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Severe head injuries in three countries

B. JENNETT, G. TEASDALE, S. GALBRAITH, J. PICKARD, H. GRANT, R. BRAAKMAN, C. AVEZAAT, A. MAAS, J. MINDERHOUD, C. J. VECHT, J. HEIDEN, R. SMALL, W. CATON, AND T. KURZE

*From the Department of Neurosurgery, Institute of Neurological Sciences, Glasgow, Scotland; Department of Neurosurgery, Academic Hospital, Rotterdam and Department of Neurology, Academic Hospital, Groningen, Netherlands; the Division of Neurosurgery, Los Angeles County Hospital, University of Southern California Medical Center, USA

SUMMARY Methods for assessing early characteristics and late outcome after severe head injury have been devised and applied to 700 cases in three countries (Scotland, Netherlands, and USA). There was a close similarity between the initial features of patients in the three series; in spite of differences in organisation of care and in details of management, the mortality was exactly the same in each country. This data bank of cases (which is still being enlarged) can be used for predicting outcome in new cases, and for setting up trials of management.

Head injury is a common cause of death and disability, particularly in the first half of life. Patients with severe head injury put a considerable burden on acute hospital services in the early stages after injury, and on many aspects of the health services of the community for a long period if they survive (Jennett, 1975; Field, 1976). Controversy surrounds discussions about initial severity and ultimate outcome, about the effect of early management and of late rehabilitation on the final state, and about the possibility of making a reliable prognosis soon after injury. The value of a data bank of clinical cases collected in a standardised way, as a basis for the management of new cases, and for relating therapeutic endeavours to outcome, has recently been pointed out by Fries (1976).

We set out to accumulate such a data bank of patients with severe head injury in the Institute of Neurological Sciences, Glasgow in 1968; extension of data collection to two Netherlands centres in 1972, and to an American centre in 1974, made it possible to test the feasibility of standardising methods of clinical recording among several teams of clinicians. It also provided a comparison in respect of initial characteristics and ultimate outcome, of severely head injured patients in three quite different health care systems. This paper describes the methods of assessment which were evolved, and their application to the first 700 cases in our study.

*Glasgow: B. J., G. T., S. G., J. P., and H. G.
Rotterdam: R. B., C. A., and A. M.
Groningen: J. M. and C. J. V.
California: J. H., B. S., R. C., and T. K.

Address for reprint requests: Professor B. Jennett, Institute of Neurological Sciences, Southern General Hospital, Glasgow G51 4TF, Scotland.

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The different centres

The Institute in Glasgow contains the only neurosurgical unit for the 2.7 million population of the West of Scotland, about half are in the Clyde conurbation, the rest widely scattered over thinly populated rural areas. Only 4% of the head injuries admitted in the West of Scotland are transferred for neurosurgical investigation and care to the Institute, usually because they are severely injured or are deteriorating; primary admission of these patients has been to general surgical or orthopaedic wards in other hospitals. No cases are admitted primarily to the neurosurgical unit.

Each of the Dutch centres is a city university hospital serving a population of 1 million, where almost 90% of head injuries are admitted within about two hours of injury, from the surrounding 30 miles. The rest come from outlying hospitals because they are considered to need specialist care. In both cities, most head injuries (including all mild cases) are treated in the neurology department. In Rotterdam, the more seriously injured patients go to the neurosurgical department, even though surgery is not considered necessary; consequently two-thirds of the patients in this study had been in the neurosurgical department. In Groningen, even the seriously injured patients are admitted to the neurology department where this study is based. Those requiring immediate surgery (usually for compound depressed fracture or intracranial haematoma) go to neurosurgery, and are not available for the study.

The Los Angeles County USC Medical Center provides emergency evaluation and treatment for approximately 1000 acute head injuries per year. Most patients are admitted to the neurosurgical unit within six hours of injury, sometimes after outlying community hospitals have provided initial treatment with parenteral fluids, steroids, and tracheal intubation. Paediatric injuries are underrepresented because several children's hospitals have their own neurosurgeons. Industrial head injuries are likewise uncommon because private insurance guarantees payment for medical services in community hospitals. Primary admission for all head injury patients is to the neurosurgical unit, except for multiple injuries associated with shock; these patients are admitted to the general surgical service, with neurosurgical consultation.

