Computed tomography alone versus computed tomography and magnetic resonance imaging in the identification of occult injuries to the cervical spine: a meta-analysis

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CRD summary
The review assessed magnetic resonance imaging for detection of cervical spine injuries after negative computed tomography (CT) and concluded that reliance on CT alone can lead to missed injuries. This conclusion reflected the data presented, but limitations in reporting and analysis methods mean that it should be interpreted cautiously.

Authors' objectives
To assess the ability of magnetic resonance imaging (MRI) to detect injuries to the cervical spine not detected by computed tomography (CT).

Searching
MEDLINE, CINAHL and Cochrane Central Register of Controlled Trials (CENTRAL) were searched from January 2000 to December 2008 for studies published in English. Search terms were reported. Bibliographies of review articles and identified publications were screened for additional studies.

Study selection
Prospective or retrospective studies of at least 30 patients who underwent MRI to exclude injury to the cervical spine after a negative CT scan were eligible for inclusion. Included studies had to report the clinical decision/outcome based on positive MRI findings and/or sufficient data to determine the numbers of true positive, false negative, false positive and true negative MRI results. True positive was defined as an MRI finding that led to change in management. False negative was defined as no abnormality on MRI and injury subsequently discovered on physical examination or flexion-extension films. False positive was defined as positive MRI findings that were not deemed clinically significant. True negative was defined as MRI that showed no injury and resulted in removal of cervical precautions.

Radiologist interpretation (no further definition) was treated as the reference standard in all studies.

Three authors assessed studies for inclusion. Disagreements were resolved by discussion.

Assessment of study quality
Methodological quality of included studies was assessed using published criteria; no details were reported and it was unclear how many reviewers performed the assessment. Only limited summary results of quality assessment were reported.

Data extraction
Data were extracted on the total number of positive MRI examinations and numbers of participants who underwent interventions (prolonged collar or operative). Where sufficient data were available, the relative risk with 95% confidence interval (CI) of a positive MRI that resulted in a change of management was calculated. Data were extracted on the numbers of each type of cervical injury detected.

The authors did not state how many reviewers performed data extraction.

Methods of synthesis
Pooled estimates of sensitivity, specificity, positive likelihood ratio and positive and negative predictive values, with 95% CIs, of MRI for detection of cervical injury were calculated; the methods used were not reported. A pooled estimate of the relative risk, with 95% CI, of a positive MRI that influenced change of management was calculated; studies were weighted by inverse variance.
Between-study heterogeneity was assessed using the Q statistic.

Results of the review
Eleven studies of 1,550 blunt trauma patients with negative cervical spine CT scans were included in the review. Studies were reported to have minimal bias, but none used an independent reference standard test to confirm diagnosis.

A total of 194 MRI abnormalities were detected in 182 patients: ligamentous injuries (n=86); degenerative changes (n=47); disc disruption (n=17); cord contusion (n=16); muscle or soft tissue injury (n=12); spinal stenosis (n=6); fractures and dislocations (n=4); and spinal haematoma (n=3).

The pooled sensitivity of MRI for detecting a clinically significant spinal injury was 100% (95% CI 95% to 100%) and the pooled specificity was 94% (95% CI 93% to 95%). The pooled positive predictive value of MRI was 53% (95% CI 45% to 60%) and the pooled negative predictive value was 100% (95% CI 99% to 100%). The likelihood ratio of significant to non significant injury given a positive MRI was 17 (95% CI 13.8 to 20.8). No false negatives were identified in any study.

The pooled estimate for the relative risk of a positive MRI that resulted in a change in management was 149 (95% CI 46.5 to 477.2) based on seven studies with no evidence of significant heterogeneity (p=0.99).

Authors' conclusions
Reliance on CT imaging alone to "clear the cervical spine" after blunt trauma can lead to missed injuries.

CRD commentary
The review addressed a clearly stated research question; inclusion criteria were defined and the clinical role for which the test (MRI) was evaluated was specified. A range of sources were searched for relevant studies. Only studies published in English were included, which left open the possibility of language and publication biases. Measures were taken to minimise error and bias in the study selection process; it was unclear whether similar measures were applied throughout the review process. The authors reported that methodological quality of included studies was assessed, but only limited results were reported and these were not used in the synthesis. Methods used to generate pooled estimates of outcome measures were not reported and insufficient details of the included studies were reported to determine whether pooling was appropriate. Crucially, the method used to determine whether or not a positive MRI result was clinically significant (true or false positive) was not reported and so it was not possible to assess the validity of these results. Overall, the authors' conclusions reflected the data presented, but limitations in reporting of study details and analysis methods mean that they should be interpreted cautiously.

Implications of the review for practice and research
Practice: The authors stated that the review supported a role for the addition of MRI in evaluating patients who were obtunded or unexaminable despite a negative CT scan.

Research: The authors specified no recommendations for future research.

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