Outcome of percutaneous transluminal angioplasty for subacute lower limb ischemia

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Context
Management of acute limb ischemia (<14 days) has been studied in a number of prospective randomized trials, and endovascular techniques, especially thrombolysis, in high-risk patients were found to be superior than open surgery. However, owing to the better results observed in patients presenting with subacute ischemia (14 days to 3 months) treated with surgery coupled with the associated complications of thrombolysis, surgery has been the recommended treatment for these patients. Patients who present with subacute ischemia have not been well recognized in the literature.
Aim
The aim of this study was to evaluate the clinical and hemodynamic outcome of percutaneous transluminal angioplasty for subacute lower limb ischemia.
Settings and design
A total of 22 limbs that presented with subacute leg ischemia admitted to Alexandria Main University Hospital have been studied prospectively. All patients had femoro-popliteal occlusions shown by multislice computed tomographic angiography and severe leg ischemic pain +/– crippling claudication. Patients with acute leg ischemia or extensive foot necrosis necessitating amputation were excluded from the study.
Patients and methods
All patients were subjected to ankle-brachial index (ABI) measurement, color duplex ultrasound (CDU) scan, and multislice computed tomographic angiography before intervention. Percutaneous transluminal angioplasty (balloon angioplasty +/– stent deployment) was performed for all participants. Clinical follow-up with ABI measurement was done at 1-, 3-, and 6-month intervals. CDU after 6 months for patency and restenosis was performed.
Statistical analysis
Statistical Package for the Social Sciences, version 15.0 was used. Values were compared with a paired samples *t* test. *P* values less than 0.05 were considered significant.
Results
Mean follow-up period was 6.2 months. The mean (±SD) ABI before and at 1-, 3-, and 6-month interval was 0.4 (±0.2), 0.53 (±0.11), 0.62 (±0.12), and 0.86 (±0.16), respectively, with *P* value less than 0.0001. Limb salvage rate for those patients who had constant ischemic pain and had primary technical success was 89%. As for those patients who had severe claudication, at 6-month follow-up, they had no complaint. Primary patency rate by CDU was 95%.
Conclusions
Balloon angioplasty is a safe and effective tool for management of subacute leg ischemia. It avoids high surgical risks and carries promising patency and limb salvage rates.

Keywords:
percutaneous transluminal angioplasty, plain old balloon angioplasty, subacute ischemia

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Introduction

Management of acute limb ischemia has been studied in a number of prospective randomized trials [1–3], and endovascular techniques, especially thrombolysis, were found to be associated with reduced need for open interventions [3], decreased amputation rates [2], and decreased mortality [1] when compared with surgery as the initial treatment in patients with less than 14 days (acute) of limb ischemia. However, owing to the better results observed in patients presenting with subacute ischemia (from 14 days to 3 months) treated with surgery coupled with the associated complications of thrombolysis [2], surgery has been the recommended treatment for patients with subacute ischemia. Following the increased adoption of endovascular

interventions, complex lesions with occlusions have been increasingly treated by endovascular means, especially in higher risk patients with significant comorbidities who cannot tolerate the recommended bypass procedures [4–7]. Although surgery can be performed in good-risk patients, most patients are in the higher risk category, and endovascular recanalization of these lesions with least harm to the patient (embolization, bleeding, acceptable patency) is preferred by many interventionalists.

Clinical presentation and classification of patients with symptomatic subacute limb ischemia is very different than acute limb ischemia. Patients with acute limb ischemia are grouped into Rutherford classes I–VI, which mainly focuses on the immediate viability of the limb [8]. The decision to intervene in subacute ischemia is usually based on the level of symptoms, and the optimum treatment modality is recommended to be based on the severity of the lesion characteristics, with more complex diseases being treated by surgical means and less complex occlusions and stenoses by endovascular means [9,10].

The time frame used to define the acute versus subacute versus chronic has varied depending on the study. The 14-day cutoff between acute versus subacute has been largely adopted after the STILE trial (Surgery versus Thrombolysis for Ischemia of the Lower Extremity) [2], which also formed the basis of patient inclusion in the TOPAS (Thrombolysis or Peripheral Arterial Surgery) trial [3], which used the 14-day cutoff to only include the 'acute' cases. Ironically, the Rochester Trial [1] used 7 days as the cutoff point, and Wholey *et al.* [11] chose more than 14 days and less than 3 months as subacute.

