The Minithoracotomy Approach: A Safe and Effective Alternative for Heart Valve Surgery

Giovanni Mariscalco, MD, PhD, and Francesco Musumeci, MD

Department of Heart and Vessels, Cardiac Surgery Unit, Varese University Hospital, Varese; and Department of Cardiac Surgery and Transplantation, S. Camillo Hospital, Rome, Italy

Despite criticisms over the last decade, heart valve surgery through right anterior minithoracotomy (MT) proved excellent short-term and long-term results, becoming a feasible and popular alternative to the sternotomy approach. The rapid development and refinements of techniques have led to MT valve surgery being considered safe, effective, and durable. Minithoracotomy has been demonstrated to be a valid cost-effective and cost-saving strategy for valve surgery, being associated with reduced morbidity and mortality. Tangible benefits include less pain, faster postoperative recovery, and better cosmetic results. As a result, MT has been increasingly used as a routine approach in many centers for both aortic and mitral valve surgery.


Material and Methods

A systematic search was performed using the PubMed database to identify all studies reporting results and outcomes of MT heart valve surgery. Search strategy combined “mitral valve,” “aortic valve,” “tricuspid valve,” “minimally invasive,” and “minithoracotomy.” Published original articles, case series, and individual reports were analyzed. All studies were identified from the existing literature until April 2013. In addition, the “related articles” function in PubMed was used as a further check of rigor. When multiple studies had been published by a single institution, the largest, most recent, or most informative study was considered.

Historical and Technical Notes

In 1996, Carpentier and colleagues [25] performed the first video-assisted MV repair through a right anterolateral MT using peripheral extracorporeal circulation with ventricular fibrillation. A video-assisted controlled by a voice-activated camera arm and by robotic telemanipulation and three-dimensional endoscopy was subsequently introduced [26–30]. In the same years, feasibility and myocardial functional preservation were reached through right MT with the port-access technique [28]. In 1998 Carpentier’s group performed the first completely robotic MV repair [32].

A variety of surgical approaches and techniques for MV surgery through right MT have been proposed. A dual-lumen endotracheal tube or bronchial blocker are generally required [6–16, 26–34]. The entire procedures are performed through a 4 cm to 7 cm port located in the right inframammary groove, usually in the fourth intercostal space [6–16, 26–34]. Arterial cannulation is accomplished with femoral artery or direct aortic cannulation, whereas venous drainage requires femoral vein with or without concomitant internal jugular cannulation, generally under transesophageal echocardiography guidance. Aortic occlusion is performed by either percutaneous endovascular intraluminal balloon (the port-access system) or transthoracic aortic clamp, inserted through a separate transthoracic incision [6–16, 26–34]. The majority of procedures utilize antegrade delivery of cardioplegia into the aortic root, administered through

Address correspondence to Dr Mariscalco, Department of Heart and Vessels, Cardiac Surgery Unit, Varese University Hospital, Via Guicciardini 7, Varese 21100, Italy; e-mail: giovannimariscalco@yahoo.it.
the balloon endovascular clamp or the direct aortic root cannulation [10–20, 29–37].

In 1997, Benetti and coworkers [35] proposed the right anterior MT approach also for AV. A transverse incision of 5 cm to 7 cm is generally placed over the second or the third intercostal space [18–24]. Central cannulation involving ascending aorta and right atrium or a femoral cannulation is required [18–24]. A direct cross clamping of the aorta with antegrade cardioplegia delivery is usually employed. Left ventricular venting is accomplished as in other conventional AV operations. In 1999, Robin and associates [36] performed the first video-assisted tricuspid valve surgery.

Results

Despite criticisms over the last decade, various institutions have proved excellent results for MT valve surgery [6–26].

Hospital Mortality

Patients undergoing MV and AV surgery through right MT have 0% to 10% hospital mortality, although recent series testify to lower rates ranging from 0% to 2.2% along with the modification and simplification of surgical techniques [6–26]. None of the largest series documented differences in hospital mortality between the MT and ST approaches (Tables 1 and 2). Chitwood and associates [27] firstly suggested that video-assisted mitral operations can be performed safely as compared with the conventional ones. Their first experience enrolled 31 consecutive patients undergoing MT mitral valve surgery (repair and replacement) compared with 100 patients having conventional ST [27]. No hospital deaths were documented in the MT group, and 30-day mortality was comparable between groups (3.2% versus 2.2%, p = nonsignificant). Recent series report even better results [6–16]. Galloway and associates [7] enrolled 1601 patients affected by degenerative MV disease. The MV repair was performed in 1,071 patients with right anterior MT and in 530 with the ST approach, and hospital mortality was identical (1.3% versus 1.3%). Iribarne and associates [16] provided similar results with 1,121 isolated MV operations. After propensity matching analysis, 382 pairs were obtained: no differences in 30-day mortality were observed between the two groups (1.8% versus 1.8%, p = 0.622) [16].

