Malignancy-Related SVC Syndrome

Endovascular treatment of this patient population has been shown to be effective.

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Superior vena cava (SVC) syndrome is an uncommon entity that affects approximately 15,000 Americans per year. Symptoms result from near or complete obstruction of the SVC and include facial and upper-extremity edema, chest pain, cough, dyspnea, dysphagia, proptosis, cyanosis, and headache. The severity of these symptoms relies upon the degree of SVC compression and the location of the obstruction relative to the azygous vein or other potential routes of collateralization.[1-7]

Although 5% to 20% of SVC syndrome cases arise as a result of fibrosis after thrombosis or the presence of indwelling catheters, the majority of cases are caused by malignancy. Lung cancer accounts for 65% to 85% of malignant SVC syndrome, and the remaining cases are secondary to lymphoma, mediastinal masses, tumors of the breast, mesothelium, thyroid, thymus, esophagus, or other rare malignancies. It is estimated that 3% to 15% of patients with lung cancer and 5% to 20% of patients with intrathoracic malignancy develop SVC syndrome.[5,7-13] In contrast to SVC syndrome of nonmalignant etiology, malignancy-related SVC syndrome is usually progressive, and prompt treatment is often critical. Quality of life is dramatically affected with SVC syndrome. With malignant causes, SVC syndrome typically evolves over a course of 2 to 4 weeks. In nonemergent cases, palliation of symptoms is usually the goal. SVC syndrome becomes a medical emergency, and prognosis suffers if serious cerebral edema develops or if laryngeal edema compromises airway patency.[5]

CONVENTIONAL TREATMENTS

Before endovascular treatment methods became widely available, relief of venous obstruction was possible only through supportive therapy, radiation, chemotherapy, or in rare cases, surgical intervention. Chemotherapy and radiation therapy can effectively reduce tumor burden by approximately 60% to 80%,

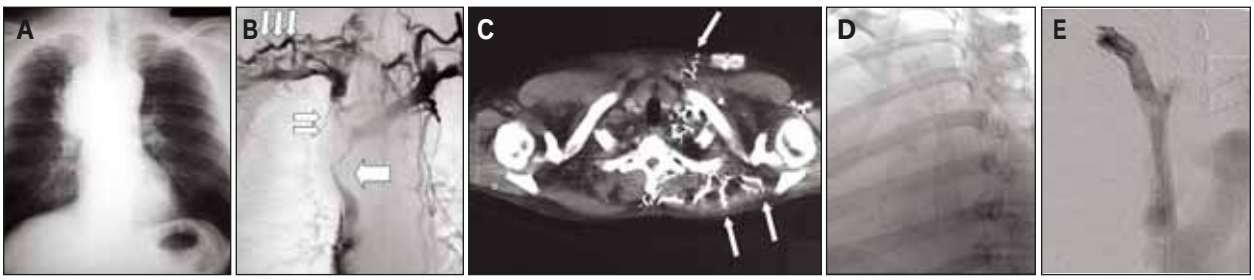

Figure 1. A 45-year-old man developed SVC syndrome caused by a primary mediastinal lymphoma, as evidenced by the large mediastinal mass on a chest x-ray (A). Bilateral upper-extremity venography revealed a high-grade SVC stenosis (single arrow), right innominate vein stenosis (double arrows), and prominent venous collateral networks (triple arrows) in the upper chest due to proximal venous obstruction (B). The prominent venous collaterals are seen in a CT scan of the upper chest wall (arrow) (C). A self-expanding Wallstent (Boston Scientific Corporation, Natick, MA) (16 mm X 90 mm) is deployed to treat the SVC and right innominate vein stenosis (D). Completion venography demonstrated resolution of the right innominate and SVC compression after placement of the Wallstent (E).