Definition of a severe head injury

It was essential to be able to decide at an early stage that a case was sufficiently severe to admit to the study. The most widely accepted indicator of brain damage is the extent and duration of impairment of conscious level; its advantage is that it is universally available as a bedside test, its disadvantage the lack of a generally agreed scale of assessment. For this reason the Glasgow 'Coma' Scale was devised (Teasdale and Jennett, 1974), and coma was defined, using this scale, as inability to obey commands, to utter recognisable words, or to open the eyes; if any of these could be achieved the patient was regarded as not in coma. For inclusion in this study, coma had to last for at least six hours; patients who had been lucid at some stage after injury but who subsequently became comatose for six hours or more were included. Patients who died within six hours were excluded.

The period of six hours was chosen to allow time for the diagnosis and management of other injuries and their associated early complications (such as shock and respiratory insufficiency). It is well known that these may affect several parameters of neurological function, in particular the pupils and level of responsiveness; the extent of brain damage may therefore be overestimated on the basis of the patient's state in the first few hours after injury. Indeed it seems likely that several reported series of 'severe' head injuries might have included a number of patients who appeared severely brain damaged at the time of admission but who had improved rapidly after initial management.

Retrospective assessment of the severity of brain damage associated with acceleration/deceleration injuries is based, especially in Britain, on the duration of the post-traumatic amnesia (PTA). Both Russell and Smith (1961) and Lewin (1968) proposed that PTA of more than 24 hours be taken to indicate a severe injury, and of more than a week a very severe injury. Post-traumatic amnesia always exceeds the duration of coma by a considerable factor. In the present series, coma persisted for three days in only 60% but all had PTA longer than this; in 91% of survivors PTA was more than a week. There can be no doubt, therefore, that the patients studied did indeed suffer severe head injury.

Data collected on severe injuries

Cases with coma lasting more than six hours who were admitted to each of the centres during the period of the study were accepted into the series. Data were recorded by one of a series of specified clinical trainees who had been made aware of the broad purposes of the study and of the categorisation of various features agreed between the participating centres. The evolution of these naturally began in Glasgow, but when the other centres joined the study, considerable care was taken to arrange visits between clinicians in the different centres to discuss methods of classification, and to ensure uniformity of eliciting, interpreting, and recording clinical data.

Several different types of data were recorded—demographic, aspects of coma, clinical details about the head injury, and certain items of laboratory investigation. The latter included neuroradiological tests, blood gas, and intracranial pressure levels; these were not available for every patient, and they are not further discussed in this report, which is limited to clinical features. Data from the bedside day sheets were transcribed by the clinician to two computer-compatible forms. The one which dealt with features designated as aspects of coma was identical with that used by the neurologists in an associated study of non-traumatic coma (Caronna *et al.*, 1975); it included assessment of outcome (at six months after injury) using the scale devised for this study (Jennett and Bond, 1975).

Results

DEMOGRAPHIC INFORMATION

In the Netherlands and Los Angeles about 90% of patients were seen by the neuroservice within six hours of injury (Table 1), compared with 32% in Glasgow, where 30% were transferred to neurosurgical care more than 24 hours after injury.

Table 1 *Time till admitted to neuroservice*

	Glasgow	*Netherlands*	*Los Angeles*
	(422)	*(171)*	*(94)*
< 6 hours	32%	92%	88%
7–24 hours	38%	4%	9%
> 24 hours	30%	4%	3%

The mean age in the three series was similar (Table 2). In the whole series of 700 patients there were 81% males, but they were rather less preponderant under 10 and over 70 years of age.

