Case Report

Subclavian venoplasty: A second life to the upper limb

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ABSTRACT

Venoplasty, a forgotten art now rescued the upper limb circulation and made the left brachial arteriovenous fistula for hemodialysis functional avoiding the long-time need of a femoral arteriovenous fistula for hemodialysis. We report a rare case of successful left subclavian venoplasty in a 43-year-old male with end-stage chronic kidney disease on alternate day hemodialysis therapy with critical chronic total occlusion of the left subclavian vein secondary to traumatic central line insertion 8 months back presenting with gross wet edema of the left upper limb with visible venous collaterals over the left neck and the left anterior chest wall. Due to acquired left subclavian stenosis, the left brachial arteriovenous fistula for hemodialysis became non-functional and the patient was on alternate day hemodialysis with right femoral arteriovenous fistula.

Key words: Arteriovenous, Fistula, Subclavian, Venoplasty

Venous occlusion can be either primary or secondary. Primary venous occlusion or stenosis is defined when it occurs without prior instrumentation or external venous compression. Primary venous stenosis usually occurs as idiopathic venous thrombosis or secondary to thrombophilias or hormone therapy. Secondary venous stenosis most commonly occurs due to prior instrumentation like central line insertion as in the present case or with external vein compression due to impingement of the subclavian vein between the first rib and the clavicle ("subclavian crush") that occurs during pacemaker implantation. Prior instrumentation results in vessel wall damage, inflammation, and promotion of thrombogenesis and later venous occlusion [1].

In a retrospective study by Ji *et al*., the rate of venous stenosis was as high as 5% [2]. In chronic kidney disease (CKD) patients, subclavian stenosis makes brachial arteriovenous fistula for hemodialysis, non-functional, and nephrologists opt for the femoral arteriovenous fistula to continue hemodialysis. Obstruction of venous drainage in subclavian stenosis leads to boggy edematous swelling of the upper limb resembling a filarial limb. Venoplasty, although a simple art, is gradually becoming a dying practice among budding interventionists as most centers do not adopt the same and send the patient for surgical resection of the stenosed segment and polytetrafluoroethylene (PTFE) patch grafting of the resected segment.

In contrast to conventional stenting for arterial stenosis, venoplasty with simple balloon dilation achieves better results as compared to venous stenting due to a more inherent risk of producing local thrombosis and restenosis secondary to the presence of a local metallic foreign body. Venoplasty with a simple balloon dilatation being a percutaneous approach always avoids the inherent risk of general anesthesia and surgery as well as it is performed with generous local anesthesia only with rare periprocedural complications. Although antegrade subclavian venoplasty is well described in the literature, we performed retrograde subclavian venoplasty in the present case due to impossible venous access in grossly edematous left arm and forearm. We report a rare case of left subclavian venoplasty in a case of acquired near-total occlusion of the left subclavian vein at the point of the left subclavian and left internal jugular vein junction secondary to central line insertion.

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CASE REPORT

A 43-year-old male presented with grossly edematous left upper limb (Fig. 1a) with prominent superficial veins over the left neck and the left anterior chest wall (Fig. 1b) for the last 8 months after he had undergone central line insertion during an intensive care unit stay when he was fighting with an episode of urosepsis. Boggy swelling of the grossly edematous left upper limb resembled that of a chronic filarial limb. He was a long-standing hypertensive patient for the past 20 years and had CKD with alternate day hemodialysis therapy.

At presentation in the outpatient department, he was hemodynamically stable with a blood pressure of 140/90 mmHg

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in the right arm supine position, a pulse rate of 82 beats/min with clear lung fields, and the presence of left ventricular fourth heart sound due to chronic hypertension.

Electrocardiogram revealed left ventricular hypertrophy and an echocardiogram revealed concentric left ventricular hypertrophy with a left ventricular wall thickness of 14 mm and normal left ventricular ejection fraction. Computed tomography venogram of the left upper limb revealed near total focal chronic occlusion of the left subclavian vein at the left subclavian and the left internal jugular vein junction with multiple collaterals between distal left subclavian and left internal jugular vein (Fig. 2a).

The patient reported to have a non-functioning left brachial arteriovenous fistula for hemodialysis created 1 year back and secondary to this, he acquired left subclavian vein stenosis. The patient was on alternate day hemodialysis therapy with femoral arteriovenous fistula due to a non-functioning left brachial arteriovenous fistula. The hematological profile revealed that the patient had a hemoglobin of 9 g/dl and on weekly darbepoetin therapy with normal total leukocyte and differential counts, normal blood sugar with blood urea of 57 mg/dl, and serum creatinine of 13 mg/dl.

