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Effect of aortic valve type on patients who undergo Type A aortic dissection repair

Gabriel Loor, MD,[1,13,14] Thomas G. Gleason, MD, MS,[2] Truls Myrmel, MD, PhD,[3] Amit Korach, MD,[4] Santi Trimarchi, MD, PhD,[5] Nimesh D. Desai, MD,[6] Joseph E. Bavaria, MD,[6] Carlo de Vincentiis, MD,[5] Maral Ouzounian, MD, PhD,[7] Udo Sechtem, MD,[8] Daniel G. Montgomery, BS,[9] Edward P. Chen, MD,[10] Hersh Maniar, MD,[11] Thoralf M. Sundt, MD,[12] and Himanshu Patel, MD[9]

From the [1]Division of Cardiothoracic Surgery, University of Minnesota, Minneapolis, Minn.; [2]Division of Cardiothoracic Surgery, University of Pittsburgh, Pittsburgh, Penn.; [3]Department of Thoracic and Cardiovascular Surgery, Tromso University Hospital, Tromso, Norway; [4]Department of Cardiothoracic Surgery, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [5]Department of Vascular Surgery, IRCCS Policlinico San Donato, San Donato, Italy; [6]Department of Cardiovascular Surgery, University of Pennsylvania, Philadelphia, Penn.; [7]Division of Cardiac Surgery, Toronto General Hospital, Toronto, Ontario, Canada; [8]Division of Cardiology, Robert-Bosch Krankenhaus, Stuttgart, Germany; [9]Department of Cardiac Surgery, University of Michigan, Ann Arbor, Mich.; [10]Division of Cardiothoracic Surgery, Emory University, Atlanta, GA; [11] Division of Cardiothoracic Surgery, Department of Cardiovascular Surgery, Washington University, St. Louis, MO; [12]Thoracic Aortic Center, Massachusetts General Hospital, Boston, Mass.; [13]Division of Cardiothoracic Surgery, Baylor College of Medicine, [14] Division of Cardiothoracic Transplantation and Circulatory Support, Texas Heart Institute, Houston, Texas.

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Ethics statement:

Institutional review board approval was obtained by each participating center, with consent requirements determined by each hospital's institutional review board.

Address for reprints: Gabriel Loor, MD, Department of Surgery, Baylor College of Medicine, One Baylor Plaza, MS: BCM390, Houston, TX 77030. Phone: 832-355-3000; e-mail: Gabriel.Loor@bcm.edu.

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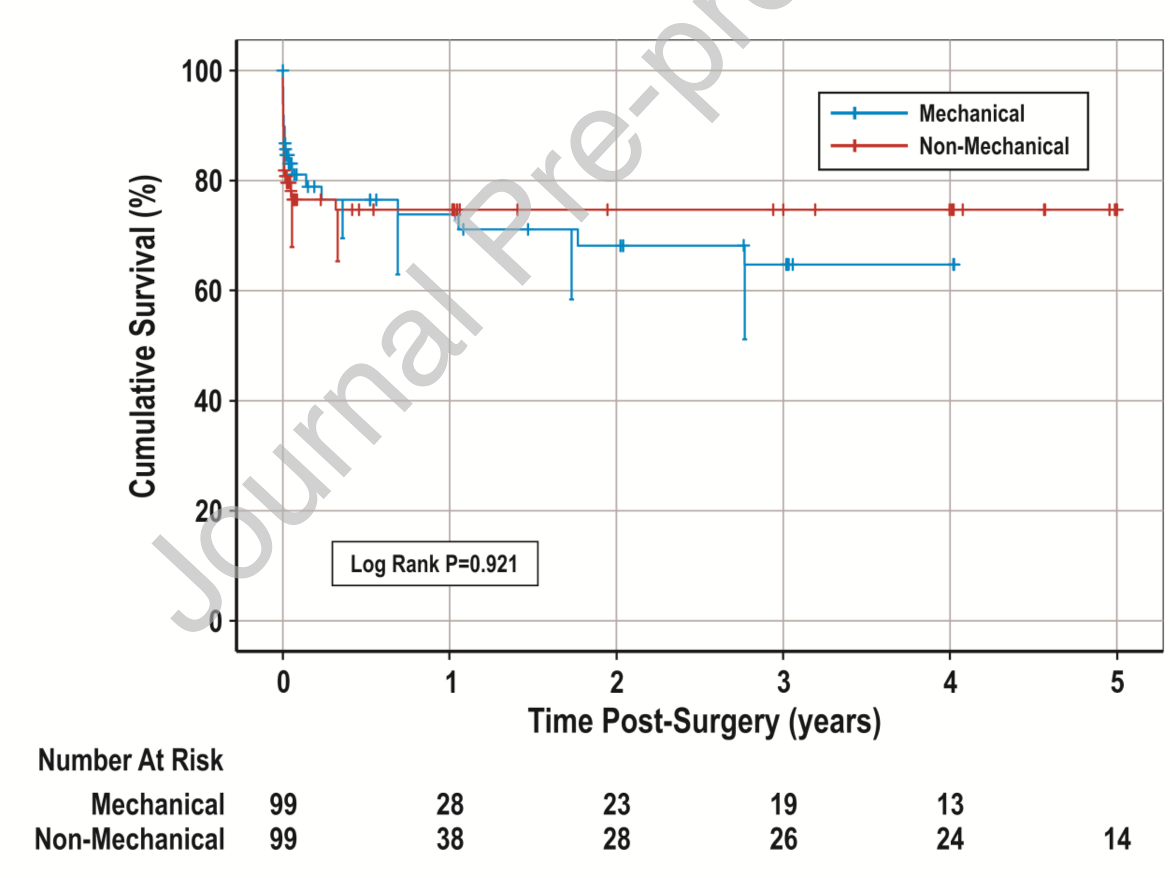
Abbreviations and Acronyms

