Head injuries in the accident and emergency department: are we using resources effectively?

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SUMMARY

This paper reports a retrospective criterion based audit which reviewed head injury management in two accident and emergency (A&E) departments. Management was compared with regionally agreed criteria¹ for ordering a skull radiograph (SXR) and a computerized tomogram (CT scan) and for admission, and the quality of medical documentation was assessed. A total of 158 patients were reviewed and 132 patients (84%) satisfied the three key areas of recommended head injury management. Failures to satisfy recommended guidelines were present in 19 patients (12%) for SXR, four (2%) for admission and three (2%) for CT scanning. Three skull fractures (two in young babies) would have been missed if the criteria had been adhered to strictly. There was one adverse outcome when a patient who should have been admitted returned to A&E 8 days after initial attendance with a subdural haemorrhage and died shortly afterwards. Apart from 'loss of consciousness', the quality both in content and legibility of the medical documentation was poor. The result of 84% correctly managed patients may be over-optimistic according to the criteria used. Although criteria have a valuable role to play, there are problems with prescriptive standard setting. A recommendation was made to develop a head injury pro forma to address the poor quality medical documentation and it was also recommended that the SXR, CT scan and admission criteria for babies and young children be reviewed.

Keywords: audit, documentation, guidelines, head injury, pro forma.

INTRODUCTION

Head injuries are an important cause of morbidity, mortality and long-term disability, often in otherwise healthy young people. Their management in the A&E department plays a key role in the diagnosis

and treatment of potentially avoidable secondary brain damage.

It is more than 15 years since Jennett first drew attention to the need for improved organization of the system for managing patients with a head injury.² In 1986, a Commission by the Royal College of Surgeons of England³ made recommendations for the organization of services provided for head injury cases in England and Wales. Those recommendations have since been endorsed and several regional working parties have been established. Regional guidelines for head injury management have been developed,^{1,4} and individual districts have been encouraged to develop suitable modifications tailored to their own resources and requirements.

In recent years, several papers^{5–8} have drawn attention to the economy of bed usage and radiological services which could be obtained from better triage: to the improved results which can be obtained from early admission to specialized neurosurgical units; to the enormous diagnostic and prognostic value of computed tomography; to the benefit of intensive care facilities; and to the contribution of skilled rehabilitation.

The use of skull radiography in the management of these patients is common but controversial.^{9–16} One study has suggested that the number of skull radiographs carried out on new patients attending A&E departments in the United Kingdom could be reduced from approximately 600 000 to 168 000 per annum using guidelines,¹⁷ a trend recently confirmed by the Royal College of Radiologists Working Party.¹⁸ At 1992 prices,¹⁹ the potential saving could be around £8.9 million per annum.

The application of a set of criteria in an A&E department in Nottingham²⁰ led to a significant drop in the number of patients admitted with a head injury. Admissions fell from 941 before the policy was implemented to 536 and 460 admissions in the subsequent 2 years, without adversely affecting the

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outcome of head-injured patients; this has been confirmed by other studies.^{17,21,22}

CT scanning has shown that cerebral compression may be present before it is clinically detectable.³ Appropriate use can facilitate early surgical intervention, often with improved outcomes as a result of reductions in mortality and morbidity.^{8,23–28} Although guidelines for the use and availability of CT scanning are becoming established, there are limited resources to effect them.^{1,3,28}

The Department of Health and Social Services (DHSS) seminar on the management of head injuries in Harrogate in 1983 produced guidelines for SXR and hospital admission.²⁹ However, appropriate action has not necessarily been widely adopted.

The acute management of head injuries has been an area of concern and discussion among public health physicians and hospital clinicians in Brighton. The Department of Public Health Medicine convened a Head Injury Group to address the 'appropriate' usage of SXR, CT scanning and admission to hospital according to guidelines based on national recommendations,³ as supported in the South East Thames Region's own specific guidelines.¹ To do this, a retrospective criterion based audit was performed in two A&E departments in Brighton.

METHODS

The Brighton Head Injury Group comprised doctors from public health medicine, A&E, general and paediatric surgery, radiology and anaesthetics.