More than half the injuries were due to road accidents, the victims of which were more often pedestrians in Europe (Table 3a). Accidents at work contributed almost 10% of injuries over the age of 10 years in Europe (Table 3b), but only 2% in Los Angeles where alternative care was available for industrial accidents. Assaults and 'falls under the influence of alcohol' were common in Glasgow and Los Angeles, accounting between them for almost a third of all injuries over the age of 10 years; these kinds of accident were rare in the Netherlands. Alcohol was recorded as a contributory factor (in patients over 10 years) in 44% in Glasgow, in 55% in Los Angeles, but in only 15% in the Netherlands.

Table 2 *Age and sex distribution*

(a)

Age	*Glasgow*	*Netherlands*	*Los Angeles*
Mean	*34 yr*	*33 yr*	*36 yr*
< 10 years	12%	12%	3%
10–19 years	19%	27%	14%
20–59 years	55%	44%	68%
⩾ 60 years	14%	17%	15%

(b)

Age	*Total*	*Males for each decade*
< 10 years	11%	61%
10–19 years	20%	79%
20–29 years	17%	83%
30–39 years	12%	93%
40–49 years	13%	90%
50–59 years	12%	86%
60–69 years	10%	80%
⩾ 70 years	5%	66%

Table 3 *Cause of injury*

(a)

	Glasgow (424)	*Netherlands (171)*	*Los Angeles (99)*	*Total (694)*
Vehicle occupant	14%	29%	21%	19%
Pedestrian	24%	19%	11%	21%
Total road traffic accidents	53%	78%	47%	58%

(b)

> 10 years	*Glasgow (371)*	*Netherlands (151)*	*Los Angeles (96)*
Work	8%	9%	2%
Assault	19%	1%	17%
Drunken fall	17%	1%	17%

HEAD INJURY DATA

Lucid interval and deterioration (*Table 4*)

Patients who talked before going into coma were recorded as having been *lucid*; those who had been considered sensible and normally alert at any time after injury were regarded as having been *completely lucid*. The proportion who were lucid was similar in each of the three countries (25–32%), as was the number recorded as completely lucid (11–13%).

Table 4 *Lucid interval and deterioration*

	Glasgow (424)	*Netherlands (171)*	*Los Angeles (85)*
Lucid interval (talked)	32%	25%	27%
Completely lucid	13%	13%	11%
Deterioration	61%	39%	44%
Interval to detection of deterioration			
< 6 hours	45%	43%	72%
6–24 hours	28%	32%	19%
> 24 hours	27%	25%	8%

As would be expected from the greater number of secondary referrals, there were more patients in Glasgow with evidence of deterioration than in the Netherlands or Los Angeles. Rather more cases began to deteriorate within six hours in Los Angeles than in the European series, in which more than a quarter did so more than 24 hours after injury. Of all patients known to have deteriorated about half had talked.

Skull fracture (*Table 5*)

In the whole series a vault fracture was detected radiologically in 62%, a basal fracture in 19%, and

Table 5 *Skull fracture*

	Glasgow (423)	*Netherlands (172)*	*Los Angeles (100)*	*Total (695)*
Vault (± base)	68%	54%	49%	62%
Base (± vault)	15%	26%	28%	20%
No radiological fracture	28%	41%	43%	34%
Signs of base	37%	62%	55%	46%
No clinical/ radiological fracture	—	—	—	23%

both in 27%; there was a depressed fracture in 14%. There were no important differences between the centres. In a third of cases no radiological fracture was found, but in a fifth of these patients there were clinical signs of a basal fracture in the anterior fossa (bilateral orbital haematoma or CSF rhinorrhoea), or in the middle fossa (mastoid haematoma or blood/CSF otorrhoea). When account was taken of this, the proportion without a fracture fell to 23%; this corresponds closely to the figure of 19% of 151 autopsied head injuries in Glasgow in which no fracture was found by the pathologist (Adams, 1975).

