Endovascular repair of thoracoabdominal aortic aneurysms

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Submitted Jun 05, 2023. Accepted for publication Oct 09, 2023. Published online Nov 22, 2023.
doi: 10.21037/acs-2023-adw-0078
View this article at: https://dx.doi.org/10.21037/acs-2023-adw-0078

Clinical vignette

A 69-year-old female presented for evaluation of an 8.3 cm extent II post-dissection thoracoabdominal aortic aneurysm (PD-TAAA). She had a prior ascending and aortic arch repair for a Stanford Type A dissection. She presented to our clinic with an 8.3 cm extent II PD-TAAA with a 5.2 cm right common iliac aneurysm, and a 3.8 cm left common iliac aneurysm with dissection extending into both iliac arteries. Her past medical history included hypertension, hyperlipidemia, a 30-pack year smoking history with chronic obstructive pulmonary disease (COPD) on home oxygen, coronary artery disease, obstructive sleep apnea, and chronic kidney disease. Given her risk factors, the decision was made to proceed to an endovascular repair of this PD-TAAA.

Surgical technique

Computed tomography angiography (CTA) was used to create a centerline of flow reconstruction to allow for precise measurement of the aortic and target vessel (TV) diameters, arc lengths, clock positions, and landing zones. Consideration was given to the appropriate use of fenestrations *vs.* branches. The senior author has a Food and Drug Administration (FDA) approved investigational device exemption (IDE; #G190192) and all physician-modified endografts (PMEG) are performed under this IDE. This allows the endograft to be tailored for each individual patient's anatomy. We strategize for spinal cord protection by staging the different components to allow time for accommodation of the spinal cord to coverage of important vascular beds.

The PMEG build is initiated in the operating room when the patient is brought in, and completed by the time patient is anesthetized, sterile prepped, and draped. The endograft is partially deployed on the back table, and the plan is transferred onto the endograft to re-create the exact location of fenestrations/branches. Ophthalmologic cautery is used to create fenestrations, followed by reinforcement with platinum wires sutured around the edges with 5-0 Ethibond to prevent fraying. When branches are indicated, Viabahn graft is cut to size and reinforced at the ostium in a similar fashion. Temporary constraints are placed on the posterior aspect of the graft to facilitate transvenous (TV) cannulation. Several silk sutures are placed to re-sheath the endograft into its original delivery system. The patient is positioned supine with arms placed in surrender position to minimize radiation. Our approach to these procedures is a totally percutaneous approach with bilateral groin access.

A combination of computed tomography (CT) fusion and intra-vascular ultrasound (IVUS) is used to mark the locations of the visceral and renal TV. The PMEG is then positioned carefully in accordance with the anatomy and deployed. Because the constraining ties are in place, it only deploys to 50–70% its diameter. A 14 Fr sheath is positioned from the contralateral access, the PMEG cannulated, and a steerable sheath is then used to sequentially select each fen/branch and their respective TV. Amplatz or Rosen wires are left in place. At this point, the constraining wire is removed allowing for expansion of the endograft, followed by use of a non-compliant balloon such as CODA Balloon Catheter (Cook Inc., Bloomington, USA) to ensure complete expansion. Next, sequential stenting of each TV is performed. Balloon expandable covered stent grafts (BESGs) are preferentially used in the author's experience for precise deployment in all fenestrations and most branches. A covered self-expanding stent graft (SESG) may be considered for branches when anatomically preferable. When vessels have angulation causing 'tenting-up' after placement of a BESG, a bare metal SESG may be used to smooth out the transition.

Ideally, BESG should extend approximately 5 mm into the aortic endograft and 15 mm into the TV. Balloon molding of the stent graft is followed by flaring the stent graft into the aortic lumen to optimize seal. On completion of placement of mating stents in each TV, a digital subtraction angiography (DSA) run can be performed to insure brisk opacification without any evidence of dissection or kinks. At this point, an endovascular aortic repair (EVAR) may be performed in a standard fashion with extension of iliac limbs, or an iliac branch device if indicated. A completion DSA may be obtained to evaluate for any type I or III endoleaks. It is our practice to perform a cone beam CT on all patients undergoing fenestrated/branched endovascular aortic repair (F/BEVAR) prior to removal of sheaths. It allows evaluation of stent architecture, adequate extension into TV and correction of any kinks, stenosis, or fractures, avoiding potential adverse events/reinterventions later.

Comments

Endovascular repair of TAAA is feasible and has been shown to have excellent results even in a high-risk population (1). In the absence of FDA approved custom-made devices, PMEG have been used to provide timely and expeditious repairs to these high-risk patients who otherwise would have been deemed unfit for any repair. These should ideally be done under the precept of an IDE to allow for prospective data collection and intensive review and monitoring to optimize outcomes (2). The efficacy and durability of PMEGs has been demonstrated in centers of excellence in previous reports (3,4). Our outcomes are commensurate with those demonstrated. Our group has demonstrated 100% technical success and 98.2% TV patency. There has been no aortic-related mortality and overall mortality rate is low at 1.8%. One-year freedom from reintervention remains high at 98%, and freedom from TV instability at 91%. We have learnt to minimize the use of contrast using adjuncts such as CT fusion and IVUS, with a median contrast volume of 26 cc per patient. Our median fluoroscopy time is 40 minutes. Our median intensive care unit (ICU) stay is 2 days (interquartile range, 1–3 days). Our median total hospital stay is also 2 days (interquartile range, 1–5 days).

The role of sex in endovascular TAAA repair has been examined previously (5). Women had a higher proportion of TAAA than pararenal aneurysms compared to men. Further findings from Witheford *et al.* suggest that women have a higher risk of early mortality following endovascular TAAA repair when compared with matched men. Overall, in appropriately selected patients, repair of complex TAAA in high-risk patients is safe, efficacious, and lifesaving. With technical advances and extensive experience, our outcomes compare favorably to alternative methods. Most of these patients are discharged to their homes after a short hospital stay with minimal associated morbidity, preserving quality of life.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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Cite this article as: Rossi MJ, Shults CC, Fatima J. Endovascular repair of thoracoabdominal aortic aneurysms. Ann Cardiothorac Surg 2023;12(6):609-611. doi: 10.21037/acs-2023-adw-0078