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Are outcomes of thoracoabdominal aortic aneurysm repair different in men versus women? A propensity-matched comparison

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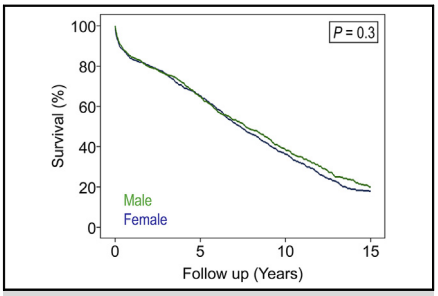
ABSTRACT

Objective: Women fare worse than men after many cardiovascular operations, including coronary artery bypass grafting and valve surgery. We sought to determine whether sex affects outcomes after open thoracoabdominal aortic aneurysm repair.

Methods: We evaluated data on 3353 consecutive patients (1281 women, 38.2%) who underwent open thoracoabdominal aortic aneurysm repair between October 1986 and July 2015. We compared preoperative characteristics, surgical variables, and outcomes between men and women in the overall group. A propensity-matching analysis was performed to adjust for preoperative and intraoperative differences. A multivariable analysis was conducted to identify predictors of poor outcomes using relevant preoperative and intraoperative factors.

Results: Men had a significantly higher prevalence of comorbid conditions, including coronary artery disease, and presented more often with dissection; women were slightly older than men (median age, 69 [62-74] years vs 67 [57-73] years; $P < .001$) and more often symptomatic. Men underwent extent II and IV repairs more often, whereas women more often had extent I and III repairs. The propensity analysis resulted in 958 matched pairs. Overall, women and men had similar early mortality (7.9% vs 7.2%, $P = .5$) and adverse event rates (14.8% vs 14.1%, $P = .6$), which were similar in propensity-matched groups. Multivariable analysis showed that predictors of operative death and adverse event differed between the sexes. Survival and freedom from repair failure were similar between the overall and matched groups.

Conclusions: Men and women who undergo thoracoabdominal aortic aneurysm repair have similar outcomes, but there are important differences in several perioperative factors and predictors of poor outcomes. (J Thorac Cardiovasc Surg 2017;154:1203-14)



Age-adjusted survival for propensity-matched men and women after open TAAA repair.

Central Message

Outcomes after open TAAA repair are similar in propensity-matched groups of men and women, but predictors of operative mortality and adverse event differ between sexes.

Perspective

Although women tend to fare worse after procedures such as CABG, heart valve surgery, and AAA repair, we show that early and long-term outcomes are similar between men and women in 3353 patients who underwent open TAAA repair, including 958 propensity-matched pairs. Important preoperative and perioperative differences between the sexes were noted.

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Over the last 20 years, considerable research has focused on analyzing the differences between men and women in outcomes after cardiovascular surgery procedures, including coronary artery bypass grafting (CABG),[1-7] aortic valve replacement surgery,[8,9] combined CABG and valve surgery,[10,11] and abdominal aortic aneurysm (AAA) repair.[12-18] The results of several cardiovascular studies have shown that women typically have worse outcomes than men.[2,3,7-12,19] Moreover, in some studies, female sex

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Abbreviations and Acronyms

AAA = abdominal aortic aneurysm
CABG = coronary artery bypass grafting
CSFD = cerebrospinal fluid drainage
eGFR = estimated glomerular filtration rate
HCA = hypothermic circulatory arrest
LHB = left heart bypass
RRR = relative risk ratio
TAAA = thoracoabdominal aortic aneurysm

was an independent predictor of higher postoperative morbidity and mortality, even after adjustment for age and comorbidities.[2,8,12,13,17-19]

Open thoracoabdominal aortic aneurysm (TAAA) repair is a challenging operation with significant risks, including paraplegia, renal failure, stroke, and death. The use of adjunctive techniques for organ protection, such as left heart bypass (LHB), cerebrospinal fluid drainage (CSFD), and cold renal artery perfusion,[20-23] may contribute to improved postoperative outcomes. Although most patients who present with a TAAA requiring open surgical repair are men,[24] there is scant evidence indicating the impact of sex on postoperative outcomes. We sought to examine the effect of sex on postoperative outcomes after open TAAA repair.

PATIENTS AND METHODS

Study Enrollment and Patient Characteristics

Baylor College of Medicine's institutional review board approved our clinical research protocol in 2006. For patients who underwent operation after protocol approval, clinical data were collected prospectively, and informed consent was obtained whenever possible. A waiver of consent was approved for patients who were unable to provide consent because of their illness and had no family members available who could provide consent for them. For patients who underwent surgery before the protocol was approved, data were collected retrospectively from medical records and consent was waived.

