Best evidence topic - Valves

Is a port-access mitral valve repair superior to the sternotomy approach in accelerating postoperative recovery?

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Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether port-access mitral valve repair reduces the recovery period of patients compared to the conventional sternotomy approach. Using the reported search, 778 papers were identified. Thirteen papers represented the best evidence on the subject and the author, journal, date and country of publication, patient group studied, study type, relevant outcomes, results and study comments and weaknesses were tabulated. The 13 papers demonstrated that patients who undergo minimally invasive mitral valve repair have a shorter ICU and total hospital stay than those who undergo the sternotomy approach. Results vary but mean hospital stays range from 5.6 to 13 days in port-access groups compared to 6.25–15 days in sternotomy groups. Other advantages over the sternotomy approach were reduced postoperative bleeding and pain, shorter time to extubation and a quicker return to daily activities. However, it is consistently reported that operative time is longer, with the increase in bypass time being around 30 min. We conclude that in several cohort studies minimally invasive mitral valve repair is reported to result in a shorter ICU and hospital stay, reduced postoperative bleeding and pain and a shorter time to resuming normal activities. This is at the expense of longer bypass and operative times.

Keywords: Minimally invasive mitral valve repair; Sternotomy; Hospital/ICU stay

1. Introduction

A best evidence topic was constructed according to a structured protocol, described in the ICVTS [1].

2. Clinical scenario

You are a general practitioner who suffered from two episodes of paroxysmal atrial fibrillation. Having heard a pansystolic murmur on self-examination, you see a cardiologist who demonstrates moderate mitral regurgitation from a prolapsing P2 segment. You are aware of port-access mitral valve repair as an alternative to sternotomy but elect to search for the evidence that this approach is both safe and superior to the more conventional approach prior to being referred for surgery.

3. Three-part question

In [patients requiring mitral valve repair] does [minimally invasive mitral valve repair] compared to [conventional repair] safely improve [clinical outcomes]?

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4. Search strategy

Medline 1950 to March 2008 using OVID Interface. [exp mitral valve prolapse/OR exp mitral valve insufficiency/OR exp heart valve prosthesis implantation/OR mitral repair.mp] AND [exp surgical procedures/OR exp minimally invasive/OR exp port-access/OR exp heartport]. Embase 1980 to March 2008. [exp mitral valve prolapse/OR exp mitral valve insufficiency] AND [exp minimally invasive/OR exp port access]. Cochrane Database of Systematic Reviews and the Cochrane Controlled Trials register searched on 1st March 2008 using search terms ‘minimally invasive’ and ‘mitral valve repair’. References of resulting papers were also reviewed.

5. Search outcome

Four hundred and forty-five papers were found in Medline, 332 abstracts from Embase and one paper from the Cochrane controlled trials register. From these studies 13 represented the best evidence on the topic (Table 1). We included seven cohort studies [2–8], four of which were comparative and three that studied the peri- and post-operative outcomes of minimally invasive mitral valve surgery alone, four comparative case-control studies [9–12] and two prospective randomised studies [13, 14].
Table 1

