Cardiac Tamponade after Stenting for Superior Vena Cava Obstruction

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Percutaneous transluminal stenting has been well documented in use for the treatment of superior vena cava (SVC) obstruction. It offers relatively safe and rapid alleviation of the symptoms of SVC obstruction due to malignancy compared with other treatment modalities. However, cardiac tamponade after stenting treatment occasionally occurs. Here, we present a case of 48-year-old female patient with cardiac tamponade after endovascular stenting for malignancy-related SVC syndrome. This patient had facial swelling, headache, dysphagia and dyspnea as the initial presentations. After clinical workup, she had SVC obstruction, due to lung cancer. She received SVC endovascular stenting with an Easy-Wall stent. Three hours after the procedure, she developed cardiac tamponade. An urgent operation confirmed that the protruding pin of the Wall stent had punched through the wall of the SVC and into the aorta, which led to the complication. To avoid this unfortunate result, we suggest that for an obstruction site in the lower half of the SVC, the lower margin of the stent should be placed protruding into the right atrium to get a short free end in the right atrial cavity after stent expansion, so that it will not injury the SVC or the atrial wall after stent expansion. From this case report, we can learn a possible hazard of SVC stenting and propose a technique of stent placement to prevent cardiac tamponade.

Key Words: Cardiac tamponade • Complication • Stent • Superior vena cava obstruction

INTRODUCTION

SVC obstruction usually results from malignancy, in 85–97% of patients.1 Among the related malignancies, pulmonary tumor has the predominance and accounts for 80% of the malignant diseases.2 The other malignant diseases are lymphoma, mesothelioma, thymoma and metastatic diseases. With the increasing usage of intravascular devices such as pacemakers, defibrillators, hemodialysis catheters and central venous catheters (e.g. Port-A) in current medical practice, the etiologies of SVC obstruction unrelated to malignancy are increasing.3

The obstruction of the SVC can result from extrinsic compression of the vascular wall or intravascular thrombosis formation. Regardless of either extrinsic or intrinsic mechanism, patients have increasing venous pressure and therefore experience various symptoms and signs, i.e. headache, visual disturbance, facial swelling, dyspnea, cough, dysphagia, hoarse voice (with recurrent laryngeal nerve involvement), chest pain, dilation of the collated vein over the chest wall, upper extremity swelling and syncope with altered mental status (with cerebral venous hypertension).4,5 The diagnosis of SVC obstruction is usually suspected by clinical evaluation at first. Further confirmation can be made by computed tomography, magnetic resonance imaging and venography.

To choose the appropriate treatment for SVC obstruction, the patient should be evaluated for the underlying disease. For malignancy-related SVC obstruction,
physical position with head elevation, diuretics, steroid, thrombolysis, radiotherapy, chemotherapy, operation and endovascular stenting have been used to alleviate the symptom.\(^6\) Compared with other treatment modalities, endovascular stenting assumes high priority in the current practice because of its easy procedure, safety and rapid efficacy.\(^2,7\) However, even with the low complication rate, several hazards after stenting have been encountered, including cardiac tamponade.\(^1,8\) Here, we report a case of cardiac tamponade following stenting for lung tumor-induced SVC obstruction, and to avoid such complications, we propose a strategy of stent placement from the operative findings.

**CASE HISTORY**

A 48-year-old female patient had suffered from facial and neck swelling for 1 month prior to admission. The symptoms and signs became more severe and complicated with headache, dysphagia and dyspnea 1 week before admission. Chest radiography revealed a perihilar mass over the right lung. Computed tomography showed that the mass was at the central part of the right upper lobe of the lung with compression of the SVC (Figure 1A). Lymphadenopathies were noted at the right hilum, prevascular and right paratrachea. Cardiac ultrasonography showed good heart contractility, with left ventricle ejection fraction of 65% and no pericardial effusion. To palliate the symptoms of SVC obstruction, the patient was referred for SVC stenting.

