AngioJet™ rheolytic thrombectomy with covered balloon-expandable stent deployment in a superior vena cava syndrome: a case report

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Abstract

The Superior Vena Cava Syndrome (SVCS) is a rare mediastinal syndrome, frequently due to compression by a mediastinal malignant leading to venous flow obstruction through the Superior Vena Cava (SVC) towards the heart. The symptoms may consist of edema of the upper body and distended veins, dyspnea up to a life-threatening condition. Restoring the SVC flow by endovascular means can be beneficial in order to achieve a rapid relief of the clinical symptoms. A 51-year-old male with a recent diagnosis of squamous cell lung tumor diagnosis presented to the emergency department with persistent cough, neck and face swelling, and distended jugular veins on clinical examination. No dyspnea and normal vital parameters were reported. Computed Tomography angiography (CT) examination demonstrated thrombosis of subclavian veins and SVC due to compression by malignancy. Compression also involved the right upper lobar bronchus. Through a percutaneous transvenous right humeral access, phlebography confirmed total occlusion of the right subclavian vein, brachiocephalic venous trunk, and superior vena cava. We performed AngioJet™ (Boston Scientific, Marlborough, MA, USA) rheolytic endovascular thrombectomy. The phlebography demonstrated the unlying hemodynamic stenosis due to the ab-extrinsic compression and underwent stenting with a covered balloon-expandable stent. The final phlebography confirmed the patency of the stent and restoration of venous flow. Although there was a complete recovery of the symptoms, the patient died from respiratory complications caused by malignancy involvement.

AngioJet™ mechanical thrombectomy and covered balloon-expandable stent deployment is a useful solution for SVCS to quickly achieve relief of the clinical symptoms. There are few case series where thrombectomy and primary stent placement are studied. Further follow-up studies are needed to understand the patency of treated vessels better.

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Introduction

Superior Vena Cava Syndrome (SVCS) is a mediastinal syndrome due ab-extrinsic compression of Superior Vena Cava (SVC), with a high mortality rate. The most common etiology is malignancy, such as a primary pulmonary tumor or metastatic disease (70% of total cases).[1] SVCS often presents with progressive symptoms worsening over weeks or may cause abrupt symptoms leading to a medical emergency. The typical clinical presentation is dyspnea with swelling of the neck, trunk, or extremities, while cough and chest pain are less common.[2] Patients with this syndrome can be extremely uncomfortable and may develop life-threatening complications. The endovascular approach for SVCS is a less invasive treatment which allows a quick symptoms relief with few complications. Endovascular strategies may include mechanical thrombectomy combined with balloon angioplasty with or without stenting. We present a case with SVCS treated with mechanical and drug r-alteplase (rTPA) thrombolysis of superior vena cava and its branches with AngioJet™ (Boston Scientific, Marlborough, MA, USA) rheolytic thrombectomy[3] in conjunction with the need of a mechanical scaffold. We performed a review of the current literature in regard to the thrombolysis strategy for SCVS. This case report has been reported in line with the 2020 SCARE Guidelines.[4]

Case Report

A 51-year-old male patient presented to the emergency department with neck and face swelling and distended jugular veins with a persistent dry cough. His medical history consisted of a squamous cell lung cancer diagnosis (p40+, TTF1-, 40% PD-L1+) and had been staged with total body CT-PET and bronchoscopy. He was a smoker (30 packs/year) with an occupational history of chemical dust exposition. On clinical examination he had no dyspnea and normal vital parameters. The patient received five palliative cytoreductive radiotherapy cycles and prolonged steroid therapy with the aim of reducing mediastinal bulking. The total body Computerized Tomography (CT) showed a 7x4,5 cm lung mass infiltrating the upper right bronchus and superior vena cava (Figure 1). PET exam confirmed no other metastatic lesions. The CT scan demonstrated the complete thrombosis of the left subclavian vein, the brachiocephalic venous trunk, and the superior vena cava. Considering the persistence of symptoms despite the anticoagulant therapy, in agreement with oncologists, it was chosen for an invasive treatment by endovascular means. The patient provided the informed consent.

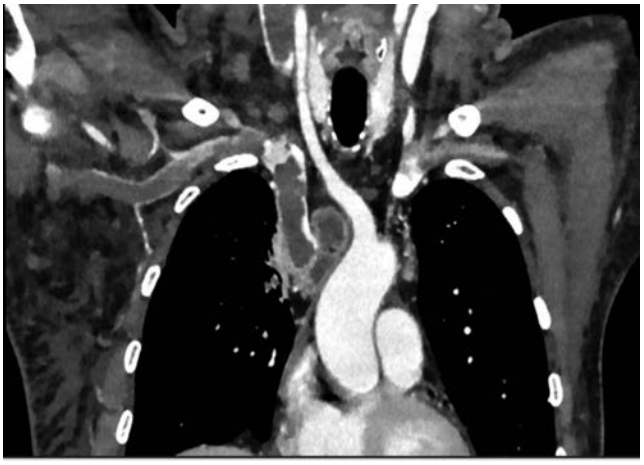

Figure 1. Preoperative CT showed complete right subclavian vein, brachiocephalic venous trunk and superior vena cava thrombosis.

