Accepted Manuscript

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PII: S1043-0679(18)30289-2
DOI: https://doi.org/10.1053/j.semtcvs.2018.09.026
Reference: YSTCS 1171

To appear in: *Seminars in Thoracic and Cardiovascular Surgery*

Received date: 17 September 2018
Accepted date: 26 September 2018

Novel Implementation of a Cerebral Protection System During Ascending Thoracic Endovascular Aortic Repair (TEVAR)

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Conflicts of Interest: None

Source of Funding: Dr. Kossar is funded by an Institutional National Research Award (NIH T32: 5T32HL007854-23)

Article Word Count: 743

Central Message:

TEVAR of the ascending aorta is associated with increased risk of stroke, which may be mitigated by use of cerebral protective devices.

Background:

Thoracic endovascular aortic repair (TEVAR) has emerged as the standard of care for management of most descending aortopathies. Despite rapid evolution of associated devices, materials, and techniques, however, TEVAR of the ascending aorta and aortic arch is currently reserved for patients with prohibitive risk for open surgical intervention [1]. Over 80% of patients undergoing TEVAR demonstrate post-procedural radiologic evidence of stroke associated with significant neurocognitive decline, and this incidence is estimated to be even higher in ascending TEVAR [2,3]. Increasingly widespread application of transcatheter aortic valve replacement (TAVR) has encouraged the development and implementation of cerebral protection devices for prevention of intra-operative stroke. The Sentinel Cerebral Protection System (Claret Medical, Santa Rosa, CA) is currently the only FDA-approved cerebral protection device for TAVR, and preliminary data regarding its efficacy in both TAVR [4] and TEVAR of the descending aorta [5] have been promising. Here we present the first published report of cerebral protection device utilization during TEVAR for an ascending aortic aneurysm.

Clinical Summary:

An 85 year-old woman with a medical history significant for atrial fibrillation status post ablation with placement of permanent pacemaker/implantable cardioverter-defibrillator, also status post remote open mitral valve repair, who was referred to our institution from an outside hospital for further evaluation of a chronic ascending aortic aneurysm. A small ascending aortic pseudoaneurysm with surrounding hematoma was noted 4 years prior to her presentation at our clinic and was managed conservatively. Pre-operative CT angiography revealed an increasingly dilated ascending aorta measuring 4.2 cm, and a 20 x 12 mm distal ascending aortic pseudoaneurysm with an 8 mm neck without significant atheroma burden, with extensive surrounding hyperdensity adjacent to the aortic lumen involving the aortic root, aortic arch, and thoracoabdominal aorta consistent with intramural and/or para-aortic hematoma [Figure 1]. Pre-operative transesophageal echocardiography (TEE) revealed mild to moderate aortic regurgitation, without evidence of major aortic atheroma. Given her age, prior cardiac surgical history, medical co-morbidities (STS Risk Score 8%), and elevated risk of peri-operative stroke (CHA_2DS_2-VASc score 5), the patient was offered endovascular repair of her pseudoaneurysm using vascular plug placement and thoracic endograft (TEVAR) placement, with utilization of the Sentinel Cerebral Protection System (SCPS).

Procedure in Detail:

Both radial and groin arterial access was obtained. After heparinization, the 6F SCPS was placed under fluoroscopic guidance via the right radial artery and positioned such that proximal and distal filters were within the innominate and left common carotid arteries, respectively, as previously described [6, Figure 2]. A temporary pacing wire was placed in the right ventricle. Intra-operative aortography and TEE confirmed favorable anatomy for TEVAR placement. Fluoroscopic visualization of the pseudoaneurysm neck, however, was technically difficult and the decision was made to forego vascular plug embolization. The arterial access site was preclosed with sutures. Two Cook Alpha thoracic endografts (42 x42 x 90 mm) (Indianapolis, IN) were modified on the backtable to accommodate our echocardiographic aorta measurements; both grafts were partially unsheathed and trimmed for a total length of 70 mm, and subsequently re-sheathed into the original delivery sheath. Both grafts were deployed under rapid pacing without incident, ultimately facilitating almost 2 cm of pseudoaneurysm coverage proximally. Completion aortography showed no extravasation or endoleak, and TEE confirmed successful exclusion of the pseudoaneurysm. The SCPS and endograft sheath were removed sequentially without incident. There were no embolic debris noted within the SCPS filters following retrieval. The patient was awakened from anesthesia and extubated without incident, and was discharged the following day without any evidence of neurologic deficit.

