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Original Article

Endovascular Approach to Combined Ipsilateral Supra-inguinal and Infra-inguinal Artery Stenosis through a Single Common Puncture in a Single Sitting: Technique and Follow-Up

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ABSTRACT

Background: Significant stenosis in both supra-inguinal and infra-inguinal arteries can be seen in a single given patient. When both are diseased, crossover technique from opposite femoral arteries or upper limb approach is the preferred technique. However, lot of anatomical factors can affect reaching the area from opposite femoral artery or upper limb. The purpose of this study is to determine the safety, efficacy, mid-term clinical and radiological outcome of the endovascular treatment using retrograde and antegrade femoral artery approach in those patients who have significant stenosis of both supra and infra inguinal arteries, from a single ipsilateral common femoral artery puncture. **Materials and Methods:** Between 2015 and 2017, we performed angioplasty to lower limb arteries for 73 patients at our centre. Among them 17 patients had significant stenosis of ipsilateral supra and infra-inguinal arteries. 12 patients underwent ipsilateral retrograde femoral artery puncture to access iliac arteries under fluoroscopy guidance, followed by converting the same puncture into antegrade approach to tackle superficial femoral artery or popliteal artery. Rest of the 5 patients, had alternative approaches (left upper limb or contralateral femoral artery) because of the involvement of ipsilateral femoral artery at the puncture site. **Results:** Acute success rate was 100%. There were no significant peri-procedure complications. At the latest clinical follow-up (mean of 21.25 months), a restenosis rate of 16.67% in infra-inguinal arteries and none in supra-inguinal arteries. **Conclusion:** Percutaneous retrograde femoral artery puncture and converting the same puncture into antegrade approach, to high-grade combined ipsilateral supra-inguinal and infra-inguinal artery stenosis is a viable, reasonably safer, one of the options to contralateral cross over or upper limb approach, with good midterm clinical results and patency rates.

Key words: Percutaneous trans-arterial angioplasty, Supra-inguinal arteries, Infra-inguinal arteries, Common femoral artery, Superficial femoral artery.

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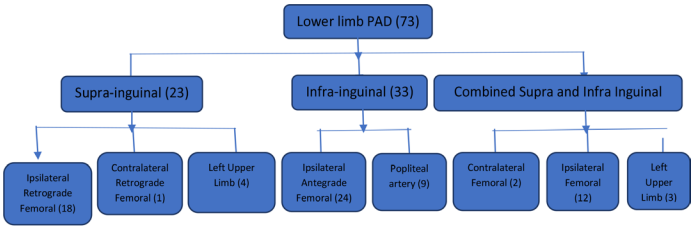
INTRODUCTION

Angioplasty with or without stent placement is a treatment of choice for symptomatic supra-inguinal (iliac) and infra-inguinal (superficial femoral, popliteal)[1] artery stenosis or occlusions. Multiple approaches, from ipsilateral common femoral artery (CFA), crossover from the contralateral CFA and upper limb artery approach have been described for the access to and endovascular treatment of supra-inguinal and infra-inguinal arteries.[2-3] The ipsilateral approach has the advantage of permitting the use of shorter tools and additional support for manipulating catheters and guidewires.[2] Its main drawbacks are the more demanding technical skills required for percutaneous puncture of the CFA and the potential difficulties of entering the superficial femoral artery (SFA), avoiding its origin. Ultrasound guided or fluoroscopy guided puncture may help to increase the success rate, especially in obese patients.[2,4] When both iliac arteries and superficial femoral arteries are diseased, contralateral crossover or upper limb artery approach is preferred.[3] Narrow aortic bifurcation angle, concentric or eccentric calcific plaque at the bifurcation, significant stenosis at the bifurcation may discourage entry of hardware's from opposite femoral artery approach.[3] The use of longer devices within tortuous iliac arteries may prove a major inconvenience for a correct navigation and deployment of larger devices. Upper limb artery approach may have its own disadvantages, radial artery won't accept bigger sheaths which are required for larger peripheral artery balloons or stents.[2] It may go into spasm. Brachial artery or axillary artery approach may have higher local access site complications like bleeding, hematoma, nerve compression and limb ischemia. If the lesions are below popliteal artery, the length of the hardware's may not be sufficient enough to reach the lesion site.[2] In this study, an alternative method, retrograde access (direction of puncture is towards the head of the patient, against the blood flow) to the ipsilateral iliac artery (supra-inguinal) followed by conversion of the same puncture site into an antegrade approach (direction of puncture is towards the foot of the patient, along the blood flow) to infra-inguinal arteries, is described. Its indications, advantages and drawbacks are analyzed, based on the experience in a short series of patients.