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Study type</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
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<tbody>
<tr>
<td>Casselman et al., (2003), J Thorac Cardiovasc Surg, Belgium, [2]</td>
<td>Retrospective cohort study (level 2b)</td>
<td>187 patients (mean age 60.7 ± 13.1 years) underwent endoscopic mitral valve repairs between February 1997 and October 2001. All performed by a single surgeon. Carpentier classification used to describe pre-op valve dysfunction: 9.1% type 1, 89.3% type 2 and 1.6% type 3</td>
<td>Type of annuloplasty inserted</td>
<td>Carpentier-Edwards Physio ring: 183 patients Carpentier-Edwards Classic ring: 4 patients</td>
<td>Early procedures performed on only low-risk patients. As experience grew, higher risk patients also selected</td>
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<td>Woo et al., (2006), Surgery, USA, [3]</td>
<td>Retrospective cohort study (level 2b)</td>
<td>Between February 2002 and June 2005, 64 patients underwent mitral valve repair, 39 (mean age 60 ± 2 years) by sternotomy (ST) and 25 (mean age 60 ± 3 years) by minimally invasive robotic-assisted (RA) surgery. Procedures performed by a single surgeon</td>
<td>Peri-operative outcomes</td>
<td>Time on bypass (min): ST group: 162 ± 10, RA group: 239 ± 12 (P &lt; 0.001)</td>
<td>Patient groups not equally matched for their co-morbidities such as history of myocardial infarction and diabetes mellitus</td>
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<td>Gulielmos et al., (1998), Eur J Cardio-thorac Surg, Germany, [6]</td>
<td>Between May 1996 and May 1997, 21 patients (median age 64 years) underwent minimally invasive mitral valve surgery. Eleven had mitral valve insufficient,</td>
<td>Peri-operative outcomes</td>
<td>Cardiopulmonary bypass (min) 139.5 ± 56.1</td>
<td>No direct comparison to the sternotomy approach</td>
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<tr>
<td>Uncontrolled cohort study (level 2b)</td>
<td>5 mitral stenosis and 5 combined. A 6–8 cm right thoracotomy was performed. Four patients underwent mitral valve repair, and 15 replacements</td>
<td>Postoperative outcomes</td>
<td>ICU stay (days): 1 ± 5.2 &lt;br&gt; Hospital stay (days): 10.5 ± 5.3 &lt;br&gt; 3/12 follow-up: No perivascular leak</td>
<td>Lower number of mitral valve repairs performed</td>
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<td>Glower et al., (1998), Eur J Cardiothorac Surg, USA, [7]</td>
<td>41 consecutive patients underwent isolated mitral valve replacement (14) or repair (27). Twenty patients (mean age 59 ± 14) had a sternotomy (14 repairs) and 21 (mean age 60 ± 15) (13 repairs) underwent the Port access technique. Both groups were well matched for age, mitral pathology, ejection fraction and comorbidity. Two surgeons performed all procedures</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): &lt;br&gt; Sternalotomy: 157 ± 36 &lt;br&gt; Port access: 212 ± 53 &lt;br&gt; P&lt;0.05 vs. sternotomy</td>
<td>Two surgeons performed the procedures rather than a single surgeon, therefore some difference in surgical technique and skills</td>
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<tr>
<td>Yamada et al., (2003), J Anaesthesia, Japan, [8]</td>
<td>The procedures were carried out from January 1999 to June 2001. 66 patients (mean age 57 ± 13) underwent minimally invasive cardiac surgery (MICS), which included 21 mitral valve repairs. 50 patients (mean age 57 ± 10) underwent conventional cardiac surgery (CCS), which included 14 mitral valve repairs</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): &lt;br&gt; MICS: 224 ± 58 &lt;br&gt; CCS: 179 ± 27</td>
<td>Study includes patients who underwent aortic valve replacement or repair, not solely mitral valve repair patients</td>
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<td>Comparative cohort study (level 2b)</td>
<td></td>
<td>Postoperative outcomes</td>
<td>Pain medication (rectal buprenorphine and IM pethidine): &lt;br&gt; MICS: 18/66 (27%) &lt;br&gt; CCS: 26/50 (52%)</td>
<td>Minimally invasive surgery was performed using a mini sternotomy, therefore creating a more invasive technique than other studies</td>
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<td>Folliguet et al., (2006), Eur J Cardio-thorac Surg, France, [9]</td>
