Background: The post-operative complications of median sternotomy, especially the post-operative pain and wound complications, has led many surgeons to adopt less invasive techniques to perform open heart surgery. Video-assisted mitral valve surgery via mini thoracotomy is now widely used and is becoming the standard of care in many centers all-over the world.

Aim of the study: Comparing the early post-operative outcome of video-assisted minimally invasive mitral valve replacement versus the conventional approach via median sternotomy.

Patients and methods: 34 patients undergoing mitral valve replacement (MVR) were randomly selected for this study and were divided in 2 equal groups. Group (A) included 17 patients who had MVR via median sternotomy while group (B) included 17 patients who had MVR via video-assisted anterior minithoracotomy.

Results: The cross-clamp time was 63.7 ± 2.34 min in group (A) versus 83.4 ± 7.21 min in group (B), which was statistically significant. The operative time was 3.27 ± 1.22 h in group (A) versus 5.62 ± 1.67 h in group (B), which was statistically significant. The duration of mechanical ventilation and the mean units of blood needed were significantly higher in group (A) compared to group (B). There was no statistically significant difference between the 2 groups regarding the postoperative complications including mortality, bleeding or mediastinitis.

Conclusion: Minimally invasive mitral valve replacement is a safe procedure, with comparable post-operative outcome to conventional median sternotomy.

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Keywords: Mitral valve replacement (MVR); Video-assisted thoracoscopic surgery (VATS); Minithoracotomy

1. Introduction

Minimally invasive techniques are cautiously growing in cardiac surgery. Many surgeons are now using fewer and smaller incisions to avoid wound infection, to decrease post-operative pain and for better cosmetic outcome.
Full median sternotomy has been well established as a standard approach for open heart surgeries for many years. It still has always been criticized for its length, post-operative pain and possible complications like wound infection and instability [1].

The goal of minimally invasive mitral valve surgery (MIMVS) is to reduce surgical trauma to the patient (pain, scarring, and inflammatory response) while maintaining the proven surgical efficacy of the conventional open approach [2].

Thoroscopically assisted MIMVS relates to mitral valve surgery procedures which use thoracoscopic visualization of the operative filed for at least part of the operation [3].

Moreover, new robotic methods offer endoscopic possibilities for mitral valve surgeons that before where impossible via both video-assisted and direct visions. Minimally invasive mitral valve surgery now is within the reach of most cardiac surgeons. Yet the steep learning curve still can be an impediment to its non wide spread adoption [4].

This study aims at the evaluation of the early post-operative outcome of thorcoscopically assisted mitral valve surgery, in comparison to the standard median sternotomy technique.

2. Patients and methods

34 patients with isolated rheumatic mitral valve disease requiring MVR were randomly selected for this study and were divided into two groups:

- Group A included patients who underwent MVR via median sternotomy (17 patients)
- Group B included patients who underwent the same procedure via small anterolateral, video-assisted, minithoracotomy.

The study was performed in 4 centers: Cairo University, Benisuef University, New Kasr El Aini Teaching Hospital as well as Dar Al Fouad Hospital between March 2014 and September 2015.

2.1. Exclusion criteria

Patients with left atrial thrombus, other valve pathologies, ischemic heart disease (IHD), redo cases and significant comorbidities were excluded from this study. Patients with morbid obesity were also excluded.

2.2. Surgical technique of MIMVS

- Patients were positioned supine, with the right shoulder elevated 30–50° with the right arm abducted. A double lumen endotracheal tube was used for ventilation.
- Exposure of the femoral vessels was done at the beginning of the operation, heparin administration and cannulation of both the femoral artery and vein was done using Seldinger's technique. A 22Fr femoral vein, double stage cannula was used with its tip just inserted in the superior vena cava (SVC). For the femoral artery, a 21 Fr femoral cannula was used. Cannulation was always done guided by TEE to make sure that the cannulae were in the proper position, and to assess proper deairing and valve function at the end of the operation.
- The right thoracotomy was carried out just lateral to the nipple in males and in the mammary crease in females, and over the right 4th intercostal space for 7–8 cm. The chest was entered and a soft tissue retractor was used to deflect the soft tissues, followed by insertion of the rib spreading retractor.
- Cardiopulmonary bypass (CPB) was the initiated, the lung deflated to expose the pericardium which was opened just ventral to the phrenic nerve, up to expose the ascending aorta and down to the diaphragm.

Assisted venous return should generally be used either via vacuum assist or by use of a biomedicus centrifugal pump in the venous line.

- A purse string suture was placed in the proximal part of the ascending aorta and the aortic root cannula was inserted for delivery of the cold crystalloid cardioplegic solution. The aortic clamp was placed through an
incision in the 3rd space cephalad to the original incision, the Chitwood clamp was used in all cases. The edges of the pericardium were tucked by transthoracic sutures via small incisions.

A 30° camera was used for video-assisted visualization and placed through a separate incision just anterior to the one used for the aortic clamp.

- After the cardioplegia was given and the heart arrested, the left atrium was opened as usual, and a retractor was placed through a transthoracic incision, placed at the same place, medial to the thoracotomy taking care not to injure the internal thoracic vessels at the same place. MVR was done, preserving the posterior leaflet; mechanical valves were used in all cases.
- After closure of the atriotomy, deairing was done via the aortic root, guided by TEE, and then the aorta was declamped. Weaning was done, hemostasis and closure in layers was done over two intercostal drains.

N.B: pacing wires were placed while the heart was still empty and exposure was easy.

