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Clinical decision rules for adults with minor head injury: a systematic review

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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 aimed 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

Several key electronic bibliographic databases (biomedical, scientific and grey literature), were searched from inception to March 2010. Retrieved citations were considered for inclusion by at least two independent reviewers. Cohort studies that described a clinical decision rule to identify adults with minor head injury (GCS 13-15) at risk of intracranial injury or injury requiring neurosurgical intervention were included in the review. 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).

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 (Figure 1). The CCHR high-risk criteria have sensitivity ranging from 99 to 100% and specificity from 48 to 77% for neurosurgical injury. The CCHR high and medium risk criteria have corresponding values of 99 to 100% and 37 to 48%, whilst the NOC have similar sensitivity of 99 to 100% but generally poorer specificity, ranging from 3 to 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 to 98% and 29 to 67% respectively.

Intracranial injury: For intracranial injury, the estimates of sensitivity range from 80 to 100% for CCHR high and medium risk criteria, whilst for NOC they range from 95 to 100% (Figure 2). However, this would seem to be at the expense of specificity, as CCHR achieves specificities from 39 to 50%, whilst NOC specificity ranges from 3 to 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 to 99% while specificity may be superior with a range from and 31 to 70%. It should be noted that two of these studies report data from the same cohort, but with different outcome definitions.

Figure 1. CCHR and New Orleans Criteria for need for neurosurgery

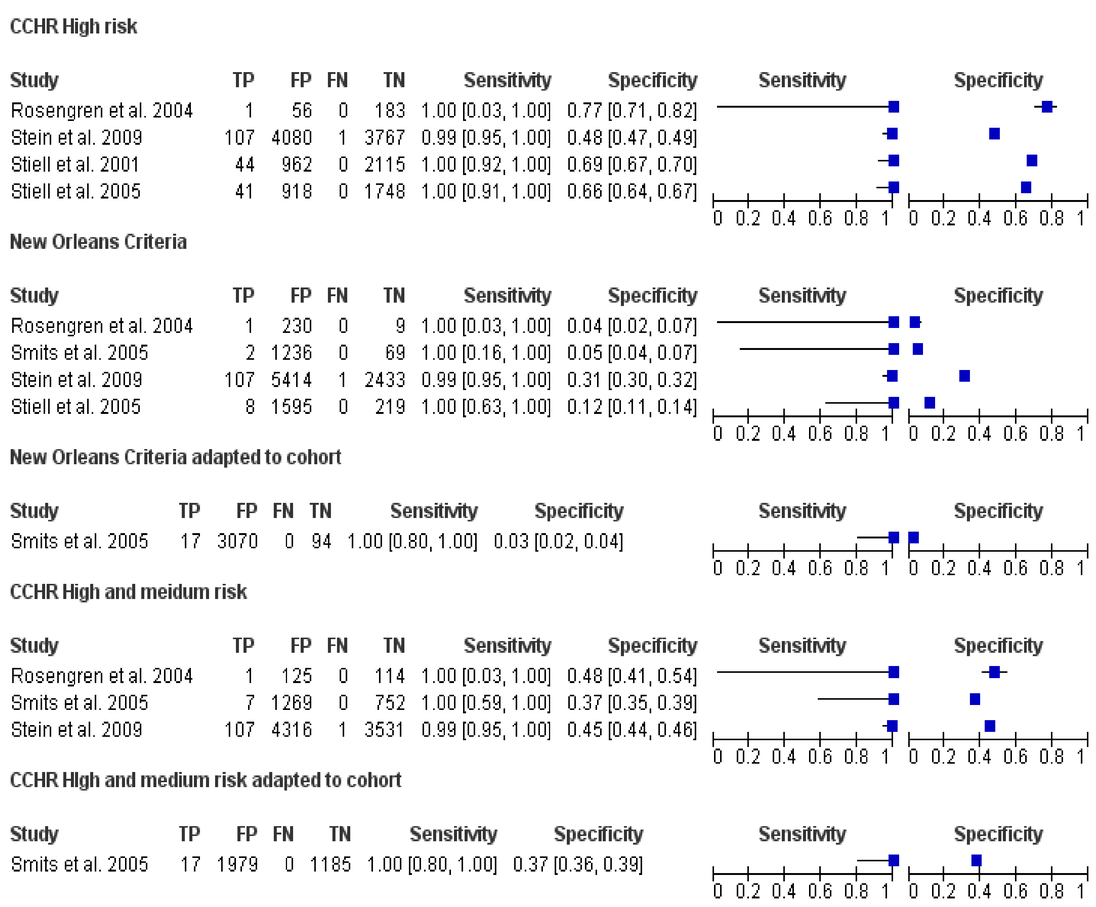
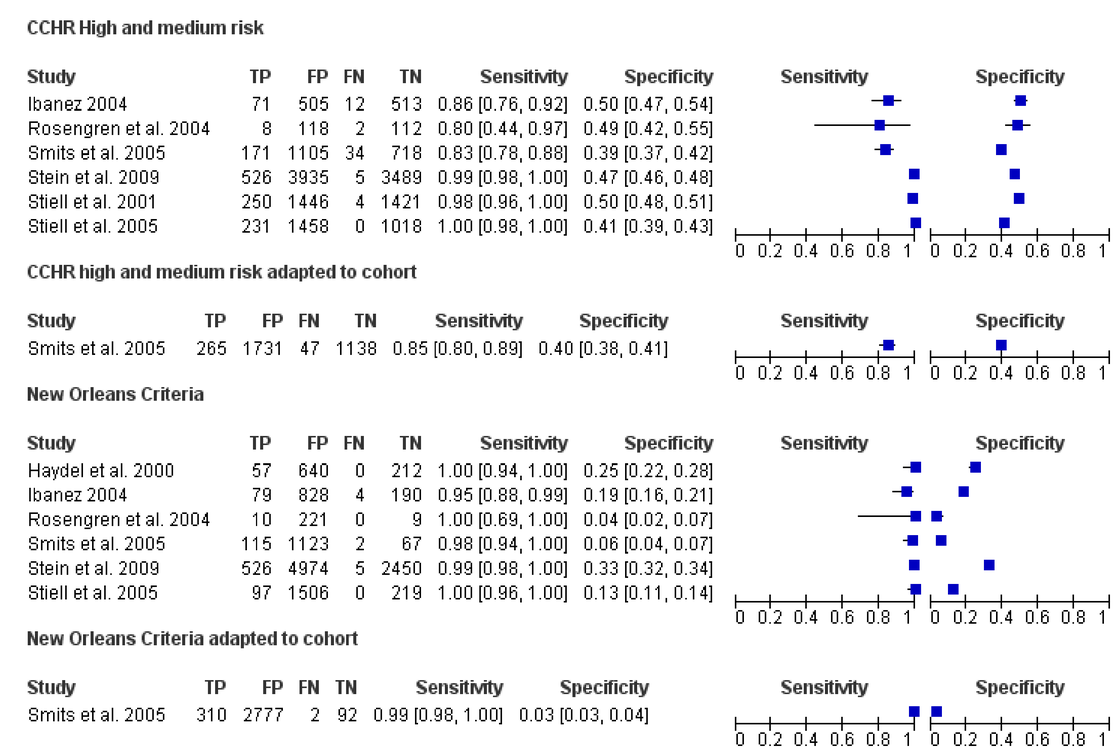


Figure 2. CCHR and New Orleans Criteria for intracranial injury



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.

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