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 concerns 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 75 years-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 for the endovascular treatment of infragenual 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

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 infragenual 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 75 years-old patient affected by COPD and diabetic nephropathy, who was successfully treated with Da-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 1 month 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 200 seconds, 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-phase 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 arteries (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

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

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 3 days following the intravascular administration of a iodinate contrast medium in the absence of an alternative etiology. 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 Seeler and Coll.,[15] 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 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 angiography[5] 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 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 lesion by both hemodynamic and morphologic parameters, and effective alternative to conventional PTA and should be taken into account. Du-PTA has the advantage of direct visualization of the lesion by both hemodynamic and morphologic parameters, concomitant use of iodinate contrast material exposure.

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.

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.

References

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