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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Successful Catheter-Directed Thrombolysis of Massive Bilateral Upper Extremity DVT Presenting as Superior Vena Cava Syndrome

Yashwant Agrawal, MD,[a] Jean-Yves R. Nazroo, BSc, MS,[a] Nihar Jena, MD,[a] Vince Marceau, BSc,[a] Dominika Zoltowska, MD,[b] Michele DeGregorio, MD,[a] Kirit Patel, MD[a]

ABSTRACT

Superior vena cava syndrome (SVCS) is traditionally associated with malignancy. However, approximately one-third of SVCS cases are due to intravascular devices and pacemakers. No specific guidelines exist for managing catheter-associated SVCS. We present catheter-associated SVCS resistant to anticoagulation, angioplasty, and thrombectomy but resolved with ultrasound-assisted catheter directed thrombolysis. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2019;1:803–6) © 2019 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 54-year-old man undergoing plasmapheresis via a right internal jugular vein (IJV) Ash catheter (Bard HemoStar, Tempe, Arizona) for Hashimoto's encephalitis presented to the emergency department after continued suffering from facial swelling, globus sensation, and dyspnea for 3 days. His plasmapheresis occurs monthly and his last Ash catheter change was 59 days before presentation because of blood culture-proven bacteremia. Initial vitals were normal. Physical examination was significant for swelling, erythema, and a diffusely tender neck. The superior aspect of the anterior chest wall was erythematous as well.

LEARNING OBJECTIVE

- For successful CDT of massive bilateral upper-extremity deep vein thrombosis presenting as SVC syndrome, it is important to understand the etiology of SVCS, the role of EKOS CDT in treating catheter-associated SVCS, and to appreciate the emerging literature supporting CDT as a treatment modality worthy of more immediate consideration in catheter-associated SVCS.

MEDICAL HISTORY

The patient had experienced takotsubo cardiomyopathy, immunoglobulin G deficiency, hypothyroidism, rheumatoid arthritis, Barrett's esophagus, hypertension, transient ischemic attack, and seizure.

DIFFERENTIAL DIAGNOSIS

Differential diagnoses included cellulitis, right heart failure, tricuspid regurgitation, retropharyngeal abscess, and goiter.

From the [a]St. Joseph Mercy Oakland Hospital, Pontiac, Michigan; and the [b]University of Florida College of Medicine, Cardiovascular Disease Fellowship, Jacksonville, Florida. The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Informed consent was obtained for this case.

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ABBREVIATIONS AND ACRONYMS

AV = axillary vein

BCV = brachiocephalic veins

CDT = catheter-directed thrombolysis

CTV = computed tomography with venogram

EKOS = EndoWave infusion catheter system

IJV = internal jugular vein

SCLV = subclavian veins

SVCS = superior vena cava syndrome

INVESTIGATIONS

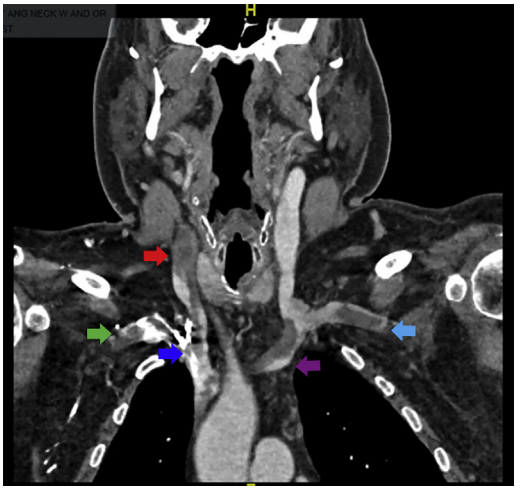
Initial laboratory results were within normal limits. Initial computed tomography (CT) angiogram of the neck revealed a filling defect at the tip of the Ash catheter in the right IJV, as well as a 2.9 × 1.3 × 7.5-cm retropharyngeal fluid collection.

