

CLINICAL VIGNETTE

Superior Vena Cava Syndrome

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Case Report

A 75-year-old female came to the Emergency Department complaining of upper extremity swelling and shortness of breath. These symptoms had been present for 3 weeks and had progressively worsened. On the day of admission, the patient reported significant dyspnea at rest. She also had a cough productive of clear sputum for several months. Past medical history was significant for osteoporosis and a 60 pack-year history of smoking. Medications included alendronate and aspirin. Examination revealed a blood pressure of 190/100 mm Hg, heart rate of 101 beats/min, respiratory rate of 18 breaths/min, and oxygen saturation of 95% on room air. There was facial, neck, and severe upper extremity swelling. Besides distended neck veins, the cardiovascular and pulmonary examinations were within normal limits. Laboratory studies and electrocardiogram were normal. Chest radiograph (**Figure 1**) showed right hilar lymphadenopathy with associated right upper lobe collapse and small pleural effusions. Computed

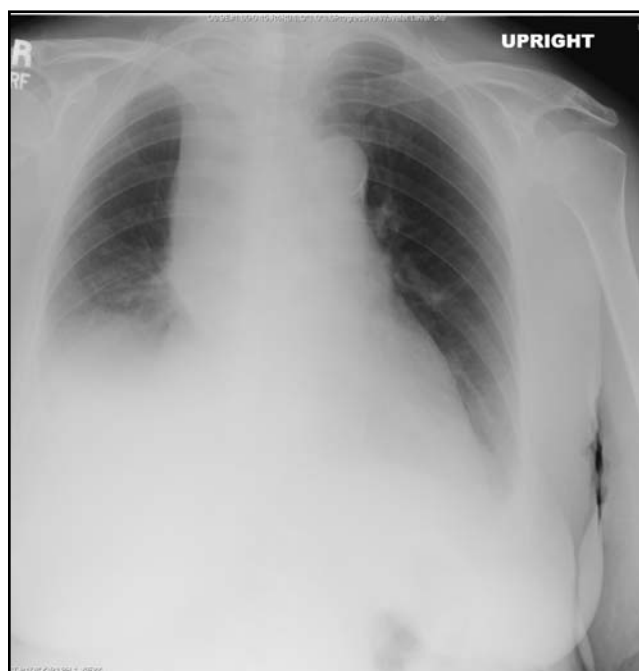


Figure 1. Chest radiograph

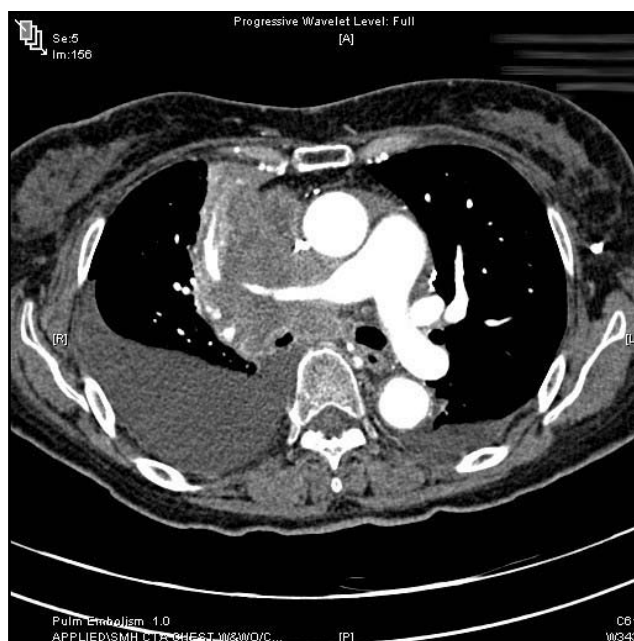


Figure 2. CT angiogram of the chest

tomographic angiogram of the chest (**Figure 2**) revealed a right paratracheal mass encasing the superior vena cava (SVC) causing stenosis with moderate collateralization across the chest wall. In addition, the mass encroached on the right mainstem bronchus and there was complete collapse of the right upper lobe and bilateral pleural effusions. Upper extremity venous duplex scan showed bilateral subclavian vein deep vein thrombosis. Bronchoscopy with endobronchial biopsy was performed which revealed small cell lung cancer (SCLC). Subsequently, angioplasty and endovascular SVC stent placement were performed by interventional radiology (**Figure 3**). The patient had almost immediate subjective relief of her symptoms. A diagnosis of superior vena cava syndrome secondary to SCLC was given and oncology was consulted for further treatment.