MATERIALS AND METHODS

Patient Population

We at our centre performed angioplasty to lower limb arteries in 73 patients from 2015 to 2017. Based on radiological and angiographic imaging, 23 patients had significant stenosis only in supra-inguinal segment. 33 patients had significant stenosis only in infra-inguinal segment. 17 patients had significant stenosis in both supra and infra-inguinal segments. Details of the approach has been mentioned in the flow diagram. Among the combined ipsilateral supra-inguinal and infra-inguinal artery group, we used single common puncture in 12 patients (all men) who were aged 58.25 years (range, 41–67 years) with high-grade (90-100%) symptomatic stenosis. Rest of the 5 patients in the combined group underwent alternative approaches (left upper limb or contralateral femoral artery) because of the involvement of ipsilateral femoral artery by stenosis at the puncture site. Patients were selected for endovascular therapy after discussion with patient and their relatives, after informed consent. All interventions were part of routine clinical management. Patient data, technical and clinical success, complications



Approach used at our centre from 2015 to 2017 for Infra-aortic lesions.

of the procedure and results of follow-up controls were reviewed retrospectively from the patients charts and radiologic reports. The patient's characteristics, clinical symptoms, cardiovascular risk factors and comorbidities are summarized in the Table 1. All patients underwent pre-interventional clinical examination and duplex sonography. As part of the preoperative work-up, patients underwent either computerised tomography angiogram (CTA) or conventional angiogram to confirm the suspected lesion.

Approach used at our centre from 2015 to 2017 for Infra-aortic lesions.

Technique

Percutaneous trans arterial angioplasty (PTA) with or without stent placement were performed with the patient under local anaesthesia, in the angiography suite on a high-resolution angiography system (Philips, FD 10). Access to the lesion was gained through a percutaneous puncture of the ipsilateral common femoral artery in all 12 patients under fluoroscopy guidance. In all 12 patients, either CTA or conventional angiogram showed normal common femoral artery over femoral head which is a usual femoral artery puncture site. Using retrograde femoral artery approach, 8F femoral artery sheath was inserted. Through retrograde CFA sheath, initially iliac artery lesions were addressed in all 12 patients with stent implantation (Figure 1). After obtaining a satisfactory result in iliac artery, angled 0.028-inch guide wire (Radio focus Guide Wire; Terumo, Tokyo, Japan) was parked retrogradely from the puncture site into the abdominal aorta. One more angled 0.025 to 0.028-inch guidewire (Radio focus Guide Wire; Terumo, Tokyo, Japan) was inserted into the same sheath. Gradually the femoral artery sheath was withdrawn till the puncture site seeing on fluoroscopy, the angle of sheath and location of initial puncture site, which was at the femoral head. Once sheath tip was at the level of the puncture site over the femoral head, second angled guidewire was manipulated, antegradely into superficial femoral artery under fluoroscopy guidance. Entry into superficial femoral artery was confirmed by cine angiography or fluoroscopic dye injection. Once confirmed, wire which was parked in the abdominal aorta was removed and sheath is inserted into superficial femoral artery over dilator from the same CFA puncture, converting into antegrade technique for either superficial femoral, popliteal or tibial arteries (Figure 2) Using antegrade CFA puncture infra-inguinal artery angioplasty is done (Figure 3). Vascular closure device was not used because of the financial reasons.

