Winter 2-1-2011

Mechanical Versus Bioprosthetic Valve Replacement in Valvular Heart Disease: A Systematic Review

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Mechanical Versus Bioprosthetic Valve Replacement in Valvular Heart Disease: A Systematic Review

Abstract
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Bioprosthetic valves are made from valves of a pig or pericardium of a cow. Bioprosthetic valves are not as durable and have a shorter lifespan.

The main purpose of this systematic review is to compare the long-term outcome in mechanical and bioprosthetic valve replacement. The Grading of Recommendation Assessment Development and Evaluation (GRADE) tool will be used to evaluate the quality of evidence.

Methods: An extensive literature search was performed using PubMed, Medline, Cochrane Systematic Reviews, and CINHAL. Two randomized control trials and one observational study met the inclusion and exclusion criteria.

Results: Better survival with a mechanical valve implantation in AVR and similar survival with bioprosthetic and mechanical valve replacement in MVR was reported in two studies, while the third study reported similar survival in both valve groups. The two randomized control trials reported higher occurrence of bleeding in mechanical valve recipients. The observational study reported higher occurrence in bleeding in mechanical valve recipient for AVR. There were no differences in the number of embolism or endocarditis cases between the two valve groups.

Conclusion: Survival was reported to be similar in both valve type and position except in one study where there was better survival with a mechanical valve implantation in AVR.

Degree Type
Capstone Project

Degree Name
Master of Science in Physician Assistant Studies

Keywords
Tissue or bioprosthetic or biological valve, mechanical valve, valve replacement

Subject Categories
Medicine and Health Sciences

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Mechanical Versus Bioprosthetic Valve Replacement in Valvular Heart Disease: A Systematic Review

Thang Yang

A course paper presented to the College of Health Professions in partial fulfillment of the requirements of the degree of

Master of Science

Pacific University School of Physician Assistant Studies

February, 2011

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Clinical Graduate Project Instructors: Torry Cobb, DHSc, MPH, PA-C & Annjanette Sommers MS, PA-C
Acknowledgements

To my family, thank you for your unconditional love, support and encouragement. I am truly blessed to have such a wonderful family.

To my Kong, thank you for your love and patience. I could not have accomplished my dream of becoming a Physician Assistant without you.
ABSTRACT

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Keywords: Tissue or bioprosthetic or biological valve, mechanical valve, valve replacement
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INTRODUCTION

Background

Valvular heart disease is a congenital or acquired condition that involves injury or a defect to any one of the four heart valves: the mitral (MV), aortic (AV), tricuspid (TV) and pulmonary (PV). Normal heart valves open and close in a timely manner, which allows blood to flow forward and fill each chamber before the next contraction. In valvular heart disease, the heart performs insufficiently because the valves are unable to open (stenotic) or close (prolapse/insufficient) properly. The mitral and aortic valves are most frequently affected by valvular heart disease. In aortic stenosis (AS), the valve is unable to open completely due to narrowing and is most commonly caused by progressive wear and tear and scarring from rheumatic fever as a child. In mitral valve prolapse (MVP), the valves are unable to close completely. The condition may be inherited; otherwise the cause is unknown for most people. Mild valvular heart disease can be asymptomatic and non-problematic. Moderate to severe valvular heart disease can cause symptoms such as fatigue, shortness of breath, weakness, palpitation and lightheadedness, which can lead to a more serious condition and likely require treatment (Bonow et al., 2006).

Treatment for valvular heart disease depends upon the degree of the disease. For example, medications can be effective for patients with mild valvular regurgitation, but are ineffective in changing the structure and will not resolve the mechanical problems in AS. In mild cases, medication may be used for treatment and for severe cases, surgery is the preferred intervention (Bonow et al., 2006). Surgical interventions involve percutaneous balloon valuloplasty and valvotomy, but valve replacement by a
mechanical or bioprosthetic valve is the standard protocol for patients with severe
valvular heart disease (Bonow et al., 2006).

