Combined rheolytic thrombectomy and stent placement in SVC and brachiocephalic vein thrombosis due to metastatic lymphadenopathy

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The current management of neoplastic obstruction, SVC, and brachiocephalic vein thrombosis, especially of SVC, is based on the combined use of interventional (endovascular thrombolysis or thrombectomy, stent placement) and noninterventional (radiation, chemotherapy) means of treatment. We present the case of a forty-year-old woman with SVC and left brachiocephalic vein thrombosis secondary to lymph node metastasis of non-small-cell lung cancer. A combination of rheolytic thrombectomy (Angiojet device) and stent placement was performed for both venous sites with complete technical success. We discuss the principles of percutaneous rheolytic thrombectomy, its effectiveness, and potential complications.

Case report

A 40-year-old female patient with recently diagnosed non-small-cell lung cancer (NSCLC) was referred to our department for diagnosis and therapeutic intervention due to acute superior vena cava (SVC) syndrome symptoms. The patient had facial and superior limbic swelling and extensive superficial venous collaterals. Contrast-enhanced computed tomography (CT) scan demonstrated enlarged superior mediastinal lymph nodes compressing and obstructing both brachiocephalic veins and the distal segment of the SVC. The acute onset of symptoms raised a strong suspicion of acute thrombosis, and the patient was brought to the angiography department for a venogram and (if possible) for interventional recanalization of the obstructed vessels.

Access was gained via a 5F-size sheath in the right common femoral vein, as preinterventional Doppler examination of all the possible access sites unmasked the presence of an obstructive thrombus in the right internal jugular vein and a narrow lumen of the right brachial vein. Initially, a 0.035-inch hydrophilic guidewire (Radiofocus, Terumo, Somerset, NJ) was used for catheterization of the right brachiocephalic vein, but the occlusion was resistant to guidewire passage. Then, the guidewire was advanced to the left brachiocephalic vein and, after selective catheterization, the venogram through a vertebral catheter revealed total occlusion of the SVC at the level of the brachiocephalic veins confluence and the presence of a large acute thrombus in left brachiocephalic vein (Figs. 1A, B).

Due to the patient's acute onset of symptoms and her deteriorating clinical condition, it was decided (after consulting with her attending physician) to immediately recanalize the left brachiocephalic vein and SVC by applying the Angiojet device, and then to place a stent. A supplementary informed consent was taken, and the patient was constantly monitored.

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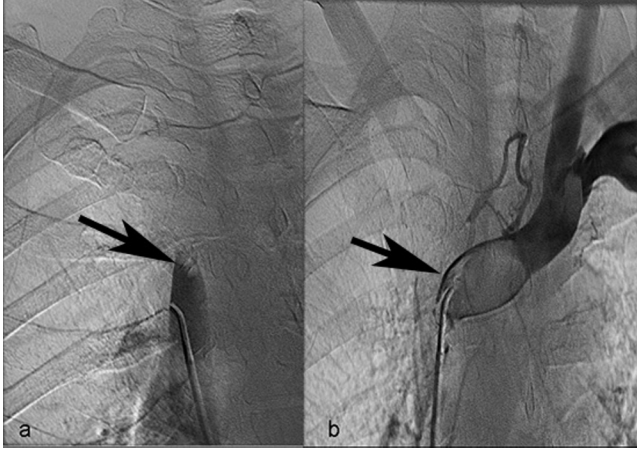
Figure 1. A. Superior vena cava venogram revealing the presence of thrombus at the more distal part of SVC at the level of brachiocephalic veins confluence (arrow). B. After selective catheterization of the left brachiocephalic vein, a large thrombus was revealed (arrow).

The introductory 5Fr sheath was replaced with a 6 Fr -40 cm long Arrow sheath, and the thrombus was crossed using an hydrophilic 0.035-inch guide wire (Radiofocus;Terumo, Somerset, NJ). The hydrophilic guidewire was then exchanged for a stiff guidewire (Amplatz Super Stiff 0,035-inch), and a 6 Fr rheolytic thrombectomy catheter was placed within the thrombus. After three passes of the Angiojet catheter through the whole length of the left brachiocephalic vein and peripheral SVC, the procedure was terminated because significant reduction in thrombus burden was observed angiographically. A postprocedure, repeat venogram revealed a partial recanalization of the two vessels (Fig. 2).

Figure 2. After rheolytic thrombectomy, the venogram revealed a partial recanalization of the left brachiocephalic vein and peripheral superior vena cava.