AVR	= aortic valve replacement
BMI	= body mass index
CVA	= cerebrovascular accident
IRAD	= International Registry of Acute Aortic Dissection
IRAD-IVC	= International Registry of Acute Aortic Dissection Interventional Cohort
SD	= standard deviation
TAAD	= type A aortic dissection



Central Picture Legend

Survival in patients with aortic dissection who receive mechanical vs nonmechanical valves

Central Message

The choice of aortic valve prothesis does not affect postoperative morbidity or 4-year survival for patients undergoing type A aortic dissection repair who require an aortic valve replacement.

Perspective Statement

In this large international experience, the choice of prosthesis in patients undergoing type A aortic dissection repair did not have a significant effect on short-term outcomes after adjusting for perioperative factors. A biologic valve is reasonable in this unique patient population because of competing comorbidities and the advancement of minimally invasive valve replacement options.

ABSTRACT

Objective: Aortic valve replacement (AVR) is common in the setting of type A aortic dissection (TAAD) repair. Here, we evaluated the association between prosthesis choice and patient outcomes in an international patient cohort.

Methods: We reviewed data from the International Registry of Acute Aortic Dissection (IRAD) interventional cohort to examine the relationship between valve choice and short- and mid-term patient outcomes.

Results: Between January 1996 and March 2016, 1290 surgically treated patients with TAAD were entered into the IRAD interventional cohort. Of those, 364 patients undergoing TAAD repair underwent aortic valve replacement (AVR; mean age, 57 years). The mechanical valve cohort consisted of 189 patients, of which 151 (79.9%) had a root replacement. The nonmechanical valve cohort consisted of 5 patients who received homografts and 160 patients who received a biologic AVR, with a total of 118 (71.5%) patients who underwent root replacements. The mean follow-up time was 2.92 ± 1.75 years overall (2.46 ± 1.69 years for the mechanical valve cohort and 3.48 ± 1.8 years for the nonmechanical valve cohort). After propensity matching, Kaplan-Meier estimates of 4-year survival rates after surgery were 64.8% in the mechanical valve group compared with 74.7% in the nonmechanical valve group (P=0.921). A stratified Cox model for 4-year mortality showed no difference in hazard between valve types after adjusting for the propensity score (P=0.854).

Conclusions: A biologic valve is a reasonable option in patients with TAAD who require AVR. Although this option avoids the potential risks of anticoagulation, long-term follow up is necessary to assess the effect of reoperations or transcatheter interventions for structural valve degeneration.

INTRODUCTION

Nearly one-third of patients undergoing a Stanford type A aortic dissection (TAAD) repair require an aortic valve replacement (AVR).[1,2] Whether the choice of mechanical versus nonmechanical valve affects clinical outcomes remains unclear.

Mechanical valves are often considered in patients younger than 60 years of age who are undergoing primary AVR.[3] In patients with TAAD, choosing a mechanical valve at the index procedure avoids the risk of a complex and risky reoperation on the valve and root at the expense of greater perioperative bleeding and thrombosis. Reoperation rates on the distal aorta are as high as 30% because of aneurysmal degeneration, which may be related to the lack of false lumen thrombosis.[4,5] Thus, the potential for increased short-term risks, decreased overall life expectancy, and the risk of long-term distal aortic reinterventions are all reasons to question whether a mechanical valve is preferred in this patient population.

On the other hand, nonmechanical valves do not require anticoagulation, they have a low bleeding and thrombotic rate, and they may not have as high of a reintervention rate. A recent series of patients who underwent biologic AVR showed actuarial estimates of reoperation for structural valve degeneration at ten years of only 1.9% and 5.6% for patients greater than and less than 60 years of age, respectively.[6] Although reoperations can be performed with a low risk of morbidity when needed, valve-in-valve transcatheter aortic valve replacement is a promising minimally invasive alternative for dealing with valvular reinterventions.[7-10] In this study, we reviewed data from the International Registry of Acute Aortic Dissection Interventional Cohort (IRAD-IVC) to evaluate the effect of prosthesis choice on short- and mid-term patient outcomes.

METHODS

The makeup of the IRAD database has been described previously.[1,11] We reviewed data from all patients registered in the IRAD-IVC who underwent an operative intervention for a TAAD. This registry excludes chronic and traumatic aortic dissections and contains demographic and historical data, presenting clinical information, imaging findings, surgical details, and clinical outcomes. Follow-up data are obtained at 6 months after discharge and annually up to 5 years. We included patients who underwent any form of aortic valve replacement with either a mechanical or nonmechanical valve and excluded patients who underwent valve-sparing procedures. Institutional review board approval was obtained by each participating center, with consent requirements determined by each hospital's institutional review board.

