earlier diagnosis and treatment. Reports of clinical remission induced by immunosuppression have not taken this into account and future trials may need to be evaluated in this light.²⁶ Early detection of metabolic abnormalities would improve the chances for success of intervention, but prediction at a much earlier stage (even before impaired glucose tolerance is found) would offer the best prospect of preserving viable numbers of functioning β cells.

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Comprehensive care of patients with head injuries

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Abstract

The comprehensive head injury service run by the neurosurgeons at the Hull Royal Infirmary for the surrounding population of one million was analysed. The analysis showed that all patients with either a fractured skull or a lowered level of consciousness should be admitted to a district general hospital because the associated risk of their having a major head injury is over 20%. Those patients with both a fractured skull and a lowered level of consciousness have a 60% likelihood of a major head injury and should be transferred immediately to the neurosurgical unit. Patients with compound or complicated fractures of the skull and those without fractured skulls but with neurological impairment persisting for four hours or more, should also be transferred to the neurosurgical unit.

If these guidelines are followed about 200 patients/million population will be referred to the neurosurgical centre. Patients

with a minor head injury and none of the clinical risk factors may safely be sent home. This should reduce the rate of admissions to hospital for head injuries by 60%.

Introduction

When the Royal Infirmary in Hull was opened in 1967 it was decided that all patients who required admission to hospital after a head injury would come directly under the care of the neurosurgeons. In addition to patients with obvious major head injuries, those with minor head injuries were admitted if they had the following signs: loss of consciousness (however brief); headache; and vomiting and unsteadiness, particularly in children. Skull radiographs were obtained for all patients with any kind of head injury, and radiological proof of a fractured skull was a further criterion for admission.

The neurosurgeons at this hospital have thus provided a clinical service for all patients with minor or major head injuries for the population on the north bank of the Humber (about 500 000). During this time the neurosurgeons have also accepted all patients with head injuries referred to them from the two district general hospitals south of the Humber and other smaller hospitals around Hull. The total population served by these referring hospitals is also about 500 000 (see figure). This combined service is part of a neurosurgical practice that has grown in recent years (see table I) with satisfactory results.

In the past two years the identification of several factors correlated with the risks of intracranial haematoma in patients with

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head injuries, and the obvious benefits of combining the siting of neurosurgical skill with the efficient use of computed tomography have led to suggestions that more patients should be referred early to neurosurgical units and that many patients with minor head injuries need not be admitted to hospital at all.¹² An admission policy for

District health authorities and their respective populations served by the head injury service at the Hull Royal Infirmary. (Figures from 1981 census.)

patients with head injuries based on these observations, as suggested recently by a group of neurosurgeons,³⁴ would probably increase efficiency and improve allocation of resources.²⁵ Before putting this policy into practice in Humberside, however, we analysed the current practice to confirm the risk factors and predict the probable effect of any changes in policy.

Patients and methods

A prospective study of all patients admitted to this hospital with head injuries between 1 July and 31 December 1984 was undertaken to obtain detailed information about particular clinical features, diagnosis, and duration of stay. The research assistant saw all of the patients with head injuries each morning with the medical staff. The clinical features recorded included the level of consciousness when the patient was seen in the accident and emergency department (as judged by the Glasgow coma scale⁶), the absence or presence of fractured skull (all patients with head injuries having undergone skull radiography), and any other major injuries. The diagnosis was recorded from the classification used in the neurosurgical department (see table II); the details of patients with head injuries for the years 1982, 1983, and 1984 were obtained from the same source.

Results

The figure shows the area and populations served by the neurosurgeons at this hospital for direct admissions and referrals, respectively, and table I shows the number of patients with minor and major head injuries admitted to the neurosurgical department over the past seven years. Table II shows the diagnostic groups for the years 1982, 1983, and 1984. Tables III to VI show the relation of level of consciousness and the absence or presence of a fractured skull to the diagnosis of minor and major head injury and to the duration of stay in hospital, respectively.

Using these observations we calculated risk factors as percentages by taking the number of patients with major head injuries with the particular

TABLE I—Number of patients seen in neurosurgical department 1977-84

	1977	1978	1979	1980	1981	1982	1983	1984
No of patients seen	1507	1579	1786	1738	1690	1707	1879	2047
No of patients with minor head injuries	1008	1007	1114	1022	862	935	1092	1161
No of patients with major head (and spinal) injuries	116	108	128	143	164	140	129	186

TABLE II—Patients seen with head injuries 1982-4. Figures in parentheses are patients referred from other hospitals

Type of injury	1982	1983	1984
Minor head injury	935	1092	1161
Major head injury	119 (35)	99 (35)	122 (35)
Cerebral contusion	86	62	76
Open fracture of skull	7	7	16
Dural tears	2	7	5
Extradural haematoma	6	6	9
Subdural haematoma	15	13	10
Intracerebral haematoma	3	4	6

TABLE III—Relation between level of consciousness and severity of head injury. Values are numbers (%) of patients

	Severity of head injury		
	Major	Minor	Total
Lowered level of consciousness	44 (28)	111 (71)	155
Alert	9 (2)	588 (99)	597
Totals	53	699	752

clinical feature $\times 100$ /all patients with head injuries with the same clinical feature. For the 155 patients who were suffering from a lowered level of consciousness when seen in the accident and emergency department this was 28% and for the 111 with a fractured skull 32%; for the 41 patients who had a lowered level of consciousness and a fractured skull the factor was 64%. The same calculation for either of these clinical features gives the probability that a patient with a fractured skull or a lowered level of consciousness has a major head injury as 22%, and if these two criteria had been used all patients with major head injuries would have been admitted.