The technique of criterion based audit described by Shaw^{30,31} was used for the study and the criteria chosen are listed in Table 1. Although the standard used for each criterion was '100% completion in each set of medical records', they could not always be applied rigidly in every case. Firstly, the criteria for CT scan were not applicable in those patients who had only suffered a minor head injury. Secondly, a few allowable exceptions to the criteria were permitted, where one criteria took priority over the next. For example, if a seriously head-injured patient required an urgent CT scan, then the SXR was omitted because the clinical information from the latter could be obtained from the scan. Thirdly, symptoms not applicable to babies and young children were not included for this age group e.g. 'post-traumatic amnesia' (and hence its length of duration), 'headache', 'disturbed vision' and 'having taken alcohol or drugs recently'.

Baseline data concerning the number of head-

Table 1. The criteria used in the study for ordering an SXR and a CT scan and for admission

Skull Radiograph (SXR)

- (1) Any loss of consciousness.
- (2) Post-traumatic amnesia exceeding 10 min.
- (3) Suspected penetrating injury.
- (4) Intoxication, alcohol or drug.
- (5) Difficulty in assessing the patient, e.g. the young, the elderly, those with epilepsy.
- (6) Neurological signs, disorientation or confusion.
- (7) Leaking of cerebrospinal fluid and/or blood from the nose/ear.
- (8) Haemotympanum.
- (9) Significant scalp laceration (exceeding 10 cm).
- (10) Significant scalp haematoma (exceeding 10 cm).

CT scan

- (1) Glasgow Coma Score of 8 or less.
- (2) Fall of 2 points in Glasgow Coma Score within 1 h.
- (3) Fits.
- (4) Unequal or unreactive pupils.
- (5) Skull fracture extending for more than 10 cm.
- (6) Extensive soft tissue injury to scalp.
- (7) Focal neurological signs.
- (8) Children — not withdrawing to pain.

Admission

- (1) Unconscious for more than 10 min.
- (2) Post traumatic amnesia for more than 10 min.
- (3) Skull fracture.
- (4) Abnormal neurological examination.
- (5) Falling level of consciousness/more tired than usual.
- (6) Severe headache.
- (7) Persistent vomiting.
- (8) Disturbance of vision.
- (9) Strange behaviour.
- (10) Inadequate supervision at home.

injured patients were obtained for a chosen 3-month period from several sources: the District Information System (DIS); the Unisys A&E computer at the main hospital; the CT scan register; the manual A&E administration system; and the surgical ward admission register at the childrens hospital.

As the number of patients with a head injury who had either died, had a CT scan or had a skull fracture was important, it was decided to study all these cases. Although the resultant sample would be skewed, this effect would be minimal as the numbers involved were relatively small. For the remaining head injury cases from the 3-month study period, a random sample of patients was used. This sample represented 18% of the total number of head injuries seen in the 3-month period.

A data extraction form was developed to check

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whether the relevant information from the medical records adhered to the pre-determined criteria. In those cases where there was difficulty deciding whether the management had been correct, two consultants from the Head Injury Group peer reviewed the case.

RESULTS

A total of 950 patients with a head injury were seen in both A&E departments during the 3-month study period (April–June 1989). Of the 171 patients in the original sample, only 158 could be analysed. Of the 13 (8%) patients who were not included, six (4%) were omitted because of missing medical records and 7 (4%) were omitted as a result of miscoding of the original diagnosis as a head injury.

Of the 158 patients: 81 (51%) were children under the age of 16 years; 78 (49%) had a SXR; 84 (53%) were sent home; 74 (47%) were admitted; 17 (11%) had a CT scan; 20 (13%) had a skull fracture; and six (4%) died. A total of 132 (84%) patients were judged to have received appropriate management

and 26 (16%) inappropriate management according to the criteria.

Table 2 gives a complete breakdown of each of the categories analysed and the numbers who received inappropriate management according to the criteria used in the study.

Criteria for ordering a skull radiograph

Table 2 gives an analysis of the appropriate and inappropriate use of SXRs and divides the 19 (24%) patients who were investigated inappropriately into adults and children, and differentiates whether they were admitted or sent home. Of the 78 (49%) patients who had an SXR, 29 were children (36% of all children seen) and 49 were adults (64% of all adults seen).

