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Isolated Vomiting as a Predictor of Clinically Significant Head Injury in Children: A Retrospective Evaluation

Aisia Lea, Meenu Pandey

University Hospitals Derby and Burton NHS Trust, Burton, United Kingdom
Email: aisia.lea4@nhs.net

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Abstract

Vomiting is common (13% - 17%) in paediatric head injury (HI) and leads to emergency department (ED) referral and prolonged observation. NICE recommends ED assessment in those with ANY vomiting, though emerging evidence suggests isolated vomiting is a low-risk predictor (0.2% - 0.3%) of Clinically Significant Head Injury (CSHI). Evidence is limited in the UK, and there is variation in current practices. This retrospective evaluation aimed to evaluate the association between vomiting and CSHI. We conducted a retrospective observational evaluation in a population aged 0 - 18 years with HI in a paediatric ED between 9th - 29th June 2025. Data were extracted from electronic health records. CSHI was defined as intracranial injury requiring neurosurgical intervention, admission >24 hours, or death. Demographic characteristics, mechanism, red flags and outcomes were analysed. 166 children were included. Vomiting occurred in 23/166 (13.8%); 19/23 (82.6%) had isolated vomiting; 4/23 (17.4%) had red flags. 7/166 (4.2%), including 1/23 in the vomiting group, underwent CT. CSHI occurred in 2/166 (1.2%); 0/23 (0.0%). CT in the vomiting group was normal. No child with isolated vomiting had CSHI. None had intracranial bleed or underwent neurosurgery. Isolated vomiting was not associated with CSHI, regardless of number of episodes, a low-risk group. This questions the current recommendation for all ED assessments in those with vomiting. This has informed the multicentre VOM-HI evaluation, to evaluate CT imaging utilisation and variation in practice across regional UK EDs. With up to 500,000 annual UK paediatric HI attendances, small refinements in pathways could have substantial implications.

Keywords

Head Injury, Vomiting, Paediatric, Emergency Department

1. Introduction

The incidence of paediatric patients presenting with head injury and vomiting is approximately 13% - 17% in large prospective cohorts of children evaluated for head trauma in emergency departments [1] [2].

Clinically important traumatic brain injury occurs in only 0.2% - 0.3% of children with isolated vomiting after head injury, while the risk increases to 2% - 2.5% when vomiting is accompanied by other concerning features (e.g., altered mental status, signs of skull fracture, headache, abnormal behaviour) [1]-[3]. The risk of traumatic brain injury on CT in isolated vomiting is also low (1.7%), compared to 6.4% in those with additional symptoms [2]. Most children with isolated vomiting do not require neurosurgical intervention, and observation without immediate CT is considered appropriate [1] [2].

Validated clinical decision rules (e.g., PECARN) identify low-risk patients and guide imaging decisions, with vomiting considered a small to moderate risk factor for intracranial injury when not isolated [4]-[8]. Overall, isolated vomiting is a poor predictor of serious injury, and most children have favourable outcomes without sequelae [1] [2] [4].

The aim of this evaluation was to determine, for patients presenting to CED with head injury, if isolated vomiting after head injury is a reliable predictor of clinically significant head injury (CSHI), or whether observation can be safely shortened in the absence of other markers [9].

2. Methodology

We conducted a retrospective evaluation of children presenting with head injury to the Royal Derby Hospital (RDH) Children's Emergency Department (CED) between 9 and 29 June 2025. The project was registered through the local clinical audit process. Electronic attendance records coded as "head injury" were reviewed using a standardised data collection tool outlined in Appendix 1. Attendance records were filtered by the code "head injury". Patients were followed up for up to 48 hours post discharge of the index visit, to capture reattendance to our department. Presentations at other emergency departments or healthcare providers were not captured. Data collected included patient demographic details, date and time of CED attendance, time of injury, associated symptoms, vomiting at time of injury, by presentation to CED, and whilst in the department, red flag symptoms, whether a CT head was performed, and final outcome (admission, discharge, and re-attendance). This data was analysed in Microsoft Excel.