Categorical data are presented as a frequency and percentage, whereas continuous data are presented as the mean$\pm$standard deviation for normally distributed variables or as the median and first and third quartiles for variables with skewed distributions. A nonparsimonious propensity model was developed (Supplemental Table) to obtain a propensity score from the conditional probabilities generated for each patient who underwent repair with a mechanical valve versus a nonmechanical valve. To handle missing data for variables in the propensity model, Little's missing completely at random (MCAR) test (P=.0915) was first performed to reject the hypothesis that there was a pattern to the missing data. Multiple imputation for the missing data was then performed by using 5 imputations with 1000 iterations each to infer values for missing data. A mean of the propensity scores generated from the imputed data sets was then computed for each patient. Propensity score matching was performed for the two groups by using the "R" Statistics module "MatchIt" from within SPSS. (R Core Team [2013]. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.) A nearest neighbor match (1:1) was utilized with the caliper set at 0.25, yielding matched groups of 100 patients each.

For the pair-matched group, categorical variables were compared by using McNemar's test. A paired *t*-test or Wilcoxon signed rank test was used for continuous variables when appropriate. Effect sizes were calculated by using the phi coefficient for nominal variables or Cohen's d for continuous variables. The primary outcome was propensity-matched short-term survival after surgical aortic dissection repair with a mechanical valve or a nonmechanical valve. The secondary outcomes included in-hospital morbidity and mortality rates. The log-rank chi-square statistic was used to compare Kaplan-Meier survival curves between the propensity-matched groups. Longitudinal mixed-effect modeling was used to analyze changes in descending aortic diameter over time. IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp.; Armonk, NY) was used for the analyses.

RESULTS

Patient Demographics (Mechanical Valve versus Nonmechanical Valve)

In the unmatched cohort, 189 patients had a mechanical valve, whereas the nonmechanical valve cohort consisted of 165 patients (5 who received homografts and 160 who received biologic AVR). Patients who received a mechanical valve were younger than those who received a nonmechanical valve (mean age, 53.9 versus 60.1, $P<0.001$). Men composed 78.8% of the mechanical valve group and 69.7% of the nonmechanical valve group ($P=0.049$). In patients who received a mechanical valve, 42% were current smokers compared with 16.8% in patients who received a nonmechanical valve ($P<0.001$). In the mechanical valve group, 11.7% of patients presented in shock compared with 6.5% in the nonmechanical valve group ($P=0.105$).

Imaging findings were similar between groups except that the mechanical valve group had more arch vessel involvement than did the nonmechanical valve group (55.6% versus 42.9%, P=0.035).

A Bentall or modified Bentall procedure was used more often in the mechanical valve group than in the nonmechanical valve group (88.4% versus 78.9%, P=0.023). Cerebral perfusion was used in 75% of mechanical valve cases compared with 87.7% of nonmechanical valve cases (P=0.003). The mean minimal temperature reached was 22 °C in the mechanical valve group versus 25.5 °C in the nonmechanical valve group (P<0.001). Longer cross-clamp times were noted in the mechanical valve group (161 minutes versus 135 minutes; P=0.227).

Patients were matched on their propensity to receive a mechanical valve versus a nonmechanical valve. Data showing the baseline and procedural differences between the matched cohorts are shown in Table 1. Apart from balancing the demographic details between cohorts, the matching process provided similarities in valvular anatomy and body mass index (BMI). The median mechanical valve size was 25.0 mm (interquartile range, 23.0-26.3), and the median nonmechanical valve size was 25.0 mm (interquartile range, 23.0-27.0; P=0.137). Similarly, the mean BMI was 27.7 kg/m^2 for the mechanical group and 27.5 kg/m^2 for the nonmechanical group (P=0.931). The mean aortic annulus size was 2.5 cm for the mechanical group and 2.6 cm for the nonmechanical group (P=0.069).

Effect of Valve Choice on Patient Outcomes

After propensity matching, no differences in the rates of in-hospital complications, including death, were noted between groups (Table 2).

The mean follow-up time for propensity-matched patients was 2.22±2.15 years overall (1.46±1.87 years for the mechanical valve group and 2.93±2.17 years for the nonmechanical valve group). After propensity matching, Kaplan-Meier estimates of 5-year survival after surgery were 64.8% in the mechanical valve group compared with 74.7% in the nonmechanical valve group (*P*=0.921) (Figure 1). A propensity-matched stratified Cox model for death at 4 years after surgery demonstrated that valve type was not associated with mortality (hazard ratio for nonmechanical valve group, 0.947; *P*=0.854; Table 3).

After propensity matching, longitudinal mixed effects modeling detected significantly greater linear changes in total descending aortic diameters (ie, composite of true and false lumen) among patients in the mechanical valve group than in the nonmechanical valve group after considering baseline aortic diameters (Figure 2, Table 4).

DISCUSSION

The main finding in our analysis of the IRAD-IVC data was that patients who underwent TAAD repair with AVR had similar short-term survival rates regardless of the type of valve prothesis (Figure 3). The rates of in-hospital postoperative complications, including mortality, were similar between patients with nonmechanical valves and those with mechanical valves after matching.

Survival in non-TAAD patients who receive mechanical or nonmechanical AVR has been analyzed in several studies. Similar to our study, a large-scale meta-analysis by Zhao and colleagues[12] in a cohort of 8,661 patients between the ages of 50 and 70 years showed no difference in survival between patients with mechanical valves and those with biologic valves.

