

A case report of duplex-guided femoral angioplasty in a patient with severe renal insufficiency still an option to consider

Abstract

Introduction: One of the main concern of percutaneous transluminal angioplasty (PTA) is the risk of renal injury in nephropathic patients. A valid alternative is represented by CO₂ angiography, which is however contraindicated in patients with chronic obstructive pulmonary disease and is not always available in hospitals. In these cases, the role of duplex guided balloon angioplasty (Du-PTA) should be reassessed.

Case presentation: We describe the case of a 75years-old nephropathic Caucasian male patient who underwent a duplex-guided percutaneous transluminal angioplasty (Du-PTA) for a 10-cm occlusion of his right femoral superficial artery causing rest pain. A review of the literature about the use of duplex ultrasound for the endovascular treatment of infrainguinal vascular disease in selected high-risk nephropathic patients was also performed.

Conclusion: In well selected patients who present with critical limb ischemia and are at high risk for contrast-induced nephropathy, and when CO₂ angiography cannot be performed, Du-PTA of femoral-popliteal district can still be a safe and effective alternative to conventional PTA and should be taken into account.

Keywords: duplex guided angioplasty, critical limb ischemia, renal failure, case report, diabetology, angiography

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Abbreviations

PTA, percutaneous transluminal angioplasty; Du-PTA, duplex-guided percutaneous transluminal angioplasty; CLI, critical limb ischemia; DSA, digital subtraction angiography; COPD, chronic obstructive pulmonary disease; SFA, superficial femoral artery; PSV, peak systolic velocity; CIN, contrast induced nephropathy; eGFR, estimated glomerular filtration rate

Introduction

Since the concept of bypass surgery using vein graft was introduced by Kunlin¹ in 1949, Vascular Surgeon's approach to steno-obstructive pathology of lower limbs has significantly changed. The cornerstone was placed in 1960, when Dotter et al.,² introduced the concept of endovascular revascularization with percutaneous transluminal angioplasty (PTA). The importance of this acquisition is evidenced by the growing space given to the endovascular approach as the first choice in many cases of infrainguinal arterial disease causing critical limb ischemia (CLI). The Consensus Document of the Italian Society of Diabetology together with the Italian Society of Radiology and the Italian Society of Vascular and Endovascular Surgery published in 2014³ underlined the role of PTA as a first line therapy, most of all in patient with diabetic lower limb ulcerations.

However one of the main concerns of this procedure is the risk of renal injury in these same patients, who often are affected by pre-existent diabetic nephropathy. In these patients, in fact, even a small amount of iodinate contrast medium can precipitate a precarious balance of the renal function, eventually leading to the need for dialysis treatment in the short to medium term.

For this reason Cluley et al.,⁴ in 1991 suggested the use of Duplex-guided Percutaneous Transluminal Angioplasty (Du-PTA) for the treatment of femoral-popliteal disease in patient with critical limb ischemia or severe disabling claudication and concomitant risk factors such as creatinine serum levels >1.5mg/dL. Another valid alternative for patients with chronic kidney disease or with a known allergy to contrast medium, is represented by CO₂ angiography, whose efficiency and effectiveness has been demonstrated in the literature to be comparable to that of conventional Digital Subtraction Angiography (DSA).⁵ However, the CO₂ angiography is relatively contraindicated in patients with chronic obstructive pulmonary disease (COPD). Moreover, it requires a special delivery system to prevent air contamination and gas compression, which is not always available in all hospitals. We describe the case of a 75years-old patient affected by COPD and diabetic nephropathy, who was successfully treated with Du-PTA for a 10-cm occlusion of his right femoral superficial artery causing CLI with rest pain. A review of the literature was also performed about the treatment of femoral-popliteal disease using Du-PTA in selected high risk patients.

Case presentation

A 75-year-old Caucasian male with CLI on his right leg was admitted at our Institute fifteen months ago. He had a clinical history of COPD at GOLD C class, renal failure (preoperative serum creatinine 4.22mg/dL) and type 2 diabetes mellitus treated with insulin. Seven and six years before he had undergone endarterectomy and stenting of his right and left internal carotid artery, respectively. He was also affected by coronary artery disease which was previously treated with a coronary artery bypass graft and afterwards with implantation

of drug eluting stent on circumflex artery for recurrent angina. The patient had been complained for right leg rest pain for 1month without ischemic ulcers or gangrene. Ultrasonography on his right leg showed the presence of a 10-cm occlusion at the mid third of superficial femoral artery (SFA) (Figure 1), with a poor distal flow which was recorded from the popliteal to the pedal artery. Both posterior tibial and peroneal arteries were occluded. On the left leg, both femoral and popliteal pulses were palpable. Transcutaneous oximetry on the first toe was 35mmHg on the right side and 58mmHg on the left side in a sitting position. The precise location of the occlusion after ultrasound mapping was marked preoperatively with a sign on the skin to facilitate the treatment in the operating room.

