Implementing the National Institute for Health and Clinical Excellence Head Injury 2014 Guidelines in a major children's hospital emergency department

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Objectives and background: Head injury is a common paediatric emergency department presentation. The National Institute for Health and Clinical Excellence updated its guidance in January 2014 regarding imaging required for adults and children following a head injury (CG176). This study looked at the rates of computed tomography (CT) head scans performed and adherence rates to CG176.

Patients and methods: A single-centre audit was carried out, examining imaging practice in children with head injuries. CG176 was implemented formally in August 2014 to the new trainee doctors. The primary outcome was adherence to CG176. As the data were binary, 95% confidence intervals were used for comparison.

Results: In all, 1797 patients were identified as having a head injury. Implementation at the Sheffield's Children NHS Foundation Trust resulted in a statistically significant increase in guideline adherence from 79.2% [95% confidence interval (CI): 76.4–81.9%] to 85.1% (95% CI: 82.9–87.4%). The greatest impact in adherence was found in CT head scans, from 95.8% (95% CI: 94.5–97.2%) to 97.7% (95% CI: 96.7–98.6%).

Conclusion: The implementation at the Sheffield's Children NHS Foundation Trust was successful in satisfying the aim of CG176 by increasing adherence and decreasing CT head scans. This success could be explained by the formal implementation to the new cohort of doctors and better physician agreement with the guidelines. The increase in adherence is contrary to the previous studies.

Background

Overall, 1.4 million people annually attend emergency departments (EDs) in England and Wales with a recent head injury, of which between 33 and 50% are children below the age of 15 years [1]. The incidence and pre- valence of traumatic brain injury (TBI) associated with head injury in children is relatively unknown and varies between 100 and 300 per 100 000 per year [2–4]. A TBI is defined as an insult or trauma to the brain by an external mechanical force, which can lead to temporary or permanent impairment of physical, cognitive and psycho- social functions [5].

The relative risk of cancer following computed tomography (CT) is increased in the paediatric population compared with adults, therefore, the use of CT scans should be monitored carefully, especially those under 2 years old who are more sensitive to radiation [6–8].

The first National Institute for Health and Care Excellence (NICE) guidelines for head injury were introduced in 2003 and updated in 2007 [9,10].

Previous studies have investigated the impact and adherence of the 2007 head injury guidelines in children and found that introduction of the guidelines did not increase in adherence. One study found that 77.1% of children with an indication did not receive a head CT scan [10].

Updates to existing criteria and new advice were implemented in the 2014 NICE guidelines for the management of head injuries (CG176) following various systematic reviews [9]. These new guidelines focused on earlier imaging, within 1 h of identification, and reporting, within 1 h of CT head scan. It also decreased the indications for a CT head scan in the paediatric population, from requiring only one low-risk factor to two low- risk factors [1].

We aimed to determine whether this more conservative guideline resulted in improved adherence after its introduction in a major children's hospital ED.

Patients and methods

The objective of this study was to establish whether clinical practice changed following the implementation of CG176, the standards set by the NICE guidances for all paediatric patients with a head injury attending the ED.

We undertook an audit cycle review of anonymized patients' records at the Sheffield Children's Foundation Trust (SCFT) before and after the implementation of CG176. All new doctors were trained on the new NICE guidelines in their induction to the department.

The preimplementation data collection consisted of a 2-month period: November and December 2013 and the postimplementation period: September and October 2014.

An electronic database search identified all patients with a presenting complaint or diagnosis of head injury, eye injury, neck injury, back injury, other facial injury, multiple injuries or road traffic crashes who were seen in the ED at SCFT during the suggested time periods.

Furthermore, all CT head scans performed in the ED during the specified months were analyzed.

The primary outcome measure was clinical adherence with the CT head imaging guidelines.

Results

The baseline characteristics for children with head injuries during the study periods are shown in Table 1.