Patients were stratified into those with isolated vomiting at presentation and vomiting with other NICE red flags [9]. Isolated vomiting was defined as vomiting in the absence of red flag features such as seizure, loss of consciousness, significant mechanism of injury, and amnesia >5 minutes [9]. Free text was used to classify symptoms that did not fit this definition but were deemed relevant.

CSHI is defined in this study as intracranial injury requiring neurosurgical intervention, admission for more than 24 hours for head injury with confirmed in-

tracranial injuries, or death. The aim was to include patients who needed in-hospital care due to significant head injury. This definition is adapted from the other commonly available descriptions of clinically important traumatic brain injury (ciTBI), some of which have been defined as "death, neurosurgery, intubation for >24 hours, or hospitalization for ≥2 nights" [10].

3. Results

166 patients were identified from 9th June 2025 to 29th June 2025 attending CED at RDH. The mean age of attendees was 68 months (range 1 - 216 months, SD 57.8). 64.5% of attendees were male and 35.5% were female. Mechanism of injury was divided into five categories: fall, collision, sports, RTC, and "other" (Figure 1).

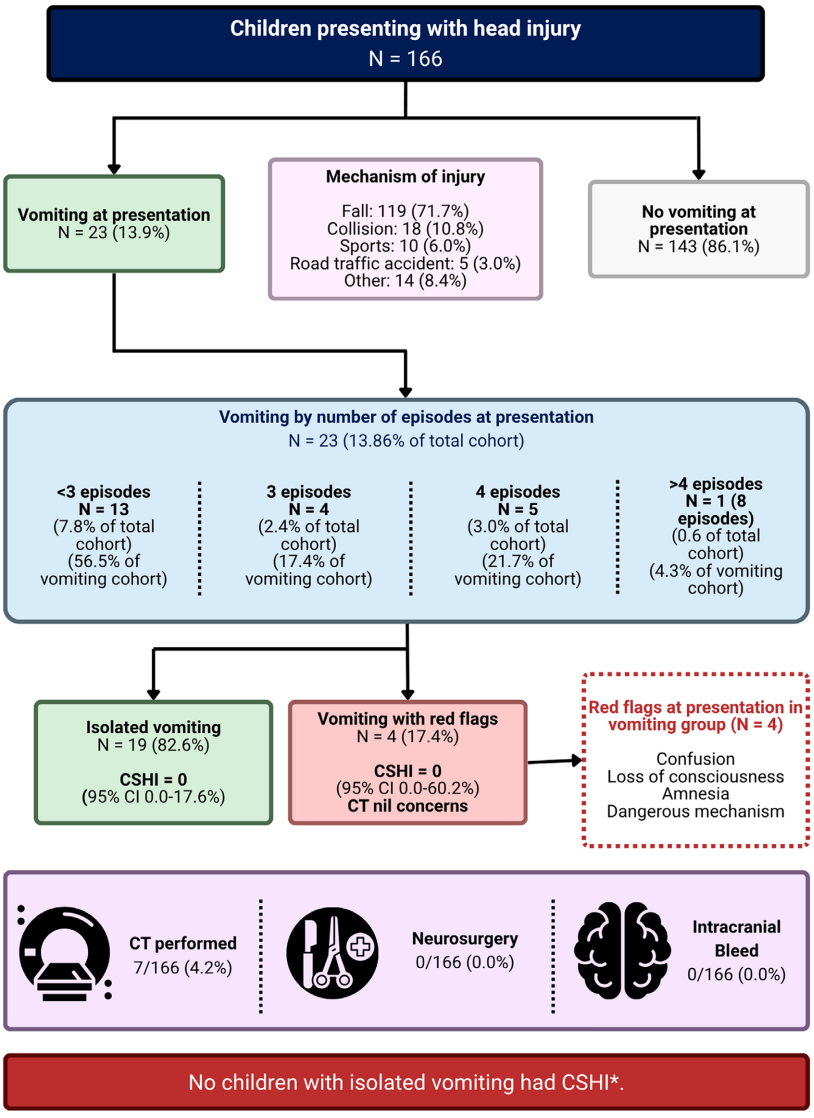


Figure 1. Flowchart showing the outcomes of children presenting with head injury. *Clinically Significant Head Injury (CSHI): head injury requiring neurosurgical intervention, admission for more than 24 hours for head injury with confirmed intracranial injuries, or death.

