Ministernotomy versus conventional sternotomy for aortic valve replacement: a systematic review and meta-analysis

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CRD summary
This review found that mini-sternotomy for aortic valve replacement could be performed safely, without increasing the risk of death or other major complication, but there were few advantages over a full sternotomy. Due to the high levels of heterogeneity for some outcomes and the poor quality of the primary studies, these conclusions might not be reliable.

Authors' objectives
To compare the efficacy of aortic valve replacement through a mini-sternotomy against a full median sternotomy.

Searching
MEDLINE, EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched for published studies in any language; publication dates spanned 1950 to January 2007. Search terms were reported and bibliographies were handsearched.

Study selection
Randomised controlled trials (RCTs) and observational studies that compared patients undergoing aortic valve replacement through a mini-sternotomy against replacement through a full sternotomy were eligible for inclusion, if they reported outcomes specific to aortic valves. The primary outcome of interest was the 30-day mortality. Secondary outcomes included: cardiopulmonary bypass time, cross-clamp time, operative time, ventilation time, blood loss within 24 hours, intensive care unit (ICU) stay, hospital stay, pain score, cosmesis and postoperative stroke, atrial fibrillation, mediastinitis, and sternal instability. The rate of conversion from a mini-sternotomy to a full sternotomy was reported. The included studies were of L-, J-, I- or V-shaped, reverse L-, C- or T-shaped, upper, or parasternal procedures. The mean or median age ranged from 49 to 71 years and the proportion of males ranged from none to all. The mean or median ejection fraction varied from 48 to 67%.

Studies were selected by two reviewers and disagreements were resolved by consensus.

Assessment of study quality
Methodological quality was assessed on the basis of whether the sample represented the general population, secure ascertainment, comparability of groups, and adequate outcome assessment. Whether the RCTs were blinded was also noted.

The number of reviewers who assessed quality was not reported.

Data extraction
Odds ratios for comparative categorical outcomes, weighted mean differences for continuous outcomes, and simple proportions for non-comparative rates were calculated for each study with the respective 95% confidence intervals. When only the median was available, it was considered to be the mean and a standard deviation was calculated, using the range and p-value reported. When a study arm reported no events, a continuity correction was used.

The number of reviewers who extracted the data was not reported.

Methods of synthesis
Odds ratios, weighted mean differences, proportions, and the 95% confidence intervals were pooled, using a random-effects model. Heterogeneity was assessed using the $I^2$ and $\chi^2$ statistics and using a priori subgroup analyses comparing randomised and observational studies. Tests of interaction were conducted.
Results of the review

Twenty-six studies were included (n=4,586 patients, range 27 to 1,042). Four were RCTs (n=280) and 22 were observational studies (n=4,306). In one RCT the surgeons were randomised, rather than the patients. None of the RCTs were blinded and only three observational studies attempted to match patients.

There was no significant difference in the 30-day mortality between the two sternotomy approaches (24 studies). With mini-sternotomy compared with the full sternotomy, the times were significantly longer for cross-clamp (WMD 7.90 minutes, 95% CI 3.50 to 10.29; 24 studies) and bypass (WMD 11.46 minutes, 95% CI 5.26 to 17.65; 22 studies). The stay in the ICU was significantly shorter with mini-sternotomy (WMD -0.46 days, 95% CI -0.72 to -0.20; 18 studies) as was the stay in hospital (WMD -0.91 days, 95% CI -1.45 to -0.37; 21 studies). Ventilation time was also significantly shorter with mini-sternotomy (WMD -2.1 hours, 95% CI -2.95 to -1.30; 17 studies) and there was less 24-hour blood loss (WMD -79mL, 95% CI 136 to -23; 17 studies). Significant heterogeneity was reported for ventilation time (I²=85.5%).

Subgroup analyses generally reported similar results, except for the outcomes of hospital stay and ventilation time. When only RCTs were included, there was no significant difference in hospital stay between the two approaches and, in a test for interaction between RCTs and observational studies, there was a probability of 0.02 for ventilation time. Significant heterogeneity was found for cross-clamp time (I²=96.4%), cardiopulmonary bypass time (I²=96.7%) and 24-hour blood loss (I²=77.1%).

Authors’ conclusions

Mini-sternotomy for aortic valve replacement could be performed safely, without increasing the risk of death or other major complication, but there were few advantages over full sternotomy.

CRD commentary

The research question was well defined. The searches identified studies in any language, which reduced the risk of language bias, but only published studies were included, so publication bias cannot be ruled out. Some aspects of study quality were assessed. The studies were selected by two reviewers, reducing the risk of reviewer error and bias, but it was unclear whether this occurred for data extraction and validity assessment. The meta-analyses reported significant heterogeneity for some outcomes, which means that the reliability of these results was unclear. The generally poor quality of the selected studies limits the reliability of the pooled data.

Due to the high levels of heterogeneity for some outcomes and the poor quality of the primary studies, the authors’ conclusions might not be reliable.

Implications of the review for practice and research

Practice: The authors did not state any implications for practice.

Research: The authors stated that the outcomes of bleeding and postoperative pain needed further definition and that surgeons should conduct properly designed, prospective studies, with relevant and consistent outcomes.

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