Results of mitral valve repair for Barlow disease (bileaflet prolapse) via right minithoracotomy versus conventional median sternotomy: A randomized trial

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Objective: The results of mitral repair for complex Barlow valves are adequate and support earlier intervention. It is unknown whether these results are reproducible in the context of minimally invasive surgery via right minithoracotomy.

Methods: We randomized patients with Barlow mitral disease (bileaflet prolapse) to have conventional open repair via median sternotomy (MS group) or minimally invasive (MI group) repair. Repair was done using polytetrafluoroethylene chordal reimplantation for both leaflets. In the MI group, we adopted right minithoracotomy, peripheral cannulation, external aortic clamping, and surgery under direct vision.

Results: Both groups comprised 70 patients. The operative and the cardiopulmonary bypass times were significantly longer in the MI group ($P = .003$ and $P = .012$). Mitral repair was successful in 98.5% MI patients and 100% MS patients. Operative mortality was comparable. The mean mechanical ventilation time, intensive care unit stay, and hospital stay were lower in the MI group ($P = .014$, $P = .02$, and $P = .03$). Mean pain score was lower in the MI group at postoperative days 2 and 4. At follow-up, the freedom from moderate (2+) or severe (3+ or 4+) mitral regurgitation was 98% versus 97% ($P = .9$). Two patients underwent reoperation (1 in each group) for late failure of repair. The Kaplan–Meier analysis confirmed these results.

Conclusions: Our data indicate that the optimal standard-of-care results of mitral repair for complex disease (Barlow) are reproducible in the minimally invasive settings through right minithoracotomy and direct vision. The minimally invasive technique can be proposed for complex mitral disease and early referral of these patients can be encouraged. (J Thorac Cardiovasc Surg 2011;142:77-83)

Barlow disease, also referred to as bileaflet prolapse, is considered to be a more generalized disease of the valve than other forms of mitral valvular degeneration¹ and is believed to carry a different outcome after repair for severe mitral regurgitation (MR). However, the surgical experience has consistently grown in past decades and recent reports have suggested that the results of the repair of Barlow valves may be similar to those obtained for simpler mitral conditions (fibroelastic deficiency, single-scallop prolapse).² Nonuse of annuloplasty rings, nonuse of sliding

plasty, and chordal shortening have been associated with MR recurrence in patients with Barlow disease. Excellent results have been obtained with bileaflet resection and posterior sliding plasty plus ring annuloplasty³ or chordal reimplantation for both leaflets.

A variety of technical solutions have been proposed for the performance of minimally invasive surgery of the mitral valve (use of the endoclamp or an external aortic clamp, direct vision or video-assisted surgery, robotic or direct-hand operation). Whichever the case, any less invasive strategy to repair the mitral valve entails a greater surgical complexity than open surgery. Standard-of-care mitral repair using the totally videoscopic approach is indeed reproducible^{4,5}; however, few specific data on patients with Barlow valve are available in the published reports. With the present randomized trial we sought to compare the feasibility, the operative results, and the follow-up outcomes (recurrence of MR and need for mitral reoperation) among patients undergoing mitral repair for Barlow disease using either the median sternotomy approach or a less invasive strategy through a right minithoracotomy, peripheral cannulation, and direct vision. Thus, the reproducibility of standard-of-care mitral repair is tested in the minimally invasive settings.

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Abbreviations and Acronyms

AF	= atrial fibrillation
CPB	= cardiopulmonary bypass
MI group	= minimally invasive treatment group
MR	= mitral regurgitation
MS group	= median sternotomy treatment group

METHODS**Patient Selection and Study Design**

Starting in January 2006, we prospectively selected patients according to the following criteria:

- Patients had to have isolated, severe MR with indication to undergo elective reparative surgery on the basis of the current guidelines.⁶ Patients with associated coronary disease, other more than mild valvular disease, congenital heart defects, and aortic disease were excluded from the study. Indication for concomitant ablation of atrial fibrillation (AF) was not an exclusion criterion.
- The etiology of MR had to be represented by Barlow disease (bileaflet prolapse) of the mitral valve, as documented by preoperative echocardiography.
- Patients were fully informed and willing to enter the study and had signed an informed consent.
- The patients were free from any contraindication to right minithoracotomy and femoral cannulation and were facing their primary cardiac operation. Patients affected by functional secondary tricuspid regurgitation (grade > mild) were excluded, in view of their advanced disease and prognosis distinct from that of patients with isolated MR.⁷

