Original Article

Long-term Outcomes Following Mechanical or Bioprosthetic Aortic Valve Replacement in Young Women

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ABSTRACT

Background: Studies performed to date reporting outcomes after mechanical or bioprosthetic aortic valve replacement (AVR) have largely neglected the young female population. This study compares long-term outcomes in female patients aged < 50 years undergoing AVR with either a mechanical or bioprosthetic valve.
Methods: In this propensity-matched study, we compared outcomes after mechanical AVR (n = 57) and bioprosthetic AVR (n = 57) between 2004 and 2018. The primary outcome of this study is survival. Secondary outcomes include the rate of reoperation, stroke, myocardial infarction, rehospitalization for heart failure, and incidence of serious adverse events. Outcomes were measured over 15 years, with a median follow-up of 7.8 years.
Results: In patients receiving a mechanical AVR vs a bioprosthetic AVR, overall survival at median follow-up was equivalent, at 93%. There is a lower rate of reoperation in patients receiving a mechanical

RÉSUMÉ

Contexte : Les études réalisées à ce jour portant sur le bilan après un remplacement mécanique ou bioprothétique de la valve aortique (RVA) ont largement négligé la population de jeunes femmes. Cette étude compare le pronostic à long terme chez les patientes âgées de moins de 50 ans qui subissent un RVA par une valve mécanique ou bioprothétique.
Méthodes : Dans cette étude d'appariement par score de propension, nous avons comparé les résultats après un RVA mécanique (n = 57) et un RVA bioprothétique (n = 57) entre 2004 et 2018. Le principal critère d'évaluation consiste en l'étude de la survie. Les critères d'évaluation secondaires comprennent le taux de réopération, d'accident vasculaire cérébral, d'infarctus du myocarde, de réhospitalisation pour insuffisance cardiaque et l'incidence des événements indésirables graves. Les critères d'évaluation ont été mesurés sur une période de 15 ans, avec un suivi médian de 7,8 ans.

Valvular heart disease continues to affect millions of people worldwide, having a significant impact on survival and quality of life.[1,2] Due to a lack of medical treatment for the majority of valvular heart disease cases, the burden of management falls on a surgical replacement. The 2 most commonly implanted prosthetic valve replacement constructs are mechanical and bioprosthetic. Mechanical valves are more durable than bioprosthetic valves but require lifelong anticoagulation treatment, contributing to the risk of bleeding, thromboembolic

events, and teratogenicity in women.[3] Consequently, bioprosthetic valves are used in > 80% of all aortic valve replacements.[4] Unfortunately, bioprosthetic valves are subject to structural valve deterioration, and they often require a repeat intervention to address a dysfunctional prosthetic valve. Long-term studies have demonstrated a time-dependent increase in rates of bioprosthetic valve failure, with younger age at implant being a significant predictor of structural valve degeneration.[5,6]

Several studies have been performed reporting outcomes after aortic valve replacement using both mechanical and bioprosthetic valve constructs.[4−11] These studies have tended to focus on an older population of patients (mean age > 65 years) and disproportionately represent males (> 65% of included patients). Thus, outcomes in young women have been largely neglected, spurring interest in developing sex-specific approaches to cardiovascular research and clinical care.[12] Thus far, sex-related differences have been identified in

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AVR vs a bioprosthetic AVR (1.8% vs 8.8%). The rate of new-onset atrial fibrillation was significantly higher in the mechanical AVR group vs the bioprosthetic AVR group (18.2% vs 7.3%). No significant difference was seen in the rate of serious adverse events.

Conclusions: These results provide contemporary data demonstrating equivalent long-term survival between mechanical and bioprosthetic AVR, with higher rates of new atrial fibrillation after mechanical AVR, and higher rates of reoperation after bioprosthetic AVR. These results suggest that either valve type is safe, and that preoperative assessment and counselling, as well as the follow-up, medical treatment and indications for intervention, must be a collaborative decision-making process between the clinician and the patient.

Résultats : Pour les patientes soumises à un RVA mécanique par rapport à un RVA bioprothétique, la survie globale au suivi médiane était équivalente à 93 %. Le taux de réopération est plus faible chez les patientes avec un RVA mécanique que chez celles soumises à un RVA bioprothétique (1,8 % contre 8,8 %). Le taux de fibrillation auriculaire d'apparition récente était significativement plus élevé dans le groupe ayant eu un RVA mécanique que dans le groupe ayant eu un RVA bioprothétique (18,2 % contre 7,3 %). Aucune différence significative n'a été observée concernant le taux d'événements indésirables graves.

