Lung volume reduction surgery: a cost and outcomes comparison of sternotomy versus thoracoscopy
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Video-assisted thoracoscopic surgery (VATS) in patients with severe emphysema, undergoing lung volume reduction surgery (LVRS).

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Patients with severe emphysema, undergoing LVRS. The exclusion criteria were as follows: age greater than 75 years, pulmonary hypertension (mean, PA > 35 mm Hg), PCO2 > 50, previous thoracotomy, or major comorbidity.

Setting
Hospital. The economic study was carried out in Los Angeles, USA.

Dates to which data relate
Effectiveness and resource use data corresponded to patients treated between 1995 and 1997. The price year was not specified.

Source of effectiveness data
The evidence for the final clinical outcomes was derived from a single study.

Link between effectiveness and cost data
Costing was retrospectively undertaken on the same patient sample as that used in the effectiveness analysis.

Study sample
Power calculations were not used to determine the sample size. The study sample consisted of 42 patients, 19 in the sternotomy group with a mean (SD) age of 62 (11) years and 23 in the VATS group with a mean (SD) age of 60 (4) years.

Study design
This was a retrospective cohort study, carried out in a single site. The duration of the follow-up was not explicitly
specified (it was mentioned as "long-term" without any specification). It was reported that the follow-up was identical for the two groups and included regularly scheduled postoperative/follow-up appointments and pulmonary rehabilitation. Loss to follow-up was not reported. It was noted that the sternotomy approach was generally performed early in the authors' experience. A single surgeon performed the operations. Preoperative and postoperative data were obtained from medical records.

**Analysis of effectiveness**

The principle used in the analysis of effectiveness (intention to treat or treatment completers only) was not explicitly specified. The clinical outcomes were intraoperative time, days in the ICU, days on the ventilator, days with an air leak, length of hospital stay, and postoperative pulmonary function outcomes including percentage of total lung capacity (TLC), percentage of forced expiratory volume in 1 second (FEV1), percentage of diffusion capacity CO, PO2, and PCO2, oxygen dependence, and morbidity, mortality, and patient self-assessment of daily activities and quality of life. The patient groups were comparable in terms of preoperative features.

**Effectiveness results**

The average (SD) intraoperative time was 118 (29) minutes in the sternotomy group versus 169 (20) minutes in the VATS group, (p<0.01).

No intraoperative complications related to the procedures performed were observed in either group.

The other outcomes were as follows:

- days in the ICU, sternotomy group 8.9 days versus VATS group 1.2 days, (p=0.05);
- days on the ventilator, sternotomy group 7.1 days versus VATS group 1.1 days, (p=0.06);
- days with an air leak, sternotomy group 10.7 days versus VATS group 6.7 days, (p not reported);
- overall length of stay, sternotomy group 13.8 days versus VATS group 9.7 days, (NS);
- the percentage of decrease in postoperative oxygen dependence, sternotomy group 25% versus VATS group 40%;
- TLC percentage postoperative improvement, sternotomy group 7% versus VATS group 11%;
- the FEV1 percentage postoperative improvement, sternotomy group 28% versus VATS group 62%.

The majority of patients reported were to have a moderate to significant improvement with respect to ability to perform daily activities and quality of life.

The VATS group had a 30-day mortality of 4% versus 15% in the sternotomy group. The respective long-term mortality rates were 4% and 10%, respectively.

**Clinical conclusions**

Overall, this study demonstrates that the minimally invasive thoracoscopic approach achieves clinical results at least as good as, or better than, the traditional median sternotomy. Although, both groups achieved equally beneficial results in the long-term, there were notable differences associated with the perioperative period.

**Measure of benefits used in the economic analysis**

No summary benefit measure was identified in the economic analysis, and only clinical outcomes were reported separately.
Direct costs
Costs were not discounted due to the short time frame of the cost analysis (hospitalisation period). Some quantities were reported separately from the costs. Cost items were not reported separately. Cost analysis covered the direct costs of inpatient hospitalisation. The perspective adopted in the cost analysis was not explicitly specified. The source of cost data was the financial records of the study institution. It is not clear whether charges were used or true costs (both were mentioned by the authors). The price year was not given.

Indirect Costs
Not included.

Currency
US dollars ($).

Sensitivity analysis
Not conducted.

Estimated benefits used in the economic analysis
Not applicable.

Cost results
The total inpatient cost associated with the VATS approach was $27,178 (SD, $11,130) versus $37,299 ($47,139) for sternotomy.

Synthesis of costs and benefits
Not applicable.

Authors’ conclusions
This study concludes that LVRS seems to be beneficial for selected patients with end-stage emphysema. Postoperative morbidity and length of hospital stay are decreased in the VATS group, long-term improvement in postoperative pulmonary function is not influenced by surgical approach and the overall charges and costs of the VATS approach is less than of sternotomy.

CRD COMMENTARY - Selection of comparators
A justification was given for the choice of the comparator (the strategy of performing median sternotomy). It was the traditional method used in the context in question. You, as a database user, should consider whether this is a widely used health technology in your own setting.

Validity of estimate of measure of effectiveness
The internal validity of the effectiveness results cannot be guaranteed due to the retrospective design of the study. The study groups were found comparable in terms of preoperative features. In an attempt to explain the reason behind the longer operating room time for the VATS procedure, the possibility of a learning curve factor being involved in the VATS approach was discussed. Furthermore, it was mentioned that in more recent VATS patients, modified stapler-bovine pericardium interfaces were used which resulted in an easier and more efficient application, and seemed to help decrease the operating room times. The follow-up period was not explicitly specified. The patient sample appears to have been representative of the study population.
Validity of estimate of measure of benefit
The authors did not derive a measure of health benefit. The study may therefore be regarded as a cost-consequences analysis.

Validity of estimate of costs
Some quantities were reported separately from the costs. Insufficient details of methods of cost estimation were given; consequently, it is not clear whether all relevant cost components were included in the cost analysis. The effects of different procedures on indirect costs were not evaluated. Based on the information provided, it is not clear whether the cost analysis was based on charge data or true costs. Statistical analysis was not fully employed in the analysis of resource use and cost data. Cost results may not be generalisable to other settings or countries.

Other issues
Given the retrospective nature of the study design, the relatively small sample size, and the lack of sensitivity analysis and statistical analysis of the costs, the study results may need to be interpreted with some degree of caution. The issue of generalisability to other settings or countries was not addressed although some comparisons were made with other studies. The degree to which the study sample was representative of the study population was not discussed. With regard to the involvement of quality of life and patients' preference (being invasive or minimally invasive), a cost-utility framework may have been a more appropriate approach in the context in question.

Implications of the study
Presently, additional work is being performed not only to minimise the length of operation for the VATS approach, but also to elucidate more specific criteria for patient selection as well as operative indications. It seems that, with further refinement and validation of LVRS, especially through the multicentre, randomised trial, the goals of improving quality of care as well as quality of life can be achieved.

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