
AIM: Retrospective review of aorto-iliac infections in a single vascular surgery center.

METHODS: From a retrospective review of their experience in the last 20 years, the Authors analyze a series of 12 cases of aorto-iliac infection. Prognostic factors, surgical options and results are discussed and compared with the literature.

RESULTS: Infections of the aorta eventually associated with aneurysmal degeneration are uncommon (less than 3% of all aortic aneurysms) but still a life-threatening condition with high hospital mortality (25%). No statistical evaluation can be drawn from small series; however, early results are apparently influenced by emergency surgery and comorbidities affecting the immune response; in-situ reconstruction is associated with better long-term results (patency 100%, recurrent infection 0%).

CONCLUSIONS: In our experience, in situ aortic grafting reconstruction associated with proper antibiotic therapy obtained satisfactory results in terms of mortality and long-term survival. Endovascular treatment can be adopted in critical patients with prohibitive surgical risk.

KEY WORDS: Aorta and iliac artery infections, Infective aneurysm, Vascular infections

Introduction

Infections of the aorta, eventually associated with aneurysm development, are rare (0.5-2.6%) with higher rates observed in Eastern countries (13%) 1-6. Only small series are available from the literature, so it is very difficult to identify risk factors for this disease; most patients are aged, with generalized sepsis and serious comorbidities often associated with a depressed immune response.

Hospital mortality rates are high (16-44%) in spite of improvements in imaging, surgical techniques and available antimicrobial therapy; most of deaths are observed in patients with infections by Salmonella or Staphylococcus Aureus, in ruptured aneurysms and when the suprarenal aorta is affected 1.

This retrospective, single-center study reports early and late results of treatment in 12 patients observed in the last 20 years.

Patients description

In the last 20 years, 1280 patients were treated in our Unit for aorto-iliac aneurysmal disease; infection of the
aorta or iliac arteries were observed in 12 cases (0.94%) (Table I). They were 9 men and 3 women with mean age of 63.3 years (range 45 - 84); the site of arterial infection was thoracic aorta in 2 cases, suprarenal aorta in 1, infrarenal aorta in 7, external iliac artery in 2. History revealed in 4 patients a recent event possibly related to vascular infection (arteriography in 1 case, prostatic biopsy in 1 case, acute pyelonephritis in 2); in one case of suprarenal aortic infection with positive cultures for Cl. Septicum, a small cancer of the ascending colon was found at endoscopy. Fever, leucocytosis and increased Eritrocyte Sedimentation Rate were found in all cases. All patients with abdominal aorto – iliac infection presented with abdominal pain and pulsatile mass; lumbar pain was complained in one case, in association with aneurysmal rupture into the left iliopsoas muscle and erosion of vertebral body L3. Recurrent Rematemesis was observed in a patient affected by infective aneurysm of the thoracic aorta who developed an aortoesophageal fistula.

In all patients, angio-CT study was performed to confirm diagnosis as well as to obtain useful details for surgical strategy (cranial extension, involvement of visceral vessels and other regional structures). The morphologic and densitometric patterns found resulted specific in 100% of cases: all patients presented saccular aneurysms with polycyclic contour and dishomogenous thrombus while the non-infected aorta resulted in normal ranges; gas bubbles and periaortic fluid collection were also found in 5 of 6 patients with infrarenal aortic infection. Cultures of peripheral blood and/or the arterial wall resulted positive in 10 cases (83.3%), the most common bacterial species found were Salmonella and St. Aureus; two patients with negative cultures were already on antibiotic therapy when observed but intraoperative findings and histologic appearance suggested an acute suppurative infection. Broad spectrum antibiotics (Imipenem + Teicoplanine) were given in all patients as first choice, and further adjustments were done on the results of cultures; intravenous therapy was maintained for average 2 postoperative weeks. All patients received surgical (open or endovascular) treatment as emergency; two patients were already on oral antibiotic therapy (amoxicillin and ciprofloxacin) resulted uneffective.

