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REVIEW

A Comprehensive Review of In Situ Fenestration of Aortic Endografts

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WHAT THIS PAPER ADDS

Besides commercially available fenestrated/branched endografts, parallel stent techniques and surgeon modified endografts, evolution of endovascular technologies has rendered possible in situ fenestration (ISF) of aortic endografts. This study documents the means and tools that allow ISF, the clinical settings in which ISF has been performed, and summarizes available results. Although there may be publication bias, high technical success rates and satisfactory short-term results were reported. Long-term outcomes and comparison with alternative techniques are lacking.

Objective: Despite technical advances of fenestrated and branched endografts, endovascular exclusion of aneurysms involving renal, visceral, and/or supra-aortic branches remains a challenge. In situ fenestration (ISF) of standard endografts represents another endovascular means to maintain perfusion to such branches. This study aimed to review current indications, technical descriptions, and results of ISF.

Method: A review of the English language literature was performed in Medline databases, Cochrane Database, Web of Science, and Scopus using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Sixty-seven relevant papers were selected. Thirty-three papers were excluded, leaving 34 articles as the basis of the present review.

Results: Most experimental papers evaluated ISF feasibility and assessed the consequences of ISF on graft fabric. Regarding clinical papers, 73 ISF procedures have been attempted in 58 patients, including 26 (45%) emergent and three (5%) bailout cases. Sixty-five (89%) ISF were located at the level of the arch, and eight (11%) in the abdominal aorta. Graft perforation was performed by physical, mechanical, or unspecified means in 33 (45%), 38 (52%), and two vessels (3%), respectively. ISF was technically successful in 68/73 (93%) arteries. At 30 days, two (3.4%) patients died in the setting of an aorto-bronchial fistula and an aorto-oesophageal fistula, respectively. No post-operative death, major complication, or endoleak was described as secondary to the ISF procedure. With follow-up between 0 and 72 months, four (6.9%) late deaths were noted, unrelated to the aorta. One (1.7%) LSA stent was stenosed without symptoms.

Conclusions: Although there may be publication bias, multiple techniques were described to perform ISF with satisfactory short-term results. Long-term data remain scarce. Aortic endograft ISF is an off-label procedure that should not be used outside emergent bailout techniques or investigational studies. A comparison with alternative techniques of preserving aortic side branches is needed.

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INTRODUCTION

Despite the technical advances in endovascular aortic repair (EVAR), endovascular exclusion of aortic aneurysms involving one or more renal, visceral, and/or supra-aortic branches remains a challenge.[1] Commercially available fenestrated and branched endografts (FBE) now represent a valid option in scheduled patients,[2] but significant manufacturing delay and high cost[3,4] limit the use of these

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devices. Besides FBE, off-label techniques have emerged during the last decade, including endografts with parallel stents, namely CHIMPS (Chimney, Periscope, Sandwich),[5,6] surgeon modified endografts ("homemade fenestrated endografts"),[7] and various other reported techniques.[8]

First described in 2004 by McWilliams et al.,[9] in situ fenestration (ISF) of standard endografts represents another off-label endovascular means to maintain perfusion to aortic side branches located in the excluded area. Its principle is based on fenestration of an endograft following its deployment inside the vascular system (Fig. 1). As data are scarce regarding ISF, the aim of this study was to critically review current indications, technical descriptions, and results of ISF in the available literature.

METHOD

A comprehensive review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.[10]

Search strategy

A systematic review was performed of the English language literature in September 2016 regarding ISF of endografts on several medical databases: Medline databases using Pubmed (www.pubmed.org), the Cochrane Database, Web of Science, and Scopus. The search period was from January 2003 to September 2016. Keywords used were "in situ fenestration," "fenestration," "endograft," "stent-graft," and "aortic aneurysms." Searches were also performed for related articles.

