Limited root repair in acute type A aortic dissection is safe but results in increased risk of reoperation

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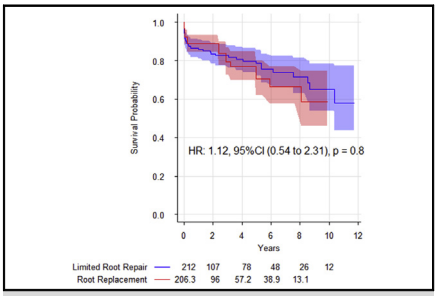
ABSTRACT

Objective: Management of the aortic root is a challenge for surgeons treating acute type A aortic dissection.

Methods: We performed a retrospective review of the acute type A aortic dissection experience at Stanford Hospital between 2005 and 2015 and identified patients who underwent either limited root repair or aortic root replacement. Differences in baseline characteristics were balanced with inverse probability weighting to estimate the average treatment effect on the controls. Weighted logistic regression was used to evaluate in-hospital mortality. Weighted Cox proportional hazards regression was used to evaluate differences in the hazard for mid-term death. Reoperation was evaluated with death as a competing risk with the Fine-Gray subdistribution hazard.

Results: After we excluded patients managed either nonoperatively or with definitive endovascular repair, there were 293 patients without connective tissue disease who underwent either limited root repair or aortic root replacement. There was no difference in weighted perioperative mortality, odds ratio 0.89 (95% confidence interval [CI], 0.44-1.76, $P = .7$), and there was no difference in weighted survival, hazard ratio 1.12 (95% CI, 0.54-2.31, $P = .8$). Risk of reoperation was greater in limited root repair (11.8%, 95% CI, 0.0%-23.8%) than for root replacement (0%), $P < .001$.

Conclusions: Limited root repair was associated with increased risk of late reoperation after repair of acute type A aortic dissection. Surgeons with adequate experience may consider aortic root replacement in well-selected patients. However, given good outcomes after limited root repair, surgeons should not feel compelled to perform this more-complex operation. (J Thorac Cardiovasc Surg 2017;■:1-7)



There was no survival difference between aortic root replacement and limited root repair.

Central Message

Aortic root replacement reduces the risk for late reoperation compared with limited root repair in acute type A aortic dissection, but survival is no different.

Perspective

Appropriate management of the aortic root in acute type A aortic dissection remains uncertain. This study reports the adequacy of limited root repair in acute type A aortic dissection but also underlines the increased risk of reoperation with the more-conservative approach.

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ACQ

Acute type A aortic dissection is a life-threatening process that has remained a persistent challenge for cardiovascular surgeons. In the International Registry of Acute Aortic Dissection, perioperative mortality remains high, at 18.4%.[1] Consolidation of care to a focused team experienced with the particular challenges of these complex patients may improve outcomes, with perioperative mortality ranging from 9% to 16.4%,[2-5] but the call for regionalization has not yet been answered.[6]

One of the perennial challenges confronting the surgeon tasked with the care of a patient with acute type A aortic dissection has been the appropriate management of the aortic root.[4,5,7-11] The pendulum has swung from aggressive replacement of the root in all patients to conservative root repair and back again.[6] With the emerging evidence that

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Abbreviations and Acronyms
CI = confidence interval
HR = hazard ratio

operative volume affects outcome in operations of the proximal aorta,[12] the role for each strategy (limited root repair vs aortic root replacement) has again been brought under the microscope. We undertook the current study to evaluate the effectiveness of limited root repair and aortic root replacement in patients with acute type A aortic dissection.

METHODS

This was a retrospective review of consecutive patients undergoing operative repair of acute type A aortic dissection at Stanford Hospital between January 2005 and December 2015. After approval from the institutional review board at Stanford University (IRB-32951, date of last approval January 31, 2017), we used internal departmental databases and a query of billing data using the Stanford Translational Research Integrated Database to discover patients treated for acute type A aortic dissection at our institution. Patients undergoing definitive endovascular repair were excluded. In addition, those with Marfan or similar syndromes (strong indication for root replacement) were excluded.[13] We identified the subset of patients for whom an intervention on the aortic root was performed. Limited root repair was defined as aortic valve resuspension, sinotubular junction reconstruction, use of biological glue in the dissected root, felt neomedia repair, or Yacoub aortic root remodeling of 1 or 2 sinuses. Aortic root replacement was defined as valve-sparing aortic root replacement or root replacement with either a composite valve graft or porcine xenograft (Freestyle; Medtronic Inc, Minneapolis, Minn).

