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Mitral Valve Bioprosthesis Is Safer han Mechanical Mitral Prosthesis in Young Women

Hamdy Singab, PhD,[1] Gamal Sami, PhD[1, 2]

[1]Department of Cardiovascular and Thoracic Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt; [2]Nasser Institute for Research and Treatment, Cardiothoracic Surgery Cairo, Egypt

ABSTRACT

Background: The ultimate goal of mitral valve surgery in young women is to extend life expectancy and improve quality of life. Mitral valve replacement (MVR) prosthesis in middle-aged women is a difficult choice between the lifelong anticoagulation by mechanical prosthesis versus the limited long-term durability of bioprosthesis. The current trend towards reducing women's age for selecting bioprosthesis over mechanical prosthesis leads to a dilemma for younger women decision making. The aim of this study was to compare the safety and freedom from complications in pregnancy and survival rate after mitral valve bioprosthesis versus mechanical prosthesis in young women for whom mitral valve repair is not feasible, or unsuitable.

Methods: This single-center non randomized prospective study included all female patients undergoing MVR at our center from January 2010 to February 2020.

Results: In total, 355 young women patients underwent MVR at our center, of whom 174 received a bioprosthesis and 181 received a mechanical prosthesis. The use of anticoagulation among young women with mechanical prosthesis was associated with a remarkable risk of postoperative bleeding, abortion, and increased frequency of pregnancy-related complications ($P < .0001$). In contrast, there was a considerable survival benefit for those who received bioprosthesis ($P = .0001$).

Conclusion: Our data confirm that the use of mitral bioprosthesis in young women who desire to become pregnant is safe, reduces complications, and increases survival.

INTRODUCTION

The ultimate goal of mitral valve surgery in young women is to extend life expectancy and improve quality of life. Mitral valve replacement (MVR) prosthesis in middle-aged women is a difficult choice between the lifelong anticoagulation of mitral mechanical prosthesis (MMP) versus the limited long-term durability of mitral bioprosthesis (MBP). The current trend towards reducing women's age for selecting MBP over MMP leads to a dilemma for younger women decision making [Frater 1998; Kulik 2006] However, limited literature supports the use of MBP over MMP, and many surgeons and cardiologists recommend reducing women's age for MBP [Chikwe 2015].

The guidelines of the American College of Cardiology/ American Heart Association advise using MBP for sinus rhythm in young women who choose this valve according to their lifestyle considerations, after having been comprehensively informed on the anticoagulation risk of MMP versus the necessity of future reoperation after MBP [Nishimura 2014]. Several studies have reported that both MBP and MMP have equivalent effects on postoperative survival and quality of life in the middle-aged population [Wang 2015; Cunanan 2001].

Young women, particularly those in child-bearing period, are concerned about MMP due to its bothering valve sounds, the need of repeated medical visits and blood tests, as well as the probability of anticoagulant-related teratogenicity, thrombosis, and bleeding complications [Kaneko 2014; Kyriacou 2016].

The aim of this study was to compare the safety, freedom from complications during pregnancy, and the survival rate after MBP versus MMP in young women for whom mitral valve repair is not feasible, or unsuitable.

MATERIALS AND METHODS

Study Design and Participants

This was a single-center; non-randomized, prospective study registration of female patients who underwent MVR at our center, from January 2010 to February 2020. This study was approved by the local ethics committee and was conducted in accordance with the Helsinki Declaration. All patients provided written informed consent before the surgical procedures.

Selection Criteria

We included all women patients undergoing MVR at our center from January 2010 to February 2020. We also included patients who underwent MVR with atrial fibrillation (AF) ablation and tricuspid valve repair or replacement. Age, sinus rhythm, and lifestyle were considered as a recommendation

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Correspondence: Hamdy Singab, PhD, Department of Cardiac Surgery, Faculty of medicine, Ain Shams University, P.O. Box 11517, Abbasia Square, Cairo, Egypt; +201001008859; fax: +2022604465 (e-mail: hamdi_singab@hotmail.com; drhamdy-ahmed@med.asu.edu.eg).

