Effects of timing of thoracoscopic surgery for primary spontaneous pneumothorax on prognosis and costs


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
The study compared strategies that used different timing of video-assisted thoracoscopic surgery (VATS) in patients with primary spontaneous pneumothorax (PSP). Three strategies were compared.

In the VATS first strategy, VATS was performed for the first episode of PSP.

In the drainage once strategy, pleural drainage was performed for the first episode of PSP and VATS was performed for the second.

In the drainage twice strategy, pleural drainage was performed for the first two episodes of PSP and VATS was performed for the third.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 20-year-old male patients who had complete unilateral lung collapse or dyspnoea caused by the first episode of PSP, and had no underlying diseases. No further inclusion or exclusion criteria were reported.

Setting
The setting was secondary care. The economic study was carried out in Japan.

Dates to which data relate
The effectiveness, demographic and epidemiological data were collected from studies published between 1993 and 2002. The dates relating to the cost data were not reported. The costs were adjusted to the year 2002.

Source of effectiveness data
The effectiveness data were derived from a review and synthesis of completed studies, augmented by assumptions made by clinical experts.

Modelling
A Markov model was constructed to evaluate the health states and associated costs for the three strategies. The software
DATA (version 4.0; TreeAge Software) was used for the baseline and sensitivity analyses. Each patient was assigned transition probabilities in each health state and the cycles of the model were 1 month in duration. The time horizon of the model was 1 year. Further details of the model were provided elsewhere (Bauerle et al., see Other Publications of Related Interest). The following assumptions, which were based on current practice in the authors' setting, were made:

VATS is performed only once, while thoracotomy is performed only after PSP recurrence after VATS;

patients with recurrence after thoracotomy are offered a second thoracotomy, after which no recurrence takes place;

patients who are not eligible for pleural drainage (i.e. pneumothorax cannot be re-expanded) are offered VATS during the next cycle;

if VATS does not re-expand the pneumothorax, patients are offered thoracotomy in the next cycle;

according to the literature, various VATS procedures (i.e. resection of apical blebs, pleural ablation) do not demonstrate major difference in efficacy; and

chest computed tomography (CT) of the pneumothorax is used after the decision to offer VATS, as this decision rarely depends on the results of the CT.

Outcomes assessed in the review
The following input parameters were used in the model:

the probability (given as a percentage) of failure to re-expand with pleural drainage, with VATS, and with thoracotomy;

the probability of surgical death with pleural drainage, with VATS and thoracotomy;

the annual recurrence probability (%/year) after the first pleural drainage, after the second pleural drainage, after VATS, and after the first and second thoracotomy; and

the annual mortality probability after the first and second pleural drainage, after VATS and after thoracotomy.

Study designs and other criteria for inclusion in the review
Studies that contained clinical outcomes of PSP and were published between January 1966 and December 2002 were included in the review. Further information on the designs included in the review was provided elsewhere (Morino et al., see Other Publications of Related Interest).

Sources searched to identify primary studies
MEDLINE was searched for primary studies.

Criteria used to ensure the validity of primary studies
No criteria were reported to ensure the validity of the primary studies. The reader is referred to another study for further information (Morino et al., see Other Publications of Related Interest).

Methods used to judge relevance and validity, and for extracting data
No methods were reported. The reader is referred to another study for further information (Morino et al., see Other Publications of Related Interest).

Number of primary studies included
In total, the authors used 30 studies to provide the effectiveness data.
Methods of combining primary studies
The authors used weighted means to combine the findings of the primary studies.

Investigation of differences between primary studies
Further information on the investigation of differences between the primary studies was reported elsewhere (Morino et al., see Other Publications of Related Interest).

Results of the review
The probability of failure to re-expand was 29.5% (range: 15.2 - 4.4) with pleural drainage, 1.97% (range: 0 - 1.0) with VATS, and not applicable for thoracotomy. The probability of surgical death was 0% (range: 0 - 1.0) with VATS and thoracotomy, and was not applicable for pleural drainage.

The recurrence probability was 23.8% per year (range: 11.5 - 35.0) after first pleural drainage, 37.3 % per year (range: 23.8 - 50.0) after the second pleural drainage, 3.19% per year (range: 0 - 19.9) after VATS, 1.67% per year after the first thoracotomy, and not applicable after the second thoracotomy.

All mortality probabilities were zero, while the ranges were not applicable from model assumptions.

Methods used to derive estimates of effectiveness
The authors used experts’ opinion to derive ranges of probabilities that were not available in the literature. In particular, these were provided by one pulmonologist and one surgeon at a teaching hospital.

Estimates of effectiveness and key assumptions
It was not explicitly stated which estimates of effectiveness were based on expert opinion.

Measure of benefits used in the economic analysis
The summary measure of benefit used was the quality-adjusted life-years (QALYs). Utilities were derived from the literature or were based on individual patient’s preferences, and were varied from unity (perfect health without any physical or mental discomfort) to zero (death). Further information was provided elsewhere (Morino et al., see Other Publications of Related Interest). The authors also calculated the quality-adjusted life-months (QALMs), which represent the expected life lengths in months when taking quality of life into account. The QALMs were not combined with the costs. They were derived by multiplying months spent by a patient in a health state by the utility of that health state. No further details on the extrapolation of the quality of life values were reported.