Mechanical valves are made from carbon, Teflon, Dacron, titanium and polyester
and are very durable. The current designs for the aortic and mitral positions include
ball-and-cage valves, single tilting disc prostheses, and bileaflet prostheses. The
bileaflet prostheses are manufactured by St. Jude, CarboMedics, ATS Medical, and On-
X and are the most commonly used mechanical prostheses in the aortic position
(Bonow et al., 2006). They are unlike the other mechanical prostheses because they
are mechanically stable and are hemodynamically efficient (Jaron et al., 2008).

Mechanical prosthetic valves are intended to last a lifetime, decreasing the risk of
reoperation. A disadvantage to mechanical valves is the risk of thromboembolism.
Warfarin, an anticoagulant must be taken concurrently for the duration of the patient’s
life. Warfarin requires constant monitoring of the prothombin time and international
normalized ratio (INR) which requires frequent postoperative follow-up appointments.
Also, because warfarin is a blood thinner, the risk of bleeding is higher (Pick, A., n.d.).

Bioprosthetic valves are made from actual valves of a pig (porcine) or
pericardium of a cow (bovine). The pericardium of the cow is processed into the proper
shape of a valve. Porcine heterografts and bovine pericardial valves are similar in
lifespan when comparing structural valve deterioration. The bioprosthetic valves are
treated chemically for transplantation to the human heart. Bioprosthetic valves are not
as durable, have a shorter lifespan and are more susceptible to calcification than human
and mechanical valves (Pick, A., n.d.). Risk for reoperation is higher for younger
patients receiving a bioprosthetic valve. The advantage to bioprosthetic valves is, that
unlike mechanical valves, they do not require life long anticoagulant therapy. Selection on the type of prosthetic valve is based on the age of the patient, valve position, comorbidity, and the risks and benefits of anticoagulation (Bonow et al., 2006). Although, the selection process has some defined basis, much of the decision depends on the logic and experience of the surgeon.

The current recommendation by the American Heart Association/American College of Cardiology (AHA/ACC) is to perform a mechanical prosthesis for aortic valve replacement (AVR) in patients with a mechanical valve in the mitral or tricuspid position already in place or who is under 65 years old without contraindication to anticoagulants. In addition, a mechanical prosthesis should be considered for mitral valve replacement (MVR) in patients under 65 years old with long-standing atrial fibrillation (Bonow et al., 2006). Bioprosthetic valves are recommended in the aortic position in patients who are over 65 years old and thromboembolism risk free. In the mitral position, bioprosthetic valves should be considered in patients who are over 65 years old or are unable to take anticoagulants (Bonow et al., 2006). The patient may choose either valve against the recommendations of the AHA/ACC guidelines or surgeon, as long as the risk of anticoagulant therapy versus reoperation has been discussed in detail with the patient.

The Society of Thoracic Surgeons (STS) National Cardiac Surgery Database reported close to 63,000 AV replacements performed from 1999 to 2004. The database also reported that the in-hospital mortality by year ranged from 2.9% to 3.6% while the national average in-hospital mortality rate for primary isolated AVR was 3% to 4% and 6% to 7% in combined AVR and coronary bypass graft (CABG). The use of mechanical valves in the aortic position decreased from 41% to 33% during 1999 to 2002, while the
use of bioprosthetic valves increased from 50% to 65% (The Society of Thoracic Surgeons, n.d.).

In addition, STS reported over 20,000 MVR performed from 1999-2004. Mortality rates were 5.4% to 6.4%. Mechanical valves were used more frequently than bioprosthetic valves in MVR. In patients older than 65, the mortality for isolated MVR was 14.1% and in low-volume centers, the mortality rate reached 20.5%. Patients undergoing MVR with CABG averaged 3,637 per year and had a mortality rate from 7% to 8.7% (The Society of Thoracic Surgeons, n.d.). Bioprosthetic valves were used more frequently in these patients.

In more recent data, there were 8,510 isolated AV replacements with 2.6% in-hospital mortality, 6,429 combined AVR and CABG with 4.1% in-hospital mortality, 1,834 isolated MVR with 4.7% in-hospital mortality, and 905 combined MVR and CABG procedures performed in 2009 (The Society of Thoracic Surgeons, n.d.). Although STS is not an inclusive directory but voluntary, it gives the best approximation currently available.