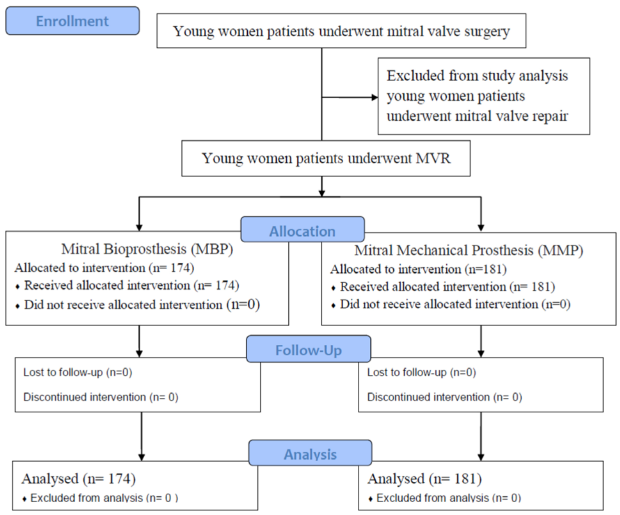

Figure 1. CONSORT flow chart of our nonrandomized study.

for MBP. Women who desired to become pregnant, for whom oral anticoagulants were contraindicated, and who showed poor anticoagulant compliance were also considered for MBP, even if they were <60 years old. Our exclusion criteria were cardiogenic shock, prior cardiac operation, emergency operation, and concomitant coronary artery bypass graft or aortic valve replacement. All patients with MBP received oral acetylsalicylic acid at 150 mg daily only for the first 3-6 months, while those with MMP ± AF regularly received daily oral anticoagulants such as coumadin (Warfarin, Bristol-Myers Squibb, Egypt).

Data Collection

Follow-up data were collected at our center's outpatient clinic. The follow-up rate was 98.5% for the MBP group and 99.4% for the MMP group. Doctors and nurses in our research team did their best to reduce the number of patients lost to follow-up by maintaining telephone contact with the participants or their relatives at regular intervals or by using the national data death registration database through the participants' unique national ID for those who could not be contacted after multiple efforts.

For all patients, we collected basic preoperative sociodemographic and clinical data (age, body mass index, socioeconomic status, New York Heart Association (NYHA) classification, previous cardiological interventions, cardiovascular risk factors, comorbidities, European System for Cardiac Operative Risk Evaluation (EuroScore), echocardiography), and laboratory data. We also recorded the patients' preoperative and postoperative echocardiographic data, including ejection fraction, left ventricular end diastolic diameter (mm), left ventricular end systolic diameter (mm), left atrium (mm), right atrium (mm), mitral opening (mm), and mitral valve pathologies; intraoperative transesophageal echocardiography (TEE) data, as well as TTE data at one week postoperation and upon clinical follow-up [Sordelli 2014; Castillo

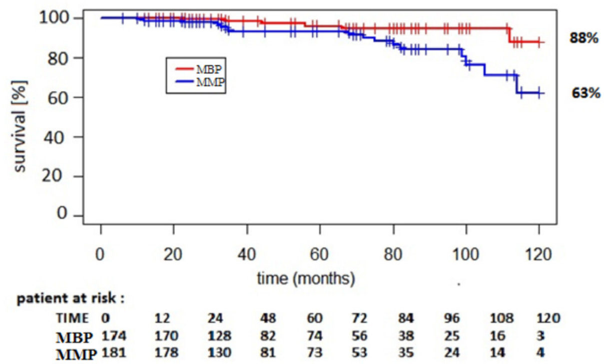

Figure 2. Kaplan-Meier curve for the long-term survival after mitral bioprosthesis versus mitral mechanical prosthesis.

2011]; relevant medical or surgical history; operative variables (surgical approach [conventional or minimally invasive], cross-clamp time, bypass time, type and size of mitral prostheses, concomitant AF ablation, and tricuspid procedures); and postoperative variables (ventilation time, intensive care unit [ICU] stay, hospital stay, pleural effusion, pericardial tamponade, wound infection, arrhythmia [atrio-ventricular (A-V) block–AF],pneumothorax, pneumonia, stroke, acute renal failure [ARF], temporary dialysis, neurological complication, pacemaker implantation, 30-day and 10-year cardiac and non-cardiac death).

