Need to Know: CJEM Journal Club

Does the CATCH clinical decision rule adequately determine which children with minor head injury require computed tomography (CT) imaging?

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INTRODUCTION

Background

Clinical decision rules such as CATCH, derived in 2010 with near-perfect sensitivity, provide physicians with an evidence-based approach to determining which children with minor head injury need imaging.

Objectives

1) Prospectively validate the CATCH clinical decision rule for children with minor head injury to determine who requires computed tomography (CT) imaging; and 2) explore clinical decision rule refinement to improve its performance.

METHODS

Design

Prospective multicentre cohort study.

Setting

Nine Canadian emergency departments.

Subjects

Table 1. Inclusion and exclusion criteria of study	
Included	Excluded
• Children 0–16 years of age • ED GCS 13–15 • Blunt trauma • Minor head injury in last 24 hours (any of): ○ LOC/amnesia/disorientation ○ >1 Emesis ○ Irritable if < 2 years of age	• Penetrating/depressed fracture • Focal neurologic deficit • Developmental delay • Child abuse • Pregnant • Reassessment

ED GCS = emergency department Glasgow Coma Scale; LOC = level of consciousness.

Intervention

Application of CATCH for CT imaging:

Table 2. CATCH decision rule criteria	
High risk	Medium risk
• GCS < 15, 2-hour post-injury • Suspected open/depressed fracture • Worsening headache • Irritability	• Signs of basal skull fracture • Scalp hematoma • Mechanism: ○ MVC ○ Fall > 3 feet/five stairs ○ Bike non-helmeted

GCS = Glasgow Coma Scale; MVC = motor vehicle collision.

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Table 3. CATCH rule performance for children with minor head injury

	Neurosurgical intervention		Brain injury on CT	
	Yes	No	Yes	No
CATCH (+)	21	1,733	192	1,562
CATCH (-)	2	2,304	5	2,301
Sensitivity (95% CI)	91.3% (72.0–98.9)		97.5% (94.2–99.2)	
Specificity (95% CI)	57.1% (55.5–58.6)		59.6% (58.0–61.1)	

Table 4. New 8-item CATCH-2 rule performance for children with minor head injury

	Neurosurgical intervention		Brain injury on CT	
	Yes	No	Yes	No
CATCH (+)	23	2,191	196	2,018
CATCH (-)	0	1,846	1	1,845
Sensitivity (95% CI)	100% (85.2–100)		99.5% (97.2–100)	
Specificity (95% CI)	45.7% (44.2–47.3)		47.8% (46.8–49.4)	

Outcomes

- Primary: Neurosurgical intervention within 7 days.
- Secondary: Brain injury on CT.

RESULTS

A total of 4,494 eligible patients were enrolled with 4,060 included in the final analysis. Mean age was 9.7 years; 463 (11.4%) of patients were younger than 2 years; 1,417 (34.9%) patients underwent CT imaging.

The removal of high and medium risk stratification and the addition of 8th criterion (≥ 4 episodes of emesis) provided improved performance.

APPRAISAL

Strengths

- Relevant, important clinical question
- Unbiased, consecutive, prospective patient enrolment process
- Multicentre, nationwide study
- Congruity of CATCH rule to derivation study
- Good inter-observer interpretation of predictor variables (kappa = 0.67)
- High degree of physician comfort with rule (81.5%)
- Patient follow-up at 14 days post discharge to ensure no missed adverse outcomes
- Clear description of recursive partitioning process to refine rule

Limitations

- High proportion lost to follow-up (n = 434; 9.7%)
- Event rate unclear in children < 2 years (n = 463)
- Low primary outcome event rate resulting in wide confidence intervals

- Bootstrap analysis of CATCH-2 completed with original CATCH derivation cohort, posing risk of sample bias

CONTEXT

The 2010 CATCH derivation study[1] reported 100% sensitivity for high-risk and 98.1% sensitivity for medium-risk variables aiming to rule out pediatric minor head injuries requiring neurosurgical intervention. In contrast, the prospective validation of CATCH (91.3% sensitivity) is less sensitive than other validated clinical decision rules (PECARN: 100% sensitivity if < 2 years; 96.8% sensitivity if > 2 years).[2,3]

By refining the 7-item CATCH rule to the 8-item CATCH-2 rule, 100% sensitivity for neurosurgical intervention is achieved at the cost of increased CT rate compared with CATCH and PECARN. CATCH-2 provides a user-friendly "list" compared with PECARN and CHALICE,[3] but validation of CATCH-2 is necessary prior to use.

BOTTOM LINE

This validation study of the CATCH clinical decision rule for pediatric minor head injury failed to provide a sensitivity as high as its derivation study. The results make CATCH inadequate to be safely applied in the emergency department. Consequently, the authors used recursive partitioning to derive the CATCH-2 clinical decision rule by removing "high risk" and "medium risk" stratification and instead adding an eighth criterion of "vomiting ≥ 4 episodes." These changes provided 100% sensitivity for neurosurgical intervention. Although CATCH-2 shows promise, it has not yet been prospectively validated, a requisite step prior to clinical implementation.[4]

REFERENCES

1. Osmond MH, Klassen TP, Wells GA, et al. CATCH: a clinical decision rule for the use of computed tomography in children with minor head injury. *CMAJ* 2010;182:341–8.

2. Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet* 2009;374:1160E70.

3. Lyttle MD, Crowe L, Oakley E, et al. Comparing CATCH, CHALICE and PECARN clinical decision rules for paediatric head injuries. *Emerg Med J* 2012;29:785–94.

4. McGinn TG, Guyatt GH, Wyer PC, et al. Users' guides to the medical literature: XXII: how to use articles about clinical decision rules. Evidence-Based Medicine Working Group. *JAMA* 2000;284(1):79–84.