The patient's cardiac rhythm was monitored, as cardiac arrhythmias may occur during catheter use. The patient complained about a continuous sharp chest pain during every implementation of the thrombectomy rheolytic system, which was not followed by ECG changes and was relieved with the deactivation of the device.

Finally, a self-expanding stent (14mm-60mm Bard E-Luminex Vascular stent) was placed in the vessel lumen, followed by balloon dilation (Figs. 3A, B).
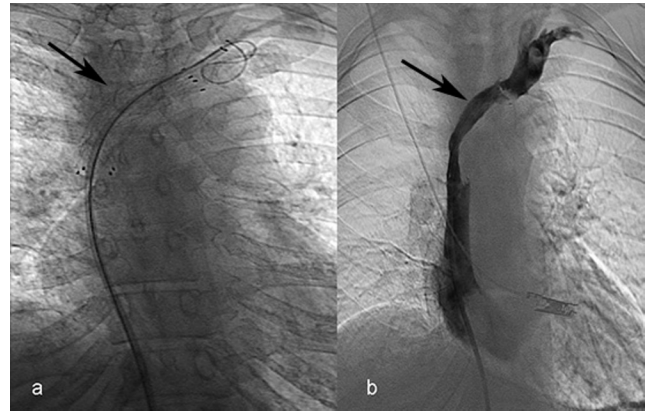

Figure 3. A. A stent (arrow) was deployed in the left brachiocephalic vein. B Venogram after stent deployment (arrow).

The final venogram revealed a satisfactory patency of the SVC and left brachiocephalic vein, and no treatment complications were noted. The neck and arm swelling decreased, as well as the self-reported shortness of breath, which was relieved within a few minutes after the end of the procedure. The patient was hospitalized for continuing heparin therapy (to ensure stent patency), and was then discharged.

At 3-month followup, the patient was still asymptomatic, and the followup CT scan confirmed a patent left brachiocephalic vein and SVC with the stent in place, without any complications (Figs. 4A, B).
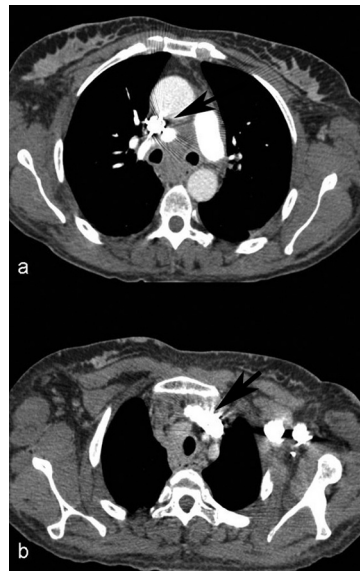

Figure 4. At 3-month followup CT with intravenous contrast media, a patent left brachiocephalic vein (A, arrow) as well as superior vena cava and the stent in place (B, arrow) were imaged.

Discussion

SVC and brachiocephalic vein thrombosis, especially SVC, occurs when a mechanical obstruction occludes the SVC. Obstruction may either be the result of extraluminal compression by a tumor or enlarged lymph nodes (1), or intraluminal obstruction by thrombosis or tumor. Acute and complete obstruction of the SVC is caused more often by thrombosis than by compression or infiltration by a tumor (2). Risk factors for the formation of thrombus in the SVC include a hypercoagulable state in patients with malignancy, damage to the intima of the SVC from central venous catheters, and venous stasis from extraluminal compression (3, 4). The most common causes are bronchogenic carcinoma (small-cell lung cancer and [less frequently] NSCLC) (5) and lymphoma. In the present era, benign causes account for 20-40% of cases of SVC syndrome.

Symptoms may include cough; dyspnea; orthopnea; dysphagia; swelling of the face, neck and upper extremities; and severe headache, as well as distension of the superficial collateral veins in the chest wall (6). When venous circulation through the SVC is impaired, venous hypertension, venous stasis, and decreased cardiac output may ensue. If untreated, these symptoms progress to laryngeal and cerebral edema, stupor, coma, pulmonary complications, and death. Contrast-enhanced CT is the preferred diagnostic modality (5).

Traditionally, the treatment of choice for patients with mediastinal vein obstruction is radiotherapy, chemotherapy, or surgery (7). In order to acutely restore vascular flow and palliate symptoms, mechanical or pharmaceutical thrombolysis and endoluminal stenting may be performed. In our case, there was a successful clinical outcome with the combined use of rheolytic thrombectomy and stent placement in one treatment session. A variety of therapeutic strategies may be employed in the individualized clinical setting, in the absence of large-scale trials comparing therapeutic alternatives.

