Title: Durability of porcine and pericardial prostheses in tricuspid valve replacement

Short Title: Porcine versus pericardial tricuspid replacement

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Glossary of Abbreviations

TVR = tricuspid valve replacement
CI = cumulative incidence
HR = hazard ratio
STS = Society of Thoracic Surgeons

Central Picture Legend
No difference in structural deterioration after tricuspid valve replacement over time

Central Message
Porcine and pericardial prostheses in tricuspid valve replacement demonstrate similar durability, with no difference in structural valve deterioration, reoperation, regurgitation, or stenosis.

Perspective Statement
In this large single-institution study, we present clinical and echo data of porcine and pericardial tricuspid valves. We found no significant differences in survival or durability (structural valve deterioration, failure mode, mean gradient, and reoperation) between porcine and pericardial valves. Our study can inform surgeons on valve choice, particularly as newer devices become available.
Abstract

Objective: Biologic valves dominate tricuspid valve replacement, yet data on different valve types is lacking. Here we compare survival and durability of porcine and pericardial tricuspid prostheses.

Methods: A retrospective review of consecutive patients undergoing tricuspid valve replacement with porcine (N=542) or pericardial (N=144) prostheses between 1975 and 2022 was performed using a prospectively-maintained institutional database. Concurrent procedures were included. Cox proportional hazards and logistic regression were performed.

Results: Patients who received the porcine prosthesis, compared to pericardial, were younger (56±17 versus 63±15 years old), and more likely to present urgently (55% porcine, 44% pericardial); however, there were no differences in redo status or concomitant operations. Ten-year survival was not significantly different between porcine and pericardial groups (35±3% versus 28±4%, respectively, p=0.2). The 10-year cumulative incidence of structural valve deterioration (porcine 9±2%, pericardial 11±3%, p=0.8), reoperation for structural valve deterioration (porcine valve 5±1%, pericardial valve 4±2%, p=0.06), and severe regurgitation (porcine 4±1%, pericardial 5±2%, p=0.7) were not significantly different between groups. The failure mode was similar, with no difference in severe stenosis (porcine 32/47(68%), pericardial 11/16(69%), p=0.9) or severe regurgitation (porcine 18/47 (38%), pericardial 7/16(44%), p=0.7). On regression analysis, valve type was not associated with survival (p=0.6). Valve type was not associated with structural valve deterioration (p=0.1) or reoperation for structural valve deterioration (p=0.9).
Conclusions: In our series, there were no differences in survival or durability between porcine and pericardial valves. In most patients undergoing tricuspid valve replacement, choice of porcine versus pericardial prosthesis is unlikely to affect clinical outcomes.

Keywords: tricuspid valve, porcine bioprosthetic, pericardial bioprosthetic, structural valve deterioration, reoperation, tricuspid stenosis, tricuspid regurgitation
Introduction

Biologic valves dominate tricuspid valve replacement. In a large study of isolated tricuspid valve operations using the Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database, 92.4% of patients undergoing valve replacement received a biologic valve, compared to mechanical. Unfortunately, guidelines surrounding tricuspid valve surgery are limited due to a paucity of literature, including robust studies on late outcomes based on valve type. Furthermore, with a 1-year all-cause mortality after tricuspid valve replacement of 25%, further studies on this challenging patient population are essential.

Commercially available biologic prosthesis for the mitral or tricuspid position first became available in 1974 with the Edwards porcine model 6625. In 2000, the pericardial bioprosthetic tricuspid valve was introduced in the United States with the Edwards 6900 model, followed by the 7200 and 7300 series. To date, only one large series has directly compared porcine (n=199) and pericardial (n=342) prostheses in the tricuspid position. At five years, there was no difference in all-cause mortality, but the cumulative incidence of reoperation and prosthetic valve stenosis were higher in the pericardial valves compared to porcine. Most studies on biologic tricuspid valve replacement are small and heterogeneous, and comparative series are challenged as new models and brands are introduced. Recent studies that compare biologic and mechanical valves in the tricuspid position do not report the biologic valve type and models included, thereby assuming identical durability and characteristics in the biologic models.