In reality, these cutoff time points are all arbitrary, and development of chronic limb ischemia is likely a gradual process. Patients who present late with acute leg ischemia, from 2 weeks to 3 months after the event (subacute), have not been well recognized in the literature. At this age of the blood clot, its consistency is not soft anymore to allow successful thrombolysis or embolectomy, and at the same time, not well organized to allow early endovascular angioplasty. The aim of this study is to evaluate the clinical and hemodynamic outcome of percutaneous transluminal angioplasty for subacute lower limb ischemia presenting between 2 weeks to 3 months.

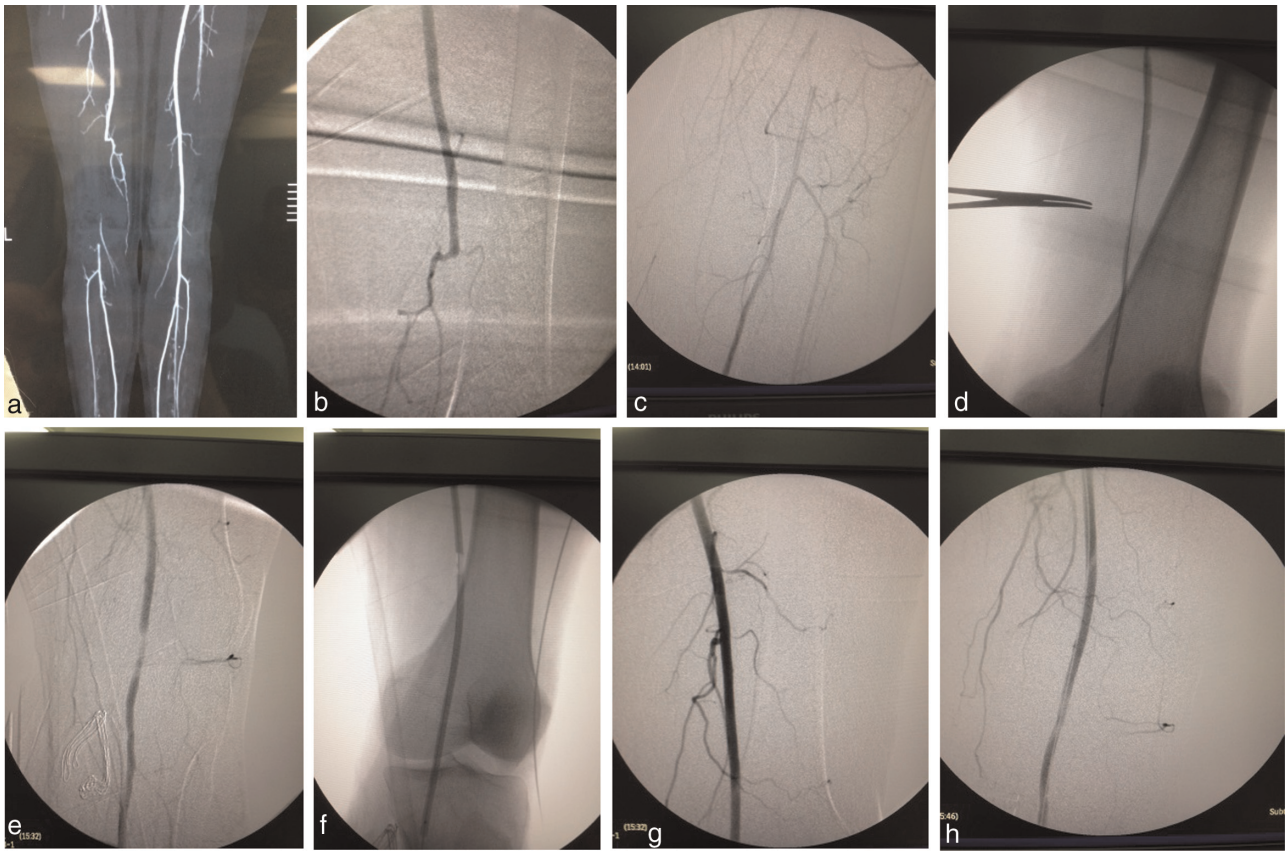
Patients and methods

Patients with subacute leg ischemia admitted to the ward of the Vascular Surgery Unit at the Main University Hospital, Alexandria University participated in this study. A total of 22 limbs have been studied prospectively. Patient selection depended upon clinical examination, laboratory investigations, color duplex ultrasound (CDU), and multislice computed tomographic angiography (MCTA). All patients had subacute lower limb ischemia (>2 weeks to <3 months) with femoro-popliteal occlusions shown by MCTA. All patients had either severe leg ischemic pain and/or crippling claudication. Patients with acute leg ischemia or extensive foot necrosis necessitating amputation were excluded from the study.