Purpose of the Study

The main purpose of this systematic review is to evaluate and compare the long term outcomes between mechanical and bioprosthetic valve replacement in patients with valvular heart disease. The outcomes will include incidence of mortality, reoperations, bleeding, thromboembolism, and endocarditis. The Grading of Recommendation Assessment Development and Evaluation (GRADE) tool developed by the GRADE Working Group will be used to evaluate the quality of evidence (GRADE Working Group, n.d.).
METHODS

An extensive literature search was performed using PubMed, Medline, Cochrane Systematic Reviews, and CINHAL. These databases were accessed through the Pacific University Library system. The search was limited to human subjects, the English language, full text articles and articles published from 2000 to 2011. In the PubMed database, the keywords searched included “valve replacement”, “mechanical valve” and “tissue, bioprosthetic, or biological valve.” All keywords were searched individually and in combination. The results included 158 articles. In the Cochrane Systematic Review, Medline and CINAHL databases, the keywords searched included “mechanical valve” and “tissue, bioprosthetic, or biological valve” and resulted in 3, 43 and 22 articles, respectively. Duplicate articles, narrative reviews, editorials and letters to editors were excluded. Only articles that investigated bioprosthetic and mechanical valve replacements in the mitral and aortic valve position and included a full range of adult participates were reviewed in this study.

RESULTS

The literature search resulted in one observational study and two randomized controlled trials.

Khan et al.

An observational study by Khan et al. retrieved data from a computerized database, where the study enrolled patients who had undergone an aortic, mitral or combined aortic and mitral valve replacement with a bioprosthetic (Hancock, Carpentier-Edwards porcine, or Carpentier pericardial) or St. Jude Medical bileaflet...
mechanical valve at the Cedar-Sinai Medical Center in Los Angeles, CA during and after 1976. The study excluded patients who received a homograft or a combination of both mechanical and porcine valves and who had any prior valve replacement. These limitations resulted in a total of 2,533 patients. The purpose of the study was to provide long-term outcomes on the results of prosthetic valve replacement. Data was collected by mailed questionnaire and telephone calls. Sixty-six patients (2.6%) were lost to follow-up. No information was given for reason to loss of follow-up.

There were 1340 patients who received a mechanical valve and 1193 patients who received a bioprosthetic valve. Five hundred and ninety-one patients who received a mechanical valve and 666 patients who received a bioprosthetic valve underwent CABG procedure concurrently.

The operative mortality was 106 (7.9%) and 117 (9.8%) for mechanical and bioprosthetic valve, respectively. Operative mortality included patients who died anytime during their hospitalization before the surgery and within 30 days of all the procedure. Deaths within 30 days of reoperation were also included. Postoperative mortality included 1,132 deaths, 564 in mechanical valve recipients and 568 in bioprosthetic valve recipients. When analyzed separately, survival was better in mechanical valve recipients for the aortic (p-value=0.02) and mitral (p-value=0.03) positions. Because the bioprosthetic valve recipients were on average more than 7 years older, grouping of patients on the basis of age and valve position was performed. The end result is similar survival in both valve groups for AVR and MVR.

Reoperation in mechanical valve recipients at five, 10, and 15 years was 1.45%, 1.75% and 1.82%, respectively. Reoperation in bioprosthetic valves at five, 10 and 15
years was 1.89%, 10.5% and 21.4%, respectively. The risk for reoperation was similar at 5 years, but notably different by 10 and 15 years between mechanical and bioprosthetic valves.

Eighty-six percent of bioprosthetic valve recipients and 85% of mechanical valve recipients were found to be free of hemorrhage at 15 years. Patients who received a mechanical valve in the aortic position had a higher incidence of hemorrhage (p-value<0.001), while the rates were similar in the mitral position for both mechanical and bioprosthetic valves.