Consonant results are reported for AV surgery [17–23]. Glower and associates [19] collected more than 300 AV undergoing MT, documenting a hospital mortality of 1.3%. Glauber and associates [23] enrolled data from 637 consecutive patients undergoing isolated AV surgery: 138 MT patients were propensity matched to those undergoing ST, and equal in-hospital mortality was registered [9]. Excellent results are also reached in reoperative valve surgery conducted through MT [37–40].

Neurologic Events

Similarly to other minimally invasive valve surgery approaches, concerns have arisen for MT with reference to possible postoperative cerebrovascular accidents (CVA). The reduced surgical field with its theoretically inadequate deairing was advocated as the main cause for possible negative neurologic outcomes. Although early series seem to suggest an increased CVA rate, the use of transesophageal echocardiography and continuous CO2 insufflation have recently allowed the achievement of comparable outcomes [41]. Iribarne and associates [16] registered no differences in early stroke (0.3% versus 1.3%, p = 0.217) and delayed stroke (0.8% versus 1.3%, p = 0.725) after MV surgery. Dogan and associates [42] randomly allocated 40 consecutive patients affected by severe MV disease to undergo right anterior MT or ST. Neuropsychological tests were performed a day before and 5 days and 2 months after the operation, and failed to demonstrate significant differences between the two approaches. No CVA differences were also observed for elderly patients and for AV surgery [17–23, 43–46]. Interestingly, comparison of endoaortic balloon occlusion (EABO) and transsthoracic clamping revealed controversial results [7, 8, 47]. Modi and colleagues [8] observed a trend toward an increased risk of stroke in the EABO group (2.7% versus 1.2%, p = 0.08), whereas other studies did not, although more microembolic events were detected in the same group [6, 47].

The atherosclerotic burden in aortic arch and descending aorta seems to play a crucial role in postoperative CVA, especially in elderly patients, using retrograde perfusion [48]. Several studies analyzing MT valve surgery identified retrograde perfusion as the only independent risk factor for stroke (odds ratio 8.5; p = 0.04), suggesting that retrograde perfusion is a viable option for younger patients without vascular disease only [10, 12, 48, 49].

Reexploration and Transfusions

Since the first MT experiences, a potential reduction in transfusions, bleeding, and reexplorations was expected. However, both observational and randomized studies
have demonstrated conflicting results [10–27, 45, 53, 54]. El-Fiki and associates [50] randomly collected 100 consecutive MV patients to undergo right anterolateral MT and ST, observing significantly lower postoperative blood loss in the MT group (481 ± 142 mL versus 930 ± 357 mL, p = 0.01). Conversely, Dogan and associates [42] did not find differences in chest tube output in their randomized series (446 ± 375 versus 446 ± 312, p = 0.99). Similarly, disputed data exist for blood product transfusions [10–27, 45, 53, 54]. Grossi and colleagues [43] observed that MT operations required less fresh frozen plasma, and platelet units [16, 42, 44]. Finally, reexplorations for bleeding yielded comparable results in AV and MV surgery using either the MT or the ST approach [11, 14, 15, 17–23, 43–46]. Reexploration generally ranges from 1% to 7% in AV cases, and from 0% to 11% in MV operations with the MT approach [6–23]. Iribarne and coworkers [16] encompassing more than 1,100 patients undergoing isolated MV operations, did not find any difference in reexploration for bleeding between the two groups (3.7% versus 2.9%, p = 0.685). Sharony and colleagues [17] observed similar data for a total of 921 consecutive patients undergoing isolated AV replacement, observing an identical reexploration rate between two propensity matched cohorts of 233 patients undergoing MT and ST (3.4% versus 3.4%, p = 1.00).

### Atrial Fibrillation and Acute Kidney Injury

Limited heart manipulation and trauma is associated with reduced postoperative atrial fibrillation (AF) [52]. Although the Port-Access International Registry (PAIR) reported a 10% incidence of postoperative AF with the port-access technique, no differences were documented between MT and ST in MV surgery [6, 16, 26, 46]. Suri and associates [14] observed an equal AF rate between 350 isolated MV repair performed with a MT approach compared with 365 ST operations (26% versus 27%, p = 0.627). A lower AF rate is commonly registered in AV patients undergoing MT access [20, 22, 23].

