Does bronchoalveolar lavage enhance our ability to treat ventilator-associated pneumonia in a trauma-burn intensive care unit?


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 diagnosis of ventilator-associated pneumonia (VAP) with and without bronchoalveolar lavage (BAL). A surgical resident or the trauma-attending physician performed BAL. BAL involved passing a bronchoscope down the right bronchus. A positive quantitative culture had more than 104 colony-forming units/mL.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised mechanically ventilated patients admitted to the mixed trauma-burn unit at the study hospital during 2001, and who went on to develop pneumonia signs and symptoms. The signs and symptoms of pneumonia were fever, elevated white blood cell count (>10,000/mm³), purulent sputum, developing infiltrate on chest radiograph, and increased oxygen requirements.

Setting
The setting was secondary care. The economic study was set in the mixed trauma-burn unit at the University of Michigan Health System, USA.

Dates to which data relate
The effectiveness data were collected prospectively from 1 January 2001 to 31 December 2001. The resource use data were collected for the same time period. A price year was not reported.

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 study.

Study sample
Power calculations, used to rule out the influence of chance on the results, were not reported. The sample was selected by identifying patients with pneumonia signs and symptoms, who were admitted to the study hospital during the relevant time period. The initial sample was appropriate for the study question since it included patients with VAP. A
total of 68 patients were treated for VAP in the study period. The BAL group comprised 37 patients (age: 50 +/- 8 years). The no BAL group (diagnosis by Gram's stain and sputum culture) comprised 29 patients (age: 44 +/- 22 years). Two burn patients with inhalation injuries were excluded from treatment during the BAL period.

**Study design**
This was a retrospective cohort study that was performed in a single centre. The patients were not followed up beyond the initial diagnosis and treatment. BAL appears to have been considered as the 'gold' standard diagnostic technique in terms of correctly identifying VAP in patients. The patients received BAL or no BAL depending on when they were admitted to the study. Patients admitted from 1 January 2001 to 30 June 2001 received no BAL, while those admitted from 1 July 2001 to 31 December 2001 received BAL. There was no report of the use of blinding.

**Analysis of effectiveness**
All of the patients included in the study were considered in the effectiveness analysis. The primary health outcomes were Gram's stain findings, final VAP culture, and the comparison between BAL final culture and sputum final culture. There was no statistical difference between the two groups for VAP rates. The injury severity score, age, ventilator days, hospital length of stay and mortality of VAP patients did not differ between the groups. The no BAL group contained more burn patients. Therefore, the results for burn patients and trauma patients were reported separately, to prevent any confounding.

**Effectiveness results**
Six patients in the no BAL group and 5 patients in the BAL group had both a positive Gram's stain and positive culture.

Three patients in the no BAL group and 5 patients in the BAL group had both a negative Gram's stain and negative culture.

Fourteen patients in the no BAL group and 5 patients in the BAL group had both Gram's stain with mixed flora and culture with mixed flora.

There were no patients with a negative Gram's stain and positive culture in either group.

Two patients in the no BAL group and 3 patients in the BAL group had a positive Gram's stain and negative culture.

Five patients in the no BAL group and 3 patient in the BAL group had a Gram's stain with mixed flora and either a positive or negative culture.

Six patients in the no BAL group and 6 patients in the BAL group had a positive or negative Gram's stain and a culture with mixed flora.

One patient in the no BAL group and 2 patients in the BAL group had a Gram's stain that gave no organism and a culture that grew any organism.

The final cultures were identical for 14 patients, had some overlap for 8 patients, and had no overlap for 2 patients. For 5 patients the sputum sample was not sent (BAL culture available only).

**Clinical conclusions**
The authors concluded that, in their one-year study, they "did not see the expected benefits of BAL”.

