A systematic review of clinical decision rules in the management of adult minor head injury

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Introduction

Computed tomography (CT) of the head is the diagnostic standard for identifying intracranial injury. Routine CT of all minor head injury patients would result in a large number of normal CT scans being performed with associated risks of radiation exposure and waste of health care resources. Researchers have therefore attempted to derive clinical decision rules to identify those at risk of intracranial injury based on clinical characteristics at presentation in order to select them for imaging.
It is currently unclear how existing rules compare in terms of diagnostic accuracy. This study aims to systematically identify clinical decision rules for adults with minor head injury and compare the decision/prediction rules in terms of estimated diagnostic accuracy for any intracranial injury and injury requiring neurosurgery.

Methods

Potentially relevant studies were identified by an electronic search of key databases. Papers in English were included with a cohort of more than 20 patients and over 50% being adults having suffered a minor head injury (GCS 13-15). Studies described a decision rule derived to identify patients at risk of intracranial injury or neurosurgery.
The QUality Assessment of Diagnostic Accuracy Studies (QUADAS) checklist was used to assess study quality. Data was extracted by one reviewer (SH) and checked by a second (APa). Variables relating to study design, patient characteristics, study quality and diagnostic accuracy were extracted. Where discrepancies occurred, these were resolved through discussion. Where differences were unresolved, a third reviewer's opinion was sought (SG or APi).

Discussion

The CCHR has high sensitivity for detecting neurosurgical injuries, whether high-risk or high and medium risk criteria are used. This is a consistent finding in the available data so clinicians can be reasonably assured that selecting patients for CT scanning on the basis of the CCHR will carry a very low risk of missed neurosurgical injury. The sensitivity of the CCHR medium-risk criteria for detecting any intracranial lesion is less consistent, although the lower reported sensitivity in some studies may reflect failure to detect injuries that are of little clinical significance. Clinicians using the CCHR should be aware that it may miss some non-neurosurgical lesions of questionable clinical significance.

Data limitations should be considered when using the CCHR in practice. Patients with coagulopathy, aged under 16, pregnancy, seizure post-injury, focal neurological deficit or injuries considered minimal were excluded from developmental work, so the rule may not be applicable to such patients. However, diagnostic accuracy was maintained in a subsequent study that included these patients (see "CCHR High and medium risk adapted to cohort").(1)
Whenever rules have been directly compared in the same patient cohort, only marginal differences in sensitivity have been identified, translating to very little clinical difference in injury detection. The primary advantage of the CCHR over other decision rules is in its improved specificity, leading to a reduction in the number of scans required to identify the same number of injuries.

Conclusions

The current evidence base suggests that the CCHR has the most consistent and acceptable sensitivity and specificity when compared to other decision rules for adults with minor head injury.

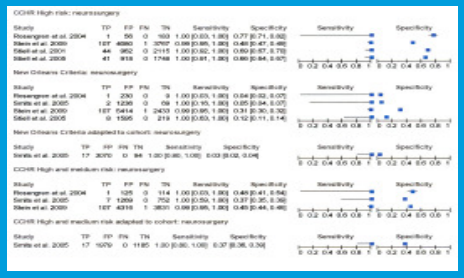
Reference List

(1) Smits M, Dippel DW, de Haan GG. External validation of the Canadian Head Rule and the New Orleans Criteria for CT scanning in patients with minor head injury. JAMA [294], 1519-1525. 2005.
Ref Type: Journal (Full)

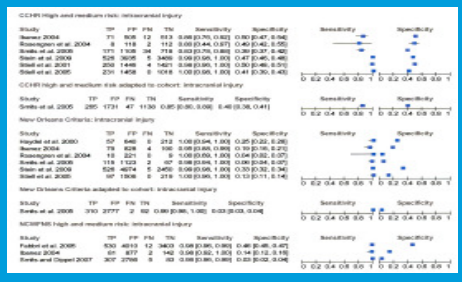
Results

Twenty-two articles, representing nineteen studies, were identified. The median prevalence of intracranial injury was 7.2% (IQR 6.3 to 8.5%) and for neurosurgical injury was 0.95% (IQR 0.31 to 1.5%).
Patient selection, use of reference standards and outcome definitions all varied. These variations are likely to affect comparability across cohorts and application of conclusions to practice. Follow-up of subjects where CT was not performed for all could affect estimates of sensitivity and specificity. For outcome definition the main variation involved the perception of clinical significance; four cohorts used a precise definition for significant injury, whilst the others defined this broadly as any acute lesion on CT, often excluding isolated skull fracture. Definitions of surgical lesions also varied but most included requiring procedures such as haematoma evacuation, elevation of depressed skull fracture and intracranial pressure monitoring.

Neurosurgical injury:
The Canadian CT Head Rule (CCHR) and the New Orleans Criteria (NOC) have been most extensively tested. Five studies evaluated both rules allowing direction comparison. The CCHR high-risk criteria have sensitivity ranging from 99-100% and specificity from 48-77% for neurosurgical injury. The CCHR high and medium risk criteria have corresponding values of 99-100% and 37-48%, whilst the NOC have similar sensitivity of 99-100% but generally poorer specificity, ranging from 3-31%.
The National Institute for Health and Clinical Excellence (NICE) guidelines were developed from the CCHR high and medium risk criteria. However, sensitivity and specificity for neurosurgical injury seemed poorer, ranging from 88-98% and 29-67% respectively.



Intracranial injury:
For intracranial injury, the estimates of sensitivity range from 80-100% for CCHR high and medium risk criteria, whilst for NOC they range from 95-100%. However, this would seem to be at the expense of specificity, as CCHR achieves specificities from 39-50%, whilst NOC specificity ranges from 3%-33%. In most cohorts, application of NOC would have resulted in nearly all patients having a CT scan, whilst for CCHR specificity is adequate to allow a meaningful proportion of patients to avoid a CT scan. CCHR sensitivity for any intracranial injury is more modest but the missed cases are unlikely to be clinically significant.
For intracranial injury, NICE sensitivity was poorer, and ranged from 67-99% while specificity may be superior with a range from and 31-70%. It should be noted that two of these studies report data from the same cohort, but with different outcome definitions.



Other rules:
The National Emergency X-Radiography Utilization Study II (NEXUS II) rule appears to have high sensitivity for both neurosurgical and any injury, but variable specificity and very limited validation. The Neurotraumatology Committee of the World Federation of Neurosurgical Societies (NCWFNS) guidelines and Scottish Intercollegiate Guidelines Network (SIGN) guidelines both have sensitivities in a similar range to the CCHR when lenient criteria are used, but results for specificity are very variable and generally much lower. The Scandinavian lenient criteria have similar diagnostic parameters but with more variation. Other rules have not been validated in sufficient cohorts and settings to draw meaningful conclusions.