---

**Table 1. Major Published Clinical Series on Mitral Valve Surgery Through Minithoracotomy Involving More Than 1,000 Patients**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of study</td>
<td>PO/Multi</td>
<td>CC/Sc</td>
<td>PO/Bc</td>
<td>RO/Sc</td>
<td>RO/Sc</td>
</tr>
<tr>
<td>Number of patients</td>
<td>1,059</td>
<td>1,071</td>
<td>1,178</td>
<td>1,339</td>
<td>1,280</td>
</tr>
<tr>
<td>Preoperative data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>57 ± 14/60 ± 14a</td>
<td>60.4 ± 14.0</td>
<td>61.1 ± 13.9</td>
<td>60.3 ± 12.7</td>
<td>59 ± 14/63 ± 13b</td>
</tr>
<tr>
<td>Male, %</td>
<td>51.5</td>
<td>61.7</td>
<td>49</td>
<td>61.2</td>
<td>45.4</td>
</tr>
<tr>
<td>Prior surgery, %</td>
<td>16.1</td>
<td>4.2</td>
<td>18.8</td>
<td>6.1</td>
<td>–</td>
</tr>
<tr>
<td>Intraoperative data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPB time, min</td>
<td>–</td>
<td>–</td>
<td>146.1 ± 51.4</td>
<td>121 ± 38</td>
<td>132 ± 53/136 ± 57c</td>
</tr>
<tr>
<td>ACC time, min</td>
<td>–</td>
<td>–</td>
<td>104.6 ± 40.3</td>
<td>70 ± 32</td>
<td>79 ± 43/95 ± 43c</td>
</tr>
<tr>
<td>Mitral valve repair, %</td>
<td>46.4</td>
<td>66.5</td>
<td>79.9</td>
<td>100</td>
<td>75.6</td>
</tr>
<tr>
<td>EABO, %</td>
<td>91.5</td>
<td>74.8</td>
<td>40.7</td>
<td>0</td>
<td>4.4</td>
</tr>
<tr>
<td>Concomitant surgery, %</td>
<td>–</td>
<td>6.8</td>
<td>33.1</td>
<td>38.8</td>
<td>23.7</td>
</tr>
<tr>
<td>Type of vision</td>
<td>Video assisted</td>
<td>Direct vision</td>
<td>Video assisted</td>
<td>Video assisted</td>
<td>Video assisted</td>
</tr>
<tr>
<td>Postoperative data, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reoperation for bleeding</td>
<td>4.3</td>
<td>–</td>
<td>5.4</td>
<td>5.13.7</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>2.1</td>
<td>2.3</td>
<td>2.0</td>
<td>1.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>10.2</td>
<td>22.8</td>
<td>26.7</td>
<td>–</td>
<td>23.2</td>
</tr>
<tr>
<td>Transfusion</td>
<td>30.2</td>
<td>–</td>
<td>45.5</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Infections</td>
<td>–</td>
<td>0.8</td>
<td>0.6</td>
<td>–</td>
<td>0.6</td>
</tr>
<tr>
<td>Aortic dissection</td>
<td>0.4</td>
<td>–</td>
<td>0.8</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Hospital mortality</td>
<td>3.7</td>
<td>1.3 (2.0)d</td>
<td>2.6</td>
<td>2.4</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*a Age for the mitral valve repair and mitral replacement groups, respectively.  
*b Data available with reference to the adopted perfusion strategies.  
atk Data from a larger series (3,125 patients) by the same group [66].  
*t Data from a larger series (1,282 patients) by the same group [52].

ACC = aortic-cross clamp; Bc = bicenter; CC = case control; CPB = cardiopulmonary bypass; EABO = endoaortic balloon occlusion; Multi = multicenter; PO = prospective observational; RO = retrospective observational; Sc = single center.
For renal outcomes, a difficult comparison across studies exists because of the wide variation of the adopted definitions for acute kidney injury [53]. Generally, no differences are reported in both AV and MV surgery using MT or ST approaches [15, 16, 43, 44, 57]. McCreath and associates [54] specifically explored the acute kidney injury issue, evaluating data from all isolated MV operations over a 10-year period. They demonstrated a highly significant association between surgical approach and peak postoperative fractional change in creatinine (F value = 13.33, p = 0.0003) indicating a greater risk of acute kidney injury with standard ST access. For peak postoperative creatinine, ST operations were associated with greater renal injury (F value = 12.72, p = 0.0004) [54].

