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Safe cervical spine clearance in adult obtunded blunt trauma patients on the basis of a normal multidetector CT scan—A meta-analysis and cohort study

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ABSTRACT

Background: A true gold standard to rule out a significant cervical spine injury in subset of blunt trauma patients with altered sensorium is still to be agreed upon. The objective of this study is to determine whether in obtunded adult patients with blunt trauma, a clinically significant injury to the cervical spine be ruled out on the basis of a normal multidetector cervical spine computed tomography.

Methods: Comprehensive database search was conducted to include all the prospective and retrospective studies on blunt trauma patients with altered sensorium undergoing cervical spine multidetector CT scan as core imaging modality to "clear" the cervical spine. The studies used two main gold standards, magnetic resonance imaging of the cervical spine and/or prolonged clinical follow-up. The data was extracted to report true positive, true negatives, false positives and false negatives. Meta-analysis of sensitivity, specificity, negative and positive predictive values was performed using Meta Analyst Beta 3.13 software.

We also performed a retrospective investigation comparing a robust clinical follow-up and/or cervical spine MR findings in 53 obtunded blunt trauma patients, who previously had undergone a normal multidetector CT scan of the cervical spine reported by a radiologist.

Results: A total of 10 studies involving 1850 obtunded blunt trauma patients with initial cervical spine CT scan reported as normal were included in the final meta-analysis. The cumulative negative predictive value and specificity of cervical spine CT of the ten studies was 99.7% (99.4–99.9%, 95% confidence interval). The positive predictive value and sensitivity was 93.7% (84.0–97.7%, 95% confidence interval).

In the retrospective review of our obtunded blunt trauma patients, none was later diagnosed to have significant cervical spine injury that required a change in clinical management.

Conclusion: In a blunt trauma patient with altered sensorium, a normal cervical spine CT scan is conclusive to safely rule out a clinically significant cervical spine injury. The results of this meta-analysis strongly support the removal of cervical precautions in obtunded blunt trauma patient after normal cervical spine computed tomography. Any further imaging like magnetic resonance imaging of the cervical spine should be performed on case-to-case basis.

Introduction and background

The safe management of cervical spine (CS) injury in a patient with multiple trauma is one of the major challenges faced by trauma surgeons. The incidence of cervical spine injury in the majority of blunt trauma is 2–4% [1] but rises to 34.4% in unconscious patients [2]; potentially resulting in long-term morbidity and carrying with it medico-legal repercussions.

"Clearing" the cervical spine implies declaring no significant injury and removing the spinal precautions based on clinical and/or radiological grounds. An injury to the cervical spine is considered "significant" when if overlooked could result in irreversible neurological deterioration including paralysis and death.

Early cervical spine clearance is of paramount importance as any delay in the clearance process can lead to difficulties in safe

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airway management, increased risk of aspiration, increased intracranial pressure [3], increased risk of thrombosis and decubitus ulceration [4].

In awake and alert patients with blunt cervical spine trauma, the absence of distracting injuries, no cervical spine tenderness or pain on full range of movements plus a normal neurological examination implies the cervical spine can be safely cleared on clinical grounds [5]. It is accepted that radiological screening is indicated in patients with pain or cervical spine tenderness, neurological deficit, patients with significant distracting injuries or the patients with altered sensorium. [2,6,7]. Guidelines are available to aid the safe clearance of the CS in most of the above-mentioned groups of patients [8]. Clearing the CS in obtunded blunt trauma patients without apparent neurological deficit however remains controversial. The term "obtunded" implies a state of cognitive dysfunction in which the clinical examination of a patient becomes unreliable due to decreased GCS including alcohol/drug intoxication.

The ideal method for detecting CS injury should be highly sensitive, cost effective and readily available in the emergency department. Different approaches have been advocated to settle this dilemma. A well-defined algorithm hasn't been agreed upon due to limited information on the validity and reliability of the imaging modalities, inconclusive best available evidence and the fear of devastating consequences in the event of missed injury.

