Clearance of the cervical spine in clinically unevaluable trauma patients
Halpern CH, Milby AH, Guo W, Schuster JM, Gracias VH, Stein SC

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.

CRD summary
This study evaluated the cost-effectiveness of management strategies for trauma patients whose cervical spines could not be evaluated due to impaired consciousness, endotracheal intubation, or painful distracting injuries. The authors concluded that even theoretical clearance testing, with perfect sensitivity, was unlikely to be cost-effective, compared with a collar until clinical assessment was possible. The reporting was poor on key components of the evaluation, so an assessment of the results cannot be made.

Type of economic evaluation
Cost-utility analysis

Study objective
This study evaluated the effectiveness and cost-effectiveness of management strategies for trauma patients whose cervical spines could not be clinically evaluated due to impaired consciousness, endotracheal intubation, or painful distracting injuries.

Interventions
Immobilisation with a semi-rigid cervical collar was compared with three common cervical clearance techniques: dynamic (flexion/extension) radiography or fluoroscopy, computed tomography (CT), or magnetic resonance imaging (MRI). Semi-rigid cervical collars were applied for 10 days, in the main analysis.

Location/setting
USA/in-patient care.

Methods
Analytical approach:
A decision-tree model used data from a systematic review and meta-analysis to evaluate the cost-effectiveness of the interventions, over a patient’s lifetime, from 25 years old. Potential complications from the use of a collar, and from no collar, were modelled. The authors stated that they took a societal perspective.

Effectiveness data:
The effectiveness data were from several meta-analyses of studies identified by a broad literature search. The primary effectiveness data were the sensitivity and specificity of each of the three cervical clearance techniques. Other key model parameters were the probabilities of cervical spine lesion, that the lesion was unstable, and of collar complications, and the life expectancy of a normal 25-year-old patient and of a 25-year-old quadriplegic patient. Assumptions were made, including: no complications before a decision was made; patients who were diagnosed with instability had no long-term consequences; and patients who were not diagnosed, but had unstable lesions, developed permanent quadriplegia when the collar was removed.

Monetary benefit and utility valuations:
The utility values were from meta-analyses, for each patient health state. The five health states were normal health, collar complications at two, seven, and 10 days, and quadriplegia.

Measure of benefit:
The primary measure of benefit was quality-adjusted life-years (QALYs). Future benefits were discounted at 3% annually.
Cost data:
The costs included the cervical collars, testing procedures, additional costs (including complications) of the cervical collar, and annual costs for quadriplegia. The costs for cervical collars and tests were from Medicare and Medicaid 2005 reimbursement rates. Additional costs were estimated in the model. The annual costs for quadriplegia were from a meta-analysis, for the first year and for subsequent years. All costs were updated to 2007 US $. Future costs were discounted at 3% annually.

Analysis of uncertainty:
One-way and probabilistic sensitivity analyses were undertaken. The probabilistic sensitivity analysis used Monte Carlo simulation, with 1,000 trials of 1,000 patients, with beta distributions for all the parameters that were varied. This analysis focused on simulating the results of future randomised controlled trials. Scenario analyses were undertaken, in which the collars were removed at two or seven days; an improved hypothetical test with 100% sensitivity and 80% specificity was evaluated; and the threshold for the cost of the clearance study was assessed.

Results
In the main analysis, the mean QALYs were 27.65 (95% CI 27.65 to 27.65) for 10 days in a cervical collar, 27.57 (95% CI 27.44 to 27.64) for CT clearance, and 27.59 (95% CI 27.49 to 27.65) for MRI clearance.

The costs were $186.40 (95% CI 182 to 192) for the collar, $26,892.54 (95% CI 5,255 to 64,803) for CT clearance, and $21,460.25 (95% CI 521 to 45,182) for MRI clearance.

The collar for 10 days was cheaper and more effective than the other two options.

In the scenario with a theoretical 100% sensitivity test, the test would have to cost $139.27 for the total costs to equal the $186.40 of the cervical collar strategy. For this strategy to be cost-effective, at a $50,000 per QALY threshold, its cost would have to be $150.17, or $160.94, at a threshold of $100,000 per QALY.

Shorter collar applications (two or seven days) were found to be more cost-effective.

Authors’ conclusions
The authors concluded that even a theoretical test or combination of tests, with perfect sensitivity, was unlikely to be cost-effective, compared with the application of a cervical collar until clinical examination was possible.

CRD commentary
Interventions:
The interventions were described in enough detail, and they appear to have included the most common management strategies.

Effectiveness/benefits:
The details of the search for the effectiveness evidence were reported, and it was sufficiently comprehensive. The inclusion criteria were not listed, but the publication of the search was referenced. Means and 95% confidence intervals for some of the effectiveness data were reported, but the methods of pooling were not, making it difficult to comment on their appropriateness. The utility data were combined from a variety of sources, which used different methods, some of which were not preference based. Each method produces results that are not comparable with those of other methods, and they would need to be translated into a single measure. It is unclear if this was done or a subset of comparable outcomes was used. This lack of reporting makes the accuracy of the results unclear.

Costs:
The authors stated that a societal perspective was adopted, but the costs for lost productivity, formal and informal care, hospitalisation, and other items relevant to the perspective, were not reported. The primary cost driver was false-negative results that led to quadriplegia. The costs of quadriplegia were presented as two items (the first year of quadriplegia, and subsequent years), with no definition of what was included in each item. This lack of detail makes it impossible to assess these costs.

Analysis and results:
The some results were reported, but not those for plain radiography. The model structure indicated that patients who were put in a cervical collar for 10 days never became quadriplegic, because clinical examination became possible and any cervical instability was correctly diagnosed. It is not clear if this was appropriate. Also, it was assumed that all false-negative results led to quadriplegia. This may be reasonable, but sensitivity analysis on this assumption would have been useful. The results of the one-way and probabilistic sensitivity analyses were omitted; given the uncertainty in all of the model inputs, it is unclear why they were not reported. The reporting was generally poor, and the methods used cannot be critiqued.

Concluding remarks:
The reporting was poor on key components of the evaluation, so an assessment of the results cannot be made.

**Funding**
No funding received.

**Bibliographic details**
Halpern CH, Milby AH, Guo W, Schuster JM, Gracias VH, Stein SC. Clearance of the cervical spine in clinically unevaluable trauma patients. Spine 2010; 35(18): 1721-1728

**PubMedID**
21374896

**DOI**
10.1097/BRS.0b013e3181e9acb2

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Braces; Cervical Vertebrae /injuries /pathology /radiography; Diagnostic Imaging /economics /methods; Humans; Predictive Value of Tests; Spinal Injuries /diagnosis /economics /therapy; Wounds and Injuries /diagnosis /economics /therapy

**AccessionNumber**
22010001590

**Date bibliographic record published**
16/02/2011

**Date abstract record published**
06/08/2013