Surgical treatment (conventional or endovascular) was offered in all cases. Of 7 patients with abdominal aortic infection, aortic exclusion + abscess drainage and axillobifemoral bypass was performed in our first case; in situ reconstruction was performed in the later 6 cases using antibiotic-bound (Rifampicin) dacron graft. Omental flap was always used for additional graft wrapping. In 1 patient with suprarenal aortic infection (Fig.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>SIRS</th>
<th>Site</th>
<th>Blood cultures</th>
<th>Wall cultures</th>
<th>Microbiology</th>
<th>Treatment</th>
<th>Outcome</th>
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<tr>
<td>1</td>
<td>78</td>
<td>f</td>
<td>y</td>
<td>TA</td>
<td>pos</td>
<td>NA</td>
<td>St. Aureus</td>
<td>TEVAR</td>
<td>Dead 2 months (aortoesophageal fistula?)</td>
</tr>
<tr>
<td>2</td>
<td>81</td>
<td>m</td>
<td>y</td>
<td>TA</td>
<td>pos</td>
<td>NA</td>
<td>E.Coli</td>
<td>TEVAR</td>
<td>Dead 3rd POD (endoleak type I, aortoesophageal fistula + recurrent emethemesis)</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>F</td>
<td>Y</td>
<td>SAA</td>
<td>Neg</td>
<td>Pos</td>
<td>Cl. Septicum</td>
<td>Homograft</td>
<td>Dead 18 months (acute cardiac failure)</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>M</td>
<td>Y</td>
<td>AAA</td>
<td>Pos</td>
<td>Neg</td>
<td>Salmonella</td>
<td>Aortobiiliac graft</td>
<td>Dead 12 months (myocardial infarction)</td>
</tr>
<tr>
<td>5</td>
<td>56</td>
<td>M</td>
<td>Y</td>
<td>AAA</td>
<td>Pos</td>
<td>Pos</td>
<td>Salmonella</td>
<td>Axilllobifemoral bypass</td>
<td>Alive 8 yrs.</td>
</tr>
<tr>
<td>6</td>
<td>71</td>
<td>M</td>
<td>N</td>
<td>AAA</td>
<td>Neg</td>
<td>Neg</td>
<td>None</td>
<td>Aorto-aortic graft</td>
<td>Alive 7 yrs.</td>
</tr>
<tr>
<td>7</td>
<td>76</td>
<td>M</td>
<td>Y</td>
<td>AAA</td>
<td>Pos</td>
<td>Pos</td>
<td>St. Aureus</td>
<td>Aortobiifemoral graft</td>
<td>Dead 15th POD (rupture of undiagnosed hypogastric aneurysm)</td>
</tr>
<tr>
<td>8</td>
<td>63</td>
<td>M</td>
<td>Y</td>
<td>AAA</td>
<td>Neg</td>
<td>Neg</td>
<td>(microabscessual flogosis at histology)</td>
<td>Aorto-aortic graft</td>
<td>Alive 3 yrs.</td>
</tr>
<tr>
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<td>n</td>
<td>AAA</td>
<td>Pos</td>
<td>Pos</td>
<td>Salmonella, Enterobacter, E.Coli</td>
<td>Aortobiilliac graft</td>
<td>Alive 2 yrs.</td>
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<td>84</td>
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<td>AAA</td>
<td>neg</td>
<td>pos</td>
<td>St. Aureus</td>
<td>Aorto-aortic graft</td>
<td>Dead 19th POD (Pneumonia + MOF)</td>
</tr>
<tr>
<td>11</td>
<td>62</td>
<td>f</td>
<td>y</td>
<td>EIA</td>
<td>pos</td>
<td>NA</td>
<td>Salmonella</td>
<td>Femorofemoral bypass</td>
<td>Dead 24 months (Pneumonia+MOF)</td>
</tr>
<tr>
<td>12</td>
<td>64</td>
<td>m</td>
<td>y</td>
<td>EIA</td>
<td>pos</td>
<td>Neg</td>
<td>St. Aureus</td>
<td>Femorofemoral bypass</td>
<td>Alive 7 yrs.</td>
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A, B), a cryopreserved homograft was used for in situ aortic reconstruction with reimplantation of the celiac, superior mesenteric and right renal arteries; a left nephrectomy was also necessary due to left renal artery disruption and massive renal infarction.