Table one: Baseline Characteristics

	Pre-implementation of CG176	Post-implementation of CG176
Total ED attendances	8854	8876
With head injury, n (%) (95% CI)	841 (9.5) (8.9 to 10.1)	956 (10.8) (10.1 to 11.4)
Male, n (%) (95% CI)	527 (62.7) (59.4 to 65.9)	600 (62.8) (59.7 to 65.8)
Median age (Months)	50	51
Median GCS on arrival	15	15
Mechanisms of Injury, n (%) (95% CI)		
• Hit Head on object	323 (38.4) (35.1 to 41.7)	343 (35.9) (32.8 to 38.9)
• Simple Trip	174 (20.7) (18.0 to 23.4)	193 (20.2) (17.6 to 22.7)
• Fall from elevation < 1 metre or 5 stairs	113 (13.4) (11.1 to 15.7)	135 (14.1) (11.9 to 16.3)
• Other	231 (27.5) (24.5 to 30.5)	285 (29.8) (26.9 to 32.7)
CT head performed, n (%) (95% CI)	40 (4.8) (3.3 to 6.3)	23 (2.4) (1.4 to 3.4)
Abnormal CT head scan, n (%) (95% CI)		
• TBI	0 (0)	2 (0.2) (-0.1 to 0.5)
• Simple Skull fracture	1 (0.1) (-0.1 to 0.4)	3 (0.3) (0.0 to 0.7)
Mortality, n (%)	0 (0)	0 (0)
CT C-spine performed, n (%) (95% CI)	3 (0.4) (0 to 0.8)	3 (0.3) (0 to 0.7)
Abnormal CT C-spine scan, n (%) (95% CI)	0 (0)	0 (0)
Three-view C-spine X-ray performed, n (%) (95% CI)	4 (0.5) (0 to 0.9)	5 (0.5) (0.1 to 1.0)
Observed 4-hour post-injury, n (%) (95% CI)	95 (11.3) (9.2 to 13.4)	77 (8.1) (6.3 to 9.8)
Admission rates, n (%) (95% CI)	7 (0.8) (0.2 to 1.4)	8 (0.8) (0.3 to 1.4)

The proportion of CT head scans performed decreased from 4.8 to 2.4%. The number of TBI identified increased from 0 in the preimplementation of the 2014 guidelines group to 2 (0.2%) in the postimplementation of the 2014 guidelines group. One child suffered a cerebral contusion and the other a complex skull fracture. No patients died as a result of TBI or required intensive care unit support.

The rates of observation 4-h postinjury decreased from 11.3% in the preimplementation group to 8.1% in the postimplementation group.

Adherence: computed tomography head scan

Table two: CT Head scan adherence

	Pre-Implementation of CG176		Post-Implementation of CG176	
	CT Head Scan Not Indicated	CT Head Scan Indicated	CT Head Scan Not Indicated	CT Head Scan Indicated
CT Head Not Performed, n (%) (95% CI)	781 (92.9) (91.1 to 94.6)	20 (2.4) (1.3 to 3.4)	917 (95.9) (94.7 to 97.2)	16 (1.7) (0.9 to 2.5)
CT Head Performed, n (%) (95% CI)	14 (1.7) (0.8 to 2.5)	26 (3.1) (1.9 to 4.3)	4 (0.4) (0.0 to 0.8)	19 (2.0) (1.1 to 2.9)

Table 2 shows that there was a decrease in the proportion of patients who had an indication for a CT head scan but did not have one performed from 20 (2.4%) in the preimplementation group to 16 (1.7%) in the postimplementation group.

There was a decrease in the proportion of CT head scans performed without indication from 14 (1.7%) to 4 (0.4%).

Compliance for CT head imaging with CG176 increased from 96.0% [95% confidence interval (CI): 94.6–97.3%] to 97.9% (95% CI: 97.0–98.8%).

Adherence: observation

The proportion of patients discharged when indicated to be observed decreased from 74 (8.8%) to 66 (6.9%) (Table 3). However, this is not a statistically significant decrease and is still a high proportion of patients being discharged and not observed.

