VIA MEDICA

CASE REPORT

Acta Angiol
Vol. 28, No. 4, pp. 166–170
DOI: 10.5603/AA.2022.0016

ISSN 1234–950X
e-ISSN 1644–3276

Severe acute kidney injury after pharmacomechanical thrombectomy for acute limb ischemia

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Abstract

Pharmacomechanical thrombectomy (PMT) with AngioJet (AJ) catheter is one of the most efficacious endovascular techniques for rapidly removing clots and thrombi from occluded vessels. It has a high technical success rate but at the cost of hemolysis which may lead to renal damage. Such a complication after AJ has been published but is still underreported in the literature. In this report, a case of a 68-year-old male patient with acute limb ischemia (ALI) and severe acute kidney injury (AKI) developed after the use of catheter-directed thrombolysis (CDT) and PMT AJ has been presented.

Key words: acute kidney injury; pharmacomechanical thrombectomy; angiojet; catheter-directed thrombolysis; acute limb ischemia

Acta Angiol 2022; 28, 4: 166–170

Introduction

Acute limb ischemia (ALI) is defined as a sudden decrease in limb perfusion that threatens its viability. This state requires urgent recognition with prompt revascularization to preserve the limb [1]. Endovascular therapy with CDT and PMT is widely used in the treatment of ALI. The AJ device is considered to be a fast and effective technique which may rapidly restore blood flow. The technical success rates of AJ range from 56 to 95% and primary patency rates from 68 to 58% at 1 and 3 years, respectively [2–4]. Over the last few years after AJ usage the increased risk of AKI has been noticed [5–7].

Hereby, the case report of severe renal failure, occurring after CDT and AJ use in ALI patient has been presented.

Case report

A 68-year-old male was admitted to our institution due to severe symptoms of ALI such as pain, paresthesia, paralysis, and pallor. These symptoms occurred after the previous one-week rest pain. In addition, his past medical history also included atrial fibrillation, diabetes mellitus, and arterial hypertension. He recovered from a stroke 8 years ago and denied any impairment of renal function in the past. The patient did not comply with the recommended treatment for his medical conditions. During the physical examination, the patient's lower right limb was cold with a pulse present only in the groin. Moderate sensory and motor deficit was found. Duplex scanning revealed thrombosed superficial femoral (SFA) and popliteal arteries (PA) with atherosclerotic changes. Rutherford class IIb of ALI was stated.

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Endovascular treatment

The patient was qualified for endovascular treatment. The intraoperative initial angiography revealed a completely occluded distal part of SFA with a significant amount of thrombi and a trace of flow in PA (Fig. 1 A, B). Occluded arteries were crossed via antegrade puncture of the common femoral artery with Laureate guidewire 0.035, and CDT Fountain catheter was placed inside the thrombus and lytic therapy with low-dose alteplase infusion (1.0 mg/h) was initiated. Control angiography was performed 24 hours later and showed a patent distal part of SFA; however, the arterial lumen was narrowed by atherosclerotic plaques. The blood flow in PA had improved but the artery was still filled with many thrombi (Fig. 2 A).

Given the situation, first, a self-expanding stent (Complete 8 x 150 mm) was implanted into the distal SFA. A bigger-than-usual size of the stent was chosen because the arteries were wider in diameter, even though both SFA and PA did not fulfill the criteria for an aneurysm (Fig. 2 B). As a next step, the residual thrombotic changes in PA were removed with a 6F AngioJet, Solent Omni catheter. Thrombi inside PA were forcefully pulsed from the catheter with 10 mg of tPA using the Power Pulse technique. After 20 minutes, the traditional mechanical thrombectomy of this artery was performed with the same catheter. The total duration of the mechanical thrombectomy did not exceed 4 minutes, as stated in the manual of the device. Completion angiography showed a good flow through the stent and a total recanalization of PA (Fig. 3).

Postprocedural period

Despite good hydration status (blood pressure, heart rate, hour urine collection, hemoglobin, HCT hematocrit, MCV — mean corpuscular volume, MCHC mean corpuscular hemoglobin concentration — values were normal) immediately after the procedure patient's urine became strongly „bloody" in appearance. During several hours the urine output decreased and creatinine level steadily started to elevate. Comparing HCT values between admission day and early postprocedural period a significant decrease was noted, from 51.0% to 33.1%. Stage III of AKI was diagnosed. The following day after the procedure patient presented oliguria and acidosis, the serum creatinine level continued to rise and the HCT value dropped to 25.4%. Hemodialysis, intensive insulinotherapy, and antihypertensive treatment were initiated. Worthy of note was an insignificant increase of plasma creatinine kinase (CK) to 2617 U/l level on the day of the procedure when the blood flow was restored. The next day CK dropped to 1240 U/l.

