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Self Made Xeno-pericardial Aortic Tubes to Treat Native and Aortic Graft Infections

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WHAT THIS PAPER ADDS

There is no consensus on the most appropriate material to be used for in situ reconstruction of the aorta for native or graft infection. This retrospective study shows that the use of self made bovine pericardial tube grafts is an option with good clinical results in the mid-term. Early radiological results regarding graft durability are encouraging.

Objectives: The most appropriate material for reconstruction of the aorta for native or graft infection remains a matter for debate. This study examines the mid-term outcome of patients and graft durability after in situ aortic reconstruction with self made bovine pericardial tube grafts.

Methods: This was a retrospective analysis of all patients who underwent in situ aortic reconstruction using self made bovine pericardial tube grafts between January 2008 and December 2015 at a tertiary referral centre. Peri-operative and mid-term outcomes including mortality and re-infection were analysed at the end of January 2017. Available follow-up imaging was reviewed to assess graft durability.

Results: Bovine pericardial aortic tube grafts were used in 35 patients (86% male) with a median age of 69 years (range 38–84) to reconstruct the ascending aorta or the aortic arch (7), the descending (7), the thoraco-abdominal (7), or the abdominal (14) aorta. Twelve patients (34%) were treated for infection of the native aorta and 23 (66%) for prosthetic graft infection. Twenty-two patients (63%) underwent emergency surgery. Thirty day mortality was 31% ($n = 11$). Additionally, six patients died during follow-up after a median of 33 months (range 3–70). For the remaining patients, mean follow-up was 48 months ($\pm$ 26) with a mean Follow-Up Index of 0.98 $\pm$ 0.08. There were no readmissions or re-operations for re-infection or graft related complications. Follow-up imaging showed no signs of graft degeneration after a median of 15 months (range 3–68).

Conclusions: Surgical treatment of native and aortic graft or endograft infection remains high risk. Self made bovine pericardial tube grafts for in situ reconstruction are a promising option offering many advantages. Despite high early mortality rates, early radiological and mid-term clinical results are good. Definitive eradication of the infection seems feasible after in situ insertion of xeno-pericardial material for aortic repair.

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INTRODUCTION

Aortic infection is a challenging life threatening disease in cardiovascular surgery. Whereas infection of the native aorta (i.e. in the form of an infected aneurysm) is relatively rare in Europe, aortic graft infection continues to be a relevant complication of aortic surgery with a recently reported incidence of up to 4.5%.[1]

The clinical presentation of patients with aortic infection may vary considerably but complications are usually dramatic, including sepsis and rupture that result in high morbidity and mortality.[2,3] For native aortic infection, some authors report minimally invasive endovascular repair, avoiding removal of infected tissue, combined with long-term antibiotic therapy.[4,5] However, open surgical repair, including removal of the infected material and local debridement followed by aortic reconstruction, is still the most established option for definitive eradication of the infection in both native and aortic graft infection. Extra-anatomic reconstruction has mostly been replaced by in situ reconstruction[6,7] using different graft materials.[8–12] Compared with antibiotic and silver coated prosthetic

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grafts,[8,9] biological grafts such as homografts[10,11] or autologous veins[12] are generally considered more resistant to re-infection. However, the availability of homografts is limited while harvesting of autologous veins prolongs procedural time and may cause additional morbidity.

Xeno-pericardial material is widely used in cardiovascular surgery. Bovine pericardium is very supple, easy to handle, always available, and finally extremely stable and its compliance is similar to that of native arteries.[13] Excellent long-term experience is available for the use of bovine pericardial patches to close the arterial incision following carotid endarterectomy[14,15] but some concerns about durability, especially in terms of calcification and (pseudo-) aneurysm formation have been raised.[13]

Nevertheless, bovine pericardium has been proposed as ideal graft material in infections early on[16] and results regarding its resistance to re-infection are promising.[17]

This group has previously published the results of a small series of patients with aortic graft infection, treated by graft removal and in situ reconstruction with self made bovine pericardial tube grafts constructed from a patch.[18] The aim of this study is to update the experience with this technique to reconstruct all aortic segments and to add follow-up data, looking at survival, re-infection, and graft durability.