Statistical Analysis

Skewness and kurtosis test were used to test the normality distribution of our continuous variables data set. Continuous data are presented as means ± standard deviations for normally distributed variables or as median and interquartile range for non-normally distributed variables. Categorical data are presented as absolute values and frequencies (%). Comparative analyses for the MBP and MMP groups were performed using Fisher exact or chi-square test for categorical variables and Student t-test or Mann-Whitney U test for continuous variables, as appropriate. $P < .05$ was considered statistically significant. All statistical analyses were performed using IBM SPSS 20 (IBM, USA). We used Cox proportional hazard models to analyze the competing risk data and Fine and Gray cumulative incidence function-based proportional hazard competing risk regression model to analyze survival data. A Kaplan-Meier curve to analyze survival was generated using SPSS [Fine 1999].

RESULTS

Between January 2010 and February 2020, 556 female patients underwent mitral valve surgery at our center, of whom 355 (64%) were subjected to MVR and were included in the study, and 201 (36%) were subjected to mitral valve repair (Figure 1). Our mitral valve repair was low because a majority of our young women patients had high incidence of mitral

Table 1. Preoperative Baseline Characteristics

	Mitral Bioprosthesis n = 174	Mitral Mechanical Prosthesis n = 181	*P*
Age, y	47.6 ± 9.9	46.5 ± 10	.30
Childbearing period, n (%)	134 (77)	132 (73)	.39
Body mass index (kg/m^2)	26.2 ± 1.6	26.5 ± 1.8	.098
Socioeconomic status, n (%)			
Poor	66 (38)	65 (36)	.69
Middle	75 (43)	85 (47)	.45
Rich	33 (19)	31 (17)	.62
Hypertension, n (%)	77 (44)	76 (42)	.70
Diabetes mellitus, n (%)	47 (27)	45 (24.8)	.64
Obesity, n (%)	44 (25.3)	46 (25.4)	.93
Family history of cardiac surgery, n (%)	19 (11)	27 (15)	.26
Past history of cardiology intervention, n (%)	9 (5)	11 (6)	.68
History of previous mitral valve repair, n (%)	5 (3)	7 (3.7)	.61
Renal failure, n (%)	6 (3.6)	6 (3.3)	.87
Cerebrovascular accident, n (%)	4 (2.4)	3 (1.7)	.83
Chronic lung disease, n (%)	25 (14.4)	28 (15.5)	.75
Peripheral vascular disease, n (%)	26 (15)	29 (16)	.79
Atrial fibrillation, n (%)	61 (35)	67 (37)	.69
EuroScore	5.6 ± 1.4	5.9 ± 2.3	.14
New York Heart Association class	3.86 ± 0.34	3.88 ± 0.31	.56
Echocardiographic data			
Mitral valve pathology			
Mitral stenosis, n (%)	57 (32.8)	59 (32.6)	.97
Severe mitral regurgitation, > grade 4, n (%)	118 (68)	125 (69)	.84
Rheumatic, n (%)	127 (73)	136 (75.1)	.67
Degenerative, n (%)	31 (18)	29 (16)	.62
Endocarditis, n (%)	16 (9)	14 (7.7)	.73
Ejection fraction, %	50 ± 10	52 ± 12	.09
Left ventricular end diastolic diameter, cm	5.1 ± 0.7	5 ± 0.5	.12
Left ventricular end systolic diameter, cm	3.6 ± 0.4	3.7 ± 0.6	.07
Left atrium, cm	4.3 ± 0.5	4.4 ± 0.7	.12
Right atrium, cm	4.6 (3.9–5.2)	4.8 (4–5.5)	.32
Pulmonary artery pressure, mmHg	43 ± 7	44 ± 9	.24
Annular dilatation, n (%)	106 (61.1)	114 (63)	.71
Annular or subvalvular calcification, n (%)	123 (71)	130 (72)	.83

Values are presented as number of patients and percentage, means and standard deviation, or median and interquartile range. EuroScore indicates European System for Cardiac Operative Risk Evaluation (low risk: <2 points, moderate risk: 3–5 points, high risk: ≥6 points).

annular calcification as a result of chronic rheumatic heart disease. Among those subjected to MVR, 174 (49%) received MBP (Group I) and 181 (51%) received MMP (Group II). In the overall included population, 266 (75%) patients were in child-bearing period (Group I: 134 [77%]; Group II: 132 [73%]). Moreover, 263 (74%) patients had rheumatic mitral valve disease; 243 (74%) severe mitral regurgitation grade (≥V); 220 (62%) annular dilatation, and 128 (36%) had AF.