Two patients with isolated external iliac infective aneurysm were treated by proximal exclusion (ligature or embolisation) and femorofemoral bypass. Endovascular therapy was chosen as emergency treatment for infection of the thoracic aorta in two patients at pro-

Fig. 1: Post-contrast axial (A) and volume rendering reconstruction (B) in a 55-years old patient with suprarenal infective aneurysm. The aortic lumen is irregular and an asymmetrical periaortic soft tissue mass with air bubbles (arrows) is observed. The left kidney shows multiple hypodense areas of infarction (asterisks) correlated to the involvement of the renal artery by the aneurysm.

Fig. 2: 3D Volume Rendering oblique sagittal reconstruction (A) in a 81-years old man with infective aneurysms of descending aorta (arrows). The corresponding axial scan (B) shows a saccular focal dilatation of isthmic aorta. Mediastinal and bilateral pleural effusions are also evident. CT findings were consistent with acute contained rupture of infective aneurysm.
hibitive risk for conventional surgery. One of these patients (Fig. 2) presented in critical conditions with hematemesis and CT scan found an infective aneurysm close to the origin of the left subclavian artery with aortoesophageal fistula. The operative risk was considered too high for open surgery, so the patient underwent TEVAR plus aortic arch debranching; a type I endoleak was observed and unsuccessfully treated by proximal extension. Further endovascular attempts were technically unreliable and he died 2 days later from uncontrollable hematemesis; at autopsy the proximal landing zone resulted infected and weakened as well.

Results

Overall operative mortality was 25% (3 pts., see Table I for detailed causes of death); procedure-specific mortality was 50% after TEVAR, 28.6% after in situ reconstruction, and 0% after extra-anatomic revascularization. The patient with suprarenal aortic infection treated by homograft developed postoperative acute renal failure requiring hemodialysis.

At follow-up, the mean survival was 42.2 months; 3 late deaths due to cardiac or respiratory disease were observed at 2, 12, 18 respectively. Late graft infection was observed in 1 case, 15 months after femorofemoral bypass, with fatal outcome due to multiple organ failure at 24 months.

All survivors are in good general conditions; all grafts resulted patent and we did not found late outflow impairments. Intravenous specific antibiotic therapy was given for at least 6 weeks after discharge then shifted to oral therapy for further 3-4 months and suspended in absence of inflammation markers and with negative CT scan.

Discussion

Aorto-iliac infection is a rare disease: in our 20 year experience on 1280 patients treated for aneurysmal disease we observed only 12 cases for an incidence rate of 0.94%, similar to those (0.5-2.5%) reported in other Western countries. In Eastern series these rates rise up to 13.3% due to the higher incidence of Salmonella infections in the Asian populations.

Several microbial species have been isolated in these patients; the most common are Salmonella Sp. (18-74% of cases), Str. Pneumoniae and Cl. Septicum, this last one showing a significant association with colonic cancer. Sporadic observation of other species have been reported, including Mycobacteria, fungi, Coxiiella and Lysteria.

Aortic infection may result from embolizing endocarditis or septicemia with bacterial seeding of the arterial wall; a preexisting atherosclerotic aneurysm may become infected or, more often, aneurysm develops in an artery with normal size. Direct extension of an adjacent infection or via the lymphatics located in an infected area are also been avocated. The natural history of aortic infections is characterized by a fast evolution often complicated by rupture of the arterial wall and perivascular hematoma. The term of “bacterial aortitis” has been proposed to define the rupture occurring in absence of pre-existing aneurysm; all patients in our experience presented with this particular condition.

Not surprisingly, we found in our experience a prevalence of infections of the abdominal aorta (7 cases), in line with a review of the literature where the femoral artery resulted the most affected site. We observed only 3 cases of infection of the suprarenal – thoracic aorta but they have been reported at consistant rates (45%) in other series.