They did note more bleeding complications and fewer reoperations in patients with mechanical valves. Several authors have noted similar findings in this age group.[13,14]

On the other hand, others have noted important survival advantages for mechanical valves, especially in patients younger than 65 years of age. A propensity-matched analysis by Brown and colleagues[15] at the Mayo Clinic showed a 10-year unadjusted survival rate of 68% for patients with mechanical AVR compared with 50% for those with bioprosthetic valves. A randomized controlled study from the Veterans Affairs group also showed improved survival rates with mechanical valves.[16] Several others have noted a survival advantage for patients with mechanical valves who are younger than 65 years of age.[12,17-19] However, these findings were not corroborated by the IRAD dataset. In general, survivors of TAAD have a reduced life expectancy because of several factors including the initial shock, a complex operation, circulatory arrest, and residual dissection flaps with distal reinterventions.[5] Thus, a survival advantage that may otherwise be observed with a mechanical valve could be undermined by these competing factors.

Biologic valves provide several theoretical advantages to this complex patient cohort that may translate into long-term survival. These are generally related to the lack of anticoagulation requirement, which could affect two issues: short-term morbidity and long-term aortic remodeling. Patients in our study who underwent AVR were more likely to present in shock, a major risk factor for in-hospital morbidity and mortality. The anticoagulation requirements of a mechanical valve could compound this morbidity. Up to 30% of patients who survive a DeBakey Type I dissection repair with a residual flap will require a downstream reintervention. Conceivably, anticoagulation may negatively affect aortic remodeling by hindering false lumen thrombosis. This theory is supported by our finding that, after matching, the mechanical valve cohort showed increased linear changes in descending aortic diameter up to 5 years after discharge. Of note, valve-sparing procedures such as isolated Cabrol, commissural resuspension, or valve-sparing root replacement are viable options for some patients, but these were not analyzed in our current study.[20]

Zhao and colleagues[21] showed that patients undergoing aortic dissection repair with a mechanical valve and a stent graft were less likely to experience complete false lumen thrombosis than were those without the need for anticoagulation. Song and colleagues[22] showed that early anticoagulation resulted in greater false lumen patency after type I dissection, with fewer reoperations, less aortic growth, and fewer deaths. This is counterintuitive but consistent with study findings showing the significance of partial thrombosis. Trimarchi and colleagues[23] showed that segments of the aorta with partial thrombosis were at increased risk of aneurysmal expansion. In the case of type B dissections, partial thrombosis has been associated with a significant risk of death.[24] However, Larsen and colleagues[25] showed that preoperative partial thrombosis in type A dissections was not associated with risk of death, aneurysmal degeneration, or reintervention.

In our study, we detected greater aortic growth in patients receiving a mechanical valve than in patients receiving a nonmechanical valve, with a 3-fold greater increase in average diameter at 2-year follow-up. The in-hospital mortality rate associated with a distal reintervention varies (depending on presentation) between 6% and 38%, which would be expected to contribute to morbidity and mortality in survivors of the original TAAD. However, after matching, our population had too few events to detect a difference in the need for distal or any reintervention between patients who received a mechanical valve and those who received a nonmechanical valve.[5,26]

What is the risk of choosing a biologic valve in a patient undergoing a TAAD repair who is younger than 65 years of age? By far, the biggest concern is the risk of proximal reoperations. In-hospital mortality associated with proximal reoperations varies between 11% and 18% compared with 2% for non-TAAD redo AVR.[9,26,27] The expected risk of reoperation for patients with a previous TAAD is 9% to 24% at 10 years.[28,29] Wang and colleagues[29] showed no difference in proximal reoperations between TAAD patients receiving isolated AVRs, homografts, or composite grafts. Geirsson and colleagues[28] found no difference in 5- and 10-year freedom from proximal reoperation in patients undergoing aortic valve preservation procedures or composite root replacements. In our series, we had too few events to capture differences in reoperation between groups; however, the 5-year follow-up period for IRAD may not have been sufficient to capture many valve-related reoperations.

Moreover, the choice of valve may pose unique technical issues at the time of reintervention. Reinterventions most often occur for chronic, aneurysmal dissections, which can be challenging to treat. Open distal repairs are only minimally affected by the valve choice.[5,30] However, endovascular options, often used as an alternative to or in conjunction with open repair, are affected by the presence of a mechanical prosthesis.[5,31] For instance, arch and proximal descending stent grafts require wire access close to or even through the valve. This can be hazardous if the valve is mechanical. While antegrade aortic access circumvents this challenge, it commits the patient to a concomitant procedure which is not always ideal.[32]

Biologic valves are being increasingly used for younger patients for a variety of reasons. Several recent studies have shown that the risk of reoperation may not be as high as previously reported.[6,33] A review of data from the National Inpatient Sample showed a trend towards the use of biologic valves in younger patients during the last decade. Percutaneous valve-in-valve options may partly be a reason for this.[34] The lack of size difference between the biologic and mechanical valves used in our patient cohort supports the feasibility of these procedures for patients with a nonmechanical valve who experience late valve degeneration. The future of this technology is optimistic; in conjunction with the data in this registry, one could argue for biologic valve implantation in patients with acute dissections. These valves are reasonably convenient to implant and are often sewn into a conduit when the root is repaired. Stentless options such as the St. Jude Freestyle valve also facilitate root replacement with good postoperative hemodynamics and durability.[35] However, the risk of biologic valve degeneration necessitating reintervention is generally not seen for 10 to 15 years after implantation and would not be evident at the 5-year follow-up timepoint examined here.