Seventy-one percent of bioprosthetic valve recipients and 74% of mechanical valve recipients were found to be free of embolic events at 15 years, regardless of valve position. Twenty-four mechanical valve recipients and 37 bioprosthetic valve recipients reported postoperative endocarditis.

Hammermeister et al.

The second study was a randomized controlled trial by Hammermeister et al. (2001). Five hundred and seventy-five male patients were randomly selected for a Bjork-Shiley spherical disc mechanical prosthesis or Hancock porcine bioprosthetic valve in a single AVR or MVR from 1977 to 1982. The purpose of the study was to provide a long-term comparison and valve related complications between mechanical and bioprosthetic valve. Data was collected by mailed questionnaire and telephone calls. Sixteen patients were lost to follow-up (3%). No information was given for reason to loss of follow-up.
Mortality at 15 years for patients who had undergone AVR was 66±3% in mechanical valve recipients and 79±3% in bioprosthetic valve recipients (p-value=0.02). For MVR, the mortality rate was 81±4% for mechanical prosthetic valve recipients and 79±4% for bioprosthetic valve recipients (p-value=0.30).

The percentage for reoperation in AVR was 29±5% with a bioprosthetic valve and 10±3% with a mechanical prosthetic valve (p-value=0.004). In MVR, the reoperation rate was 50±8% with a bioprosthetic valve and 25±6% with a mechanical prosthetic valve (p-value=0.15).

Bleeding was reported higher in patients with a mechanical valve than bioprosthetic valve for the aortic (51±4% versus 30±4%, p-value=0.0001) and mitral positions (53±7% versus 31±6%, p-value=0.01).

Incidence of embolism were 18% in each valve group for AVR (p-value=0.66). For MVR, embolism was reported at 18% of mechanical prosthetic valve recipients and 22% of bioprosthetic valve recipients (p-value=0.96).

Endocarditis for AVR in mechanical and bioprosthetic valve recipients were 15% and 7%, respectively (p-value=0.45). Eleven percent of mechanical valve recipients and 17% of bioprosthetic valve recipients in the mitral valve position reported endocarditis (p-value=0.37).

Oxenham et al.

The second randomized controlled trial reviewed was titled, “Twenty year comparison of a Bjork-Shiley tilting disc mechanical heart valve with porcine bioprosthesis.” The study was performed in the United Kingdom and was first published
in 1991, originally titled “Twelve year comparison of a Bjork-Shiley mechanical heart valve with porcine bioprosthesis.” This more recent study, published in 2003 compared survival and outcomes in patients receiving mechanical or bioprosthetic valves after extending the follow-up period from 12 to 20 years. The study included the same participates and the surviving 254 patients from the original study were followed up an additional 545 times.

From 1975 to 1979, 533 patients were randomized to receive either a mechanical (Bjork-Shiley) or bioprosthetic (Hancock or Carpentier Edward porcine) prosthesis. Two hundred and sixty-six underwent a porcine valve replacement and 267 underwent a Bjork-Shiley mechanical valve replacement. The primary outcomes were death, bleeding, embolism, reoperation and endocarditis. Data was collected from follow-up hospital visits, mailed questionnaires, hospital records and family doctors. Six patients were lost to follow-up (1.12%). No information was given for reason to loss of follow-up.

After a mean of 20 years follow-up, there were a total of 404 deaths. There were 202 deaths in Bjork-Shiley valve recipients and 202 deaths in porcine valve recipients. Mortality included patients who underwent reoperation. Survival in Bjork-Shiley prostheses were similar to porcine prosthesis for both AVR (p-value=0.57) and MVR (p-value=0.41).

There were 22 recipients who required reoperation (27%) for Bjork-Shiley valve recipient and 54 who required reoperation (12%) for porcine valve, p-value <0.0001.

One hundred and seventy-five cases of bleeding were reported in 127 patients, of which, 114 were major bleeds in 87 patients (p-value = 0.007). Major bleeds were
significantly higher in Bjork-Shiley mechanical valve recipients in MVR (p-value = 0.044) and AVR (p-value = 0.021).