Evidence of focal brain damage
This was recorded simply as indicative of a definite or of a suspected lesion in the right or left cerebral hemisphere or in the posterior fossa (Table 6). This evidence was recorded for each time block during the first month after injury—because it might not be evident during the early stages. Evidence of focal damage was recorded equally frequently in all three countries, and the following analysis is for the total series. Cerebral hemisphere damage (definite or suspect) occurred in 85% of patients, and in 27% of these there was evidence of bilateral lesions. In patients with a unilateral vault fracture and with either neurological signs indicative of unilateral cerebral hemisphere damage, or with a unilateral supratentorial haematoma, the signs or the haematoma were contralateral to the fracture in rather more than a third of cases. These clinical findings emphasise what our neuropathologists have already reported, namely that in severely head injured patients brain damage is frequently widespread in the brain (Mitchell and Adams, 1973).

Table 6 *Evidence of cerebral hemisphere damage*

Definite	*Suspect*
Intracranial haematoma	Linear fracture
Depressed fracture—dura mater torn	Hemiplegia only
Epilepsy	Depressed fracture—dura mater intact or closed
Dysphasia	
Hemianopia	

Intracranial haematoma
This was frequent in this patient population (46%); it occurred twice as often in the two wholly surgical services as in the Netherlands (Table 7a). It commonly accounted for the delayed development of coma, or for the deterioration of patients already in coma, The majority of haematomas were verified by operation but thin subdural (smear) haematomas revealed by burr hole exploration were excluded. A few were recognised radiologically and not submitted to surgery, or were revealed only at postmortem examination; such haematomas were included only if associated with significant brain shift. The availability of EMI scanning may increase the number of radiologically recognised haematomas which remain unoperated; already it is evident that sizable haematomas are not uncommon in patients who are not deteriorating (and may even be improving)—and that a satisfactory recovery can occur without the removal of such haematomas (Jennett *et al.*, 1977). Haematomas were recorded as present or absent, in the extradural, subdural, or parenchymal situation, and in the right or left supratentorial or in the infratentorial compartment. No attempt was made to grade haematomas by size.

Extracranial injuries
These occurred in 34% of the whole series, being somewhat more common in the Netherlands and Los Angeles, where patients were admitted primarily (Table 7b).

Table 7 *Complications*

(a)

	Glasgow (428)	*Netherlands (172)*	*Los Angeles (100)*
Intracranial haematoma	51%	27%	58%

(b)

	Glasgow (428)	*Netherlands (172)*	*Los Angeles (100)*
Extracranial injury	30%	44%	37%

COMA DATA
Considerable attention was devoted to ways and means of assessing and recording the state of consciousness, both because this was the criterion of admission to this study, and because depth and duration of coma are commonly acknowledged as the most consistent guides to the severity of brain damage in non-missile injuries. We followed the general principles expounded by Fisher (1969), and by Plum and Posner (1972) in their classical texts on coma, which emphasised that the responsiveness of patients with impaired consciousness due to lesions at different sites throughout the brain depends largely on the functional state of the brain stem. Various brain stem functions may be affected separately; together with the site of any focal brain damage associated with the lesion causing the coma, this accounts for the variety of signs found in patients in coma. Brain stem functions commonly affected include wakefulness (eyes

open), pupillary size and reaction, eye movements, and several autonomic activities (respiration, heart rate, blood pressure, and temperature regulation). Some of these are so labile that at any one time they alone may be unreliable as a guide to the degree of brain damage, while others change less rapidly. All are dynamic, however, and an essential feature of this study was that data on the patient were noted repeatedly at the bedside; from these a summary was made which recorded the 'best' and 'worst' state within a series of time periods from the onset of coma —first 24 hours, two to three days, four to seven days, second week and so on. The use of the terms 'best' and 'worst' implies a hierarchy of responses, from normal to the most abnormal. Unless otherwise stated the following paragraphs refer to the best state during the first 24 hours of coma.