**Measure of benefits used in the economic analysis**
There was no summary measure of benefits. The study was therefore categorised as a cost-consequences analysis.
Direct costs
A perspective for the costing was not reported. However, the perspective appears to have been that of the hospital since the analysis included the costs of antibiotics, respiratory care and the ventilator. Discounting was not carried out, which was appropriate since the authors were concerned only with the immediate treatment costs. The costs and the quantities were both derived from actual data. Some quantities of resources used, such as length of stay and ventilator days, were presented separately, but the respective unit costs were not reported. Resource use was measured retrospectively (for the study period) from the trauma registry and from online patient records at the study hospital. The costs were obtained from the University of Michigan Health System Financial Data Warehouse. A price year was not reported.

Statistical analysis of costs
Continuous variables were analysed using unpaired two-tailed t-tests. Significance was defined as a p-value of less than or equal to 0.05.

Indirect Costs
The indirect costs were not reported.

Currency
US dollars ($).

Sensitivity analysis
No sensitivity analysis was reported.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The mean antibiotic cost was $1,157 (+/- 1,219) in the no BAL group and $843 (+/- 777) in the BAL group, (p=0.38).

The median antibiotic cost was $792 in the no BAL group and $492 in the BAL group.

For trauma patients, the mean respiratory and ventilator cost was $5,095 (+/- 3,313) in the no BAL group and $8,087 (+/- 3,779) in the BAL group, (p=0.008). The corresponding median costs were $4,039 (no BAL) and $8,636 (BAL), respectively.

For burn patients, the mean respiratory and ventilator cost was $15,834 (+/- 6,581) in the no BAL group, and $6,518 (+/- 2,497) in the BAL group. This difference was non significant when controlled for by total surface area burn. The corresponding median costs were $15,030 (no BAL) and $5,212 (BAL), respectively.

Synthesis of costs and benefits
Not relevant as the study was a cost-consequences analysis.

Authors' conclusions
The authors concluded "the antibiotic and respiratory costs...did not appear to justify BAL for trauma patients" and "a potential cost benefit may be present for burn patients". Overall, the authors did not find that bronchoalveolar lavage (BAL) reduced the ventilator-associated pneumonia (VAP) rate or costs associated with treatment.
CRD COMMENTARY - Selection of comparators
Diagnosis with VAP was compared with diagnosis using Gram's stain and sputum final culture. The comparator was justified by acknowledging the number of false-positive patients identified and treated using alternative diagnostic techniques. Current practice was no BAL prior to 30 June 2001, and BAL from after this date to 31 December 2001.

Validity of estimate of measure of effectiveness
The analysis used a retrospective cohort study, which was appropriate for the study question. The study sample was representative of the study population as it included patients with VAP. Patients in the two groups were shown to be comparable at analysis with the exception of the number of burn patients in each group. The results for burn patients and trauma patients were presented separately, to avoid confounding. These factors enhance the internal validity of the study. The study was unlikely to be able to detect statistically significant differences in the outcomes given the very small sample sizes. However, the authors later calculated that a sample size of 1,540 would be required to detect a potential difference in the number of ventilator days. They suggested that such a trial would require many years to complete.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The analysis was therefore categorised as a cost-consequences study.

Validity of estimate of costs
A perspective for the costing analysis was not reported, making it impossible to assess whether all the relevant costs were included in the analysis. Although there were differences in the cost, these were not statistically significant. Therefore, different categories of cost estimated from different perspectives may significantly affect the principle results and conclusions of the study. Some of the quantities were reported separately, but the unit costs were not presented. No sensitivity analyses of the costs were performed. The transferability of the cost results to other settings appears low.

Other issues
The authors made appropriate comparisons of their findings with those from other studies. They focused on the reasons for differences, such as the criterion for positive BAL, and the method of obtaining sputum cultures. The issue of generalisability to other settings was not addressed (no sensitivity analyses). The results were not presented selectively. The study conclusions accurately reflected the results presented and were appropriate given the clinical question posed. No specific limitations were presented.

Implications of the study
The authors did not make any recommendations for policy or practice as a result of the study. Future work in the form of a larger study, to provide insight into the sub-set of patients with burn injuries, was proposed.

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