

Diagnostic imaging for cervical spine clearance in multiple trauma patients – a comprehensive review

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Abstract

Missed cervical spine injuries may have tremendous consequences in trauma patients. Thereby, multiple trauma patients are at special risk for cervical spine injuries. In awake and evaluable patients cervical spine could safely be cleared by clinical criteria even without any radiological imaging. In contrast, diagnostic imaging is mandatory in obtunded patients with relevant concomitant injuries. However, there is no validated diagnostic algorithm for the exclusion of cervical spine injuries in multiple trauma patients. Here, we present a comprehensive review of current literature and evidence concerning diagnostics for cervical spine clearance in adults suffering from blunt multiple trauma.

Introduction

Multiple trauma patients are at special risk for cervical spine injuries [1]. The incidence of cervical spine injuries in adult multiple trauma patients is up to 10% [2-5]. Concomitant traumatic brain injury and maxillofacial lesions represent relevant risk factors for cervical spine injuries [6-11]. In awake and evaluable patient's cervical spine could safely be cleared by clinical criteria even without any radiological imaging according to the Canadian C-spine rule and NEXUS (National Emergency X-Radiography Utilization Study) criteria [12-15]. Due to painful and awareness affecting injuries as well as preclinical procedures like intubation these clinical criteria are not applicable in multiple trauma patients [16,17]. Accordingly, diagnostic imaging is mandatory in these patients in order to rule out cervical spine injuries.

Diagnostic imaging

Based on current literature there is no validated diagnostic gold standard for cervical spine clearance in multiple trauma patients [18]. As a result, a broad variety of diagnostic algorithms exists for cervical spine clearance [19]. There is only a consensus about the diagnostic superiority of computer tomography (CT) compared to conventional x-ray diagnostics [20]. In general, CT-scan is recommended in multiple trauma due to its higher diagnostic accuracy and timely clarification of cervical spine [21-27]. The question whether cervical spine could be sufficiently cleared by solitary CT or whether additional imaging procedures are needed, e.g. magnetic resonance imaging (MRI) or functional x-ray imaging, is controversially discussed [28]. According to the high negative predictive value of CT for cervical spine injuries current studies suggest that solitary CT is adequate for the exclusion of cervical spine injuries, even ligament instabilities. In a prospective study of 9.227 patients Duane et al. reported a 100% negative predictive value of CT for cervical spine injuries [19]. With a negative predictive value of 99.97% Inaba et al. described comparable results in a prospective multi-centre study of 10.276 patients [29]. These results are supported by current meta-analyses reporting cervical spine injuries despite inconspicuous CT-scan only in 0-0.3% [18,30]. Comparable rates of false negative CT-scans of 0.04-1.09% were found

in further retrospective and prospective studies [31-33]. In a prospective study by Berne et al. and in a retrospective study by Steigelman et al. with a relatively small number of cases (85 and 120 patients) a higher amount of false negative CT-scans of 5-5.8% was found [5,21]. Due to an even higher proportion of false negative CT-scans of 22% in a prospective study of 1.577 patients Diaz et al. suggested that CT safely exclude bony lesions, but not ligament injuries of the cervical spine [34]. Most of the cited studies obtain their results concerning the diagnostic accuracy of CT in regard to additionally conducted MRI as reference imaging procedure. In general, magnetic resonance imaging plays a tangential role as a diagnostic tool in the acute phase of multiple trauma management due to lack of time and logistical reasons. Substantial indications for MRI scanning are neurological deficits. Besides spinal cord injuries, ligament lesions and damaged intervertebral discs could be excluded by MRI [22,35,36]. However, the clarification of ligament injuries of the cervical spine was found to be unnecessary in a prospective study by Patton et al. due to the low incidence [37]. Alternatively, traction or functional x-ray imaging of the cervical spine could be performed in order to rule out ligament injuries [38-41]. Sliker et al. found no significant differences between MRI and functional x-ray imaging regarding the accuracy in diagnosing ligament lesions of the cervical spine [42]. Nevertheless, the routine and selective use of functional x-ray imaging also seems to be questionable as pathological findings are rare [43-45].

Conclusion

Up to date there is no validated diagnostic gold standard for cervical spine clearance in multiple trauma patients. Based on the current literature cervical spine could be sufficiently cleared, even for

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ligament injuries, by CT without any further diagnostic imaging. MRI plays an additional role in clarification of neurological deficits.

Authorship and contributorship

All authors have made substantial contributions to 1) conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; 3) final approval of the version to be published; and 4) agreement to act as guarantor of the work (ensuring that questions related to any part of the work are appropriately investigated and resolved).

Conflicts of interest

There is no conflict of interest. All authors disclose any financial or non-financial competing interests. The presentation of the issue is independent.

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