Two of the patients who were managed inappropriately were children who, on the basis of the criteria, were not considered to require an SXR, but had one performed and in both cases a skull fracture was diagnosed with no adverse outcome.

Of the remaining patients in this group who were

Table 2. Summary of analysis of a sample of patients with a head injury admitted to hospital or sent home (April–June 1989)

	Appropriate management	Inappropriate SXR	Needed an SXR	Inappropriate admission	Needed admission	Inappropriate CT scan	Needed a CT scan	Total
Children admitted with no skull fracture	21 (13%)	2 (1%)	1 (1%)	0	0	0	0	24 (15%)
Children admitted with a skull fracture	0	2 (1%)	0	0	0	0	0	2 (1%)
Adults admitted with no skull fracture	29 (19%)	0	0	0	0	0	0	29 (19%)
Adults admitted with a skull fracture	10 (6%)	1 (1%)	0	0	0	2 (1%)	0	*13 (8%)
Adults admitted with or without a skull fracture who died	5 (3%)	0	0	0	0	0	1 (1%)	6 (4%)
Total number of patients admitted	65 (41%)	5 (3%)	1 (1%)	0	0	2 (1%)	1 (1%)	74 (47%)
Children sent home from A&E	47 (30%)	5 (3%)	+1 (1%)	0	2 (1%)	0	0	55 (35%)
Adults sent home from A&E	20 (13%)	3 (2%)	4 (2%)	0	2 (1%)	0	0	29 (18%)
Total number of patients seen and sent home	67 (43%)	8 (5%)	5 (3%)	0	4 (2%)	0	0	84 (53%)
Total number of patients admitted and sent home	132 (84%)	13 (8%)	6 (4%)	0	4 (2%)	2 (1%)	1 (1%)	158 (100%)

Notes: The percentages have been rounded up.

* Four of the six deaths had a skull fracture. Therefore, the total numbers of adult skull fractures in this sample was 17 (13 + 4).

+ This patient was sent home with a skull fracture which was diagnosed the following day.

managed inappropriately, there was no evidence from the medical records that their outcome was affected by the management that they received.

Table 3 demonstrates the degree of completion in the medical records of the criteria for skull radiography. This refers to doctors' recording negative as well as positive findings.

Of the 78 SXR's ordered by a doctor, only 27 (35%) cases had a reason for the request documented in the medical notes. However, of these 78 radiographs ordered, an opinion about the presence or absence of a skull fracture by the requesting doctor was found in 67 (86%) records.

Criteria for admission

Table 2 gives an analysis of the 74 (47%) patients who were admitted to hospital. All cases were considered to be appropriate.

However, four patients (two children and two adults representing 2% of all patients seen) were identified who should have been admitted, but were sent home from the A&E department. One of these four patients returned 8 days following initial presentation having collapsed with a subdural haemorrhage and died shortly afterwards. There were no adverse outcomes in the other three.

As with the criteria for SXR's, the written details addressing the criteria for admission and discharge were poor both in content and quality, with only 50% of case notes considered to have adequate clinical detail. Only 89 (56% of all patients seen) case notes gave a written explanation as to why the patient had been admitted or sent home. This was better addressed for children (67% of all children seen) than for adults (46% of all adults seen).

Criteria for ordering a CT scan

Of 17 (11% of all patients seen) patients who were scanned, 16 (21%) were adults and one (1%) was a child. Table 2 shows that two (12%) of the CT scans were considered unnecessary according to the criteria and one patient should have had a scan, but for clinical reasons was not scanned until 24 h later. Although one of these patients died, none were judged by peer review to have had a worse outcome as a result of their management.

Although the content of clinical information in the notes of the more seriously injured group was more detailed, only nine sets of records (53%) had a reason for ordering a CT scan recorded by the doctor. There were no written details in the A&E

medical records to suggest that there were any problems ordering or obtaining a CT scan. Of the 17 CT scans performed, 12 (71%) showed intracranial pathology.

