

The Single-Incision Technique for Treating SVC Syndrome

Utilizing endovascular venoplasty for central venous occlusion through a single infraclavicular incision to manage superior vena cava syndrome.

BY SEAN O'NEILL, MD; ISSAM KABLY, MD; AND GOVINDARAJAN NARAYANAN, MD

Superior vena cava (SVC) syndrome is a serious complication of thoracic malignancy. Endovascular palliative treatment of SVC syndrome related to malignancy has largely supplanted open surgical techniques. Venoplasty and endovascular stenting are associated with rapid clinical improvement and rare occurrence of complications.¹ Some authors have previously described using a dual-access technique, involving snaring and externalizing a through-wire across femoral and jugular access points.^{2,3}

In this article, we report a case of a 62-year-old patient with SVC syndrome who was treated through a single infraclavicular incision. The patient presented to our service for placement of a chest port for chemotherapy. During a single-incision procedure to place the chest port, the patient's degree of SVC narrowing was found to be greater than anticipated based on a preoperative CT scan. A successful attempt was made to treat the SVC narrowing through the single incision. Compared to the standard dual-access endovascular technique for management of SVC syndrome, this approach has the potential for decreased invasiveness, improved cosmetic result, and decreased risk of infection.

CASE REPORT

A 62-year-old man presented with 1 month of neck pain, progressive bilateral upper extremity weakness, and 30 pounds of unintentional weight loss. Magnetic resonance imaging of the spine revealed compression fractures of the C5 and C7, with epidural and paraspinal soft-tissue abnormalities extending from the C6 through T2. Further workup with CT revealed a large mediastinal mass causing marked narrowing of the SVC (Figure 1), azygous vein dilatation, and collateral vein formation. Additional lesions suspicious for metastases were identified in the adrenal

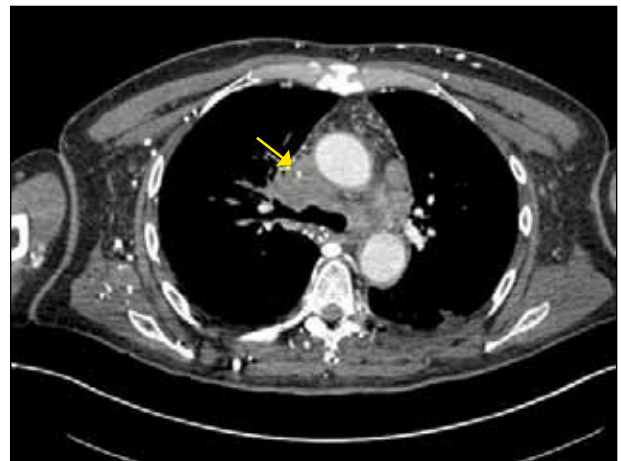


Figure 1. An axial postcontrast CT image approximately 1 month prior to port placement demonstrates a markedly narrowed SVC (arrow).

glands and liver. Biopsy of an enlarged cervical lymph node revealed poorly differentiated adenocarcinoma, most likely originating in the lung or upper gastrointestinal area.

The patient was referred to the interventional radiology department for placement of a chest port to initiate palliative chemotherapy. Ultrasound imaging of the patient's right internal jugular vein revealed that it was patent and compressible. An approximately 2-cm incision was made in the right upper chest, one finger-width beneath the clavicle, and a subcutaneous pocket was formed for the port hub. A micropuncture needle (Coaxial micro-introducer set, Bard Access Systems, Inc., Salt Lake City, UT) was bent into a gentle C shape, as described by Contractor et al.⁴



Figure 2. A fluoroscopic spot image shows the microwire looped at the junction of the SVC and left brachiocephalic vein.

The needle was then guided from the incision through the subcutaneous tissues over the clavicle, with access to the right internal jugular vein achieved under ultrasound guidance. A 0.018-inch microwire (4-F stiffened microintroducer kit, AngioDynamics, Latham, NY) was introduced under fluoroscopic guidance. The microwire could not be advanced into the SVC and instead became coiled in the brachiocephalic vein (Figure 2). The micropuncture needle was therefore exchanged for the 4-F coaxial micropuncture sheath (AngioDynamics). The sheath was repeatedly advanced and retracted through the subcutaneous tissues to create a tunnel. Contrast was injected for central venography, which revealed near-complete occlusion of the SVC with collateral vessels, as well as stenosis of the left brachiocephalic vein (Figure 3).