The procedure was performed via right femoral approach under local anesthesia. The hydrophilic guide wire (Terumo, Asahi, Japan) was introduced into the right common femoral vein through a 6-French sheath and pass to the obstruction site smoothly. By using a JR4 diagnostic

![Figure 1](image-url)  
**Figure 1.** (A) An axial CT image reveals the SVC (superior vena cava) (arrow) is compressed by the pulmonary tumor (arrow head). (B) A cava venogram confirms the location of the obstruction (arrow). (C) Post-inflation at the middle portion of the stent. (D) Final venography reveals a patent SVC.
catheter (Cordis, U.S.A.), a cava venogram was taken and the location of the obstruction was identified (Figure 1B). After that, direct stenting with an 16×60 mm Easy-Wall stent (Boston Scientific, U.S.A.) was performed successfully. A XXL balloon (Boston Scientific, U.S.A.) of dimensions 14×20 mm was inflated at the middle portion of the stent (Figure 1C) to fully expand the stent. Final venography demonstrated a patent SVC without residual stenosis (Figure 1D). The SVC pressure gradient decreased from 25 mmHg to 11 mmHg after stenting. The patient felt relief of dyspnea and headache immediately after the procedure. The procedure time was about 30 minutes. However, the patient had chest discomfort accompanied with unstable hemodynamics. Her blood pressure decreased from baseline 117/73 mmHg to 85/50 mmHg three hours after stenting. Emergent treatment with inotropic agents and hydration were given. A cardiac ultrasonography examination revealed pericardial effusion with signs of right atrium and right ventricle compression. An urgent pericardiocentesis with insertion of a pig tail were performed immediately. Bloody pericardial effusion of about 400 ml was drained out. Due to persistent pericardial effusion drainage from the pig tail catheter in the following hours (about 100 ml/hr), the patient was referred for surgical intervention three hours after pericardiocentesis under the impression of vena cava perforation. The operative findings showed an unexpectedly bleeder on the aortic wall and a small laceration wound at the SVC. The lower margin of the stent was located a short distance above the entrance of the SVC into the right atrium. The pin of the stent’s lower margin was protruding outside the SVC. The aorta wall near the pin-whole bleeding site was erosive (Figure 2A). After hematoma evacuation inside the pericardial cavity, the aorta was repaired with prolene suture and wrapped with hemashield graft. The SVC was also repaired with prolene suture. Excision of a whitish, elastic and firm tumor was also performed during the operation. The pathology revealed pulmonary adenocarcinoma.

DISCUSSION

In the literature, cardiac tamponade following SVC stenting usually occurs after radiotherapy or chemotherapy, because the vascular wall will become more fragile when a tumor has shrinkage after irradiation or chemotherapy. Also, cardiac tamponade can take place during the procedure of stenting because of wire penetration or the pressure tension of balloon dilation. In previous studies, acute cardiac tamponade may result from inadvertent extraluminal traversal of the SVC in the so-called danger zone above the right atrium, because in that zone, SVC is not completely covered by serous pericardium over a length of nearly 3.5 cm above the right atrium, and the anatomical boundaries may also become altered or obliterated by neoplasia or inflammation. This danger zone is also the level where the greatest narrowing was present in our patient. Our patient ubiquitously developed cardiac tamponade three hours after stenting.
after the stenting procedure. The operative findings confirmed that the protruding pin of the Wall stent had punctured the wall of the SVC. The laceration wound and pin-hole bleeder of the aortic wall might result from the sliding motion between the protruding pin of the stent and the aorta wall during heart beating and respiratory motion. This could explain why cardiac tamponade occurred in this patient three hours later.

During endovascular stenting, there are several kinds of stents that could be chosen at present. Self-expanding stents, such as the Wall stent, are used in patients because of their advantages such as flexibility, intrinsic radial expansive force, and suitable for respiratory movements. However, the pin of the Wall stent margin is free and sharp. The pin might bend and protrude out of the vascular wall after post-dilation. In order to prevent this complication, the technique of stent placement should emphasize the stent localization. Because the length of the stent usually gets shorter by around 1-2 cm after stent expansion, the stent localization should pay more attention to the stent’s lower margin. For an obstruction site in the lower half of the SVC, the lower margin of the stent should be placed protruding into the right atrium to get a short free end in the right atrial cavity after stent expansion (Figure 2B). This protrusion should not be too much to avoid injury to the cardiac wall such as was seen in one case with cardiac tamponade due to cardiac perforation after Port-A insertion. By this way, the sharp and free margin of the Wall stent or other stent will not punch out the wall of the vena cava after placement. If the obstruction site is located in the higher or upper half of the SVC (Figure 2C), it would be appropriate and safe to place the stent end away from the aorta to avoid the pulsating friction which might cause SVC and aortic perforation.

This case illustrates a possible etiology of cardiac tamponade after endovascular stenting in cases of SVC obstruction due to lung cancer, and a technique of stent placement is proposed for the procedure strategy in such circumstances. In the future, an alternative stent designed to avoid the sharp end of the Wall stent might be another choice to avoid cardiac tamponade after stenting.

REFERENCES