All patients were subjected to history taking including the grade of ischemia. Thorough clinical examination was done for all patients including distal pulsation and ankle-brachial index (ABI) measurement. All participants had a CDU scan to demonstrate the extent and age of the clot (degree of echogenicity). All patients had a MCTA before intervention.

All procedures were done under totally aseptic conditions, mostly under regional or general anesthesia. Under a mobile C-arm machine, the vascular access was through either femoral or brachial artery approach depending on the anatomical distribution of the disease. Modified Seldinger technique [12] was done for all vascular access percutaneously. Upon vascular access, lesions were crossed with a 0.035 or 0.014-inch steerable guide wires solely or with a support catheter or a balloon catheter. After lesion crossing, the stenoses were dilated with a balloon. Depending on the arterial distribution, angioplasty result, flow characteristics, and presence or absence of flow dissection, lesions were occasionally stented. However, as for occlusions that were impossible to be traversed by the aforementioned technique, more aggressive measures were applied. Either 0.035-inch stiff wire or 0.014-inch extra support coronary wire was employed for lesion crossing. These wires were introduced alone or over dedicated stiff support catheter (e.g. Terumo Glidecath TM, Spectrasestics Quick corss TM, TrailBlazer TM). These lesions were often traversed in the subintimal space, with reentry into the true lumen at the distal end of the occlusion. After lesion crossing and confirmation that the distal wire is intraluminal, balloon angioplasty +/– stent deployment was done [13]. Figure 1 shows the steps for percutaneous transluminal angioplasty of distal superficial femoral artery (SFA) and popliteal subacute thrombosis.

Figure 1



(a) CTA reconstruction. (b) DSA showing thrombus in distal SFA. (c) Distal runoff at popliteal artery. (d) POBA. (e) Residual subacute thrombus in P2. (f) Redilatation. (g) Final completion angiography P1. (h) Final completion angiography P2. DSA, digital subtraction angiography; POBA, plain old balloon angioplasty; SFA, superficial femoral artery.

Follow-up

Clinical follow-up with ABI measurement was done at 1-, 3-, and 6-month intervals. CDU after 6 months for patency and restenosis was performed.

End points

Primary end points

Technical failure was defined as the inability to cross the lesion with a guide wire. This led to termination of the procedure and was considered an immediate clinical and anatomic failure [14].

Immediate anatomic success was defined as leaving a residual stenosis more than 30% at the completion of the procedure. A residual stenosis more than 30% or flow-limiting dissection successfully treated with immediate stent deployment was not considered an immediate anatomic failure.

Secondary end points

After day 1, ABI increased by more than 0.15 [15]. After 3 months, clinical success was defined as improvement in walking distance that is greater than 50% in claudicants, resolution of ischemic rest pain, or limb salvage in patients with tissue loss. After 6 months, clinical, ABI, and CDU were assessed.

Results

Patient population

A total of 22 patients who presented with subacute lower limb ischemia were included in the study. There were 18 males [82% (18/22)] and four females [18% (4/22)]. The mean age (±SD) was 65.4±8.8 years. Table 1 shows the relevant risk factors and comorbidities. Overall, 40% of patients were diabetics, 57% were hypertensive, and 78% were either smokers or ex-smokers.

All patients had unilateral lower limb ischemia. A total of 20 patients [91% (20/22)] had constant ischemic rest pain and two patients [9% (2/22)] had crippling claudication. Ten patients [45% (10/22)] had a previous vascular intervention in the same limb being treated in the study, all of which were endovascular revascularization. The mean ABI was 0.4±0.2.

All patients had a preoperative CDU and CTA done, of which 19 [86% (19/22)] had SFA occlusion and three [14% (3/22)] had popliteal occlusion.

