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Case Report Open Access

Endovascular Intervention in Chronically Occluded Inferior Vena Cava with Modified Sharp Recanalization Technique

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Abstract

Though endovascular interventions for venous obstructive lesions have evolved, chronic total occlusions are difficult to negotiate. We are describing our experience of successfully using modified sharp recanalization technique in which the Brockenbrough needle in the Mullin sheath was used to negotiate the chronic total occlusion of inferior vena cava in a case in which the lesion was not crossed with repeated attempts with a guide-wire. Finally the lesion was predilated with mitral valvuloplasty balloon. A balloon-mounted stent was deployed with optimum post-procedural results. At the follow-up of 6 months, the patient was asymptomatic with optimal clinical outcome in form of patent stent on Doppler and computed tomography studies.

Keywords: Inferior vena cava; Chronic total occlusion; Modified sharp recanalization technique; Stent

Introduction

Chronic total occlusion (CTO) of inferior vena cava (IVC) may be totally asymptomatic or may present with myriad of signs and symptoms, depending on the level of obstruction and collateral venous drainage. Symptoms associated with the IVC obstruction, often referred to as "IVC syndrome", can be debilitating including lower extremity pain, edema, venous congestion and skin changes like venous ulcers and eczema. Medical treatment in the form of anticoagulation and external compression (for varicose veins) have limited role with suboptimal results while surgical management in the form of venous bypass grafting has limited efficacy and applicability [1,2]. Short term results of percutaneous transluminal angioplasty in the venous system are good [3]. Endovenous stent placement in the IVC has emerged as a promising technique for the treatment of CTO of IVC. However, success rate is comparatively lower in revascularization of CTO then in stenotic lesions [4]. We are reporting our experience of endovascular intervention and stent placement with modified sharp recanalization technique in a case of CTO of IVC with excellent midterm results.

Case Report

A 20 years male, chronic smoker, presented with a history of bilateral pedal edema and progressive abdominal distension for 20 months. Abdominal examination showed ascites and superficial venous collaterals flowing from below upwards towards the superior vena cava. Patient was on conservative management in form of oral anticoagulants, elastic compression of lower limbs and leg elevation for 9 months but with no relief of symptoms. Ultrasonography and color Doppler of the abdomen showed obstruction in the IVC in hepatic part and it raised the suspicion of thrombotic occlusion of the IVC. His thrombophilia work-up including coagulation parameters; antithrombin 3, protein C and S levels; anticardiolipin antibodies, lupus anticoagulant, prothrombin and Leiden gene mutations, and platelet count were within normal limits except hyperhomocystinemia (>15 mg/L). He denied history of trauma or surgery to abdomen or pelvis. Catheter-based venogram was planned to determine the further line of management.

Procedure

After obtaining a consent, right femoral and right internal jugular venous access were obtained. A venogram from right femoral vein and right internal jugular vein with 6F multipurpose catheters (Cordis Corporation, Miami, USA) showed complete occlusion of the hepatic part of the IVC below the drainage of hepatic veins and above the level of superior mesenteric and renal veins (intrahepatic suprarenal portion of IVC). It also showed multiple deep collaterals flowing upwards towards the superior vena cava (Figure 1). A catheter directed intervention for recanalization of IVC was planned.

A road-map of occluded IVC segment was created with venogram from right common femoral vein and right internal jugular vein with 6F multipurpose catheters in postero-anterior and lateral views using the overlay technique. Attempts to cross the occluded segment of IVC with 0.035" J-tipped hydrophilic glide-wire (Terumo Interventional Systems, Japan) with support of 4F multipurpose catheter from right femoral venous access were repeatedly unsuccessful. Finally it was exchanged with the Brockenbrough needle (BN) in the Mullin sheath. After confirmation in postero-anterior, lateral, shallow left anterior

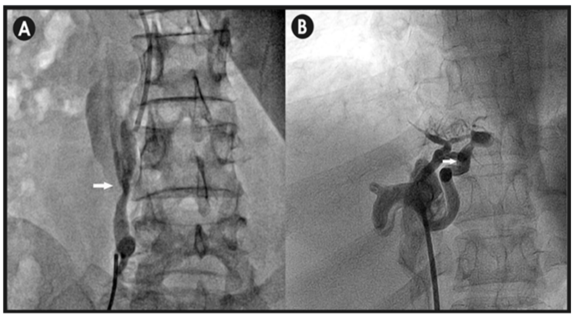

Figure 1: Pre-Procedure venograms of inferior vena cava.
(A) Venogram from femoral and jugular venous catheters demonstrating total occlusion of the inferior vena cava (arrow). (B) Venogram from femoral venous catheter demonstrating complete occlusion of inferior vena cava and well flowing collaterals (arrow).

