Clinical Case Report

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Long-term follow-up of endovascular repair of iatrogenic superior vena cava injury

A case report

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Abstract

Rationale: This report aimed to present the long-term follow-up results of the management of superior vena cava (SVC) rupture during balloon angioplasty in an attempt to relieve SVC obstruction as a result of hemodialysis (HD) catheter-related central vein stenosis.

Patient concerns: We present a case of a 42-year-old woman with end-stage renal disease on HD for 4 years, initially from an autogenous fistula for 2.5 years and then from a right internal jugular vein (IJV) catheter. She presented with clinical manifestations of SVC obstruction (dilated anterior chest wall and abdominal wall veins and facial swelling), which progressed over the last 1.5 years.

Diagnosis: A venogram confirmed right and left brachiocephalic vein and SVC obstruction.

Interventions: She underwent balloon angioplasty of the SVC through the right IJV, during which the dilated area ruptured, resulting in right hemothorax and hypovolemic shock. A covered stent was placed over the bleeding site, and the patient recovered.

Outcomes: Rapid and skilled endovascular intervention through placement of a covered stent at the bleeding site can be lifesaving.

Lessons: It is superior to open surgical management in terms of complexity and morbidity especially in patients who are poor surgical candidates, and its durability is proving to be comparable.

Abbreviations: ESRD = end-stage renal disease, HD = hemodialysis, IJV = internal jugular vein, SVC = superior vena cava.

Keywords: balloon angioplasty, covered stent, endovascular repair, iatrogenic injury, superior vena cava, tunneled hemodialysis catheter

1. Introduction

End-stage renal disease (ESRD) is a major healthcare concern. At the end of 2016, a total of 16,315 patients in the Kingdom of Saudi Arabia were treated by hemodialysis (HD),[1] with an average annual net increase of 6.2% in the number of patients, of which 26% were dialyzing from a jugular catheter, which has shown an increasing trend for the past 5 years.[2]

Tunneled-cuffed catheters provide reliable and instant long-term intravenous access for HD.[3] Potential injury to the central veins, as a complication, is markedly higher early during the insertion of the catheter or later during the angioplasty for the central vein stenosis catheter complication. The injury to the superior vena cava (SVC) can be associated with hemodynamic instability, hemothorax, and pericardial tamponade. This is a potentially fatal complication if not recognized and treated promptly.[4] This article presents the long-term follow-up results of the management of SVC rupture during balloon angioplasty in an attempt to relieve SVC obstruction as a result of HD catheter-related central vein stenosis.

2. Case report

A 42-year-old woman, with hypertension, polycystic kidney disease post left nephrectomy, ESRD on HD for the last 4 years, initially dialyzing from a left brachiocephalic fistula for 2.5 years, then from a right internal jugular vein (IJV)-tunneled-cuffed catheter due to fistula failure, presented with signs and symptoms of SVC obstruction (dilated anterior chest wall and abdominal wall veins and facial swelling), which progressed over the last 1.5 years. A venogram was performed, which showed right and left brachiocephalic vein and SVC occlusion. Balloon venoplasty of the SVC attempted through the right IJV by the interventional radiologist resulted in rupture of the dilated area and contrast leak with massive right hemothorax and patient hypotension (Fig. 1). Reinflation of the angioplasty balloon in the area of the bleeding helped in patient stabilization, and vascular surgery team were consulted. With the angioplasty balloon inflated in place, the patient was moved to the operating theater, where the balloon access was changed to the right femoral vein and a covered stent (GORE EXCLUDER Contralateral Leg Endoprosthesis; W.L. *Gore* & Associates, *Flagstaff*, AZ) was deployed at the injured site from the right IJV, which stopped the bleeding and stabilized the patient (Fig. 2); however, due to the available graft

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Figure 1. Digital subtraction angiography showing contrast leak from the SVC during balloon angioplasty. SVC = superior vena cava.

Figure 3. Chest computed tomography scan shows the graft in place with no signs of flow within or leak around the graft.

length and to avoid the proximal part extending into the right atrium, the distal part of the graft was laid outside the IJV, resulting in the absence of flow in the endoprosthesis. The patient was managed in the intensive care unit with initial ventilatory support and chest cavity drainage. The patient recovered over the next month and was discharged from the hospital with a right femoral-tunneled catheter. At 7-year follow-up, the patient is still on HD from the well-functioning right femoral-tunneled catheter with resolved symptoms of SVC obstruction, and a recent chest CT scan showed the graft in place, with no flow within or contrast leak around the graft (Fig. 3). Ethical approval was not necessary as this is a case report. Written informed consent was obtained from the patient for the publication of this case.