The aim of the present investigation was to analyze the clinical outcomes associated with different routes of access to the mitral valve, rather than the results of an established repair technique. The study design relied on preoperative ultrasound imaging to differentiate the patients affected by Barlow disease of the mitral valve from those carrying MR owing to other causes. The finding of hoodlike bulging of different portions of the anterior leaflet plus multiple bulging posterior scallops with excess tissue and prolapse was referred to as Barlow valve. In the present article, the term “bileaflet prolapse” identifies the same condition described above and will be interchangeably used with the term “Barlow valve.” The involvement of both leaflets in the disease process was an obligatory criterion to define Barlow disease. In the event of such findings at transthoracic echocardiography, preoperative transesophageal echocardiography was used to confirm the diagnosis as part of the study protocol. After inclusion, patients were randomized with the aid of a computerized algorithm to receive mitral valve repair via either the minimally invasive approach with right minithoracotomy (MI group) or via conventional full median sternotomy (MS group). In both groups, mitral repair was the first objective of the surgical treatment. To reduce the probability of bias, we started the present investigation after our surgical team had reached a good mastery of the minimally invasive technique and of the related technologies. The study was planned on the basis of historical data from the GVM electronic database concerning patients subjected to conventional mitral repair for bileaflet prolapse. A sample size calculation indicated that 60 observations per study group were adequate to detect with a 90% power a statistically significant difference, if any, for the following study end points: operative mortality, occurrence of at least 1 postoperative morbidity (among revision for bleeding, myocardial infarction, renal failure, neurologic complications, wound infection, and femoral complications), and recurrent moderate-to-severe MR within the 12-month follow-up. The intention-to-treat methodology was used.

The present randomized trial was conducted within 2 institutions (Villa Azzurra Hospital, Rapallo, Italy, and Anthea Hospital, Bari, Italy) pertaining to the GVM Hospitals of Care and Research Group. The local review board approved the study protocol. The present clinical trial conforms to the principles enunciated in the Helsinki declaration and the CONSORT statement (available online at <http://www.consort-statement.org>). This study was sponsored neither fully nor in part, and all the authors had complete freedom of investigation. This investigation was not designed to evaluate the performance of any specific medical device.

Study End Points

- Feasibility of successful mitral repair for Barlow disease (bileaflet prolapse) via right minithoracotomy (rate of conversion to median sternotomy, rate of conversion to valve replacement).
- Operative results in the study groups (mortality, perioperative complications, postoperative course, and postoperative pain as assessed by a visual analogic scale).
- Midterm follow-up: rates of overall survival, recurrent MR-free survival, and reoperation-free survival.

Surgery

In the MI group, the surgical technique entailed a minimally invasive access to the mitral valve via a 4- to 5-cm right anterolateral minithoracotomy in the inframammary groove (third intercostal space, working port). An instrument port was done at the fifth to seventh intercostal space at the midaxillary line for cardiomy suction and carbon dioxide insufflation. The procedure was carried out using long-shafted instruments through the minithoracotomy incision and under direct vision. Selective bronchial intubation and single lung ventilation were required. The pericardium was incised parallel to the phrenic nerve and stay sutures were placed. After the adequacy of exposure was confirmed, cardiopulmonary bypass (CPB) was established. The venous drainage was obtained with cannulation of the superior vena cava percutaneously through the right internal jugular vein (FEMII016AS 16F cannula; Edwards Lifesciences Research Medical Inc, Midvale, Utah) and of the common femoral vein via a right or left groin incision (QuickDraw QD22 femoral-atrial venous cannula; Edwards Lifesciences Research Medical Inc). Arterial inflow was provided with direct cannulation of the ascending aorta. In case of technical difficulties and inability to adequately dominate the ascending aorta, the common femoral artery was cannulated (Seldinger technique) using the Straight Tip 23F with Autoincisor Introducer (Edwards Lifesciences Research Medical Inc). The ascending aorta was crossclamped externally using a Chitwood clamp (Chitwood; Scanlan International, St Paul, Minn). The endoclip device was not used in our practice. A cardioplegia needle was inserted in the ascending aorta and secured with tourniquets (9F needle; Maquet Cardiopulmonary AG, Hirrlingen, Germany). After cardiac arrest using cold antegrade blood cardioplegia, left atriotomy was performed and the mitral valve was accessed.