MANAGEMENT

The retropharyngeal fluid collection was drained percutaneously by interventional radiology. An intravenous heparin loading dose with a maintenance drip to a goal activated partial thromboplastin time of 55 to 75 s was initiated and he was moved from the emergency department to the CCU. However, on day 2 he developed bilateral upper extremity swelling and interval worsening of neck swelling. With worsening dyspnea, he went into respiratory distress requiring intubation. Repeat CT with venogram (CTV) revealed acute superior vena cava (SVC) thrombus with high-grade stenosis, in addition to acute thrombus within the right axillary vein (AV) and subclavian vein (SCLV) with associated persistent brachiocephalic vein (BCV) thrombus located at left IJV and SCLV bifurcation (**Figure 1**). Mechanical thrombectomy was performed by interventional radiology using a Penumbra Indigo CAT8 catheter (Penumbra Inc., Alameda, California). SVC and right BCV angioplasty followed. Stent deployment was not considered as flow was satisfactorily restored. He was then appropriately transitioned to oral apixaban and heparin was discontinued. Despite these interventions, he continued to experience worsening neck and bilateral upper extremity swelling and worsening dyspnea. Suspecting re-thrombosis, Doppler ultrasound of bilateral upper extremities was performed which revealed residual thrombus along the right IJV wall and thrombi in the bilateral AV and right SCLV causing significant stenosis. Workup for heparin-induced thrombocytopenia was negative. He was then transitioned back to intravenous heparin. Venogram showed thrombus in the SVC and the distal right IJV with stenosis of the right SCLV into AV with associated thrombus and collateralization (Video 1). Left AV and SCLV thrombosis was also shown (**Figure 2**).

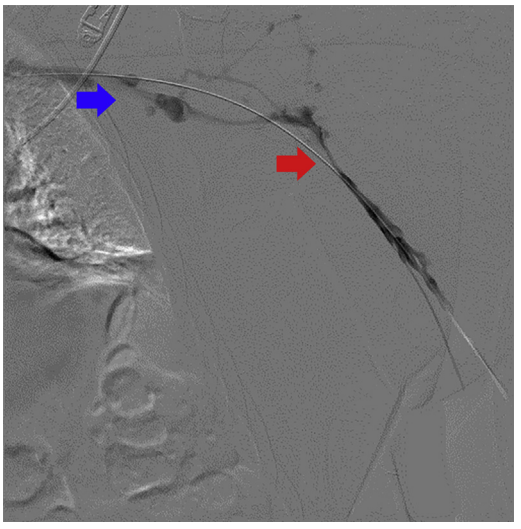
On day 16 of hospitalization, EKOS EndoWave (EKOS Corporation, Bothel, Washington) catheter-directed thrombolysis (CDT) was considered. Percutaneous transluminal angioplasty of the distal right IJV and right SCLV with placement of EKOS catheters for CDT was performed with tissue plasminogen activator (tPA) infusion at 1 mg/h for 24 h (**Figure 3**). A 0.035 Seeker support catheter (Bard, Tempe, Arizona) was used to direct EKOS catheters into all involved

FIGURE 1 Repeat Computed Tomography With Venogram



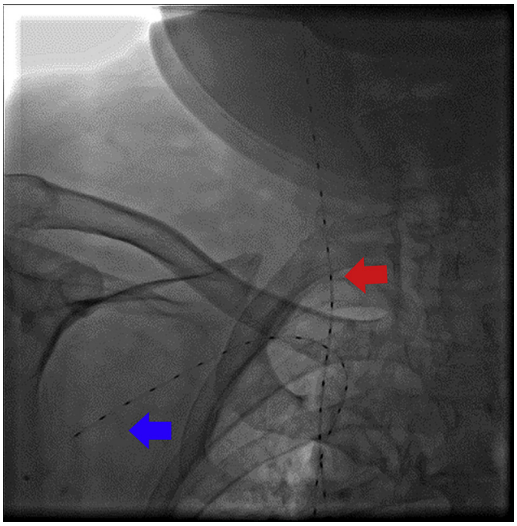
Computed tomography venogram (CTV) showing acute right axillary vein (AV) **(green arrow)**, subclavian vein (SCLV) **(dark blue arrow)**, and internal jugular vein (IJV) **(red arrow)** thrombi, as well as left brachiocephalic vein (BCV) **(purple arrow)** and left SCLV **(light blue arrow)** thrombi.