Moreover, in this study, propensity matching resulted in two groups with similar valve sizes, root sizes, and BMIs. Thus, any conclusions drawn from this study are predicated on the assumption that either valve choice results in acceptable hemodynamic profiles. For instance, if a biologic valve will lead to patient prosthetic mismatch but the mechanical valve will not, the short-term survival rate may be different following the two choices. Also, if one were to plan for a downstream valve in a valve procedure, the hemodynamic profile that will result from that decision needs to be considered. For instance, a bioprosthesis smaller than 23 mm at the index procedure could result in a young patient having a significant patient-prosthetic mismatch after a valve-in-valve procedure, especially if the patient's body surface area is above average. Thus, nonmechanical valve durability in patients with TAAD repair in conjunction with the limitations of a percutaneous valve-in-valve approach in smaller nonmechanical valve prostheses requires further research.

Limitations

In our study, data on the incidence of reinterventions on the aorta were not provided. This may be an important issue for patients on coumadin, given that the residual aortic diameter was significantly larger in the mechanical group than in the nonmechanical group, suggesting failure of the false lumen to thrombose. In addition, the choice of valve was not randomized; thus, there may be unaccounted biases that made the nonmechanical valve appear to perform better in this cohort. This should be kept in mind when making broad statements about valve choice. The propensity-matched analyses were performed to adjust for these biases and demonstrated no differences in patient outcomes with respect to valve type. However, because the database is a nonrandomized, outcomes-based registry, it is impossible to account for all possible cofounders. Clearly, surgeons should consider unique patient preferences and characteristics in their decision as to which valve prosthesis to implant in these patients. To focus on the effects of the prothesis, we did not include an analysis of patients receiving valve repair or resuspension. Long-term aortic dilation and reintervention could very well progress beyond the 5-year follow-up point, and survival curves could diverge. Another limitation of this study was the inability to record the cause of death in these patients. Hence, we do not know if subsequent deaths were or were not due to the type of prosthesis that was inserted.

CONCLUSION

We conclude that short-term survival rates after TAAD repair do not appear to be affected by the choice of a mechanical versus nonmechanical prosthesis. A longer follow-up period will be necessary to determine whether the avoidance of anticoagulation, its potential for bleeding, and its prevention of false lumen thrombosis resulting in aortic growth and the need for open or endovascular interventions will be offset by the limited durability of nonmechanical prostheses and the need for reoperations or transcatheter procedures.

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FIGURE LEGENDS

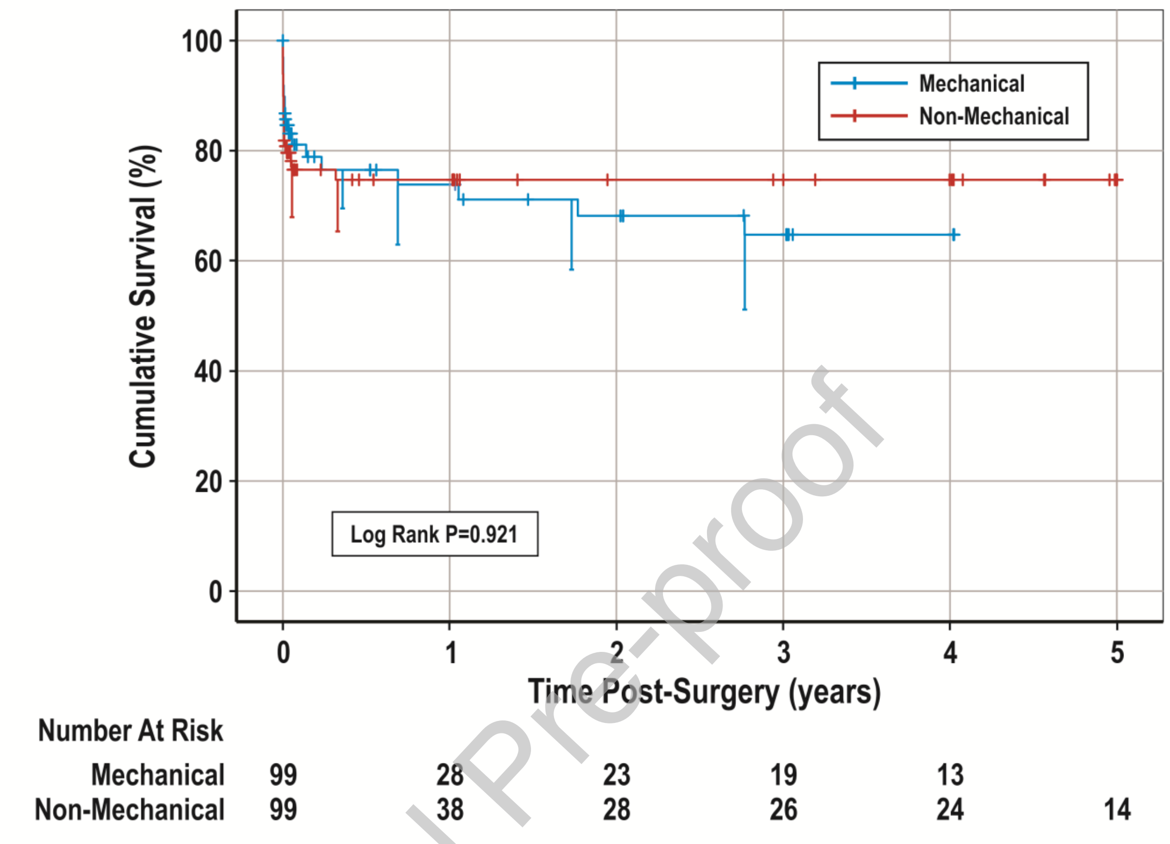

FIGURE 1. Kaplan-Meier survival analysis showing the 5-year survival rates of propensity-matched patients with type A aortic dissection (TAAD) who received a mechanical valve versus a nonmechanical valve. Note that this difference was not statistically significant after propensity adjustment Cox proportional hazard ratio analysis. The curve for the nonmechanical valve cohort is truncated at 4 years when the number of patients at risk drops below 10 cases.