The patient was considered for subclavian venoplasty the next day through the left femoral venous access due to the presence of the right femoral arterio-venous fistula for hemodialysis. Through a 6F left femoral sheath, a 6F Judkins Right (JR) catheter was negotiated to the ostium of the left subclavian vein. The injection revealed near total focal occlusion of the osteoproximal left subclavian vein (Fig. 2b) and the lesion in the left subclavian vein was crossed with 260 cm exchange length 0.035" angled tip terumo wire and the terumo wire was parked in distal basilic vein. The lesion was initially dilated with 5 mm×40 mm Mustang (Boston Scientific) peripheral balloon at 4 atm pressure.

We decided to dilate with a smaller balloon initially as terumo wire completely occluded the stenosed segment and the distal part of the subclavian vein was not at all visible. Post-dilatation with this 5 mm balloon, partial opening up of the subclavian vein was noted with a small (2–3 ml) non-forceful injection through the JR guide. Then, we dilated the lesion again with 8 mm×40 mm Mustang (Boston scientific) balloon at 2 atm pressure (Fig. 3a) which completely relieved the obstruction. A guide-catheter injection revealed complete opening up of the osteoproximal left subclavian vein stenosis (Fig. 3b) with fair normal distal drainage. Throughout the procedure, we used only 30 ml of low osmolar contrast (Visipaque, i.e., Iodixanol) in 1:1 normal saline dilution to avoid contrast-induced nephrotoxicity. We put the patient on hemodialysis therapy in the afternoon to avoid even minimal contrast-induced nephropathy.

The next day morning, gross boggy edema of the left upper limb subsided to a significant extent. The patient was advised to undergo hemodialysis through the left brachial arteriovenous fistula to avoid the potential drawbacks of femoral arteriovenous fistula and keep the bifemoral access alive for the dire need of long-term renal replacement therapy in the form of hemodialysis due to end-stage CKD.

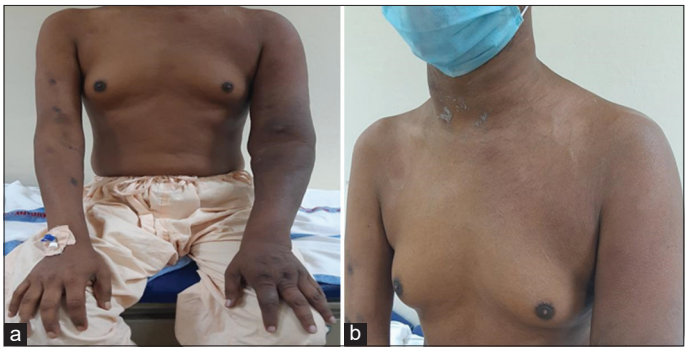

Figure 1: (a) Grossly edematous left upper limb; (b) prominent venous collaterals over the left neck and the left anterior chest wall

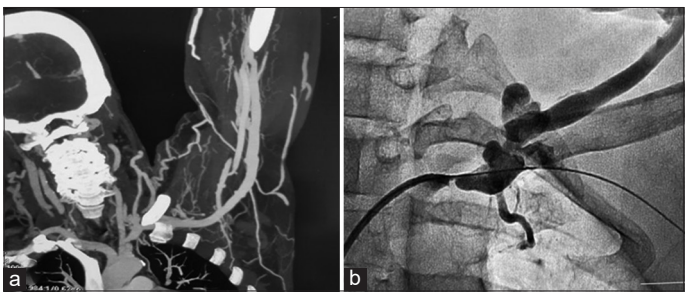

Figure 2: (a) Computed tomography venogram showing near total subclavian vein occlusion; (b) fluroscopy showing subclavian chronic total occlusion

DISCUSSION

We achieved the complete opening of the left subclavian chronic total occlusion (CTO) with simple balloon dilatation using an 8 mm×40 mm peripheral balloon. Debate always arises whether simple balloon dilatation can alone suffice to achieve good and long-term patency in venous stenosis; in contrast to arterial stenosis where arteries recoil post-balloon dilatation and mandates stenting, dilatation of a vein achieves far better result in comparison to conventional stenting.

Post-balloon dilation of the venous stenosis, stenting may be considered if primary balloon angioplasty fails. In a study including 146 stenosed veins, there was a higher primary patency rate with venoplasty alone (24%) compared to stenting (13%) [3]. Therefore, balloon dilatation is the preferred modality of treatment in comparison to venous stenting in venous stenosis.