Conclusions : Ces résultats fournissent des données actualisées démontrant une survie à long terme équivalente entre les RVA mécaniques et bioprothétiques, avec des taux plus élevés de fibrillation auriculaire d'apparition récente après une RVA mécanique, et des taux plus élevés de réopération après une RVA bioprothétique. Ces résultats suggèrent que chaque type de valve est sûr, et que l'évaluation et le counselling préopératoire, ainsi que le suivi, le traitement médical et les indications d'intervention, doivent être un processus de décision concerté entre le clinicien et le patient.

valve surgery, coronary surgery, and mechanical circulatory support.[13-17] These differences are particularly important in the young female population, for whom the decision between a mechanical and a bioprosthetic valve requires careful counselling and extensive consideration, especially for women who want to become pregnant following valve replacement.

Our objective was to compare long-term outcomes in female patients aged < 50 years undergoing aortic valve replacement (AVR) with either a mechanical or bioprosthetic valve, to characterize overall survival, rate of reoperation, and incidence of morbidity in each cohort.

Methods

Data source

The **A**lberta **P**rovincial **Pr**oject for **O**utcome **A**ssessment in **C**oronary **H**eart Disease (APPROACH) database, in addition to linkage to the discharge abstract database to detect events after discharge and at other hospitals, was used to obtain all data. The APPROACH database is a prospective data collection initiative that acquires detailed clinical information on all patients undergoing coronary angiography in Alberta, Canada. All research protocols were approved by the local research ethics board.

Study cohort

Included in this study were female patients aged < 50 years who underwent AVR with either a mechanical or bioprosthetic prosthetic valve at the Mazankowski Alberta Heart Institute in Edmonton, Canada between January 1, 2004, and September 16, 2018 (Fig. 1). Patients aged < 18 years or > 50 years, male patients, transplant recipients, and emergency surgeries were excluded from this cohort. Outcomes were measured over 15 years, with a median follow-up duration of 7.8 years.

Outcomes

The primary outcome of this study is survival. Secondary outcomes include the rate of reoperation, stroke, myocardial infarction (MI), rehospitalization for heart failure, and incidence of serious adverse events. All outcomes were collected during admission for the index procedure and after discharge, being identified based on admitting diagnosis for any readmission. Reoperation was defined as any redo AVR occurring after discharge. Stroke included both hemorrhagic and ischemic mechanisms. MI was defined as being diagnosed at readmission with a primary diagnosis of non-ST elevation MI or ST-elevation MI at any time after the index procedure. Serious adverse events collected in-hospital included new-onset atrial fibrillation (AF), permanent pacemaker or implantable cardiac defibrillator implantation, sepsis, and acute kidney injury.
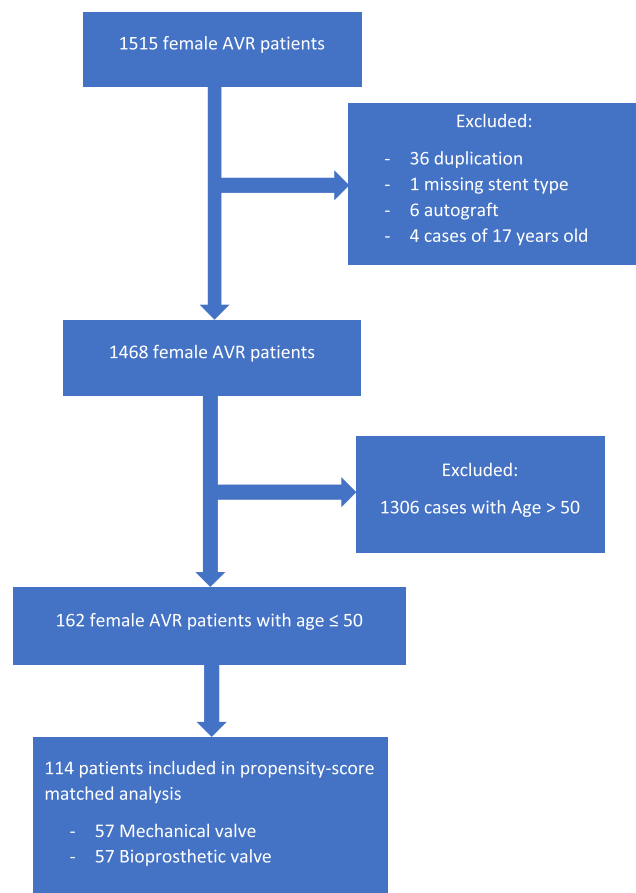
Statistical analysis

