Were you knocked out?—Yes, but I wasn't admitted

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SUMMARY

A prospective study was undertaken of the effects of applying a more selective admission policy to a group of 6685 accident and emergency attenders with head injuries. The efficacy of such a policy was assessed by comparison with 5768 head injury attenders subject to an orthodox admission policy and collected retrospectively. Epidemiological characteristics of both study groups, of patients not admitted but who would previously have been admitted, and of patients admitted because of head injury alone during the prospective study are detailed. The more selective policy was no worse than current practice in terms of immediate morbidity and mortality. Survival of patients with post-traumatic intracranial haematomas was more likely in the prospective group, as was the diagnosis and treatment of such lesions while the patients were alive. Patients admitted because of head injury alone were reduced to one-third of their expected number and all admissions, from among those attenders with head injury in the prospective study, were reduced by half. Adopting such a policy nationally could save £11,000,000 annually.

INTRODUCTION

The current method of selecting head-injured patients for admission has recently been the subject of much discussion. Much of the work has originated from Glasgow (Jennett, 1975, 1976, 1978; Galbraith *et al.*, 1977; Rose *et al.*, 1977; Strang *et al.*, 1978; Jennet & Carlin, 1978; Mendelow *et al.*, 1983), but reports have also appeared from Birmingham (Totten & Buxton, 1979), Dumfries (Welch, 1983), Edinburgh (Mendelow *et al.*, 1982), Liverpool (Jeffreys & Jones, 1981; Jones & Jeffreys, 1981) and Nottingham (Weston, 1981). The question has also been aired in a leading article (Leading article, 1978) and in a report by the Royal College of Radiologists (1981). Most question the efficacy of admitting large numbers merely on the basis of an initial period of unconsciousness or amnesia. Most recently a national group of neurosurgeons

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suggested guidelines for selecting which adult accident and emergency attenders should be admitted (Briggs *et al.*, 1984). They omitted initial unconsciousness and amnesia as absolute indications for admission. A similar policy was applied to adult attenders in Nottingham in 1978 (Weston, 1981). The present article compares such a policy applied to all ages with the orthodox policy as previously applied in the same hospital.

PATIENTS AND METHODS

All head injury attenders at the Accident and Emergency Department at Chester Royal Infirmary during two 12-month periods were studied. The earlier study was retrospective and covered the period 1-7-76 to 30-6-77. The later study was prospective and covered the 12 months ending 30-11-80. During both study periods head injury attenders were selected by the author alone. A head-injured patient was defined as any patient with one or more of the following features:

- A history of a blow to the head with or without a period of unconsciousness or amnesia
- External evidence of head injury
- Any patient issued with 'head injury instructions'
- All patients undergoing skull X-ray examination

This definition approximates to rubrics N800-804, N850-854, N870-873, N900, N910, N918-921, N925, N929, N950 and N951 of the International Classification of Diseases (ninth revision). Patients with epistaxes or foreign bodies in the eye, ear or nose were excluded unless they fulfilled the criteria, as, with the same proviso, were patients with burns. Patients with facial injuries, including fractures of the mandible, were generally included since they usually fulfilled the definition criteria. All patients with head injury who were brought in dead were included as were all patients dying at the scene, certified there and taken directly to the mortuary.

Data on each presenting sample of patients were transferred to a computer input form by the author. This information was subsequently analysed using the facilities of the Mersey Regional Computer Centre.

During the retrospective study the admission criteria were:

<i>Absolute indications</i>	<i>Relative indications</i>
History of unconsciousness	Alcohol
Amnesia of any duration	Symptoms
Any neurological sign	
A skull fracture	
Early epilepsy,	

However, for the prospective study unconsciousness and amnesia, irrespective of their duration, were omitted, leaving three absolute and two relative indications. During both study periods patients admitted wholly or in part because of their head injury were those included in rubrics N800-804, N850-854. Patients not admitted because of the changes in the admission policy were identified. Subsequently their general

practitioners were contacted to determine whether these patients suffered any problems which could be attributed to their head injury.

Statistical comparisons were made using the *chi*-squared, Fisher's, Poisson's and *z**I* tests.

RESULTS

Characteristics of the two main study groups are shown in Table 1. There was a 15.9% (4.7% per annum) increase in head injury attendances between the two study periods, while the number of cases of post-traumatic intracranial haematoma more than doubled (5 *vs* 11 patients, 6 *vs* 14 lesions) and the number of deaths increased by 12%. There was no significant difference between the two groups in regard to the hourly or monthly distribution of attendances. The daily distribution was, however, significantly different, largely due to different attendance rates on Fridays and Saturdays.

