

Clinical Research

Very High Repair Rate Using Minimally Invasive Surgery for the Treatment of Degenerative Mitral Insufficiency*

Amine Mazine, MSc,^{a,b,†} Nicola Vistarini, MD,^{b,c,†} Aly Ghoneim, MD,^{a,b}
Jean-Sébastien Lebon, MD,^{a,d} Philippe Demers, MD, FRCSC,^{a,b}
Hugues Jeanmart, MD, FRCSC,^{a,b} Michel Pellerin, MD, FRCSC,^{a,b,‡} and
Denis Bouchard, MD, PhD, FRCSC^{a,b,‡}

^a Faculty of Medicine, Université de Montréal, Montreal, Québec, Canada

^b Department of Cardiac Surgery, Montreal Heart Institute, Montreal, Québec, Canada

^c Department of Cardiac Surgery, Pavia University School of Medicine, Pavia, Italy

^d Department of Anesthesiology, Montreal Heart Institute, Montreal, Québec, Canada

ABSTRACT

Background: Minimally invasive mitral valve surgery (MIMVS) is an established alternative to median sternotomy for mitral valve repair. However, this technique has yet to gain widespread adoption, partly because of concerns that this approach might yield lower repair rates or repairs that are less durable than those performed through a sternotomy. The purpose of this study was to report our inaugural experience with MIMVS, with a focus on mitral valve repair rate and midterm outcomes.

Methods: Between May 2006 and April 2012, minimally invasive mitral valve repair was attempted in 200 consecutive patients with degenerative mitral disease. The approach used was a 4- to 5-cm right anterolateral minithoracotomy with femorofemoral cannulation for cardiopulmonary bypass. Mean follow-up was 2.9 ± 1.8 years, and follow-up was 99% complete.

RÉSUMÉ

Introduction : La chirurgie minimalement invasive de la valve mitrale (CMIVM) est une alternative établie de la réparation de la valve mitrale par sternotomie médiane. Cependant, l'adoption de cette technique est encore peu répandue, en partie en raison des préoccupations que cette approche suscite concernant les taux de réparation plus faibles ou de réparations moins durables que celles réalisées par sternotomie. Le but de cette étude était de rapporter notre première expérience de CMIVM en nous concentrant sur le taux de réparation de la valve mitrale et les résultats à moyen terme.

Méthodes : Entre mai 2006 et avril 2012, la réparation minimalement invasive de la valve mitrale a été entreprise chez 200 patients consécutifs souffrant de maladie dégénérative de la valve mitrale. L'approche utilisée pour effectuer le pontage cardiopulmonaire était une minithoracotomie antérolatérale de 4 à 5 cm par canulation

The first successful mitral valvuloplasty performed through a minithoracotomy was reported by Carpentier et al.¹ nearly 2 decades ago. In the ensuing years, innovations in surgical instrumentation, cardiopulmonary bypass technology, and aortic clamping techniques have led to the rapid development and refinement of minimally invasive mitral valve surgery (MIMVS) techniques.²⁻⁶ The proposed benefits of minimally

invasive approaches to the mitral valve include reduced postoperative pain, faster patient recovery, and improved cosmesis.⁷ The right anterolateral minithoracotomy approach has demonstrated encouraging results and is now used routinely in several major centres.^{4,6,8-10}

Our MIMVS program was inaugurated in 2006, and the right anterolateral minithoracotomy has progressively become our preferred approach for isolated mitral valve repair. The purpose of this study was to report our inaugural experience with MIMVS in the first 200 consecutive patients operated on at our centre using this technique. This report focuses on the rate of successful mitral valve repair, as well as perioperative outcomes, midterm survival, and freedom from reoperation.

Methods

Between May 2006 and April 2012, a total of 750 isolated mitral valve operations were performed at the Montreal Heart

Received for publication September 12, 2014. Accepted December 5, 2014.

*This article was presented as an oral communication at the 2012 Canadian Cardiovascular Congress, October 27-31, 2012, Toronto, Ontario, Canada.

[†]These authors contributed equally to this work as first coauthors.

[‡]These authors are co-senior authors.

Corresponding author: Dr Denis Bouchard, Department of Surgery, Montreal Heart Institute, 5000 Belanger St, Montreal, Québec, Canada H1T 1C8. Tel.: +1-514 376-3330; fax: +1-514-376-4766.

E-mail: denis.bouchard@icm-mhi.org

See page 750 for disclosure information.

Results: The mitral valve was successfully repaired in all but 2 patients, yielding a repair rate of 99%. Hospital mortality occurred in 2 patients (1%). Intraoperative conversion to sternotomy was necessary in 12 patients (6%), including 1 of the 2 unsuccessful repairs. Mean cardiopulmonary bypass and aortic cross-clamp times were 130.8 ± 41.3 minutes and 104.8 ± 35.6 minutes, respectively. Median hospital stay was 5 days. The 5-year survival and freedom from reoperation were $97.9\% \pm 1.5\%$ and $98.1\% \pm 1.3\%$, respectively.