In all cases, we observed the clinical features already described for infective abdominal aortic aneurysms: fever, abdominal and/or back pain, pulsatile abdominal mass and hemodynamic instability when rupture or systemic sepsis occurs. Lesions of the thoracic aorta have been diagnosed only when locoregional complications occurred - like aorto-esophageal or aorto-bronchial fistula. The most accurate imaging evaluation is obtained by CT scan; pathognomonic findings include gas within the aneurysm, lack of calcifications in the aortic wall, periaortic mass with dyshomogeneous necrotic areas, lob-
ulated or saccular aneurysm of an otherwise normal aorta (Fig.). The rupture is usually contained and resembling a pseudoaneurysm. At serial studies, infective aneurysms may also show a rapid expansion rate. Intraoperative findings are focal, contained rupture of a thinned and inflamed aortic wall; periaortic adenopathy is common, eventually with colliquative necrosis and purulent collection. Cultures of the aneurysmal wall are usually positive but a microscopic pattern of microabscessual foci can be found also in patients with negative cultures – 2 cases in our experience.

Recently, some Authors focused on the importance of immune status in the clinical evolution and ultimate outcome of these patients. The SIRS (Systemic Inflammation Response Syndrome) criteria are 1) temperature <37°C or >38°C, 2) heart rate >90 bpm, 3) respiratory rate >20 or pCO₂ >32 Torr, and 4) WBC count <4000 or >12000; patients are considered as affected by SIRS when two or more criteria are found. A significant correlation has been described between SIRS and mortality rates. Immunosuppression is often found in these patients, either as a diabetes-related condition either resulting from other comorbidities; immunosuppressed patients show more aggressive infections and early aneurysmal rupture, as well as higher postoperative morbidity and mortality rates.

In our series, 10 patients showed SIRS and 3 dead at 30-days; both residual patients without SIRS are alive at 1 and 7 years, respectively. Therapeutic options for aortic infective aneurysms are still debated. The goal of ideal treatment should include complete excision of infected tissues and vascular structures as well as blood flow restoration by infection-resistant graft. Essentially two strategies are possible: debridement, aortic interruption and extra-anatomic bypass or in-situ reconstruction using antibiotic-bound conventional vascular graft; cryopreserved allografts are also available for direct aortic replacement.

Extra-anatomic revascularization has been proposed to avoid the hazard of placing a vascular graft in a contaminated site with related risks of secondary graft infections; 30-day mortality rates from the literature are 24–39%. In some reports on Salmonella infections, long-term survivals are better than after in-situ reconstruction (77% vs. 53%) probably due to high virulence of these infections with increased risk of late complications. We adopted this technique in early phase of our experience on aortic infections (1 case) and in 2 patients with isolated external iliac artery infection. The limited number of patients does not allow any statistic evaluation; the operative mortality (0%) and the good long-term survival may suggest to use this reconstruction in selected cases (iliac lesions) although endovascular solutions now available should be evaluated in the future.

The weak point of extra-anatomic approach is the proximal aortic stump, possibly at risk of late blowout (20%) with catastrophic consequences. Lower rate of late patency of extra-anatomic bypasses has also been reported with amputation rate of 20-29% but these findings are not confirmed in other experiences. Late graft infections have been observed in 10-20% of cases; we had only 1 case in our series (femorofemoral bypass).

In-situ aorto-iliac reconstruction using conventional or antibiotic-bound dacron conduits allows favorable results in terms of early mortality (0 – 13.3%) and long-term patency (86 – 92%). Recurrent graft infections have been reported with lower rates (0-10%) in recent studies; this could be also related to the efficacy of antibiotics currently available. In our practice, we adopted this technique as first choice for infrarenal aortic infections in patients with acceptable surgical risk. Our procedure-specific mortality rates are high if compared with other series, but all our patients were operated in emergency without proper preoperative antibiotic therapy, both conditions with adverse effects on immediate outcome. However, the operative mortality in these patients compares favourably with that observed after surgery for ruptured non-infective aneurysms in our institution (45%, unpublished data). Moreover, late results in terms of patency (100%) and recurrent infection (0%) support our current strategy.