<td>Between February 2004 and September 2005, 25 patients (mean age 59.4 ± 11.2) underwent mitral valve repair using the da Vinci system. Patients were retrospectively matched to 25 patients (mean age 60.4 ± 11.1) who underwent mitral valve repair via the sternotomy approach. All patients had posterior leaflet resection and a ring annuloplasty</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): &lt;br&gt; Sternalotomy: 85.7 ± 19.8 &lt;br&gt; Robotic: 122.1 ± 25.7 (P&lt;0.003)</td>
<td>Robotic (da Vinci system) assistance</td>
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<td>Case-control study (level 3b)</td>
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<td>Postoperative outcomes</td>
<td>Mean ICU stay (h): &lt;br&gt; Sternalotomy: 48.5 ± 4.3 &lt;br&gt; Robotic: 35.7 ± 4.8</td>
<td>The 25 sternotomy patients underwent surgery earlier between January 2000 and February 2004, therefore had a longer follow-up</td>
</tr>
<tr>
<td>De Vaumas et al., (2003), J Cardiothoracic Vasc Anaesthesia, France, [10]</td>
<td>In an 8-month period, 41 matched pairs of patients underwent valve surgery by minithoracotomy (MT) or sternotomy (ST). Ten pairs underwent mitral valve repair (10 MT and 10 ST)</td>
<td>Postoperative course of mitral valve repair patients</td>
<td>Mean ICU stay: &lt;br&gt; MT patients: 3 days (2–9) &lt;br&gt; ST patients: 3.5 days (2–5)</td>
<td>Sternotomy patients were sent to cardiac rehabilitation unit post-op, whereas mini invasive group discharged home, hence difference in hospital stay</td>
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<td></td>
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<td>Preliminary questionnaire results</td>
<td>Return to daily routine: 2 weeks after discharge</td>
<td>Two surgeons performed the surgery</td>
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<td>Srivastava et al., (1998), J Heart Valve Dis, India, [11]</td>
<td>Retrospective case control study (level 3b)</td>
<td>Between July 1991 and December 1996, 52 patients (mean age 30.10 ± 9.14) with rheumatic heart disease underwent mitral valve surgery (50 replacements, 2 repairs) through a right thoracotomy (RT). Fifty-two patients (mean age 32.40 ± 11) were retrospectively chosen who underwent mitral surgery through a median sternotomy (MS)</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): RT: 74.8 ± 34.2 MS: 81.3 ± 32.2</td>
<td>Patients included in the minimally invasive group underwent surgery due to rheumatic heart disease, which does not reflect an average population of patients, this may affect post-op recovery etc.</td>
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<tr>
<td>Ryan et al., (2005), J Heart Valve Dis, USA, [12]</td>
<td>Case-control study (level 3b)</td>
<td>Between December 1997 and December 2004, 92 patients who underwent mitral valve repairs, (mean age 53.61 ± 12.9) via the ‘Heartport’ technique. A control group of 92 sternotomy-approach matched patients (mean age 53.99 ± 13.83) were retrospectively collected</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): Heartport: 144.6 ± 50.68 Sternotomy: 116.26 ± 39.23</td>
<td>The ‘Heartport’ patient group includes mitral valve replacement</td>
</tr>
<tr>
<td>Dogan et al., (2005), The Society of Thoracic Surgeons. Germany, [13]</td>
<td>Prospective randomised study (level 1b)</td>
<td>28 patients were prospectively randomised to undergo mitral valve repair via minimally invasive technique (14 patients, mean age 60.1 ± 12.3) or conventionally as a sternotomy (14 patients, mean age 63.2 ± 13.6)</td>
<td>Peri-operative outcomes</td>
<td>Bypass time (min): Sternotomy: 132.6 ± 55.5 Mini invasive: 141.7 ± 32.1</td>
<td>Small patient group analysed, hence a lack of statistically significant results</td>
</tr>
<tr>
<td>El-Fiky et al., (2000), Eur J Cardiothorac Surg, Egypt, [14]</td>
<td>Prospective randomised study (level 1b)</td>
<td>100 patients who were prospectively randomised to undergo mitral valve surgery via a mini-right anterolateral thoracotomy (50 patients, mean age 22 ± 10 years) (test group) or via a median sternotomy (50 patients, mean age 23 ± 9 years) (control group). 4 in test group and 3 in the control group underwent repair, all others had valve replacement</td>
<td>Peri-operative outcomes</td>
<td>Mean bypass time (min): Test: 64 ± 12 Control: 59 ± 11 P = 0.04</td>
<td>Most patients underwent valve replacement, not repair</td>
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6. Comments