The micropuncture sheath was carefully exchanged for an 8-F vascular sheath (Brite Tip sheath introducer, Cordis Corporation, Bridgewater, NJ), which necessitated further tunneling through the subcutaneous tissues (Figure 4). A second contrast injection suggested the presence of filling defects in the left brachiocephalic vein. The microwire was removed, and a 0.035-inch Glidewire (Terumo Interventional Systems, Somerset, NJ) with KMP catheter (4-F Beacon Tip Torcon NB Advantage catheter, Cook Medical, Bloomington, IN) combination was used to successfully cross the SVC into the right atrium. The Glidewire was exchanged for a 0.035-inch Rosen wire (Cook Medical), which was advanced into the inferior vena cava. Intravenous heparin was then administered. Subsequently, serial dilatation of the SVC stenosis with 8-mm X 4-cm and

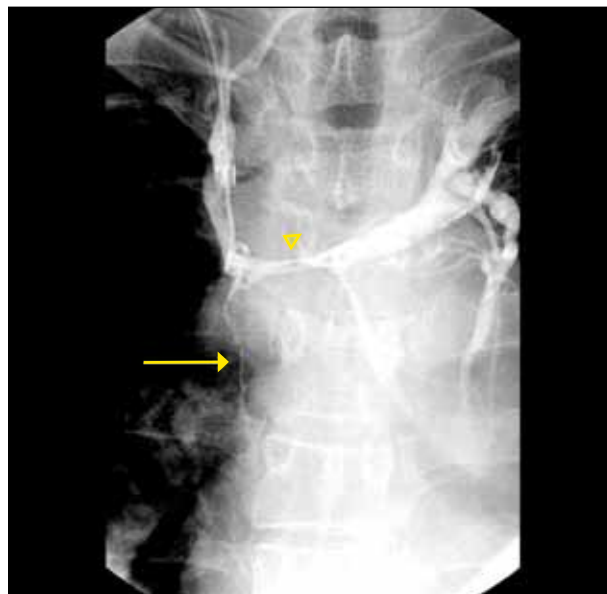


Figure 3. A fluoroscopic image during contrast injection demonstrates a markedly narrowed SVC (solid arrow), as well as narrowing at the junction of the left brachiocephalic vein with the SVC (arrowhead).

then 12-mm X 4-cm Conquest PTA dilatation catheters (Bard Peripheral Vascular, Inc., Tempe, AZ) was performed (Figure 5). Postdilatation contrast injection demonstrated recanalization of the SVC (Figure 6).

We then turned our attention to the stenosis at the junction of the left brachiocephalic vein and the SVC. The stenosis was crossed with a Glidewire and dilated with the 8-mm X 4-cm balloon. Postdilatation venography showed minor



Figure 4. An intraoperative photograph showing the vascular sheath through the single infraclavicular incision with an attached normal saline drip line. A KMP catheter alongside a Rosen wire are traversing the sheath.

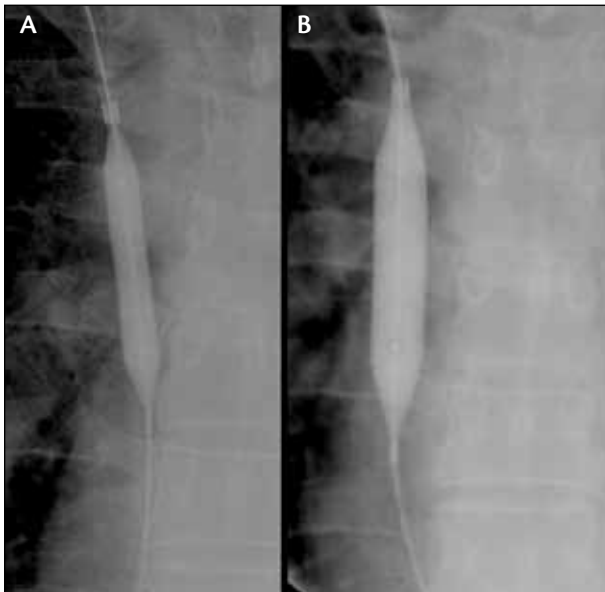


Figure 5. Serial dilatation of the SVC with an 8-mm X 4-cm balloon (A) followed by a 12-mm X 4-cm balloon (B).

improvement in the stenosis and a decrease in prominence of the collateral vessels (Figure 7).