Stent Placement

Stent selection was based on vessel reference diameter and lesion length. Stainless balloon-expandable stents were preferred due to their better delivery profile and deployment precision except one in supra-inguinal lesions. Self-expandable nitinol stent was deployed due to non-availability of balloon expandable stent in one patient. The stent diameter was chosen not to exceed the vessel reference diameter. We used stent with diameter which varied from 7 to 8 mm (mean of 7.9 mm) for supra-inguinal lesions and the length, from 29 to 59 mm (mean of 42.3 mm) (Figure 1). For SFA and popliteal arteries, angioplasty with balloon with provisional stenting was the strategy. Only two patients out of 12 required stents to superficial femoral artery because of flow limiting dissection, 7x59 mm balloon expandable stent in one patient and 7x120 mm self-expandable stent in another patient. After the interventional procedure, a final angiography was always performed to confirm the technical success and patency of the vessel. Technical success was defined as a stenosis grade reduction of >80% of the target vessel. No vascular closure device was used in any patient because of financial reasons.

Table 1: Patient, lesion and procedure characteristics.

Parameters	No of patients	Percentage
Total No. of patients		
Men	12	100%
Women	0	0%
Symptoms		
Symptoms of lower limb ischemia	12	100%
Gangrene	4	33.33%
Cardiovascular risk factors and comorbidities		
Arterial hypertension	4	33.33%
Diabetes mellitus	8	66.67%
Smoking	5	41.67%
Hyperlipidaemia	3	25.00%
Coronary heart disease or previous myocardial infarction	3	25.00%
Previous arterial bypass surgery	0	0%
Previous ischemic stroke or transient ischemic attack	0	0%
Other Peripheral arterial disease	4	33.33%
Lesion severity (Supra-inguinal)		
100%	9	75.00%
90 to 100%	3	25.00%
Lesion severity (Infra-inguinal)		
100%	5	41.67%
90 to 100%	7	58.33%
Lesion length (Supra-inguinal)		
<30 mm	1	8.3%
30-60 mm	8	66.67%
>60 mm	3	25.00%
Lesion length (Infra-inguinal)		
<100 mm	3	25.00%
>100 mm	9	75.00%
Lesion duration		
< 1month	0	0%
1 to 3 months	2	16.67%
3 to 12 months	7	58.33%
> 1 year	3	25.00%
Atherosclerotic	12	100%
Stent used (Supra-inguinal)	12	100%
Stent used (Infra-inguinal)	1	8.3%
Restenosis	2	16.67%

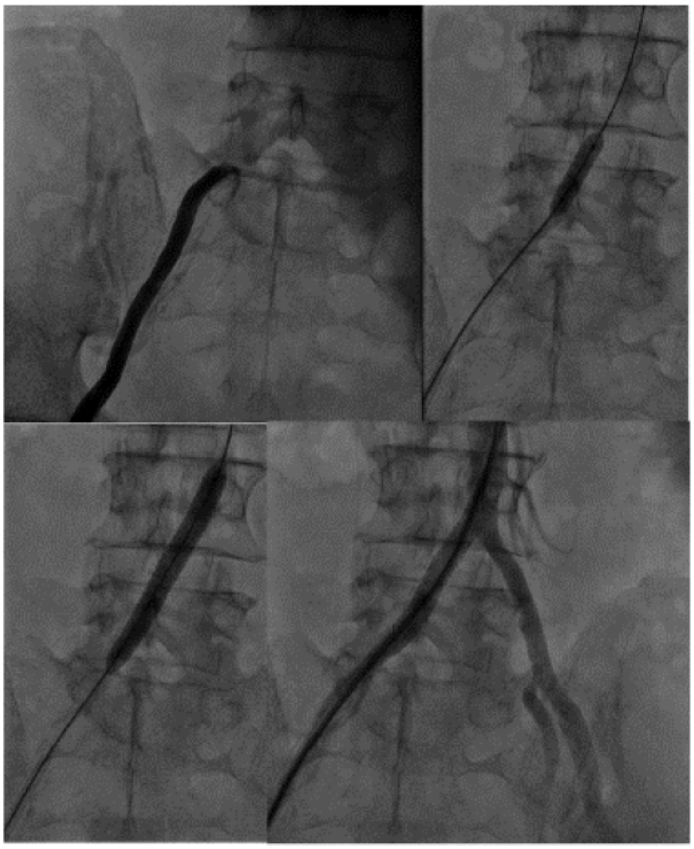


Figure 1: Angioplasty of Supra-inguinal artery stenosis with ipsilateral common iliac artery puncture.