Direct costs
The hospital costs included in the analysis were hospitalisation costs for pleural drainage, VATS and thoracotomy, and costs related to death. The costs were based on actual data derived from the claims of a teaching hospital in Japan. The quantities of resources used were analysed separately. The authors calculated the mean cost for hospitalisation per day for each of the interventions from the hospital claims of 10 PSP patients who had no co-morbidity or complications. The cost of death was calculated directly from the model. All of the costs were discounted at an annual rate of 3% and were reported for the year 2002.

Statistical analysis of costs
The costs were treated deterministically.

Indirect Costs
The indirect costs were not included in the economic analysis.

**Currency**

Japanese yen (Y), although the costs were reported in US dollars ($). The conversion rate for December 2002 was $1 = Y120.

**Sensitivity analysis**

To investigate variability in the data, a one-way sensitivity analysis was conducted for all input parameters used in the model. The ranges used were derived from the literature if available; if not they were based on experts' opinion. A two-way sensitivity analysis was also conducted, in which the length of hospital stay and the utility values for the follow-up period after VATS were varied.

**Estimated benefits used in the economic analysis**

The QALM (follow-up for 1 year) was 9.57 months for VATS first strategy versus 8.17 months for drainage once strategy and 7.99 months for drainage twice strategy. The estimated QALYs were not reported.

**Cost results**

The average total intervention costs were reported per patient. The average cost for the 1-year follow-up period was $2,532 for drainage twice strategy, $2,988 for drainage once strategy, and $6,556 for VATS first strategy.

The cost-difference between the drainage twice strategy and VATS first strategy was $4,353 for a 4-month follow-up period. This difference was smaller ($3,459) for a 24-month follow-up period.

**Synthesis of costs and benefits**

An incremental analysis was performed. It was demonstrated that the drainage once strategy incurred an incremental cost of $29,915 per QALY compared with the drainage twice strategy. The VATS first strategy incurred an incremental cost of $30,564 per QALY compared with the drainage once strategy, and a cost of $28,919 per QALY compared with the drainage twice strategy.

In the one-way sensitivity analysis, the VATS first strategy incurred an incremental cost per QALY in comparison with the drainage once strategy that ranged from $30,556 per QALY (when the annual percentage probability of recurrence after the second pleural drainage was varied) to $99,272 per QALY (when the follow-up period was varied, i.e. 4 to 24 months).

When comparing the drainage once strategy with the drainage twice strategy, the incremental cost varied from $29,876 per QALY (when varying the follow-up health state after the first pleural drainage) to $135,084 per QALY (when the follow-up duration was varied, i.e. 4 to 24 months).

In the two-way sensitivity analysis, when the utility of the follow-up period after VATS was 0.7 and the length of hospitalisation was 14 days, the incremental cost of the VATS first strategy compared with the drainage once strategy was $103,752 per QALY. This decreased to an incremental cost of $1,609 per QALY when the utility was 0.93 and the length of hospitalisation was 2 days.

**Authors' conclusions**

Although video-assisted thoracoscopic surgery (VATS) proved to be twice as expensive as pleural drainage for the initial management of primary spontaneous pneumothorax (PSP) patients, it incurred a tolerable incremental cost per quality-adjusted life-year (QALY) for young adult male patients because of a reduced probability of future recurrence.
CRD COMMENTARY - Selection of comparators
The authors provided a justification for their choice of the comparators. You should decide if these are widely used health technologies in your own setting.

Validity of estimate of measure of effectiveness
The authors stated that a systematic review had been carried out and referred the reader to a separate study for details of the review method and data extraction. It is therefore not possible to comment on the methodology and conduct of the review, and the extraction of the effectiveness data. In terms of the use of experts’ opinion to derive some estimates of effectiveness, the authors did not report any methods used for effectiveness estimation. However, the authors carried out a number of sensitivity analyses relating to the efficacy estimates. These analyses improve both the internal validity and the generalisability of the study by demonstrating the robustness of the results to changes in the base-case estimates.

Validity of estimate of measure of benefit
The measure of benefit used was the health utility (QALYs and QALM), which reflected individual patient utilities for specific health states. The authors used utilities from a published study.

Validity of estimate of costs
The study adopted the perspective of a health care payer and, appropriately, only the direct costs were included. The costs were derived from actual data (hospital claims), but the use of average costs made it impossible to ascertain what hospital services and overhead and capital costs were included. For death, the quantities were derived from the model while hospital resources were derived from the literature. The costs were treated deterministically, but sensitivity analyses were conducted to test the robustness of the estimates used. Charges were used to proxy price, which seems to have been appropriate given the perspective adopted. The unit costs, price year, currency conversion adjustments and discounting were all reported, all of which improve the generalisability of the results.

Other issues
The authors compared their results with those from other studies, reporting consistency in their findings. The authors directly addressed the issue of generalisability of the results to other settings, and do not appear to have presented their results selectively. The study concentrated on young male patients with the highest incidence rate of PSP and this was reflected in the authors’ conclusions. The authors reported a number of limitations to their study. For example, they stressed that their cohort was hypothetical and might not have reflected real conditions. Second, the time horizon of the model was quite short (1 year), owing to a lack of long-term data, thus impeding the extrapolation of the findings to longer timeframes. Third, chemical pleurodesis was not considered in the model since existing results have demonstrated that it is most suitable for untreatable patients. The utility values were based on a rather small sample size of Japanese men and might differ from other populations. In addition, the authors commented on some limitations of the data contained in the studies retrieved.

Implications of the study
The authors did not make explicit recommendations for changes in policy or practice. They did, however, call for a randomised controlled trial to confirm or validate their findings.

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Other publications of related interest


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