In the MS group, conventional full median sternotomy with ascending aortic and bicaval cannulation was used. A vacuum-assisted venous drainage was used in both groups (digital regulation by AMVEX 100 device; Amvex Corp, Richmond Hill, Ontario, Canada). A phosphorylcholine-coated circuit with low priming volume was used routinely in all cases.

The same concepts and standardized surgical protocols for mitral valve repair were adopted in both study groups. Rather than quadrangular resection with sliding or edge-to-edge approximation, we routinely adopted artificial chordal polytetrafluoroethylene reimplantation (Gore-Tex; W. L. Gore & Associates, Inc, Flagstaff, Ariz) for both leaflets. All mitral repair procedures were completed with semirigid ring annuloplasty. After completion of the procedure and weaning from CPB, the continence of the valve was checked by transesophageal echocardiography. We indicated concomitant ablation of AF in patients with paroxysmal or persisting AF and having a left atrial diameter not exceeding 60 mm (parasternal long

axis view). Concomitant ablation of AF was performed using a saline-irrigated tip disposable unipolar radiofrequency device. The ablation was performed after completion of mitral repair. It consisted of electrical isolation of the 4 pulmonary vein ostia and creation of a “mitral line” connecting with the mitral annulus in the region of P3.

Operative mortality was defined as all-cause death within 30 postoperative days. Perioperative neurologic complications (stroke or transient ischemic attack) were defined as a new neurologic deficit or coma, which became apparent on awakening from the anesthesia. Postoperative renal failure was defined as the increase of the serum creatinine level greater than 2 mg/dL with respect to the preoperative value. Postoperative pain was assessed by the administration of a visual analog scale (range: 0 = no pain to 10 = maximum pain) to all awake patients at the second, fourth, and sixth postoperative days. As a routine protocol, in the absence of contraindications, all patients enrolled in this study received intravenous ketorolac 30 mg each day until the fourth postoperative day. Subsequently, they received oral indomethacin, 50 mg twice a day. We adopted as a criterion for extubation the maintenance of the following blood gas parameters after disconnection from the ventilator: arterial oxygen tension greater than 80 mm Hg (arterial oxygen saturation > 95%), arterial carbon dioxide tension 32 to 48 mm Hg, and pH 7.32 to 7.48. Contraindications to extubation were recent stroke, hemodynamic instability, and mediastinal bleeding. Standardized criteria were also applied to decide the intensive care unit and hospital discharge. The postoperative data were managed in compliance with the current guidelines.⁸

Follow-up

Follow-up was conducted by outpatient visits 1 month after surgery, at the sixth and twelfth postoperative months, and every year thereafter. The visit included physical examination, surface electrocardiogram, and transthoracic echocardiogram. With respect to the study end points, recurrent MR was defined as moderate or severe (3+ or 4+) MR as demonstrated at any follow-up echocardiogram. To the purposes of MR assessment, we adopted the current criteria as per the American College of Cardiology/American Heart Association guidelines (mild, 1+; moderate, 2+; severe, 3+ or 4+). Mitral reoperation was defined as reoperation on the mitral valve owing to late failure of repair during the follow-up. Conversion to valve replacement owing to failed repair during the primary operation was not considered as a mitral reoperation. Recurrent MR and mitral reoperation were considered as mitral events during the follow-up. Patients who

received concomitant AF ablation entered a specific follow-up program consisting of periodic Holter electrocardiographic tracings to evaluate the rhythm over time.

Statistical Methods

All data were collected prospectively and entered in a computerized database by surgical assistants at the time of patients' discharge from the hospital. Continuous data are reported as mean $\pm$ standard deviation and categorical variables as percentages. Intergroup comparison was conducted using the χ^2 test and the 2-tailed Student *t* test for categorical and continuous variables, respectively. Survival analysis was performed according to the Kaplan–Meier method, and corresponding survival curves were built. Kaplan–Meier analysis was performed for both overall survival and mitral event-free survival. The date of the first echocardiogram demonstrating recurrent MR was considered as the date of event. The log–rank statistic was used to compare the survival probabilities between groups. The alpha level was .05. The statistical analysis was conducted using SPSS version 13.0 for Windows (Statistical Package for Social Sciences; SPSS, Inc, Chicago, Ill). The sample size calculation was done using the Power and Sample Size Calculation Software version 3.0.14 for Windows.⁹

RESULTS

The study design is reported in Figure 1. We screened a total of 618 patients affected by isolated mitral valve disease; of these, 159 (25.7%) were given a diagnosis of Barlow disease according to the above echocardiographic criteria. Nineteen patients refused to enter the study; thus, we enrolled and randomized a final cohort of 140 individuals. Both study groups comprised 70 patients. The baseline characteristics of the study population are summarized in Table 1.

