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The Chimney or Snorkel Technique for Rescuing Visceral Aortic Branch during Endovascular Treatment of Thoracoabdominal Aortic Aneurysm

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Abstract

Endovascular aneurysm repair of abdominal aortic aneurysm has recently been made a class 1 indication in the treatment of AAA. "Chimney" or "snorkel" technique has been used as an alternative in high risk patients unfit for open repair. We, hereby, describe the successful Chimney repair of suprarenal aneurysm involving thoraco-abdominal aorta along with celiac and superior mesenteric artery in a 71-year-old female.

Keywords: Aortic Aneurysm; Chimney Technique; Endovascular Repair;

Introduction

Abdominal Aortic Aneurysm (AAA) is a condition associated with high morbidity and mortality rates. Historically, open surgical repair has been the only available therapy for AAA. Lately Endovascular Aneurysm Repair (EVAR) has emerged as a class1 indication and a first line treatment modality for AAA in anatomically feasible circumstances [1]. With the aid of guidewires, catheters and specially designed introducer systems, an endograft is positioned inside the AAA under fluoroscopic guidance. There is significant evidence to show that EVAR has lower periprocedural morbidity and equal or lower mortality compared to open surgical repair [2-6].

The "Chimney" or "snorkel" technique (CST) involves deployment of stent-grafts into the aortic branches, with the proximal parts placed parallel to the main aortic endoprosthesis (between the aortic stent and the aortic wall) and extended beyond it to ensure perfusion of the branches.

Greenberg et al. first used renal stents to depress the proximal edge of stent-graft fabric that protruded a few millimeters above the renal artery ostium [7]. Since then, this technique has evolved and now known as the CST to restore flow in aortic branches. CST is used to preserve flow in aortic branches accidentally or intentionally covered during thoracic and abdominal endovascular repair [8-10], for patients with branch abdominal aortic aneurysm [11], and in certain cases as an off-label indication. A successful procedure is defined as successful deployment of the endograft without any AAA related rupture or death.

Case Report

A 71 years old Indian female presented to the emergency department with complaints of acute onset pain abdomen and lower back, radiating to right lower limb. She didn't complain of any other abdominal or chest symptoms, and there was no history of preceding trauma, nausea, vomiting, dizziness or blurring of vision. Past medical history included essential hypertension controlled by medications. The personal and family history was noncontributory. On general physical examination patient was seen to be anxious, her heart rhythm was regular with a rate of 90 beats per minute; the blood pressure was 130/80 mm of mercury and respiration was thoraco-abdominal with a rate of 28 breaths per minute. Findings from review of the systems, other than as reported above were normal. She underwent MRI spine prior to hospitalization that revealed presence of aortic calcification and suspected abdominal aortic aneurysm. The patient was admitted to the intensive care unit, where she remained hemodynamically stable. During her hospital stay she was evaluated and her echocardiographic examination showed concentric Left Ventricular (LV) hypertrophy, trivial aortic regurgitation and normal LV systolic function (LV ejection fraction=65%). Her CT angiography of abdominal aorta with 3-dimensional reconstruction (Figure 1) was performed to confirm the diagnosis and locate the origin of the aortic vessels and to obtain accurate aortic measurements for identification of potential landing zones for stent-graft placement. CT revealed atheromatous., tortuous abdominal aorta and a fusiform aneurysm of the distal thoracic aorta and the adjacent abdominal aorta from D11 vertebral level up to upper L2 level. CT also confirmed the origin of celiac and superior mesenteric arteries from the aneurysmal segment, 30-40 percent narrowing of left renal artery and diffusely diseased small celiac artery. The patient's aortic diameter at the aneurysmal neck was 27.3mm, and the diameter distal to the aneurysm was 22.0mm, the diameter of SMA was 10.2mm.