Septic Complications
Avoiding the potential risk of mediastinitis, MT is associated with lower wound infections and septic complications than ST. Grossi and associates [43] fully investigated this issue in a cohort of 197 patients having isolated MV and AV surgery, reporting a lower rate of sepsis/endocarditis in the MT group (0.9% versus 5.7%, p = 0.05). Raanani and associates [15] observed consonant data on superficial wound infections in a more recent series (0% versus 7%, p = 0.019). However, other groups did not observe relevant differences [11, 14, 51].

Pain, Cosmesis, and Recovery
Minithoracotomy incisions minimize surgical trauma, reduce discomfort, and improve cosmesis and patient satisfaction [13, 37, 55–58]. Analgesic usage is also diminished in minimally invasive valvular surgery, with the potential reduction of postoperative delirium [9, 27]. Consistent data support the notion that MT approaches are associated with less postoperative pain and faster return to normal activity [13, 37, 51–55, 58]. Casselman and colleagues [13] documented that 93.5% of their MV patients experienced minimal to almost no procedure-related pain after a MT access, and none of the remainder mentioned excessive pain. Speziele and coworkers [51] in their randomized MV series, investigated the postoperative pain by the administration of a visual analog scale (range, 0 = no pain to 10 = maximum pain). The main pain scores were significantly lower in the MT group at all time points (second, fourth, and sixth postoperative days: 2.8 ± 0.9 versus 4.7 ± 1.3, p = 0.01; 2.3 ± 0.8 versus 5.1 ± 1.5, p < 0.001; and 1.5 ± 0.4 versus 3.1 ± 0.9, p = 0.002, respectively) [51]. In another series, MT incision had lower pain levels from the third
postoperative day onward [55]. In addition, evidences from patients undergoing MV reoperation with a MT approach documented a less painful recovery compared with previous ST operation [37–40]. Moreover, 33.7% of the patients were back at work or at routine activity within 4 weeks postoperatively, with a 92.2% satisfaction rate [13]. Interestingly, patient age did not influence postoperative recovery [13]. Approximately 99% of patients appreciated the final MT cosmetic results [13].

Hospitalization and Costs

Minithoracotomy operations result in a decreased intensive care unit stay and hospitalization, being associated with faster recovery and earlier discharge [13, 27, 42, 46–51]. A recent review of nine studies encompassing more than 500 MV patients reported a shorter mean intensive care unit stay and total hospital stay for patients who underwent MT, ranging from 10 hours to 2.1 days, compared with ST patients, ranging from 1.6 to 3.9 days [56]. The total hospital stay was shorter, ranging from 5.6 to 13 days compared with ST patients (6.25 to 15 days) [56]. Similar results were achieved for AV procedures [17–20, 22, 23]. In the study by Glauber and colleagues [23], MT patients had a shorter mechanical ventilation time (median, 6 versus 8 hours; \( p = 0.004 \)) and postoperative length of stay (median, 5 versus 6 days; \( p = 0.02 \)). In a larger AV experience, Sharony and colleagues [17] demonstrated that MT patients were discharged home rather than sent to rehabilitation facilities or nursing homes in a greater percentage (65.7% versus 52.9%; \( p = 0.05 \)). Iriarte and coworkers [57] provided a detailed analysis of effectiveness of MT versus ST mitral valve surgery for 847 patients. The minimally invasive approach was associated with a $3,595 lower median cost of hospitalization ($33,418 versus $37,013, \( p = 0.003 \)), and the mean difference in direct costs between groups was $5,993 ± $2,008 (\( p = 0.003 \)) [57]. Lower costs were also observed for cardiac imaging (\( p = 0.004 \)), laboratory tests (\( p = 0.005 \)), and radiology expenditures (\( p = 0.002 \)) [57]. In this setting, a higher rate of patients were discharged home or with a home health aid (78% versus 58%), requiring a lower need for rehabilitation facility (22% versus 42%) [46].