Thereafter, the brachiocephalic Glidewire was withdrawn, and the catheter tubing for the chest port was advanced over the Rosen wire into the right atrium. The vascular sheath was removed, and a chest port (SlimPort dual-lumen Rosenblatt implantable port, Bard Access Systems, Inc.) was placed in the method described by Contractor et al (Figure 8). The patient tolerated the procedure well, with no complications. The primary team responsible for the patient's care subsequently placed the patient on a full treatment dose of dalteparin, given the finding of thrombus in the left brachiocephalic vein. During the patient's most recent follow-up visit, 5 months after our procedure, he showed no clinical signs or symptoms to suggest SVC syndrome.

DISCUSSION

Originally described by Glenn in 2007, then refined by Contractor et al in 2009, the single-incision technique for central venous access is an efficient, cosmetically superior alternative to the conventional double-incision technique for chest port and tunneled catheter placement.^{4,5} The technique involves bending the conventional micropuncture needle into a C shape. Through a single infraclavicular incision, the needle is advanced superiorly over the clavicle. Using ultrasonographic guidance, the internal jugular vein is accessed, with the bevel of the needle pointing inferiorly to facilitate easy passage of a microwire into the vein. Subsequently, a standard coaxial sheath and a vascular

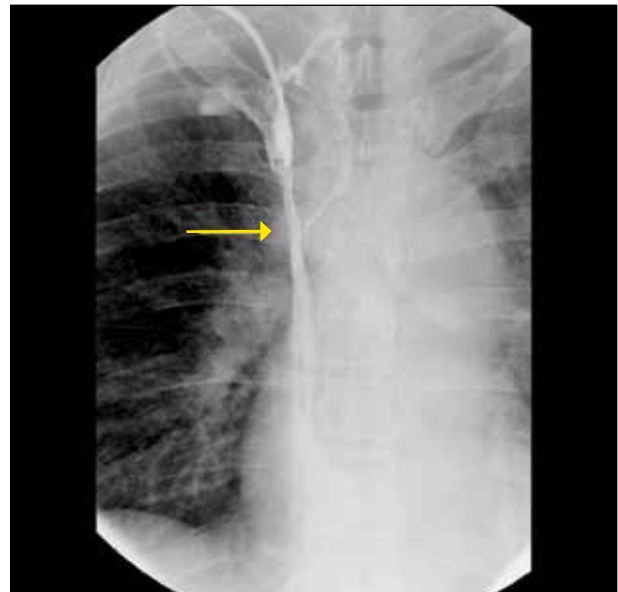


Figure 6. Postdilatation venography demonstrates enlargement of the SVC diameter.

sheath are used to advance the tubing of the chest port or tunneled dialysis catheter into the right atrium.

The major limitation of the technique is that, in some cases, the patient's body habitus can preclude access to the internal jugular for a given micropuncture needle length. In such situations, the case can quickly be converted to the standard double-incision technique. The benefits include improved cosmesis, given that the single incision is typically below the patient's collar line. There is also elimination of subcutaneous trauma from the metal tunneling device required in the conventional technique. Additionally, the