In the preimplementation group, 70 [8.3% (95% CI: 6.5–10.2%)] patients were observed when not having an indication. This decreased in the postimplementation group to 52 [5.4% (95% CI: 4.0–6.9%)].

Adherence with 4-h postinjury observation increased significantly in the postimplementation group from 82.9 (95% CI: 80.3–85.4%) to 87.7% (95% CI: 85.6–89.7%).

Table three: Observation adherence

	Pre-Implementation of CG176		Post-Implementation of CG176	
	CT Head Scan Not Indicated	CT Head Scan Indicated	CT Head Scan Not Indicated	CT Head Scan Indicated
CT Head Not Performed, n (%) (95% CI)	781 (92.9) (91.1 to 94.6)	20 (2.4) (1.3 to 3.4)	917 (95.9) (94.7 to 97.2)	16 (1.7) (0.9 to 2.5)
CT Head Performed, n (%) (95% CI)	14 (1.7) (0.8 to 2.5)	26 (3.1) (1.9 to 4.3)	4 (0.4) (0.0 to 0.8)	19 (2.0) (1.1 to 2.9)

Adherence: overall

Table 4 shows that the overall adherence with CG176 increased significantly from 79.2 to 85.1%. Overall adherence took into consideration CT head scans, C-spine imaging (including C-spine CT scans and radiographs) and observation adherence.

Table four: Overall adherence

	Pre Implementation of CG176	Post Implementation of CG176
Not adherent with overall guideline, n (%) (95% CI)	175 (20.8) (18.1 to 23.6)	142 (14.9) (12.6 to 17.1)
Adherent with overall guideline, n (%) (95% CI)	666 (79.2) (76.4 to 81.9)	814 (85.1) (82.9 to 87.4)

Discussion

Overall results

We found that at a major children's hospital ED, the implementation of the CG176 was associated with improved adherence in relation to CT scanning of the head from 96.0% (95% CI: 94.6–97.3%) to 97.9% (95% CI: 97.0–98.8%). This improvement of 1.9% represents both a reduction in unnecessary CT usage and thus radiation exposure in children, in line with the updated recommendations and reduction in indicated CT imaging. It is worth noting that adherence initially was very good.

Approximately 10% of children in both cohorts had an indication for 4h postinjury observation. The adherence rates significantly improved with this indication from 82.9 (95% CI: 80.3–85.4%) to 87.7% (95% CI: 85.6–89.7%).

Limitations

The proportion of patients with an indication or with a CT head scan performed was very small, resulting in large confidence intervals, thus, providing results that are not statistically significant (type II error). Furthermore, this was set in one hospital and therefore has limited value for extrapolation to other centres.

The majority of the notes did not specifically mention all the variables being investigated. Therefore, it was assumed that the clinician investigated the variable, deemed it to be negative and therefore did not document the negative finding. This is a reasonable assumption; however, identifying this negative finding would have increased precision for this study.

The preimplementation study period was November and December 2013; unfortunately, corresponding months could not be studied as the application for data collection commenced in November 2014 and thus, it was not possible to study November and December 2014 in the time frame for data collection; therefore, September and October 2014 were studied.

There was no active follow-up of patients with a head injury. If the patient did not represent to the ED in the month following the initial injury, it was assumed that there were no clinical consequences for the patient nor any TBI. A reliable method of obtaining adequate information to whether patients had a clinically significant TBI would be to follow-up patients with a tele-phone call to assess for any clinical indications. However, this would require additional resources, which were not feasible in this study. In addition, it is not ethically justified to perform a CT head scan on every patient; therefore, this is not a reasonable method of following up patients.

Adherence to computed tomography head scan clinical decision rules: compared with the literature

Although it cannot be said that it is a statistically significant increase, this is a contrast to a previous study, which found no change in adherence in the paediatric population, 93.4 (preimplementation) to 93.8% (post- implementation) for the NICE 2007 Head Injury Guidances [10].

