SHORT COMMUNICATION

Vomiting—is this a good indication for CT head scans in patients with minor head injury?

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ABSTRACT. The National Institute for Health and Clinical Excellence head injury guidelines advise CT imaging within 1 h if there is more than one episode of vomiting post-head injury in adults and three or more episodes in children. Since the guideline publication, studies have found that, following head injury, vomiting alone is associated with an abnormal CT head scan in 13–45% of cases. CT head scan requests referred from the emergency department between 1 May 2009 and 30 April 2010 were retrospectively reviewed. Patients with vomiting as the sole indication for an “immediate” CT head scan performed within 1 h were included in the study. Reports produced by experienced neuroradiologists were reviewed and the detection of significant head injury was noted. There were 1264 CT head scans performed during our study period. 151 (124 adults, 27 children) were indicated owing to vomiting following head injury. 5 of the 124 adult scans and 1 of the 27 paediatric scans showed an abnormal finding, giving positive predictive values (PPV) of 4% and 3.7%, respectively. None of these patients required either acute or delayed neurosurgical intervention. In our experience, vomiting alone has a PPV of 4% for significant head injury in adults. However, none of these injuries were serious enough to warrant acute or delayed intervention. Given these findings, vomiting following head injury is a reasonable indication for a CT head scan; however, as none of the patients required acute intervention, we suggest that these scans do not usually need to be performed within 1 h of request.

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CT is a quick and readily available method of neuro-imaging in the UK for patients with head injuries. With a sensitivity and specificity approaching 100% for detecting surgically significant head injuries, it is now established as the investigation of choice in patients with head injuries [1]. The 2007 National Institute for Health and Clinical Excellence (NICE) guidance [1] describes best practice for the care of patients presenting with head injuries, with separate guidance being issued for adults and children. Currently, CT head imaging within 1 h is recommended following trauma if there is more than one episode of vomiting post-head injury in adults and three or more episodes in children. These guidelines state that the “primary patient outcome of concern is “clinically important brain injury””.

The NICE-recommended indications for a CT head scan following minor head injury are shown in Figure 1 [1].

Since the NICE guidance publication, further studies producing conflicting evidence have evaluated whether vomiting alone is a good predictor of significant brain injury following minor trauma. A prospective study of 152 patients found that vomiting was associated with positive CT findings in 40–45% of cases [2]. These findings complemented a larger study which found that there was

a significant relationship between vomiting and abnormal head CT scans ($p=0.0001$) [3]. However, other publications reported a much lower correlation between head injury and vomiting. A study of 318 patients with minor head injury and criteria for scanning, which included vomiting, was found to have an abnormal CT scan in only 13% of cases [4].

Studies in children have suggested that post-traumatic vomiting is more likely related to personal or familial disposition to vomiting than the presence of intracranial lesions [5]. Another large study (3866 patients) showed that vomiting was neither a high nor a medium risk factor in the decision rule for the use of CT head scans in children with minor head injuries [6].

Our centre, the University Hospital of Wales, Cardiff, serves a population of 445 000 and is also a referral centre for specialist services, including neurosurgery. We reviewed our own centre’s experience of vomiting as a predictor of clinically important brain injury in minor head injuries.

Methods and materials

Study cohort

A retrospective review of all CT head requests from the emergency department over a 12-month period from

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Investigation for clinically important brain injury

CT imaging of the head is the primary investigation of choice.

Selection of adults for CT scanning of head

Selection of children (under 16) for CT scanning of head

Investigation of non-accidental injury in children

A clinician with expertise in non-accidental injuries in children should be involved in any suspected case of non-accidental injury in a child. Consider: skull X-ray as part of a skeletal survey; ophthalmoscopic examination for retinal haemorrhage; examination for pallor, anaemia, tense fontanelle and other suggestive features. Imaging such as CT and magnetic resonance imaging (MRI) may be required to define injuries.

Figure 1. National Institute for Health and Clinical Excellence guidance for the investigation of clinically important brain injury.

April 2009 to March 2010 was carried out. Each request form was reviewed and those which fulfilled NICE criteria for a CT head scan following head trauma based on vomiting alone were included in the study. In the adult group, all patients with more than one episode of vomiting but no other NICE indicators were included. Patients aged >64 years with amnesia or loss of consciousness and a history of coagulopathy or a dangerous mechanism of injury were excluded because they fulfilled further NICE criteria for imaging. In the paediatric group (<16 years), patients with three or more episodes of vomiting and no other NICE indicators were included.