Using the proportions found during the retrospective study, the expected number of admissions during the prospective study was 1282. These would have consisted of 919 patients (72%) admitted because of their head injury alone, 156 patients (12%) admitted both because of their head injury and because of another injury or condition, and 207 patients (16%) admitted solely because of another injury or condition. In fact only 324 patients were admitted because of their head injury alone. Patients not admitted because of the change in admission policy numbered 630 and this total was not significantly different to the expected number (919–324 = 595).

In Table 2 the non-admitted group is compared with all attenders and in Table 3 with patients admitted because of their head injury alone.

Follow-up of the non-admitted group was for a minimum of 3 and a maximum of a little over 4 years. During this time 97 patients (15%) were lost to follow-up. Neither the age nor the sex distribution of this latter group was significantly different to that of the remaining 533 patients. Likewise, causes of injury were not significantly different between the two groups. A further 8 patients (1.3%) were lost to follow-up 8–28 months after their injury.

Twenty patients (3.8%) in the non-admitted group died during the follow-up period. If the age and sex specific mortality rates in 1980 (Office of Population Censuses and Surveys [OPCS], 1982) continued throughout the follow-up period then 11 male and 5 female deaths would have been expected in the 533 patients followed, whereas 16 males and 4 females actually died. This difference between the total observed and expected number of deaths is not significant. The median age at death was 77 years and the range was 7–100 years, while the median age at the time of injury was 74 years and the range 5–98 years. All except 2 patients were over 50 when they died. One 7-year-old boy died as a result of a severe head injury sustained 18 months after the counting injury. Another patient, a 37-year-old man, died from an overdose 2 years after his head injury. Three deaths occurred within 12 months of injury, the earliest being at 11 weeks, and these patients were aged 72, 85 and 87 years when they died; 5 died during the second, 11 during the third and one during the fourth year after injury.

Although 505 non-admitted patients were known to be alive 3–4 years after their head

Table 1 Comparison of the two studies

Characteristic	Percentage 1976-77 <i>n</i> = 5768	Percentage 1979-80 <i>n</i> = 6685	Significance of difference
New A & E patients	17	18	****
Age 0-14	45	41	****
Age 15-64	49	52	***
Age 65+	6.1	7.0	*
Male	68	67	N.S.
Alcohol [% adults]	9.2	11	*
GP referral	5.3	5.1	N.S.
Cardiovascular	1.5	1.9	N.S.
Epilepsy	0.8	0.8	N.S.
Assault	9.4	12	****
Industrial	5.9	5.7	N.S.
Sport	6.4	6.6	N.S.
Fall	37	33	****
Fall bike	4.7	4.7	N.S.
RTA	17	17	N.S.
Other	15	14	N.S.
Not recorded	4.3	6.9	****
Vomited	7.4	6.7	N.S.
Knocked out	15	15	N.S.
Amnesic	7.3	6.9	N.S.
Signs	4.9	4.8	N.S.
Skull X-ray	50	39	****
% of SXR = #	3.1	4.5	**
% of all = #	1.5	1.8	N.S.
Head injury only	14	4.8	****
Head injury + other	2.3	1.0	****
Other only	3.1	4.9	****
(HI + other) + other only	5.4	5.9	N.S.
Intracranial haematoma	0.09	0.16	N.S.
All deaths	1.1	1.3	N.S.
Head injury deaths	0.7	0.7	N.S.

N.S. = not significant, $p > 0.05$ * = $p < 0.05$; *** = $p < 0.005$ ** = $p < 0.01$; **** = $p < 0.0005$

injury no information regarding complications was known in 17 (3.4%) of them. In only 10 (2.0%) of the remaining 488 cases did any complaint possibly attributable to their head injury occur. Six patients had consulted their GP because of headache but in none of these did symptoms last longer than 4 months. One patient with headache also complained of poor concentration, in this case symptoms lasted 3 weeks. Another patient complained that he was forgetful/vacant, although his GP considered him to be in good health. A further patient was off work for 4 weeks and complained of light-headedness for a further 4 weeks. Her GP attributed these symptoms to nervous tension. A young man, 22 years old at the time of injury, suffered episodes of unconsciousness $3\frac{1}{2}$ and 7 months after injury but had no further problems in the ensuing $2\frac{1}{2}$ years. As a child he had suffered from convulsions and had also sustained