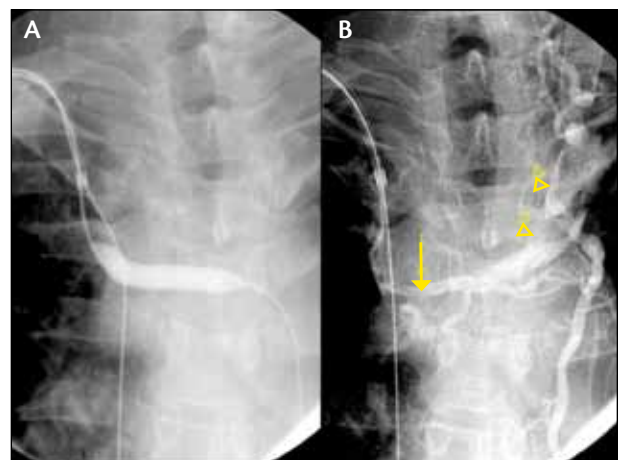


Figure 7. Dilatation of the brachiocephalic-SVC junction with an 8-mm X 4-cm balloon (A), with subsequent mild improvement in the degree of stenosis (B, arrow) and the presence of intraluminal filling defects (B, arrowheads).

rate of infection may be lower due to the elimination of one skin incision.

Standard management of SVC syndrome involves treating the symptoms as well as the underlying disease process. Basic supportive care includes elevation of the head, fluid restriction, and diuretics.¹ In severely symptomatic patients, treatment can involve irradiation or chemotherapy (in the case of extrinsic compression by a tumor), bypass surgery, or endovascular techniques such as venoplasty or stenting. Chemotherapy and radiation may take days to have any effect, and bypass surgery is invasive, particularly if performed in a palliative setting. Therefore, endovascular treatment is gaining acceptance as first-line management for the rapid relief of symptoms from SVC syndrome.

The procedure usually involves a vascular sheath placed via a femoral approach, preceded by administration of a heparin bolus. Some have described placement of a wire through the femoral access point and snaring it via a second jugular access point for externalization of a through-wire.^{2,3} Thereafter, balloon dilation of the narrowed SVC is performed. Across the stenosis, a stent of a slightly larger diameter than the narrowed venous segment is placed to decrease risk of stent migration. If there is significant improvement with balloon venoplasty alone, stent placement may not be necessary. Anticoagulation is typically recommended if a stent is used. Complications with endovascular treatment are rare but include stent migration, pulmonary embolism, and pericardial effusion or tamponade.¹

In our case, we encountered an unexpected degree of SVC narrowing during placement of a chest port via the single-incision technique. The microwire could not be advanced into the right atrium, so we performed venography through the coaxial sheath, which showed the nearly occluded SVC and narrowed brachiocephalic junction. Rather than making a second femoral access point, we elected to dilate the subcutaneous passage over the clavicle into the internal jugular vein to a sufficient degree to allow passage of an 8-F vascular sheath. Subsequently, we were able to pass a stiffer wire past the SVC into the right atrium and balloon dilate the SVC and brachiocephalic stenoses via the single access. At the end of the procedure, we successfully placed the chest port, with the catheter tip in the right atrium. To our knowledge, endovascular treatment of SVC syndrome via a single infraclavicular incision has not previously been described.

CONCLUSION

With our case, we have demonstrated that it is possible to obtain a sufficient access point (via an 8-F vascular sheath) with the single-incision technique to perform an intervention such as balloon venoplasty for SVC syndrome. If indicated, a stent could be placed through a vascular sheath of this diameter. Additionally, our technique did not



Figure 8. A postprocedural image of the right chest port in its final location.

necessitate a second femoral venotomy for a through-wire. Compared to the standard dual-access endovascular technique for management of SVC syndrome, this approach has the potential for decreased invasiveness, improved cosmetic result, and decreased risk of infection. ■

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1. Lepper PM, Ott SR, Hoppe H, et al. Superior vena cava syndrome in thoracic malignancies. *Respir Care*. 2001;56:653-666.
2. Malinowski M, Milner R. Recurrent SVC syndrome treatment. *Endovasc Today*. 2012;11:30-31.
3. Lauten A, Strauch J, Jung C, et al. Endovascular treatment of superior vena cava syndrome by percutaneous venoplasty. *Heart Lung Circ*. 2010;19:681-683.
4. Contractor SG, Phatak TD, Klyde D, et al. Single-incision technique for tunneled central venous access. *J Vasc Interv Radiol*. 2009;20:1052-1058.
5. Glenn BJ. Single-incision method for the placement of an implantable chest port or a tunneled catheter. *J Vasc Interv Radiol*. 2007;18:137-140.