Stent-Graft Treatment of Iatrogenic Vertebral Artery Pseudoaneurysm and Arteriovenous Fistula

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ABSTRACT

Very rare incidence of vertebral artery pseudoaneurysm as a complication caused by central venous catheterization has been reported. The treatment strategy is dependent on location, anatomic structure and coexisting vascular injuries. The Stent-graft placement was performed in a 69-year-old woman who underwent Hemo-Cath® insertion for emergent hemodialysis complicated with right vertebral artery pseudoaneurysm and arteriovenous fistula (AVF) formation.

INTRODUCTION

Central venous catheterization (CVC) is widely used for hemodynamics measurement, volume resuscitation, medication delivery, nutritional support and cannulation of large-bore double-lumen catheters for temporary hemodialysis [1-3]. Mechanical complication is encountered in about 5-19% of patients including arterial puncture, hemothorax and pneumothorax [1, 4]. Incidence of inadvertent arterial puncture of carotid artery ranges between 0.5% and 11.4% [2]. The complication with resultant inadvertent arterial puncture of vertebral artery is quite rare. Most cases of vertebral artery pseudoaneurysm (VAP) undergo traditional surgical excision [2, 3]. Endovascular treatment has evolved recently and become an alternative to surgical repairs since the availability of stent grafts. To our knowledge, this case is the first report of stent-graft treatment of vertebral artery injuries caused by central venous catheterization.

CASE REPORT

A 69-year-old female with known hypertension and Parkinson’s disease presented as acute on chronic renal failure (elevation of creatinine from 5.5 to 6.8 mg/dl in one month) and was admitted in March 2012. On hospital day 16, intractable metabolic acidosis (pH 7.348, HCO3-17mmol/L) and symptomatic azotemia (BUN 148 mg/dl) with drowsy consciousness occurred. Normal coagulation profile was obtained before catheterization of central venous dialysis catheter.

The emergent Hemo-Cath® insertion for hemodialysis was attempted through right internal jugular access by a medical resident. Initial sonographic evaluation of internal jugular vein was conducted. Sterile technique for the ultrasound probe was not available to be performed in the dialysis unit. A 23-guage needle connected to a 5-ml syringe served as “finder needle” for internal jugular vein localization was successful without real-time ultrasound guidance. Unfortunately, a separate attempt with an 18-gauge introducer needle was complicated by arterial puncture and manual compression was initiated. The patient soon developed arterial oxygen desaturation without obvious neck swelling or local hematoma. Emergent endotracheal intubation was done immediately. She was then transferred to the intensive care unit for further management and Hemo-Cath® was inserted via the left internal jugular vein.

On hospital day 17, drop of hemoglobin (from 9.1 to 7.1 g/dl) was noticed with a hematoma in the right neck region. Chest CT angiography (CTA) revealed massive fresh hematomas and a complex-form pseudoaneurysm arising from the right vertebral artery in the cervical prevertebral space.
extending down to the posterior mediastinum with tracheal deviation (Fig. 1a).

On hospital day 18, we performed diagnostic angiography to survey right common carotid, subclavian and vertebral arteries. A complex-form pseudoaneurysm arising from the proximal right vertebral artery extending to the mediastinum was confirmed, and the other contained ruptured pseudoaneurysm and arteriovenous fistula (AVF) were also depicted (Fig. 1b). To treat the pseudoaneurysm and AVF concurrently, a stent graft was then chosen in term of minimal invasion and feasibility to seal both lesions.

Endovascular therapy was proceeded on hospital day 19. In concern of uremic bleeding and thrombocytopenia status (820,000/μL), dual anti-platelet drugs may be given in more stable condition. Prolonged aPTT (> 120 sec) indicated coagulopathy before endovascular stenting, and heparinization was not performed during the procedure. An 8-F sheath was securely inserted in the right femoral artery. Patent posterior circulation was validated with bilateral vertebral arteriograms. Persistent pseudoaneurysm and prominent AVF in the proximal right vertebral artery were again identified. An 8-F multipurpose guiding catheter was navigated into the proximal right vertebral artery. An exchange 0.035 Fr. wire was then navigated into the right vertebral artery. A peripheral stent graft of 4-9 mm by 38 mm (Jostent, Abbott Vascular, Rangendingen, Germany) was manually mounted on a PTA balloon of 4 mm by 4 cm and was placed across the AVF and pseudoaneurysm under roadmapping. The PTA balloon catheter was inflated to expand the covered stent onto the vascular wall. Post-procedure arteriogram showed no longer contrast-filling of pseudoaneurysm, contrast extravasation or opacification of AVF (Fig. 1c).

Follow-up chest CTA on hospital day 37 showed remarkable regression of hematomas in the neck and mediastinum and non-opacification of pseudoaneurysm (Fig. 1d). Since

**Figure 1.** a. Extravascular contrast opacified the complex-form pseudoaneurysm (arrow) arising from the right vertebral artery on CTA. b. Pre-stenting right vertebral arteriogram showed a tiny beak (white thin arrow), which was considered as a contained ruptured pseudoaneurysm, AVF (white arrowhead) and a complex-form pseudoaneurysm (white thick arrows). c. Right vertebral arteriogram after deployment of a Jostent® showed no opacification of the pseudoaneurysm, AVF, and the tiny beak. d. Follow-up chest CTA revealed no longer opacification of the right vertebral pseudoaneurysm but resolving hematoma in the mediastinum.
the success of the endovascular treatment, she did have an uneventful recovery until she died suddenly of presumed acute pulmonary embolism on hospital day 73.