Table 1 Basic demographic data, risk factors, and comorbidities

	n (%)
Sex	
Male	18 (81.8)
Female	4 (18.2)
Age	
Range	52–73
Mean±SD	62.9±6.6
Risk factors	
Diabetes mellitus	9 (41)
Hypertension	13 (59)
Dyslipidemia	2 (9)
Coronary artery disease	8 (36)
Atrial fibrillation	3 (14)
Chest disease	2 (9)
Smoking	
Smoker	10 (45)
Nonsmoker	5 (22)
Ex-smoker	7 (32)

Intervention

All patients had unilateral interventions, and all except two [91% (2/22)] had femoral artery as the site for vascular access, whereas the rest had brachial artery approach. Technical success was 95% (21/22) among all patients. In only one case the guide wire did not pass the lesion because of heavy calcification and hard thrombus, and this was considered an immediate anatomical failure of the procedure. Overall, 95% (20/22) of the patients had their lesions crossed in an antegrade fashion, whereas one patient had a retrograde approach done. In 15 patients [71% (15/21)], the guide wire passed intraluminal; however, in six cases [20% (6/21)], the guide wire passed subintimal, denoted by the loop made by the distal end of the wire. No reentry devices were used. All patients had plain old balloon angioplasty (POBA) done primarily. Figure 2 shows a short segment of SFA at the adductor canal with subacute thrombosis. Three patients [14% (3/21)] had stents deployed secondary to recoil, flow-limiting dissection, or more than 30% residual stenosis. No waist in the balloon upon inflation was demonstrated in seven patients [33% (7/21)]; however, the rest [67% (14/21)] showed evident waist during inflation, denoting thrombosis on top of chronic atherosclerotic lesions. The mean occlusion length was 13.6±4.5 cm. Two patients [10% (2/21)] had distal embolization shown on completion angiography: one into the peroneal artery, who was left untreated because of patent other tibial vessels, whereas the other had trash foot, who was managed by anticoagulation and prostaglandins.

Follow-up

Mean follow-up period was 6.2 months. Figure 3 is a box plot showing the changes in the ABI during the period of the study. The mean ABI (±SD) before and at 1-, 3- and 6-month interval was 0.4 (±0.2), 0.53 (±0.11), 0.62 (±0.12), and 0.86(±0.16), respectively (mean change 0.3). This was clinically and statistically significant ($P<0.0001$).

Limb salvage rate for those patients who had constant ischemic pain and had primary technical success was 89% (17/19), where they had complete resolution of the pain at 6 months. Two patients [11% (2/19)] had recurrence of the ischemic pain in less than 2 weeks of the intervention. Those two patients and the one who had immediate anatomic failure were treated afterward using bypass revascularization procedures and were not followed up by CDU as per the study protocol. As for those patients who had severe claudication, at 6-month follow-up, they had no complaint.

During follow-up, all 19 patients who had immediate anatomic success and did not need a bypass procedure had postoperative duplex after 6 months of intervention. The primary patency rate was 95%. Only one patient has reocclusion of his SFA diseased segment, but because his ischemic pain had resolved, and he was not offered any intervention for the interim.