Continuous variables were expressed as mean ± SD or as median (interquartile range) if not normally distributed, and categorical variables were expressed as frequency (percent). Continuous variables were compared using the Student t test or Mann-Whitney U test in cases of non-normal distribution. Categorical variables were compared with the χ^2 test or the Fisher exact test, as appropriate. Missing values in body mass index (8%) were filled with the mean of the non-missing observations. The direct comparisons of distinct groups may be misleading in nonrandomized studies because the groups generally differ systematically. To obtain a cohort of patients with similar baseline characteristics, we used the Rosenbaum and Rubin propensity score—matching technique.[18] Formatting... please wait. The propensity score was estimated with the use of a multivariable logistic regression model with valve type as the dependent variable and all the baseline characteristics as covariates including age, body mass index, hypertension, dyslipidemia, diabetes mellitus, congestive heart failure, pulmonary disease, liver disease, gastrointestinal disease, malignancy, peripheral vascular disease, cerebrovascular disease, current smoker, chronic kidney disease, dialysis, prior MI, prior percutaneous coronary intervention, prior coronary artery bypass grafting, and ejection fraction. Greedy matching techniques without replacement and a caliper width equal to

0.05 were applied to match young female patients 1:1 who were implanted with mechanical valves to patients who were implanted with bioprosthetic valves. A histogram was used to evaluate the balance after propensity-score matching. After the match, Kaplan-Meier curves and log-rank tests were used to determine if there were statistically significant differences in the primary outcome between young female recipients of mechanical and bioprosthetic valves. Survival analyses with competing risk were performed for the nonfatal secondary outcomes. Gray's tests were used to test the difference of cumulative incidence curves. Statistical analysis was performed using the SPSS software version 24 (SPSS, Chicago, IL) and SAS 9.4. A P value < 0.05 was considered to indicate statistical significance.

Results

Study population

The study sample included 162 consecutive female patients aged < 50 years who underwent either mechanical or bioprosthetic AVR at the Mazankowski Alberta Heart Institute in Edmonton, Canada between January 1, 2004, and September 16, 2018 (Fig. 1). Of these patients, 66 underwent mechanical AVR, and 96 underwent bioprosthetic AVR. Baseline demographic data before and after propensity-score matching are summarized in Table 1. Significant statistical


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┌─────────────────────────────────┐
│   1515 female AVR patients      │
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              │
              │      ┌──────────────────────────┐
              │      │  Excluded:               │
              ├─────▶│  - 36 duplication        │
              │      │  - 1 missing stent type  │
              │      │  - 6 autograft           │
              │      │  - 4 cases of 17 years old│
              │      └──────────────────────────┘
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│   1468 female AVR patients      │
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              ├─────▶│  Excluded:               │
              │      │  1306 cases with Age > 50│
              │      └──────────────────────────┘
              ▼
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│  162 female AVR patients with   │
│  age ≤ 50                       │
└─────────────────────────────────┘
              ▼
┌─────────────────────────────────┐
│  114 patients included in       │
│  propensity-score matched       │
│  analysis                       │
│   - 57 Mechanical valve         │
│   - 57 Bioprosthetic valve      │
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Figure 1. Study population. AVR, aortic valve replacement.

differences between groups before propensity-score matching included a higher prevalence of the pulmonary disease in the mechanical AVR group, with trends toward more liver disease, malignancy, and cerebrovascular disease in the bioprosthetic AVR group. The indications for mechanical and bioprosthetic valves can be variable; thus, comparing these groups before propensity-score matching would not be valid. Table 1 summarizes the baseline characteristics after propensity matching 114 patients (57 in each group) and demonstrates that the groups were evenly balanced based on prognostic factors. Of these patients, 24 (21.0%) were between the ages of 18 and 30 years, 27 (23.7%) were between the ages of 31 and 40 years, and 63 (55.3%) were between the ages of 41 and 50 years.

Operative characteristics for the propensity score–matched cohort are summarized in Table 2. Isolated AVR was less common in the mechanical AVR group vs the bioprosthetic AVR group (29.8% vs 40.4%, $P = 0.239$). The most common indication for AVR was aortic stenosis in 33 (28.9%), followed by congenital aortic stenosis in 20 (17.5%), and aortic regurgitation in 19 (16.7%). Procedure time, cardiopulmonary bypass time, and cross-clamp time did not vary considerably between the mechanical and bioprosthetic AVR groups. Table 3 summarizes the specific devices implanted for both cohorts. The most commonly implanted devices in the bioprosthetic AVR group were from the CE Perimount line (Edwards, Irvine, CA) (n = 29; 50.8%) followed by the Medtronic Freestyle (Medtronic, Dublin, Ireland)(n = 23; 40.4%). The most commonly implanted device in the mechanical AVR group was the On-X (Cryolife, Atlanta, GA) (n = 23; 40.4%), followed by the SJM Heart Valve (St. Jude Medical, St. Paul, MN) (n = 14; 24.6%).