Available therapies include medical therapy (anticoagulation, corticosteroids), venous bypass, chemotherapy, external beam irradiation, and endovascular therapy. Evidence-based guidelines for management of SVC thrombosis in malignancy, according to National Comprehensive Cancer Network (NCCN) guidelines version 2012.1, support anticoagulation therapy and pharmacomechanical thrombolysis. Endovascular stenting is a safe and effective, minimally invasive technique for acute symptom relief of SVC obstruction and is preferred, as the average survival of patients with malignancy complicated by SVC syndrome is 6 months. Stenting usually provides instant relief of symptoms and, as it does not interfere with chemotherapy and radiotherapy, they can be combined. The main indication for stent placement is symptomatic malignant SVC obstruction, either at initial presentation or after failed chemotherapy or radiotherapy (8). There are no absolute contraindications to stent placement. Relative contraindications are malignancies with a very good chance of cure or remission. In addition, stenting should be avoided if at all possible in benign disease, because patients have long life expectancies

and occlusion of the stent would be expected during long-term followup (8). Success rates range between 95% and 100%, and 1-year primary patency rates are between 64% and 76% (9). Symptoms may recur, usually as a result of thrombotic occlusion of the stent (reocclusion due to thrombosis or tumor in-growth was only 11%, as compared to 17% to 19% with radiation or chemotherapy). This can be treated with thrombolysis or further coaxial stent placement.

Thrombectomy or thrombolysis is often attempted before stent deployment, when stent placement is difficult or dangerous due to the presence of a large amount of thrombus. In one series, technical success of transcatheter thrombolysis and stent placement was 95%, with primary clinical patency of 79% in patients with underlying malignancy (10). However, catheter-directed thrombolysis before stent placement is usually time-consuming (12 to 48 hours), and with a high procedural risk for the patient. More specifically, there is a greater risk of hematoma, gastrointestinal bleeding, epistaxis, hemoptysis, and stent insertion morbidity. In order to avoid the adverse effects of pharmaceutical thrombolysis, we chose to perform percutaneous mechanical thrombectomy

Rheolytic thrombectomy is a type of mechanical thrombectomy that has been used to remove thrombus in coronary arteries, saphenous vein grafts, and peripheral veins and arteries, and in clotted dialysis fistula grafts plus cases of dural sinus thrombosis, with good results. It has been also used successfully to treat both pulmonary embolism (11) and deep-vein thrombosis. The literature provides only case reports of combined pharmacomechanical thrombolysis in SVC thrombosis, and not a single case of rheolytic thrombectomy (12).

The rheolytic thrombectomy catheter's function is based on the principle of Bernoulli. High-speed saline jets through a small-caliber tip create a negative pressure zone, causing a vacuum effect. The thrombus is pulled from the vessel and is fragmented into particles smaller than erythrocytes. These particles are then evacuated through the body of the catheter and collected into a collecting bag. Several sizes of rheolytic thrombectomy catheters can be used, including 4F 135-cm (used mainly for coronary intervention), 5F 140-cm, and 6F 120-cm (used mainly for peripheral vascular intervention) that are designed to go over a 0.014-inch guidewire. The maximum volume recommended to be aspirated is approximately 200–600 mL, depending on the catheter diameter and on whether the treated vessel is occluded or not (13).

The rheolytic thrombectomy catheter system has the advantage of being able to clear a vessel with a much larger diameter than the catheter diameter, compared to other mechanical devices. In addition, a shorter revascularization time is needed, which may reduce complications such as hemorrhage or distal embolization of a clot. Even in cases of combined pharmacorheolytic thrombolysis, this system can reduce the amount of thrombolytic agent administered, thereby reducing the risk of hemorrhagic conversion, which is one important advantage (14).

The usual observed complication is transient hemolysis. Although hemolysis is usually well tolerated, it can rarely cause arrhythmias. Other complications of rheolytic thrombectomy, which are rare in experienced operators, include wound hematoma and infection, a reperfusion syndrome with hemorrhage, and distal embolization. Additionally, the cost of the pump-drive set and the risk of fluid overload are important factors to take into consideration. Due to procedure-related complications and deaths (most commonly hemoptysis), FDA has issued a black-box warning for the Angiojet device (15).

In conclusion, SVC and brachiocephalic vein thrombosis, clinically presented as SVC syndrome, is an everyday complication in patients with lung cancer. Treatment options include thrombolysis or thrombectomy with stent placement along with radiotherapy and chemotherapy.

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