This study was undertaken to directly compare porcine and pericardial tricuspid prostheses, with extended follow-up at a single institution. Given that both porcine and pericardial prostheses are available on the market today, the goal of the study was to provide insight into valve choice for surgeons.
Patients and Methods

Patient population

A retrospective analysis was performed using a prospectively-maintained institutional database on consecutive patients who underwent tricuspid valve replacement with biologic valve between 1975 and 2022. Patients were divided into two groups: porcine and pericardial prostheses. Concurrent procedures were included. Choice of tricuspid prosthesis was driven by market availability and surgeon preference. Waiver of informed consent was approved by the IRB (Pro00105933, approved June 22, 2020).

Study outcomes

The primary endpoint was the cumulative incidence of structural valve deterioration, which excluded deterioration due to endocarditis. Secondary endpoints included patient survival and cumulative incidence of reoperation for structural valve deterioration, severe tricuspid regurgitation, and severe tricuspid stenosis. Tricuspid valve findings on post-operative echocardiography were reported according to the American Society of Echocardiographers guidelines. Structural valve deterioration was defined as onset of severe tricuspid stenosis, severe tricuspid regurgitation, or tricuspid reoperation for prosthetic stenosis/regurgitation not due to endocarditis. Severe tricuspid stenosis was defined as a mean mitral gradient of 10 mmHg or more. Calculated valve orifice area was not reliably reported in our cohort. Follow-up data were obtained from the electronic medical record with linkage to multiple national hospital databases and the National Death Index.

Statistical methods
Binary outcomes were compared with Pearson’s chi-square or Fisher’s exact test as appropriate, and presented as frequency counts and percentages (n [%]). Continuous outcomes were compared with Wilcoxon rank-sum or t-test as appropriate, and summarized with mean and standard deviation or median and interquartile range (IQR). Cumulative incidence curves were compared using Gray’s test.

A competing risk analysis was performed to compute cumulative incidence of endpoints other than survival occurring over time using the variables in Supplemental Table 1. Death, cardiac transplantation, or insertion of a left-ventricular assist device were censored at time of last echo follow-up. Outcomes based on echo findings were censored for the last known echo. Missing data were handled with complete case analysis after checking the assumption of missing completely at random.

To correct for differences between the porcine and pericardial groups, Cox proportional hazard analysis was used for patient survival after checking for hazard proportionality. Variables were chosen based on clinical judgement, prior literature, and univariate covariables associated with porcine and pericardial grouping (Supplemental Table 1). Survival estimates were presented as ± standard error. Survival curves were compared using the log-rank test.

Statistical software was SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Waiver of informed consent was approved by the IRB (Pro00105933, approved June 22, 2020).

**Results**

From 1975 to 2022, 686 consecutive patients underwent tricuspid valve replacement with biological prostheses (Supplemental Figure 1). The porcine prostheses (N=542) implanted
included Mosaic (N=292) (Medtronic, Inc, Minneapolis, MN), Edwards Model 6625 (N=129) (Edwards Lifesciences, Irvine, CA), Hancock (N=65) (Medtronic, Inc, Minneapolis, MN), Biocor (N=42) (Abbott Laboratories, Abbott Park, IL), and Epic (N=32) (Abbott Laboratories, Abbott Park, IL). The pericardial prostheses implanted included the Edwards Models 6900 or 7300 TFX (N=144) (Edwards Lifesciences, Irvine, CA) beginning in 2002. The median patient survival in this series was 5.1 (0.7, 11.3) years. One-year mortality was 24±2%. Median clinical follow-up of patients was 2.3 (0.5, 6.3) (range 0-41) years after porcine replacement and 4.0 (1.7, 7.5) (range 0-19) years after pericardial replacement. Median echo follow-up of patients was 1.1 (0.1, 4.4) (range 0-30) years after porcine replacement and 1.6 (0.2, 5.2) (range 0-17) years after pericardial replacement. Completeness of echo follow-up of living patients was 122/236 (52%) at 5 years and 54/104 (52%) at 10 years. Data missingness was < 5% for patient demographics.

