Contemporary outcomes of open thoracoabdominal aortic aneurysm repair in octogenarians

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Objectives: We sought to evaluate our contemporary outcomes with open thoracoabdominal aortic aneurysm (TAAA) repair in octogenarians to determine whether open TAAA repair is a viable option, with acceptable risk, in this elderly cohort.

Methods: We analyzed clinical data from 1267 enrolled patients who underwent open TAAA repair between 2003 and 2013. Eighty-eight patients (7%) were octogenarians (median age, 82 years; range, 80-92 years) and 1179 were 79 years of age or less.

Results: Aneurysm rupture was more common in octogenarians (14% vs 4.7%, $P = .001$), whereas aortic dissections predominated in younger patients (43.9% vs 13%, $P < .001$). Octogenarians had higher rates of visceral-branch endarterectomy/stenting (58% vs 33.5%, $P < .001$), adverse postoperative outcomes (36% vs 15.3%, $P < .001$), operative mortality (26% vs 6.9%, $P < .001$), and prolonged hospital stay ($P = .004$). Among octogenarians, preoperative aortic dissection was most commonly associated with extent I repair (42% vs <10% for other extents, $P < .001$). Extent II repairs most frequently necessitated concomitant visceral-branch procedures and carried the highest risk of mortality (62%). Extent I and III repairs carried intermediate operative risk, and extent IV repairs posed the least risk (11%). Multivariate modeling analysis identified extent II TAAA ($P = .001$; odds ratio, 11.6), presence of concomitant dissection ($P = .02$; odds ratio, 5.6), and aneurysm rupture ($P = .02$; odds ratio, 5.7) as independent predictors of operative mortality in octogenarians.

Conclusions: Open extent II TAAA repair carries significant risk for octogenarians; extent I, III, and IV repairs incur more reasonable postoperative risk. Although TAAA repair should not be denied to octogenarians based solely on age, extensive TAAA repair should be performed with caution. (J Thorac Cardiovasc Surg 2015;149:S134-41)

See related commentary on pages S142-3.

Nonsurgical treatment of thoracoabdominal aortic aneurysms (TAAAs) carries a poor prognosis.[1] The mainstay in managing TAAAs has been open surgical repair[2,3]; however, historically this is associated with a substantial risk of perioperative mortality and morbidity.[3,4] The use of improved contemporary techniques[5-8] for end-organ protection has resulted in greatly improved outcomes.[9-12] Although most patients undergo TAAA repair in their 60s,[2,3,9-12] many older patients remain at risk for TAAA. Worldwide, people 80 years of age and older are the fastest growing segment of the population.[13] Currently, there are 11.9 million octogenarians in the United States, which constitutes the world's second largest octogenarian population, and this number is projected to nearly triple by 2050.[13] On reaching the age of 80 years, life expectancy for Americans is 8.9 years,[14] and thus, measures to extend life are often warranted.

Multiple series have reported that major cardiovascular surgery can be performed with acceptable perioperative mortality and excellent postoperative quality of life in appropriately selected octogenarians.[15-19] Conversely, other reports and national registries have shown that cardiovascular surgery in older patients overall incurs higher mortality, major complication rates, and total cost than in younger populations.[20-22] The purpose of this study is to report our contemporary experience with open TAAA repair in octogenarians and compare it with the outcomes in a younger population to determine whether open TAAA repair is a viable option in this high-risk cohort.

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Abbreviations and Acronyms
CSF = cerebrospinal fluid
IQR = interquartile range
LHB = left heart bypass
OR = odds ratio
TAAA = thoracoabdominal aortic aneurysm

PATIENTS AND METHODS

The Baylor College of Medicine institutional review board approved our clinical research protocol in 2006. For patients who underwent surgery after protocol approval, clinical data were collected prospectively and informed consent was obtained whenever possible; waiver of consent was approved for patients who were unable to provide consent as a result of their illness if they did not have family members available. For patients who underwent surgery before protocol approval, data were collected retrospectively and consent was waived with approval.

