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Late mortality in females after endovascular aneurysm repair

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ABSTRACT

Background: Abdominal aortic aneurysm (AAA) rupture is an adverse arterial remodeling event with high mortality risk. Because females have increased rupture risk with smaller AAAs (<5.5 cm), many recommend elective repair before the AAA reaches 5.5 cm. Elective repair improves survival for large AAAs, but long-term benefits of endovascular aneurysm repair (EVAR) for small AAAs in females remain less understood. The objective of this study was to identify if differences in late mortality exist between females undergoing elective EVAR at our institution for small and/or slow-growing AAAs compared with those who meet standard criteria.

Methods: We retrospectively analyzed all patients that underwent EVAR for infrarenal AAA from June, 2009–June, 2013. We excluded patients that were male, treated emergently or for iliac artery aneurysm, and that received renal and/or mesenteric artery stenting. Patients did not meet anatomic criteria if preoperative AAA diameter was <5.5 cm or enlarged <0.5 cm over 6 mo. Late mortality was assessed from the social security death index.

Results: Thirty-six of 162 elective EVAR patients (22.2%) were female (mean follow-up, 37.2 mo). Twenty patients (55.6%) met AAA size and/or growth criteria, whereas 16 (44.4%) did not meet criteria. Despite comparable demographics, comorbidities, and complications, patients that did not meet criteria had higher late mortality (37.5% *versus* 5%; $P = 0.03$) with a trend toward increased reoperation rate (25% *versus*. 5%; $P = 0.48$). Meeting size and/or growth criteria decreased odds of late death (odds ratio, 0.09; 95% confidence intervals, 0.01–0.83).

Conclusions: There is increased late mortality in females receiving elective EVAR at our institution for small and/or slow-growing AAAs. This late mortality may limit the benefits of EVAR for this population.

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1. Introduction

Abdominal aortic aneurysm (AAA) rupture is associated with significant mortality and is lethal in 90% of patients [1]. Despite declining global incidence over the past two decades, AAA burden in the United States remains high, with aortic rupture accounting for >13,000 deaths annually [2,3]. Over this same period, females have experienced a smaller decrease in AAA rupture rates compared with males, and continue to represent a disproportionate amount of AAA-related mortality [4,5]. Although AAA prevalence in women is approximately six times lower than men, females account for over 40% of AAA-attributable deaths [6,7].

High AAA mortality rates in females have been partially attributed to gender variations in AAA rupture risk. Compared with AAAs in males, aneurysms in females rupture at smaller average diameters and are up to four times as likely to rupture at the same aneurysm size [8–11]. Additionally, females are more likely to present emergently and at an older age, whereas less likely to receive surgical intervention or be eligible for endovascular aneurysm repair (EVAR). These factors have contributed to the comparatively poor outcomes for females after elective and emergent AAA repair, including longer lengths of stay, lower rates of discharge to home, and increased early mortality [5,12–15].

Increased rupture risk, worse outcomes after emergent repair, and potential for losing EVAR eligibility have led many surgeons to suggest smaller AAA size and/or growth thresholds for elective EVAR in females [4,5,16–18]. The survival benefit for elective open repair of large (≥5.5 cm) and/or fast-growing (≥0.5 cm in 6 mo) AAAs is well established, but the size indications and long-term outcomes for elective EVAR in females are less well understood. Elective EVAR has demonstrated improved early outcomes compared with traditional open repair, but these benefits appear to decrease over time and are less pronounced in females [14,19–23]. Additionally, Society for Vascular Surgery practice guidelines acknowledge increased rupture risk and potential benefit of repairing small aneurysms in women but give weak recommendation for elective EVAR of AAAs <5.5 cm in females [24,25]. These recommendations are based on results from the Comparison of Surveillance Versus Aortic Endografting for Small Aneurysm Repair [26] and Positive Impact of Endovascular Options for Treating Aneurysms Early [27] trials. Both studies failed to demonstrate survival benefit for elective EVAR of small AAAs but were underpowered to allow subgroup analysis in female patients [26,27].

Data are lacking regarding late outcomes after EVAR in females, especially those with small AAAs. To better assess the benefit of EVAR in female patients at our institution, the objective of this study was to identify if there are differences in late mortality between female patients undergoing elective EVAR for small, slow-growing AAAs compared with those that meet standard criteria.

2. Methods

Medical records from patients undergoing endovascular intervention from June 2009–June 2013 were used to identify all patients that had received EVAR at our institution. Under an approved institutional review board protocol and in accordance with the Helsinki Declaration of 1975 ethical standards on human experimentation, we performed retrospective evaluation of identified electronic medical records for study inclusion.

We collected patient demographics, insurance status, comorbidities, medication use, imaging studies, perioperative data, and clinical follow-up reports for all patients that underwent elective EVAR for infrarenal AAA during the study period. Charlson comorbidity index (CCI) was calculated based on patient preoperative comorbidities [28,29]. All procedures were performed at a single institution by fellowship-trained vascular surgeons. Patients were excluded from analysis if they were male, had symptomatic or ruptured AAA, underwent concomitant treatment for iliac artery aneurysm, or received renal or mesenteric artery stenting at the time of EVAR. Arterial vessel diameters, lengths, and angles were collected from preoperative three-dimensional (3D) imaging, intraoperative angiograms, and operative reports. Iliac artery and aortic neck dimensions were compared with graft manufacturers' instructions for use (IFU) guidelines to determine if patients met endoprosthesis-specific IFU criteria. Preoperative AAA size was determined from last-documented 3D imaging before intervention and was measured in axial views at the level of maximum external aortic diameter. Preoperative AAA growth rate was determined from both 3D imaging and ultrasound surveillance reports and was compared with corresponding notes from our vascular clinic and outside records. These imaging variables were used to group female EVAR patients by whether they did or did not meet preoperative AAA size and/or growth criteria for elective intervention. Patients were considered to have met criteria if maximum AAA diameter was ≥5.5 cm or AAA diameter was <5.5 cm but had grown ≥0.5 cm in ≤6 mo. Conversely, patients were classified as not meeting aneurysm criteria if AAA diameter was <5.5 cm and without rapid growth.

The primary objective of this study was to compare late mortality rates after EVAR between females that did and did not meet preoperative AAA size or growth criteria. Secondary outcomes measures included comparison of 30-d morbidity and/or mortality and graft-related reoperation rates between cohorts.

Late mortality was defined as all-cause death >30 d after EVAR and was determined from the electronic medical record and the social security death index. Criteria for 30-d morbidity were determined before data collection. Major complications were prospectively defined before data collection as new dysrhythmia requiring cardioversion or not resolved by discharge, acute decline in renal function (rise in postoperative creatinine ≥0.5 mg/dL or new-onset dialysis), myocardial infarction (confirmed with electrocardiogram and troponin elevation), respiratory compromise (prolonged and/or repeat intubation or ventilator-associated pneumonia), clinically significant bowel ischemia or pulmonary embolism, and iliac artery rupture. Minor complications were defined as clinically significant events that did not meet major complication criteria.