There are several reasons to explain the increase in adherence in this study compared with the literature. First, there was formal teaching led by senior clinicians to the new junior doctors in August 2014, at the start of their rotation. Furthermore, throughout the ED there were posters of the new guidelines to help remind all clinicians of the indications for CT scans. In addition to formal implementation, timing is also paramount with implementation of guidelines having more of an impact with doctors starting a new post, which occurred in this study [10–12].

The vomiting variable was often seen as not being specific enough to indicate a TBI in children, as children are much more likely to vomit following a head injury and it can be difficult to distinguish three discrete episodes [13]. It was found to be the most common variable present in children not having a CT performed when indicated in both the studies by Mooney and Ghosh [10,14]. In the 2007 guidelines, a child vomiting more than three times would be an indication for a CT head scan, but in CG176 another risk factor or deterioration during observation must also be present [1]. Most clinicians agreed with the lack of specificity of vomiting in a child and this positive general consensus to this change could have contributed to the better adherence.

Mooney and Ghosh [10,14] were concerned at the proportion of under-imaging in children. We found in the postimplementation stage that 45.7% (95% CI: 29.2–62.2%) of patients had an indication for a head CT scan but did not have one performed. Of the 16 patients who did not have a CT head scan performed but had an indication, eight were kept in for a period of observation and none represented. It is assumed as SCFT is a major trauma centre covering a large area; if the child did not represent in 30 days, there were no significant consequences following the missed CT head scan. The most common variables present in patients who did not receive a CT head scan were abnormal drowsiness with three or more discrete episodes of vomiting. Therefore as shown previously, ‘vomiting’ still appears to be the most problematic for clinicians’ for under-imaging children [10].

Unnecessary, CT head scans have been previously identified as being problematic and this study was no exception. Reasons for these unindicated CT head scans include parental anxiety, clinical experience of the doctor and insufficient documentation of the history and examination. To help reduce the numbers of unnecessary CT head scans, both positive and negative findings should be clearly documented and clear explanations to parents to ease anxiety.

In all, 74.7% (95% CI: 66.2–83.3%) and 72.5% (95% CI: 63.4–81.7%) of patients in the preimplementation and postimplementation stage, respectively, were discharged despite having indications for observation.

One reason for this high proportion of patients being discharged before 4h postinjury could be because of crowding and demand on the ED. Brown et al. [15] found that the management of head injuries was influenced more by the ease of access to beds than clinical findings. A busy or crowded ED could result in increased discharge of patients. Furthermore, clinicians' judgement is much more influential in this variable and a combination of sensible parents and a well child could result in earlier discharges.

Future implications and research

This is the first study to investigate the impact and adherence of head injury guidelines in an exclusively paediatric population. Preimplementation and post- implementation of CG176 patient cohorts were similar in terms of injury and demographic characteristics. The study has shown significant improvement in adherence with the new guidelines in a paediatric ED.

This study demonstrated that formal teaching of new guidelines works especially well when taught to new doctors to the department. Continuous monitoring and teaching sessions of new cohorts of trainee doctors should be reinforced to ensure better adherence to all guidelines. A better, updated guideline based on high-quality evidence-based medicine has also helped to improve adherence especially in regard to CT scanning of the head. At the time of the study, there was no official proforma for head injuries; therefore, the use of a proforma could be implemented for better adherence to CG176.

As this study investigated the adherence of the 2014 head injury NICE guidelines in a children's hospital; a multicentre study investigating the adherence in a mixed ED would be useful.

Conclusion

Specific teaching of the NICE 2014 head injury guidance at the start of junior doctor's training alongside posters in the ED and combined with a better guideline was asso- ciated with a significant improvement in overall adher- ence to guidelines in a major children's hospital ED. The timing of the implementation and the specialist nature of the site may explain successful implementation in con- trast to previous mixed ED studies. Successful imple- mentation of the CG176 in children's EDs is likely to be associated with reductions in CT scans and unnecessary exposure to radiation.

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