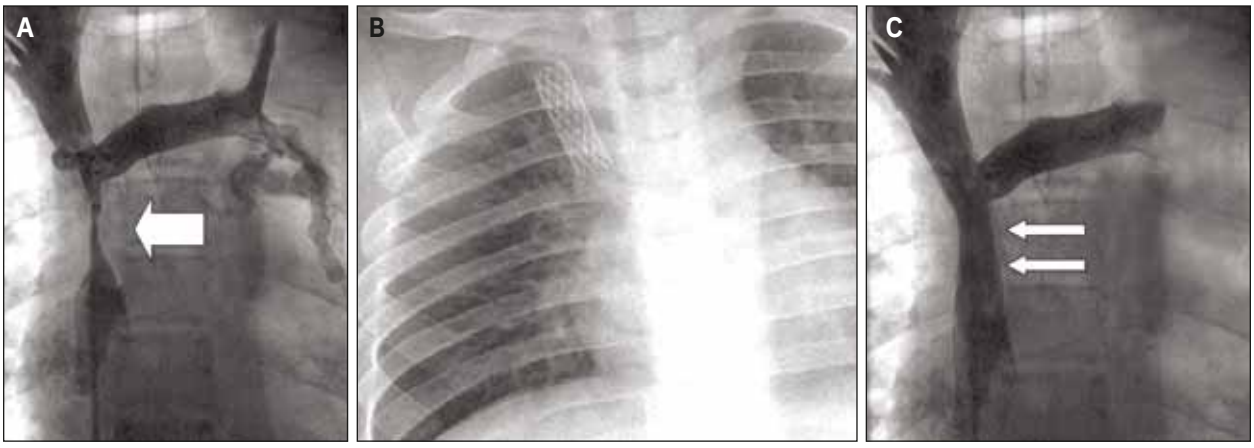

Figure 2. A superior vena cavagram of a 65-year-old man with a squamous cell carcinoma of the lung demonstrated a symptomatic compression of the SVC (arrow) (A). A balloon-expandable Palmaz 4010 stent (Cordis, a Johnson & Johnson company, Miami, FL) was deployed to treat the SVC compression (B). Completion cavagraphy revealed an excellent radiographic result of the SVC (double arrows) after deployment of the Palmaz stent (C).

and improvement of symptoms occurs in as many as 90% of cases. However, with these treatment modalities, it may take 3 to 4 weeks before regression in tumor size adequately relieves caval compression, and thus their utility in an emergent setting is limited. Chemotherapy and radiation therapy are generally temporising measures, and recurrence rates between 10% and 50% have been reported. Surgical bypass to re-establish venous return from the SVC has been utilized in SVC syndrome refractory to conservative therapy.[8,12,14-20]

INTERVENTIONAL TECHNIQUES

With the development of interventional techniques, new treatment methods have become available to alleviate symptoms of SVC syndrome. Simple balloon angioplasty or venoplasty has been attempted, although results have been poor.[15] Stent placement, first reported in 1986 by Charnsangavej et al, has been shown to be effective for malignancy-associated SVC syndrome.[21] SVC stenting has offered immediate symptomatic improvement and complete resolution of symptoms in 68% to 100% of patients.[7,13] SVC stenting should be offered in the event of failure of chemotherapy or radiation therapy based on the persistence or progression of SVC syndrome symptoms.[11-13] Stent placement does not preclude the use of adjuvant therapy, and the addition of radiation therapy may provide prompt resolution of symptoms.[7] SVC stenting prior to chemotherapy can additionally allow patients to receive the extensive hydration that is required in some chemotherapy regimens, which would otherwise exacerbate SVC syndrome symptoms. SVC stenting has also assisted in establishing the correct diagnosis in certain cases.[8]

TREATMENT

In an emergency setting, there is little alternative to prompt intervention. SVC stenting can rapidly alleviate symptoms of malignancy-related SVC syndrome.[16] In these instances, SVC stenting has become the standard therapy for severe or rapidly progressive symptoms related to SVC syndrome. It has also been indicated with failure of chemotherapy or radiation therapy based on persistence or progression of symptoms.[11-13]

Symptomatic grading scales have been described based upon facial, neurologic, and respiratory symptoms. The Stanford classification categorizes SVC syndrome based on the degree of stenosis and the direction of flow of the azygous vein. The anatomic and physiologic relationship of these two criteria correlate well with clinical symptoms (Table 1).[3]

Imaging techniques are utilized universally for the assessment of stenosis or obstruction. Venography and CT are utilized to assess the degree of stenosis.[1,12,13,16] Anatomic criteria differ but obstructions ranging from 50% to 90% have been described as significant.[7,8,16] MRI has also been implemented to aid in diagnosis but is not as widely used.[1] Duplex sonography is helpful to determine thrombosis in the extremities but is rarely used for thoracic imaging. Although duplex sonography has been utilized to determine blood flow and velocity in the SVC, its effectiveness in visualization of the azygous and collateral vessels is uncertain.[22] Direct caval pressures can be measured and are helpful in stratifying patients into treatment groups. SVC pressure greater than 22 mm Hg has been associated with severe clinical symptoms and has been used as a threshold for treatment.[11]

STENT DEVICES

A variety of devices are available for use in SVC syndrome. Experience with three particular stents has been widely published in the literature. The Palmaz stent, the Wallstent, and the Gianturco Z-stent (Cook Incorporated, Bloomington, IN) have been well described, but there are no large prospective trials comparing these devices.[2]