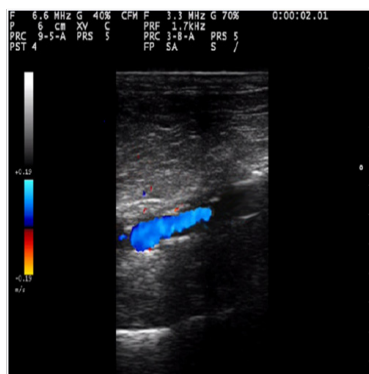


Figure 1 Preoperative color image of the lesion.

A local anesthesia (1% lidocaine) was performed at the right groin. A 7.5MHz probe of a Esaote Mylab 50-X Vision allowed the correct visualization of the common femoral artery for an ipsilateral antegrade percutaneous approach with a 5Fr sheath. A bolus of 2500IU of unfractionated heparin was administered intrarterially to have an activated clotting time of more than 200seconds, then an hydrophilic .035 inch guide wire with J tip (Terumo) and a directional 5Fr angle tapered directional catheter (Berenstein) were successfully advanced throughout the occlusion (Figure 2) and towards the infrapopliteal segment in the correct lumen, under the direct echographic visualization. The diameter of the SFA at the target lesion was measured and a 4x80mm over-the-wire balloon (Evercross, Covidien) was chosen for dilatation. Duplex control showed the complete resolution of the occlusion from the morphological point of view, without any sign of dissection or recoil and with normalization of both the peak systolic velocity (PSV) and the PSV ratio. Moreover, a direct bi-phasic flow was recorded on the pedal artery. No stent was

needed. Postoperative course was uneventful and the patient was discharged on 2nd postoperative day on acetyl salicylic acid 100mg/ daily. At 1-year follow-up the patient was still asymptomatic and a duplex ultrasound showed neither recurrent nor residual stenosis.

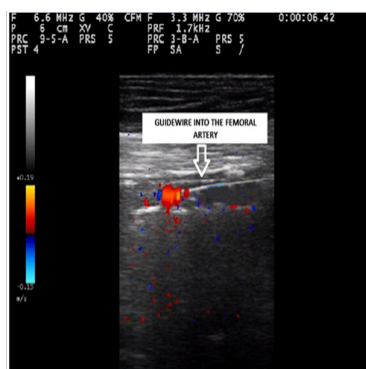


Figure 2 The hydrophilic .035 inches guide wire with J tip (Terumo) advanced throughout the occlusion in the correct lumen.

Literature review

A systematic review searching the MEDLINE, Scopus, Web of Science, ClinicalTrials.gov and Cochrane Central Register of Controlled Trials (CENTRAL) databases was also conducted using the key-words “duplex-guided angioplasty”. Nine papers published between 1996 and 2015 were analyzed for the review (Table 1), as they specifically addressed the clinical use of ultrasound as a substitute of fluoroscopy in the endovascular treatment of infrainguinal disease. Papers reporting cumulative results after duplex guided angioplasty of both suprainguinal and infrainguinal vascular disease was excluded. A total of 603 arteries⁶⁻¹⁴ (490 femoral-popliteal, 80 infrapopliteal, 33 failing infrainguinal bypass grafts) were treated using duplex-guided angioplasty with a reported technical success of 84.6%-97%. Procedural complications occurred in up to 12.5% of reported cases, being mainly not related to the use of ultrasound. In all examined cases, duplex-guided balloon angioplasty was reported to be a safe and effective technique that allowed renal patients to experience limb salvage and relief from claudication without the risk of developing dye-induced acute renal failure. Other reported advantages included direct visualization of the puncture site, accurate selection of the proper size of balloon and stent, confirmation of the adequacy of the technique also by hemodynamic parameters, and avoidance of any radiation, both for the patient and for the operators.

Table 1 Resume of literature review

Author	Year	Arteries	Technical success	Procedural complication	Primary patency	Limb survival
Ascher ⁶⁻¹¹	2005-2008	360 SFA-pop	95%	n.r.	TASC A: 90%	n.r.
		80 infra-pop	96%		TASC B: 59%	
					TASC C: 52%	
					TASC D: 46%	(at 12 mths)
Marks ¹²	2006	33 failing infrainguinal by pass grafts	97%	6%	69% at 6 mths	100% at 6 mths

Table Continued..

Ahmedi ¹³	2002	104 SFA-pop	84.60%	12.50%	60.2% at 6 mths	n.r.
Katzenschlager ¹⁴	1996	26 SFA-pop	96.10%	n.r.	80.9% at 6 mths	n.r.

