Homemade fenestrated stent-graft for thoracic endovascular aortic repair of zone 2 aortic lesions

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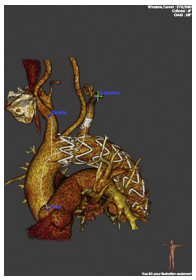
ABSTRACT

Objective: The aim of this retrospective analysis was to evaluate the outcomes of homemade fenestrated stent-grafts for thoracic endovascular aortic repair of zone 2 aortic lesions.

Methods: From November 2013 to January 2017, 24 patients underwent thoracic endovascular aortic repair with left subclavian artery revascularization using a homemade fenestrated stent-graft to preserve the patency of the left subclavian artery. Elective cases accounted for 54% (n = 13) of the sample. Indications included acute complicated type B aortic dissection (n = 9), degenerative aneurysm (n = 9), penetrating aortic ulcer (n = 5), and intramural hematoma (n = 1). Routine postoperative follow-up imaging with computed tomography angiography was performed to assess thoracic endovascular aortic repair and left subclavian artery fenestration patency and endoleak.

Results: Median duration for stent-graft modification was 16 minutes (range, 14-17 minutes). The technical success rate was 100%. One patient had a distal type I endoleak requiring additional stent-graft placement. One patient had partial coverage of the left common carotid artery requiring left common carotid artery stenting. One patient had a stroke without permanent sequelae (4.1%). Overall mortality was 0%. All left subclavian arteries were patent. Two type III endoleaks required additional left subclavian artery covered stent placement. One type II endoleak is currently observed. During a mean follow-up of 13.2 ± 2 months, there were no conversions to open surgical repair, aortic rupture, paraplegia, or retrograde dissection.

Conclusions: The use of a homemade fenestrated stent-graft for thoracic endovascular aortic repair of zone 2 aortic lesions is both feasible and effective for left subclavian artery revascularization during thoracic endovascular aortic repair involving a spectrum of thoracic aortic pathology. Durability concerns will need to be assessed in additional studies with long-term follow-up. (J Thorac Cardiovasc Surg 2017;■:1-6)



Patients treated with a homemade fenestrated stent-graft for TEVAR of a complicated chronic type B dissection.

Central Message

The use of a homemade fenestrated stent-graft for TEVAR of zone 2 aortic lesions is both feasible and effective for LSA revascularization during TEVAR.

Perspective

The use of a homemade fenestrated stent-graft for TEVAR of zone 2 aortic lesions is both feasible and effective for LSA revascularization during TEVAR. Durability concerns will need to be assessed in additional studies with long-term follow-up.

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ACQ

Since the first report by Dake and colleagues,[1] endovascular repair has emerged during the past decades as a valuable treatment for descending thoracic aortic diseases. Left subclavian artery (LSA) coverage during thoracic endovascular aortic repair (TEVAR) often is required to achieve a suitable proximal landing zone and is performed in to up to 40% of procedures.[2] Intentional stent-graft coverage of the LSA initially was thought to be a viable alternative in this setting to extend the applicability of TEVAR. Experience with intentional LSA coverage without revascularization unfortunately has demonstrated a significant association with

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Received for publication Feb 22, 2017; revisions received May 13, 2017; accepted for publication July 3, 2017.

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0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2017.07.045

Abbreviations and Acronyms
LCCA = left common carotid artery
LSA = left subclavian artery
TEVAR = thoracic endovascular aortic repair

spinal cord and left upper limb ischemia, as well as vertebral territory stroke.[3,4]

Reports of procedures that maintain the patency of the LSA include debranching before elective TEVAR,[5] the chimney technique of deployment of a LSA stent parallel to the thoracic stent-graft,[6] and retrograde laser fenestration.[7] Branched stent-grafts have been proposed that permit complete endovascular aortic arch repair.[8] This approach has several limitations. The time required to manufacture and deliver custom-made stent-grafts preclude their use for urgent cases. We have already reported the use of homemade proximal scalloped stent-grafts for TEVAR of zone 2 acute aortic syndromes.[9] However, patients are only considered suitable for a scalloped stent-graft if the minimum healthy aorta is at least 15 mm from the expected position of the edge of the scallop, both proximally and laterally. Therefore, several patients are not eligible for this approach, especially for lesions involving the outer curve of the aortic arch.