Figure 2: Conversion of retrograde puncture into reverse antegrade puncture.

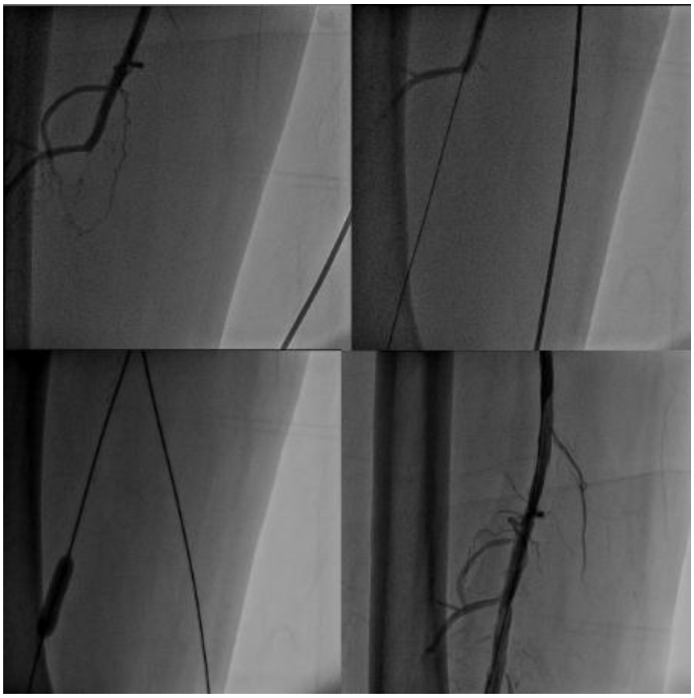


Figure 3: Infrainguinal artery angioplasty from the same ipsilateral puncture.

Pharmacologic Treatment

All patients were given aspirin 325 mg, clopidogrel 300 mg as a loading dose 6 to 12 hr before the procedure and continued with aspirin 150 mg once a day and clopidogrel 75mg once a day for 1 year followed by single antiplatelet. During the procedure, 5000–8000 IU of heparin was administered.

Follow-Up

Clinical follow-up consisted of a history of recurrent or new onset of symptoms, physical examination including peripheral pulses and duplex sonography post interventionally and at 1, 3, 12 months and 6 monthly thereafter. CTA or Conventional angiogram was done if significant change in the duplex examination or relevant clinical symptoms occurred and if duplex sonography was not conclusive or if additional new or progressive occlusive lesions were suspected.

RESULTS

Technical Success

Stent deployment was done in all 12 patients for supra-inguinal lesion, 2 out of 12 in infra-inguinal lesions, as balloon angioplasty result achieved brisk flow with less than 20% residual lumen stenosis in rest of the 10 patients. Technical success rate was 100%. Hospital stay was mean of 51 h. Patients were mobilised at an average of 8 h. They were back to their routine activities at a mean of 8 days.

Complications

No access-related or procedure related complications were seen in any of the patients.

Follow-Up and Restenosis

Follow-up varied between 1–36 months (mean of 21.25 months). At least 1 clinical and radiologic follow-up could be performed in all 12 patients. Immediate complete resolution or improvement of the symptoms could be achieved in all patients. At the latest clinical follow-up, all patients were clinically asymptomatic, radiologically having normal flow on colour doppler. 2 patients (16.67%), needed repeat procedure due to a symptomatic restenosis of the SFA lesion. Both underwent balloon

angioplasty without stent implantation with excellent results. In all other patients, no significant restenosis was found at latest clinical follow-up.