Discussion:

Endovascular approaches to treat complex aortopathies have been attempted out of necessity when surgical repair is not an option. Despite substantial research efforts in pre-operative risk stratification and various intra-operative preventive strategies [3,6], stroke remains a major complication of TEVAR and is associated with substantial morbidity and mortality. The high stroke rates of aortic arch grafts have previously raised concern about excessive morbidity [9]. Cerebral protection devices for TAVR such as the SCPS have demonstrated feasibility and efficacy for stroke risk reduction [4,8], and preliminary reports of their use in the descending aorta are promising. Here we report the first published account of cerebral protection device utilization in the endovascular management of proximal aortic arch pathology, with an excellent outcome. Further prospective studies are needed to comprehensively characterize aortic anatomy that permits the use of cerebral protection devices. Nevertheless, utilization of cerebral protection devices should be considered on a case-by-case basis for patients with elevated risk of stroke undergoing both ascending and descending TEVAR.

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Acknowledgements:

[1]Reprinted from JACC: Cardiovascular Interventions, Volume 9, Issue 25, Cerebral Protection During MitraClip Implantation: Initial Experience at 2 Centers, Pages 171-179, 2016, with permission from Elsevier.

Central Picture:

Sentinel Cerebral Protection System utilization during ascending TEVAR.

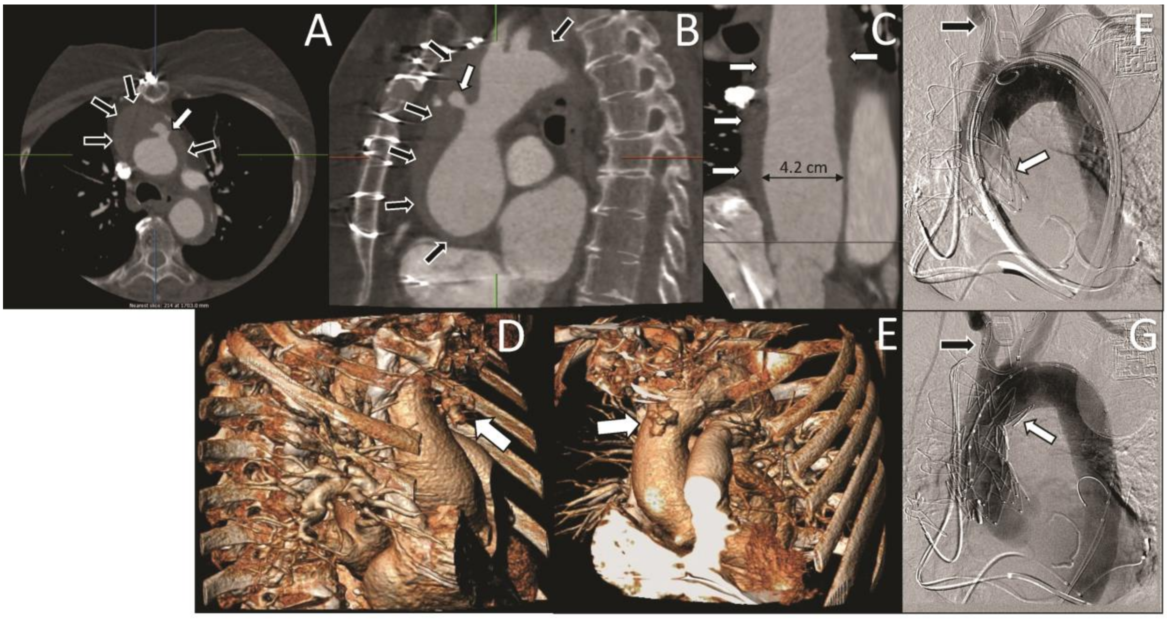

Figure 1

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Figure #1:

Axial (A) and Sagittal (B) CT imaging demonstrating aortic pseudoaneurysm (white arrows) and large intramural and/or periaortic hematoma (black arrows). (C) Elongated CT view of aorta with dimensions and with hematoma (white arrows). 3D CT reconstructions demonstrating aortic pseudoaneurysm (white arrows) from right anterior (D) and left anterior (E) oblique views. Fluoroscopic imaging of proximal (F, white arrow) and distal (G, white arrow) aortic endografts following deployment with visible Cerebral Protection System (black arrows).