Operative Results

The overall operative time, the aortic crossclamp time, and the CPB time were significantly longer in the MI group (Table 2). The mean number of neochordae implanted per

FIGURE 1. Study design. *MI group*, Minimally invasive treatment group; *MS group*, median sternotomy treatment group.

TABLE 1. Baseline characteristics of the study groups

Characteristic	MI group	MS group	P
Age (y)	53.2 ± 10.4	54 ± 10.1	.68
Sex (male/female)	41/29	43/27	.86
NYHA class III-IV	21 (30%)	19 (27%)	.85
Preoperative AF (n)	16 (22.8%)	18 (25.7%)	.84
Preoperative LVEF < 50% and > 35% (n)	11 (15.7%)	12 (17.1%)	.99
Preoperative LVEF < 35% (n)	2 (2.8%)	2 (2.8%)	—

MI group, Minimally invasive treatment group; MS group, median sternotomy treatment group; NYHA, New York Heart Association; AF, atrial fibrillation; LVEF, left ventricular ejection fraction.

patient was similar between the groups. No leaflet resection was performed in any case. Conversion of the procedure to mitral replacement was required in 1 case. This was due to failed repair that became evident at transesophageal echocardiography after weaning from CPB. Prosthetic replacement could be carried out by minithoracotomy. Concomitant ablation of AF was performed in 11 patients in the MI group and in 12 patients in the MS group (no statistically significant difference). Causes of operative mortality were stroke in 1 case, adult respiratory distress syndrome in 1 case, and postoperative low output in 1 case. The average mechanical ventilation time was significantly shorter in the MI group. The mean pain scores were significantly lower in the MI group at all time points (second, fourth, and sixth postoperative days). The shorter ventilation time observed in the MI group is also reflected by the earlier

discharge from the intensive care unit and from the hospital. The rates of the remaining postoperative morbidity (renal failure, neurologic complications, myocardial infarction, bleeding, and bleeding-related morbidity) were comparable between groups.

Follow-up Results

Mean follow-up time was 12.4 months. One patient in the MS group was lost at follow-up; thus, the follow-up was 99% complete. One patient (MI group) died during the follow-up owing to a noncardiac cause (car crash). Overall, the outcome variables pertaining to study end point 3 were comparable between the MI and the MS groups. Among the surviving patients, the freedom from moderate or severe MR was 97% in the MS group versus 98% in the MI group ($P = .9$). One patient in each group had a reoperation on the mitral valve owing to late failure of repair and symptoms of heart failure. In both cases, valve replacement via median sternotomy was performed. Thus, a total of 3 mitral events (2 reoperations and 1 case of severe MR) were included in the follow-up (Table 3).

The Kaplan–Meier curves for overall survival in the 2 study groups are reported in Figure 2: there was no statistical difference between the curves ($P = .86$). Mitral event-free survival was also comparable between the MS and the MI groups ($P = .74$) (Figure 3). Thus, time-to-event analysis confirmed that the follow-up outcomes are comparable between the study groups. Among the patients who