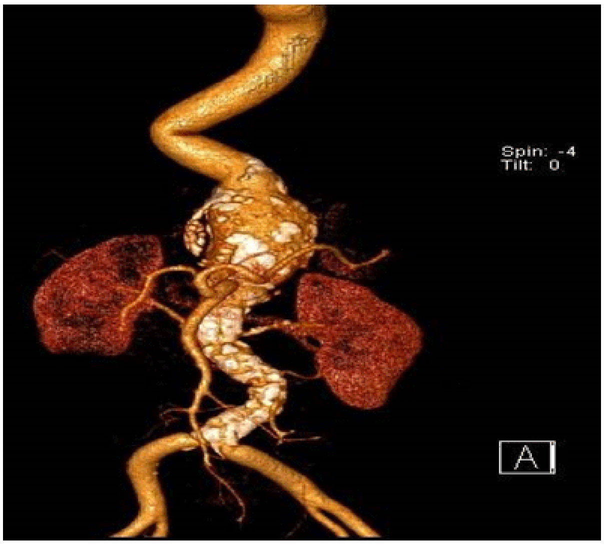

Figure 1: CT angiography of abdominal aorta with 3D reconstruction showing atheromatous., tortuous abdominal aorta and a fusiform aneurysm of the distal thoracic aorta and the adjacent abdominal aorta. CT showing the origin of celiac and superior mesenteric arteries from the aneurysmal segment.

After a written informed consent patient was taken up for endovascular repair (abdominal aorta and superior mesenteric artery) under dissociative anesthesia. Patient was planned to be treated with Thoracic Endovascular Aneurysm Repair (TEVAR) and stent or snorkel to Superior Mesenteric Artery (SMA) as celiac artery was stenosed. The patient was placed in the supine position and prepared for the procedure under routine sterile conditions. Unfractionated heparin (100 U/Kg) was chosen as an anticoagulant during the procedure.

The procedure (Figure 2, A-F) started with bilateral common femoral artery cannulation. With a 5 French marker pigtail catheter, a preliminary abdominal aortogram was obtained and a correct length of the aneurysm (based on the intra cavitary catheter length) was calculated. The SMA was entered with a Judkin right (6F-JR, 3.5) catheter and a terumo guidewire that was later exchanged with 0.0350' x 260 cm, Amplatz super stiff wire (Boston Scientific) was parked in distal SMA. Over the wire 12 x 40mm, Fluency vascular stent graft (Bard Peripheral Vascular, Inc. Tempe, AZ) was advanced and positioned at the ostia of SMA hanging into the aorta. Then another 0.0350' x 300cm, Lunderquist extra stiff guidewire (Cook Medical Inc. Bloomington, USA) was parked in the thoracic aorta. Over the wire a 30 x 150 mm Capitivia stent graft (Medtronic Vascular, Santa