DISCUSSION

The main aim of this study was to determine whether the management of head injuries in Brighton corresponded to recommended guidelines suggested by the South East Thames Regional Head Injury Group.¹ The major objective of ordering SXR's and CT scans or admitting the patient to hospital is to help prevent secondary brain damage, especially the effects of delayed intracranial haematoma, such as an extradural haematoma. The occurrence of such a complication is rare in relation to the total population of head-injured patients,³² and could be

Table 3. Evidence in the medical notes that the criteria for ordering a skull radiograph had been documented

Criteria for ordering an SXR	Children	Adults	Mean
Loss of consciousness	76 (94)	67 (87)	143 (91)
Length of time unconscious	5 (100)	33 (97)	38 (97)
Post-traumatic amnesia (PTA)	NA ⁺	26 (34)	26 (34)
Length of post-traumatic amnesia	NA ⁺	9 (60)	9 (60)
Suspected penetrating injury	4 (5)	3 (4)	7 (4)
Alcohol/drug recently	NA ⁺	33 (43)	33 (43)
Neurological signs	51 (63)	62 (81)	113 (72)
Blood/CSF* from ear/nose	10 (12)	16 (21)	26 (16)
Haemotympanum	7 (9)	0 (0)	7 (4)
Scalp laceration	42 (52)	47 (61)	89 (56)
Length of scalp laceration	22 (81)	25 (61)	47 (70)
Scalp haematoma	44 (54)	34 (44)	78 (49)
Length of scalp haematoma	2 (7)	4 (15)	6 (11)

Notes: The numbers and percentages (brackets) refer to the criteria being documented as either a positive or negative finding in the medical notes. For example, out of the sample of 158, 143 (91%) sets of notes documented whether the patients had been unconscious or not. There was no need to document length of time unconscious if the patient had not been unconscious. Hence, out of 39 patients who had been unconscious, 38 (97%) had the length of time appropriately documented.

* CSF, cerebrospinal fluid, ⁺ NA, not assessed in babies and children.

likened to 'looking for a needle in a haystack'. One study suggests that the incidence of unsuspected intracranial haematoma with skull fracture among patients with uncomplicated head injury who had been radiographed was 1 in 4800.³³

The overall results of this study suggest that 84% of the sample were managed appropriately according to the criteria under consideration. If the remaining 27 patients (16%) were managed inappropriately (representing 18% of the total number of head injuries seen in the 3-month period), then the possibility of several hundred such patients annually stresses the importance of this diagnosis. With the death of one of these patients being potentially avoidable, it emphasizes the need for a constant monitoring and review of head injury management in the A&E setting.

However, the number of patients who were managed inappropriately may be higher than this. Firstly, probable under-recording, miscoding and lost medical records may have given an inaccurate picture of the true incidence of head injuries in the Brighton Health District. Secondly, the accuracy of the results is dependent upon the quality and content of the medical records.

The content and legibility of the medical records reviewed in this study was poor. Only loss of consciousness and the length of time unconscious were well documented (Table 3). The absence of relevant details and the presence of poor quality clinical information made it difficult to decide objectively whether a patient had been managed appropriately.

Peer review helped decide whether patients had been managed correctly, but inevitably this made the process more subjective, potentiating the introduction of observer variation. It might have been more accurate to have had a third category where no judgement could be made because of insufficient information, but this would have included almost the entire sample.

Therefore, the result of 84% of patients having been managed correctly may well be over-optimistic, implying that any further study would necessitate much improved documentation for head-injured patients. In order to improve the quality of documentation (both in legibility and content) and to simplify and standardize the assessment of head-injured patients, a recommendation for developing a head injury pro forma to address these issues in the A&E department was suggested.

As well as documentation, the reliability of the results was also dependent upon the accuracy of

the criteria themselves. They must be unambiguous to minimize inter-observer error and be of proven scientific value. The time taken to clearly identify and explicitly define the criteria is a prerequisite of a successful criterion based audit.

In this study, three fractures would have been missed if the criteria for ordering an SXR had been adhered to strictly. Two of these were in young babies, which raises questions about the validity of such criteria in this age group. Recent evidence suggests that children (under 14 years) are at a lesser risk of intracranial haematoma than adults²⁸ and that fewer children have evidence of brain damage as the result of a head injury.³⁴ Although the main indicators of risk, a skull fracture and conscious level, are the same as for adults,²⁸ the clinical criteria used in this study failed to diagnose these fractures.