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oblique and right anterior oblique views; the needle was advanced into the obstructed IVC segment very gradually with simultaneous advancement of the Mullin sheath. It was guided by the predetermined roadmap and a catheter placed from above acted as a target. Entry into the proximal true lumen (right atrium) was checked by a venogram. Mullin sheath was advanced over it and the needle was withdrawn and exchanged with a 0.025" spring coiled wire, which was parked in the right atrium. Mullin sheath was exchanged with the Mullin dilator (Lifetech Scientific, Shenzen, China) over the spring coiled wire and obstructed segment of IVC was dilated. After adequate dilatation, angioplasty of the IVC was done sequentially using Admiral Xtreme balloon – 6 × 40 mm (Medtronic, Inc. Roncadelle, Italy), OptaPro balloon – 8 × 40 mm (Cordis Corporation, Miami, USA) and finally a mitral valvuloplasty balloon – SYM balloon – 24 mm (Lifetech Scientific, Shenzhen, China) to optimize the results. Post balloon dilatation venogram showed brisk flow across the obstructed segment of IVC up to the right atrium. SYM balloon was taken out and 10F long Sheath (Cook Inc., Bloomington, USA) was placed over the supper-stiff 0.038" Amplatzer wire (Boston Scientific Corporation, Marlborough, USA), which was exchanged for the spring coiled wire and parked into the right atrium. Hand-crimped balloon-mounted Palmaz Stent – 14 × 50 mm (Cordis Corporation, Miami, USA) was deployed at the obstruction site through the long sheath (Figure 2). After deployment, the stent was further expanded using Maxi-LD balloon – 14 × 40 mm (Cordis Corporation, Miami, USA). Post-procedure venogram showed a brisk flow in the IVC with disappearance of all the collaterals (Figure 3). The procedure was performed under the cover of heparinization and the patient was prescribed warfarin so as to maintain international normalized ratio of 2–3 and aspirin. He was asymptomatic and venous Doppler and

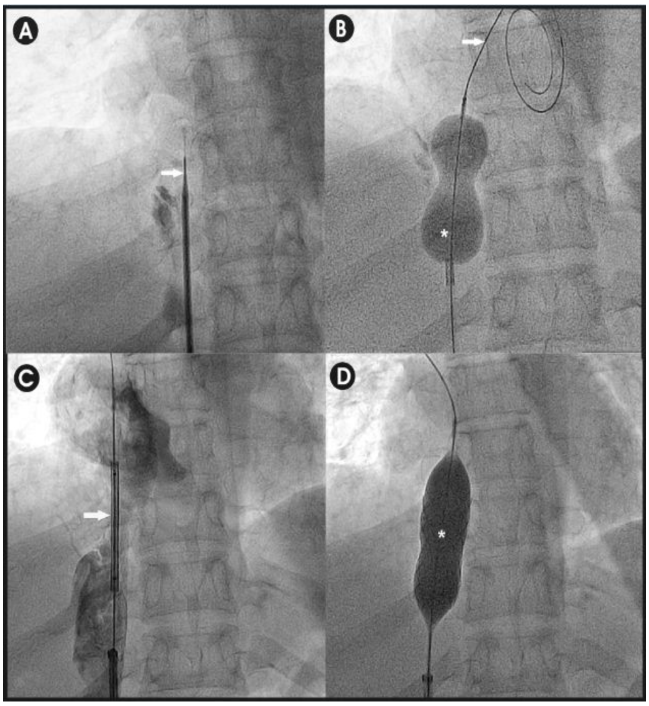

Figure 2: Balloon angioplasty and stent placement in inferior vena cava.
(A) Brockenbrough needle and Mullins sheath (arrow) crossed from right femoral vein into the inferior vena cava across the occluded segment. (B) Balloon angioplasty of inferior vena cava done using SYM balloon (*) negotiated over spring coiled wire (arrow). (C) Stent (arrow) placed across occluded segment of inferior vena cava. (D) Stent deployment (*) across the occluded segment of inferior vena cava.

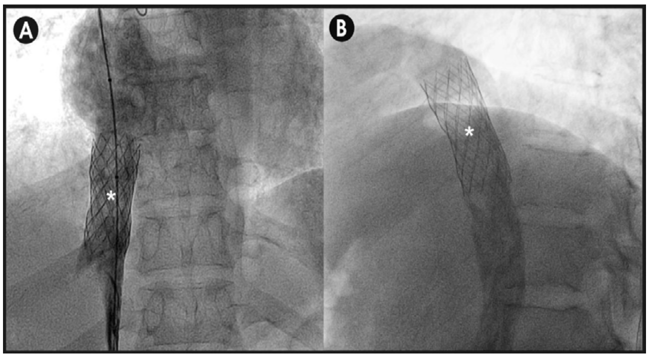

Figure 3: Post-stent deployment venogram of inferior vena cava.
(A) Postero-anterior and (B) Lateral views showing brisk flow across the stent (*).