The purpose of the following retrospective analysis was to review our experience with a homemade fenestrated stent-graft for TEVAR of zone 2 aortic lesions.

MATERIALS AND METHODS

Patients

Protocol and informed consent were approved by the Institutional Review Boards. All patients gave written consent, and the local authorities approved the study. Patients treated using physician-modified thoracic stent-grafts for the treatment of aortic arch lesions in 3 tertiary referential center were included (A de Villeneuve Hospital, Montpellier, France; Hakodate Municipal Hospital, Hakodate, Japan; and Santa Helena Hospital, Florianopolis, Brazil). All patients were considered to be at high surgical risk because of serious comorbidities (American Society of Anesthesiologists score ≥III or emergency repair).

This experience with homemade fenestrated thoracic stent-grafts started in August 2013. Consecutive patients with zone 2 aortic lesions undergoing endovascular repair using homemade fenestrated stent-grafts were included. The homemade stent-grafts created at our institutions are individually designed to fit the aortic configuration of each patient. Patients with zone 2 aortic lesions with a proximal and distal aortic neck diameter of less than 40 mm were considered possible candidates for endovascular aortic repair using a fenestrated thoracic stent-graft. We only consider the use of fenestrated thoracic stent-grafts if the proximal neck is healthy (nondissected) and more than 15 mm in length. The distance between the LCCA and the proximal part of the lesion has to be 15 mm in length. If not, this lesion will be considered as a zone 1 aortic arch lesion.

All patients underwent high-resolution computed tomography angiography preoperatively. Demographic, anatomic, intraoperative, and postoperative data were recorded by means of a prospectively maintained database. Follow-up computed tomography angiography was performed at 1 week and 3 and 6 months and annually thereafter.

Planning, Sizing, and Device Preparation

Procedure planning and device sizing were performed using a dedicated 3-dimensional vascular imaging workstation (Aquarius WS, Terarecon Inc, Mateo, Calif; or the OsiriX Imaging Software package, Geneva, Switzerland) with centerline luminal reconstructions.

Centerline luminal reconstruction is used to determine the aortic diameter at the proximal and distal landing zone. Stent-grafts of sufficient length were selected to enable proximal and distal landing zones in healthy aorta of at least 15 mm. The stent-graft oversizing was less than 10% for acute aortic dissection and between 10% and 15% for other aortic arch pathologies. Centerline luminal reconstruction also is used to determine the distance between the proximal edge of the stent-graft and the center of the fenestration. The centerline length measurement between the top of the landing zone (or fabric) and the middle of the origin of each target vessel is recorded and used to determine the distance between the proximal edge of the stent-graft and center of the fenestration. Volume-rendering images are used to determine the optimal position of the C arm and to evaluate the aortic arch tortuosity.

Modification of the stent-graft was performed on a back table, commencing before the start of anesthesia (Video 1). A portion of the device is unsheathed. Our preference is to unsheathe the area to be modified plus 1 additional stent. The fenestration is premarked in the main stent-graft according to the measurements obtained from centerline analysis.

A single fenestration for the supra-aortic trunk target vessel of appropriate size and location is made between the stent-graft stent struts (Figure 1). Fenestrations are circular, do not have stent struts going across them, and are of comparable size to the target vessel. A sterile marking pen was used to mark the location of the fenestrations on the basis of length measurements determined using the reconstructed. Minor adjustments were made permitted to the site fenestrations to facilitate use of strut-free fenestrations. A cautery device was used to carefully burn the Dacron fabric to create the fenestration. Thereafter, to enforce sealing power around the fenestration (the covered stent may be dilated and locked against the nitinol ring to create a seal), a radiopaque nitinol wire is sewn onto the edge of the fenestration.

Technique

All procedures were performed under general anesthesia, through a surgical cut-down of the common femoral artery. Procedures have been performed in an operating room equipped with a C-arm or in a hybrid room. Heparin (5000 IU) is administered as the thoracic stent-graft is introduced over an ultra-stiff guidewire. Angiographic runs are performed through a pigtail catheter, introduced percutaneously

VIDEO 1. Technique of creation of a homemade fenestrated stent-graft for TEVAR. Video available at: http://www.jtcvsonline.org.