Table 2. Operative Data

	Mitral Bioprosthesis n = 174	Mitral Mechanical Prostheses n = 181	P
Cardiopulmonary bypass time, min	105 ± 15.7	115 ± 18.2	.0001
Aortic cross-clamping time, min	73 ± 12	75 ± 13	.13
Mitral valve size, n (%)			
25 mm	24 (14)	27 (15)	.79
27 mm	79 (45)	89 (49)	.45
29 mm	66 (38)	58 (32)	.24
31 mm	5 (3)	7 (4)	.61
Concomitant atrial fibrillation ablation, n (%)	61 (35)	67 (37)	.69
Tricuspid valve repair, n (%)	54 (31)	53 (29)	.68
Tricuspid valve replacement, n (%)	9 (5)	13 (7.1)	.43

Values are presented as number of patients and percentage or means and standard deviation.

Comparison of preoperative patient demographics, socioeconomic status, mitral valve pathology, and echocardiographic data showed no statistically significant differences between groups (Table 1). Operative parameters were also not significantly different between groups, except cardiopulmonary bypass time that was significantly shorter in Group I than in Group II (P = .0001; Table 2) due to difficult weaning of cardiopulmonary bypass and higher rate of bleeding in Group II than those in Group I. Moreover, the postoperative ICU and clinical follow-up course were better and hospital and ICU stays were significantly shorter in Group I than in Group II (P < .0001) (Table 3); the postoperative ICU was significantly shorter in Group I than in Group II because patients in Group II had more early postoperative complications such as postoperative bleeding than those in Group I; hospital stay was significantly shorter in Group I than in Group II, probably because patients in Group II needed to wait in the hospital for the target therapeutic international normalized ratio (INR) (range 2.5-3 folds the normal value) and had more postoperative complications than those in Group I.

Postoperative NYHA-class status was much improved in Group I compared to that in Group II (P = .04), most probably because of the higher incidence of postoperative bleeding, pregnancy-related complications, anticoagulant-related complications, and postoperative complications in Group II than those in Group I .

Notably, the frequency of mitral valve re-replacement was higher in Group II than in Group I (3.7% versus 0.6 %; P = .02), probably because of the high incidence of poor compliance of oral anticoagulant and thromboembolic events among young women patients in Group II which associated with a higher rate of mechanical mitral valve dysfunction, thrombosis, and mitral valve re-replacement in Group II than those in Group I.

Postoperative complications, including wound infection, pericardial tamponade, AF, pneumothorax, pneumonia, and ARF, showed no significant differences between groups. Immediate operative death was only seen in 0.6% of the patients in Group II. After 10 years of follow-up, the postoperative transvalvular pressure gradient was significantly lower and the vena contracta was significantly wider in Group I than in Group II (P < .0001and P = .006, respectively).

At 30 days postoperatively, 3 (0.8%) patients in the overall population died: one in Group I (0.6%) and two in Group II (1.2%). The most common complication at 30 days after surgery was AF: 68 patients (19%).Moreover, 36 (10%) patients experienced pneumonia, 5 (1.4%) wound infection, 28 (7.9%) pericardial tamponade, 13 (3.7%) pneumothorax, 9 (2.5%) pleural effusion, and 10 (2.9%) stroke. However, in general 10 (2.9%) patients stroke after MVR is relatively high due to the higher prevalence of the thromboembolic stroke among young women patients in Group II 8 (4.4%) in comparison to that in Group I 2 (1.1%) as a result of poor oral anticoagulant compliance; there was no statistically significant differences between groups (P = .6). Additionally, 34 (9.6%) patients had ARF, with only 10 (2.8%) requiring temporary hemodialysis, while 29 (8.2%) patients suffered from A-V block grade III and 27 (7.6%) had pacemaker implantation. Reexploration for postoperative bleeding occurred in 22 (6.2%) patients and was significantly more frequent among Group II (18 [10%]) than in Group I (4 [2.4%]) patients (P < .0001). Abortion occurred in 32 (9%) women in child-bearing period and was significantly more frequent among Group II (27 (15%]) than in Group I (5 [3%]) patients (P = .0001). Anticoagulant complication-free pregnancy occurred in 242 (68.2%) women in child-bearing period, and the rate was significantly higher in Group I (141 patients [81%]) than in Group II (101 [56%]) (P < .0001; Table 4).

