The efficacy of magnetic resonance imaging in pediatric cervical spine clearance

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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
The use of a magnetic resonance imaging (MRI) protocol for cervical spine clearance in paediatric trauma patients. The protocol covered several indications for performing MRI. These included obtunded or nonverbal child with likely mechanism of injury, equivocal plan films, neurologic symptoms without radiographic findings, and inability to clear the cervical spine clinically or radiologically within 72 hours of hospital admission.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised children who were intubated by the time of hospital admission, remained in the intensive care unit (ICU) for at least 3 days, and had a mechanism of injury consistent with potential cervical spine injury. Patients diagnosed with cervical spine injuries from plain radiographs and computed tomography (CT) scans, and who were not treated according to the study protocol, were excluded from the analysis.

Setting
The setting was a hospital. The economic study was carried out at the Children's Hospital of Philadelphia, USA.

Dates to which data relate
The effectiveness and resource use data were gathered from February 1989 to August 1993 for the pre-protocol group and from September 1993 to September 1996 for the post-protocol group. The price year was 2000.

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

Link between effectiveness and cost data
The costing was performed retrospectively on the same patient sample as that used in the effectiveness study.

Study sample
Power calculations to determine the sample size were not performed. The patient charts were reviewed retrospectively. Of an initial sample of 118 eligible children, a final sample of 102 patients was included in the study. There were 51 children in each of the groups (pre-protocol and post-protocol). The mean age in the pre-protocol group was 7.2 years (range: 2 months - 17 years) and there were 35 boys. The mean age in the post-protocol group was 7.2 years (range: 2
months - 15 years) and there were 37 boys. Sixteen patients (5 in the pre-protocol group and 11 in the post-protocol group) were excluded from the initial study sample because of positive plain radiograph or CT findings, or non-adherence to the protocol. There was no evidence that the initial study sample was appropriate for the study question.

**Study design**

This was a retrospective before-and-after study using two cohorts, which was carried out in a single centre (the Children's Hospital of Philadelphia). The follow-up lasted until hospital discharge. No loss to follow-up was reported.

**Analysis of effectiveness**

The patients included in the final study sample were accounted for in the effectiveness analysis. The primary health outcomes were:

- the number of patients with MRI,
- the number of patients with positive MRI findings,
- the MRI yield rate,
- the average time from admission to MRI administration,
- the number of patients who were cleared,
- the average time to clearance,
- the average length of stay in the ICU, and
- the average total hospital stay.

The study groups were found to be comparable at baseline in terms of the demographics and distribution of mechanism of injuries.

**Effectiveness results**

The results are presented for the pre-protocol and post-protocol groups, respectively:

- the numbers of patients with MRI were 19 (pre-) and 31 (post-);
- the numbers of patients with positive MRI findings were 3 (pre-) and 4 (post-);
- the MRI yield rates were 15.8% (pre-) and 12.9% (post-);
- the average time from admission to MRI administration was 6.8 days (pre-) and 2.5 days (post-);
- the numbers of patients who were cleared were 46 (pre-) and 47 (post-);
- the average time to clearance was 5.1 days (pre-) and 3.2 days (post-), with the difference reaching statistical significance;
- the average length of stay in the ICU was 9.2 days (pre-) and 7.3 days (post-); and
- the average total hospital stay was 20.1 days (pre-) and 15.5 days (post-).

**Clinical conclusions**

The effectiveness analysis showed that time to clearance was significantly shorter in the MRI protocol. All the
remaining outcome measures favoured the MRI protocol, although the differences did not reach statistical significance.

**Measure of benefits used in the economic analysis**
The health outcomes were left disaggregated and no summary benefit measure was used. A cost-consequences analysis was therefore performed.

**Direct costs**
Discounting was irrelevant, as the time horizon of the study was short (less than 1 year). The unit costs and the quantities of resources were reported separately. The economic analysis included the costs of MRI and the length of hospital stay (both in the ward and the ICU). The cost/resource boundary adopted appears to have been that of the hospital. The resource quantities were estimated from the patients’ charts that were reviewed in the effectiveness study. The source of the cost data is presumed to have been the study hospital. The price year was 2000.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not included.

**Currency**
US dollars ($).

**Sensitivity analysis**
Sensitivity analyses were not performed.

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

**Cost results**
The total costs per patient were $37,400 in the pre-protocol group and $29,700 in the post-protocol group. Consequently, the MRI protocol led to savings of $7,700 per patient.

**Synthesis of costs and benefits**
Not relevant as a cost-consequences analysis was carried out.

**Authors’ conclusions**
The magnetic resonance imaging (MRI) protocol was effective, and resulted in cost-savings in the evaluation of cervical spine injury in obtunded and intubated paediatric trauma patients.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparator was clear. The routine diagnostic protocol was selected as it represented the standard practice before the introduction of the MRI protocol. You should decide whether it is a valid comparator in your own setting.
Validity of estimate of measure of effectiveness
The analysis of effectiveness used a retrospective before-and-after study with different cohorts. The study sample appears to have been representative of the study population, but the authors stated that "caution should be used in extrapolating these findings to the general pediatric trauma population". The study groups were comparable at baseline. However, no power calculations were performed. The main threat to the internal validity of the study was the fact that the effectiveness data were gathered in two different timeframes, thus external factors might have affected the outcome measures.

Validity of estimate of measure of benefit
The health outcomes were left disaggregated and no summary benefit measure was reported. The analysis was therefore categorised as a cost-consequences study.

Validity of estimate of costs
The study appears to have been conducted from the perspective of the hospital, and all the relevant categories of costs were included in the analysis. The unit costs were reported separately from the quantities of resources and the price year was appropriately given. However, the cost analysis presented some drawbacks. First, charges rather than costs were used in the economic analysis. Second, the costs were treated deterministically as no statistical analyses were conducted. Finally, the cost estimates were specific to the study setting and sensitivity analyses were not carried out.

Other issues
The authors made some comparisons of their findings with those from other studies. The issue of the generalisability of the study results to other settings was not addressed and sensitivity analyses were not performed. Thus, the external validity of the analysis was reduced. The study enrolled paediatric trauma patients and this was reflected in the conclusions of the study.

Implications of the study
The authors highlighted the advantages of MRI, such as early spine clearance and reduced hospitalisation time. However, they also acknowledged that the diagnostic procedure might present some limitations, which have to be taken into account. Future studies should incorporate all paediatric trauma patients who undergo cervical immobilisation.

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