Study selection

Clinical and experimental papers were considered. In total, 67 relevant papers were selected and further analysed by two independent analysts (MG and RC). Unrelated papers ($n = 25$), review articles ($n = 4$), letters and commentaries ($n = 3$), and duplicate research ($n = 1$) were excluded.

Data extraction

Data were extracted regarding the type of paper (clinical or experimental, and case report or series), number of subjects and target arteries, demographics, anatomical location (abdominal or thoracic), ISF type (retrograde or antegrade), ISF technique (puncture system, hole enlargement technique, graft type, stent use, perfusion method during ISF), technical success rate, and early and late results (mortality, endoleak).

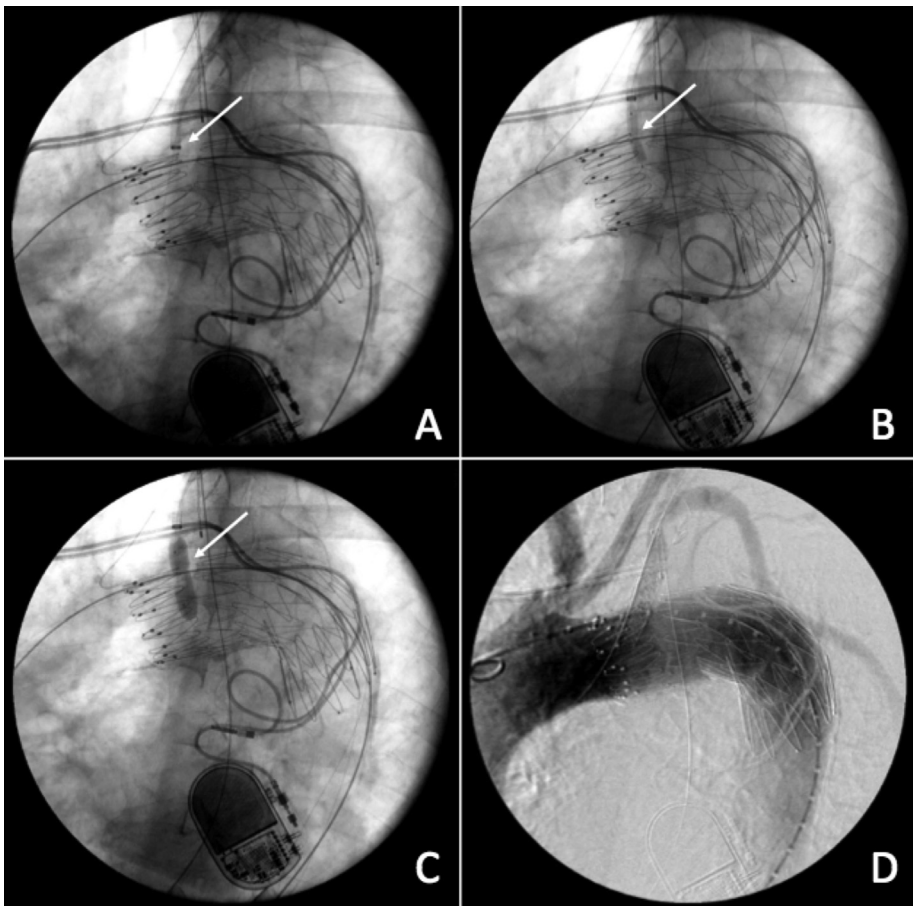

Figure 1. In situ fenestration of a thoracic endograft to preserve the left subclavian artery (intra-operative views) in the setting of a saccular aneurysm of the arch. Following thoracic endograft deployment, the graft is punctured through the left axillary artery using the reversed end of a 0.014′ wire (A). A low profile 4 mm diameter balloon (Viatrac 0.014, Abbott Vascular) is used to enlarge the fenestration (B) and allow the introduction of a larger 8 mm high pressure non-compliant balloon (Conquest, Bard Inc) (C). The fenestration is then stabilized with a balloon expandable covered stent (Advanta V12, Atrium). The saccular aneurysm of the arch is excluded on completion angiogram (D).

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