Complications

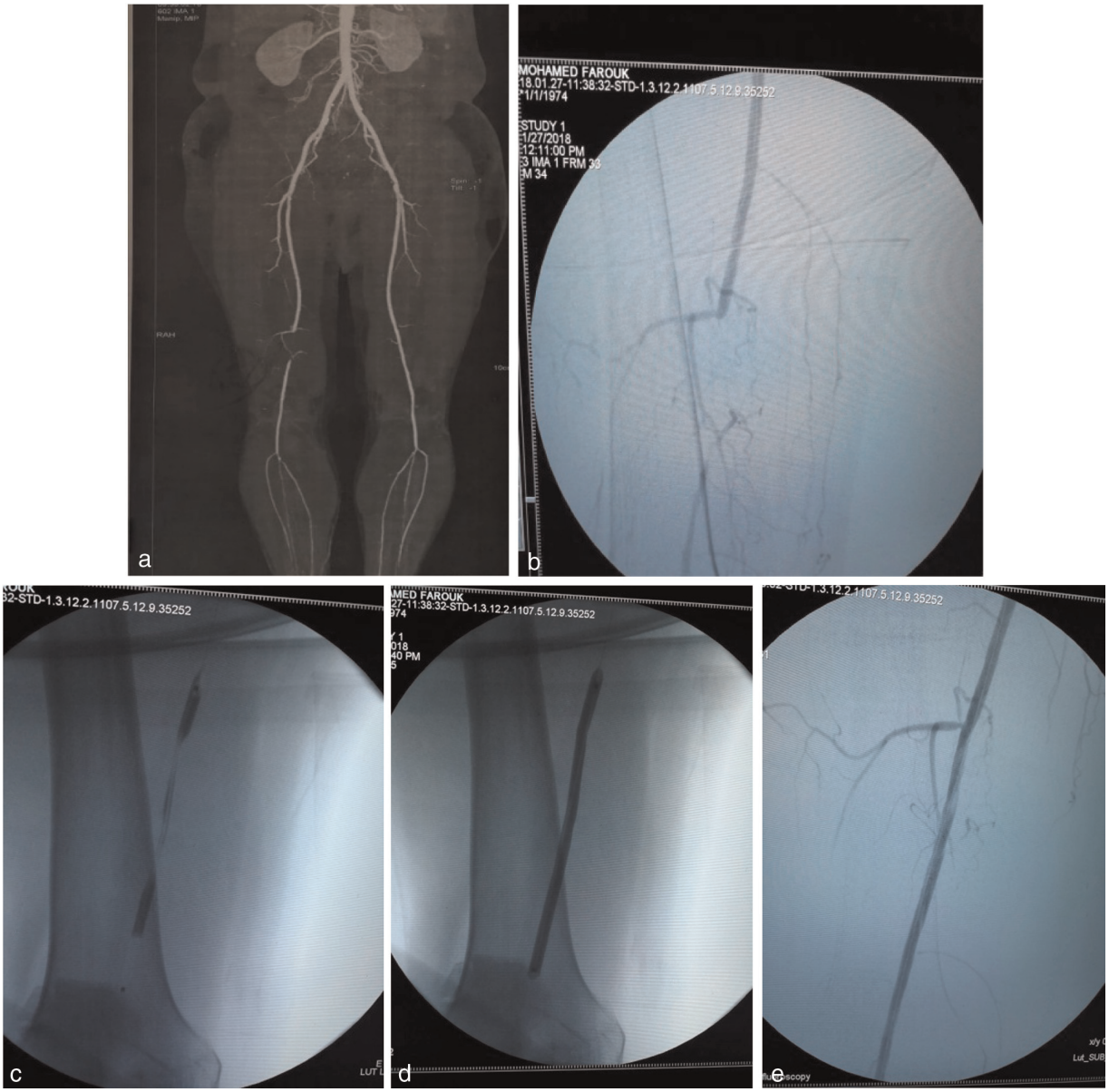
Perioperative morbidities are listed in Table 2. The 30-day mortality rate was 0%. Overall, 81% (18/22) of patients did not experience any complications. None of the complications were systemic. Two patients [9% (2/22)] had postoperative groin hematomas and one patient [5% (1/22)] had a groin seroma; they were all managed conservatively. Two patients [9% (2/22)] had distal embolization. One patient [5% (1/22)] had postoperative reocclusion of the SFA arterial segment angioplastied.

Discussion

POBA with selective stenting is an effective means of management of subacute femoro-popliteal occlusion with excellent short-term patency rate (95%). As for claudicant patients, this technique has proved successful in eliminating claudication for at least 6 months. Regarding patients with constant ischemic pain, limb salvage rate was 89% after 6 months.

The small number of patients (22) has been a limiting factor. A larger sample size would have made the results more comprehensive and reliable. A good number of