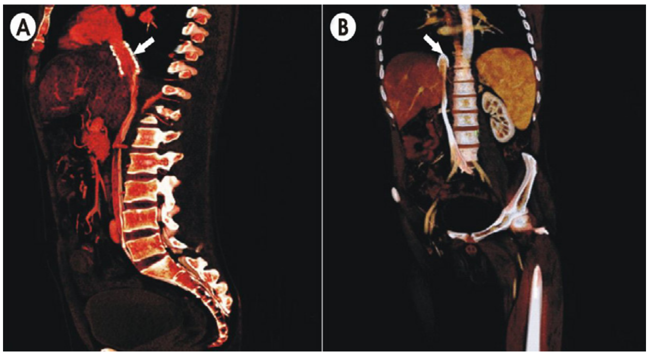

Figure 4: Follow-up computed tomography images.
(A) Sagittal and (B) Coronal sections showing well placed stent (arrow) across occluded segment of the inferior vena cava.

Computed Tomography (CT) venogram (Figure 4) showed well flowing stent at 6 months follow-up.

Discussion

Chronic thrombotic occlusion of the IVC is a pathology with multiple possible etiologies which may be inherited or acquired. History of smoking and presence of hyperhomocysteinemia which seem to have played the role as etiological factors in our patient are amongst the risk factors mentioned [5].

In patients with symptomatic chronic venous occlusive disease, conservative management entailing anticoagulation, and physical measures are often associated with disappointing long term outcomes [6]. Swelling, venous claudication, skin changes, and ulceration have all been linked to a significant impairment in the quality of life [6]. At median follow-up of 5 years, 44% of patients with Ilio-Femoral thrombosis treated conservatively experienced venous claudication, commencing at a distance of 130 meters, and 15% were forced to stop at 240 meters [6]. Surgical interventions (with grafts or spiral vein IVC reconstruction) are limited by limited availability, suboptimal results, increased morbidity and poor long term outcomes [1].

Though ultrasound plays an important role in the diagnosis, evaluation of deep veins like IVC requires CT or catheter-based venogram [7]. The technique of percutaneous transluminal venous angioplasty was for the first time described in autogenously venous bypass grafts in lower limb [8] Usual approach is from right common femoral vein just below the inguinal ligament [7] However, if the extent of thrombus precludes this approach, the femoral vein can be approached from mid-thigh with the ultrasound guidance or even the patient can be positioned prone and the popliteal vein can be accessed [9]. As the site of occlusion in our patient was suprarenal IVC, we obtained the access from right femoral vein in supine position. Jugular vein access may be used for treatment of IVC lesions,[10] but evaluation and treatment of distal disease is also more difficult from this approach [9]. In our case, we obtained access from the right jugular vein to determine the true lumen and to create a roadmap of the IVC.

In contrast to arterial techniques, endovenous intervention utilizes torqueable, pushable catheters in combination with stiff guide-wires. Stiff guide-wires with supporting catheters are typically manipulated until an appropriate channel is entered, at which point the wire can be looped and advanced [9]. Floppy tipped guide-wires have also been used for traversing stenotic lesions [4]. The floppy tip invariably remains within the occluded venous structure. After the lesion is crossed, further easy passage of the wire signifies proper IVC re-entry, which should be confirmed by venography/intravascular ultrasound (IVUS) [4]. In our case, the lesion could not be crossed with hydrophilic glide-wire despite of multiple attempts. In CTO, interventionists have used septal puncture needle, biopsy needle and stiff end of guide-wires [11,12]. We used modified sharp recanalization technique, in which BN with Mullin sheath was used to negotiate the lesion.

There are reports mentioning the use of BN to cross calcific peripheral arterial lesions followed by bougie dilatation to allow monorail balloon crossing and stent deployment [13]. BN has been used to perforate membranous obstructions of IVC [14]. BN and subsequently Mullin sheath have also been used to create a track in a long CTO of IVC [10,11]. It may help negotiate the fibrosed CTO which could not be crossed with a simple guide-wire. The straightened BN remains within the IVC with minimal chances of perforation and bleeding. This is due to fibrosis and containment by perivenous structures. In addition, the need of IVUS is also not there as the straightened BN remains within the IVC and re-entry is not the mechanism with this technique. Achievement of "through and through" wire access with jugular and femoral venous route by snaring it from one vein and out the other is useful for advancing catheters and angioplasty balloons through very long or fibrotic venous occlusions/stenosis as the control of both ends of a guide-wire allows maximum catheter pushability over the taut wire [7]. In our case, stiff spring coiled wire and super-stiff Amplatzer wire provided adequate support for negotiation of the balloons and stent respectively.