Outcomes

Primary outcomes, secondary outcomes, and in-hospital outcomes are reported in Table 4. In our primary outcome of survival, in patients receiving a mechanical vs a bioprosthetic AVR, survival at 30 days was 98.2% vs 100% ($P = 0.317$), survival at 1 year was 96.5% vs 98.2% ($P > 0.546$), and overall survival at median follow-up of 7.8 years was 93% vs 93% ($P = 0.885$; Fig. 2). There was a trend toward a lower rate of reoperation in patients receiving a mechanical vs a bioprosthetic AVR (1.8% vs 8.8%, $P = 0.216$; Fig. 3). The etiology of reoperation in the mechanical AVR group was for thrombosis of the mechanical valve (n = 1), and in the bioprosthetic AVR group, for structural valve degeneration (n = 5; Supplemental Table S1). Readmission due to bleeding was defined by gastrointestinal or intracranial bleeding. In the mechanical group, there were 2 patients with intracranial bleeding (3.5%), and 4 with gastrointestinal bleeding (7.0%). In the tissue valve group, there were 3 with intracranial bleeding (5.2%), and none with gastrointestinal bleeding ($P = 0.297$). Incidence of stroke did not differ between the mechanical and bioprosthetic AVR groups (3.5% vs 5.3%, $P = 0.774$), and the rate of MI was higher in the mechanical AVR group compared to the bioprosthetic group, but the difference was not statistically significant (3.5% vs 0%, $P = 0.118$; Fig. 3). Finally, there was a trend toward a lower rate of readmission for heart failure in patients receiving a mechanical vs a bioprosthetic AVR (7% vs

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Table 1. Baseline characteristics before and after propensity-score matching

Demographics	Mechanical, n = 66	Bioprosthetic, n = 96	P	Standardized difference†	Mechanical, n = 57	Bioprosthetic, n = 57	P	Standardized difference
Age, y	39.4 ± 8.9	39.0 ± 9.6	0.797	0.042	38.2 ± 8.9	39.8 ± 9.7	0.377	−0.166
Age groups			0.822	0.091			0.393	−0.272
18 ≤ age ≤ 30	13 (19.7)	22 (22.9)			13 (22.8)	11 (19.3)		
30 < age ≤ 40	16 (24.2)	20 (20.8)			16 (28.1)	11 (19.3)		
40 < age ≤ 50	37 (56.1)	54 (56.3)			28 (49.1)	35 (61.4)		
BMI, kg/m^2	28.5±8.2	28.7±7.8	0.898	−0.021	28.5±7.9	29.0±8.4	0.746	−0.061
Hypertension	20 (30.3)	30 (31.3)	0.898	−0.021	17 (29.8)	21 (36.8)	0.427	−0.149
Dyslipidemia	20 (30.3)	34 (35.4)	0.498	−0.109	16 (28.1)	19 (33.3)	0.542	−0.114
Diabetes mellitus	3 (4.5)	4 (4.2)	0.907	0.019	2 (3.5)	3 (5.3)	0.647	−0.086
Heart failure	14 (21.2)	22 (22.9)	0.798	−0.041	14 (24.6)	13 (22.8)	0.826	0.041
Pulmonary disease	23 (34.8)	20 (20.8)	0.047	0.317	18 (31.6)	15 (26.3)	0.536	0.116
Liver disease	1 (1.5)	4 (4.2)	0.338	−0.160	1 (1.8)	2 (3.5)	0.558	−0.110
GI disease	5 (7.6)	8 (8.3)	0.862	−0.028	4 (7.0)	5 (8.8)	0.728	−0.065
Malignancy	0 (0.0)	3 (3.1)	0.147	−0.254	0 (0.0)	0 (0.0)	NA	0
Peripheral vascular disease	0 (0.0)	1 (1.0)	0.406	−0.145	0 (0.0)	0 (0.0)	NA	0
Cerebrovascular disease	2 (3.0)	7 (7.3)	0.245	−0.194	2 (3.5)	3 (5.3)	0.647	−0.086
Current smoker	28 (42.4)	31 (32.3)	0.188	0.211	24 (42.1)	23 (40.4)	0.849	0.036
Chronic kidney disease	2 (3.0)	1 (1.0)	0.356	0.141	1 (1.8)	1 (1.8)	1	0
Dialysis	2 (3.0)	2 (2.1)	0.703	0.060	1 (1.8)	1 (1.8)	1	0
Prior MI	1 (1.5)	1 (1.0)	0.789	0.042	0 (0.0)	1 (1.8)	0.315	−0.190
Prior CABG	0 (0.0)	0 (0.0)	NA	0	0 (0.0)	0 (0.0)	NA	0
Prior PCI	2 (3.0)	2 (2.1)	0.703	0.060	1 (1.8)	2 (3.5)	0.558	−0.110
Ejection fraction, %			0.658	−0.192			0.918	−0.109
< 35	1 (1.5)	3 (3.1)			1 (1.8)	1 (1.8)		
35−50	14 (21.2)	15 (15.6)			12 (21.1)	14 (24.6)		
> 50-	45 (68.2)	72 (75.0)			39 (68.4)	36 (63.2)		
Unavailable	6 (9.1)	6 (6.3)			5 (8.8)	610.5)		

All values are mean ± SD or n (%).