Two venous accesses were obtained percutaneously under ultrasound guidance such as right humeral (9 Fr sheath) and right femoral vein (6 Fr sheath). The procedure was performed under local anesthesia in the hemodynamic suite. The patient was heparinized with a bolus of 5000 UI sodic heparin. Phlebography confirmed a total occlusion of the right subclavian vein, brachiocephalic venous trunk, and superior vena cava. A 180 cm angled tip 0,035" Hydrosteer™ (Abbott, Plymouth, MN, USA) guidewire was positioned beyond the thrombus in the atrium. AngioJet ZelanteDVT™ 8Fr catheter-directed thrombolytic therapy with 12 mg of Recombinant Tissue Plasminogen Activators (rtPA) was performed using the Power Pulse™ modality. Next, phlebography after 20 minutes showed complete recanalization of the right subclavian vein and brachiocephalic trunk and the underlying stenosis due to ab-extrinsic compression of the SVC. The stenosis was treated by delivering through the humeral vein access a 12x29 mm balloon-expandable stent (Advanta V12™).[5] A restored venous flow to the atrium was confirmed at the final phlebography (Figure 2). A period of desaturation of about 2 minutes occurred during the procedure, probably due to pulmonary microembolization. We used a Perclose ProGlide™ system (Abbott Cardiovascular, Plymouth, MN, USA) to close the humeral vein access and manual compression for the femoral vein access. The use of this device in this case assumes an off-label choice, but it was preferred by the

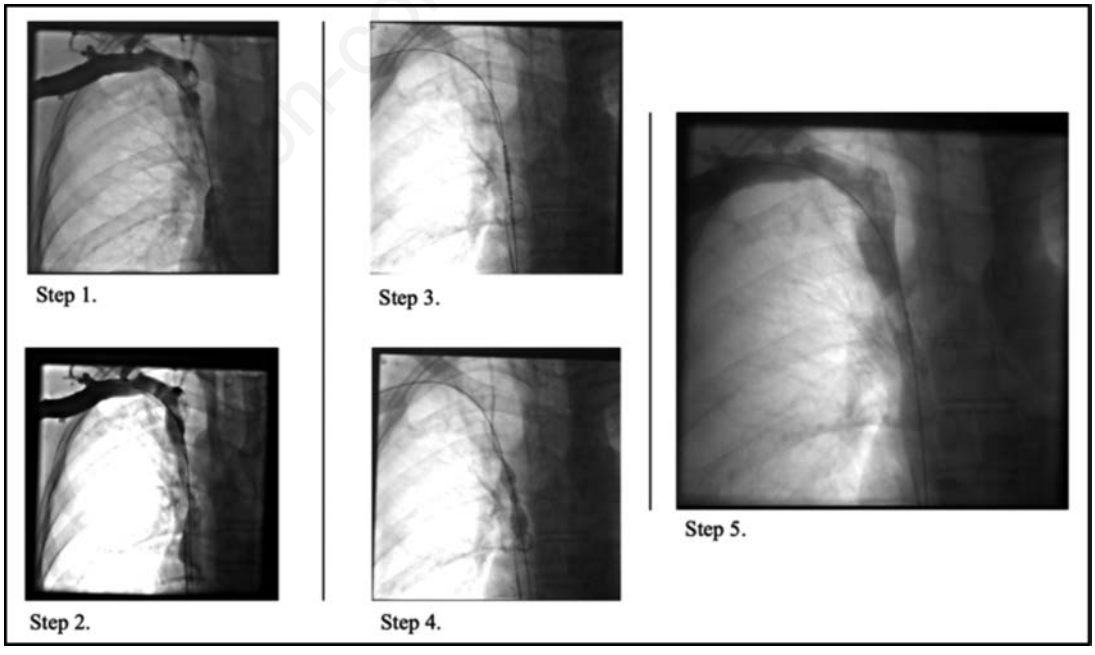

Figure 2. All procedural steps. Step 1. Complete SVC occlusion. Step 2. Residual SVC stenosis after rheolytic trombectomy. Step 3. Advanta V12TM covered balloon-stent positioning. Step 4. Advanta V12TM deployment. Step 5. Final procedure phlebography.

operator to achieve a better hemostasis after the high dose of thrombolytic given during the procedure and considering that the patient must follow an anticoagulation therapy. Systemic heparinization was continued for 24 hours after the procedure with strictly monitoring of the Activated Partial Thromboplastin Time (apTT). According to the Cardiology and Oncology Units, the patient was maintained under oral anticoagulant therapy with edoxaban 60 mg once daily. No post procedural complications occurred and progressive improvement of the upper body edema. The patient died 23 days later due to hemoptysis and due to progressive bronchi involvement by the lung mass.