Ranking of responsiveness on 'coma' scale
This practical scale has been described elsewhere (Teasdale and Jennett, 1974, 1976); it has been subjected to formal observer/error study in each of the three countries, and found to be a reliable instrument in the hands of a wide range of staff (Teasdale and Jennett, 1976). Three separate aspects of the patient's behaviour are evaluated independently of each other: the stimulus required to induce eye opening, the best motor response, and the best verbal response. Each aspect of behaviour is described in terms of a defined series of responses which indicate degrees of increasing dysfunction (Table 8). By giving each response on each component of the coma scale a number, higher by one for each response better than the next, and adding the responses together, it is possible to rank the patient's overall performance on the scale. The validity of the assumption that each of the three parts of the scale should count equally, and that each step should differ equally from the next to it, has still to be tested; however, this simple system has proved useful in practice as a means of expressing the overall responsiveness of the patients as a group.

Table 8 *Glasgow 'coma' scale*

Best motor response	obeys	M6
	localises	5
	withdraws	4
	abnormal flexion	3
	extensor response	2
	Nil	1
Verbal response	orientated	V 5
	confused conversation	4
	inappropriate words	3
	incomprehensible sounds	2
	Nil	1
Eye opening	spontaneous	E 4
	to speech	3
	to pain	2
	Nil	1

There was a close correspondence between these three series when the ranking was divided into four levels (Table 9a). The only difference was that in Los Angeles there were rather more patients in the 5–7 band and fewer who were more responsive than this.

Analysis of the best response from the *best* limb (as recorded on the same scale) shows that the proportion with the lowest two levels of response was similar in the three countries (Table 9b). When the responses of the *worst* limb are taken account of various abnormal motor patterns can be described, and these were approximately similar in each country (Table 9c).

Table 9 *Responsiveness (best in first 24 hours)*

a. *Score on Coma Scale*	*Glasgow (396)*	*Netherlands (148)*	*Los Angeles (100)*
3/4	19%	22%	19%
5/6/7	51%	51%	66%
≥8	30%	27%	15%

b. *Best motor response*	*Glasgow (410)*	*Netherlands (167)*	*Los Angeles (100)*
Nil/extensor	21%	22%	20%
Flexor	36%	41%	50%
Localises/obeys	43%	37%	30%

c. *Motor pattern*	*Glasgow (420)*	*Netherlands (158)*	*Los Angeles (100)*
Hemiparesis/plegia	19%	21%	10%
Any extensor limb	19%	22%	28%
Tonic spasms	15%	18%	24%

Pupils
As with motor responses the pupils can provide evidence both of functional depression in the brain stem, and also of focal lesions; these may be anywhere from the nuclei in the brain stem to the iris itself, and in the early stages of the coma it may be difficult to determine whether there are such focal lesions. Data were recorded about reaction, size, and equality of the pupils; but light reaction was recorded only as present or absent, because deciding whether the reaction was brisk or sluggish proved impossible to standardise.

The pupils were more often non-reacting in the Netherlands and Los Angeles series, which probably reflects the high proportion of admissions soon after injury (Table 10a). When pupils were fixed they were equal and dilated (more than 4 mm) in about 30%.

Eye movements, spontaneous and reflex
Plum and Posner (1972) drew attention to the value of studying eye movements as an indication of brain stem function. *Spontaneous eye movements* in coma

are usually roving, and may be conjugate or dysconjugate; in deeper coma there are no spontaneous eye movements, and this was equally frequent in the three countries (Table10b). Reflex eye movements can be elicited by moving the head and watching for 'doll's eye' movements, which may be full, minimal, or absent. This *oculo-cephalic* reflex is not always easy to interpret, and there may be reservations about provoking neck movements soon after injury, before a cervical spine fracture has been excluded. The *vestibulo-ocular* reflex can be more consistently elicited and interpreted—provided the ear drum is not obscured by wax or perforated by reason of previous otitis or recent petrous fracture. Iced tap water is simple to use, and 20 ml are slowly irrigated into the external auditory meatus. Tonic deviation of the eyes is the usual response in coma and this may be conjugate or dysconjugate, whereas in deep coma there is no movement at all. Dysconjugate or nil response was observed in 40% overall, but was rather more frequent in the Netherlands (Table 10c).