For patients living more than 30 days, postoperative echocardiography data missingness was 17% (106/619). A total of 33 surgeons were included; however, 10 surgeons performed 80% (550/686) of cases. Patients who received the porcine prosthesis, compared to pericardial, were younger (56±17 versus 63±15 years old), and more likely to present urgently (porcine 55%, pericardial 44%) with endocarditis (porcine 21%, pericardial 13%) and history of intravenous drug use (porcine 13%, pericardial 5%) (Table 1). However, pericardial patients were more likely to have class 3-4 heart failure (pericardial 76%, porcine 67%). Groups demonstrated no difference in redo status, concomitant operations, or severity of tricuspid regurgitation.

Intraoperatively, patients experienced similar cardiopulmonary bypass times, but the pericardial group had longer cross clamp times (Table 1). After adjustment with regression analysis, valve type was not associated with clamp time (P=0.2). The porcine group was more likely to receive sternotomy (porcine 389/542 (72%), pericardial 67/144 (47%)). Mean valve size
was 30±3 for porcine and 28±2 for pericardial valves (Supplemental Figure 2). Almost half of the patients in each group underwent isolated tricuspid valve replacement (porcine 281/542 (52%), pericardial 65/144(45%), P=0.15). Concurrent procedures (coronary artery bypass grafting, aortic valve replacement, mitral valve replacement, left ventricular assist devices, and MAZE procedure) were similar between groups. Postoperatively, patients with porcine and pericardial valves experienced similar 30-day mortality, stroke, reoperation for bleeding, and implantation of permanent pacemaker (Table 2). The porcine group were more likely to have renal injury (porcine 95/542 (18%), pericardial 12/144 (8%)), prolonged ventilation (porcine 84/542 (16%), pericardial 13/144 (9%)), and longer length of stay (17 days versus 13 days, respectively).

Ten-year survival was not significantly different between patients with porcine and pericardial valves (35±3% versus 28±4%, p=0.2) (Figure 1, Table 2). The 10-year cumulative incidence of structural valve deterioration (porcine 9±2%, pericardial 11±3%, p=0.8), reoperation for structural valve deterioration (porcine valve 5±1%, pericardial valve 4±2%, p=0.06), and severe regurgitation (porcine 4±1%, pericardial 5±2%, p=0.7) were not significantly different between porcine and pericardial groups (Figure 2, Figure 3, Supplemental Figure 3, Table 2). Similarly, there was no difference in structural valve deterioration between valve model (p=0.1) (Figure 4). The failure mode was similar, with similar incidence of severe stenosis (porcine 32/47(68%), pericardial 11/16(69%), p=0.9) and severe regurgitation (porcine 18/47 (38%), pericardial 7/16(44%), p=0.7). Porcine and pericardial valves demonstrated identical median tricuspid gradients at last echo (4 (3,6) mmHg in each group, (p=0.7) (Figure 5). Likewise, the 10-year cumulative incidence of severe stenosis was similar (6±1%, 7±2%, p=0.6) (Supplemental Figure 4, Table 2).
Multivariable Cox model analysis demonstrated that the multivariable correlates of death were older age (HR 1.02, p<0.0001), class 3-4 heart failure (HR 1.16, p=0.001), hemodialysis (HR 1.3, p=0.01), lung disease (HR 1.4, p=0.01), and radiation therapy (HR 1.2, p=0.01). Bioprosthetic valve type (porcine versus pericardial) was not significantly associated with survival (p=0.6). On multivariate logistic regression, the valve type (p=0.1) and size (p=0.8) were not associated with structural valve deterioration. Reoperation for structural valve deterioration was associated with younger age (<50 years) (HR 1.05, p<0.0001), but not valve type (p=0.9).