Table 2 Comparison of non-admitted group with all attenders

Characteristic	Percentage of all attenders <i>n</i> = 6685	Percentage of non-admitted <i>n</i> = 630	Significance of difference
Age 0–14	41	26	***
Age 15–64	52	66	***
Age 65 +	7.0	7.5	N.S.
Male	67	68	N.S.
Alcohol [% adults]	11	21	***
GP referral	5.1	4.8	N.S.
Cardiovascular	1.9	3.7	*
Epilepsy	0.8	1.1	N.S.
Assault	12	14	N.S.
Industrial	5.7	6.0	N.S.
Sport	6.6	6.0	N.S.
Fall	33	34	N.S.
Fall bike	4.7	4.9	N.S.
RTA	17	28	***
Other	14	4.8	***
Not recorded	6.9	2.4	***
Vomited	6.7	7.9	N.S.
Skull X-ray	39	72	***

N.S. = not significant, $p > 0.1$ * = $p < 0.01$; *** = $p < 0.0005$ **Table 3** Comparison of non-admitted group with patients admitted because of head injury alone

Characteristic	Percentage head injury only <i>n</i> = 324	Percentage of non-admitted <i>n</i> = 630	Significance of difference
Age 0–14	45	26	****
Age 15–64	51	66	****
Age 65 +	4.0	7.5	N.S.
Male	69	68	N.S.
Alcohol [% adults]	23	21	N.S.
GP referral	9.9	4.8	**
Cardiovascular	1.9	3.7	N.S.
Epilepsy	0.3	1.1	N.S.
Assault	7.7	14	*
Industrial	3.4	6.0	N.S.
Sport	6.5	6.0	N.S.
Fall	36	34	N.S.
Fall bike	7.4	4.9	N.S.
RTA	26	28	N.S.
Other	11	4.8	***
Not recorded	1.9	2.4	N.S.
Vomited	41	7.9	****
Skull X-ray	99	72	****

N.S. = not significant, $p > 0.05$ * = $p < 0.01$; *** = $p < 0.001$ ** = $p < 0.005$; **** = $p < 0.0005$

two head injuries requiring admission 3 and 5 years before the counting injury, on one occasion fracturing his skull. Finally a baby girl, 9 months old at the time of her injury sustained a further head injury with skull fracture 2 months after the counting injury. Immediately following this latter injury she fited and was subsequently subject to breath-holding attacks. There was a family history of epilepsy and an EEG was non-specifically abnormal. No patient in the non-admitted group developed a post-traumatic intracranial haematoma, either acute, subacute or chronic.

During the retrospective study 23 head injury attenders (0.4%) returned to the accident and emergency department because of symptoms and following reassessment were again sent home. A further 8 patients (0.1%) returned and were admitted. Six more patients (0.1%), originally admitted, were readmitted. During the prospective study the numbers in each of these groups were 61 (0.9%), 20 (0.3%) and 7 (0.1%). This difference in regard to returning patients, who were again sent home, was significant; however, the differences in regard to returners who were admitted and in regard to readmissions were not significant.

Even though the number of post-traumatic intracranial haematomas doubled between the two study periods the difference was not significant. During the retrospective study 5 acute haematomas developed in 4 patients alive on admission but only 2 were recognized and treated during life. In the prospective study 9 acute lesions developed in 7 patients alive on admission, and 8 were identified and treated during life. Although clearly superior the latter results are not significantly different to those in the retrospective study. Ultimately, all 4 patients with acute lesions in the retrospective study died whereas only 3 of the 7 patients with acute lesions in the prospective study died. Again, however, this difference is not significant. The higher ratio of acute extradural to acute intradural lesions in patients alive on admission in the prospective study (ratio 5:4) compared to the retrospective study (ratio 1:4) could account for the difference in mortality. Combined intradural and extradural lesions were present in a quarter of the patients in the retrospective study but in one-seventh in the prospective study. However, in the prospective study 2 of 7 patients alive on admission had more than one acute lesion whereas only 1 of 4 patients in the retrospective study had more than one acute lesion.

DISCUSSION

Between 1970 and 1980 all new accident and emergency attendances at Chester Royal Infirmary increased by an average of 1109 per year; however, between 1979 and 1980 they fell by 551. Almost at the start of the prospective study a national steel strike was followed by closure of the local steel plant with thousands of redundancies. Employees from this plant accounted for a significant proportion of the work of the department in the preceding years, most cases having hand injuries, burns or subtarsal or corneal foreign bodies. This loss of prospective patients could have accounted for the deficit in new attenders and could explain the significantly higher proportion of new patients which head injuries comprised in the prospective study.