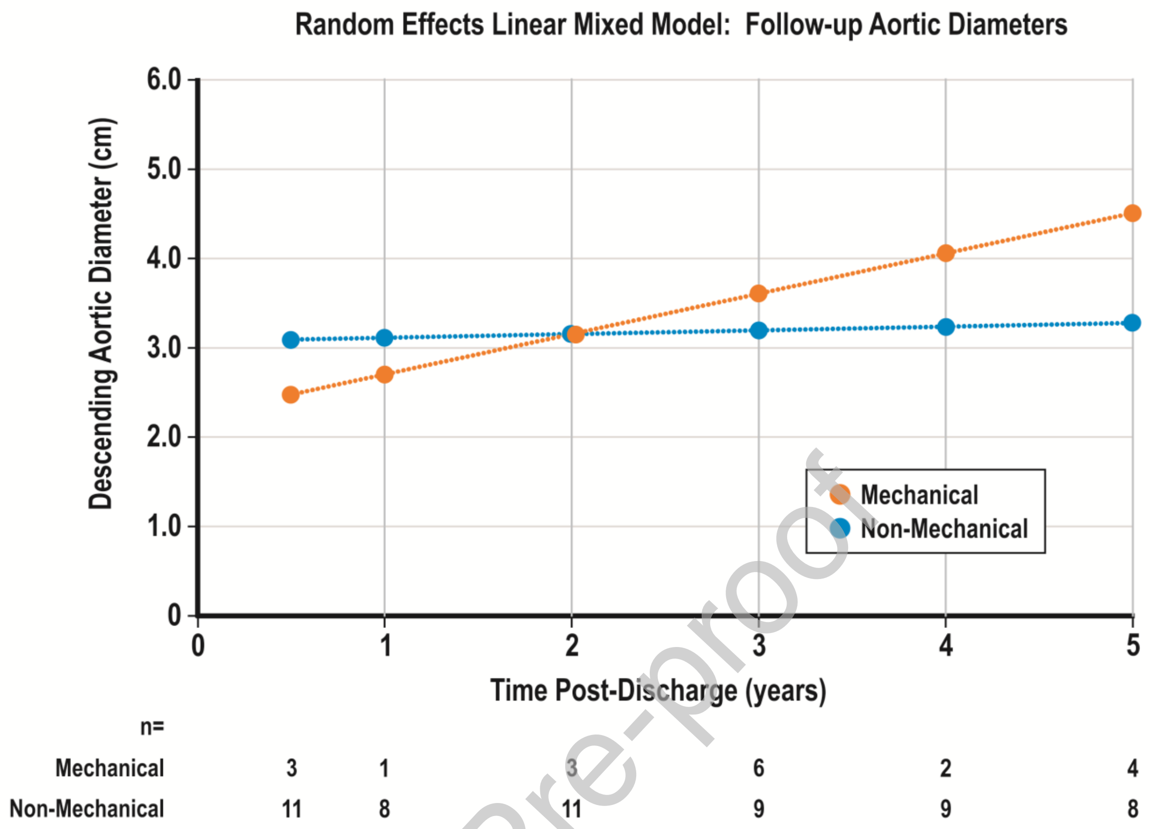

FIGURE 2. Propensity-matched random effects linear mixed model of total descending aortic diameter (ie, composite of true and false lumen) at follow-up.