Midterm and Long-Term Outcomes

Patients operated on for MV surgery using a MT approach exhibit excellent survival rates, ranging from 100% to 99%, 98% to 97%, and 96% to 80% at 30 days, 1 year, and 5 years postoperatively, respectively [7, 9, 13, 34]. Freedom from reoperation ranges from 99% at 1 year to 93% at 5 years [7, 9, 13, 33, 58, 59]. After a follow-up of 4.2 ± 2.4 years, Iriarte and coworkers [20] registered no significant differences in mortality at 30 days (\( p = 0.622 \)) or at 1 year (\( p = 0.599 \)) between the two approaches. Quality of MV repair in the Raanani series [15] was also comparable. In their patient population, follow-up extended for as long as 100 months (34 ± 24); NYHA class similarly improved in both groups (\( p = 0.394 \)). Late echocardiographic analysis revealed that 82% in the port-access group and 91% in the ST group were free from moderate or severe mitral regurgitation (\( p = 0.11 \)), and freedom from reoperation was 97% and 95% (\( p = 0.6 \)), respectively [15].

In AV patients, Glauber and colleagues [23] presented a median follow-up of 30 months (range, 17 to 54), with a survival of 96% ± 2% versus 88% ± 4% (\( p = 0.3 \)) for MT and ST, respectively. Sharony and colleagues [17] observed a 36-month cumulative survival of 85% for the MT group and 84.4% for the ST group (\( p = 0.55 \)).

Specific Patient Populations

ELDERLY AND OBESE PATIENTS. Among elderly patients, valve surgery using MT compared with ST is associated with shorter hospitalization, decreased resource use, and improved postoperative functional status [43–46]. Grossi and coworkers [43] first addressed the potential benefits of minimally invasive approach in the elderly (>70 years) by enrolling 370 consecutive patients undergoing isolated AV or MV surgery. Although hospital mortality was comparable in the two groups, the MT approach conferred a significantly lower incidence of sepsis or wound complications, less fresh frozen plasma, and shorter length of stay. Lamelas and associates [45] also collected data on elderly patients (≥75 years) with both approaches, registering lower inhospital mortality (1.7% versus 9.5%, \( p = 0.01 \)) and lower composite postoperative morbidity and mortality (21% versus 45.2%, \( p < 0.001 \)) in the MT group. Holzhey and associates [44] observed that long-term survival for elderly patients (>70 years) undergoing MT and ST was 66% ± 5.6% versus 56% ± 5.5% at 5 years and 35% ± 12% versus 40% ± 7.9% at 8 years (\( p = 0.43 \)), respectively. Recent data suggest that also obese patients and subjects affected by chronic obstructive pulmonary disease operated on for isolated valve surgery benefit from the MT approach [60, 61].

REOPERATIONS. Right MT has potential benefit for both reoperative MV and AV surgery, avoiding sternal reentry and the risk of injury to cardiac structure and patent grafts [37–40]. In addition, the partial dissection of adhesions implies a limited postoperative bleeding, with reduction in the risk of blood transfusion and reexploration [37–40]. The largest series, from Sharony and colleagues [40], accounted for 498 patients with previous cardiac operations, of whom 337 were operated on through ST (AV = 160, MV = 177) and 161 through MT (AV = 61, MV = 100), documenting equal hospital mortality, less hospital morbidity, decreased length of stay, and slightly favorable midterm survival in the MT group. Patients undergoing reoperation through MT state they have less perioperative pain, faster recovery, and better final aesthetic results with respect to their prior ST [37–40].

Tricuspid and Combined Valve Surgery

Data on tricuspid valve (TV) surgery through MT are lacking. The largest reported series by Lee and colleagues [64] retrospectively enrolled 141 consecutive patients undergoing TV operation through MT, although 73% of
subjects had a concomitant MV operation [64]. Thirty-day mortality was 2.1%, whereas stroke occurred in 2.8% of patients and reexploration for bleeding in 5.6% [64]. Survival at 5 years was 48% ± 12% for patients having TV surgery alone [64]. The same investigators also compared the outcomes of 124 TV operations using MT, with an equal number of subjects with ST [65]. The TV group through MT revealed a lower 30-day mortality (2% versus 11%, \( p = 0.007 \)), less postoperative AF (18% versus 24%, \( p = 0.0025 \)), less acute kidney injury (3% versus 11%, \( p = 0.016 \)), and shorter length of stay (11 versus 15 days, \( p = 0.012 \)). Seeburger and colleagues [66] analyzed 35 isolated TV: valve repair was obtained in 77% of cases and hospital mortality accounted for 5.7% of subjects. The mean follow-up was 35 ± 40 months and revealed a 5-year survival of 90%. Similarly to MV and AV operations through MT, excellent results are reported for isolated reoperative TV operations [67].