Discussion

Knowledge of the probability that a patient might have more than a minor head injury, or by our diagnostic criteria one of the various forms of major head injury, is more useful to the doctor assessing these patients in the accident and emergency department than knowledge of the risk of an intracranial haematoma as calculated from the widespread analysis of head injuries in Scotland.¹ Our analysis shows that a fractured skull or a lowered level of consciousness is associated with a greater than one in five chance of a head injury that is more than minor, and these patients should obviously be admitted to the local hospital. It also confirms that patients with the combination of a fractured skull and a lowered level of consciousness have an almost two in three chance of having a major head injury and should therefore immediately be transferred to a neurosurgical unit. The findings support and supplement the observations from Scotland¹; they also endorse two of the main points in the recently published guidelines for the initial management of patients with head injuries.³⁴ The relation between the same clinical features and whether or not the patient was kept in hospital for 24 hours reflects the practical aspects of running a head injury service (tables IV and V). Of the patients with major head injuries, 11 died, 34 remained in hospital for 48 hours, and three were in hospital for 24-48 hours. Of the five patients with major head

injuries who stayed in hospital for less than 24 hours, two discharged themselves, two had been referred from another hospital, which they returned to after assessment, and one was a patient with a compound fractured skull who underwent surgical repair on admission and was then transferred for orthopaedic management.

TABLE IV—Relation between fracture of skull and severity of head injury. Values are numbers (%) of patients

	Severity of head injury		Total
	Major	Minor	
Fractured skull	36 (32)	75 (68)	111
No fracture	17 (3)	624 (97)	641
Total	53	699	752

TABLE V—Relation between level of consciousness and duration of stay in hospital. Values are numbers (%) of patients

	Duration of stay		Total
	≤24 h	>24 h	
Lowered level of consciousness	76 (49)	79 (51)	155
Alert	504 (84)	93 (16)	597
Total	580	172	752

TABLE VI—Relation between fracture of skull and duration of stay in hospital. Values are numbers (%) of patients

	Duration of stay		Total
	≤24 h	>24 h	
Fractured skull	52 (47)	59 (53)	111
No fracture	528 (82)	113 (18)	641
Total	580	172	752

When all those with a fractured skull or a lowered level of consciousness are removed from the no risk group the number of patients requiring admission is reduced from 752 to 278 (a reduction of 63%), and with the use of these criteria no patients with a diagnosis of a major head injury would have been discharged. In practice, 66 of the patients with no risk of major head injury were detained for more than 24 hours, and of these, 39 remained in hospital because of non-neurosurgical problems such as orthopaedic, faciomaxillary, or general surgical injuries. The remaining 27 patients stayed in hospital because of persistent symptoms such as nausea, dizziness, headaches, and vomiting. These 27 represent 4% of all the patients seen and could constitute the small proportion of the no risk group that might reattend hospital having been sent home initially.

Tables I and II show that the number of patients admitted with major head injuries rose in 1979 to reach its present level by 1980, indicating the effect of computed tomography on the diagnosis of head injuries.⁷ The absence of a further rise in 1982, when the Humber Bridge was opened, suggests that patients were already being brought to the hospital by helicopter or a long ambulance transferral. Table II indicates, however, that for the past three years analysed only about a third of the patients with major head injuries came from outside the Hull Royal Infirmary. If referrals were encouraged according to the criteria set out above the number of patients with major head injuries for the population of a million might increase to 200 a year. Among these, the number of patients admitted with surgically treatable intracranial haematomas each year might rise above the remarkably constant 25 but is unlikely to reach the 36 or more per million suggested by the Clydeside and Merseyside studies.^{1,8}

This study has confirmed the value of obtaining skull radiographs of good diagnostic quality in all patients with a history or signs of a definite impact to the head, or both, and of treating a fractured skull as a criterion for admission to hospital and the complications of a fractured skull as criteria for neurosurgical referral. These findings also support the recently produced guidelines.^{3,4}

The allocation of 28 beds for neurosurgical patients, with an average of four or five used for patients with major head injuries (those with minor head injuries being admitted to empty beds elsewhere in the hospital), was therefore changed to 36, allowing some eight to 10 beds for patients with head injuries. This number is larger than that suggested by other units, where the emphasis has been on referral for surgery rather than comprehensive care.⁵ Our experience indicates, however, that eight to 10 beds are needed for the neurosurgical care of all patients with a major head injury from a population of one million.

The admission of the lower risk and no risk patients to a short stay ward in the accident and emergency department has freed neurosurgical resources for the care of the high risk group. Children with head injuries and high or low risk factors are admitted to the paediatric ward, as are many other children with no risk factors other than difficulty in clinical neurological assessment, particularly if they are unlikely to be observed accurately at home. When patients with minor head injuries and no risk factors are sent home they are provided with printed instructions on care and observation.

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