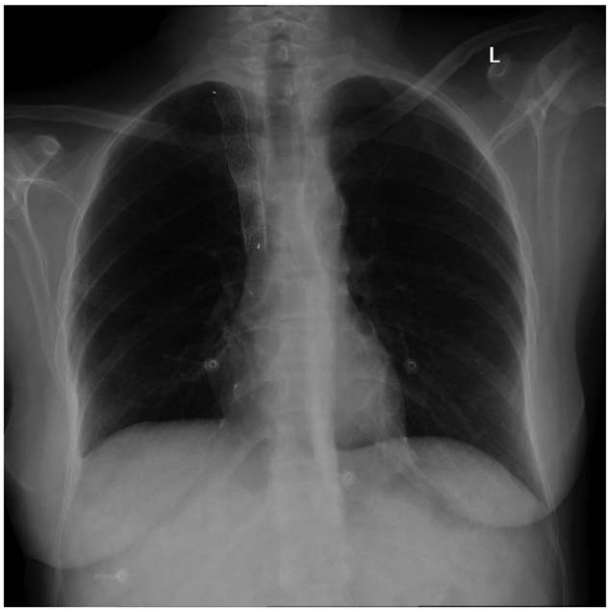

Figure 2. Chest x-ray showing covered stent in the superior vena cava extending to the right internal jugular vein.

3. Discussion

Central vein stenosis caused by intimal hyperplasia from chronic intimal injury resulting from indwelling catheter friction and high-flow turbulent flow, in contrast to the low flow normally seen in veins, remains a significant problem in the long-term management of HD patients,[5,6] with an occurrence rate of up to 40%.[7] Clinical presentation of the SVC stenosis are the swelling and/or cyanosis of the face, head, neck, and upper extremities, distended veins over the chest as well as paresthesia, headache, and dyspnea with possible engorgement of mucus membrane, upper airway, and laryngeal edema depending on the degree of the stenosis, airway patency and impaired venous drainage are always a concern in cases of SVC obstruction.[8–10] Generally, there are 2 methods of providing treatment: surgical repair requiring a median sternotomy and endovascular repair (balloon angioplasty with stent placement).[11] Justification of the choice of the time consuming open surgical approach with its higher morbidity and risk of thoracic structures injury in the era of advanced endovascular therapies need to be evaluated and tailored to special situations. Interventions on the central veins must be approached with care. The most-feared sequela of central venous angioplasty is SVC rupture. Although SVC rupture is rare, occurring in 0.1% to 1.8% of interventions, it is frequently fatal.[12] SVC injuries can cause massive hemorrhage in the form of hemothorax and hemopericardium with hemodynamic instability and require prompt intervention for patient survival. Traditionally, SVC injuries are dealt with by an open approach with emergency thoracotomy or sternotomy and surgical repair by stitch or patch closure or by placing an interposition graft (autologous/synesthetic) replacing the damaged segment;[13]

however, this carries higher risk of injury to the surrounding structures, is technically and time demanding in a lifesaving emergency intervention, and with longer and more challenging patient recovery. Burket[14] reported the first successful stent graft repair of SVC rupture in 2003. In 2007, Azizzadeh et al[4] reported a case of an iatrogenic injury to the SVC that was treated by an endovascular covered stent. They demonstrated in their conclusion the utility of stent graft repair in managing iatrogenic SVC injuries and that the technique affords control of often exsanguinating hemorrhage in a very rapid fashion. However, the long-term patency of stent grafts in the venous system remains to be determined. Since then, several reports in the literature have described the endovascular approach to the SVC injuries wherein covered stent placement at the injury site is the main treatment objective. Mansour et al.[10] studied a case in which emergency stent placement led to effective sealing of the SVC perforation, and they concluded that stenting for SVC wall perforations can be an effective first-line therapy. Song et al.[11] reported a case in which emergency endovascular stent graft repair was successful in treating the iatrogenic innominate vein injury. Lou et al[13] reported a case of successful emergency SVC stenting for SVC tear in a patient with previous cardiac surgery, and they concluded that endovascular intervention is a viable option for rapid repair of iatrogenic SVC injury. Immediate diagnosis of SVC injury by intraoperative venography and rapid stent deployment were key to the successful management. One question concerning venous stent grafts for vessel injury that remains unclear is their durability.[15] In our patient, SVC rupture was caused by balloon venoplasty of the SVC through the right IJV, and rapid endovascular intervention with covered stent deployment at the injury site was life-saving. Our follow up for 7 years showed the stent still sealing the injury; however, there was no flow within because the jugular end is outside the vein.

4. Conclusion

SVC injuries during angioplasty are rare but carry a high risk of mortality. Rapid and skilled endovascular intervention with placement of a covered stent at the bleeding site can be lifesaving. It has superiority to open surgical management in terms of complexity, morbidity, time required for the intervention, and patient recovery, especially in patients who are poor surgical candidates, and its durability is proving to be comparable.

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