Not all patients had data about spontaneous and both types of reflex eye movements because, for various reasons, one or other was not tested. A method was devised to take account of one or other feature being impaired, absent or normal, by exploiting the dependency between the different responses. The three series showed a similar distribution between the resulting composite grade of eye movement response (Table 10d).

Table 10 *Eye signs (best in first 24 hours)*

	Glasgow (415)	*Netherlands (159)*	*Los Angeles (100)*
a. *Non-reacting pupils*	19%	29%	32%

	Glasgow (222)	*Netherlands (103)*	*Los Angeles (100)*
b. *No spontaneous eye movements*	43%	43%	41%

	Glasgow (138)	*Netherlands (156)*	*Los Angeles (86)*
c. *Vestibulo-ocular response nil/ dysconjugate*	37%	50%	38%

	Glasgow (271)	*Netherlands (162)*	*Los Angeles (100)*
d. *Composite eye movement grade*			
Absent	19%	27%	25%
Impaired	26%	15%	10%
Good	54%	57%	65%

Vital signs in the first week (Table 11)

Although the nervous centres for various autonomic activities lie in the brain stem, there are so many factors which can influence respiration, heart rate, blood pressure, and body temperature that it is unwise to consider these as reliable indicators of brain stem function; nonetheless, certain changes are traditionally associated with severe dysfunction of the brain. The lability of these features makes it difficult to apply strict criteria of measurement, and abnormalities which are temporary and explainable on outside events need to be excluded as far as possible; only abnormalities persisting for at least three hours were recorded. The data analysed for respiration were limited to whether or not there was spontaneous apnoea, periodic respiration, or sustained episodes of respiratory frequency in excess of 30 per minute. Heart rate over 120 beats per minute and systolic blood pressure over 160 mmHg were recorded, as was a pyrexia greater than 39°C which was not related to infection. There was considerable consistency in the frequency with which various autonomic abnormalities were recorded in the three countries.

Table 11 *Vital signs in first week*

Signs	*Glasgow (250)*	*Netherlands (166)*	*Los Angeles (100)*
Respiration > 30/min	34%	32%	27%
Periodic respiration	24%	26%	9%
Heart rate > 120/min	24%	24%	24%
< 60/min	9%	11%	11%
Systolic BP > 160 mmHg	13%	19%	18%
Pyrexia > 39°C	12%	15%	14%

TREATMENT

All patients were treated with the skills and vigour which is normal in a specialised unit. Each of several neurosurgeons/neurologists had responsibility for a proportion of the patients in each centre: they received no prediction data from the study about patients still under treatment, which might have influenced their management. No attempt was made to standardise treatment, even within a single centre. In the event, there were considerable differences in the proportion of patients receiving osmotic agents or steroids, or controlled ventilation, in the different centres and this aspect of the study will be analysed in a future paper.

OUTCOME

This was assessed according to a five-point scale previously described (Jennett and Bond, 1975). Survivors are categorised by their overall social abilities, not by specific disabilities. The *vegetative state* has been described elsewhere (Jennett and Plum, 1972). *Severe disability* indicates dependence, such that the patient cannot get through 24 hours on his own, either because of mental or physical disability. *Moderate disability* indicates ability to organise their lives, travel by public transport, and work—either in a sheltered environment or at a lower level than before injury. *Good recovery* need not imply complete restoration of normality nor return to work; but it indicates an ability to resume all previous occupational and leisure pursuits. Studies on disabled patients by psychologists and psychiatrists have shown that mental disability contributes more significantly to overall handicap than the physical sequelae (Bond, 1975). Indeed several patients with severe disability are at present in mental hospitals, many of them with little physical disability.

In view of the frequent assertion that substantial recovery may continue for a year or more, a careful assessment was made at three, six, and 12 months (and in many cases at later periods). Of those moderately disabled at a year, 62% were already in this category within three months of injury, and 92% by six months; for good recovery at a year the figures were 60% already good at three months and 89% at six months. Of those graded as severely disabled at three months only an occasional patient made a good recovery by one year. Serial psychological tests confirmed that most recovery occurs within six months of injury (Bond, 1976). This is not to deny that some improvement may not continue for longer—only that this is seldom sufficient to change a patient's category on this simple outcome scale.