Figure 2

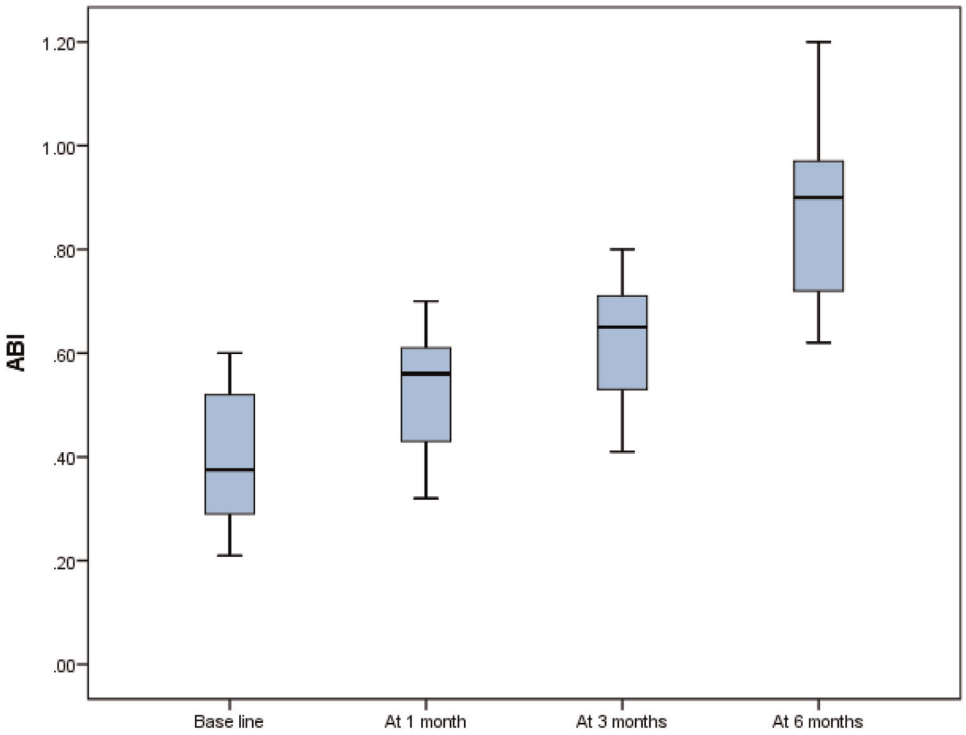


(a) CTA subacute thrombosis at adductor canal. (b) DSA picture. (c) Balloon inflated, with evident waist. (d) Balloon fully inflated. (e) Completion angiography.

patients with critical limb ischemia – who were excluded from the study – were believed to have some degree of subacute thrombosis. Based on our results, we may suggest that those patients with critical limb ischemia whose CDU reveals subacute thrombosis can be managed by POBA only without the need for adjunctive thrombolysis or endovascular thrombectomy devices.

When reviewing the literature, one would recognize that most vascular interventionists have combined adjunctive thrombolysis or endovascular thrombectomy devices before angioplasty when dealing with subacute thrombosis. Dosluoglu *et al.* [16] have prospectively studied 16 patients with popliteal subacute occlusions presenting with chronic leg ischemia manifestations. They performed rheolytic thrombectomy and angioplasty with optional stenting. Their 1-year primary and secondary patency rates were 84 and 92%, respectively. The 1-year limb salvage rate was 83%. It is obvious from this study that their study group included patients with chronic ischemia, contrary to our study protocol, which included those with subacute ischemia only. This was based on their observation that many patients with popliteal artery occlusion harbor varying degrees of organized clot, as suggested by rapid and easy passage of wire through the lesion.

Figure 3



Box plot showing the changes in ABI after 1, 3, and 6 months of intervention. The bold lines denote the mean and the boxes in blue show the range of ABI. ABI, ankle-brachial index.

Table 2 Perioperative morbidities related to the interventions

Complications	*n* (%)
Death	0
Groin hematoma	2 (9)
Groin seroma	1 (5)
Distal embolization	2 (9)
Reocclusion	1 (5)

Kasirajan *et al*. [17] evaluated the use of percutaneous mechanical thrombectomy catheter (Angiojet) as an initial treatment for acute (<2 weeks) and subacute (2 weeks to 4 months) arterial occlusion. They studied 86 patients retrospectively. The need for adjuvant thrombolysis was crucial in 58% of patients. Success was more likely in the setting of in situ thrombosis, with 90% procedure success rate, compared with embolic occlusion, which showed 60%. Their primary patency rate after 6 months was 79%. Because POBA is not accepted as a primary treatment for acute thrombosis, our study, in contrary to Kasirajan *et al.* [17] group, excluded these category of patients.

We hope that the results of this study encourage vascular interventionists to adopt low-risk endovascular procedures in treating patients with subacute leg ischemia, who would otherwise be treated with open surgical procedures with the added risks and complications.

We believe that more comprehensive work is needed in this area. A bigger sample will definitely produce more countable data. Furthermore, comparative analysis between POBA and open surgery in the context of subacute ischemia will yield more evidence-based data and help in establishing guidelines.

Lastly, a study that would evaluate a means of measuring thrombus load in an arterial segment will certainly aid vascular surgeons in the decision making when dealing with subacute leg ischemia.

Conclusion

In conclusion, POBA is a safe and effective tool for management of subacute leg ischemia. It avoids high surgical risks and carries promising patency and limb salvage rates.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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