BMI, body mass index; CABG, coronary artery bypass grafting; GI, gastrointestinal; MI, myocardial infarction; NA, not available; PCI, percutaneous coronary intervention.

19.3%, $P = 0.138$; Fig. 3). No significant differences were seen in the rate of permanent pacemaker implantation, implantable cardioverter-defibrillator implantation, sepsis, or acute kidney injury (all $P > 0.05$). Time to extubation, intensive-care unit length of stay, and hospital length of stay did not vary considerably between the mechanical and bioprosthetic AVR groups. The rate of new-onset AF was significantly higher in the mechanical AVR group vs the bioprosthetic AVR group (18.2% vs 7.3%, $P = 0.034$). The postoperative AF experienced in our cohort was transient in 15 of 19 (78.9%) and sustained at 3-month follow-up on electrocardiogram in 4 of 19 (21.1%) requiring long-term anticoagulation treatment. We examined whether new-onset AF developed during hospitalization is a confounder between valve type (mechanical vs bioprosthetic) and the long-term outcomes, using Cox proportional hazard

Table 2. Operative characteristics in the propensity-matched cohort

Operative characteristic	Mechanical, n = 57	Bioprosthetic, n = 57	P
Procedure category			0.645
Isolated AVR	17 (29.8)	23 (40.4)	
AVR + MVR	11 (19.3)	8 (14)	
AVR + PVR	2 (3.5)	1 (1.8)	
AVR + PVR + TVR	0 (0.0)	1 (1.8)	
AVR + CABG	2 (3.5)	1 (1.8)	
AVR + CABG + MVR	0 (0.0)	1 (1.8)	
AVR + others	25 (43.9)	22 (38.6)	
Etiology			0.178
Aortic stenosis	16 (28.1)	17 (29.9)	
Aortic regurgitation	12 (21.1)	7 (12.3)	
Congenital aortic stenosis	12 (21.1)	8 (14.0)	
Endocarditis	2 (3.5)	8 (14.0)	
Rheumatic	3 (5.3)	9 (15.8)	
Prosthetic valve dysfunction	8 (14.0)	6 (10.5)	
Others	4 (7.0)	2 (3.5)	
Procedure times, h	4.6 ± 1.5	4.4 ± 1.5	0.456
CPB times, min	162.3 ± 68.6	154.5 ± 65.5	0.545
X-clamp times, min	122.7 ± 54.3	121.0 ± 53.2	0.877

All values are mean ± SD or n (%). AVR, aortic valve replacement; CABG, coronary artery bypass grafting; CPB, cardiopulmonary bypass; MVR, mitral valve replacement; PVR, pulmonary valve replacement; TVR, tricuspid valve replacement; X-clamp, cross-clamp.

Table 3. Implanted devices

Implanted device	n (%)
Bioprosthetic	
CE Perimount Magna Ease Pericardial Aortic-ThermaFix (Edwards, Irvine, CA)	11 (19.3)
CE Perimount Pericardial Aortic (Edwards)	2 (3.5)
CE/EL Peri-mount/cardial (Edwards)	6 (10.5)
CE/EL Pericardial Magna (Edwards)	10 (17.5)
Medtronic Freestyle (Medtronic, Dublin, Ireland)	1 (1.8)
Medtronic Freestyle-Root (Medtronic)	22 (38.6)
SJM Trifecta (St. Jude Medical, St. Paul, MN)	1 (1.8)
Sorin Group Freedom Solo Stentless Pericardial Valve (Sorin, Saluggia, Italy)	3 (5.3)
Medtronic Mosaic Porcine (Medtronic)	1 (1.8)
Mechanical	
CarboMedics Mech (LivaNova, London, UK)	2 (3.5)
On-X Aortic Valve (Cryolife, Atlanta, GA)	20 (35.1)
On-X Valve (Cryolife)	3 (5.3)
SJM Heart Valve (St. Jude Medical)	14 (24.6)
SJM Masters Series (St. Jude Medical)	11 (19.3)
SJM Masters Series Heart Valve (St. Jude Medical)	2 (3.5)
SJM Regent Valve (St. Jude Medical)	4 (7.0)
Sorin Top Hat Supra-Annular Aortic Valve (Sorin)	1 (1.8)

regression. We found that AF did not affect the long-term outcomes of death ever, MI, stroke, heart failure, redo AVR, or bleeding complications (Supplemental Table S2). This result should be interpreted with caution, however, given the relatively small number of patients developing AF (n = 19 of 114) and the low incidence of events.