Oral anticoagulants such as coumadin were available at all times for all patients, but compliance to these drugs was 81%. The INR of Group II patient was in the therapeutic target most of the times. Moreover, 5 out of 7 patients in this group who had mitral valve re-replacement due to poor oral

Table 3. Postoperative Follow-Up Data

	Mitral Bioprosthesis n = 174	Mitral Mechanical Prostheses n = 181	*P*
Ventilation time, hours	13.8 (9–18)	14.3 (8–20)	.17
Intensive care unit stay, hours	38.2 ± 15.7	46 ± 17	<.0001
Hospital stay, days	11.7 ± 2	15.5 ± 2.6	<.0001
New York Heart Association class	1.1 ± 0.4	1.2 ± 0.5	.04
Wound infection, n (%)	2 (1.2)	3 (1.7)	.82
Pericardial tamponade, n (%)	11 (6.5)	17 (9.3)	.33
Atrio-ventricular block grade III, n (%)	13 (7.3)	16 (8.8)	.61
Atrial fibrillation, n (%)	37 (21)	31 (17)	.34
Pneumonia, n (%)	17 (9.5)	19 (10.5)	.82
Pneumothorax, n (%)	4 (2.4)	9 (5)	.27
Pleural effusion, n (%)	6 (3.6)	3 (1.7)	.19
Pacemaker implantation, n (%)	13 (7.3)	14 (7.7)	.94
Acute renal failure, n (%)	16 (9)	18 (10)	.75
Temporary dialysis, n (%)	3 (2)	7 (3.7)	.27
Stroke, n (%)	2(1.1)	8(4.4)	.06
Reexploration for postoperative bleeding, n (%)	4 (2.4)	18 (10)	<.0001
Immediate operative death	0	1 (0.6)	
30-day death, n (%)	1 (0.6)	2 (1.2)	.29
30-day cardiac death, n	0	0	
30-day non-cardiac death, n (%)	1 (0.6)	2 (1.2)	.29
10-year death, n (%)	6 (3.6)	18 (10)	.01
10-year cardiac death, n (%)	2 (1.2)	12 (6.7)	.007
10-year non-cardiac death, n (%)	4 (2.4)	6 (3.3)	.58
Mitral re-replacement, n (%)	1 (0.6)	7 (3.7)	.02
Abortion, n (%)	5 (3)	27 (15)	.0001
Abortion due to teratogenicity related to coumadin, n (%)	>	18 (10)	
Abortion due to teratogenicity not related to coumadin, n (%)	4 (2.4)	5 (3)	.73
Abortion due to other causes (infection, physical problem, uterine anomalies), n (%)	1 (0.6)	4 (2)	.25
Pregnancy free of anticoagulant complications, n (%)	141 (81)	101 (56)	<.0001
Echocardiographic data			
Ejection fraction, %	53 ± 11	52 ± 13	.44
Left ventricular end diastolic diameter, cm	5.1 ± 0.3	5 ± 0.6	.05
Left ventricular end systolic diameter, cm	3.7 ± 0.6	3.8 ± 0.5	.08
Left atrium, cm	4.3 ± 0.4	4.2 ± 0.6	.07
Right atrium, cm	4.7 (4.2–5.2)	4.8 (4.2–5.4)	.09
Transprosthetic pressure gradient, mmHg)	7 ± 3	15 ± 4	<.0001
Pulmonary artery pressure, mmHg	43 ± 5	42 ± 6	.08
Width of the vena contracta, cm	0.67 ± 0.08	0.64 ± 0.12	.006

Values are presented as number of patients and percentage, means and standard deviation, or median and interquartile range.