From January 2003 to September 2013, 1279 consecutive patients underwent open TAAA repair; 12 (0.9%) patients did not provide consent and did not meet the criteria for waiver. Of the 1267 patients enrolled, 88 (7%) were octogenarians and 1179 (93.1%) were 79 years old or less; these groups are the focus of this study. Operative mortality[23] (early death) was defined as death occurring within 30 days of surgery or before final discharge from hospital (including any time hospitalized in cases of transfer). Adverse event, a composite end point, was defined as the occurrence of any of the following: operative death, stroke, or permanent (defined as present at time of hospital discharge) paraplegia, paraparesis, or renal failure requiring dialysis.[24] All the preoperative, operative, and outcomes variables were collected using standard definitions as reported in recent publications.[11,25]

Surgical Technique

Our current technique of TAAA repair has been described in recent publications.[25,26] We used moderate heparinization and mild permissive hypothermia in all repairs on octogenarians. For extent I and II TAAA repairs, we routinely used cerebrospinal fluid (CSF) drainage and left heart bypass (LHB) to provide distal aortic perfusion during aortic crossclamping; these adjuncts were used selectively in other extents. When appropriate, we also used sequential crossclamping techniques and selectively reimplanted intercostal and lumbar arteries. We selectively perfused the celiac and superior mesenteric arteries with isothermic blood from the LHB circuit, and, whenever accessible, delivered intermittent cold (4°C) perfusion to the renal arteries. We assessed the origins of renal and visceral arteries for occlusive disease or dissection. In case of significant stenosis caused by atherosclerosis or dissection, endarterectomy, balloon-expandable stent deployment, or both were used to enhance renal and visceral perfusion.[27]

Follow-up

Follow-up was completed for all surviving octogenarian patients and 92% of surviving nonoctogenarians; median follow-up was 35.4 months (interquartile range [IQR], 15.7-68.8 months) and 39.2 months (IQR, 9.7-69.7 months), respectively. Clinical and research staff telephoned the patients, their designated family members, and physicians. When telephone contact was not successful, letters were mailed to the patients' last mailing address. The Social Security Death Index was queried to determine the patients' vital status.

Statistical Analysis

The data are summarized as n (%) for all discrete variables. Continuous data are presented as either median and interquartile range, or mean ± standard deviation. Associations between TAAA extent and preoperative characteristics, surgical details, outcomes, and causes of early death were calculated among the 88 octogenarians and compared with those of nonoctogenarians. Binary variables were analyzed using the Pearson χ^2 or Fisher exact test when expected cell sizes were small. Continuous variables with nonnormal distribution and nonequal variances were analyzed using the Kruskal-Wallis equality of populations rank test. Further analyses focused on associations between demographics, preoperative characteristics, operative variables, and outcomes among octogenarians and nonoctogenarians for all TAAA extents. We sought to identify significant predictors of operative mortality and adverse events among octogenarians using logistic regression modeling techniques. Bivariate associations with P values less than .25 were considered for entry into the models. A forward stepwise selection algorithm with a likelihood ratio criterion was used to build the regression models, which were stratified by age group. Analyses were performed using Stata IC 13 (Stata Statistical Software release 13. StataCorp, College Station, Tex) and IBM SPSS Statistics 21 (released 2012. IBM SPSS Statistics for Windows, version 21.0. IBM Corp, Armonk, NY). Survival was determined with the Kaplan-Meier method of estimation and the intergroup comparison was performed using the log-rank test.

RESULTS

During an 8-year period, 88 octogenarians (median age, 82 years [81-83.5]; range, 80-92 years) underwent open TAAA repair. Significant differences existed between octogenarians and nonoctogenarians with regard to baseline characteristics, comorbidities, and distribution of extent of repair (Table 1). Octogenarians had a higher incidence of aneurysm rupture (14%) and acute symptoms (25%) at presentation than nonoctogenarians (4.7%, $P = .001$, and 15.0%, $P = .03$, respectively). Conversely, nonoctogenarians had more aortic dissections (43.9%) than octogenarians (13%, $P < .001$).

Although most of the baseline characteristics for octogenarians did not differ significantly by extent of repair, the distribution of aortic dissection, the presence of acute symptoms, and coronary artery disease did vary significantly (Table 2). These patients had more extent I TAAA aortic repairs for dissection (42%, $P < .001$) and more extent III TAAA repairs for acute symptoms (43%, $P = .03$) than other extents. Aneurysm rupture was present in 25% of octogenarians undergoing extent III repairs. More than half of the extent III repairs (54%) were performed either urgently or as an emergency (Table 3).

As expected, the use of operative techniques in octogenarians varied by extent of repair (Table 3). LHB was used in most extent I (79%) and extent II repairs (85%). Similarly, CSF drainage was used mostly in extent I (95%) and extent II repairs (100%). Cold renal perfusion was used in most extent II (85%), III (86%), and IV (93%) repairs. Selective visceral perfusion to the celiac and superior mesenteric arteries was provided in most extent II repairs (62%, $P < .001$). Extent II TAAA repairs required more branch vessel adjuncts, such as concurrent endarterectomy or stenting or both, compared with other extents (85%, $P < .001$). Overall, octogenarians required significantly more renal/visceral vessel endarterectomy or