Duplex Ultrasound-Guided Percutaneous Transluminal Angioplasty

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Introduction

• Contrast-induced nephropathy (CIN) is a well known complication of PTA and PTCA and is associated with increased patient morbidity and mortality

• A study of 213 patients with peripheral vascular disease documented transient acute renal dysfunction (≥20% decrease in renal function within 24 hours, as estimated by Cockroft's formula) in 12% of cases within 24 hours of PTA

• 1 patient (0.5%) developed persistent renal failure, with stable serum creatinine not requiring dialysis
  – Risk factors for ARF by logistic regression analysis included CHF, hypertension, raised HbA1c levels, and coronary artery disease
  – Pre-existing impaired renal function and contrast dosage were independent predictors of ARF

1Schillinger et al, Predicting Renal Failure After Balloon Angioplasty in High-Risk Patients, Journal of Endovascular Therapy: Vol. 8, No. 6, pp. 609–614, 2001
• The pathogenesis of CIN is complex and not fully understood, but iodinated contrast agents induce intense and prolonged vasoconstriction at the corticomedullary junction of the kidney. Moreover, high-osmolar dyes directly impair the autoregulatory capacity of the kidney through a loss of nitric oxide production. These effects, coupled with direct tubular toxicity of contrast media, lead to overt acute tubular necrosis and the syndrome of CIN.

• CIN may be minimized by use of N-acetylcysteine with judicious hydration\(^1\), and the use of carbon dioxide arteriography; however CO2 arteriography gives inadequate visualization below the knee\(^2\).

Furthermore, PTA is contraindicated in patients with proven allergy to iodinated contrast media as severe anaphylaxis with potentially life-threatening airway compromise (1.4%) may result post-administration of iodinated contrast agent.

Duplex-guided angioplasty is a feasible alternative for patients at high risk of CIN or with contrast allergy.

Ramazanali et al, Duplex Ultrasound–Guided Femoropopliteal Angioplasty: Initial and 12-Month Results From a Case Controlled Study, Journal of Endovascular Therapy: Vol. 9, No. 6, pp. 873–881
• A study of 253 patients who underwent duplex-guided balloon angioplasties of the SFA and/or popliteal artery in 218 limbs reported a technical success rate of 93%.

The SGH pilot study

• SGH is a 1515 bedded primary care hospital in Singapore

• 800 cases of lower extremity interventions were performed over the last 3 years, of which 250 were infragenicular and done in the conventional manner

• We present two cases of PTA performed in patients with critical limb ischemia, one with known contrast allergy, and the other with chronic renal failure

• Both patients had high grade distal superficial femoral artery/prox popliteal stenoses, and underwent antegrade cannulation of the ipsilateral common femoral artery under local anaesthesia
Methods

• Instead of intra-venous contrast administration, a combination of fluoroscopy and hand-held colour-coded Duplex ultrasound (Philips IU22, with a 5-MHz linear-array color probe) were used to control guidewire placement and balloon angioplasty of the stenoses

• Each patient had one primary interventionalist aided by an ultrasonographer (RVT) and a radiographer
• 66 yr old male with a history of type II diabetes mellitus, hypertension and end stage renal failure requiring thrice weekly haemodialysis
• Admitted with dry gangrene of his right great toe and non-healing ulcers of his right 2\textsuperscript{nd} toe and heel for the previous two months
• Duplex USS showed significant SFA, popliteal and distal disease R
• An attempt at conventional lower limb PTA was complicated by acute desaturation after administration of iv iodinated contrast media and was aborted
• He was treated for acute pulmonary oedema and made a full recovery
• Duplex-ultrasound guided PTA to the distal SFA / proximal popliteal artery was subsequently performed
– Femoral sheath placement was performed in the usual fashion, and guide wire insertion to the trifurcation done under duplex guidance
– The position of the wire was checked under II and multiple inflations of the popliteal and distal SFA up to mid SFA were done under II with good result
Post PTA of popliteal result

Pre PTA - monophasic

Post PTA - biphasic
Patent popliteal post PTA
- However recheck duplex showed a remaining inadequate result in one area, and a small dissection flap in another area of the popliteal region
- Duplex ultrasound guided angioplasty was performed
Persistent popliteal stenosis
Balloon placement
Angioplasty
Fully inflated balloon occluding popliteal flow
Post angioplasty result
Comparison

Pre PTA

Post PTA
Angioplasty of dissection flap
• Total procedural time : 85 min
WKY

- 81 yr old male with a history of type II diabetes mellitits, **chronic renal failure**, ischaemic heart disease with previous AMI and PTCA, sick sinus syndrome with PPM insertion, vitiligo, myaesthenia gravis, cryptococcosis meningitis and previous prostate abscess
- admitted with a non healing 3x3 cm right medial malleolus ulcer
- Duplex ultrasound showed significant SFA, popliteal and distal disease R LL.
• Duplex-ultrasound guided PTA was performed without the use of intraprocedural fluoroscopy
Pre PTA
Puncture of CFA
Guide wire insertion
Guide wire insertion
Guide wire insertion
Balloon placement
Angioplasty
Angioplasty
Angioplasty
Post angioplasty result

- Total procedural time: 45 min

![Graphs showing right pressures and toe pressures after angioplasty.]
Summary

• In patients at risk of developing contrast induced nephropathy, or who have proven allergies to iodinated contrast media, duplex ultrasound guided PTA presents a fairly safe and performable alternative to conventional PTA.

Thank you
References

• Schillinger et al, Predicting Renal Failure After Balloon Angioplasty in High-Risk Patients, Journal of Endovascular Therapy: Vol. 8, No. 6, pp. 609–614, 2001
• Ramazanali et al, Duplex Ultrasound–Guided Femoropopliteal Angioplasty: Initial and 12-Month Results From a Case Controlled Study, Journal of Endovascular Therapy: Vol. 9, No. 6, pp. 873–881
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