Discussion

Superior vena cava (SVC) syndrome most frequently occurs in patients with malignancies and is one of the oncologic emergencies that confront clinicians. The syndrome occurs as a result of obstruction of the SVC by external compression, tumor invasion, or thrombus. The vast majority of cases of SVC syndrome are caused by malignancies.¹⁻³ Benign causes are much less frequent, but thrombosis associated with the use of intravascular devices has emerged as an increasingly important cause.³ Patients usually

present with typical features resulting from an increase in central venous pressure caused by vena cava obstruction. Radiation with or without chemotherapy has long been the mainstay of treatment; however, interventional radiology techniques including catheter-directed thrombolysis and expandable metallic stents have become important treatment options.¹⁻³

SVC syndrome was first described in 1757 by William Hunter in a patient with a large syphilitic aortic aneurysm compressing the SVC.⁴ Since that time, the causes of SVC syndrome have shifted from benign conditions such as syphilitic aneurysms and tuberculosis to malignant conditions which now comprise greater than 85% of cases (**Table 1**).^{1,2} Primary intrathoracic malignancies are the most frequent cause (bronchogenic carcinoma >80%), followed by lymphoma (3%-8%) and metastatic solid tumors to the mediastinum (i.e. breast or testicular cancer).^{1,5} Superior vena cava syndrome occurs in up to 15% of patients with bronchogenic carcinoma and is 4 times more likely in patients with right-sided vs left-sided lesions.^{1,2} While all types of lung cancer are associated with SVC syndrome, small cell lung

cancer (SCLC) is the most common pathological cell type.⁶⁻⁸ Malignancy leads to obstruction by direct tumor invasion or extrinsic compression of the SVC.^{3,8} Benign conditions contribute between 3% to 13% of cases. More recently, long-term central venous catheters have emerged as an important benign cause of SVC syndrome. The frequency of thrombosis associated with central venous catheters is expected to increase in the future due to the more common use of these devices for vascular access.¹⁻³ The focus of this paper will be SVC syndrome related to malignancy which comprises the majority of cases.

The clinical presentation of SVC syndrome results from an increase in central venous pressure as a result of SVC obstruction. The most common presenting symptom is dyspnea (50%), followed by chest pain, cough, and dysphagia.^{2,6,8} On physical examination, the most commonly reported clinical findings include facial and upper extremity edema (40%-45%) along with dilated superficial veins on the chest wall.^{1,2} Depending on the location of the obstruction, both vocal cord paralysis and Horner syndrome can occur.^{6,8} The onset of symptoms usually is gradual, with symptoms being present for 2 to 4 weeks before