Cryo-preserved allografts have been proposed because of their supposed lower propensity to secondary infections and foreign-body reaction. Early mortality rate of 20% has been reported with 55% survival at 5 years. Fresh allografts have been dismissed because of the significant rates of death from graft rupture but it is still undefined, for cryopreserved grafts, the real risk of late occlusion (27%) or aneurysmal degeneration (4-44%) with eventual para-anastomotic disruption. Moreover, these allografts could be not easily suitable because of dimensional unfitting or temporary unavailability from the tissue bank. We limited our experience with such graft to one case of Citrobacter infection of the suprarenal aorta, in order to reduce the risk of secondary graft infection in such a critical location; a late pseudoaneurysm was observed at the site of right renal artery reimplantation.

Endovascular treatment of infective aneurysms has been described in recent years as a new therapeutic option, particularly in critically ill patients with prohibitive surgical risk. Perioperative mortality rates (9-10%) are quite better than in open surgery patients. In experienced centers, the endovascular approach is safe enough to be used also as a bridge procedure in selected cases (aorto-duodenal fistula with active bleeding, aortic arch infection, aorto-esophageal or aorto-bronchial fistula) with acceptable mortality and morbidity. However, it is questionable to compare the better early results of endovascular treatment with those of conventional surgery because of substantial differences in criteria for patients selection, single-center experience with both

therapeutic options and number of cases treated. Moreover, endovascular approach does not allow local debridement nor drainage of fluid collections; cultures from the arterial wall are unavailable and this could impair a proper antibiotic therapy. While mid-term results are encouraging, longer follow-up and multicentric perspective studies are still required; however, if we consider the very poor results of medical treatment alone with in-hospital mortality as high as 50% and 1-year survival even worse, it seems reasonable and ethically correct to attempt endovascular treatment in all patients considered at prohibitive risk for open surgery. The optimal duration of postoperative antibiotic therapy is not well established; some authors advocate lifelong therapy, particularly in Salmonella infections and following in–situ reconstruction. However, most reports including our present series suggest that specific intravenous antibiotics should be given for at least 4-6 weeks and prolonged for the next 3-6 months, then suspended if inflammation markers and local conditions evaluated by CT scan result normal.

Conclusions

Prospective and randomized studies on aortic infections are unavailable, thus single centre results cannot be conclusive. In our limited experience, in–situ reconstruction has been done whenever possible in patients with good prognosis and acceptable surgical risk, with satisfactory long-term and infection-free survival. Extra-anatomical reconstruction has been done in our first case of aortic infection and thereafter reserved to patients with infection limited to external iliac artery. Antibiotic therapy should be modulated on the results of CT scan and evaluation of flogosis indexes; however, a lifelong follow-up is mandatory. Our endovascular experience is recent and limited but it looks promising in aortic arch infections where open surgery could be a prohibitive challenge in critical patients with serious comorbidities.

Riassunto

Le infezioni dell’aorta e delle arterie iliache costituiscono una condizione, seppure infrequente (3% dei casi), potenzialmente letale e ancora oggi gravata da elevati tassi (25%) di mortalità operatoria. L’evoluzione della patologia, accompagnata o meno da degenerazione aneurismatica, è rapida ed esita nella rottura del segmento interessato. La limitata numerosità delle esperienze riportate in Letteratura non consente un’analisi statistica attendibile per quanto riguarda fattori di rischio e condizioni predisponenti; tuttavia, sembra indicativo il riscontro di comorbilità che riducono l’immunocompetenza del paziente esponendolo a un aumentato rischio infettivo. Le possibilità di trattamento chirurgico convenzionale consistono nella rivascularizzazione extra-anatomica o nella ricostruzione vascolare diretta con protesi sintetica o homograft; recentemente è stato proposto anche in questo campo l’impiego di endoprotesi. Gli Autori presentano la loro esperienza su 12 casi osservati negli ultimi 20 anni e, anche sulla base della Letteratura disponibile, espone le principali problematiche e i risultati delle diverse opzioni terapeutiche.

References