Drawbacks of subclavian venous stent placement include an overlap of the stent with the internal jugular vein which would limit future central line placement; occlusion of the contralateral brachiocephalic or other small venous branches causing superior vena cava or brachiocephalic vein syndrome. Systemic anticoagulation is

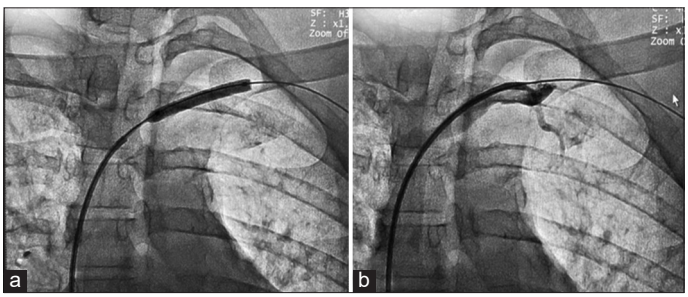

Figure 3: (a) Balloon dilatation with 8×40 mm balloon; (b) complete opening up of subclavian chronic total occlusion

not necessary after routine post-dilatation of venous stenoses. We crossed the lesion with conventional 0.035" angled tip terumo wire but like coronary CTOs, extremely hard proximal cap venous CTOs are crossed with CTO hard wires like Confianza Pro 12 and with microcatheter support [4]. In the event of extreme tortuosity and need of additional support, Amplatz Extra Stiff wire may be used to track the balloon across the difficult stenoses.

Veins are friable in nature; only one clue during successful venous dilatation or stenting is that it should be performed slow and steadily at very low pressure of 2–4 atm, high pressure inflation across the subclavian vein leads to a catastrophe such as venous rupture and thoracic tamponade. Subclavian venoplasty has been successfully performed for lead placement in redo devices such as a pacemaker or intracardiac defibrillator implantation where subclavian vein stenosis is noted long after implantation especially during pulse generator change or device reimplantation due to device failure [4]. Worley *et al*. showed that two-thirds of encountered subclavian stenoses occur at the subclavian to distal innominate vein junction [5] as noted in our case where subclavian vein stenosis was noted in the osteoproximal region with profound collateralization. Success to our venoplasty was that it was focal in nature with tapering proximal cap; so we were able to cross the lesion with standard workhorse angled tip terumo wire.

Long segment venous occlusions pose particular challenges as they have an ambiguous proximal and distal cap which is difficult to define during the intervention and also difficult to probe with a high-risk of perforation. The most common cause of venous occlusion is prior instrumentation [6] as in our case it was an inadvertent central line insertion; therefore, imaging especially ultrasound-guided central line insertion is always a better option to be exercised to avoid venous injury and subsequent stenosis.

Hemodialysis is the only life-saving procedure in patients with end-stage CKD; therefore, our principal goal, in this case, was to open up the critically stenosed left subclavian vein to keep the left brachiocephalic arteriovenous fistula patent for further hemodialysis. Some degree of venous obstruction has been reported in almost 15% of patients with prior device implantation [7].

Subclavian venoplasty has been described as an effective method to introduce even multiple leads including left ventricular lead during cardiac resynchronization therapy implantation [8]. Duration of dilatation of venous stenosis with a balloon should be brief; 30-s dilatation achieves good angiographic and long-term patency [9]. This venoplasty was sufficient to maintain long-term patency of the subclavian vein to continue hemodialysis in future through brachial arteriovenous fistula. We do not attempt venoplasties so frequently as arterioplasty. Venous stenosis is rarely encountered as compared to arterial stenosis as most of the thrombotic venous occlusion well respond to anticoagulants with no further progression to stenosis while arterial stenosis is most often atherosclerotic with superimposed thrombosis which requires atherosclerotic plaque modification in the form of arterioplasty.

Venous stenoses are usually fibrotic in nature without much calcification due to excessive proliferation of connective tissue as a response to injury, long-term patency after balloon dilatation of venous stenosis is promising. The most dreaded complication of venoplasty is rupture or perforation of the vein, one should be extremely cautious while crossing the lesion or dilatation with a balloon [10]. Aggressive high-pressure dilatation of venous stenosis should never be exercised. Simple procedure sometimes rescues if cautiously performed as in our case; balloon dilatation of a long-standing critical left-sided subclavian vein stenosis rejuvenated the left upper limb circulation and turned the left brachiocephalic arteriovenous fistula functional for life-saving hemodialysis.

CONCLUSION

We report a rare case of successful left subclavian venoplasty in a case of near-total subclavian stenosis secondary to central line insertion which salvaged the limb and turned the left brachial arteriovenous fistula functional for future regular hemodialysis with relief of gross boggy edema of the left upper limb. Subclavian venoplasty, a forgotten art now although simple to perform with less periprocedural complications; in the fear of inadvertent perforation or rupture of the subclavian vein many centers refer for surgical resection of the stenosed segment with PTFE patch closure. Simple subclavian balloon venoplasty can regain the lost circulation of the upper limb and avoid surgical correction.

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