TABLE 2. Intraoperative and early postoperative results

Characteristic	MI group	MS group	P
CPB time (min)	139 ± 28	101 ± 24	.012
Aortic crossclamp time (min)	92 ± 23.3	70 ± 18	.02
Operative time (min)	296 ± 118	249 ± 91	.003
Conversion to mitral replacement (n)	1 (1.3%)	0	.8
Average number of prolapsing segments per patient	2.9 ± 0.6	3.0 ± 0.6	.89
Average No. of neochordae per patient	5.4 ± 0.9	5.6 ± 1.0	.53
Average No. of treated segments per patient	2.8 ± 0.6	2.9 ± 0.5	.77
ICU stay (d)	2.1 ± 0.9	3.2 ± 1.1	.02
Mechanical ventilation time (d)	1.2 ± 0.2	2.3 ± 0.5	.014
Revision for bleeding* (n)	4 (5.7%)	3 (4.3%)	.99
Overall bleeding (mL/m ²)	759 ± 387	741 ± 370	.63
Patients transfused with blood products (n)	19 (27.1%)	21 (30%)	.85
Hospital stay (d)	8.6 ± 4.7	11.8 ± 5.2	.03
Myocardial infarction* (n)	1 (1.4%)	0	.99
Postoperative renal failure* (n)	3 (4.3%)	3 (4.3%)	—
Neurologic complications* (n)	1 (1.4%)	2 (2.8%)	.99
Femoral complications*† (n)	0	—	—
Wound infection* (n)	0	1 (1.4%)	.99
Operative mortality (n)	2 (2.8%)	1 (1.3%)	.99
Postoperative pain: 2nd day	2.8 ± 0.9	4.7 ± 1.3	.001
Postoperative pain: 4th day	2.3 ± 0.8	5.1 ± 1.5	<.001
Postoperative pain: 6th day	1.5 ± 0.4	3.1 ± 0.9	.002

MI group, Minimally invasive treatment group; MS group, median sternotomy treatment group; CPB, cardiopulmonary bypass; ICU, intensive care unit. *Number of patients affected by each complication cited. †Complications at the level of the femoral vessels cannulation (pseudoaneurysm formation, bleeding, revision of the groin incision).

TABLE 3. Follow-up results

Characteristic	MI group	MS group	P
End-of-follow-up overall mortality	3 (4.3%)	1 (1.4%)	.61
Mild MR (n)	1	2	.99
Moderate or severe MR (n)	2	1	.61
Mitral reoperation (n)	1	1	.99

MI group, Minimally invasive treatment group; MS group, median sternotomy treatment group; MR, mitral regurgitation.

received concomitant AF ablation, 72% and 75% (MI and MS groups, respectively) were in stable sinus rhythm at the last follow-up available (no statistically significant difference).

DISCUSSION

The Third Adult Cardiac Surgical Database Report 2006 of the European Association for Cardio-Thoracic Surgery¹⁰ indicates that a total of 4491 isolated mitral valve operations were performed in 2006 in the 18 contributor countries. The database probably underestimates the real number of operations performed. Additionally, it is limited by the impossibility to distinguish between patients operated on for rheumatic disease versus those operated on for degenerative disease and between patients who received mitral repair versus those who received mitral replacement. However, it is evident that mitral disease is one leading indication for heart surgery. In the published series of mitral repair, the

Patients at risk:

MI Group	68	67	67	67	67
MS Group	69	69	69	69	69

FIGURE 2. Kaplan–Meier survival curves: overall survival in the MI and in the MS group during follow-up. Difference is not statistically significant (log–rank). Number of patients at risk at each time point (5, 10, 15, 20, and 24 months) is reported below. MI group, Minimally invasive treatment group; MS group, median sternotomy treatment group.

Patients at risk:

MI Group	68	67	66	66	66
MS Group	69	68	67	67	67

FIGURE 3. Kaplan–Meier survival curves: mitral event-free survival in the MI and in the MS group during follow-up. Difference is not statistically significant (log–rank). Number of patients at risk at each time point (5, 10, 15, 20, and 24 months) is reported below. MI group, Minimally invasive treatment group; MS group, median sternotomy treatment group.

proportion of individuals with Barlow disease, also referred to as bileaflet prolapse, ranges between 15% and 25%. This condition entails a myxoid appearance of the whole valve and several factors contributing to incompetence, including annular dilation, bileaflet prolapse, chordal elongation, excess tissue, and billowing. As such, the long-term outcome of the repaired valves may be influenced by the progression of the disease within the native leaflets. In the current era, the results of mitral repair for complex disease are approaching those observed after repair for simpler degenerative conditions (ie, isolated P2 prolapse), thanks to a deeper knowledge of mitral pathophysiology and to standardized surgical techniques.² However, minimally invasive surgery for the atrioventricular valves is becoming increasingly popular. Robotic surgery has also been advocated in this instance¹¹; however, escalating costs and scarce reproducibility have confined this approach to little more than clinical research. On the contrary, the right minithoracotomy approach with thoracic ports, long instruments, and peripheral cannulation with or without videoscopic assistance is a clinical reality and has proved to be safe and feasible.^{4,5,12}

A large retrospective analysis of mitral repair operations (rheumatic or degenerative disease) has indicated that the results of the repair of myxomatous valves are excellent and superior to those obtained for rheumatic valves.¹³ The proportion of Barlow patients in the myxomatous valve subgroups was not, however, available. Nonetheless, the minimally invasive operations involve a higher level of technical complexity. This is probably reflected by the

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longer operative and CPB times observed in the MI group. The present randomized study was designed to ascertain whether the results of minimally invasive mitral repair for the complex bileaflet prolapse condition are comparable with those obtained via median sternotomy.