**DISCUSSION**

Several factors may contribute to complicated central venous catheterization, such as operator’s experience, urgency of placement, as well as patient factors such as obesity, prior difficult cannulation, and coagulopathy.[5] In addition to conventional landmark-guided approaches, the assistance of real-time ultrasound guidance helps reduction of the complications of central venous catheterization. [6] However, most of emergency medicine physicians, internal medicine doctors and surgeons lack for sufficient training in using real-time ultrasound assistance for CVC in our hospital. Hayashi H et al. also depicted that prepuncture ultrasound evaluation didn’t improve successful rate in establishing CVC in the right jugular vein. [7]

The most dominant pathologies of vertebral artery injury are AVF and pseudoaneurysm. The VAP is a rarely encountered complication with a reported incidence of 0.05-2%. Most patients are asymptomatic, but some have delayed onset of symptoms. Patients with an AVF usually present with a bruit in the neck or a pulsating tinnitus, while those with a pseudoaneurysm present with a rapidly growing mass in the neck that may result in airway obstruction.

Vertebral artery consists of four parts as V1 (origin to C6 transverse foramen), V2 (C6 to C2 transverse foramen), V3 (C2 to skull base), and V4 (intracranial) segment. The V1 segment of vertebral artery is the predilection site for injury by catheterization as encountered in our case. The needle is thought to be directed slightly inward and deeper, resulting in penetrating the jugular vein and puncturing the vertebral artery. [8] It may be technically very difficult to do manual compression for hemostasis in deeper anatomical locations. There are in total five case reports of VAP formation associated with internal jugular vein access in the literature [3, 8-10, 11].

Treatments of vertebral arterial injuries include surgical intervention and endovascular treatment. Most cases with normal contralateral counterpart underwent surgical occlusion of the affected vertebral artery without complication. However, neurological deficits have been reported to be as high as 8% and are even higher in patients who have hypoplasia or congenital atresia of vertebral artery [12]. In recent years, endovascular occlusion or stenting of the affected vertebral artery was preferred first line treatment. Pseudoaneurysm is commonly treated with endovascular coiling and detachable balloon. Stent grafts have been used to treat aneurysms, pseudoaneurysm and AVFs in the aorta, coronary and peripheral vessels. According to the review article [13], positive outcomes for stent-graft placement were reported except one immediate complication as dissection and then spontaneously recovery with patent flow after one month [14]. The followed patency of covered stent placements for iatrogenic or traumatic vertebral artery injury was kept for 6 day to 5 year in total 16 patients from 1995 to 2011 [13]. Huttl et al. described asymptomatic total occlusion of a Jostent in the vertebral artery, which caused by external compression [15]. Suncak et al. reported in-stent stenosis on a follow-up angiogram after 18 month and balloon dilatation was performed with 50% successful rate [16]. In our patient complicated with pseudoaneurysm and AVF in a critically ill condition, surgical repair was deemed to carry a very high risk. The contralateral vertebral artery provided sufficient blood supply for posterior circulation, and occlusion of affected vertebral artery was considered. However, we couldn’t seal off all these lesions completely from anterior coiling and it was technically difficult in retrograde posterior coiling from contralateral side. Stent graft was considered optimal to prevent massive bleeding resulted from pseudoaneurysm rupture.

Another major concern of our case was no premedication of antiplatelet agents or heparinization during the procedure, due to clinically uremic bleeding status and coagulopathy during procedure. Clinical bleeding in uremia may involve the skin resulting in easy bruising, or the oral and nasal mucosa, gingiva, gastrointestinal and urinary tracts, and respiratory system. [17] Generally, it is highly recommended to use antiplatelet agents during placement of covered stents for reduction of thromboembolic events. We and clinicians concerned about that the risk of antiplatelet or anticoagulation therapy would have far outweighed the risk of possible thromboembolism from the stent in our patient under clinically sever condition. [18] After hemo-stasis and improved uremic status, dual antiplatelet agents should be prescribed for 3 months and lifelong aspirin. The coagulation parameters and platelet accounts returned within normal limit after cover-stent placement. However, bleeding risk is still concerned by clinician.

Although the Jostent® is indicated for the treatment of perforated coronary artery, a couple of successful results in managing traumatic vertebral arterial injuries have been reported recently. Behrang et al. reported the first case using Jostent® in traumatic vertebral arterial pseudoaneurysm in 2009 [19]. We reported the first case of vertebral artery injury at central venous catheterization that had undergone stent-graft insertion successfully. In our case complicated with vertebral artery AVF and pseudoaneurysm, covered stent deployment may be considered as the treatment of choice. However, the result of long-term vertebral artery patency remained unclear due to inability to follow the patient.

Placement of the central venous catheter is a important technique in daily practice of medical care. However, severe complication may occur without skillful ultrasound guidance.

Interventional radiologists can offer alternative
stent-graft placement rather than surgery for iatrogenic vertebral artery injury and the result is conviced.

REFERENCES