DISCUSSION

Peripheral arterial disease in significant number of patients, especially in diabetics involves multiple arteries and is diffuse in nature.[1] One of the main causes of acute or chronic limb ischemia and amputation, is peripheral arterial disease.[1] Ipsilateral involvement of both supra-inguinal and infra-inguinal arteries in a given patient is not uncommon. It may not be possibly to access it from either upper limb or contralateral femoral artery approach, because of anatomical and technical difficulties.[3] Ipsilateral CFA approach is useful for both supra-inguinal and infra-inguinal artery lesions.[2] But retrograde approach to supra-inguinal arteries, later, after few days antegrade approach to infra-inguinal arteries is usually done. But it is uncomfortable for the patient to undergo in two different sitting. Access site complications increase with multiple punctures. One more practical problem is, if infra-inguinal arteries are opened first, it may close because of proximal obstruction and under filling. If supra-inguinal arteries are opened first, it may close because of distal poor run off of the blocked infra-inguinal arteries. There are reports in the literature where antegrade approach was tried in difficult cases by using different techniques. Antegrade punctures have been tried with support of balloons,[5-6] have been tried with pre-curved needles,[7-8] tried with wires,[9] or more complex tools.[10-11] Diagnostic catheters with different tip shapes which can make antegrade entry into SFA like Sidewinder,[12] SOS,[13] Cobra,[14]angled[15] and triangulard[16] catheters have all been tried with varied success. More, we try to use bulkier hardware's, more chance of arterial trauma. Use of balloons, preshaped catheters, precurved needles definitely increase the chance of local complications. In none of the cases reported in the literature, they have addressed both suprainguinal and infrainguinal vessels in a single sitting. As far as the literature survey is concerned, this will be the first-time, wherein initially retrograde puncture is used to address ipsilateral iliac arteries, then the same puncture is converted to antegrade, to address either SFA or popliteal arteries is reported in literature. Our technique doesn't require any specific bulky hardware. It is easy, simple, affordable, easily available and safe. One more advantage of this technique is, in patients who have disease of bilateral supra and infrainguinal vessels, procedure can be completed in one single sitting saving a lot of time, finance, manpower and catheterization labarotory time. Main important trick is, one should confirm healthy common femoral artery at the puncture site either by ultrasonography, conventional angiography or by CTA. Ultrasound guidance of the puncture will definitely help.

Limitations

Main limitations of this approach are. This technique can't be used if common femoral artery is diseased at the puncture site. Sample size is small. No comparison was made with standard technique. Retrospective analysis of data. Ultrasound assistance for puncture was not used.

CONCLUSION

Peripheral artery disease may involve supra-inguinal and infra-inguinal vessels in a given patient. Retrograde and antegrade approach from a same common femoral artery puncture site is feasible, safer and an alternative effective approach in ipsilateral supra-inguinal and infra-inguinal artery stenosis in a given patient. Prospective, large, randomized control study is needed to validate this technique more effectively.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

CFA: Common femoral artery; **SFA:** Superficial femoral artery; **CTA:** Computerised tomography angiogram; **PTA:** Percutaneous trans arterial angioplasty.

SUMMARY

Lower limb peripheral arterial disease is one of the commonest cause of claudication pain or critical limb ischemia. Significant stenosis in both supra-inguinal and infra-inguinal arteries can be seen most often than not in a single given patient. When both are diseased, crossover technique from opposite femoral arteries or upper limb approach is the preferred technique. However, lot of anatomical factors can affect reaching the area from opposite femoral artery or upper limb. Percutaneous retrograde femoral artery puncture and converting the same puncture into antegrade approach, to high-grade combined ipsilateral supra-inguinal and infra-inguinal artery stenosis is a viable, reasonably safer, one of the options to contralateral cross over or upper limb approach, with good midterm clinical results and patency rates. Prospective, large, randomized control study is needed to validate this technique more effectively.

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