In contrast to the arterial system, where restoration of flow is the aim; in venous system, the lesion should be dilated to normal anatomical caliber (20-25 mm for IVC in most normal sized adults) as the reduction of peripheral venous pressure is the aim [7,15]. Different balloons were used by different interventionists [10]. We used SYM mitral valvuloplasty balloon. It carries clear advantages as adult IVC measures around 20–22 mm [16]. Thus, balloon-to-IVC ratio for this balloon is 1:1–1.1:1, which is ideal to dilate IVC at lower inflation pressures (1–2 atmospheric pressure), for a shorter period of time (3 seconds) [10]. Stronger rubber- nylon micromesh of this balloon is ideal and it can also be used even when the occlusion was before head crossed with a hydrophilic glide-wire [10]. Bleeding complications from such judicious dilatation are extremely rare, presumably due to the low prevailing venous pressure and containment by perivenous structures [15].

Since 1990s, endovenous stent therapy has emerged as an effective, minimally invasive technique for restoring patency in chronic iliofemoral/caval vein obstructions [10]. In case of segmental obstruction as in our case, the results of balloon angioplasty are disappointing in contrast to those in cases of discrete membranous obstruction [7,10] This is attributable to recurrent stenosis due to IVC elasticity and elastic recoil of the fibrotic tissue in chronic stenosis, low flow state and thrombogenesity of the IVC [7,10] So, stents are mandatory in the treatment of IVC occlusions [7,9]. Large stents, preferably oversized by at least 2 mm (10-20% compared to normal sized vessel) have been recommended to facilitate over dilatation later in case of restenosis [7]. Balloon-mounted as well as self-expanding stents have been used for this purpose [9,10] Generally, the self-expanding stents are preferred in the venous system [7]. Compression and deformation of balloon-expandable stents do not spontaneously reverse as occurs with self-expanding stents. Placing balloon-expandable stents where they can undergo such external force can lead to severe consequences such as restenosis or re-occlusion which may be difficult to treat percutaneously [7]. But this is true especially in superficial areas and also outside the thoracic and abdominal cavit [7], which was not the case over here. Balloon-expandable stents are used when extra radial force is needed for complete expansion and only in deep areas like in our case of chronic occlusion with perivenous fibrosis [7]. In our case, the stent was placed safely with no occurrence of stent migration, pulmonary embolism, and bleeding or access site complications. Immediate post-procedure results were satisfactory and transfemoral venography showed brisk flow with disappearance of collaterals suggestive of resolution of pressure gradient. Completion IVUS has also been recommended to assess for stent expansion and apposition [9]. However, we have demonstrated this with catheter-based venogram (Figure 3).

Proper pharmacotherapy during and following endovenous intervention is essential to keep the stent patent. Extended anticoagulation therapy after venous intervention for acute thrombotic occlusion is recommended especially in the patient is having thrombophilia, long segment recanalization or the cases like ours with placement of stent in suprarenal IVC [4,15,17]. Low-molecular weight heparin like bemiparin can be useful in patients with venous thrombosis with excellent pharmacological profile including long half-life, high anti-Factor Xa/anti-Factor IIa activity ratio as well as cost-effectiveness [18]. Platelet inhibition has been favored when placing a prosthesis (stent) into the IVC, because platelet activation and deposition is a potent stimulus for fibrin formation [4,17].

The long term results of endovenous stenting are good [10]. In one of the largest studies to date, at 72 months follow-up, cumulative primary, primary-assisted, and secondary patency rates were 79%, 100%, and 100% for primary non-thrombotic obstruction, respectively, and 57%, 80%, and 86% for post-thrombotic obstructions, respectively [16]. Restenosis occurred more frequently in post-thrombotic occlusion (10%) as compared to primary non-thrombotic occlusion (1%) [15]. In those who develop re-occlusion, it can be opened up with re-intervention successfully [10]. However, a long term follow up is required.

Conclusion

Endovascular intervention in form of stent placement in the thrombotic CTO of IVC may be an effective treatment option with excellent midterm results. Though successful revascularization in CTO is more difficult than that in stenotic lesions, it can be better attempted by modified sharp recanalization technique.

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