FIGURE 2 Venogram



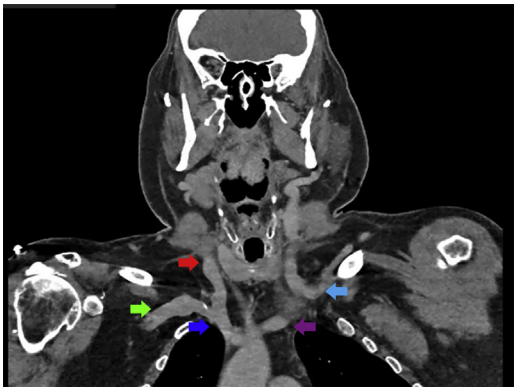
Venogram showing left AV **(red arrow)** and left SCLV **(blue arrow)** thrombosis. Abbreviations as in **Figure 1**.

FIGURE 3 Venogram



Venogram showing EKOS catheters in the right IJV **(red arrow)** and right SCLV **(blue arrow)**. Abbreviations as in Figure 1.

FIGURE 4 Follow-Up CTV



CTV showing resolution of thrombi in right AV **(green arrow)**, SCLV **(dark blue arrow)**, and IJV **(red arrow)**, as well as the left BCV **(purple arrow)** and left SCLV **(light blue arrow)**. Abbreviations as in Figure 1.

veins. On the next day, the procedure continued into the right AV. CDT with EKOS catheter and 24-h tPA infusion at 1 mg/h was then used in the left SCLV, BCV, and left brachial vein. Concomitant heparin was administered during the tPA infusion. Repeat venogram results showed resolution of thrombus burden bilaterally in the SCLV, AV, and BCV (Videos 2 and 3). Follow-up CTV results showed significant interval thrombus burden improvement in all the involved vessels (**Figure 4**). With significant clinical improvement, he was successfully extubated. There were no associated vascular or periprocedural complications, and there was no need for blood product transfusions. He was eventually discharged in stable condition.

DISCUSSION

Superior vena cava syndrome (SVCS) is defined by occlusion of SVC secondary to either thrombus formation or extrinsic compression. Traditionally, malignancy remains the most common cause of SVCS. Bronchial carcinoma, squamous cell carcinoma of the lung, and lymphomas are the most common malignancies. However, 20% to 40% of cases of SVCS are associated with the use of intravascular devices and pacemakers (1). Other risk factors associated with the higher end of this range include hypercoagulable states, increased catheter luminal diameter, multiple insertion attempts, and catheter tips located above the junction of the SVC and right atrium (2). There are no specific guidelines for management of catheter-associated SVCS. Several treatment modalities have been reported, including percutaneous transluminal venoplasty, stent implantation, thrombolysis, mechanical thrombectomy, and venous grafting (1,3-5).

Therefore, we present this case because it shows the effectiveness of CDT with EKOS and tPA infusion for massive bilateral upper extremity catheter-associated deep vein thrombosis presenting as SVCS where angioplasty has failed. Reported success rates of traditional long-term anticoagulation and venoplasty are at 84% and 75% to 100%, respectively (6). Regarding transluminal venoplasty, SVC stenting for malignant disease is cited to have a success rate of 95% to 100% with "primary and secondary patency rates of 85% and 93%, respectively, at 3 months" (7). Although distal embolization is a known complication of peripheral arterial intervention, we have been unable to find substantial literature discussing concerns of distal embolization in the setting of venous interventions. A retrospective study by Gray et al. (3) at the Cleveland Clinic reports 11 of 16 patients treated using CDT to have had an 88% success rate if CDT was performed within 5 days or less and a 25% success rate if CDT was performed beyond 5 days. In the series by Gray et al. (3), mean infusion duration was 40 to 41 h. Repeat venography was performed 12 to 24 h after initiating therapy, and as long as there was progressive thrombolysis, thrombolytic was continued until complete lysis was achieved. Hence, given the extensive central venous thrombus burden