In 1998 the Eastern Association for the Surgery of Trauma (EAST) recommended that all patients who cannot have their cervical spines clinically cleared should have plain radiographs of the CS (anteroposterior, lateral and open mouth odontoid) followed by thin slice (3 mm) axial computed tomography (CT) with sagittal reconstructions of C_1–C_2 [7]. Additional focused CT scan was also recommended if on plain radiography a part of the CS could not be visualized or had suspicious findings. The focused CS-CT as recommended by EAST was challenged by Bern et al. [2] and Diaz JJ [9] as it would fail to depict unstable CS injuries as diagnosed by complete CS-CT. The primary screening modality was then recommended to be cervical spine CT from occiput to T1 with sagittal and coronal reconstructions [10].

Cervical spine CT is a widely accepted initial imaging modality in patients with altered level of consciousness in trauma patients. Multidetector CT scanners image a volume of tissue rather than individual slices, the thickness of which is much less than in single slice CT scanners. In contrast to getting merely axial slices, multi planar slices are retrieved from one 'sweep' in 4–10 s giving thousands of images, which are in turn reconstructed into 3D Image [11]. Whether CS-MDCT could be solely used as a screening modality to safely clear the cervical spine is controversial with the available literature showing contradicting views [12].

Objective; the clinical dilemma

In obtunded adult patients with blunt trauma, can a clinically significant injury be ruled out on the basis of a multidetector cervical spine CT scan being reported as normal?

Methodology; the paper selection

Inclusion criteria

1. Adult blunt trauma patients with altered sensorium/obtunded
2. Multidetector CT of the cervical spine as the core imaging modality

Exclusion criteria

- Studies done using single-slice CT scanners (axial/helical with single -row of detectors)
- Indication for cervical spine MDCT other than altered sensorium

Literature search

The different sources searched are as follows.

1. Electronic Indexed Bibliographic Databases
2. Cochrane Database
3. Grey literature
4. Hand searches through references, relevant journals and correspondences

A search was carried out on the health information resources website (www.library.nhs.uk) using methodology and search terms as depicted in the following flow chart (Fig. 1).

The search was conducted both as key words unmapped to MeSH (Medical Subject Headings) and through MeSH structure. The search was performed for literature published from 1998 onwards (the year when multidetector CT scanners were introduced), was limited to studies done on adult patients and had no language limits. All the search terms used were mapped to thesaurus to achieve comprehensive search results.

A total of 10 studies including 2 from hand search directly addressing my clinical question were selected for detailed appraisal. The selection process involved review of the title and abstract of the relevant studies meeting the inclusion criteria.

Results

The details of the literature search are evident from the flow chart (Fig. 1). Any study involving alert patients or where CS MDCT wasn't core-imaging modality was excluded. A fair number of studies had to be excluded due the fact that the CT scanners were not of multidetector type. In order to have homogenous sample for the meta-analysis, few more studies involving a combination of single row and multidetector CT scanners were also excluded.

A total of 10 studies summarized in Tables 1 and 2 were selected to be included in the meta-analysis, four of them were of prospective cohort design.

The sensitivity is the proportion of patients with abnormal CS by gold standard who has a positive result by CS MDCT. The specificity is the proportion of patients who have a normal CS with a negative CS MDCT. The PPV represents the probability that an abnormal CT scan correlates with an abnormal cervical spine. The NPV is the probability that a negative CT scan correlates with normal cervical spine.

Data from all the 10 studies produces a NPV of 99.7% (99.4–99.9%, 95% confidence interval) as detailed in Table 3 and Fig. 2. The positive predictive value and sensitivity was 93.7% (84.0–97.7%, 95% confidence interval).

The values of sensitivity and positive predictive value are not conclusive as two of the studies had to be excluded whilst calculating these values being a weakness of our study. The studies by Khanna et al. and Stelfox et all had no true positive values so we are not sure how accurate the MDCT would have been in diagnosing a cervical spine injury should there be such a patient in these studies.

The cohort study

Methods

The medical records of 108 patients presenting to the ED of St Georges hospital in London between October 2007 and December 2008 were retrospectively reviewed. October 2007 was the date from when MDCT was considered the investigation of choice for