Perioperative Deaths After Mitral Valve Operations May Be Overestimated by Contemporary Risk Models

Vincent Chan, MD, MPH, Azin Ahrari, BS, Marc Ruel, MD, MPH, Elsayed Elmistekawy, MD, Mark Hynes, MD, and Thierry G. Mesana, MD, PhD

Division of Cardiac Surgery and the Department of Epidemiology and Community Medicine, University of Ottawa, Ottawa, Ontario, Canada

Background. **Percutaneous therapies to manage mitral regurgitation are emerging as an alternative to conventional operations, especially for patients with a high estimated perioperative risk. However, contemporary risk models may not accurately reflect outcomes at reference mitral valve centers. The purpose of this study was to describe perioperative mortality rates after mitral valve operations in a contemporary cohort.**

Methods. **Between 2001 and 2011, 1,154 patients underwent mitral valve operations at a reference center. Of these, 851 underwent repair and 303 underwent replacement. Concomitant coronary artery bypass grafting was performed in 201 (17%). The Society of Thoracic Surgeons (STS) risk score version 2.73 and European System for Cardiac Operative Risk Evaluation (EuroSCORE) II were used to estimate the number of perioperative deaths.**

Results. **The observed perioperative mortality was 1.0%. The STS score was 2.3% ± 2.6% and was higher than the observed mortality rate for each of the STS subgroups (all $p < 0.001$). The EuroSCORE II expected mortality was 3.0% ± 3.4% and was greater than the observed mortality rate for isolated and combined procedures (both $p < 0.001$). The STS and EuroSCORE II provided fair death discrimination, with an area under the receiver operating characteristic curve of 0.74 and 0.67, respectively.**

Conclusions. **Although current risk models aid in risk stratifying patients, the contemporary perioperative mortality rate at a reference mitral valve center is significantly lower than expected. The use of alternate therapies must therefore take into consideration differences in perioperative risk based on the treating center.**

(Ann Thorac Surg 2014;98:605–10)

Percutaneous therapies are viable alternatives to traditional operations in selected patients with a high estimated perioperative risk. In particular, percutaneous coronary interventions and transcatheter aortic valve implantation offer better survival than medical therapy in certain nonoperative patients with coronary disease and aortic stenosis, respectively [1, 2]. In patients with mitral regurgitation (MR), percutaneous edge-to-edge repair is safe and effective in selected patients with organic or functional disease [3, 4].

Less invasive alternatives to treat patients with MR are particularly relevant. MR commonly occurs in patients with an acute coronary syndrome and left ventricle dysfunction, which are known to portend worse surgical outcomes [5–7]. Although the early outcomes after the surgical correction of MR have improved during the last decade, mitral valve operations remain associated with significant morbidity and death [8–11]. However, outcomes after mitral operations are not uniform across centers, and favorable results have been reported by several expert centers [12–17].

Perioperative risk is most commonly estimated with the European System for Cardiac Operative Risk Evaluation (EuroSCORE) II and The Society of Thoracic Surgeons (STS) risk score [8–10, 18]. These models have been extensively validated to predict perioperative events in patients undergoing cardiac operations. However, the applicability of a risk score depends on the characteristics of the patients from which the risk score was determined. Therefore, these risk calculators may not accurately predict outcomes for underrepresented patient groups, such as for patients undergoing mitral valve operations.

We therefore performed a cohort study involving 1,154 patients who underwent mitral operations at a reference center. Our objectives were to (1) determine characteristics that resulted in death at a reference Canadian mitral

Accepted for publication May 5, 2014.

Presented at the Fiftieth Annual Meeting of The Society of Thoracic Surgeons, Orlando, FL, Jan 25–29, 2014.

Address correspondence to Dr Chan, University of Ottawa Heart Institute, 3405-40 Ruskin St, Ottawa, ON K1Y 4W7, Canada; e-mail: vchan@ottawaheart.ca.

Dr Ruel discloses financial relationships with Medtronic and Edwards Lifesciences.