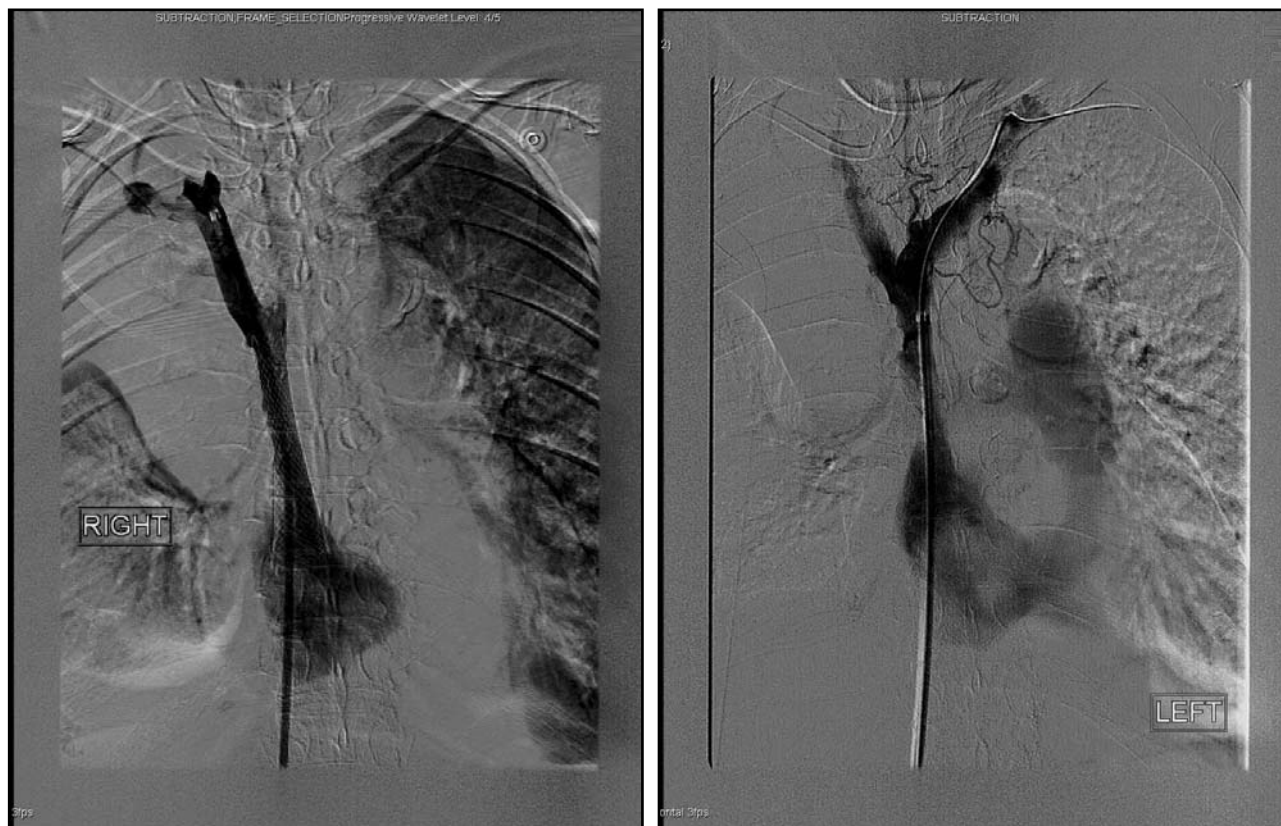


Figure 3. Angioplasty and endovascular superior vena cava stent placement

Table 1. Selected causes of superior vena cava syndrome^{1,5}

| MALIGNANT (>85%) | BENIGN (3%-15%) |
|------------------|-------------------------------------|
| Lung cancer | Indwelling central venous catheters |
| Lymphoma | Thymoma |
| Germ cell tumors | Tuberculosis |
| Breast cancer | Histoplasmosis |
| | Cystic hygroma |
| | Syphilis |
| | Substernal thyroid goiter |

diagnosis. Rarely, life-threatening laryngeal edema can develop. Due to the possibility of airway compromise, SVC syndrome has traditionally been thought of as an oncologic emergency requiring emergent radiation or chemotherapy; however, this severe presentation is uncommon and treatment can typically be delayed a few days until a tissue diagnosis is obtained.^{5,7}

Most cases of SVC syndrome are diagnosed readily on clinical examination alone, but several diagnostic tests and procedures may be useful. Chest x-ray may show widening of the mediastinum, pleural effusions, or a right-sided hilar or mediastinal mass, all of which suggest an underlying malignancy. Bronchoscopy is often helpful in diagnosis (46%-67% diagnostic yield in different series) especially when a mass is seen on chest x-ray.¹ If other diagnostic procedures fail, thoracotomy is successful in obtaining diagnostic tissue nearly 100% of the time.^{1,5} Computed tomographic scan, contrast venography, or magnetic resonance imaging are useful to show the degree of obstruction, collaterals, and frequently the cause of the obstruction.¹

Multiple treatment options are available for SVC syndrome. Medical treatment with head elevation, diuretics, and corticosteroids can be used initially to try to decrease edema but has minimal long-term value.¹ Traditionally, emergency radiation treatment was administered to some patients prior to a tissue diagnosis. However, in the absence of life-threatening laryngeal edema, it is now recommended to delay treatment a few days until a tissue diagnosis is made.⁵ The use of intravascular stents has also become an important therapeutic option for SVC syndrome. The use of surgical bypass has been reported in selected patients for palliative treatment of SVC syndrome; however, as SVC syndrome is

frequently due to a terminal malignancy, it is difficult to justify this type of major surgery especially since less invasive techniques such as intravascular stents are now available.¹⁻³