To account for operative year, the analysis was repeated with patients who underwent tricuspid valve replacement from 2002 to 2015 only (porcine=140, pericardial=142). Similar to results from the larger cohort (1975-2022), there were no differences between valve types for 10-year survival (porcine 31±5%, pericardial 28±4%, P=0.5), 10-year structural valve deterioration (porcine 14±3%, pericardial 12±3%, P=0.4), or reoperation for structural valve deterioration (porcine 6±2%, pericardial 4±2%, P=0.2).

Discussion

In this study, we compared durability of porcine and pericardial prosthetic valves used in tricuspid valve replacement. With an all-cause 1-year mortality of 25% in patients who undergo tricuspid valve replacement, studies on improving outcomes in this patient population by informing surgeon decision-making are imperative.\(^4\) Porcine and pericardial tricuspid valves demonstrated similar survival, structural valve deterioration, reoperation for structural valve deterioration, severe tricuspid regurgitation, and severe tricuspid stenosis at 10 years. After adjustment, valve type (porcine and pericardial) was not associated with survival, structural valve deterioration, or reoperation for structural valve deterioration. Even after the analysis was
limited to operations performed after 2002 when porcine and pericardial were available simultaneously, there were no differences in survival, structural valve deterioration, or reoperation for structural valve deterioration.

To our knowledge, this is one of the largest comparative analyses of porcine and pericardial tricuspid valve prosthetics. Other published series comparing biologic prostheses are small and report variable late durability of tricuspid valve replacement. Studies comparing mechanical and biologic tricuspid replacement offer larger cohorts and late follow-up, but unfortunately, combine all tissue valve models into a single group for the analyses, which eliminates access to the outcomes based on valve types.

Similar to our findings, Sohn et al. reported no difference in all-cause mortality. Sohn and Kang reported more tricuspid stenosis and tricuspid reoperation in pericardial valves, even after multivariable correction for differences in underlying patient characteristics. Our study found no difference in tricuspid stenosis or tricuspid reoperation between pericardial versus porcine valves; however, we specifically investigated reoperation for structural valve deterioration with exclusion of patients with prosthetic valve endocarditis. Unlike other studies, we included echo data in our definition of durability, which enhanced granularity of outcome.

We reported no difference between valve type in structural valve deterioration and failure mode. The incidence of severe regurgitation and stenosis were similar between porcine and pericardial valves.

The Mosaic porcine prosthesis accounted for 292 of the porcine valves in our tricuspid series. In the mitral position, studies report conflicting results on the durability of porcine and pericardial prostheses. Jamieson et al. and Uchino et al. reported a higher incidence of late
regurgitation for porcine mitral prosthetics. Buete al.\textsuperscript{17} reported a significantly higher incidence of late structural valve deterioration as well as reoperation for structural valve deterioration in patients with pericardial valves. Conversely, in a meta-analysis comparing porcine and pericardial mitral valves, porcine valves demonstrated higher freedom from SVD.\textsuperscript{18} Different valve models may have contributed to disparate results in the studies, with third-generation porcine Mosaic valve in the Buete et al.\textsuperscript{17} and Malvindi et al.\textsuperscript{18} series and first-generation porcine valve in the Jamieson et al.\textsuperscript{15} series. However, in our current series of tricuspid replacements, there was no significant difference in durability between any biological valve models, including first-generation porcine valves, pericardial valves, and later generation porcine prostheses, which includes the Mosaic porcine prosthesis (Figure 4). The applicability of data from biologic valves in the mitral position may not be generalizable to the same valve models in the tricuspid position due to different hemodynamic profiles and poor survival of patients who underwent tricuspid valve replacement (Figure 1, Figure 2).

Importantly, this study demonstrates that both porcine and pericardial prostheses provide similar clinical and echocardiographic outcomes. Still, despite similar durability, most patients undergoing tricuspid valve replacement did not outlive the prosthesis, regardless of valve type and operative year.