From October 1986 to July 2015, 3365 consecutive open TAAA repairs were performed on our service. We were unable to obtain consent from 12 patients (0.4%) with repairs performed after our protocol was approved; these patients are excluded from this report. The remaining 3353 repairs form the basis of this report; 2072 (61.8%) of the patients were men, and 1281 (38.2%) were women.

Study Definitions and Follow-up

All data were collected by using standard definitions, as reported in recent publications.[24,25] Patients were considered symptomatic if they showed symptoms associated with aortic disease, such as pain, hoarseness, or dysphagia. We defined operative death as death occurring within 30 days of surgery or before final discharge from our hospital or any other hospital (or long-term acute care facility) where a patient might have been transferred. Adverse event was defined as a composite end point comprising operative death or persistent (ie, present at hospital discharge) stroke, paraplegia, paraparesis, or renal failure requiring dialysis.[26] Proximal aortic repair included repair of the aortic root, ascending aorta, or aortic arch and did not include isolated aortic valve repair. Distal aortic repair included repair of the descending thoracic aorta, thoracoabdominal aorta, or abdominal aorta. Preoperative chronic renal insufficiency was defined as having a serum creatinine level 3.0 mg/dL or greater or requiring dialysis. To estimate the glomerular filtration rate, we used the Chronic Kidney Disease Epidemiology Collaboration equation.[27] Repair failure was defined as graft infection, fistula, pseudoaneurysm, or patch aneurysm directly related to the index TAAA repair and did not include subsequent repair in an adjacent aortic section. Postoperative surveillance information was obtained via clinic visit, telephone interview, or written correspondence. The Social Security Death Index and internet obituary searches were used to identify deaths among patients who were lost to follow-up.

Surgical Techniques

Over time, we have refined our operative strategies for open TAAA repair. We use a multimodal adjunctive protocol for organ protection based on the Crawford classification of the extent of TAAA repair.[24,25,28] Our operative strategy has been largely standardized since 2005; the evolution of our surgical approach and 30-year clinical practice has been described.[24,28] More protective adjuncts are typically used in the most extensive repair: Crawford extent II repair, which generally replaces the aorta from just distal to the left subclavian artery to the aortic bifurcation. In brief, our operative strategy involves moderate systemic heparinization (1.0 mg/kg) and mild permissive hypothermia (32°C–34°C). When appropriate, we reattach 1 or more pairs of intercostal and lumbar arteries (especially between T8 and L1) and intermittently perfuse the renal arteries with a cold (4°C) solution whenever the renal ostia are accessible. We use LHB and CSFD mainly for extent I and II TAAA repairs, for which we also provide selective visceral perfusion with isothermic oxygenated blood to the celiac axis and the superior mesenteric artery through the rerouted LHB circuit. CSFD is used selectively in extent III and IV TAAA repairs, such as in cases of reoperation after previous abdominal aortic replacement or endovascular aneurysm repair. In cases of aortic dissection extending into the visceral arteries, we ensure true lumen flow by fenestrating or excising the dissection flap, or by obliterating the false lumen, either by direct suture closure or by implanting small balloon-expandable stent-grafts. We commonly use 1 or more branch-grafts in patients in whom the visceral arteries are severely diseased or displaced, as might occur in patients with chronic dissections. We do not routinely use hypothermic circulatory arrest (HCA); rather, we reserve its use for select patients in whom the proximal aorta cannot be safely clamped.

Statistical Analysis

Statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc, Cary, NC) and STATA version 13 (StataCorp, LP, College Station, Tex). Continuous variables are presented as mean ± standard deviation or median [interquartile range], as appropriate. Categoric variables are presented as number and percentage. Univariate comparisons were conducted with the Pearson chi-square test, Fisher exact test, or nonparametric Wilcoxon rank-sum test, as appropriate.

Because of the heterogeneity between men and women, we used a 1:1 nearest neighbor matching without replacement and a caliper size of 0.005 to generate propensity score–matched pairs from clinically relevant preoperative and operative variables in the overall cohort; the variables used are shown in Tables 1 and 2 (Table E1 shows a list of >50 variables). We did not include 3 continuous variables (estimated glomerular filtration rate [eGFR], body mass index, and maximum distal aortic diameter) in the propensity score analysis because of missing data, and we purposely excluded variables that were linear combinations of other variables.

To identify independent predictors of adverse event and operative death after 3353 TAAA repairs, we built multivariable logistic regression models by using all clinically relevant preoperative and intraoperative factors that showed a univariate association with a P value of less than .1. Multivariable models were built for the overall cohort (n = 3353; the variable sex did not qualify for model entry and was forced into the model) and for separate, sex-specific models (n = 2072 men; n = 1281 women), which were then combined for a saturated model. Postoperative complications were not