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REVIEW

Treatment of Infected Thoracic Aortic Prosthetic Grafts with the In Situ Preservation Strategy: A Review of its History, Surgical Technique, and Results

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For cardiothoracic surgeons prosthetic graft infection still represents a difficult diagnostic and treatment problem to manage. An aggressive surgical strategy involving removal and in situ replacement of all the prosthetic material combined with extensive removal of the surrounding mediastinal tissue remains technically challenging in any case. Mortality and morbidity rates following such a major and risky surgical procedure are high due to the nature of the aggressive surgical approach and multi-organ failure typically caused by sepsis. However, removal of the infected prosthetic graft in patients who had an operation to reconstruct the ascending aorta and/or the aortic arch is not always possible or necessary for selected patients according to current alternative treatment options. Rather than following the traditional surgical concept of aggressive graft replacement nowadays a more conservative surgical approach with in situ preservation and coverage of the prosthetic graft by vascular tissue flaps can result in a good outcome. In this article, we review the relevant literature on this specific topic, particularly in terms of graft-sparing surgery for infected ascending/arch prosthetic grafts with special emphasis on staged treatment and the use of omentum transposition.

Keywords Prosthetic graft infection • Ascending aorta • Aortic arch • Omentum transposition • In situ preservation • Irrigation

It is not only for what we do that we are held responsible, but also for what we do not do.

– Voltaire (1694–1778)

Introduction

Prosthetic graft infection is fortunately a rare event following thoracic aortic surgery. Around 3% of patients develop prosthetic graft infection following reconstructive surgery on the

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ascending aorta, the transverse aortic arch, or the ascending aorta and the transverse aortic arch [1]. However, when this complication occurs, it is a source of major morbidity and is associated with increased mortality which has been reported to be 25–75% [1,2]. The surgical treatment of thoracic aortic prosthetic graft infections in the past often involved removal and in situ replacement of the prosthetic graft material itself as well as extensive debridement and resection of all infected surrounding mediastinal tissue followed by some form of mediastinal antiseptic irrigation, broad-spectrum antibiotic therapy and occasional obliteration of the dead space by autologous tissue, frequently of the greater omentum [1,3–9]. However, this kind of reoperation is associated with an exorbitant high mortality risk due to location of the infected graft and underlying comorbidities. As such an aggressive high-risk aortic redo procedure in many patients is often not compatible with survival a different available option for treatment is needed. In this clinical scenario several groups have reported and suggested, under certain circumstances, a more limited and graft-sparing surgical approach with open surgical extensive disinfection followed by tissue flap coverage of the infected ascending/arch prosthetic graft with excellent immediate and midterm outcomes [1–3,10–39].

Clinical Presentation

Early prosthetic graft infection (defined as early-onset infection up to four months after surgery) presents most often within the first 30 days after ascending aortic/arch surgery and is frequently related to sternal wound infection [1,3,9,20,40]. The patient may be systematically septic with fever, sweats, and chills with or without chest pain secondary to fluid collection within the mediastinum and around the aortic prosthetic graft. Purulent secretions or foul-smelling drainage from the sternal incision may signal an early aortic prosthetic graft contamination associated with surgical site infection. However, in some instances early prosthetic graft infection may occur without local complications. An unexplained leucocytosis with concomitant increase of C-reactive protein and fever may be then the only clinical or laboratory signs of aortic prosthetic graft infection. The fact that an increase in the intensity and quality of the heart sounds is detectable upon physical examination, then best heard along the upper right or left sternal borders which is linked to significant mediastinal fluid collection should provoke suspicion of prosthetic graft infection when the abovementioned clinical signs are manifest. Late prosthetic graft infection (defined as late-onset infection > 4 months after thoracic aortic prosthetic graft implantation) can occur up to 20 years after the initial aortic procedure and presents less frequently with sternal wound infection [9]. The clinical presentation of patients suffering from a late thoracic aortic prosthetic graft infection, however, does not differ from those with an early prosthetic graft infection. Signs of infections such as fever, chills, or leucocytosis are usually evident upon presentation in all cases [3].

Useful Diagnostic Imaging Options

Thoracic aortic prosthetic graft infection remains a challenging diagnostic problem requiring a multidisciplinary approach. Diagnostic imaging is essential for the diagnosis of a clinically highly suspected prosthetic graft infection and very useful for assessing anatomical features that have an impact on the type of surgical strategy. Practically, patients with a thoracic aortic prosthetic graft infection undergo multi-slice computed tomographic (CT) angiography which remains the best single and most specific and feasible examination providing accurate assessment of the anatomy of the aorta and the prosthetic graft, the anastomotic sites and the perigraft region for abscess [41]. However, in the early postoperative period such imaging modalities are often nonspecific. The contrast-enhanced CT-scan findings that are suggestive of thoracic aortic prosthetic graft infection and deserve mention are (1) presence of perigraft fluid with a density < 20 Hounsfield Units, (2) presence of ectopic gas, (3) loss of normal tissue planes of the mediastinal or perigraft structures with increased amount of soft tissue (>5 mm) between the graft and the surrounding sac, and (4) pseudoaneurysm formation [42]. Dynamic CT angiography remains an additional important diagnostic modality and should always be considered in order to definitively control the integrity of anastomotic sites. The latter technique facilitates proper interpretation of indistinct CT findings by demonstrating anastomotic details with regard to the presence of vague opaque material within the surgical field and in particular around the anastomoses like glue and Teflon felt which are frequently used in aortic surgery to support suture lines, but may be wrongly interpreted as anastomotic leak. In thoracic prosthetic graft infection, the usefulness of other diagnostic options such as echocardiography does not really provide further aspects of the perigraft region for infection. However, it is a readily available imaging technique that can be performed urgently at the bedside of critically ill patients or in emergency to study aortic valve function. Over the last years indium^{111} white blood scan, a radionuclide imaging technique has emerged as an efficient option for detecting the location and extent of the infection on prosthetic grafts with a 50–90% accuracy rate, but two main disadvantages remain [3,43,44]. First, radionuclide uptake is non-specific in the early postoperative course (three–six months after prosthetic graft implantation) due to the healing process and the anticipated perigraft inflammatory reaction and second, this specific imaging technique is only infrequently available. As a result the latter diagnostic imaging tool is basically only seldom implemented into routine diagnostic work-up for prosthetic graft infection. In this regard definitive preoperative diagnosis of prosthetic graft infection strongly depends on aspiration of the highly suspected fluid. Characteristically CT-guided aspiration of cavitary perigraft fluid collection enables the physician to exactly differentiate abscess formation from uninfected seroma or haematoma. In conclusion,