Drainage, fibrinolytics, or surgery: a comparison of treatment options in pediatric empyema

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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
Treatment modalities for paediatric empyemas were studied:

- tube thoracostomy with or without the instillation of fibrinolytics,
- video-assisted thoracoscopic surgery (VATS), and
- open thoracotomy with decortication.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The patient population studied was children who presented with parapneumonic effusions for treatment.

Setting
The setting was secondary care (the Children's Hospital, Columbus, OH, USA). The economic study was carried out in the USA.

Dates to which data relate
The effectiveness evidence and resources used related to patients admitted between February 2000 and June 2002. The prices used were hospital charges during the same period.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was carried out retrospectively on the same sample of patients as that used in the effectiveness analysis.

Study sample
The records of 54 children were reviewed retrospectively. The methods used to select the sample were not reported. There were 17 patients in group I, with an average age of 5.7 years (standard deviation, SD=4.1) and an average symptom duration of 8.8 days (SD=5.9). There were 24 patients in group II, with an average age of 6.6 years (SD=7.5) and an average symptom duration of 24 days (SD=10.7). There were 5 patients in group III, with an average age of 6.1
years (SD=6.3) and an average symptom duration of 4.8 days (SD=1.6). Finally, there were 6 patients in group IV, with an average age of 11.8 years (SD=6.6) and an average symptom duration of 11 days (SD=12).

**Study design**
This was a single-centre retrospective cohort study. Follow-up equated to duration of stay in hospital.

**Analysis of effectiveness**
The primary health outcomes measured included:

- the LOS;
- stay in the intensive care unit (ICU);
- the duration of fever;
- the duration of leukocytosis;
- the number of days from ultimate therapy to discharge; and
- the number of fibrinolytic doses.

The outcomes were measured from patient records at the hospital. Duration of symptoms, duration of preadmission antibiotics and initial white blood cell count (WBC) tended to be higher in group IV, but differences among the four groups in these and in total lymphocyte count and antibiotics were not significant. The lymphocyte counts were normal and all groups had a low serum albumin level (illustrating mild to moderate nutritional deficiency).

**Effectiveness results**
The mean LOS was 8.0 days (SD=4.4) in group I, 8.4 days (SD=2.7) in group II, 13.8 days (SD=5.4) in group III and 12.4 days (SD=3.1) in group IV.

The mean ICU stay was 0.8 days (SD=2.3) in group I, 0.1 days (SD=0.6) in group II, 4.8 days (SD=2.2) in group III and 3.5 days (SD=3.2) in group IV.

The time from ultimate therapy to discharge was 6.6 days (SD=4.3) in group I, 6.2 days (SD=2.3) in group II, 8.4 days (SD=4.0) in group III and 8.4 days (SD=1.5) in group IV.

The tabulated results showed that children in group IV had a statistically significantly higher LOS, (p=0.002), ICU stay, (p<0.01) and higher number of days from ultimate therapy to discharge, (p=0.048), than those in groups I or II. Whereas children in group III had a statistically significantly higher LOS, (p=0.002), and ICU stay, (p<0.01), than those in groups I or II. However, the textual summary of results stated that children in groups III or IV had a statistically significantly higher LOS, (p=0.002), ICU stay, (p<0.01) and higher number of days from ultimate therapy to discharge, (p=0.044) than those in groups I and II.

There were no statistically significant differences in these variables between groups I and II, or between groups III and IV.

There was no significant difference in the average number of fibrinolytic doses between groups II and III.

There was no difference in LOS for VATS versus open thoracotomy (group III versus group IV).

**Clinical conclusions**
The authors found that duration of preadmission symptoms, (p=0.025), and overall duration of fever, (p<0.01), were
predictive of LOS. They also found that duration of preadmission symptoms, antibiotics, WBC or fever were not predictive of the need for surgical therapy. They concluded that the majority (80% in this study) of children presenting with empyema did not require an operative intervention, and LOS was decreased significantly as a result. They suggested that thoracostomy tube and fibrinolytics may represent a reasonable and safe alternative to primary VATS in some children with empyema.

Measure of benefits used in the economic analysis
No summary measure of benefits was reported. In effect, a cost-consequences analysis was performed.