Radiation therapy has long been the mainstay of treatment for SVC syndrome. Approximately 70% of patients have symptomatic relief after 2 weeks of treatment.^{5,7} Recurrence typically occurs in 15% to 20% of patients after radiotherapy, although recurrence rates as high as 50% have been reported.^{2,5} Side effects associated with radiation therapy include tumor necrosis with fever, bleeding, nausea, vomiting, anorexia, anemia, leukopenia, skin irritation, and esophagitis. The mean survival of patients with SVC syndrome secondary to malignancy is 6 to 7 months. With radiation therapy, this survival time can be doubled in some cases.^{1,2} Chemotherapy can be used as a primary therapy or in addition to radiation therapy. Combination chemotherapy and radiation therapy is the treatment of choice for mediastinal lymphoma causing SVC syndrome. Chemotherapy alone may be used for SCLC. Some patients achieve symptomatic relief within 7 days of starting chemotherapy.^{1,2}

Intravascular stents can be used for both malignant and benign causes of SVC syndrome. The optimal timing of stent placement is still controversial, although recent literature supports the safety and effectiveness of stenting as primary treatment for SVC syndrome.^{2,3,9} Stenting provides the most rapid alleviation of symptoms while allowing the patient to continue with other treatment such as radiotherapy or chemotherapy if needed.^{2,9} Numerous studies have demonstrated the effectiveness of intravascular stenting for SVC syndrome. Complete resolution of the SVC syndrome occurs in 68% to 100% of patients treated with metallic stents. The majority of symptoms, including facial cyanosis and edema and upper extremity edema, often resolve 2 to 3 days after stent placement.² In addition, most stents remain patent throughout the patient's life. The reported recurrence rate of SVC syndrome ranges from 0 to 45%. When recurrence obstructive symptoms do occur, secondary patency after an additional procedure is achieved in most cases.^{2,3,9} Thrombus formation occurs in up to half of patients with SVC syndrome. Because of this, catheter-directed thrombolysis is often used in conjunction with stent placement and anticoagulation is frequently recommended

following the procedure.^{2,3,6} The use of anticoagulation is currently controversial and is has not been proven to confer a survival advantage.⁶

In one series utilizing catheter-directed thrombolysis and intravascular stenting, Kee et al³ reported on 59 consecutive patients with SVC syndrome. Most cases (73%) were due to malignancy. Among the patients with malignancy as the cause, primary clinical success, defined as a complete or partial resolution of symptoms, was achieved in 79% and secondary clinical success was achieved in 93%. Periprocedural mortality (3%) and morbidity (10%) rates were low. One patient died from multiple pulmonary emboli following the procedure and another died of severe heart failure brought on after venous return increased.³ Other reported complications include bleeding associated with anticoagulation, stent migration, transient elevation of the right hemidiaphragm due to phrenic nerve compression, and puncture of the right atrium.^{2,3}

The effectiveness of different treatment modalities for SVC obstruction in patients with bronchial carcinoma was recently reviewed.⁷ This review found that while radiotherapy and chemotherapy are effective, intravascular stenting is even more effective. In SCLC, chemotherapy and/or radiotherapy relieved SVC obstruction in 77%, while 17% of those treated had a recurrence. Insertion of an expandable SVC stent relieved SVC obstruction in 95% of patients. Of those treated with a stent, 11% had further obstruction but recanalization was possible in the majority of patients resulting in a long-term patency rate of 92%. Morbidity following stent placement was greatest if thrombolytics were used. The reviewers concluded that chemotherapy and radiotherapy were effective in relieving SVC obstruction in a proportion of patients while stent insertion appeared to provide relief more rapidly and in a higher proportion of patients.⁷ As stated above, the optimal timing of stent placement, at diagnosis or following failure of the other modalities, is still unknown.^{2,7,9}

The prognosis of patients with SVC syndrome depends on the underlying etiology. Lung cancer is currently the most common cause of SVC syndrome and the prognosis is poor. Whether SVC syndrome develops in a patient with known lung cancer, or is the presenting manifestation of the disease, average survival is typically 6 to 12 months.¹ The goal of

treatment is palliation for the majority of patients with SVC syndrome.

In conclusion, SVC syndrome is most frequently encountered in patients with malignancies and especially in patients with lung cancer. Patients classically present with dyspnea along with facial and upper extremity edema. Obtaining a tissue diagnosis is recommended prior to initiating treatment if possible. Radiation therapy with or without chemotherapy is the mainstay of treatment for most patients. Intravascular stents are proven to be safe and effective and allow the most rapid resolution of symptoms. The optimal timing of stent placement and the use of anticoagulation remain controversial. Because the overall prognosis of the majority of patients with malignancy is poor, palliation is often the focus of treatment.

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