One hundred and fifty-eight cases of embolism were reported in 121 patients. There was no difference in episodes of embolism for AVR (p-value = 0.13) and MVR (p-value = 0.32) between the Bjork Shiley mechanical and porcine valve recipients. There were 32 episodes of bacterial endocarditis in 25 patients and in 7 patients, endocarditis occurred twice (p-value = 0.60). Endocarditis cases were similar in both Bjork Shiley mechanical and porcine valve recipients for AVR (p-value = 0.71) and MVR (p-value = 0.40).

DISCUSSION

Khan et al.

In the first study, patients who underwent bioprosthetic and mechanical valve implantations for AVR and MVR reported having similar survival over a 20 year follow-up period. Reoperation was similar at 5 years between mechanical and bioprosthetic valves, but was notably different by 10 and 15 years. Bioprosthetic valve recipients had a higher rate of reoperation especially in patients who underwent double bioprosthetic valve replacement. The risk of reoperation increased progressively with time in isolated bioprosthetic MVR and AVR recipients. There was a higher incidence of bleeding in mechanical valve recipients in the aortic position, but incidence of bleeding in bioprosthetic and mechanical valve recipients was similar for MVR. Reported cases of embolism and endocarditis for AVR and MVR were insignificantly different in bioprosthetic and mechanical valve recipients.
Hammermeister et al.

In the second study, survival was similar in bioprosthetic and mechanical valve recipients in the mitral position, but mechanical valve recipients in the aortic position had better survival. Reoperation was higher in patients who underwent a bioprosthetic valve implantation in the aortic position. In the mitral position, reoperation was similar. Bleeding was reported more frequently in mechanical valve recipients in both aortic and mitral valve positions. Cases of embolism and endocarditis for AVR and MVR were insignificantly different in bioprosthetic and mechanical valve recipients.

Oxenham et al.

In the last study by Oxenham et al. (2003), overall survival was similar in both bioprosthetic and mechanical valve recipients for AVR and MVR after a mean follow-up of 20 years. In addition, Oxenham et al. (2003) reported survival with the original prosthesis was better in mechanical valves for MVR. Reoperation was higher in bioprosthetic valve recipients than mechanical valve recipients for AVR and MVR. Bjork-Shiley mechanical valve recipients reported higher incidence of bleeding than bioprosthetic valve recipients for AVR and MVR. Like the previous two studies by Khan et al. (2001) and Hammermeister et al. (2000), embolism and endocarditis cases were similar in numbers and insignificantly different in both bioprosthetic and mechanical valve recipients.

The quality of evidence of the three studies was examined using the GRADE classification system. The GRADE classification for quality of evidence was developed
in 2000 by a group of individuals whose interest was to improve the current grading system in grading the quality of evidence and strength of recommendations in studies (GRADE Working Group, n.d.). The quality of evidence is classified into one of four levels: very low, low, moderate, and high. The interpretation of each classification is as follows:

- **High quality** — Further research is very unlikely to change our confidence in the estimate of effect
- **Moderate quality** — Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
- **Low quality** — Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
- **Very low quality** — Any estimate of effect is very uncertain (Guyatt et al., 2008, 926).

Various factors may increase or decrease the quality of evidence and include study quality, consistency, directness, precision, publication bias, degree of magnitude, dose-response and confounders (GRADE Working Group, n.d.).

The GRADE classification tool was used to compare the long-term outcomes between bioprosthetic and mechanical valve replacements in valvular heart disease (Appendix, Table 1). Outcomes included mortality, reoperation, bleeding, embolism and endocarditis, in which the five outcomes were included in all three articles. Outcomes were analyzed by type of study. There were two randomized controlled trials, one by Hammermeister et al. (2000) and the other by Oxenham et al. (2003). In assessing the mortality outcome, the two randomized controlled trials had minimal loss to follow-up and consisted of at least a 15 year follow-up. The study design was significant and contributed to a high starting GRADE. In evaluating the study further, the GRADE was
downgraded due to inconsistency. The limitation to the study by Hammermeister et al. (2001) included the differences in the baseline of patient characteristics. Because it was a randomized control trial, it was impossible to divide the patients evenly by their characteristics. There were fewer mechanical valve recipients aged <50 years and more aged >70 years than porcine bioprosthetic valve recipients. In addition, a greater number of patients undergoing mechanical valve replacement had systemic hypertension. Oxenham et al. (2003) did not report significant difference in patient characteristics. In addition to the limitations, the incidence in mortality was inconsistent between the two studies. In the study by Oxenham et al. (2003), survival was similar in mechanical and bioprosthetic valve recipients for AVR and MVR. In contrast, Hammermeister et al. (2001) reported similar survival in bioprosthetic and mechanical valve recipients for AVR and MVR and better survival for mechanical valve recipients for AVR. For this reason, the GRADE of evidence for the mortality outcome in the two randomized control trials was downgraded to moderate.