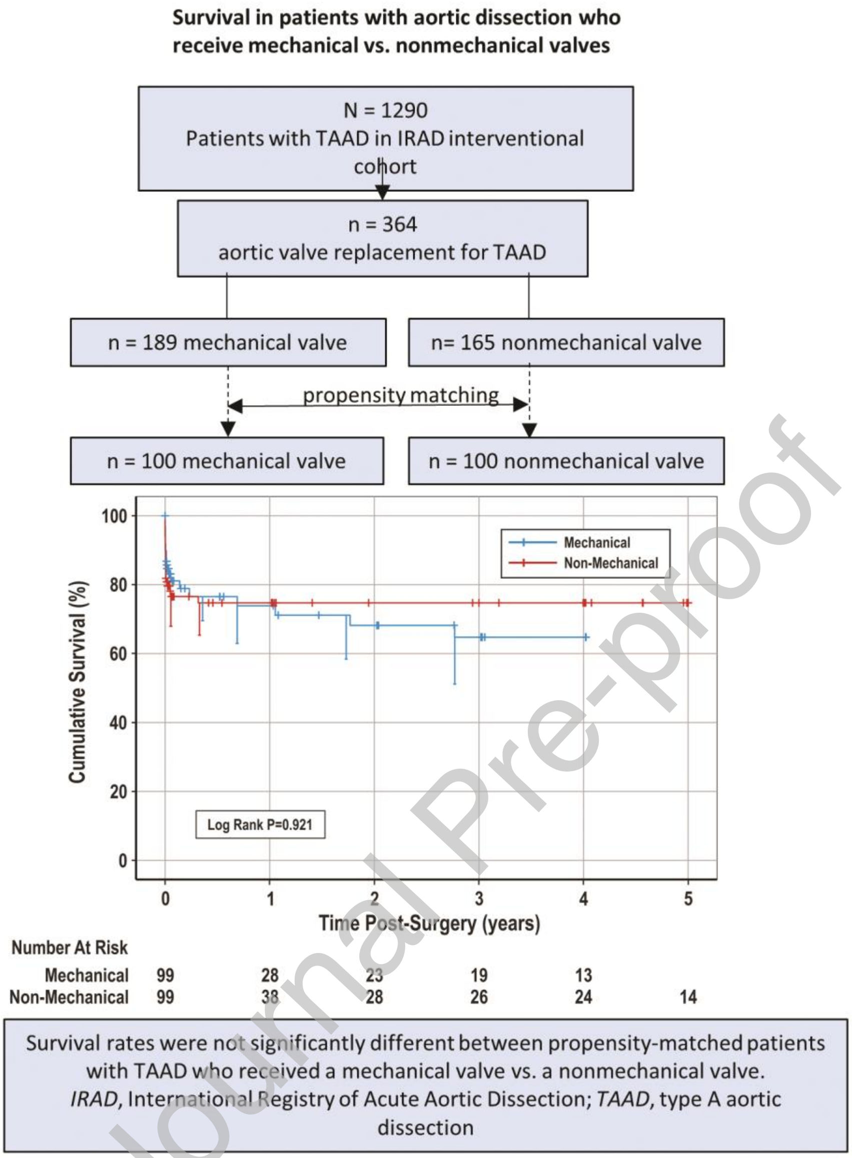

FIGURE 3. Survival rates between propensity-matched patients with type A aortic dissection who received a mechanical valve versus a nonmechanical valve.

TABLE 1. Propensity-matched aortic valve type, demographics and history, paired t-test, and McNemar's test

	Mechanical (n=100)	Nonmechanical (n=100)	*P* value	Effect size[a]
Demographics				
Age, y (mean ± SD)	56.3 ± 12.4	59.2 ± 13.8	0.092	0.221
BMI, kg/m^2 (mean ± SD)	27.7 ± 5.3	27.5 ± 7.2	0.931	0.032
Women	22/100 (22.0%)	26/100 (26.0%)	0.608	0.070
Race				
White	81/100 (81.0%)	78/100 (78.0%)	0.720	0.050
Black	7/100 (7.0%)	6/100 (6.0%)	1.000	–0.069
Asian	9/100 (9.0%)	15/100 (15.0%)	0.238	0.161
Site location				

Europe	40/100 (40.0%)	41/100 (41.0%)	1.000	0.108
Asia	12/100 (12.0%)	15/100 (15.0%)	0.629	0.276
North America	48/100 (48.0%)	44/100 (44.0%)	0.627	0.237
Patient history				
Atherosclerosis	14/94 (14.9%)	18/94 (19.1%)	0.572	–0.052
Aortic valve disease	10/91 (11.0%)	17/91 (18.7%)	0.230	–0.078
Marfan syndrome	5/93 (5.4%)	2/93 (2.2%)	0.453	–0.035
Diabetes	8/93 (8.6%)	8/93 (8.6%)	1.000	–0.094
Hypertension	59/94 (62.8%)	63/94 (67.0%)	0.652	–0.025
Bicuspid aortic valve	8/89 (9.0%)	8/89 (9.0%)	1.000	0.039
COPD	5/61 (8.2%)	5/61 (8.2%)	1.000	–0.089
Chronic renal insufficiency	4/61 (6.6%)	7/61 (11.5%)	0.549	–0.095

Ever smoked	17/35 (48.6%)	17/35 (48.6%)	1.000	–0.144
Prior cardiac surgery	14/91 (15.4%)	11/91 (12.1%)	0.664	0.029
Presenting signs and symptoms				
Abrupt onset of pain	57/79 (72.2%)	51/79 (64.6%)	0.327	0.248
Presenting hemodynamics				
Shock	8/87 (9.2%)	10/87 (11.5%)	0.815	–0.115
Tamponade	2/87 (2.3%)	1/87 (1.1%)	1.000	–0.017
Hypertensive	18/87 (20.7%)	20/87 (23.0%)	0.860	–0.077
Imaging findings				
Site of most proximal extension				
Root	73/100 (73.0%)	74/100 (74.0%)	1.000	–0.104
Sinotubular junction	13/100 (13.0%)	9/100 (9.0%)	0.523	–0.122

Ascending	14/100 (14.0%)	17/100 (17.0%)	0.720	–0.183
Patent false lumen	35/43 (81.4%)	38/43 (88.4%)	0.549	0.013
Partial false lumen thrombosis	7/43 (16.3%)	3/43 (7.0%)	0.344	–0.121
Complete false lumen thrombosis	1/43 (2.3%)	2/43 (4.7%)	1.000	–0.034
Abdominal vessel involvement	28/100 (28.0%)	20/100 (20.0%)	0.256	–0.033
Arch vessel involvement	32/59 (54.2%)	24/59 (40.7%)	0.200	–0.001
Coronary artery involvement	14/57 (24.6%)	9/57 (15.8%)	0.332	0.088
Maximum aortic diameter, cm [median (IQR)]				
Aortic annulus	2.5 (2.3-2.7)	2.6 (2.4-2.9)	0.069	-
Root	4.8 (4.2-5.6)	4.7 (4.0-5.1)	0.420	-
Sinotubular junction	4.7 (4.0-5.0)	4.6 (4.0-5.3)	0.977	-
Ascending aorta	5.3 (4.6-5.8)	5.4 (4.7-6.0)	0.935	-