2.3. Statistical methods

Data were analyzed with SPSS version 16. The normality of data was first tested with one-sample Kolmogorov–Smirnov test. Qualitative data were described using number and percent. Association between categorical variables was tested using Chi-square test. When 25% of the cells have expected count less than 5, Fisher exact test was used. Continuous variables were presented as mean ± SD (standard deviation) for parametric data. The two groups were compared with Student t test and paired t test were used to compare paired data.

3. Results

3.1. Preoperative data (Table 1):

The 2 groups were matched with no statistically significant differences regarding the age, sex, ejection fraction or pulmonary artery pressure.

<table>
<thead>
<tr>
<th></th>
<th>Group A (17)</th>
<th>Group B (17)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years) (mean + SD)</td>
<td>41.6 ± 11.94</td>
<td>43.4 ± 11.41</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>13 (76%)</td>
<td>12 (70%)</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Females</td>
<td>4 (24%)</td>
<td>5 (30%)</td>
<td></td>
</tr>
<tr>
<td>Ejection fraction % (mean + SD)</td>
<td>62.54 ± 8.2</td>
<td>63.2 ± 4.7</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>PASP (mmHg) (mean + SD)</td>
<td>45 ± 13.8</td>
<td>48 ± 6.3</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

3.2. Operative data (Table 2)

The cross-clamp, total bypass and operative times where all statistically significantly higher in group (B) than Group (A), which is due to the more complexity of the procedure.

<table>
<thead>
<tr>
<th></th>
<th>Group (A)</th>
<th>Group (B)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-clamp time (min)</td>
<td>63.7 ± 2.34</td>
<td>83.41 ± 7.21</td>
<td>≤0.001</td>
</tr>
<tr>
<td>CPB time (min)</td>
<td>54.3 ± 7.94</td>
<td>116.56 ± 5.63</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Operative time (hour)</td>
<td>3.27 ± 1.22</td>
<td>5.62 ± 1.67</td>
<td>≤0.001</td>
</tr>
</tbody>
</table>
3.3. Post-operative data

Table 3 represents the post-operative data for both groups.

<table>
<thead>
<tr>
<th></th>
<th>Group (A)</th>
<th>Group (B)</th>
<th>P-value</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation hours (mean ± SD)</td>
<td>9.85 ± 6.5</td>
<td>5.67 ± 1.63</td>
<td>&lt;0.05</td>
<td>S</td>
</tr>
<tr>
<td>Blood transfusion units (mean ± SD)</td>
<td>0–3 units</td>
<td>0–2 units</td>
<td>&lt;0.05</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>0.93 ± 0.9</td>
<td>0.22 ± 0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU stay days (mean ± SD)</td>
<td>3.72 ± 1.9</td>
<td>3 ± 1.78</td>
<td>&gt;0.05</td>
<td>N.S</td>
</tr>
<tr>
<td>Pain score (mean ± SD)</td>
<td>17.6 ± 4.98</td>
<td>11.5 ± 4.7</td>
<td>&lt;0.01</td>
<td>N.S</td>
</tr>
</tbody>
</table>

There was no statistically significant difference between the two groups regarding the ICU length of stay. However, the mechanical ventilation hours, blood transfusion units were higher in group A. Post-operative pain was significantly higher among the sternotomy group compared to the minithoracotomy group.

3.4. Post-operative complications

In group A: 3 patients had superficial wound infection (17%) which was managed conservatively without the need for intervention. In group B: 2 patients had superficial wound infection (11%) also treated conservatively. There were no mortalities in both groups. In group A: only one patient needed re-exploration for high drainage post-operatively, which revealed no surgical cause and medical management with cryo-precipitates and fresh blood transfusion was done successfully.

4. Discussion

This study showed that cross-clamp time, the total bypass time as well as the operative time in group B (83.41 ± 7.21 min, 116.56 ± 5.63 min and 5.62 ± 1.67 h respectively) were higher than in group A (63.7 ± 2.34 min,
54.3 ± 7.94 min and 3.27 ± 1.22 h respectively). In a study done by Modi et al in 2009, similar results were obtained [5]. This is obviously attributed to the more complexity of the procedure as well as the early experience and the beginning of our learning curve.

In our study, mechanical ventilation time was significantly shorter in group B (5.67 ± 1.63 h) compared to group A (9.85 ± 6.5 h). The need for blood transfusion was significantly higher in group A (0.93 ± 0.9 units) compared to group B (0.22 ± 0.62 units) which is an important advantage of minimally invasive surgery as reported by many other authors [6,7].

Post-operative pain was significantly less in minimally invasive group (group B) compared to median sternotomy group (group A). Walther and colleagues 1999 reported similar results [8]. They all reported that patients with anterolateral minithoracotomy suffered more pain during the initial 24 h post-operatively. However, by the 3rd day, the pain was much less than the median sternotomy patients.

In another study done in 2010 comparing right thoracotomy approach for mitral valve surgery to standard median sternotomy, the postoperative pain score was high in sternotomy group than thoracotomy group during hospital stay (4.3 ± 2.1 versus 2.3 ± 1.1, p < 0.05) and requirement for postoperative pain control medications was significantly more in sternotomy group than thoracotomy group [9].

McClure stated in a study published in 2009 that the minimally invasive approach for mitral surgery carried less complications and increased patient satisfaction compared to the standard median sternotomy approach [10].

There are still many limitations to the widespread use of this technique. Its cost is still higher than the conventional technique. It needs a long learning curve. Ideal patients with isolated mitral valve disease with no other co-morbidities and with a suitable BMI (less than 30) are fewer. However, the benefits of better cosmetic appearance and less post-operative pain are worthy. The limited number of cases in our study is also a result of the complexity of the procedure, and larger series are needed for the proper evaluation of this technique.

Conflict of interest

None.

References