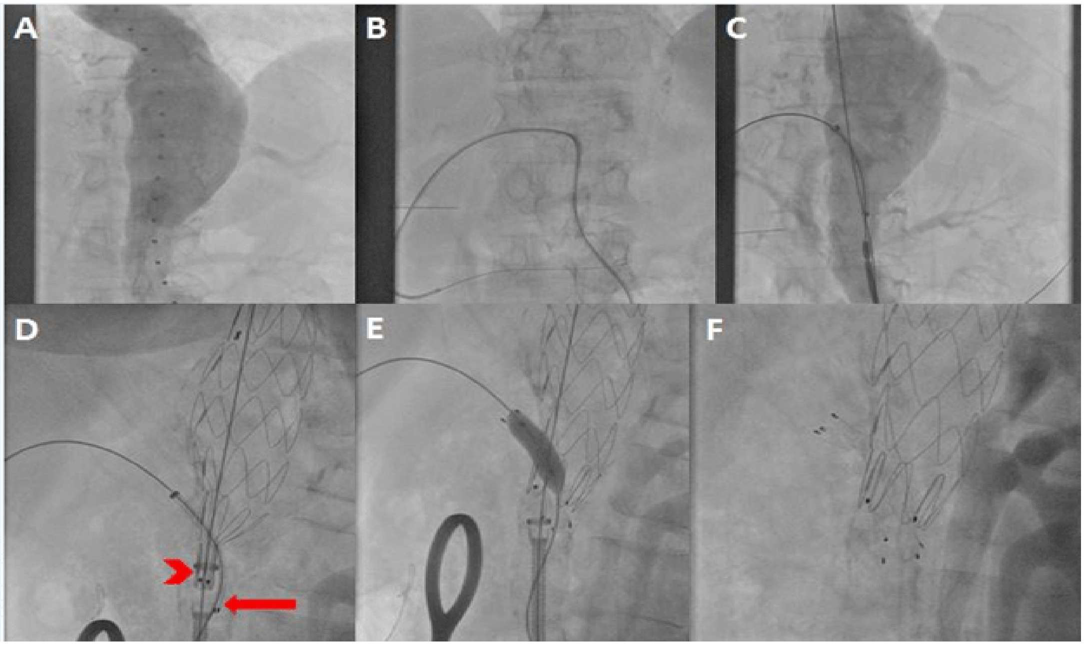

Figure 2: A. Aortogram with a marker pigtail showing aneurysm size and location
B. SMA Entry with Judkin right catheter introduced through left femoral artery
C. Lunderquist wire in thoracic aorta introduced through right femoral artery and the snorkel positioned in proximal SMA
D. thoracic stent graft deployed first at the aneurysmal segment covering the celiac and SMA. Note the caudal end of SMA Stent (arrow) protruded beyond endograft prosthesis (arrow-head)
E. Snorkel or chimney stent is deployed and post dilated
F. Final chimney formation.

Rosa, CA) was positioned covering the aneurysmal segment. After accurate positioning (ensuring SMA stent protruded beyond the endograft) the endograft device was deployed first followed by SMA stent. The self expanding SMA stent was further postdilated with 10 x 40 mm, Admiral Extreme PTA balloon (Medtronic Peripheral Therapies International) at 14 atm for 15 seconds. Check angiograms were taken post deployment, which showed that the aneurysm and SMA ostia was completely covered, with no endoleak. The remainder of her hospitalization was uncomplicated, and she was discharged in a stable condition 3 days after endovascular repair.

Discussion

Thoracoabdominal aneurysms (TAAs) involve both thoracic and abdominal aortic segments and visceral branches from the aorta are frequently involved in the aneurysmal sac. TAAs have been treated either by open repair or by endovascular repair. EVAR is associated with significantly lower periprocedural morbidity and mortality when compared to conventional open surgical techniques [12,13].

Conventional EVAR stent grafts require at least a 1.5 cm neck length (distance from the branch vessels to aneurysm sac) to allow for adequate sealing of the proximal portion of the stent graft device. Deploying such a stent graft with <1.5 cm neck length may result in either morbid coverage of the branch vessel or a leak around the seal zone into the aneurysmal sac (endoleak). The availability of stent grafts with openings or fenestrations for the branch vessels has overcome the issue of short necks. These fenestrated stent grafts are custom-made to the individual patient anatomy based on high-definition fine-sliced CT scans of the aneurysm. Once deployed, the fenestrations would be in line with the branch vessel orifices. Additional short covered stents will be introduced from the main stent graft body through the fenestrations, into the branch vessel to provide a tight seal. However, these fenestrated stent grafts have certain limitations as these are unsuitable for use in emergency circumstances. Moreover, the use of fenestrated stent grafts requires specialized training and good fluoroscopic imaging techniques. These stent grafts are also not widely available. As a result, operators have developed the CST for repair of branch vessels.

The CST utilizes the conventional stent grafts and covered stents. Essentially, covered stents are first deployed in the branch vessel and out into the aorta (like a chimney), following which a conventional stent graft, introduced from the femoral arteries in a retrograde fashion, is deployed in line with the covered stents. While fenestrated stent grafts have reported good outcomes with high patency rates and low mortality rates at up to 5 years [14], results from the use of CSTs are limited due to it being a relatively new technique [15]. Chimney grafts, however, induce large "gutters" along the main endograft which may cause a proximal type I endoleak, representing the Achilles heel of the technique [16,17]. The risk of endoleaks increase with the number of chimney grafts implanted. Certainly, the use of these techniques has extended the scope of effective treatment for juxta-vessel TAAs.

Conclusion

With the advent of new stent graft designs and the improvement of endovascular techniques, the scope of treatment for complex aortic aneurysms has widened. "Chimney" or "snorkel" graft technique can be used as an alternative in high risk patients unfit for open repair.

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