di imaging.
La radioprotezione degli operatori nelle sale di interventistica

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Nei primi anni ’80 il report 93 del NCRP (National Council on Radiation Protection and Measurements) diceva che negli Stati Uniti la maggior parte della radioesposizione collettiva era dovuta al fondo radioattivo con l’83%, quella dovuta a pratiche di tipo medico rappresentava il 15%.

Nell’ultimo NCRP report sull’argomento, il report 160 del 2006, la radioesposizione all’uomo dovuta al fondo radioattivo rappresenta il 50% mentre la radioesposizione dovuta a pratiche di tipo medico è rappresentata dal 48%, trend confermato dalle ultime pubblicazioni della Commissione delle Nazioni Unite UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation).

Sempre nel NCRP report 160, se si esaminano le tipologie delle procedure di tipo medico, risulta evidente che gli esami di Interventistica nonostante in frequenza globalmente rappresentano solo il 4%, il loro contributo per quanto riguarda la dose collettiva rappresenta il 14%.

Inoltre durante l’esecuzione di queste tipologie d’esame, a differenza della maggior parte degli esami radiologici, l’operatore che esegue l’esame è direttamente esposto alla radiazione diffusa proveniente dal paziente. Dal punto di vista dosimetrico dobbiamo considerare che gli esami che si eseguono in un laboratorio di Interventistica forniscono al paziente e agli operatori alti ratei di dose.

Si pensi che durante una comune procedura di coronarografia e ventriculografia seguita da una PTCA con stent la dose media erogata al paziente è di 21 mSv che è l’equivalente di dose che daremmo se eseguissimo 1069 radiogrammi del torace e una procedura di EVAR, in un paziente di 50 anni, complessivamente tra esami radiologici pre-procedurali, procedura di EVAR ed CT di followup, produce un rischio medio stimato di incidenza di cancro pari a 1 su 100.

Per quanto riguarda gli operatori delle sale di radiologia interventistica, soggetti esposti a basse dosi cronizzate nel tempo, la letteratura internazionale ci insegna che il loro rischio biologico riguarda le seguenti problematiche: cancro, malattie autoimmuni della tiroide, processi neurodegenerativi, cataratta e opacità del cristallino, aterosclerosi e problematiche legate alla riproduzione.

Diversi lavori scientifici dimostrano che le teorie su alcune patologie indotte dalla radioesposizione devono essere rivalutate. Ad esempio per la cataratta dove fino ad oggi si pensava che l’insorgenza dovuta alla radioesposizione fosse correlata al raggiungimento di una dose soglia, recentemente diverse pubblicazioni hanno intui che l’insorgenza potrebbe non essere determinata dal raggiungimento di una dose soglia o che questa soglia sia più bassa di quanto precedentemente determinato (150 mSv/anno), non a caso ICRP (International Commission on Radiological Protection) in un documento ufficiale dell’Aprile 2011 dichiara che questa soglia annuale dovrà essere abbassata a 20 mSv e quindi diventerà pari a quella del corpo intero.

Intervenendo sui parametri e sulle geometrie dell’angiografo e utilizzando in modo corretto i presidi radioprotezionistici si può abbassare notevolmente l’erogazione della dose al paziente e agli operatori.

Assumendo un comportamento corretto dal punto di vista radioprotezionistico e con l’aiuto di figure professionali specificatamente formate e normativamente predisposte si possono raggiungere alti livelli qualitativi non solo dal punto di vista dell’esecuzione procedurale dell’esame ma anche dal punto di vista della protezione della radioesposizione del paziente e degli operatori.
Trattamenti endovascolari: problematiche tecniche in elezione e in emergenza

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Nella nostra unità di Radiologia Interventistica vengono eseguiti molti trattamenti endovascolari inerenti la patologia di tipo aneurismatica dell’aorta, stenotica delle carotidi e steno-ostrettiva degli arti superiori ed inferiori in regime di elezione ma in circa il 30% dei casi in regime d’urgenza.

L’urgenza costituisce la quotidianità e mette a dura prova la nostra preparazione professionale, la nostra capacità di adattamento ad emergenze sempre diverse e alla capacità di risoluzione di problematiche tecniche che abbiano la finalità di consentire un risultato terapeutico efficace che spazia dal salvataggio di arti alla vita stessa del paziente, nonostante si operi spesso in circostanze tecniche-structurali e logistiche non ottimali.