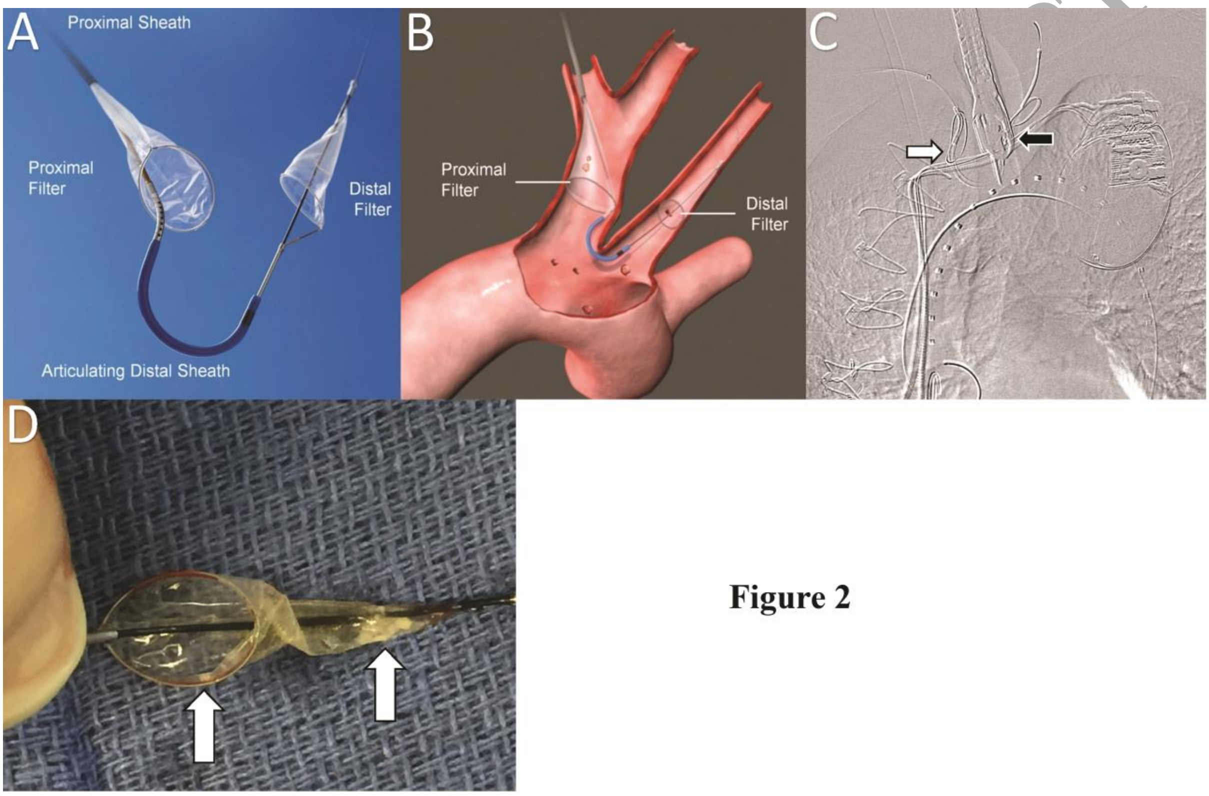

Figure 2

Figure #2

(A) Photograph of the Sentinel Cerebral Protection System with proximal and distal sheaths and filters[1] (B) Schematic *in vivo* positioning of the Sentinel Cerebral Protection System with proximal and distal filters within the innominate and left carotid arteries, respectively[1]. (C) Confirmation of Sentinel Cerebral Protection System placement with proximal filter within the innominate artery (white arrow), and distal filter within the left carotid artery (black arrow). (D)

Representative photograph of embolic debris (white arrows) following Sentinel Cerebral Protection System retrieval.

Video Legend

Aortography highlights the proximal and distal landing zones and relevant cardiovascular anatomy for both Sentinel Cerebral Protection System and TEVAR endograft positioning. Prior to deployment of the TEVAR endografts, the Sentinel Cerebral Protection System is placed under fluoroscopic guidance via the right radial artery and positioned such that the proximal and distal filters are within the innominate and left common carotid arteries, respectively. Proximal and distal TEVAR endografts are then deployed under fluoroscopic guidance. Successful exclusion of the aortic pseudoaneurysm is noted on subsequent completion angiography. The endograft sheath and Cerebral Protection System are then removed percutaneously.