EDUTORIAL

Current Management of Aortic Endograft Infection: Prepare Your Team for This New Challenge

While the reported aortic endograft infection (EGI) rate is lower than 1%,[1] the number of more challenging infected patients will increase due to the widespread use of aortic endografts (EGs). The lessons learned from the management of aortic vascular graft infections (VGIs) are not fully transposable to EGI.

DIAGNOSIS

The diagnostic criteria proposed by the Management of Aortic Graft Infection Collaboration[2] are useful if an EGI is suspected. Indeed, computed tomography angiography remains the first line radiological examination in the search for peri-graft fluid collections, soft tissue oedema, or gas bubbles. However, images may be difficult to interpret following repeated endoleak rescue procedures involving mechanical and/or liquid devices. Unfortunately, the risk of infection is higher in this subgroup of patients due to re-interventions; approximately a third of patients presenting EGI underwent one or more adjunctive procedures following the index one.[3] Nuclear imaging by positron emission tomography computed tomography and/or single photon emission computed tomography represent the second line examination for confirming the suspicion of infection or for deciphering the infected components in the event of complex endovascular repair.

TREATMENT PLAN

Owing to the complexity of the pathology, not all patients are treated the same way. Whenever possible, complete removal of the infected EG is the best option, although partial retrieval may be contemplated in frail patients presenting well delineated infection. Conservative treatment consisting of lifelong antibiotics with or without drainage is sometimes the only reasonable option, especially for patients with a complex aortic EG and poor life expectancy. A multidisciplinary team comprising nuclear medicine physicians, infectious disease physicians, microbiologist, anaesthetist, and vascular surgeons is needed in order to identify the best solution for each patient according to their past medical history and their clinical status. For each individual case, this team should also cover the following aspects: the potential need for pre-operative percutaneous drainage to decrease and identify the micro-organism load, pre-operative (un)targeted antibiotic therapy, the surgical approach, the revascularisation technique, the material used, and follow up.

SURGICAL APPROACH

To extract an EG, a midline laparotomy is sufficient in most cases, especially if an aorto-enteric fistula requires complementary bowel repair. While suprarenal aortic cross clamping allows extraction of an EG without suprarenal fixation, temporary coeliac control through the lesser omentum between the diaphragmatic crus is mandatory when dealing with an EG with suprarenal fixation. Once the extraction is complete, the aortic clamp is moved downwards to the supra- or infrarenal level, depending on the quality of the aortic wall. Alternatively, temporary coeliac endoclamping with an aortic balloon inserted under fluoroscopic guidance via the transfemoral route is safe and feasible.[4] Regardless of the clamping technique used and as a result of blind extraction, both the aortic wall and the ostia of the visceral arteries may be damaged, leaving few options to perform an efficient repair. For these reasons a retroperitoneal approach is preferable to extract an aortic EG with a long uncovered proximal stent and/or if the distance between the renal arteries and the superior mesenteric artery is short. Complex aortic EG (chimney, branched, or fenestrated aortic EG) extraction requires a thoraco-abdominal approach. As in the event of type IV thoraco-abdominal aortic aneurysm, this provides supra-coeliac control and easy management of the visceral arteries, except the right renal artery. When an additional extensive right iliac/renal artery repair is planned, a bilateral subcostal incision combined with medial rotation of all the intra-abdominal viscera to the patient's right (Mattox manoeuvre) may also be used.

EXTRACTION

In the event of suprarenal fixation, removal of the proximal uncovered stent equipped with hooks or barbs may be challenging. Various options are available for preserving the arterial wall: disconnection of the hooks one by one, after having separated the stent from the fabric in order to decrease the pressure on the aortic wall; or simultaneous recapture of all the hooks with the help of a Rumel tourniquet or the barrel of a 20 mL syringe.[4] If complete removal of the suprarenal component of the EG is impossible, the fabric may be excised from the struts, leaving the hooks in place. The collection of multiple intra-operative

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samples including the EG and surrounding tissues is mandatory, together with infected tissue debridement.

REVASCULARISATION

In situ repair outperforms extra-anatomic revascularisation in terms of early mortality, conduit failure, amputation, and re-infection rate.[5] Nevertheless, the American Heart Association guidelines[6] state that excision and extra-anatomic bypass may be considered in patients with infection due to multidrug resistant micro-organisms or in those with extensive intra-abdominal abscess or peri-graft purulence (Class IIb; Level of Evidence C). However, the 10%—20% stump blowout rate[5] reported mainly in VGI series may increase dramatically when ligating an aortic neck damaged by aortic EG extraction. Stump strengthening using biological material such as bovine pericardium or *fascia lata* is possible, although this delicate procedure may impair renal arterial flow.

MATERIALS

Owing to the risk of delayed degeneration, neo-aorto-iliac system (NAIS) *in situ* reconstruction using autologous femoral veins seems preferable to cryopreserved arterial allografts. In the event of a large neck or a damaged aortic wall due to removal of the uncovered stent, the operator may have to perform the proximal anastomosis at a higher level. In this setting, a NAIS prepared on the back table may prove unsuitable owing to a discrepancy in diameter or length. In such cases, a tubularised bovine pericardium sheath alone[7] or combined with autologous veins or homologous arteries allows the biological graft to be tailored promptly. These extensive total biological reconstructions are particularly useful when difficulties in recovering the *in situ* repair have been anticipated pre-operatively (e.g. thin or multi-operated patients without available omentum). Even if biological substitutes such as cryopreserved arterial allografts or venous autografts give better results in terms of re-infection and graft related complications, physicians currently use prosthetic conduits in more than 50% of EGI.[8] Dedicated antimicrobial synthetic grafts (antibiotic bonded or silver coated grafts) represent the off the shelf solution. Their immediate availability and shorter operating time are their main advantages, especially in situations such as emergency repair of haemodynamically unstable patients or complex aortic EG needing revascularisation of the visceral arteries. Soaking in rifampicin has recently been contested in *in vitro* experiments due to the emergence of rifampicin resistant mutants altering the efficacy of this useful drug for the post-operative course.[9] Moreover, in the 30% subgroup of patients presenting with a secondary aorto-enteric fistula,[8] fungal contamination is often documented. While rifampicin was ineffective against fungi, silver and triclosan have demonstrated an antimicrobial efficacy.[9] These findings need to be confirmed by clinical studies.

FOLLOW UP

The same multidisciplinary team that managed the patient pre-operatively should be in charge of surveillance, including scheduled physical examinations, blood tests, and (nuclear) imaging to detect early the degeneration of cryopreserved arterial allografts and the recurrence of infection especially when a partial extraction has been performed or a synthetic graft has been implanted. Targeted antimicrobial drugs must be prescribed as soon as possible and given for at least six weeks and sometimes even longer.

In conclusion, since the aortic EG was sometimes performed several years before in a younger and healthier patient, a multidisciplinary team management offering a tailored strategy is mandatory for treating an EGI.

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