Conclusions: A very high repair rate can be achieved using MIMVS for the treatment of degenerative mitral regurgitation, including during the learning phase. Midterm survival and freedom from valve-related reoperation are excellent. MIMVS is a safe and effective alternative to mitral valve repair through a sternotomy.

Institute. Of these, 456 were mitral valve repairs and 294 were mitral valve replacements. In the repair group, 404 patients had degenerative mitral insufficiency. The present study focuses on the 200 consecutive patients from this group who underwent MIMVS. Patients with ischemic mitral insufficiency, endocarditis, dilated cardiomyopathy, or mitral stenosis were excluded from the present study. In addition, patients who had concomitant aortic disease, coronary artery disease, or severe peripheral vascular disease were not candidates for a minithoracotomy approach. Three patients had undergone previous cardiac surgery and were also excluded from this analysis.

The study was approved by our institution's local ethics committee. Data were obtained from the Montreal Heart Institute's Valve Clinic database, a prospective registry containing clinical information for all patients who undergo valve surgery at our centre. Additional data were gathered from medical records.

All patients were followed on a yearly basis by mailed questionnaires and telephone interviews at our institution's dedicated valve clinic. Follow-up was 99% complete and ranged from 3 months-7.5 years. Mean follow-up was 2.9 ± 1.8 years, representing a total of 579 patient-years.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics, version 20 (SPSS, Chicago, IL). Continuous variables are presented as mean \pm standard deviation, and categorical variables are reported as frequency (percentage). Survival and freedom from valve reoperation were assessed using Kaplan-Meier actuarial methods. Mortality and morbidity were defined according to the published guidelines of The Society of Thoracic Surgeons and the American Association for Thoracic Surgery.¹¹ The mitral valve repair rate was defined as the percentage of patients scheduled for mitral valve repair who underwent a successful plasty—ie, they left the operating room with mild or less mitral regurgitation and did not require reintervention on the mitral valve during the index hospitalization. Patients in whom the valve

fémorofémorale. Le suivi dont la moyenne était de $2,9 \pm 1,8$ ans a été achevé dans 99 % des cas.

Résultats : La réparation de la valve mitrale a été réussie, à l'exception de 2 patients, ce qui a entraîné un taux de réparation de 99 %. La mortalité intrahospitalière est survenue chez 2 patients (1 %). Une conversion intraopératoire en sternotomie a été nécessaire chez 12 patients (6 %), y compris 1 des 2 patients dont la réparation n'a pas été réussie. La moyenne des pontages cardiopulmonaires et des durées de clampage ont respectivement été de $130,8 \pm 41,3$ minutes et de $104,8 \pm 35,6$ minutes. Le séjour moyen à l'hôpital a été de 5 jours. La survie et l'absence de nouvelle chirurgie après 5 ans a respectivement été de $97,9\% \pm 1,5\%$ et de $98,1\% \pm 1,3\%$.

Conclusions : Un taux très élevé de réparation peut être atteint au moyen de la CMIVM pour le traitement de la régurgitation mitrale dégénérative, y compris durant la phase d'apprentissage. La survie et l'absence de nouvelle chirurgie valvulaire à moyen terme sont excellentes. La CMIVM est une alternative sûre et efficace à la réparation valvulaire par sternotomie.

was deemed unreparable before surgery were not included in the calculation of this rate.

Surgical technique

Patients were intubated with a double-lumen endotracheal tube, allowing for single-lung ventilation. Transesophageal echocardiography was used routinely to determine the mechanism of mitral insufficiency, to assess the position of endovascular cannulas, to facilitate the deairing process, and to evaluate the result of the surgical repair. In all patients, a 4- to 5-cm right anterolateral minithoracotomy was performed in the third or fourth intercostal space. After deflation of the right lung, a soft tissue retractor (Edwards Lifesciences, Irvine, CA) was used to achieve better exposition. The pericardium was then opened 3 cm above the right phrenic nerve and retracted using transcatheter pericardial stay sutures. Video assistance was provided by a 10-mm Olympus high definition thoracoscope (Olympus Canada, Markham, ON) inserted through a small port in the fourth intercostal space on the right midaxillary line. Throughout the procedure, the surgical field was flooded with carbon dioxide through the camera port.

Cardiopulmonary bypass was established by femorofemoral cannulation in all patients. The right femoral vessels were exposed through a transverse 3-cm incision at the level of the inguinal crease. After femoral dissection, the femoral vein and artery were cannulated under direct vision using the Seldinger technique. An endovenous drainage cannula was advanced through the femoral vein to the superior vena cava under echocardiographic guidance. In the initial cases, a pulmonary vent catheter was also inserted through the right internal jugular vein. Later in the series, this approach was abandoned in favour of the use of a single venous line for right heart decompression. A 25-mm venous cannula was used in most patients and allowed excellent venous drainage with a cardiac output of up to 6 L per minute.

Two different approaches for aortic occlusion were used in this series. In the initial cases, a special endoaortic occlusion device (Port-Access System; Heartport, Redwood City, CA and ThruPort Systems; Edwards Lifesciences, Irvine, CA) was

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