Arch	3.6 (3.1-4.0)	3.6 (3.2-4.5)	1.000	-
Descending aorta	3.2 (2.9-3.6)	3.3 (2.8-3.7)	0.414	-
Aortic insufficiency	30/66 (45.5%)	34/66 (51.5%)	0.608	–0.028
Aortic insufficiency >mild	26/66 (39.4%)	30/66 (45.5%)	0.608	–0.051
Surgical details				
Ascending cross clamp	45/94 (47.9%)	45/94 (47.9%)	1.000	0.147
Commissural resuspension	5/79 (6.3%)	3/79 (3.8%)	0.727	–0.052
Bentall	62/74 (83.8%)	54/74 (73.0%)	0.169	–0.020
Modified Cabrol	2/61 (3.3%)	1/61 (1.6%)	1.000	–0.024
Valve size, mm (median ([IQR])	25.0 (23.0-26.3)	25.0 (23.0-27.0)	0.137	-
Ascending replacement	86/91 (94.5%)	85/91 (93.4%)	1.000	–0.064
Hemiarch	46/98 (46.9%)	49/98 (50.0%)	0.761	0.123

Partial arch	15/99 (15.2%)	14/99 (14.1%)	1.000	0.152
Complete arch	18/99 (18.2%)	15/99 (15.2%)	0.690	0.093
Elephant trunk	4/87 (4.6%)	2/87 (2.3%)	0.687	–0.034
Coronary ostium repair	31/93 (33.3%)	23/93 (24.7%)	0.268	–0.035
Concomitant CABG	13/91 (14.3%)	14/91 (15.4%)	1.000	–0.087
MV replacement/repair	3/93 (3.2%)	5/93 (5.4%)	0.727	–0.044
TV replacement/repair	0/92 (0.0%)	1/92 (1.1%)	-	-
Use of glue	58/90 (64.4%)	63/90 (70.0%)	0.522	0.020
Reinforce aortic anastomosis with Teflon felt	95/100 (95.0%)	90/100 (90.0%)	0.267	0.076
Hypothermic circulatory arrest	79/95 (83.2%)	80/95 (84.2%)	1.000	0.191
Cerebral perfusion	73/92 (79.3%)	78/92 (84.8%)	0.424	0.083
Antegrade	46/62 (74.2%)	48/62 (77.4%)	0.832	0.034

Retrograde	16/62 (25.8%)	14/62 (22.6%)		
Clamping time (minutes)	183.1 ± 66.3	157.6 ± 67.1	0.132	0.382
Minimum temperature, °C (any)	22.2 ± 5.0	23.7 ± 5.1	0.070	0.297

BMI, body mass index; CABG, coronary artery bypass grafting; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; MV, mitral valve; TV, tricuspid valve.[a]Effect size here is the standardized mean difference, calculated as the difference in means between the two groups divided by the pooled standard deviation of the two groups.

TABLE 2. Propensity-matched in-hospital complication rates

	Mechanical	Nonmechanical	*P* value	Effect size
Neurological deficit	18/93 (19.4%)	12/93 (12.9%)	0.327	–0.026
Stroke	6/89 (6.7%)	5/89 (5.6%)	1.000	–0.066
Coma	3/89 (3.4%)	5/89 (5.6%)	0.727	–0.046
SCI	1/88 (1.1%)	1/88 (1.1%)	1.000	–0.011
Myocardial ischemia	2/75 (2.7%)	1/75 (1.3%)	1.000	–0.019
Limb ischemia	5/90 (5.6%)	7/90 (7.8%)	0.754	0.111
Mesenteric ischemia/infarction	3/90 (3.3%)	5/90 (5.6%)	0.727	–0.045
Renal failure	19/91 (20.9%)	26/91 (28.6%)	0.311	–0.026
Requiring dialysis	4/7 (57.1%)	3/6 (50.0%)	-	-
Number not specified	93	94	-	-
Bleeding requiring rethoracotomy	1/11 (9.1%)	0/11 (0.0%)	-	-
Death	17/100 (17.0%)	22/100 (22.0%)	0.487	–0.048

SCI, spinal cord injury.

TABLE 3. Propensity-matched stratified Cox model for death at 5 years after surgery

	Hazard Ratio	95% CI Lower	95% CI Upper	***P* value**
Nonmechanical valve	0.947	0.530	1.691	0.854
Propensity score	2.770	0.638	12.022	0.174

CI, confidence interval.

TABLE 4. Propensity-matched estimates of fixed effects, descending aortic diameters

Parameter	Estimate	Standard error	df	T	*P* value	95% CI lower	95% CI upper
Intercept	3.063	0.393	34.91	7.789	<0.001	2.265	3.862
Time after surgery (years)	0.042	0.033	40.17	1.278	0.209	–0.024	0.108
Mechanical valve	–0.815	0.371	56.74	–2.196	0.032	–1.557	–0.072
Nonmechanical valve	0	0					
Mechanical valve follow-up time RPT	0.410	0.091	52.51	4.511	<0.001	0.228	0.592
Nonmechanical valve follow-up time RPT	0	0					
Propensity score	1.496	0.867	33.07	1.726	0.094	–0.267	3.259

CI, confidence interval. RPT indicates that the cases had data available for inclusion in this subanalysis.

Graphical Abstract

Survival rates were not significantly different between propensity-matched patients with type A aortic dissection who received a mechanical valve versus a nonmechanical valve.