Discussion

Although previous studies have established the role of both mechanical AVR and bioprosthetic AVR in primarily older, male patients,[4–11] this study provides contemporary data on female patients aged < 50 years undergoing mechanical or bioprosthetic AVR. First, results showed that 30-day, 1-year, and overall survival did not differ between the mechanical AVR and bioprosthetic AVR groups. Second, results showed a higher rate of redo AVR and readmission for heart failure in the bioprosthetic AVR group, whereas the mechanical AVR group had higher rates of new-onset AF. Finally, the incidence of stroke and MI did not differ significantly between the mechanical AVR and bioprosthetic AVR groups.

These results are consistent with those of several studies examining the impact of valve choice on long-term outcomes.[4,6,9,17] Brown et al. found that female patients had higher long-term mortality than did male patients. However, they did not compare mechanical and bioprosthetic devices directly, and their cohort of patients consisted of only 42% women, with 18% aged <55 years.[4] Rodriguez-Gabella et al. performed an analysis of long-term outcomes following bioprosthetic AVR with a 10-year follow-up, finding a 10.1% reintervention rate, but the mean age in their study was 72 years, and less than 40% were female.[6] Kvidal et al. demonstrated excellent long-term survival after AVR, with 85% survival at 10-years, but with only 36% female and only 11.7% aged < 50 years.[9] Most recently, Chaker et al. performed a large study of over 160,000 patients undergoing surgical AVR. They found that women had poorer in-hospital mortality compared to men and demonstrated a similar distribution of mechanical vs bioprosthetic valve use (40.1% vs 60.1%).[17] The main limitation continues to be the underrepresentation of young female patients. The lack of young female patients in these previous studies created the objective of the current study—to analyze long-term outcomes after bioprosthetic AVR vs mechanical AVR specifically in young female patients.

In the current study, long-term survival was equivalent between the mechanical and bioprosthetic AVR groups, with 93% survival to median follow-up of 7.8 years. The equivalent

Table 4. Summary of outcomes in the propensity-matched cohort

Outcomes	Mechanical, n = 57	Bioprosthetic, n = 57	P
In-hospital			
New-onset AF	12 (18.2)	7 (7.3)	0.034
New pacemaker	2 (3.0)	8 (8.3)	0.168
New ICD	0 (0.0)	0 (0.0)	NA
Sepsis	2 (3.0)	1 (1.0)	0.356
Stroke	1 (1.5)	0 (0.0)	0.226
Cardiac arrest	0 (0.0)	2 (2.1)	0.238
Acute kidney injury	0 (0.0)	1 (1.0)	0.406
First extubation time, h	24.5±55.3	18.7±37.5	0.527
ICU stay, d, median (IQR)	1.7 (2.0)	1.6 (2.8)	0.847
Hospital LOS, d, median (IQR)	7.0 (4.4)	6.7 (6.2)	0.898
Primary			
Death in 30 days %	1 (1.8)	0 (0.0)	0.317
Death within 1 year %	2 (3.5)	1 (1.8)	0.546
Death ever %	4 (7.0)	4 (7.0)	0.885
Secondary			
Rate of MI %	2 (3.5)	0 (0.0)	0.118
Rate of stroke %	2 (3.5)	3 (5.3)	0.774
Rate of HF %	4 (7.0)	11 (19.3)	0.138
Rate of re-AVR %	1 (1.8)	5 (8.8)	0.216
Rate of rehospitalization due to bleeding	6 (10.5)	3 (5.3)	0.297

Values are mean ± SD or n (%), unless otherwise specified.

AF, atrial fibrillation; AVR, aortic valve replacement; HF, heart failure; ICD, implantable cardioverter-defibrillator; ICU, intensive care unit; IQR, interquartile range; LOS, length of stay; MI, myocardial infarction; NA, not available.

