From the Southern Association for Vascular Surgery

A multicenter experience with the surgical treatment of infected abdominal aortic endografts

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Objective: **Single-center experiences with the treatment of infected endografts after endovascular aortic repair (I-EVAR) have been reported. We performed a multicenter review of the surgical care of these patients to elucidate short-term and long-term outcomes.**

Methods: **A retrospective analysis of all EVAR explants from 1997 to 2014 at four institutions was performed. Patients with I-EVAR undergoing surgical treatment were reviewed. Data were obtained detailing preoperative demographics, and postoperative morbidity and mortality.**

Results: **Thirty-six patients (30 male) were treated with endovascular graft excision and revascularization for I-EVAR with a median age of 69 years (range, 54-80 years). Average time from the initial EVAR to presentation was 589 days (range, 43-2466 days). Preoperative comorbidities included hypertension, 32 (89%); tobacco use, 31(86%); coronary artery disease, 26 (72%); hyperlipidemia, 25 (69%), peripheral artery disease, 13 (36%); cerebrovascular disease, 10 (28%); diabetes, 10 (28%); chronic obstructive pulmonary disease, 9 (25%); and chronic kidney disease, 9 (25%). The most common presenting patient characteristics were leukocytosis, 23 (63%); pain, 21 (58%); and fever, 20 (56%), which were present an average of 65 days (range, 0-514 days) before explantation. Nine different types of endograft were removed. Three patients (8%) underwent emergency explantation. Thirty-four patients (89%) underwent total graft excision, and two patients (6%) underwent partial excision. Methods of reconstruction were in situ in 27 (75%) and extra-anatomic in nine (28%). Conduits used were Dacron (DuPont, Wilmington, Del), with or without rifampin, polytetrafluoroethylene, cryopreserved allograft, and femoral vein. Forty-nine organisms grew from operative cultures. Gram-positive organisms were the most common, found in 24 (67%), including *Staphylococcus* in 13 (36%) and *Streptococcus* in six (17%). Anaerobes were cultured in 6 patients (17%), gram-negative organisms in 6 (17%), and fungus in 5 (14%). Thirty-one patients (86%) received long-term antibiotics. Early complications included acute renal failure requiring dialysis, 12 (33%); respiratory failure, 3 (8%); bleeding, 4 (11%); and sepsis, 2 (6%). Six patients required re-exploration due to hematoma, infected hematoma, lymphatic leak, bowel perforation, open abdomen at initial operation, and anastomotic bleeding. Perioperative mortality was 8% (3 of 36), and long-term mortality was 25% (9 of 36) at a mean follow-up of 569 days (range, 0-3079 days). Type of reconstruction (in situ vs extra-anatomic) or conduit type did not affect perioperative or overall mortality.**

Conclusions: **I-EVAR is a rare but potentially devastating clinical problem. Although perioperative mortality is acceptable, long-term mortality is high. The most common postoperative complication was acute renal failure requiring dialysis. Although this is the largest series of I-EVAR, further studies are needed to understand the risk factors and preventive measures. (J Vasc Surg 2015;62:877-83.)**

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More than 1 million Americans have abdominal aortic aneurysms (AAAs), many of which may require intervention. Open surgical intervention has slowly been replaced by endovascular AAA repair (EVAR) using aortic endografts.[1] EVAR was initially introduced for high-risk individuals whose open operative risk was deemed excessive. Advancements in endograft development have brought a shift in the way that most AAAs are managed; currently, most AAA repairs performed in the United States are by an endovascular approach.[2]

Aortic endovascular graft infection (I-EVAR) is an unusual complication of endograft repair and has a reported incidence between 0.05% and 5%.[3] The higher rates of infection reported may be the result of endograft deployment in infected fields, such as those in patients with mycotic aneurysms or aortoenteric fistulae.[4] Mortality from endograft explantation secondary to infection has been reported as high as 30% and is similar to infection of open aortic grafts.[5] To date, the treatment of I-EVAR

Table I. Survival summary

Interval	*Survival, %*	*Time, months*	*No. at risk*	*95% CI*
1-2 months	95	1	21	87-100
2-10 months	90	2	20	79-100
10-21 months	84	10	14	69-100
21-28 months	74	21	8	53-100
28-101 months	55	28	4	29-100
101 months	0	101	1	NA

CI, Confidence interval.

has been reported mainly by single centers. This report details the results of a multicenter experience from four geographically distinct medical centers, which will assist delineating procedural techniques, clinical challenges, and results in this patient population.