The stents are similar in their general design; however, each possesses distinct features. The stents are stainless steel and configured in a tubular lattice. Stents utilized in the treatment of SVC syndrome can be either self-expanding or balloon-expandable stents (Figures 1 and 2). The Wallstent is the most frequently used self-expanding device.[2] Advantages of the self-expanding stents include the "memory" inherent to the device because the stent exhibits a continuous externally directed force, and transient compression will not permanently collapse it. The selection of an appropriate stent should also include the determination of appropriate length and diameter. Proper length may be difficult to anticipate, and stents may exhibit foreshortening after deployment (eg, by as much as 30% as with the Wallstent).[12,23] Self-expanding stents should be oversized by 120% to 150% of the diameter of the reference vessel.[7,12] This type of oversizing is not recommended with the Palmaz stent, which represents an example of a balloon-expandable stent in which greater relative sizes have been suggested to precipitate acute thrombosis.[7]

RESULTS

Relief of symptoms is brisk after endoluminal stent placement, with complete resolution of symptoms occurring within 24 to 72 hours in 68% to 100% of patients.[7] In SVC syndrome of nonmalignant etiology, recurrence of symptoms is rare due to the slow or even nonprogressive nature of benign etiologies.[24] Reported complication rates vary between 0% and 50% of cases, and include bleeding, infection, stent migration or occlusion, and pulmonary embolus.[2,6] With malignancy-related SVC syndrome, symptoms recur in 12% to 20% of cases.[13,25] Potential causes of failure include improper stent placement, continuing expansion of tumor exacerbating the mass effect on the SVC, or overgrowth and extension of the tumor into the caval lumen.[13]

TABLE 1. STANFORD GRADING SYSTEM FOR SVC OBSTRUCTION

Type	Description
I	Up to 90% stenosis with patency of the azygous vein
II	90%-100% stenosis of SVC with patency of the azygous vein and antegrade blood flow through azygous vein
III	90%-100% stenosis of SVC with patency of the azygous vein and retrograde flow through the azygous vein
IV	Complete obstruction or occlusion of the SVC and one or more of its branches including the azygous vein

SVC stenting for intraluminal tumors has been shown to be less successful than stent deployment for extrinsic compression.[7] The nature of the tumor should be identified prior to treatment. "Tight-weave" Wallstents, or even fabric-covered stents, may limit intravascular tumor growth and reobstruction, and may be superior to the "open-design" of a Gianturco Z-stent.[12,26] A disadvantage with covered stents is the obstruction of SVC tributaries, which may be counterproductive when the aim of therapy is the relief of venous obstruction.

Thrombosis at the stent site occurs in up to 21% of cases.[12] Endothelial injury with stent deployment, slow venous blood flow, thrombogenicity of the device, and the hypercoagulable state associated with malignancy all predispose patients to thrombotic complications. In this setting, thrombolysis may be utilized in conjunction with anticoagulation during and after stent placement.[7,27] Caution should be exercised, however, because serious bleeding complications can be associated with thrombolysis in this patient population. A diameter of at least 50% of the reference vessel has been suggested as a minimum goal after stent deployment to avoid complications with certain stents. If contraindications to thrombolytic therapy exist, extrication of thrombus can be achieved with a thrombectomy catheter such as the Helix Clot Buster, Amplatz (formerly the Amplatz device; ev3, Inc., Plymouth, MN).[18,27,28]

Stent migration is a reported complication that can be minimized with a careful approach. Migration typically occurs proximally, toward the right atrium. The final conformation of the stent should have a slight middle taper, or a "waist," to minimize proximal or distal migration.[29] Double stents fixed at the common central seam have also been proposed to minimize migration.[12] Alternatively, angioplasty can facilitate the grasp of barbs to improve the stability of the Gianturco Z-stent within the venous lumen.[2] Stent migration into the right ventricle across the tricuspid valve has been reported with Wallstent placement.[30]

Induction of cardiac arrhythmia during SVC stenting is a rare, although known complication. The proximity of the stent to the right atrium, coupled with potential sudden right heart volume overload, has precipitated

supraventricular tachycardia, which was managed medically without lasting complications.[8]

SUMMARY

In the 20 years since the first reported deployment of an endoluminal stent for palliation of symptoms of malignancy-associated SVC syndrome, the understanding of the role of stenting to alleviate the symptoms has grown. When intrathoracic malignancies progressively collapse or occlude the SVC leading to the development of SVC syndrome, life-threatening symptoms including cerebral edema and respiratory emergency may develop. SVC stenting may be life saving and has become the standard of care in the emergency setting. In the absence of an emergency situation, palliation becomes the goal of therapy. Endovascular stent placement with or without radiation therapy has been shown to be very effective for the relief of symptoms in this patient population.

Certain areas require more study and investigation. The use of long-term anticoagulation and thrombolysis varies widely, and indications have not been clearly described. There are also drawbacks and benefits that have been identified with each of the commonly used stents. Although the nature of malignancy does not practically allow for prospective investigation of the stents, larger studies may identify trends of success and complications with each of the devices. ■

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