One of the two prospective randomised trials included only mitral valve repair operations, however, they recruited a small patient population [13], therefore, further larger randomised trials are needed to consolidate their findings. The remaining studies are all uncontrolled comparative studies with their obvious limitations.

In nine studies [3, 4, 7–13], a minimally invasive approach was compared to the sternotomy approach. In all these studies, the mean ICU stay was shorter in patients who underwent minimally invasive mitral valve surgery ranging from 10 h [13] to 2.1 days [3], compared to sternotomy patients which ranged from 1.6 [13] to 3.9 days [3]. In six of the comparative studies, the total hospital stay was shorter in the minimally invasive patient group ranging from 5.6 [4] to 13 days [10], compared to sternotomy patients ranging from 6.25 [12] to 15 days [10]. As the patient groups in the majority of studies were small, these results were not statistically significant, however, they suggest that patients undergoing minimally invasive mitral valve repair will leave hospital earlier than sternotomy patients.

Other advantages of minimally invasive surgery were a shorter time to extubation with a difference of 18 h [3], a statistically significant faster return to normal activity of 4 vs. 9 weeks [7], a reduction in pain medication post-operatively [8] and a reduction in postoperative bleeding with a difference ranging from 449 [14] to 670 ml [11] between minimally invasive and sternotomy patients. Two studies did not compare to sternotomy, however, they did observe low mortality rates of 1.1% [5] and no peri-vascular leak on 3-month follow-up [6].

Two of the comparative studies [3, 9] compared the sternotomy to robotic-assisted (da Vinci) minimally invasive surgery. Additionally, procedure variability was present; De Vaumas et al. [10] and Aklog et al. [4] performed a relatively long 8–10 cm incision with excision of the 3rd and 4th costal cartilages, while Yamada et al. [8] performed a mini-sternotomy. The difference in relative invasiveness of the surgeons may account for the ranges in results attained.

Casselman et al. [2] performed a retrospective study of 187 patients who underwent endoscopic mitral valve repair and distributed a patient satisfaction questionnaire at follow-up. It showed that 93.5% of patients experienced minimal pain and 33.7% had returned to routine/work activity within 4 weeks, with another 26.6% within 8 weeks.

A peri-operative outcome observed in seven of the nine comparative studies [3, 7–9, 13] was a longer time on bypass (min) in the minimally invasive group of 165.5 compared to 130.6 for sternotomy patients.

7. Clinical bottom line

Minimally invasive mitral valve repair shortens hospital and ICU stay compared to the sternotomy approach. Other postoperative benefits include less postoperative bleeding probably due to the avoidance of sternotomy, shorter time to extubation, less postoperative pain, shorter period of returning to normal activities and low hospital mortality. As the bypass period and anaesthetic set-up are longer, the operative time is longer than sternotomy.

References

The surgical experience of our group is of a total of 1734 minimally invasive cardiac surgical operations done either via a ministernotomy (921 patients) or a port access technique (813 patients) starting March 1997 to June 2007. We believe that a stronger evidence of advantages in terms of blood losses, complications and eventually hospital stay may be seen in re-do cases. In this group of patients, minimally invasive surgery (via either ministernotomy or port access technique) has reduced operative times. Re-do operation through a median sternotomy, with dissection of the adhesions is time-consuming. Reducing the width of the operative field, as in minimally invasive surgery, the total time of the operation is decreased and may be less than surgery performed by conventional sternotomy [2–4].

References