Direct costs
The analysis was conducted from the perspective of the hospital. As such, it would appear that all the relevant costs were included. The overall hospital charges from each patient's hospitalisation were gathered from patient records at the hospital, and were collected between February 2000 and June 2002. Although the costs were incurred during a 3-year period, the prices do not appear to have been updated to a single price year and discounting was not undertaken. The quantities and the costs were not analysed separately. Charges were used without adjustment as proxies for economic costs.

Statistical analysis of costs
The costs were reported deterministically. The Kruskall-Wallis non-parametric test was used to compare the total average cost of each group.

Indirect Costs
The indirect costs were not included.

Currency
US dollars ($).

Sensitivity analysis
Sensitivity analyses were not conducted.

Estimated benefits used in the economic analysis
Not relevant.

Cost results
The average hospital charges were $20,053 per patient in group I, $23,473 per patient in group II, $52,474 per patient in group III and $42,650 per patient in group IV.

Hospital charges from nonsurgery groups (I and II) were significantly, (p<0.001) lower than those from the surgery groups (III and IV).

Synthesis of costs and benefits
The costs and benefits were not combined.

Authors' conclusions
The majority (80%) of children could be safely and successfully treated for empyema using less invasive techniques.
such as tube drainage alone or with adjuvant fibrinolytic therapy. These patients could achieve comparable outcomes without being subjected to general anaesthesia and surgery, allowing video-assisted thoracoscopic surgery (VATS) to be reserved for patients truly needing this procedure. In the authors’ setting, length of stay (LOS) and hospital costs were also significantly decreased because of lower levels of operative intervention.

CRD COMMENTARY - Selection of comparators
The authors justified their choice of the comparators. The comparators represented all available treatments for paediatric empyema in their own hospital. You should decide whether they are widely used technologies in your own setting.

Validity of estimate of measure of effectiveness
The analysis was based on a single-centre retrospective cohort study, which was not necessarily appropriate for the study question. In seeking to compare the effectiveness of different treatment modalities, a randomised controlled trial would have been more appropriate. The study sample was probably representative of the local population. However, it was not shown to be representative of the national population. The patients were a convenience sample. The patient groups were shown to be comparable at baseline in terms of age and clinical indicators. The analysis of effectiveness used the number of days each patient spent as an inpatient in hospital as a proxy for clinical effectiveness. Clinical effectiveness was otherwise assumed to be identical for all patients and this is unlikely to be a valid assumption. Thus, the study is not as useful to other practitioners as it could have been, given that days spent in hospital may be influenced not only by the condition of the patient but by local practice, local guidelines, or even local resources.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of benefit. The study was in effect a cost-consequences analysis. The measurement of the overall health benefits would have been of great value in a study comparing such treatments as chest tubes and surgery, given that these would be expected to have quite a different effect on the patient's short-term quality of life. The measurement of benefit in terms of quality-adjusted life-years, for example, would have greatly increased the relevance, validity and transferability of the study to other settings.

Validity of estimate of costs
Hospital charges from the authors' setting between 2000 and 2002 were used to proxy treatment costs. These complied with the hospital perspective taken in the analysis. The costs and the quantities were not reported separately. No sensitivity analyses were conducted. A statistical analysis of the average treatment costs was performed to see if there were significant differences across treatment groups. Although the costs were incurred during a 3-year period, discounting was not undertaken, nor does it appear that the prices were updated to a single price year. The choice of cost estimates and their method of reporting considerably reduce the value of the study for other practitioners and settings.

Other issues
The authors did not make appropriate comparisons with the findings from other studies. The discussion centred on the choice between different treatment modalities for patients. The issue of generalisability was not addressed, but the authors appear to have implicitly assumed that their study could apply to other settings. The authors do not appear to have presented their results selectively. In addition, they did not recognise the limiting specificity of their study and appeared to generalise conclusions outside of the local setting. The authors did not report any further limitations of their study.

Implications of the study
The authors noted that recent findings have shown that VATS results in decreased LOS, leading several children's hospitals to adopt the practice of giving VATS to all children presenting with empyema. In contrast, this study found that the majority of children could be successfully treated non-operatively, with associated significant reductions in
LOS and hospital charges. The authors considered that percutaneous therapy with or without fibrinolytics may still be a safe, effective and less costly intervention in some children.

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