Table 4. Ten-Year Outcomes

	Mitral Bioprosthesis n = 174	Mitral Mechanical Prostheses n = 181	OR (95% CI)	AOR (95% CI)
Re-exploration for postoperative bleeding, n (%)	4 (3.2)	18 (10)	0.2052 (0.1047–0.4023)	0.1847 (0.0838–0.3902)
10-year death, n (%)	6 (3.5)	18 (10)	0.3234 (0.1252–0.8352)	0.2426(0.0808–0.7350)
Reoperation, n (%)	1 (0.6)	7 (3.7)	0.1437 (0.0175–1.1802)	0.1078(0.0113–1.039)
Abortion, n (%)	5 (3)	27 (15)	0.1687 (0.0634–0.4491)	0.0702(0.0209–0.2425)
Pregnancy free of anticoagulant complications, n (%)	141 (81)	101 (56)	3.3843 (2.0957–5.4654)	1.4079 (0.6916–2.9513)
Pacemaker implantation, n (%)	13 (7.3)	14 (7.5)	0.9632 (0.4392–2.1124)	1.5411 (0.7686–3.0947)
Acute renal failure, n (%)	16 (9)	18 (10)	0.8624 (0.4253–1.7491)	0.3277 (0.1263–0.8133)
Temporary dialysis, n (%)	3 (2)	7 (4)	0.4361 (0.1109–1.7143)	0.1657(0.0329–0.7971)
Stroke, n (%)	2(1.1)	8 (4.4)	0.7723 (0.2624–2.2733)	0.2935 (0.0777–1.0571)
30-day death, n (%)	1 (0.6)	2 (1.1)	0.5173 (0.0465–5.7576)	0.3078 (0.0239–4.0534)
Wound infection, n (%)	2 (1.4)	3 (1.7)	0.6899 (0.1139–4.1799)	0.3415 (0.0501–2.4870)
Pericardial tamponade, n (%)	11 (6.5)	17 (9.3)	0.6510 (0.2958–1.4328)	0.4687 (0.1914–1.1391)
Atrio-ventricular block grade III, n (%)	13 (7.5)	16 (9)	0.8327 (0.3881–1.7865)	0.4846 (0.1995–1.1577)
Atrial fibrillation, n (%)	37 (21)	31 (17)	1.3068 (0.7688–2.2212)	0.8886 (0.4882–1.6215)
Pneumonia, n (%)	17 (9.5)	19 (10.5)	0.9232 (0.4630–1.8410)	0.7663 (0.3602–1.6385)
Pneumothorax, n (%)	4 (2.3)	9 (4.7)	0.4497 (0.1359–1.4881)	0.4497 (0.0906–1.8750)
Pleural effusion, n (%)	6 (3.5)	3 (1.4)	2.1190 (0.5216–8.6093)	2.1614 (0.4940–9.2550)

Data are presented as number of patients and percentage. AOR indicates adjusted odds ratio for preoperative age, logistic EuroScore I, and mitral regurgitation grade 4; CI, confidence interval; OR, odds ratio calculated by logistic regression.

anticoagulant compliance, or failure of coumadin treatment to reach the INR therapeutic target in pregnant woman, resulted in life-threatening mechanical valve thrombosis in a pregnant woman who received MMP (5 ± 2) years before pregnancy. However, a majority of them were successfully treated with MBP re-replacement but had a significant risk of miscarriage. In contrast, there was only one case for mitral valve re-replacement in Group I due to structural valve deterioration. Additionally, 18 (10%) Group II patients aborted due to teratogenicity related to coumadin, representing about 67% (18/27) of all abortion cases in this group.

The Kaplan-Meier curves of postoperative complications and survival rate over the 10-year follow-up period are presented in Figure 2. The survival rate was significantly higher in Group I than in Group II (88% versus 63% $P < .0001$). The 95% confidence interval of Cox hazards survival regression ratio was significantly different between groups (0.1926 [0.0759–0.4889], $P = .0001$), whereas the adjusted 95% confidence interval for preoperative variables (age, logistic EuroScore) was not (0.5581 [0.3254–0.9581], $P = .059670$).

DISCUSSION

This single-center study delineates the safety and efficacy of two types of mitral valve prostheses. The event rate of mitral valve re-replacement was high after MMP, possibly due to poor compliance to the oral anticoagulant treatment, owing to the young women's desire to become pregnant. Furthermore, our study confirmed the remarkably high success rate of MBP in young women, whereas MMP was associated with an increased risk of postoperative bleeding. Since both prostheses types have advantages and disadvantages, specific patient characteristics must be considered when choosing the appropriate type [Tillquist 2011; Fino 2018].