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2014.05.011

valve center and (2) verify the calibration and discrimination of contemporary risk scores, namely the EuroSCORE II and STS risk score, in predicting perioperative deaths in this population.

Material and Methods

Approval was obtained from the University of Ottawa Heart Institute Human Research Ethics board to analyze death data after mitral operations.

Patient Population and Follow-Up

Between 2001 and 2011, 1,154 patients underwent mitral valve operations for MR or mitral stenosis at the University of Ottawa Heart Institute. Of these, 851 underwent repair and 303 underwent replacement. The repair patients were a mean age of 62.8 ± 13.1 years and 32% were women, whereas the replacement patients were a mean age of 64.9 ± 12.4 years and 66% were women (Table 1). Of patients who underwent mitral replacement, 24% had a previous sternotomy. Myxomatous degeneration was the most common mitral disease etiology in repair patients, whereas rheumatic disease was most common in replacement patients. Concomitant coronary artery bypass grafting (CABG) was performed in 201 (17%), and a concomitant tricuspid repair was performed in 199 (17%).

Statistical Analyses

Data were imported and analyzed in STATA 11.1 software (StataCorp LP, College Station, TX). The baseline, operative, and echocardiographic variables of patients who underwent mitral repair were compared with those who underwent replacement. Continuous data are described

Table 1. Patient Characteristics

Variables[a]	Mitral Valve		*p* Value
	Repair (n = 851)	Replacement (n = 303)	
Demographics			
Age, y	62.8 ± 13.1	64.9 ± 12.4	0.02
Diabetes[b]	72 (8)	48 (16)	<0.001
Female gender	276 (32)	200 (66)	<0.001
Previous sternotomy	45 (5)	73 (24)	<0.001
EuroSCORE II, %	2.5 ± 2.9	4.5 ± 4.3	<0.001
STS Risk Score, %	1.7 ± 2.2	3.8 ± 3.0	<0.001
Etiology of mitral valve disease			
Endocarditis	47 (6)	13 (4)	0.5
Functional MR[c]	111 (13)	13 (4)	<0.001
Other[d]	21 (2)	117 (39)	<0.001
Myxomatous degeneration	614 (72)	9 (3)	<0.001
Rheumatic disease	58 (7)	151 (50)	<0.001
Preoperative echocardiography			
LVEDD, mm	50.9 ± 19.1	46.1 ± 18.6	<0.001
LVESD, mm	32.2 ± 14.9	28.8 ± 14.7	0.001
LVEF grade[e]			
1	645 (76)	236 (78)	
2	77 (9)	34 (11)	
3	41 (5)	13 (4)	
4	88 (10)	20 (7)	0.3
Left atrial diameter, mm	48.8 ± 8.2	52.6 ± 10.1	<0.001
RVSP, mm Hg	45.2 ± 15.1	53.4 ± 17.1	<0.001
Concomitant procedures			
Aortic valve repair	15 (2)	10 (3)	0.1
Aortic valve replacement	51 (6)	36 (12)	0.001
CABG	148 (17)	53 (18)	0.9
Maze procedure	182 (21)	77 (25)	0.1
Tricuspid valve repair	99 (12)	100 (33)	<0.001

[a] Continuous variables are shown as the mean ± standard deviation and categoric variables as number (%). [b] Includes patients on oral medical therapy or insulin preoperatively. [c] Includes patients with mitral regurgitation due to annular dilation and posterior leaflet restriction on the basis of ischemic cardiomyopathy. [d] Includes patients with mixed etiologies causing mitral regurgitation or stenosis, including patients with a previous mitral prosthesis presenting for reoperative mitral valve replacement. [e] Grade 1, >0.60; grade 2, 0.35–0.60; grade 3, 0.20–0.34; grade 4, <0.20.

CABG = coronary artery bypass grafting; EuroSCORE = European System for Cardiac Operative Risk Evaluation; LVEDD = left ventricular end-diastolic diameter; LVEF = left ventricular ejection fraction; LVESD = left ventricular end-systolic diameter; MR = mitral regurgitation; RVSP = right ventricular systolic pressure; STS = Society of Thoracic Surgeons.