Significantly fewer head injury attenders were children and significantly more were

adults during the prospective study. This is in keeping with national trends. Thus, in England and Wales in 1973 26% of admissions with fractures of the skull or face and 40% of admissions with intracranial injury without skull fracture were aged 0–14 years (OPCS, 1977), by 1978 these proportions were 24% and 39% respectively (OPCS, 1981). Similarly in Scotland in 1975 33% of all head injury discharges were aged 0–14 years (Information Services Division of the Common Services Agency for the Scottish Health Service [SHS], 1977) but by 1979 the proportion had fallen to 30% (SHS, 1982).

Recent alcohol consumption was significantly commoner in the prospective group but may merely have reflected the significant increase in cases of assault, the latter commonly being associated with drinking (Galbraith *et al.*, 1977; Strang *et al.*, 1978). Falls were significantly less common in the prospective study, which is in keeping with the shift in age distribution, falls being the commonest cause in children.

Two possible explanations exist for the significantly smaller number of accident and emergency attenders undergoing skull X-ray during the prospective study, each explanation being independent of the change in admission policy. First, shortly after the start of the prospective study and resulting from a discussion of X-ray usage in the department, requests for skull X-rays, X-rays of nasal bones, distal phalanges of fingers, all toes and oblique rib films for isolated fractures declined dramatically. Subsequently, an increase in skull X-ray requests did occur but did not reach previous levels. Requests for the other sites listed above remained at a low level and some, particularly requests for X-rays of nasal bones, were seldom made again. Second, about halfway through the study period industrial action by radiographers led to a reduction in the number of skull X-rays performed. Presumably because of more selective use of this investigation more X-rayed patients had radiologically apparent skull fractures. However, assuming those not X-rayed had no fracture then there was no significant difference in the incidence of skull fractures between the two studies. The author does not believe that differences in patient selection occurred or that this was the explanation for the difference in the number X-rayed.

The significant reduction in the number of patients admitted because of head injury alone during the prospective study clearly arose as a result of the altered admission policy. Although patients previously categorized as 'head injury + other' may have been converted to 'other only', there was no significant difference between the two study groups in regard to the total number in these two categories. Thus patients formerly admitted as head injury only had not merely been transferred to another admitted group.

Adequate and reasonable explanations therefore exist for the differences between the two main study groups. Likewise, such explanations also exist for the differences between the non-admitted group and all attenders (Table 2) and between the former and patients admitted because of head injury alone (Table 3). For example, initial unconsciousness becomes more common as age increases. Omitting such a factor from the admission policy should therefore affect children less than adults or elderly patients. This is exactly the case in the prospective study, in which children were significantly less numerous in the non-admitted group but more numerous among those admitted because of head injury alone.

In assessing the non-admitted group no adverse effects on mortality or morbidity were found. Specifically, none of these patients died earlier than 11 weeks after the

relevant injury and none developed any variety of post-traumatic intracranial haematoma. Such complaints as did occur were minor and there is no reason to believe that these complaints would not have occurred if the patients had been admitted for bed and breakfast. Indeed, others have found similar complaints in patients with injuries of the same and of lesser degrees of severity as in the non-admitted group (Jones, 1974; Rimel *et al.*, 1981; Wrightson & Gronwall, 1980). Moreover, the changed policy was not difficult to understand or to implement. Although a significant increase in return visits by patients who were again sent home, occurred during the prospective study, in practice this amounted to less than one such patient per week, hardly an unmanageable number. The increase in return visits leading to admission was not significant and amounted to one such patient per month, again not an unmanageable number. The increase in return visits might suggest the possibility of adverse clinical consequences occurring; however, there was an explicit lack of evidence of such events. In most respects, therefore, the altered policy was associated with no worse results than is current practice. In fact, diagnosis of acute haematomas, while the patient was alive, was more likely during the prospective study, as was the likelihood of patients with such lesions surviving.

Introduction of the more selective policy in Chester resulted in head-injury-only admissions being reduced by about two-thirds and all admissions from among accident and emergency attenders with head injury being reduced by about half. A total of 630 patients were spared admission and came to no harm as a result. Application of such a policy nationally, given that even a brief hospital stay now costs £85 (Mendelow *et al.*, 1982), would produce a saving of £11,000,000 annually ($£85 \times 630 \times 55,000,000 / 262,500$). It has been pointed out that such a policy is common practice in the United States despite the litigious atmosphere prevalent there (Jennett, 1978). Moreover, the Chester admission policy is almost identical to that recently advocated for adult attenders by a national group of neurosurgeons (Briggs *et al.*, 1984) and that already applied to adult accident and emergency attenders in Nottingham (Weston, 1981).

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