in our patient involving not only central veins but also the SVC, in conjunction with his persistent critical condition, we followed a protocol similar to the approach used by Gray et al. (3). Furthermore, O'Dea and Schainfeld (7) report that "obstruction at the confluence of the brachial cephalic veins with the SVC poses a special problem for the interventionalist." Systemic thrombolysis with tPA can cause major bleeding events and stent deployment can cause infection, pulmonary embolism, and SVC perforation. In some cases, stents may migrate after deployment (4). More examples of CDT effectiveness for catheter-associated SVCS can be found in the literature (5). Overall, a relative paucity of literature studying the use of CDT for catheter-associated SVCS indicates need for further evaluation of its safety and effectiveness. However, as emerging literature shows promising results with CDT, stent deployment and angioplasty may very well take on new roles as second-line or adjuvant options in the treatment of catheter-associated SVCS.

FOLLOW-UP

The patient was examined in our cardiology clinic at 2, 4, and 12 weeks for follow-up after discharge. He has been asymptomatic and has returned to his baseline level of functioning and independence.

CONCLUSIONS

We present a case of central venous catheter-associated SVCS involving occlusion of the SVC, BCV, SCLV, and AV that failed to resolve with anticoagulation, percutaneous transluminal angioplasty, or mechanical thrombectomy. Treatment of this extensive thrombosis was successful with multiple sessions of CDT with EKOS.

ADDRESS FOR CORRESPONDENCE: Dr. Yashwant Agrawal, 840 Golf Drive, Apartment 202, Pontiac, Michigan 48341. E-mail: Yashwantagrawal.agrawal@gmail.com. Twitter: @maniaconboard.

REFERENCES

1. Bierdrager E, Lampmann LE, Lohle PN, et al. Endovascular stenting in neoplastic superior vena cava syndrome prior to chemotherapy or radiotherapy. Neth J Med 2005;63:20–3.

2. Wall C, Moore J, Thachil J. Catheter-related thrombosis: a practical approach. J Intensive Care Soc 2016;17:160–7.

3. Gray BH, Olin JW, Graor RA, Young JR, Bartholomew JR, Ruschhaupt WF. Safety and efficacy of thrombolytic therapy for superior vena cava syndrome. Chest 1991;99:54–9.

4. Dumantepe M, Tarhan A, Ozler A. Successful treatment of central venous catheter induced superior vena cava syndrome with ultrasound accelerated catheter-directed thrombolysis. Catheter Cardiovasc Interv 2013;81:E269–73.

5. Ghanavati R, Amiri A, Ansarinejad N, Hajsadeghi S, Riahi Beni H, Sezavar SH. Successful treatment of a catheter-induced superior vena cava syndrome through catheter-directed thrombolysis: a case report. J Tehran Heart Cent 2017;12:188–91.

6. Wilson LD, Detterbeck FC, Yahalom J. Superior vena cava syndrome with malignant causes. N Engl J Med 2007;356:1862–7.

7. O'Dea J, Schainfeld RM. Venous Interventions. Circ Cardiovasc Interv 2014;7:256–65.

KEY WORDS anticoagulation, computed tomography, Doppler ultrasound, imaging, intravascular ultrasound, shortness of breath, thrombosis, thrombus, vascular disease, x-ray fluoroscopy

APPENDIX For supplemental videos, please see the online version of this paper.