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 AVR, overall survival at median follow-up was equivalent, at 93%. There is a lower rate of reoperation in patients receiving a mechanical AVR, overall survival at median follow-up was equivalent, at 93%. There is a lower rate of reoperation in patients receiving a mechanical AVR, overall survival at median follow-up was equivalent, at 93%.

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’accidents vasculaires cérébraux, 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.
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.

Methods

Data source

The Alberta Provincial Project for Outcome Assessment in Coronary Heart 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 χ² 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. 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 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 none with gastrointestinal bleeding. 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
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 1. Baseline characteristics before and after propensity-score matching

| Demographics                      | Mechanical, \( n = 66 \) | Bioprosthetic, \( n = 96 \) | Standardized difference | Mechanical, \( n = 57 \) | Bioprosthetic, \( n = 57 \) | Standardized difference |
|-----------------------------------|--------------------------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Age, y                            | 39.4 ± 8.9               | 39.0 ± 9.6                 | 0.797                    | 38.2 ± 8.9               | 39.8 ± 9.7               | 0.377                    |
| Age groups                        | 18 ≤ age ≤ 30            | 13 (19.7)                 | 22 (22.9)                | 13 (22.8)                | 11 (19.3)                | 0.393                    |
|                                   | 30 ≤ age ≤ 40            | 16 (24.2)                 | 20 (20.8)                | 16 (28.1)                | 11 (19.3)                | 0.182                    |
|                                   | 40 ≤ age ≤ 50            | 37 (56.1)                 | 54 (56.3)                | 29 (40.1)                | 35 (61.4)                | 0.109                    |
| BMI, kg/m²                         | 28.5 ± 8.2               | 28.7 ± 8.2                 | 0.898                    | 28.5 ± 7.9               | 29.0 ± 8.4               | 0.746                    |
| Hypertension                      | 20 (30.3)                | 30 (31.3)                 | 0.898                    | 17 (29.8)                | 21 (36.8)                | 0.427                    |
| Dyslipidemia                      | 20 (30.3)                | 34 (35.4)                 | 0.498                    | 16 (28.1)                | 19 (33.3)                | 0.542                    |
| Diabetes mellitus                 | 3 (4.5)                  | 4 (4.2)                   | 0.907                    | 2 (3.5)                  | 3 (5.3)                  | 0.647                    |
| Heart failure                     | 14 (21.2)                | 22 (22.9)                 | 0.798                    | 14 (24.6)                | 13 (22.8)                | 0.826                    |
| Pulmonary disease                 | 23 (34.8)                | 20 (20.8)                 | 0.047                    | 18 (31.6)                | 15 (26.3)                | 0.536                    |
| Liver disease                     | 1 (1.5)                  | 4 (4.2)                   | 0.338                    | 1 (1.8)                  | 2 (3.5)                  | 0.558                    |
| GI disease                        | 5 (7.6)                  | 8 (8.3)                   | 0.862                    | 4 (7.0)                  | 5 (8.8)                  | 0.728                    |
| Malignancy                        | 0 (0.0)                  | 3 (3.1)                   | 0.147                    | 0 (0.0)                  | 0 (0.0)                  | NA 0                     |
| Peripheral vascular disease       | 0 (0.0)                  | 1 (1.0)                   | 0.406                    | 0 (0.0)                  | 0 (0.0)                  | NA 0                     |
| Cerebrovascular disease           | 2 (3.0)                  | 7 (7.3)                   | 0.245                    | 2 (3.5)                  | 3 (5.3)                  | 0.647                    |
| Current smoker                    | 28 (42.4)                | 31 (32.3)                 | 0.188                    | 24 (42.1)                | 23 (40.4)                | 0.949                    |
| Chronic kidney disease            | 2 (3.0)                  | 1 (1.0)                   | 0.356                    | 1 (1.8)                  | 1 (1.8)                  | 1 0                      |
| Dialysis                          | 2 (3.0)                  | 2 (2.1)                   | 0.703                    | 1 (1.8)                  | 1 (1.8)                  | 1 0                      |
| Prior MI                          | 1 (1.5)                  | 1 (1.0)                   | 0.789                    | 0 (0.0)                  | 1 (1.8)                  | 0.315                    |
| 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                    | 1 (1.8)                  | 2 (3.5)                  | 0.558                    |
| Ejection fraction, %              | 1.5 ± 0.45               | 1.5 ± 0.45                 | 0.918                    | 1.5 ± 0.45               | 1.5 ± 0.45               | 0.109                    |

### 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)                  | 0 (0.0)                    |      |
| AVR + CABG                      | 0 (0.0)                  | 1 (1.8)                    |      |
| AVR + CABG + MVR                | 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                  | 162.5 ± 68.6             | 154.5 ± 65.5               | 0.545|
| X-clamp times, min              | 122.7 ± 54.3             | 121.0 ± 53.2               | 0.877|
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, 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. 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. 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. Kvidal et al. demonstrated excellent long-term survival after AVR, with 85% survival at 10-years, but the mean age in their study was 72 years, and less than 40% were female. 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%).

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

| Implanted device                      | n (%)  |
|---------------------------------------|--------|
| Bioprosthetic                         |        |
| CE Perimount Magna Ease Pericardial   | 11 (19.3) |
| Aortic-TheraFix (Edwards, Irvine, CA) |        |
| 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) |

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±5.3          | 18.7±7.5              | 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.
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 valve 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. 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, 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
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.

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**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.