13.9% (23/166) of attendees had vomiting at the time of injury (presentation). Of these patients, 19/23 (82.6%) had isolated vomiting without other red flags, while 4/23 (17.4%) had associated red flags at presentation; one patient had a combination of loss of consciousness, confusion and amnesia. Others had amnesia, confusion and a dangerous mechanism of injury (fall from push bike at high speed, unwitnessed injury).

Overall, CT head was performed for 7/166 (4.2%) attendees for the following reasons: periorbital ecchymoses of the left eye with swelling; 2 cm indentation posterolateral parietal aspect of head; patient taking warfarin; potential convulsion followed by loss of consciousness; amnesia lasting more than 5 minutes and confusion; significant mechanism of injury with a potential loss of consciousness and facial wounds; and unwitnessed significant mechanism of injury. Of these, one had vomiting with associated red flags (dangerous mechanism of injury), but CT head did not show a significant finding.

Of the patients who underwent CT head, 2/7 (28.6%) had a positive finding, both being skull fractures. Both were discharged following ward admission and observation up to 48 hours, without any intervention.

5 patients were admitted following HI, of which one was for social reasons. One was reviewed by the maxillofacial team and wounds were closed with discharge in 24 hours. One had presented with suspected seizure, though CT head was normal, they were admitted for observation due to appearing uncoordinated. They were discharged after 48 hours.

Overall, 2/166 (1.2%) patients had CSHI due to admission over 24 hours. No child with vomiting or isolated vomiting had CSHI. No intracranial haemorrhage or neurosurgical intervention occurred. No deaths were reported.

Figure 1 outlines significant findings from the data set.

4. Discussion

In the cohort identified, vomiting at presentation was relatively uncommon (23/166; 13.9%). The majority of attendees with vomiting at presentation had no associated red flags (19/23; 82.6%), and less than 3 episodes of vomiting (13/23; 56.5%).

CSHI was defined as an intracranial injury requiring neurosurgical intervention, admission for more than 24 hours for head injury with confirmed intracranial injuries, or death. The incidence of CSHI was quite low overall (1.2% of total cohort), with no incidences of CSHI in the vomiting group. CSHI occurred in 2/166 (1.2%) children, both meeting the predefined outcome through admission for >24 hours. Neither had presented with vomiting. No intracranial haemorrhage, neurosurgical intervention or death occurred.

In this single-centre cohort, approximately one in seven children presenting with head injury had experienced vomiting, with most having no additional concerning features at presentation. No child presenting with vomiting developed CSHI, and no acute intracranial haemorrhage was identified in the overall cohort.

These findings are consistent with larger studies demonstrating that isolated

vomiting following paediatric head injury is associated with a very low risk of clinically important traumatic brain injury [1]. Our findings add real-world observational data from a UK children's emergency department and suggest that the clinical significance of vomiting should be interpreted alongside other features of the history and examination rather than in isolation.

All patients in our study group were discharged from hospital, without any instances of neurosurgical intervention, or any deaths. Our findings support existing research that suggests that isolated vomiting is a poor indicator of significant intracranial injury, given that all patients in this group were discharged from CED, and the instances of CSHI occurred outside of the group with vomiting at presentation [2] [11].

Rather than vomiting alone being used as a predictor for CSHI (and therefore CED assessment and/or observation), we may instead move towards a model that focuses on signs of skull fracture given this was the prevalent form of CSHI identified in the study, or a focus on the number of vomits or other red flags as outlined by NICE [9]. Stratified triage tools may be developed that outline head injury in the context of red flag symptoms (such as significant mechanism of injury, loss of consciousness, amnesia, confusion, or signs of skull fracture).