Limitations

Our study is a retrospective analysis from a single center over 47 years. Not all models of porcine or pericardial biological valves were examined. The practically accessible definition of severe tricuspid stenosis as a mean gradient of 10 mmHg instead of a valve area of < 1cm\textsuperscript{2} may have inaccuracy due to variation in cardiac index. The data document drift in patient selection
and operative technique over time between the two series, and measured variables may not fully account for differences in patient selection or operative technique. The use of multivariable analysis cannot entirely adjust for selection bias of choice of prosthesis, particularly in the era of pericardial valves when porcine was available. Valve manufacturing and anti-calcification techniques are proprietary and difficult to differentiate from the valve lines themselves. Finally, this study includes a patient population with a known median life expectancy of less than 10 years; likewise, the study design is limited in discerning differences between bioprostheses that commonly have durability over 20 years (Figure 2).

Conclusions

We present our large institutional experience of tricuspid valve replacement and compare durability of porcine and pericardial prostheses. Remarkably, we found no significant differences in durability between porcine and pericardial valves in the tricuspid position, despite comparison of many valve models in a wide variety of patients over many decades. We assessed durability through multiple metrics, including clinic outcomes (survival and reoperation) and echo findings (prosthetic valve regurgitation, stenosis, and mean gradient). Therefore, this study can inform surgeon decision-making on valve type, particularly as newer devices become available. In conclusion, in most patients undergoing tricuspid valve replacement, choice of porcine versus pericardial prosthesis is unlikely to affect clinical outcomes.
REFERENCES


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Table 1. Preoperative and intraoperative data

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<th>PORCINE</th>
<th>PERICARDIAL</th>
<th>P-Value</th>
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<tr>
<td>N</td>
<td>542</td>
<td>144</td>
<td></td>
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<td>Age (years)</td>
<td>56±17</td>
<td>63±15</td>
<td>&lt;0.001</td>
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<tr>
<td>Male</td>
<td>223(41%)</td>
<td>64(38%)</td>
<td>.05</td>
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<td>White</td>
<td>398(74%)</td>
<td>108(75%)</td>
<td>0.80</td>
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<td>Hypertension</td>
<td>276(51%)</td>
<td>97(67%)</td>
<td>0.001</td>
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<td>Class III-IV heart failure</td>
<td>363(67%)</td>
<td>109(76%)</td>
<td>0.05</td>
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<td>Coronary artery disease</td>
<td>87(16%)</td>
<td>33(23%)</td>
<td>0.05</td>
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<td>Prior cardiac surgery</td>
<td>296(55%)</td>
<td>85(59%)</td>
<td>0.80</td>
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<td>Urgent</td>
<td>298(55%)</td>
<td>63(44%)</td>
<td>0.02</td>
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<td>Severe tricuspid regurgitation</td>
<td>499(92%)</td>
<td>133(92%)</td>
<td>0.90</td>
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<td>Intraavenous drug abuse</td>
<td>70(13%)</td>
<td>7(5%)</td>
<td>0.007</td>
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<td>Tricuspid Disease etiology</td>
<td></td>
<td></td>
<td></td>
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<td>• Endocarditis</td>
<td>119(22%)</td>
<td>18(13%)</td>
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<td>• Rheumatic disease</td>
<td>76(14%)</td>
<td>22(15%)</td>
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<td>• Tricuspid device failure</td>
<td>36(7%)</td>
<td>7(5%)</td>
<td>0.40</td>
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<td>• Functional tricuspid disease</td>
<td>252(46%)</td>
<td>83(58%)</td>
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<tr>
<td>• Other tricuspid etiology</td>
<td>59(11%)</td>
<td>14(10%)</td>
<td>0.70</td>
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<td>Tricuspid size</td>
<td>30±3</td>
<td>28±2</td>
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<td>Sternotomy</td>
<td>389(72%)</td>
<td>287(52%)</td>
<td>&lt;0.001</td>
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<td>Cardiopulmonary bypass time (min)</td>
<td>197±91</td>
<td>205±81</td>
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<td>Cross Clamp time (min)</td>
<td>83(58, 118)</td>
<td>108(70, 155)</td>
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<tr>
<td>No cross clamp</td>
<td>215/542(40%)</td>
<td>65/144(49%)</td>
<td>0.04</td>
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<td>Isolated tricuspid replacement</td>
<td>281/542(52%)</td>
<td>65/144(45%)</td>
<td>0.15</td>
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<td>Coronary artery bypass grafting</td>
<td>33(6%)</td>
<td>12(8%)</td>
<td>0.30</td>
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<td>Aortic valve replacement</td>
<td>79(15%)</td>
<td>23(16%)</td>
<td>0.70</td>
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<td>Mitral valve repair</td>
<td>36(7%)</td>
<td>23(16%)</td>
<td>0.001</td>
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<td>Mitral valve replacement</td>
<td>164(30%)</td>
<td>40(28%)</td>
<td>0.60</td>
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<td>Left ventricular assist device</td>
<td>14(2.6%)</td>
<td>2(1.4%)</td>
<td>0.40</td>
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<td>Maze procedure</td>
<td>14(3%)</td>
<td>5(3%)</td>
<td>0.60</td>
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Table 2. Patient outcomes, unmatched