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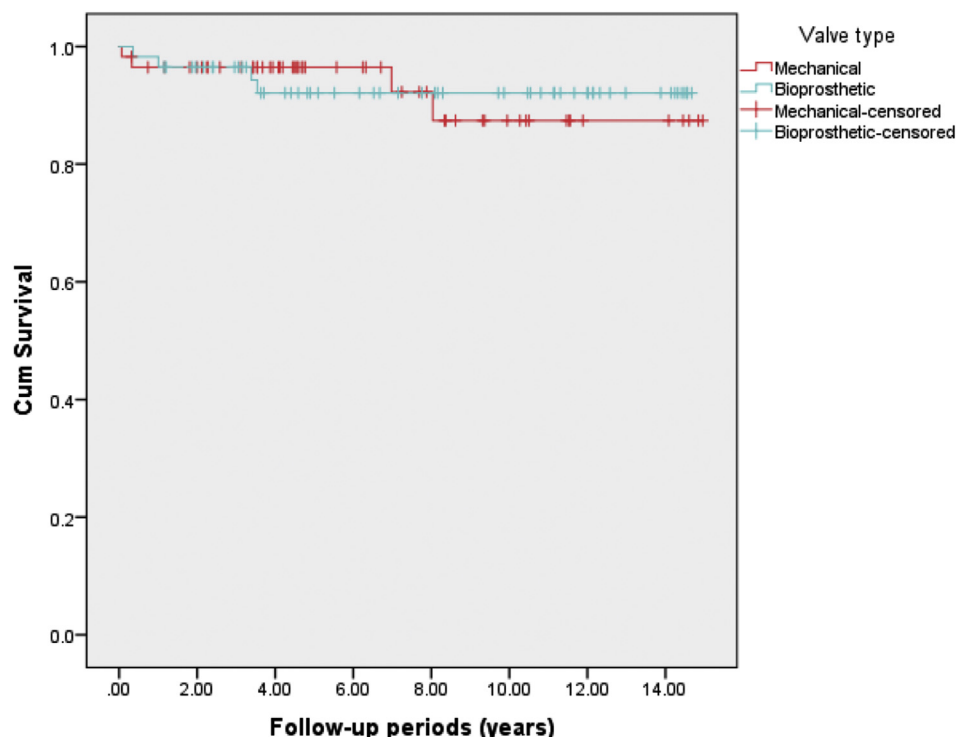
Figure 2. Kaplan-Meier curves of all-cause mortality for the longest follow-up. Cum, cumulative.

survival is further magnified when considering that 8.8% of the bioprosthetic AVR group required a redo AVR, and 19.3% required readmission for heart failure. Despite requiring more reintervention and increased rehospitalization after bioprosthetic AVR, this cohort did not have a decrease in overall survival. Reintervention for mechanical AVR can also occur (1.8% in our cohort), but it is much less common than occurs after bioprosthetic AVR. Finally, the rate of new-onset AF was significantly higher in the mechanical AVR group compared to the bioprosthetic AVR group (18.2% vs 7.3%). The higher incidence of postoperative AF seen in the mechanical valve group may be secondary to the higher number undergoing a combined procedure, especially combined AVR and mitral valve replacement (19.3% in mechanical valve group vs 14% in bioprosthetic valve group). Notwithstanding these results, anticoagulation treatment for AF may even be necessary for the bioprosthetic AVR group with a rate of new-onset AF of 7.3%. In our study, one patient receiving bioprosthetic AVR developed sustained AF requiring long-term anticoagulation treatment. Thus, the avoidance of anticoagulation treatment as a factor in deciding between valve options must be carefully considered.

We chose to analyze specifically a young female population because long-term outcomes for this group are lacking, resulting in difficulty in preoperative counselling and decision-making. One of the unique factors affecting this particular patient population is the desire to become pregnant. For this reason, women may decide to delay surgery until after pregnancy or accept a bioprosthetic AVR at a younger age, along with the risk of reoperation, to avoid the complexity of anticoagulation management. Current guidelines support this position of consideration of bioprosthetic valves for women who have a desire to become pregnant.[19] This study provides further data specifically in a young female population to allow for the most comprehensive preoperative counselling. Furthermore, given the incidence of postoperative AF seen in the bioprosthetic AVR group, counselling should include the need for anticoagulation treatment even when the patient chooses a bioprosthetic valve.

This study is not without limitations. Although propensity matching does help with controlling confounding variables, it cannot account for every confounding variable, especially those not reported in our database. Additionally, the limited size of the population made further covariate adjustment or falsification endpoints infeasible to better control for confounders in our study. Although the diagnostic code for MI, stroke, and heart failure has been validated,[20] the procedure code for redo AVR has not been validated previously. Furthermore, data were collected over a 15-year timespan, with subsequent improvements in technologies and clinical practice, possibly influencing the results of this study.

