CHALICE head injury rule: an implementation study

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ABSTRACT

Introduction Paediatric head injury is a common presentation to emergency departments (ED), and the 2007 National Institute for Health and Clinical Excellence head injury guidelines included a paediatric section to deal with this. This is based on the Children's Head Injury Algorithm for the Prediction of Important Clinical Events (CHALICE) head injury rule. To date, no studies have examined the impact of the guideline on ED resources.

Method The 2007 guideline criteria were applied to records of patients seen pre-2007. By comparing the number of scans done with these criteria with those done in actual practice, the resource implications of the 2007 guideline could be assessed.

Results If the pre-existing (2003) guideline had been strictly applied, 28 (6%) of the 464 patients analysed would have received a computed tomography (CT) scan. Applying the 2007 guideline to the same 464 patients resulted in an extra 21 (4.6%) scans.

Discussion The cost effect of an extra 21 CT scans per annum is estimated at £3570. This is offset against a potential cost saving on admissions of £10 450. The neoplasia risks of increased scanning are also discussed. Problems in this study were the preference for admission over scanning in children who qualified for scan under both guidelines and absent data from clinical records. Further work could include a prospective study of the guideline.

It was estimated in 1981 that there are one million annual attendances to English emergency departments (ED), and that half of these patients are children.[1] In 2005 108 171 patients were discharged from hospital in the UK with a diagnosis of head injury.[2] Although the overall number of patients presenting with head injury is high, actual intracranial pathology is rare, so a good objective predictor of serious pathology is very useful.

Such a predictor was derived by the Children's Head Injury Algorithm for the Prediction of Important Clinical Events (CHALICE) study group, who in 2006 published an analysis of 22 772 children's head injuries.[3] A statistical method was used to identify 14 clinical variables predicting the risk of death, the need for neurosurgery or computed tomography (CT) scan changes.

The 2003 National Institute for Health and Clinical Excellence (NICE) guideline for the management of head injury had extrapolated adult data for use in children. This guidance was revised in 2007 to incorporate the CHALICE findings into a separate specific children's guideline.[4] The 2003 and 2007 NICE guidelines for the management of head injury in children are summarised below (table 1). The key changes are the introduction of 'non-accidental injury' and 'abnormal drowsiness' as qualifiers for CT scanning.

This study observes the probable impact of the introduction of the 2007 guideline on the management of head injury in children in a small district general hospital (DGH).

METHODS

This was a retrospective evaluation of ED notes between January and December 2007. It took place in a DGH ED in the southwest of England. Patients under 16 years attending the ED of North Devon District Hospital with a presenting complaint of 'head injury' were identified through the hospital audit office, and notes were obtained and reviewed. Departmental protocol at that time was that all patients with head injury should be managed according to the NICE 2003 head injury guideline.

A proforma was written to determine which features of both 2003 and 2007 clinical decision rules the patients exhibited. The dataset was analysed first to assess compliance with the NICE 2003 guideline, and then to observe any differences in outcome in the same patients when the NICE 2007 guideline was applied. The indication for CT requests was specifically noted.

There is no facility for skull x-rays under the new guideline, and very few indications in the old guideline, so this has not been considered in this study.

RESULTS

Five hundred and ninety-two patients were identified; 64.1% were male and patients were evenly spread among the age ranges (table 2). As would be expected, attendances peaked during the summer months (figure 1).

Of the 592 patients, 71 case notes were unavailable and 57 patients did not wait for assessment. This left 464 case notes to be analysed.

The majority of patients (424; 90.3%) were discharged from the ED with head injury advice. A minority (45; 9.7%) were admitted, 44 to the local paediatric ward and one to a tertiary neurosurgical centre with a depressed skull fracture.

Eight patients (1.7%) underwent a CT scan, of which four were discharged, three were admitted locally and one was transferred to a tertiary centre. Four patients (0.9%) underwent skull radiographs, all outwith the 2003 NICE guideline.

If the 2003 NICE guideline had been strictly adhered to, 28 patients (6.0%) would have received a CT scan. If the 2007 guideline was implemented a CT scan would have been indicated in 49 patients (10.6%) (table 3). This is an extra 21 scans (4.5%) over the 2003 guideline and an extra 41 scans (8.8%) over actual management.

The clinical indication for the extra scans was mainly due to 'bruises, swellings or lacerations

Table 1 Comparison of 2003 and 2007 NICE head injury guidelines as applied to children

NICE 2003 guideline 4	NICE 2007 guideline 5 (based on CHALICE)
A patient should have a CT scan if any of the following are found:	
History	
GCS <13 at any time since injury	Witnessed LOC >5 min
Retrograde amnesia >30 min	Amnesia, retrograde or antegrade, >5 min
	Abnormal drowsiness
More than one vomit (exercise clinical judgement in children)	Three or more vomits after head injury (no leeway for clinical judgement)
	Suspicion of non-accidental injury
Post-head injury seizure	Post-head injury seizure
Examination	
GCS of 13 or 14 2 h post injury	GCS <14, or GCS <15 if age <1 year
Suspected skull fracture	Signs of skull fracture
Suspected base of skull fracture	Signs of basal skull fracture
Focal neurology	Focal neurology
	Bruise, swelling or laceration >5 cm if age <1 year
Mechanism	
If the patient has any LOC or amnesia and:	High speed projectile injury
Fall of >1 m	Fall of >3 m
Struck by or ejected from motor vehicle	High speed RTA (>40 mph)

CHALICE, Children's Head Injury Algorithm for the Prediction of Important Clinical Events; CT, computed tomography; GCS, Glasgow coma scale; LOC, loss of consciousness; NICE, National Institute for Health and Clinical Excellence; RTA, road traffic accident.