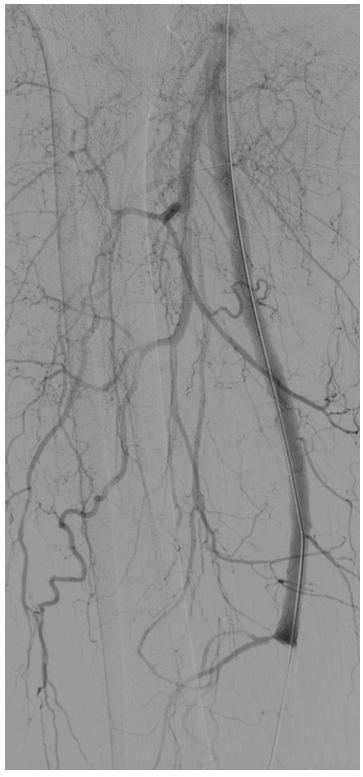

Figure 1 A. Primary angiography. The distal part of SFA is occluded

Figure 1 B. PA and its tripartite division are filled with numerous thrombi

Hemodialysis was discontinued after 3 weeks. During this period the highest level of creatinine was 8.18 mg/dl and the lowest creatinine clearance (CrCl) was 7 ml/min. After the dialysis treatment serum, creatinine level dropped to 2.01 mg/dl and CrCl elevated to 33 ml/min. The patient's urine output increased notably.

After the endovascular treatment of acute ischemia of the leg in our patient, the blood supply has improved markedly. The limb was warm with good motor function and without sensory disturbances.

Discussion

The PMT by means of AngioJet is one of the most efficacious endovascular techniques currently available for the fast removal of clots and thrombi from occluded vessels [1, 2]. It can be used alone or together with CDT. The AngioJet mode of action is well known and is based on the Bernoulli principle. Unfortunately, this process often results in mechanical damage and the lysis of red blood cells. Hemolysis following AngioJet usually causes hematuria which may lead to postprocedural AKI [3, 4].

In our case hematuria appeared at the end of the procedure and shortly after AKI was diagnosed with the requirement for further dialytic therapy which was maintained for 3 weeks. Such types of complications have been published previously. A case study, published by Dukkipati et al., reports on a 43-year-old female with 8-week intrauterine pregnancy and pulmonary embolism. The patient underwent a thrombectomy of the right pulmonary artery using the AngioJet device. AKI has been developed after the procedure and lasted for more than 3 weeks [5]. The other case, described by Arslan et al., reports the AKI complication after the use of the PMT AngioJet device in a young patient with extensive VCI and iliac vein thrombosis. Renal function returned to normal after 20 days [6].

Other published studies also indicate complications such as hemolysis, hematuria and AKI after PMT AngioJet. Escobar et al. analyzed their material which consisted of 102 patients treated with PMT AngioJet and CDT. AKI was developed in 29% of the AngioJet group vs 8% of the CDT group, $p = 0.007$. PMT AngioJet remained a significant risk factor for developing AKI, with an OR > 8 [7]. The PEARL registry assessing 283 patients with acute leg ischemia treated with AngioJet showed AKI complications requiring dialysis in 5% [8].

As mentioned above in our patient AKI was developed after CDT and PMT/power pulse tPA. Morrow et al. assessed 145 patients treated with different combinations of PMT and CDT. In the group with PMT/

Figure 2 A. Angiography of SFA and PA after 24 hours of CDT. The distal part of SFA is recanalized but parietal thrombi are present

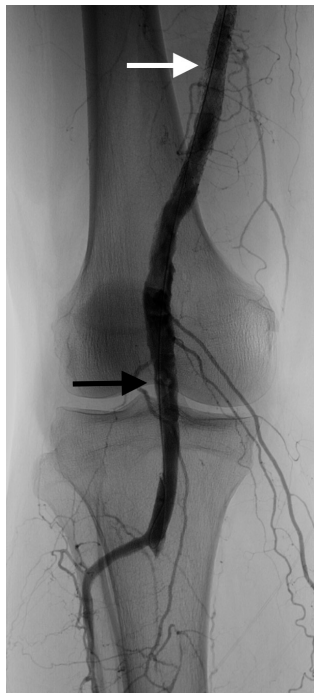

Figure 2 B. SFA with implanted self-expending stent Complete 8 x 150 mm (white arrow) and PA with thrombi (black arrow) before PMT AngioJet procedure