In this article we report the early and midterm results of this trial. We selected a homogeneous study cohort to reduce as much as possible the population bias, with particular attention to the mechanism of mitral incompetence. Our data indicate that the repair of the severely regurgitant Barlow valve is feasible and reproducible through the minithoracotomy access. Operative mortality and major morbidity were both comparable between groups. There was only 1 case in the MI group of obliged conversion to median sternotomy, owing to inadequate exposure. In addition, the patients operated on with the minimally invasive approach displayed the typical advantages associated with the preservation of the sternal bone and respiratory mechanics (shorter intubation time despite a longer CPB time). The reduced pain scores observed in the MI group are in touch with this element. These data agree with previous findings, which underline the potential of minimally invasive mitral surgery to facilitate the postoperative recovery.^{4,5} We could not demonstrate a statistically different incidence of surgical wound complications between the groups. However, a lesser surgical trauma and the preservation of the sternal bone reduces the potential for wound infection and dehiscence in the MI group. Improvements in the ventilator weaning protocols may further reduce the mechanical ventilation time. Besides the cosmetic advantages, a more rapid postoperative recovery, and reduced postoperative pain, the minimally invasive operation may be highly cost-effective owing to shorter intensive care unit and hospital stays. However, such economic benefits should be weighed against the higher costs of disposable materials and specific instrumentation. A comparison versus the MS group even under the economic profile may be advisable. A formal cost-analysis to address these points is expected in the current era, in which the management of health care expenditures represents a growing ethical and political problem.

In our practice, the MI group was characterized by a longer CPB time and aortic crossclamp time than the MS group. Thus, we believe in the importance of an optimal technique for myocardial protection in these patients and the usefulness of biocompatible CPB circuits, aimed at reducing the magnitude of CPB-related systemic inflammatory response and end-organ damage.

Our follow-up data suggest that the incidence of mitral events (including both recurrent MR and mitral reoperation) is acceptable and similar between the study groups. However, more follow-up data and long-term results are required inasmuch as in Barlow disease the spared valve tissue is abnormal and prone to evolution. An intergroup difference in outcomes related to end point 3 may appear over time. The role of an

annuloplasty ring to improve the long-term results has been definitely ascertained.^{13,14} The implantation of a ring was a constitutive part of our standardized surgical technique. In addition to ring annuloplasty, as an institutional policy we routinely treated bileaflet prolapse with chordal reimplantation without performing extensive leaflet resections. Such strategy is aimed at increasing the coaptation area and the coaptation line and at reducing the extent of the prolapse by increasing the coaptation depth. A recent prospective randomized trial has demonstrated that the implantation of neochordae made of expanded polytetrafluoroethylene achieves similar results compared with scallop resection in the treatment of the prolapse of the anterior leaflet.¹⁵ As a collateral finding, we confirm previous results¹⁶ that concomitant AF ablation is feasible during MI mitral operations. The follow-up results (maintenance of sinus rhythm) were comparable between our groups.

The present data suggest that the MI technique is similar to conventional surgery concerning the feasibility profile and the operative and follow-up results. However, the reduced postoperative pain, facilitated recovery, and cosmetic advantages support a more liberal application of the MI technique. The short follow-up time does not allow us to draw conclusions over the long-term results of mitral repair in these groups, and this is an important limitation of the present study. Nonetheless, inasmuch as our end points are related to merely technical issues, the comparability in mitral events at 1 year indicates that the clinical results of state-of-the-art mitral valve repair can be reliably achieved via the MI route.

Earlier referral for mitral valvular disease amenable to repair has been an increasing practice in recent years, supported by enlarging surgical experience. Such tendency may be further encouraged by the present data. The referring physicians should be aware that the advantages of early standard-of-care mitral repair can be achieved at the price of lesser surgical morbidity and a shorter postoperative course if minimally invasive techniques are used. Such issues may now deserve discussion in the context of interdisciplinary meetings and guideline revision committees.

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