METHODS

Consecutive patients undergoing in situ reconstruction of the thoracic, thoraco-abdominal, or abdominal aorta using self made bovine pericardial tube grafts between January 2008 and December 2015 at a tertiary referral centre (Bern University Hospital) were identified. The local ethics committee approved the study (approval number 2016-00178).

Diagnosis of aortic infection was based on clinical, radiological (computed tomography [CT], ^{18}F-fludeoxyglucose positron emission CT), and laboratory signs as well as intra-operative findings (e.g., pus), microbiological and histopathological tissue analyses. Aortic graft infections were evaluated according to the criteria proposed by Lyons et al.[19] Patients in whom aortic infection was not confirmed by microbiological or histopathological examination of tissue samples were excluded.

Data including patient demographics, comorbidities as well as type (native vs. aortic graft infection), localisation and origin of the infection, clinical presentation, urgency of surgery, antimicrobial treatment, peri-operative complications, and mortality were retrospectively collected from hospital records.

Post-operative follow-up included regular outpatient visits with CT and/or magnetic resonance (MR) imaging performed at least once and thereafter according to the patient's condition and laboratory parameters (e.g., C-reactive protein, white blood cell count). At the end of follow-up, available CT or MR angiograms, performed more than 3 months post-operatively, were reviewed by a senior radiologist using double oblique multiplanar reconstructions to assess for signs of re-infection, graft calcification, thrombosis, stenosis, or aneurysmal degeneration. CT or MR criteria for re-infection were the presence of ectopic gas, perigraft fluid collections, increased contrast media uptake/pronounced enhancement of periaortic soft tissue, pseudoaneurysm, or fistulae. Follow-up was completed by a telephone interview with all patients or their general practitioners at the end of January 2017 to assess for clinical signs of re-infection, readmission, and/or re-operation for re-infection or graft related complications and death. Patients known to have died during follow-up were reported separately with the median time to death. For all other patients, follow-up completeness was assessed using the Follow-Up Index.[20] Survival curves were calculated using the Kaplan—Meier method.

Surgical technique

Surgical management of patients with native or aortic graft infection consisted of removal of infected tissue and prosthetic material as well as thorough local debridement. Multiple samples of (peri-) aortic tissue and removed graft material were collected for microbiological and histopathological examination.

The pericardial tube graft was prepared simultaneously by a second surgeon using a 14 $\times$ 8 cm Supple Peri-Guard (Synovis Surgical Innovations, St. Paul, MN, USA) or 15 $\times$ 10 cm SJM Biocor (St. Jude Medical, St. Paul, MN, USA) bovine pericardial patch (authorized for vascular reconstructions). If necessary, the patch was tailored according to the diameter and length of the aortic segment to be reconstructed. The patch was sewn to form a tube using a non-absorbable (polypropylene) 4-0 running suture (Prolene, Ethicon, Somerville, NJ/Cincinnati, OH, USA). The suture was interrupted every 5 cm. Bifurcated grafts were constructed in a similar manner (Fig. 1).

Depending on the localisation of aortic reconstruction, surgery was performed using cardiopulmonary bypass and moderate hypothermic circulatory arrest (for involvement of the ascending aorta and aortic arch) or left heart bypass and mild hypothermia (when the descending thoracic aorta was involved). In case of expected duration of visceral ischaemia $\geq$ 30 minutes, a passive aorto-visceral shunt was used.

Antimicrobial therapy

Type and duration of antimicrobial therapy were determined after consulting with an infectious disease specialist. In cases of poor patient condition or sepsis, empirical pre-operative antimicrobial therapy was administered after obtaining blood cultures. If antimicrobial treatment had been initiated for other reasons before referral to the service, medication was continued and adapted post-operatively according to the results of the microbiological cultures. If a fistula (enteric, bronchial, oesophageal) was present or suspected pre- or intra-operatively, antifungal treatment was initiated immediately. The post-operative antimicrobial therapy regimen, always initially intravenous, depended on the type of pathogen, intra-operative findings, and clinical evolution.