Figure 3. Final angiography after PMT AngioJet procedure. Patent PA and ATA. Thrombi are almost completely removed and contrast agent saturation is more intense

/power pulse tPA and CDT, the occurrence of AKI was 14%. The authors noted a higher incidence of AKI in the group of PMT with or without power pulse tPA, 21% and 20% respectively. Renal complications were not observed in the CDT group [9].

In the same study authors also found that AKI more frequently occurred in patients with diabetes (41% vs 19%, p = 0.02), cardiac arrhythmia (23% vs 6%, p = 0.007), arterial hypertension (82% vs 47%, p = 0.002) and malignant disease (45% vs 24%, p = 0.033) [9]. Salem et al. noted that AKI besides diabetes and arterial hypertension appeared more often in patients with coronary artery disease (23.1% vs 4.7%, p = 0.002) and dyslipidemia (42.3% vs 17.9%, p = 0.008). In our patient three of the above comorbidities were present which is in agreement with these observations [10].

HCT drop after the usage of the AngioJet device is an important marker of hemolysis. In our case, 60% decrease from its baseline was noted. HCT drop was taken into account by other authors. Escobar et al. in their material have found that after the PMT AngioJet procedure HCT drop of at least 10% significantly increased the risk of AKI. In a Chinese study, Shen et al. concluded that HCT drop > 14% from baseline after PMT AngioJet was an independent risk factor of AKI (OR 2.73; 95%, 1.08–6.87; p = 0.03) [11].

The heme degradation may cause AKI through three mechanisms. Firstly — decrease perfusion of the kidney, secondly – reveal cytotoxic effects and thirdly — together with Tamm-Horsfall protein form intratubular casts. A high concentration of free heme leads to considerable cytotoxicity by dyslipidemia, activation of enzymes that destroy cells (cathepsins), and degradation of DNA and mitochondria. As a result of the pro-inflammatory effect of heme, increased expression of MCP-1 (monocyte chemoattractant protein) can contribute to tubulointerstitial disease. In the setting of microangiopathic hemolysis, thrombotic changes in capillaries were observed [12, 13].

In our patient, the period of ischemia lasted for 7 days and the appearance of reperfusion injury could contribute to AKI. After the blood restoration enhanced muscle tension was not seen, but some degree of rhabdomyolysis could potentially release myoglobin into the bloodstream. It is commonly known that myoglobin is easily filtered through the renal glomeruli. Water is reabsorbed in the tubules and elevated concentration of myoglobin causes obstructive cast formation. This process may be accelerated by dehydration and renal vasoconstriction, which decrease glomerular filtration and induce AKI [14]. We consider that in our patient muscle damage due to ischemia and further reperfusion injury was not remarkable. Following the revascularization, the increase of CK was not significant and decreased by 50% on the next day. CK seems to be a valuable marker to assess limb salvage due to ALI because its PPV (positive predictive value) accounts for 50% [15].

Based on the clinical picture and Duplex-scanning of our patient the ALI of Rutherford class IIb was diagnosed with the threatened limb. The successful, immediate revascularization with CDT and PMT using AngioJet was performed although several reports and ESVS Guidelines on the management of ALI in class IIb recommend this treatment only as acceptable and the surgical repair should remain preferred [1, 2, 16–18]. In our case, endovascular treatment was employed because of numerous patient comorbidities and the common knowledge that mortality and cardiac complications are significantly less frequent after a minimally invasive approach [19, 20]. The final result was beneficial for our patient with restored inflow and preserved lower limb.

Our case strongly confirms previous observations that AKI may develop after PMT by use of AngioJet and that hemolysis, as well as hematuria, are unavoidable with various intensities when this technique is employed. Thus, each patient should be qualified for such a treatment sensibly and should always be informed about possible renal complications. Appropriate hydration before and after PMT with AngioJet may allow avoiding possible renal failure. However, despite the good hydration status of our patient before the procedure, severe renal impairment occurred. As mentioned above existing diabetes, cardiac arrhythmia, arterial hypertension and HCT drop > 14% may raise the risk of postprocedural AKI [9, 11].

Conflict of interest

None.

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