Barriers to implementation of stratified triage tools include a greater level of perceived risk by the clinician or operator referring the patient, particularly given that telephone consultations and 111 calls do not allow for thorough assessment of the child. Moreover, reports of injury are, to a degree, subjective, based on parents' assessment and memory of the incident. These things together are coupled with clinician levels of confident in assessing children, which can be variable based on clinician seniority and paediatric experience [12]. Therefore, in clinical practice, many may take a cautious approach and refer for CED assessment or may continue to operate on the assumption that vomiting is a predictor of CSHI.

This evaluation has a few limitations. It was a retrospective, single-centre evaluation conducted over a short period and included a relatively small number of children with vomiting. The absence of CSHI among children with isolated vomiting should therefore not be interpreted as definitively demonstrating the safety of early discharge. Reliance on routinely recorded clinical documentation may also have resulted in incomplete recording of vomiting frequency or associated symptoms. The findings should be considered hypothesis-generating and require evaluation in larger multicentre cohorts. In addition, patients were not followed up in this study beyond a follow up period of 48 hours and reattendance at other centres was not captured. Patient deaths would have been identified on the electronic record. No deaths were recorded in or beyond the study window. Selective CT use means that minor intracranial injury cannot be excluded in all patients, however, it remains unlikely in the absence of red flag features.

Areas for future research include broadening the scope of the study to other centres across the country, trialling a new risk stratification tool based on NICE red flags and >3 episodes of vomiting, and assessing clinician perspectives on as-

sessing children with head injury and factors that influence their decision to admit or keep for observation.

5. Conclusion

In this single-centre cohort, no clinically significant head injuries occurred among children presenting with vomiting following head injury, including those with isolated vomiting. Although limited by the small sample size, these findings are consistent with existing evidence that isolated vomiting is a low-risk feature. Larger multicentre studies are required to determine whether children with isolated vomiting can be reliably identified for risk-stratified observation and discharge.

Author Contributions

Conceptualization, A.L. and M.P.; methodology, A.L and M.P.; validation, A.L. and M.P.; formal analysis, A.L; investigation, A.L. and M.P.; data curation, A.L.; writing—original draft preparation, A.L.; writing—review and editing, M.P.; visualization, A.L.; supervision, M.P.; project administration, M.P. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendices

Appendix 1. Data Collection Tool

	Field name	Entry/options	Definition/notes
1	Site		
2	Local record number		
3	Date of ED attendance		dd/mm/yyyy
4	Time of arrival		Hh:mm
5	Age (months)		
6	Sex		M/F/Other
7	Mechanism of injury	dropdown: fall/collision/RTC/sports/other	free text "other" option
8	Time of injury		Hh:mm
9	Time from injury to ED presentation		Minutes
10	Vomiting at presentation?	Y/N	
11	Number of vomiting episodes (total) at presentation		number before ED assessment
12	Continued vomiting in ED?	Y/N/Not recorded	
13	Number of vomiting episodes in ED/observation		
14	Total number of vomiting episodes (11 +13)		
15	Is vomiting *isolated* at presentation?	Y/N	isolated = no other NICE red flags/abnormal exam
16	If no, other red flags present at presentation	checklist: GCS < 15/severe headache/LOC/seizure/amnesia/signs skull fracture/focal neuro/irritability/other	tick all that apply
17	GCS/AVPU at assessment	GCS score or AVPU	
18	Other red flags developed during stay in ED/observation?		
19	Time of development of other red flags		Hh:mm
20	Time from injury to development of other red flags		min
21	CT head performed?	Y/N	If Y, continue fields below

Continued

22	CT head result	normal/intracranial injury/skull fracture only/other	free text allowed
23	Neurosurgical intervention?	Y/N	If Y, describe
23	Admission for head injury?	Y/N	
24	if Y, length of stay (hrs)		
25	Discharged from ED?	Y/N	
26	Return ED visit within 48 h?	Y/N	if Y, reason/outcome
27	Final CSHI outcome	No/Yes—required intervention/Yes—imaging positive but no intervention	Define CSHI as head injury requiring neurosurgical intervention, admission for more than 24 hours for head injury with confirmed intracranial injuries, or death.
28	Notes/clinical comment	free text	e.g., migraine history, motion sickness, vomiting preceded by GI symptoms