METHODS

After approval from the Institutional Review Boards of the four medical centers involved in this study (Mayo Clinic, Rochester, Minn and Phoenix, Ariz; University of Alabama at Birmingham, Birmingham, Ala; and Ochsner Medical Institutions, New Orleans, LA), databases were queried to identify patients who underwent excision of infected aortic endografts from AAAs between 1997 and 2014. The Investigational Review Board reviewer approved waiver of the requirement to obtain informed consent.

Patients who underwent explantation were included for review regardless of the institution where the endograft was initially placed. A retrospective review included pertinent history, presentation, physical findings, results of microbiologic testing, location of infection, management, and outcomes. Demographic data for each patient were collected and evaluated, including comorbidities. Time from the original EVAR implantation until the emergence of presenting signs or symptoms of infection and the type of endograft placed at original operation were also included for review.

Patients were deemed to have I-EVAR based on presence of positive blood cultures, radiologic evidence of abscess or infection, intraoperative evidence of infection as described by the operating surgeon, or positive intraoperative cultures from explanted graft material, aortic wall, or aneurysm sac contents.

Management was based on the surgeon's judgment, including method of reconstruction, timing of the operation, antibiotic duration and type, method of explantation, including proximal control, and postoperative management. Operative data collected included indications for intervention, urgency of the procedure, and the method of reconstruction. Early complications were defined as those ≤30 days of removal of the infected endograft, and late complications were those that occurred afterward. Perioperative mortality was defined as death ≤30 days. Long-term mortality was defined as death >30 days.

Demographic data describing the frequency of postoperative complications, explanted device type, and symptoms at presentation are presented. Because of the small cohort size, most data are reported as mean and range. Kaplan-Meier survival curves were used to provide 10-month and 21-month survival estimates (Table I and Fig 1). These time frames are somewhat shifted from normal yearly intervals based on patient dropout and length of follow-up in this retrospective study. Survival was summarized after each death and reported for 1 and 2 years. All analysis was performed in R 3.1.2 software (The R Foundation for Statistical Computing, http://www.r-project.org/foundation/), and the package survival version 2.37-7 was used for survival analysis.

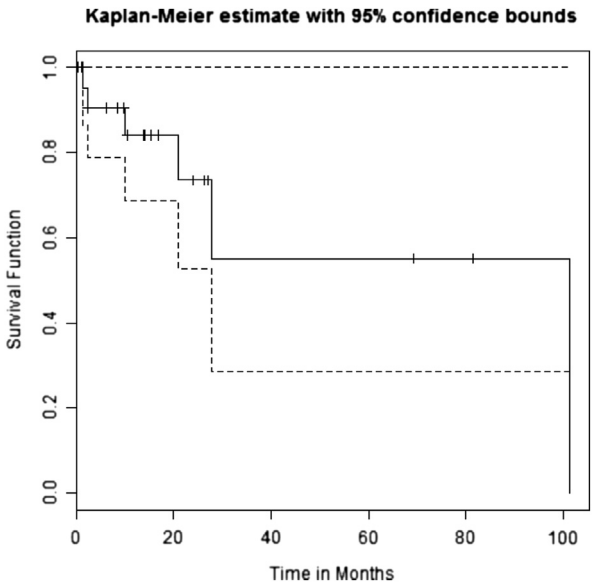

Fig 1. Survival curve for infected endograft after endovascular aortic aneurysm (AAA) repair (I-EVAR).

RESULTS

Thirty-six patients, including 30 men (83%), with a mean age of 69 years (range, 54-80 years) underwent explantation of an aortic endograft for infection and were included for review. The preoperative comorbidities, including hypertension, previous or current tobacco use, coronary artery disease, and others, appear to be those commonly seen in patients with aortic aneurysmal disease (Table I). Presenting symptoms varied, however; a majority (21 patients [58%]) presented with abdominal pain or fever (20 patients [56%]), or both (Table II). Blood cultures were positive in 10 of 34 patients (29%). Mean duration of these symptoms in these patients was 65 days before explantation (range, 0-514 days). Mean duration from initial endograft placement until development of symptoms was 589 days (range, 43-2466 days).

Multiple diagnostic imaging modalities were used to establish the diagnosis. Computed tomography (CT) was used in all patients and confirmed an infected aortic endograft in 33 of 36 patients (91.7%; Fig 2). The CT in three patients did not demonstrate obvious perigraft infection. One