A recent report demonstrated that MBP has superior antithrombotic properties and longer durability, whereas MMP is associated with thromboembolism and bleeding events [Wang 2015; Iung 2014]. Consistently, our study showed that oral anticoagulant use among young women with MMP is associated with a high risk of postoperative bleeding and abortion, and increased frequency of pregnancy-related complications. Moreover, there was a considerable survival benefit for young women with MBP.

Kaplan-Meier analysis of the long-term survival at 10 years of follow-up after MVR demonstrated a significantly higher survival rate with MBP (88%) than with MMP (63%), despite survival being equivalent between groups for the first three years of follow-up. Subsequent competing risk regression analyses indicated a significant survival difference between groups; however, adjustment for preoperative baseline variables showed no significant difference between groups.

Specific patient characteristics, including child-bearing period, frequency of medical visits and blood tests, as well as the possibility of anticoagulant-related thrombotic and bleeding events and teratogenicity, particularly in pregnant women, influenced the choice of mitral valve prosthesis type in young women. The rate of comorbidities, such as AF, renal failure, obesity, diabetes mellitus, and operative factors were not significantly different between groups. In the future, MBP implantation in young women will benefit from the trans-catheter valve-in-valve technique in cases of structural valve deterioration, thus decreasing the reoperation risk. Furthermore, newer MBPs with longer durability may also be more attractive for young women from the perspective of both the patient and medical care.

Our results match those of the Society of Thoracic Surgeons database report from 2000 to 2007, indicating that the age of women receiving MBP has been significantly reduced, and that the rate of MMP implantation has decreased from 68% to 37% among young women [Gammie 2009]. Woo et al reported that young age is not a risk factor for the structural deterioration of MBP, which agrees with our results. Moreover, the authors showed that the freedom from reoperation rates at 10, 15, and 20 years after new MBP due to structural valve deterioration were 91, 76, and 50%, respectively [Woo 2016].

Previous studies have shown that only 62% of young women on oral anticoagulants who receive MMP are within an acceptable INR range [Tillquist 2011; Rahimtoola 2010; Hui 2012]. Applegate et al reported that the structural deterioration of MBP is unclear and possibly a result of calcium and lipids accumulation over the valve surface and suggested that a complete saline rinse of the MBP more than once before surgery leads to a considerable decrease in structural deterioration frequency [Applegate 2017]. Although older-generation MBPs undoubtedly had limited durability, newer MBPs have excellent long-term durability and performance for >25 years [Gammie 2009].

Our results agree with those by Walfisch et al who reported that the use of vitamin K antagonists, such as coumadin, even at doses <5 mg during pregnancy holds a very high possibility of serious risks to the fetus, especially during the first trimester or at term. However, one of the most common international protocols suggested the substitution of coumadin by heparin between the 6th and 12th gestational week to reduce the risk of teratogenicity. Nevertheless, since coumadin has a long half-life, with a terminal elimination half-life of one week, heparin substitution starting at 6 gestational weeks is too late to avoid teratogenicity [Walfisch 2010].

In our study, abortion was significantly higher in the MMP (15%) than in the MBP group (3%). Moreover, the rate of freedom from anticoagulant-related complications among women in child-bearing period was significantly higher in the latter (81% versus 56%).

The impulse use of MBP in young female patients at childbearing period is explained by the classic surgical recommendation of lifetime anticoagulants' use after MMP, the lower risk of reoperation by using new-generation MBPs, the future possibility of valve-in-valve technique, as well as by the patients' decision to refuse the activity constraints associated with anticoagulants [Kaneko 2014; Batra 2018].

Study Limitations

Our study is limited by its non-randomized prospective design not registered in clinicaltrials.gov, without sample size calculation and a fairly small sample size report. Thus, our results should be verified in future studies including a larger prospective randomized study sample.

Conclusion

Our data confirm that using MBP in young women who wish to become pregnant is safe, decreases complications, and improves survival. The recorded 10-year survival rate was higher with MBP than with MMP in these patients. Therefore, valve selection in young women is important for the patient's survival.

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