When the outcome six months after injury was analysed for the three countries, it transpired that the mortality was almost exactly the same in each series (Table 12). Half the patients survived and the distribution of degrees of disability was similar in Glasgow and the Netherlands; the smaller Los Angeles series had more vegetative and severely disabled survivors.

Table 12 *Outcome at six months*

	Glasgow (428)		*Netherlands (172)*		*Los Angeles (100)*	
Dead	221	52%	89	52%	49	49%
Vegetative state	8	2%	1	1%	5	5%
Severe disability	34	8%	9	5%	18	18%
Moderate disability	71	17%	26	15%	14	14%
Good recovery	94	22%	47	27%	14	14%

Discussion

METHODS OF ASSESSMENT

One of the most serious hindrances to an improved understanding of the problems of management of severe head injuries has been the difficulty of comparing initial severity and ultimate outcome in cases reported from different centres. The means which we have evolved for assessing coma, other features of injury, and outcome have proved reliable and practical; they make it possible now to identify in clear and definable terms the characteristics of what have previously been somewhat vaguely referred to as 'severe' head injuries. By defining a head injury as 'severe' on the basis of a specified depth and duration of coma, rather than by administrative or outcome criteria, remarkably similar patient populations have resulted, even though they were drawn from countries with distinctive socioeconomic characteristics, and with alternative systems of delivering health care. The reproducibility of the methods of assessment in these different countries indicates that they could probably be more widely adopted.

EFFECT OF MANAGEMENT ON OUTCOME

One of the aims of this study was to discover what effect variations in management policies might have on head injuries of comparable severity. The most obvious difference in management policy was that patients in Glasgow were referred secondarily to a neurosurgical unit, which resulted in a considerable interval before coming under specialist care. It is interesting to find that this made no difference to the mortality or morbidity rate. This suggests that once a patient has sustained a certain degree of brain damage, the outcome depends largely upon the extent of this—whether it be damage due only from primary impact or includes that from secondary complications also. Primary admission to a neurosurgical or neurological unit may reduce the proportion of head injured patients who reach the degree of severity arbitrarily set for this study, with its associated high mortality rate; sufficient evidence is not yet available to know whether or not this is so. That the proportion of patients who had a lucid interval was similar in the three countries suggests that there may not be as much difference in the cases as might be expected, however. It is of interest that several recently published European series of head injuries, which appear to have been of approximately comparable severity, also had a mortality rate of about 50%. There were certainly considerable variations in the details of management of patients in these different series, as there were between the three reported here. We plan to analyse these in a future paper, but it already appears that tactical differences in deploying conventional methods of treatment currently available do not crucially affect outcome.

PREDICTION OF OUTCOME

Uncertainty about the probable ultimate outcome accounts for much of the difficulty associated with the rational management of severe head injury. The present study originated in order to discover whether the ultimate outcome after severe head injury could be predicted reliably soon after injury, and this part of our investigation is still proceeding. It has already been reported that almost half the cases can be predicted confidently within 24 hours of coma developing; this proportion increases to two-thirds of the cases at three days and three-quarters at one week (Jennett *et al.*, 1976).

ASSESSMENT OF ALTERNATIVE MANAGEMENTS

The consistent mortality and morbidity rate in spite of variations of current conventional management should not be taken to mean that these measures are all ineffective, or that nothing can be done to improve the outcome. Rather it is a challenge to find improved methods of management. Assessment of alternative and new methods of management has so far been handicapped by the lack of standardised methods of assessing initial severity. By providing such methods this study opens the way to a critical appraisal of new regimens (Jennett and Plum, 1976). Fries (1976) has pointed out that the existence of a large enough data bank may sometimes make it possible to forego the need for a 'no treatment' control group—which is always ethically difficult when any new treatment is on trial for a condition which has a high mortality rate with methods already available.

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