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<th>PORCINE</th>
<th>PERICARDIAL</th>
<th>P-value</th>
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<tr>
<td>N</td>
<td>542</td>
<td>144</td>
<td></td>
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<tr>
<td>Postop° Death</td>
<td>67 (12%)</td>
<td>13 (9%)</td>
<td>0.30</td>
</tr>
<tr>
<td>Postop° Stroke</td>
<td>19 (4%)</td>
<td>5 (3%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Postop° Reoperation for bleeding</td>
<td>45 (8%)</td>
<td>42 (8%)</td>
<td>0.90</td>
</tr>
<tr>
<td>Postop° Permanent pacemaker</td>
<td>98 (18%)</td>
<td>23 (16%)</td>
<td>0.60</td>
</tr>
<tr>
<td>Postop° New atrial fibrillation</td>
<td>46 (8%)</td>
<td>4 (3%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Postop° Renal injury</td>
<td>95 (18%)</td>
<td>12 (8%)</td>
<td>0.007</td>
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<td>Prolonged ventilation (&gt;48hours)</td>
<td>84 (16%)</td>
<td>13 (9%)</td>
<td>0.05</td>
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<td>Length of stay (median days)</td>
<td>17 (10, 31)</td>
<td>13 (9, 21)</td>
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<td>10-year survival</td>
<td>35±3%</td>
<td>28±4%</td>
<td>0.20</td>
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<td>10-year CI structural valve deterioration</td>
<td>9±2%</td>
<td>11±3%</td>
<td>0.80</td>
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<tr>
<td>10-year CI tricuspid reoperation for structural valve deterioration</td>
<td>5±1%</td>
<td>4±2%</td>
<td>0.06</td>
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<td>10-year CI severe tricuspid regurgitation</td>
<td>4±1%</td>
<td>5±2%</td>
<td>0.70</td>
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<tr>
<td>10-year CI severe tricuspid stenosis</td>
<td>6±1%</td>
<td>7±2%</td>
<td>0.60</td>
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CI = cumulative incidence
°Postop= 30-day or index hospitalization

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Supplemental Table 1. Variables used in Multivariable Analysis of Outcomes

- Pericardial versus porcine prosthesis
- Age of patient
- Gender
- Rheumatic mitral disease etiology
- Functional mitral disease etiology
- Endocarditis
- Coronary artery disease
- Hypertension
- Tricuspid prosthesis size
- Endocarditis
- Urgency
- White race
- Severe tricuspid regurgitation
- Smoking
- Class III-IV heart failure
- Weight
- Intravenous drug abuse
- Prior operation
- Atrial fibrillation
FIGURES

Figure 1. Kaplan-Meier estimates of overall survival in patients undergoing tricuspid valve surgery with porcine and pericardial prostheses. Red and blue color bars indicate 95% confidence intervals.

Figure 2. Cumulative incidence curves of structural valve deterioration after tricuspid valve replacement with porcine and pericardial prostheses. Red and blue color bars indicate 95% confidence intervals.