Il TSRM con la sua esperienza e la sua formazione Tecnico-Professionale deve contribuire alla realizzazione di una procedura angiografica complessa che sia di alta qualità, partecipando e collaborando attivamente con la sicurezza che deriva dalla profonda conoscenza delle procedure standard da attuare, ma soprattutto affrontando con sicurezza e tempestività le varianti accidentali che eventualmente possono verificarsi in corso d’opera, e fondamentalmente avere la capacità di operare in equi, in sinergia con altre figure professionali, anticipando azioni da compiere, preparando materiali da utilizzare e soprattutto senza interferire con le strumentazioni che stanno utilizzando.

Inoltre il TSRM è parte integrante del sistema protezionistico, ne è il garante quando opera in situazioni di radiologia complementare cioè quando non è presente un radiologo, essendo l’unica figura professionale che ha conoscenze circa l’uso corretto delle apparecchiature radiologiche e mettendo in atto tutti gli accorgimenti atti a limitare allo stretto necessario la dose e di conseguenza i danni ad operatori e pazienti.

In questo lavoro tratteremo in le problematiche inerenti ai trattamenti endovascolari soffermandoci in particolar modo ai trattamenti eseguiti in urgenza, della nostra esperienza in merito e alla risoluzione dei problemi emersi durante le procedure.

Trattamento endovascolare degli aneurismi toraco-addominali in emergenza: ruolo dell’infermiere

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L’emergenza chirurgica è l’evento più stressante e rischioso di tutti gli interventi chirurgici, in chirurgia vascolare il trattamento endovascolare della rottura dell’aneurisma toraco-addominale è indubbiamente un intervento ad alto impatto emotivo. Al fine di evitare perdite di tempo prezioso e di prevenire errori o dimenticanze l’emergenza viene affrontata attivando procedure standardizzate, comportamenti unificati in relazione alle priorità assistenziali.

Il ruolo dell’infermiere è determinato durante ogni fase dell’emergenza, l’alta complessità assistenziale e l’impiego di grandi quantità di risorse e le numerose figure professionali che a vario titolo partecipano all’intervento costituiscono l’elemento che caratterizza le elevate competenze che gli infermieri acquisiscono nel loro percorso professionale.
Ruolo tecnico infermieristico nel trattamento endovascolare degli aneurismi dell’aorta toraco-addominale mediante protesi fenestrate

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Le procedure endovascolari per il trattamento degli aneurismi dell’aorta addominale, fin dal loro esordio nel 1991, si sono rilevate un ottima alternativa al classico approccio chirurgico. La loro diffusione e popolarità è stata indubbiamente favorita dal continuo sviluppo tecnico dei materiali e delle apparecchiature diagnostiche e, non ultimi, dagli ottimi risultati riscontrati.

E’ importante sottolineare però che le endoprotesi aortiche si sono rivelate sicure ed affidabili esclusivamente in quei casi, selezionati ad hoc, dove, tra le altre indicazioni anatomiche, fosse ben presente un adeguato colletto prossimale d’ancoraggio. Fino a poco tempo fa infatti, il colletto prossimale è stato uno degli indici più discriminanti per destinare alla chirurgia tradizionale tutti quegli aneurismi che avessero avuto origine immediata al di sotto delle arterie renali o che ne coinvolgessero l’osso e il cui trattamento endovascolare avrebbe potuto occludere una delle arterie renali o viscerali.

Da qui l’idea di utilizzare una protesi ‘custom-made’, su misura e ‘fenestrata’, che presentasse lungo le pareti dei buchi in corrispondenza dell’origine sia delle arterie renali – nei quali vengono inseriti due stent per assicurare la ‘tenuta’ del sistema protesico - sia dell’arteria mesenterica superiore, che irriga l’intestino.

La nostra esperienza nel servizio di Radiologia dell’ospedale Mauriziano Umberto I di Torino è iniziata a fine 2010 ed è stata indubbiamente positiva anche se fin da subito ci siamo trovati di fronte alcune difficoltà.

Solamente con l’istallazione di una Tc multislices adeguata e l’ideazione di protocolli ci è stato possibile eseguire esami diagnostici ripetibili (riducendo al minimo gli errori operatori) e in grado di fornire informazioni precise sulle caratteristiche anatomiche di ogni paziente (come richiesto dalla ditta produttrice delle protesi). In sala d’Interventistica i principali problemi tecnici sono stati due tipi: il primo prettamente logistico e il secondo di gestione dell’angiografo.