In the observational study by Khan et al. (2001), there was lack of blinding and allocation concealment thus had a low starting GRADE level. A non-randomized study is often the result of surgical treatment as an intervention in a study. The lack of blinding and allocation concealment creates a potential for bias in valve selection. Thus, variables were adjusted in the survival analysis and the potential differences were discussed. Although dose response in the observational study was not measured, there was a large magnitude of evidence and all plausible confounders were identified. The result is a high quality GRADE of evidence for the survival outcome in this observational study.
The GRADE of evidence for the reoperation outcome was assessed similar to the mortality outcome. As discussed above, the outcomes were assessed separately by the type of study. The starting GRADE for the Hammermeister et al. (2000) and Oxenham (2003) studies were high because they were both randomized controlled trials. The baseline in patient characteristic varied in the two valve groups in the Hammermeister et al. (2000). There were inconsistencies in reoperation occurrences for the two randomized studies. Bioprosthetic valve recipients reported higher reoperation cases for AVR and MVR in the study by Oxenham et al. (2003). Hammermeister et al. (2000) described higher reoperation rates in bioprosthetic valve recipients for AVR, but similar reoperation rates in bioprosthetic and mechanical valve recipients for MVR. The GRADE of evidence for the survival outcome in the two randomized control trials was downgraded to moderate. In Khan et al. (2001), the starting GRADE was low due to the study being observational, but resulted in a high quality GRADE of evidence for the reoperation outcome for reasons discussed above.

In reviewing the bleeding outcome, the starting GRADE of evidence was high in the two randomized trials. The studies were consistent, direct, precise and had little to no publication bias. The resulting GRADE of evidence for the bleeding outcome was high in the two randomized trials. In the observational study, the starting and ending GRADE was low and high, respectively. The end result for the bleeding outcome in the observational and two randomized controlled studies were inconsistent. In the observation study, bleeding was more apparent in mechanical valve recipients for AVR and similar in bioprosthetic and mechanical valve recipients for MVR. In the two
randomized controlled trials, mechanical valve recipients reported higher incidence of major bleeding for both AVR and MVR.

For the embolism and endocarditis outcomes, the starting GRADE of evidence was high in the two randomized controlled trials and low in the observational study. The two randomized controlled trials were consistent, direct and precise without publication bias in evaluating the outcomes for embolism and endocarditis. Thus, the GRADE level did not change. The observational study had a high GRADE of evidence for the same reasons discussed above.

An overall high quality GRADE of evidence indicates a high confidence in the evidence found in this systematic review. “Further research is very unlikely to change our confidence in the estimate of effect (Guyatt et al., 2008, 926).”

CONCLUSION

The main purpose of this systematic review was to evaluate and compare the long term outcomes between mechanical and bioprosthetic valve replacement in patients with valvular heart disease. The outcomes included were occurrence of mortality, reoperation, bleeding, thromboembolism, and endocarditis. In the survival outcome, Khan et al. (2001) and Oxenham et al. (2003) demonstrated similar incidence in mechanical and bioprosthetic valve recipients for AVR and MVR. The third study by Hammermeister et al. (2002) reported better survival with a mechanical valve prosthesis for AVR and similar survival with bioprosthetic and mechanical valve prosthesis for MVR. Reoperation was higher in bioprosthetic valve recipients for AVR and MVR in the studies performed by Khan et al. (2001) and Oxenham et al. (2003). Hammermeister et al. (2000) reported higher reoperation in bioprosthetic valve recipients for AVR. In the
occurrence of bleeding, Oxenham et al. (2003) and Hammermeister et al. (2000) reported higher incidence in mechanical valve recipients for both AVR and MVR. Khan et al. (2001) reported higher occurrence of bleeding in mechanical valve recipients for AVR, while the occurrence between the two valve groups was similar in MVR. Across all three studies, there were no differences in the occurrence of embolism or endocarditis between bioprosthetic and mechanical valve recipients.