Reports also describe combined valve surgery using the MT approach, indicating the feasibility of either repair or replacement with a good field exposure to access the aortic, mitral, and tricuspid valves without any particular difficulties [68–70].

**Robotic Valve Surgery**

Relevant advances in telemanipulation, including combination of three-dimensional vision, the computer-enhanced EndoWrist (Intuitive Surgical, Sunnyvale, CA) with an instrument tip allowing seven degrees of freedom, a tremor filtering system, and motion scaling enable performing MV robotic surgery through incisions of only a few millimeters in diameter [71–74]. Although the robotic approach is restricted to a few specialized centers, available data demonstrate that it is as safe and effective as conventional approaches [71–74]. Equivalent early and late results, reduced patient trauma, more rapid return to work, diminished blood loss, and limited length of stay are key elements of the increasing success of robotic MV surgery [71–74].

**Study Limitations**

Valve surgery through MT is undoubtedly associated with prolonged aortic cross-clamp and CPB times [11, 14–16, 22, 23, 44, 57]. However, the longer surgery times do not imply increased morbidity and mortality, and high volume centers report shorter operative times, although an important learning curve undoubtedly exists along with consequent ethical issues [6–10, 17, 18, 20]. In evaluating their initial MT experience for MV surgery, Gammie and associates [75] documented a progressive improvement in operative efficiency over time, reaching a plateau only after 135 cases performed by a single surgeon. Brinkman and coworkers [24] collected data on 90 patients who had AV surgery through MT, reporting a learning curve that flattens after approximately 45 to 50 cases (Fig 2). The majority of complications and reoperations have been clearly demonstrated to occur in early series [31, 71, 74, 76]. Mohr and coworkers [31] reported a high mortality rate in their early MT cases with an evident reduction after refinements of surgical techniques (from 9.8% to 3%). Chitwood and colleagues [71] reported lower rates of reoperation for MV repair failure in the latter two thirds of a series of 300 robotic MV repairs. The same group subsequently observed that learning mitral valve surgery using telemanipulative technology proceeds according to a logarithmic curve, with a learning percentage of 95% [76].

The incidence of aortic dissection has been reported to be between 0.3% and 3.5% by different groups using different techniques of cannulation and aortic cross clamping [22, 37, 47]. Jeanmart and colleagues [62] described in detail their vascular complications in a cohort of 978 MV patients undergoing MT surgery. They encountered an overall rate of peripheral vascular

---

*Fig 2. Decrease in surgical time with surgeon experience using port access. (Reprinted from Brinkman et al [20], with permission from Elsevier.)*
Complications of 1%, with 44.4% happening at the time of surgery and 63.6% during long-term follow-up [62]. All aortic complications happened at the time of the surgery, with 0.9% of aortic dissection mainly due to cannulation problems. Mortality for aortic complications was 22.2% [62]. Finally, phrenic nerve palsy occurs in 3% of the patients, groin infection in 3%, groin lymphocele in 6.5%, iliac artery injury in 2.5%, and conversion to full sternotomy in 1%, respectively [14, 15, 18, 21, 27, 63].

Conclusions

Over the past decade, the rapid development and refinement of techniques have led to consider valve surgery through MT safe, effective, and durable. Despite longer surgery times compared with the ST approach, the MT approach has proven to be a cost-effective and cost-saving strategy in valve surgery, being associated with reduced morbidity and mortality rates. Patient satisfaction is a testament to a variety of tangible benefits of MT, including less pain, faster postoperative recovery, and better cosmetic results. Valve surgery through MT also demonstrated excellent results in terms of freedom from reoperation and long-term survival. However, these enthusiastic reports should be tempered based on important criticisms related to the MT approach that cannot be ignored. The majority of the published series are single-center retrospective experiences, comparing noncontemporaneous patient populations with uncertainly regarding consecutive recruitment. The influence of surgeon expertise on outcomes is also difficult to ascertain. In addition, patients with concomitant surgical procedures, diseased ascending aorta, and unfavorable chest anatomy are generally excluded from comparisons, leading to an incomplete assessment of the full spectrum of patients with valve diseases treated with MT. Powered randomized trials detecting and measuring objectively the magnitude of benefits versus risks between MT and ST approaches are needed, to definitively confirm MT as a complete and valid alternative approach for isolated and combined heart valve surgery.

We thank Fondazione Cesare Bartorelli (Milan, Italy) for his support.

References