Sotto il profilo logistico ed organizzativo l’uso della sala da parte anche dell’equipe di chirurgia Vascolare ci ha obbligato a studiare in maniera ottimale la collocazione del personale statico (operatori, anestesiisti, strumentisti, tsrm), dei carrelli, della strumentazione anestesiologica e dell’iniettore angiografico per garantire libertà di movimento e la più totale sterilità del campo operatorio e di tutto il materiale necessario alla procedura (soprattutto i vari devices per il posizionamento dell’endoprotesi particolarmente lunghi e di difficile maneggevolezza).
Angiographic study of the Vascular anatomy of the foot: the first step towards pedal recanalization

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Introduction
Recent data support the role of Percutaneous Transluminal Angioplasty (PTA) for critical limb ischemia. Intraoperative angiographic imaging of the foot is crucial for planning and performing PTA in tibial and foot arteries, and requires adequate technical and anatomical knowledge.

Purpose
The aim of this study is to illustrate the vascular anatomy of the foot and the role of angiographic imaging in planning and performing complex below-the-knee (BTK) procedures, with special attention in tibial vessels and foot arteries recanalization.

Methods and Materials
We describe our radiological protocol, including technical and anatomical aspects regarding angiographic imaging of the foot, considering patient positioning, radiological projections and contrast material injection (volume, speed and pressure). Describe the normal vascular anatomy and major anatomic variations, illustrated through the presentation of sample cases of pedal arteries revascularization.

Conclusions
In our experience a single radiological projection is not enough to study and understand the vascular anatomy of the tibial vessels and foot arteries. A comprehensive and correct radiological study of the foot vascular anatomy is mandatory to design a technical planning and perform the revascularization of the target vessel.

L’angioplastica e stenting nell’arteriopatia periferica: nuove prospettive

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Il termine ischemia, dal greco “ischein haima”, significa assenza di sangue, essa si divide in ischemia funzionale ed ischemia critica. Solitamente il paziente affetto da arteriopatia periferica si rivolge allo specialista per la progressiva comparsa di una impotenza motora, definita claudicatio intermittens proprio per il carattere transitorio e ripetitivo del disturbo, che si evidenzia durante la deambulazione. Lo stato della patologia viene classificato secondo le linee guida di Fontein e di Rutherford.

L’ischemia funzionale è caratterizzata dalla claudicatio intermittens, tipica della patologia aterosclerotica occlusiva, la cui caratteristica principale è il dolore a carico di un’unità funzionale muscolare che insorge sempre dopo attività fisica e si risolve completamente al cessare dell’esercizio muscolare.

L’ischemia critica è definita invece da un dolore a riposo che persiste per più di 2 settimane e che richiede l’utilizzo di analgesici, con o senza la presenza di lesioni distruttrici delle estremità.

Dall’esperienza condotta dall’United Kingdom Joint Vascular Research Group su 409 soggetti con ischemia critica conica: il 60% è candidato ad intervento chirurgico di rivascularizzazione o angioplastica percutanea; il 20% ad amputazione primaria dell’arto e il 20% è sottoposto a procedure alternative. I pazienti con ischemia critica hanno una sopravvivenza media inferiore alla popolazione generale e quindi l’obiettivo finale del trattamento deve essere mirato innanzitutto al controllo del dolore e al salvataggio dell’arto, senza compromettere l’aspettativa di vita già estremamente bassa.

Inizialmente tale patologia veniva studiata con l’arteriografia con tecnica convenzionale, che ha rappresentato col tempo l’esame radiologico più utilizzato per lo studio del distretto vascolare arterioso periferico. L’informatizzazione dei sistemi diagnostici ha consentito l’introduzione di nuove tecniche d’immagini, tra le quali l’angiografia digitale a sottrazione d’immagine che attualmente rappresenta, non solo un mezzo di conferma diagnostica, ma soprattutto terapeutica nel trattamento di tale patologia.

Le procedure endovascolari, ormai di utilizzo comune, sono: l’angioplastica e lo stenting, che si suddividono a loro volta in angioplastica intraluminare, angioplastica sottointimale, stent, e stent graft.

Centri di riferimento con casistiche elevate sono maggiormente accreditati e deputati, non solo a partecipare a studi multicentrici, ma anche a definire, introdurre e...
sperimentare nuovi approcci e nuovi strumenti per orientare la pratica professionale verso l’appropriatezza, l’efficacia e l’efficienza delle prestazioni sanitarie. Inoltre, è necessario organizzare l’assistenza secondo modelli gestionali, e fondare la valutazione, la decisione e l’azione clinica mediante opportuni strumenti assistenziali quali linee guida, raccomandazioni e percorsi clinico-assistenziali condivisi. La razionalizzazione e la standardizzazione delle procedure, il monitoraggio clinico e soprattutto l’innovazione tecnologica dei materiali e delle apparecchiature dedicate, insieme ad un’ottima collaborazione tra le varie figure professionali, sono da ricercare per ottenere risultati migliori e traguardi ambiziosi.