Discussion

SVCS is a rare mediastinal syndrome that can lead to a life-threatening condition.

The most common etiology consists of primary pulmonary tumor or metastatic disease (70% of total cases), which often causes rapid progression of SVCS.[1] Signs and symptoms of venous congestion of the head, neck, and upper extremities are determined by the duration, progression, and extent of the venous occlusive disease. Typical clinical presentation is dyspnea associated with swelling of the neck and cough may be rarely the first clinical manifestation.[2]

The endovascular approach restoring the venous return and the treatment of the underlying stenotic or occludent lesion leads to rapid symptomatic relief in SVC syndrome. Despite there is still low evidence, the endovascular approach is accepted as a first-line strategy for SVCS.[6,7] Leon *et al.* in their review, demonstrated that stents can be used with excellent results to treat SVCS, with a clinical response rate greater than 90% of patients experiencing immediate relief of symptoms, and low rates of fatal complications (1,46%).[8] Few case series have been reported for malignant SVC syndrome treated with catheter-directed thrombolysis and endovenous stenting.[9,10] Catheter-directed thrombolysis and venous stent placement is widely reported in the literature for femoro-iliac veins, with primary patency at 6 months and 1 year of 94,7% and 89,4% respectively.[11]

Kee ST *et al.* showed approximately 79% clinical patency with catheter-direct thrombolysis and stenting with an average 7-month follow-up. Recurrence of venous obstruction with symptoms occurred in 0% to 45% of patients.[9] In all the case series analyzed by Kee ST *et al*., the AngioJet™ rheolytic thrombectomy system was not reported. The AngioJet™ thrombectomy catheter system consists of intravascular thrombectomy with active aspiration, designed to treat the widest range of thrombosed vessels and rapidly restore blood flow.[3] The ZelanteDVT™ catheter has a double lumen; a smaller one to run saline distally and a larger one to collect aspirated material. The saline solution exits the tip at approximately 500 mL/h to create a circumferential zone of depression by the Bernoulli effect, which crumples and aspirates thrombus.[12] Stent placement after rheolytic thrombolysis is mandatory when a residual stenosis is identified. During the procedural steps a possible complication is the pulmonary microembolization during the management of guide wires and catheters into the thrombus as demonstrated in our case. This is the reason we preferred to use a high dose of thrombolytic drug with the Power Pulse modality. Another complication described in the literature consists of the early and late stent migration.[3] The explanation of this complication is related to the discrepancy between the diameter of the stent implanted and the diameter of SVC, which has a large diameter, making fundamental the preoperative planning before the stent choice. Massi *et al.* delineate the distinctions between arterial and venous stents.[13] The optimal characteristics for venous stents encompass compliance and adaptability to variations in vein diameter resulting from physiological alterations in venous blood flow. An ideal venous stent should exhibit heightened compliance and elasticity while retaining substantial radial force. The choice of the stent is still an open debate as there is a limited number of stents in the market dedicated to the venous district and mainly for femoro-iliac veins, where endovascular treatment has been extensively studied. In accordance with Jayaraj A *et al*.,[14] the varying radial forces exhibited by different stent models influence their suitability for specific venous segments. Consequently, for vein segments prone to bending, the preference leans towards the use of the Z-stents rather knitted stents.[14] The literature demonstrates an evolution in this aspect as initially used mainly bare metal stents and, in the last decades, has been a significant use of covered stents, which are more likely to prevent post-procedural bleeding.[15,16]

Another aspect to consider is the modality of the stent delivering system such as either the balloon expandable or self-expandable modality. However, as mentioned, there are very few stent brands in the market for the treatment of veins segments, mainly in the inferior vena cava and iliac veins, and the choice of stent for the SVC seems to be an off-label decision, particularly in the emergency setting. In our case, we preferred a covered balloon-expandable stent to prevent possible bleeding in case of infiltration of the SVC wall from the malignant mass. The covered balloon-expandable stents can be overdilated with a larger balloon over the nominal diameter, and this represents an advantage in case of bleeding or unsatisfactory sealing to the cava wall given its large diameter. The use of a covered stent has been demonstrated as a feasible and effective approach for malignant SVCS with better patency rate compared to the uncovered stents.[17]

Unfortunately, these patients have a short follow-up due to the high mortality rate of their underlying malignancy. Further studies with longer follow-ups are needed to shed light on the effectiveness of the direct-venous catheter thrombolysis and the role of the stent for the SVCS.

Conclusions

Rheolytic mechanical thrombectomy associated with a covered balloon-expandable stent deployment to treat tight stenosis of superior vena cava is a useful solution to reduce SVCS symptoms. Further studies are needed to better understand the role of the long-term follow-up of catheter thrombolysis and stent patency in the SVCS.

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