Conclusions

Although the published literature currently reports outcomes after mechanical AVR or bioprosthetic AVR in the general population, these studies have largely enrolled male patients over the age of 65 years. Thus, our long-term outcomes in this young, female population address a gap in the literature. This study provides objective, focused evidence to assist clinicians when counselling young women preoperatively. Our study did not find strong evidence demonstrating
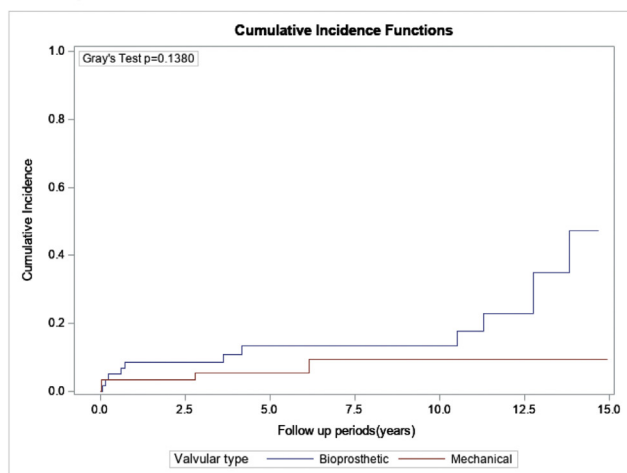
Cumulative incidence curves of MI re-admission for the longest follow up.
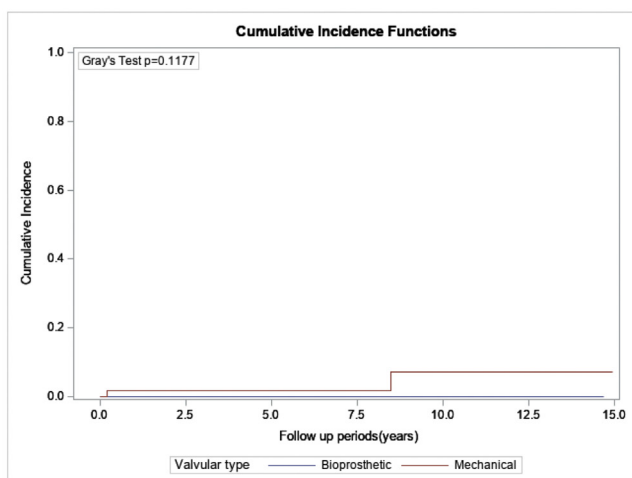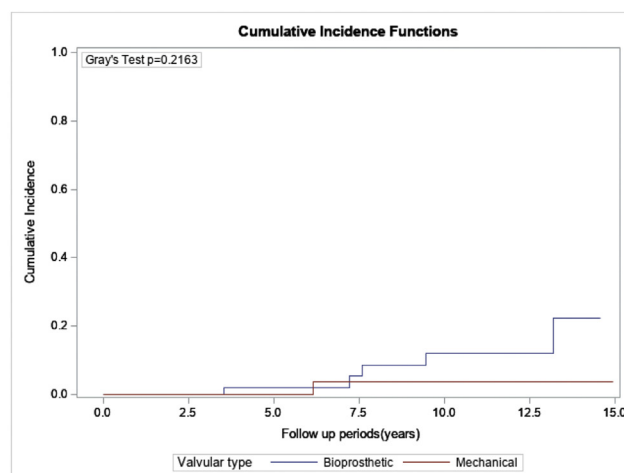

Cumulative incidence curves of Stroke re-admission for the longest follow up.
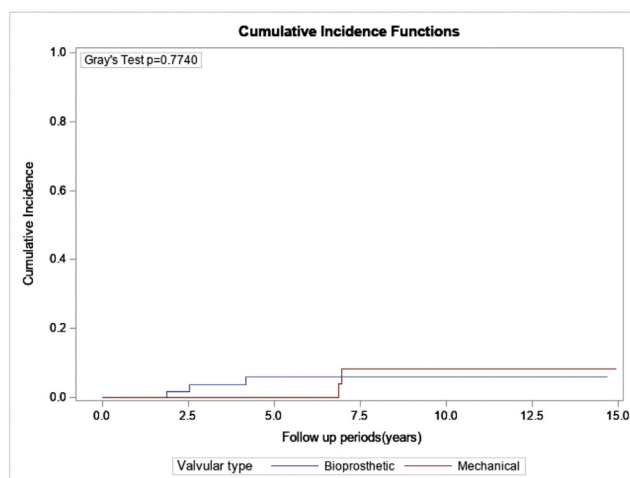
Cumulative incidence curves of heart failure re-admission for the longest follow up.

Cumulative incidence curves of Repeat AVR for the longest follow up.

Figure 3. Cumulative incidence curves of secondary outcomes for the longest follow-up. AVR, aortic valve replacement; MI, myocardial infarction.

a difference in long-term survival between the mechanical and bioprosthetic AVR recipients. We also noted a trend of increased new AF after mechanical AVR, and higher rates of reoperation after bioprosthetic AVR. These results suggest that either of the valve types is safe, and that preoperative assessment and counselling as well as the follow-up, medical treatment, and indications for intervention must be a collaborative decision-making process between the clinician and the patient.

Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2020.06.015.