Some criteria may need revision in order that they can be applied to the younger age group. For example, criteria about abnormal behaviour or play and altered eating and drinking habits might be more applicable to young children and babies than criteria about post-traumatic amnesia and visual disturbance. Evidence from one group concluded that there is an urgent need for regions to revise their guidelines to include recommendations for optimal practice for assessing children with severe head injuries.³⁵

The potential to miss skull fractures highlights the problem with unduly prescriptive standard setting and possible inappropriate restrictions. A recent case study described a patient who did not satisfy any of the usual criteria for SXR, yet assessment of the mechanism of injury revealed that the patient's head had been subjected to an impact of significant velocity against a hard surface and the risk of vault fracture therefore was judged to be high.³⁶ An SXR revealed a 6-cm linear fracture of the right occipitoparietal region. Following neurosurgical consultation, a CT scan was performed and showed a large extradural haematoma which was successfully evacuated with no residual neurological sequelae.

Guidelines are not static and must be updated continually to take account of changes in medical knowledge and practice.³⁷ At the same time, guidelines should reflect the large areas of uncertainty in management honestly and not attempt to stifle healthy variation in practice.³⁸ Mechanism of injury suggesting considerable force should be an integral part of both national and local guidelines for managing patients with head injury.^{36,39}

The primary reason for performing an SXR is to

exclude a skull fracture, as the presence of a fracture increases the risk of a serious outcome,^{9,32,33} particularly that of intracranial haematoma. Early diagnosis of an intracranial haematoma followed by prompt surgical intervention has reduced the morbidity and mortality resulting from this lesion appreciably.^{8,25}

However, over recent years there has been much discussion about the indication for this test, with radiologists^{17,32,40} favouring a more selective policy compared with neurosurgeons.^{41,42} A&E doctors have recently examined reasons why criteria were being ignored and have suggested slight alterations to the 1986 Working Party guidelines.⁴³ The objective of any diagnostic procedure is to subject the patient to the test only when risk (excess radiation in this case), cost and inconvenience are outweighed by the potential value of the result. A combination of medicolegal issues, patients' expectations and a previous lack of objective screening guidelines has exerted great pressure on the clinician to subject large numbers of patients to radiography, regardless of clinical judgement.

The purpose of admitting a patient with a head injury is either to treat an obvious lesion or observe a patient who may develop complications.⁸ Although all admissions in this study were judged to be appropriate, four cases were identified that should have been admitted. The adverse outcome (death) of one of these patients highlights the importance of adherence to recommended criteria.

Despite some evidence satisfying the criteria in the medical records of 27 patients who were managed inappropriately, the A&E doctors' reason for his/her management was unknown. Although there was an induction course covering head injury management at the start of their appointment, there could have been either an unfamiliarity with the criteria or a general lack of knowledge about managing patients with a head injury.

In conclusion, this study has highlighted the advantages and disadvantages of using guidelines and criteria. It has demonstrated that the poor quality of medical record content and poor legibility made the process less objective than was originally planned, thus potentially lowering the true number of patients who were managed correctly. It has also shown that some of the criteria were not entirely appropriate, particularly for babies.

Several recommendations have been made to improve the management of head injuries. Firstly, a head injury pro forma should be developed and piloted in several A&E departments.⁴⁴ Secondly,

the quality of the criteria should be studied, particularly for mechanism of injury, and the criteria for babies and young children require further discussion and consideration. Thirdly, as emphasized in a recent audit,⁴⁵ local A&E departments should publicize the criteria more widely by including them in the junior doctors handbook, displaying them as a poster in the A&E department and making them an integral part of the A&E doctor's induction course.

ACKNOWLEDGEMENTS

Acknowledgement is due to Mr A. Clark, Consultant Surgeon of the Royal Sussex County Hospital in Brighton for peer reviewing cases in this study. The authors are also grateful to Ms Gitta Horan for word processing assistance during the preparation of this manuscript.

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