Table 2 Demographic breakdown of the study population

Demographic		n	%
Sex	Male	379	64.1
	Female	213	35.9
Age, years	0–1	61	10.3
	1–2	95	16.0
	2–5	144	24.3
	5–11	139	23.5
	11–16	153	25.8

greater than 5 cm in those patients younger that 1 year'. The remaining indications are summarised in table 4.

Of the 44 patients admitted in our study, an extra 20 would have been scanned with strict application of the CHALICE rule.

DISCUSSION

NICE currently publishes 83 clinical guidelines.[5] These are an invaluable resource for clinicians but invariably have implications for service provision. When the original NICE head injury guideline replaced the Royal College of Surgeons guideline in

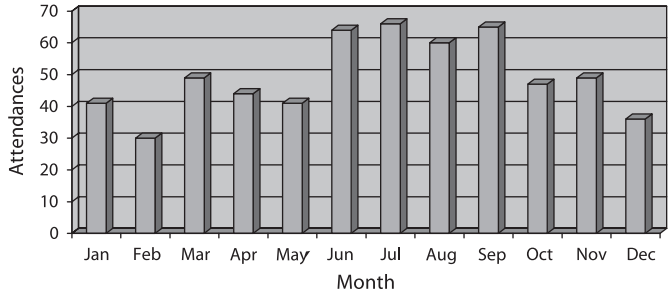

Figure 1 Paediatric head injury attendances by month.

Table 3 Number of patients managed with CT scan in reality and with the application of NICE guidelines

	No of patients who received CT scans (%)
Actual management	8 (1.7)
Management with 2003 NICE guideline	28 (6.0)
Management with 2007 NICE guideline	49 (10.6)

CT, computed tomography; NICE, National Institute for Health and Clinical Excellence.

Table 4 Reasons for extra 21 scans under NICE 2007 guideline

Reason for scan	No of scans
Bruise, swelling or laceration >5 cm if age <1 year	8
Amnesia, retrograde or antegrade, >5 min	6
Abnormal drowsiness	4
Suspicion of non-accidental injury	3

NICE, National Institute for Health and Clinical Excellence.

2003, the CHALICE study group predicted that the CT scan rate would rise from 1.6% to 8%; and hospital admissions would fall from 7.1% to 1.4%.[6]

This study found that, in a small DGH, strict application of the 2007 NICE head injury guideline (incorporating the CHALICE rule) would increase CT scanning rates from 6.0% to 10.5% of children. This represents a theoretical increase of 21 scans per annum had the NICE 2003 guidelines been strictly implemented or an increase of 41 in actual practice. This represents a spending increase of £3570 and £6970, respectively, (based on £170/scan, a figure discussed with our local radiology department).

The practice in the ED in 2007 deviated from protocol in that not all patients who had an indication for imaging underwent CT. The overall admission rate was high, but many of those patients who were admitted had an indication for immediate CT of the brain. The reasons for this are outwith this study, but it may be postulated that individual clinicians were apprehensive about exposing children to the high radiation dose of a CT of the brain. Of the eight who were scanned, four were not admitted, so we could tentatively predict a 50% reduction in the admission rate.

To put these figures into context, the Department of Health costs a hospital stay for 'head injury without intracranial injury' at £475.[7] For this cohort with 44 local admissions this represents a cost of £20 900. Strict adherence to the guidelines would perhaps save 50% of this, £10 450. However, this involves an outlay of £6970 for CT scans, giving a net saving of only £3480.

Risks associated with CT of the head in children are derived from population studies of atomic bomb survivors. The estimated lifetime risk of death from brain neoplasia attributable to a single CT study is 0.075% at 0 years and 0.01% at 15 years.[8] Depending on age, between 1300 and 100 000 CT head scans would have to be done to cause one extra death from neoplasia. This is not beyond the realms of possibility; if there really are 108 171 'head injury' attendances a year,[2] then scanning approximately 10% of them over 10 years would result in at least one, if not more, death from brain neoplasia. This is an extrapolated risk; to offset this accurately against clinical gain would require a much larger prospective study of the CHALICE rule.

The numbers of patients returning to hospital with worsening symptoms was not an endpoint in this study. However, we are not aware of any patients re-presenting to our hospital in this way and have not received any feedback of patients who are known to have significant intracranial pathology detected after discharge from the ED.

A limitation of this study is that it is retrospective; this meant that key data were not recorded in many patients' ED notes, in

particular, the absence of non-accidental injury and seizures post-injury.

We have now implemented the 2007 NICE guideline for the management of head injury in children and are prospectively auditing the actual impact on clinical practice.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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