Based on the evidence of this systematic review, the implications and recommendations for practice is to consider a mechanical prosthetic valve in patients, who have a life expectancy of at least 10 years and do not have contraindication to anticoagulant therapy. Although the necessity of lifelong anticoagulant use may be a determining factor in selecting the type of valve, Oxenham et al. (2003) points out that patients with cardiac and valvular heart disease often develop coexisting conditions such as atrial fibrillation, which will itself require anticoagulants. Bioprosthetic valves should be considered in patients, who have a life expectancy of less than 10 years or have contraindication to anticoagulant therapy.

Because there were inconsistencies in the incidence of mortality, bleeding and reoperation across the three studies, further research is recommended in these outcomes. Clearly, the risk of bleeding is higher in mechanical valve recipients and the risk of reoperation is higher in bioprosthetic valve recipients, but research comparison in valve position is needed for these results.

In addition to the inconsistencies in the outcomes, another limitation is the combination of different types of mechanical and bioprosthetic valves used across the three studies. Khan et al. (2001) used bileaflet mechanical valves and Hammermeister
et al. (2000) and Oxenham et al. (2003) used tilting disc mechanical valves. Bileaflet prostheses have been reported to be mechanically stable and hemodynamically efficient compared to other mechanical valves (Jaron et al., 2008). The reasons for why the tilted disc mechanical valves were used in two of the three studies were not discussed.

For bioprosthetic valves, the Carpentier-Edwards porcine, Hancock standard or modified orifice, and Carpentier-Edwards pericardial valves were all used in the study by Khan et al. (2001). Hammermeister et al. (2000) only employed the Hancock porcine valve. Oxenham et al. (2003) used two different types of porcine bioprostheses: the Carpentier-Edwards and Hancock porcine valves. The Carpentier-Edwards and Hancock porcine valves have been reported to have no significant differences in durability or other valve-related complications after 10 years of follow-up (Sarris, et al., 1993). The differences between Hancock porcine and Carpentier-Edward pericardial valves have not been studied extensively and are less clear. Oxenham et al. (2003) used Hancock porcine valves in the first two years of the study and switched to Carpentier-Edwards porcine valves due to “substantial cost advantage.” Otherwise, the authors failed to mention why the specific type of bioprosthetic valves was selected in the all three studies.

Further research may consider examining long-term outcomes in mechanical and bioprosthetic valves specific to valve material (porcine and bovine) and design. Future studies evaluating the differences between Hancock porcine and Carpentier-Edward pericardial valves may enhance the evidence as well. In addition, further research may
consider other types of bioprosthetic valves, such as aortic homograft, stentless valves or the Ross procedure.

A prospective valve recipient must consider the options in valve type and evaluate the associated risks and complications. The substantial portion of the evidence indicated similar survival in mechanical and bioprosthetic valve. The tradeoff is the risk of anticoagulant-related bleeding in mechanical valve recipients versus the risk of reoperation in bioprosthetic valve recipients.
REFERENCE


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<td>Oxenham et al.: highest incidence with bioprosthetic valves for AVR &amp; MVR; Hammermeister et al.: highest incidence in bioprosthetic valves for AVR</td>
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<td>Highest incidence with bioprosthetic valve for AVR &amp; MVR</td>
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<td></td>
<td>Bleeding</td>
<td>2 RCT</td>
<td>Oxenham et al. &amp; Hammermeister et al.: highest incidence in mechanical valves for AVR &amp; MVR</td>
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