Review of imaging

All the CT head scan reports and images of the cohort group were reviewed. All positive scans were re-assessed by an experienced neuroradiology consultant. Those patients with a "clinically important brain injury" were noted. Patients with uncomplicated skull fractures or facial fractures were excluded because the criteria for imaging was based upon brain injury alone. The medical notes of all patients deemed to have a clinically important brain injury were retrieved and each case was further assessed to determine if the head injury resulted in an actual intervention or in a change in the patient's management.

Results

Of 1264 CT head scans performed during the 12-month study period, 151 (11.9%) were included in our study. 27

(23 male and 4 female) children, with an average age of 7.3 years, fulfilled the NICE criteria for a CT head scan, with 3 or more episodes of vomiting post-head injury. 124 (72 male and 52 female) adult patients, with an average age of 36.3 years, had more than 1 episode of vomiting post-head injury and therefore also fulfilled the NICE criteria for a CT head scan.

Within the adult group, 5 out of the 124 patients had a "clinically important brain injury" on the CT head scan, giving a positive predictive value (PPV) of 4%. Within the paediatric group, only 1 of the 27 patients had abnormal findings, giving a PPV of 3.7%. An example of a clinically important brain injury is shown in Figure 2a,b.

The hospital notes or casualty cards were retrieved for all six patients. The children were admitted for overnight observation and then discharged with no treatment or specific follow-up. Four of the adult patients were discharged with no documented planned follow-up or treatment. One of the adult patients had a small left-sided extradural haematoma in association with a petrous bone fracture and left perforated ear drum (Figure 2). This patient was admitted for overnight observation and was discharged the next morning with conservative treatment and planned follow-up for the perforation. None of the patients required either acute or delayed neurosurgical intervention.

Discussion

At our centre, 11.9% of CT head scans performed within 1 h in compliance with NICE guidelines in the emergency department are for vomiting alone. If vomiting is not the

Figure 2. Fractured left temporal bone with an associated extradural haematoma and intracranial gas seen on (a) brain parenchyma and (b) bone windows.

reliable indicator previously thought, 151 CT head scans are performed within 1 h unnecessarily each year.

Our results reveal that vomiting alone had a PPV of 4% for clinically important brain injury in adults and 3.7% in children, and none of these patients who were deemed to have a clinically significant brain injury required any neurosurgical intervention. These findings show lower predictive values for vomiting alone in adults than the studies published since 2007. This may be explained by the fact that our study did not include skull or facial fractures as a significant injury, in accordance with the NICE criteria for “clinically important brain injury”. This may have resulted in a relative underestimation, as the quoted literature generally reported any form of head injury. In children our low predictive value correlates with some of the larger studies [6] which do not demonstrate that vomiting is a significant risk factor in predicting clinically relevant head injury.

We feel that, in adults, vomiting following head injury should still be an indicator for a CT head scan; however, as none of the patients required acute intervention, we would suggest that these scans do not necessarily need to be performed within 1 h of request. These scans could be performed within 8 h of request or, if assessed, overnight patients could be observed and scanned in the morning. This would be in keeping with the current NICE guidance for imaging head injuries in patients aged 65 years or more who present with amnesia for events more than 30 min before impact or if there is a dangerous mechanism of injury [1].

In children, the value of vomiting as an indicator of significant head injury is less clear. 2 recent studies, 1 a large multicentre cohort with 3866 participants and the other a case-control study of 444 participants, did not find that post-traumatic vomiting was significantly related to the presence of intracranial injury.

Limitations

Despite the reasonable number of adult patients included in our review, the relatively small number of children does limit the application of our results. Furthermore, while the indication for these scans required the CT to be performed and reported within the hour, we did not check whether this time limit was met. Also, some of the patients imaged may have delayed their presentation, having received the head injury some time earlier but attended only when the delayed onset of vomiting began. There is the small possibility that findings may have improved during these delays.

Conclusion

In our experience, vomiting alone has a PPV for significant head injury of 4% in adults. A similar PPV of 3.7% was shown in children, but unfortunately the patient numbers in this age group were too small to be conclusive. However, none of these injuries were serious enough to warrant acute or delayed intervention. Given these findings, vomiting following head injury is a reasonable indication for a CT head scan and, as none of the patients required acute or delayed intervention, we suggest that these scans do not need to be performed within 1 h of request.

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