Figure 3. Cumulative incidence curves of tricuspid reoperation for structural valve deterioration after tricuspid valve replacement with porcine and pericardial prostheses. Red and blue color bars indicate 95% confidence intervals.

Figure 4. Cumulative incidence curves of tricuspid structural valve deterioration after tricuspid valve replacement with the six valve prosthesis models studied. Red and blue color bars indicate 95% confidence intervals.

Figure 5. Mean tricuspid valve gradient at last echo based on valve size for porcine and pericardial prostheses. Red boxes represent pericardial valves and blue color boxes indicate porcine valves. Lower and upper borders of the box mark the 25th and 75th percentiles. Horizontal bar within the box marks the median, with circles showing the mean. Lower and upper whiskers show the minimum and maximum values of non-outliers.
Supplemental Figure 1. Institutional volume of patients undergoing tricuspid valve replacement with porcine and pericardial prostheses by operative year.

Supplemental Figure 2. Distribution of tricuspid valve sizes for porcine and pericardial prostheses.

Supplemental Figure 3. Cumulative incidence curves of severe tricuspid regurgitation after tricuspid valve replacement with porcine and pericardial prostheses. Red and blue color bars indicate 95% confidence intervals.

Supplemental Figure 4. Cumulative incidence curves of severe tricuspid stenosis after tricuspid valve replacement with porcine and pericardial prostheses. Red and blue color bars indicate 95% confidence intervals.
STRUCTURAL VALVE DETERIORATION

CUMULATIVE INCIDENCE

AT RISK
542  249  165  101  70  49
144  88   59  33  27  18

Porcine  Pericardial

Gray P=0.8

POSTOPERATIVE YEARS
Survival analysis of porcine and pericardial mechanical heart valves.

Log Rank P = 0.2

Survival percentage drops over time, with distinct curves for porcine and pericardial valves.

At risk numbers:
- 542 (Porcine)
- 261 (Porcine)
- 176 (Porcine)
- 107 (Porcine)
- 74 (Pericardial)
- 30 (Pericardial)
- 19 (Pericardial)

Postoperative years:
- 0
- 2.5
- 5
- 7.5
- 10
- 12.5
STRUCTURAL VALVE DETERIORATION

AT RISK

542 249 165 101 70 49
144  88  59  33  27  18

Porcine Pericardial

Gray P=0.8

CUMULATIVE INCIDENCE

POSTOPERATIVE YEARS
TRICUSPID REOPERATION FOR STRUCTURAL VALVE DETERIORATION

AT RISK
542  261  174  105  73  51
144  93   61  36  29  19

Porcine  Pericardial

Gray P=0.06
STRUCTURAL VALVE DETERIORATION

Gray P=0.1

N At Risk

<table>
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<th>Valve Type</th>
<th>N</th>
<th>At Risk</th>
<th>Postoperative Years</th>
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<tbody>
<tr>
<td>BIOCOR</td>
<td>42</td>
<td>9</td>
<td>5</td>
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<tr>
<td>MOSAIC</td>
<td>292</td>
<td>61</td>
<td>5</td>
</tr>
<tr>
<td>CE PERICARDIAL 145</td>
<td>129</td>
<td>68</td>
<td>27</td>
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<tr>
<td>CE PORCINE</td>
<td></td>
<td>30</td>
<td>46</td>
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<td>HANCOCK</td>
<td>65</td>
<td>17</td>
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<td>EPIC</td>
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LATE DURABILITY OF PORCINE AND PERICARDIAL PROSTHESES IN TRICUSPID VALVE REPLACEMENT

Brittany A. Zwischenberger, MD, MHSc
Assistant Professor, Duke University
April 29, 2024

Jacob Schroder MD, Carmelo Milano MD, Jeffrey Gaca MD, Keith Gay RS, Donald Glenn MD
SEVERE TRICUSPID REGURGITATION

AT RISK
542  261  173  106  74  54
144  91  59  35  29  19

CUMULATIVE INCIDENCE

Porcine  Pericardial

Gray P=0.7

POSTOPERATIVE YEARS