Continuous variables are presented as mean with standard deviation or median with interquartile range. Categorical variables are presented as absolute counts with percentages. All hazard ratios and odds ratios (ORs) are presented with 95% confidence intervals (CIs). The analysis was conducted with R-3.2.2 (R Foundation for Statistical Computing, Vienna, Austria). A P value of <.05 was considered statistically significant; all P values are 2-sided. Because of the exploratory nature of this analysis, no adjustment was made for multiple comparisons.[14]

Inverse Probability Weighting With the Propensity Score

A nonparsimonious logistic regression model was used to estimate the probability of aortic root replacement (Table E1), and inverse probability weighting was used to estimate the average treatment effect on the controls (treatment weight: [1 − propensity score]/propensity score; control weight: 1).[15-17] We undertook estimation of the average treatment effect on the controls due to the lack of strict exchangeability, ie, patients who underwent aortic root replacement were not necessarily eligible to undergo limited root repair. This allowed for the creation of a pseudo-population of patients undergoing aortic root replacement similar to the unweighted population of patients undergoing limited root repair. In this way, we evaluated the possible effect of aortic root replacement on the patients who underwent limited root repair. Patients who were dialysis dependent were excluded at this stage because of our inability to construct groups with appropriate balance. Balance was assessed with the standardized mean differences approach; a standardized mean difference less than 0.2 was considered to be acceptable balance.[18]

Survival Analysis

Our primary outcome of interest was mid-term survival. Weighted Cox proportional hazards regression with a robust variance estimator was used to compare overall survival between patients undergoing limited root repair and aortic root replacement. To account for potential differences between individual surgeons, a mixed-effects Cox model was constructed with surgeon as a random intercept in a separate analysis. Adjusted survival curves were constructed via the technique of Cole and Hernan.[19]

The secondary outcomes of interest were perioperative mortality, which was defined by death before discharge during the index hospitalization, and reoperation on either the aortic root or aortic valve. Weighted logistic regression with a robust variance estimator was used to compare in-hospital mortality. Reoperation on the root or valve was evaluated with death as a competing risk by estimating the subdistribution hazard with a weighted form of the Fine-Gray technique.[20]

Clinical follow-up of patients with aortic pathology at Stanford is maintained by a thoracic aortic monitoring program with a dedicated group of advanced practice practitioners, administrative staff, surgeons, and radiologists. Mortality is evaluated via a combination of Social Security Death Index, integration of electronic medical record with regional health systems, and direct patient contact. Our process is similar to that reported by the Yale group[21]; our efforts are aided greatly by the presence of a large integrated managed care consortium in northern California.

RESULTS

There were 391 patients with acute type A aortic dissection who presented to our institution between 2005 and 2015; 31 patients (7.9%) were managed nonoperatively, 15 (3.8%) were primarily treated with endovascular repair, and 345 (88.2%) patients underwent open surgical repair. Of the patients who underwent open repair, there were 323 patients who underwent root intervention of any form and thus were eligible for inclusion in our study. Of these patients, there were 23 patients with Marfan or a similar syndrome, and there were 7 patients who were dialysis dependent. After we excluded these patients, there were 293 patients eligible for analysis. Median follow-up was 2.1 years (interquartile range 0.4-5.2 years). The majority of patients underwent an operation within 24 hours of symptom development (226; 77.1%), and 273 patients (93.2%) were transferred from another institution.

In general, patients who underwent aortic root replacement (n = 81; 27.6%) were younger and had fewer chronic comorbidities than patients who underwent a limited root repair (n = 212; 72.4%). However, patients undergoing aortic root replacement presented more frequently with shock physiology manifested by persistent hypotension with or without the need for pressor support (n = 15; 18.5%) compared with limited root repair (n = 20; 9.4%). Inverse probability weighting appropriately controlled for observed differences in baseline covariates (Table 1).

Before weighting, patients undergoing limited root repair had shorter cardiopulmonary bypass time and shorter aortic crossclamp time than those undergoing aortic root replacement. After weighting, these differences remained. Before weighting, most patients (89.4%) received blood or blood products. Patients undergoing aortic root replacement had a greater intraoperative blood product requirement in the weighted comparison, but packed red blood cell transfusion