SFA, superficial femoral artery; Pop, popliteal artery; n.r., not reported; mths, months

Discussion

Contrast-induced nephropathy (CIN) is a clinical condition in which an impairment of the renal function (an increase in serum creatinine by more than 25% or 44µmol/l) occurs within 3days following the intravascular administration of a iodinate contrast medium in the absence of an alternative etiology.¹⁵ The pathogenesis of CIN has not been fully elucidated yet, however association between volume of administrated contrast media and the incidence of CIN has been well demonstrated by SeeligerandColl15, who reported a risk of CIN which doubles with every 20ml of contrast administered.

Patients with pre-operative renal insufficiency with creatinine serum level >1.5mg/dL and/or diabetes mellitus have been demonstrated to be at high risk of CIN.¹⁶ Unfortunately, these same subjects most frequently are affected by peripheral vascular disease causing critical lower limb ischemia. Their comorbidities however may contribute to the choice of an endovascular, less invasive approach rather than open surgery for the treatment of their vascular disease. CIN may be prevented by preoperative volume expansion with isotonic saline infusion and sodium bicarbonate 0.84%, associated with N-Acetyl cysteine administration which has a proven antioxidant and vasodilator effects.¹⁷ Nevertheless, in some cases the risk to develop CIN remains high even if the best medical therapy is performed. In 1991 Cluley et al.,⁴ suggested the use of Du-PTA for the treatment of femoral-popliteal disease in patient with critical limb ischemia or severe disabling claudication and concomitant risk factors such as creatinine serum levels >1.5mg/dL. Since then, few cases have been reported in the literature using this technique, and the reason is probably why CO₂ angiography⁵ has been introduced too as a valid alternative to conventional DSA, being as safe and effective as DSA, maybe superior to du-PTA and avoiding the risk of any contrast media. However, the CO₂ angiography is relatively contraindicated in patients with COPD. Moreover, it requires a special delivery system to prevent air contamination and gas compression, which is not always available in all hospitals. When CO₂ angiography cannot be performed, Du-PTA must be taken into account as a valid alternative to conventional DSA. In our Institution, we don't have the special delivery system for CO₂ angiography. Moreover, the patient was affected by COPD which relatively contraindicated the use of CO₂, so duplex-guided angioplasty was the preferred choice. The most representative case-series of Du-PTA have been reported by Asher et al.,⁶⁻¹¹ who treated 360 cases of occlusive and stenotic lesions of the femoral-popliteal segment and 80 cases at the infrapopliteal segment from September 2003 to June 2005 with du-PTA, with an overall technical success rate of 95% and 96% respectively. Stents were also placed when needed, without any problems. The same Authors¹² published in 2006 a series of 25 patients treated with du-PTA for primary assisted patency of failing infrainguinal femoral-popliteal by passes, with a technical success in 97% of the cases. Limb salvage and primary patency rate at 6 month were 100% and 69% respectively.

Du-PTA has been reported also for the treatment of iliac lesions in highly selected cases. In 2010 Kawarada¹⁸ reported two cases of du-PTA in the iliac artery in patients with chronic renal insufficiency

at high risk for developing CIN. Krasznai et al.,¹⁹ resumed that experience in a series of 35 patients with iliac lesions and an estimated Glomerular Filtration Rate (eGFR) <60ml/min/1.73m² or allergy for contrast media. Treatment of iliac lesions however may be hampered by the difficult visualization of the lesions with the ultrasound in a hostile abdomen. The advantage of the echo guided intervention is the real time monitoring of the procedure, from the correct location of the antegrade arterial puncture to the guide wire progression toward the central lumen and possibly in the intraluminal way. Balloon diameter and length can also be chosen according to the arterial measurements obtained by duplex guidance. Moreover, the immediate postoperative results can be assessed not only by morphology but also from the hemodynamic point of view. On the other side, the depth of the localization may hamper visualization of the superficial femoral artery at the adductor hiatus. Moreover, highly calcified plaques may also affect the correct visualization of the lesion.

Conclusion

In well selected patients who present with critical limb ischemia and are at high risk for CIN and when CO₂ angiography cannot be performed, Du-PTA of femoral-popliteal district can still be a safe and effective alternative to conventional PTA and should be taken into account. Du-PTA has the advantage of direct visualization of the percutaneous access site, accurate selection of the proper size of the devices balloon and stent and confirmation of the efficacy of the technique by both hemodynamic and morphologic parameters, without the risk of iodinate contrast material exposure.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Authors' contribution

Each Author has contributed substantially to the research, preparation and production of the paper and approves of its submission to the Journal.

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None.

Conflict of interest

The author declares no conflict of interest.

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