Clinical course and outcome of severe head injury in Australia


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The records of 159 severely head-injured patients (all in coma for longer than 6 hours) from Sydney, Australia, were studied. The clinical course, charted over a 2-week period, indicated that 60% of deaths occur by Day 3 and that 12% of patients remain in coma (Glasgow Coma Scale (GCS) score < 7) for more than 2 weeks. Overall, at long-term follow-up review more than 2 years after injury, 51% of patients were dead, 7% were severely disabled or vegetative, and 42% had a good to moderate recovery. Outcome of the patients in prolonged coma was assessed separately, with only one-third making a good or moderate recovery; two-thirds of the severely disabled patients came from this group. The high proportion of poor outcomes associated with prolonged coma suggests that this group of patients should be specifically targeted in research. One appropriate intervention with this group would be the restructuring and intensification of early rehabilitation. However, the GCS score lacks the precision needed for this type of study, and a better measure of recovery should be developed.

Key Words • head injury • outcome • Glasgow Coma Scale • Australia

Head trauma is internationally recognized as a major cause of death and disability, with an estimated annual incidence of 200 victims per 100,000 population. Indeed, it is the single most common cause of death among those under the age of 40 years. A number of studies have shown that severity of the initial injury is the major determinant for prognosis of severe head injury. Poor prognosis is associated with the most severe initial injuries, whether measured by the Glasgow Coma Scale (GCS), by impairment or absence of brain-stem reflexes, by midline shift on cerebral computerized tomography (CT) scans, or by the presence of abnormalities on evoked potentials. However, from these early assessments it is still not possible to adequately predict the quality of life of individual survivors.

The aim of this study was to provide a quantitative description of the major features of the early clinical course of patients with severe head injury admitted to two Sydney teaching hospitals. An attempt was made to assess the relationship of duration of coma and recovery status.

Clinical Material and Methods

All patients with severe head injuries who were admitted to the Royal North Shore Hospital and Westmead Centre in 1981 were included in this study. Potential cases were selected from the Hospital Morbidity Index, a computerized medical records system containing diagnostic data of all hospital admissions, using the International Classification of Diseases (ICD) rubrics (revision 9) 800-804, 851-854, 8370-8371, and 950-951. These code numbers cover conditions that include skull and facial fractures, intracranial injuries and hemorrhage, and extracranial soft-tissue damage. In order to check case ascertainment from this source, an independent examination of the casualty registers was undertaken. By these two means, records of 1530 patients were identified and reviewed for eligibility.

The criterion for entry to the study was modeled on the International Data Bank (IDB) definition of severe head injury. Consistent with that definition, this study group included patients with nonmissile head injury scoring 7 or less on the GCS within 48 hours of admis-
sion who remained in coma for at least 6 hours. Coma was defined as the inability to open eyes to a stimulus, to utter intelligible words, or to obey a command. Study eligibility also included patients who died within 6 hours of injury.

Measures of injury type and severity such as pupil reaction and pathological diagnosis were derived from details in the patient's records, and a GCS score was assigned from medical and nursing assessments on admission. Intubated patients were assumed to have a verbal score of 1 (nil response). Three other measures were also collected which on univariate analysis are all proven predictors of fatal outcome: patients' age; significant extracranial injury (an injury requiring admission in its own right); and hypotension on admission (systolic blood pressure less than 90 mm Hg). These factors along with the measures of injury type and severity were analyzed using logistic regression to produce a multivariate predictive model of fatal outcome.

Duration of coma could be calculated from neurological flow charts, which had been completed by the nursing staff for 90% of cases. For the remaining 10%, the best estimate was made from progress notes following set criteria. Study eligibility was assessed by two observers, and discrepancies were reviewed by the medical assessor. During 1984, at least 2 years following injury, survivors were interviewed and rated on the Glasgow Outcome Scale. In the minority of patients who were not interviewed, outcome was assessed at discharge from the hospital or rehabilitation unit.

Analysis was performed using the statistical packages SPPS and GLIM for multivariate logistic regression to predict binary outcome — dead or alive.

Results

Patient Population

A total of 159 severely head-injured patients were identified as being treated at the two study hospitals in 1981 (83 at the Royal North Shore Hospital and 76 at the Westmead Centre). Eleven potential cases were excluded because of incomplete documentation, and three other cases were excluded because of transfer to other hospitals.

The patients were predominantly young and male; 74% were under 40 years of age (mean age 30 years), and the male:female ratio was 2.7:1. Seventy-seven percent of cases were transferred from other hospitals. Motor-vehicle-related incidents were responsible for many of the injuries, with car occupants (31% of all cases), motorcycle riders (17%), and pedestrians (17%) most commonly represented.

Clinical Course

Review of clinical records (Table 1) revealed that 37% of cases had surgically treated lesions (extradural, subdural, and intracerebral hematomas), 46% had non-reactive pupils on admission, and 48% displayed no better than an abnormal extensor response to pain in the first 24 hours. Change in clinical condition over time was assessed in terms of death, comatose (GCS score of 7 or less), or not comatose (GCS score > 7). The patients' course during the first 2 weeks after injury is graphically presented in Fig. 1. The greatest change was observed from the time of injury to Day 3, during which period the number of patients in coma decreased by half, with deaths being the major cause of change. This occurred in 27% of the original 159 cases and, overall, accounted for three-fifths of all the deaths. After a further 4 days (to Day 7) the number of patients in coma was again halved to 24%, and the death toll rose to 42%. The 2nd postinjury week was characterized by a reduction in the death rate and a further 50% cut in the number of patients in coma. By the end of that week the rate of clinical change had almost levelled out.
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Thus, 2 weeks after injury only 55% of the 159 patients were still alive, 12% of whom were still in coma.

Fatal Outcome

A total of 47% of this population had died before hospital discharge; this figure increased to 51% at 2 years after injury (Table 1). Patients’ age and sex, time delay to admission, clinical assessment on admission (including GCS score), pupillary response and systolic blood pressure, type of intracranial injury, and other injury characteristics such as the presence of skull fracture and extracranial injury (injury serious enough to warrant admission in its own right) were included in a logistic equation as possible predictors of fatal outcome.

Univariate analysis of these data, assessing each factor in turn without reference to its association with any of the other potential predictors, had already identified increasing age (peaking in the over 50-year-old age group), low GCS score, bilaterally nonreactive pupils, and systolic blood pressure less than 90 mm Hg as being significantly associated with a fatal outcome. In the clinical setting, however, such variables do not occur independently and may even be highly correlated. For example, this correlation occurred in the present study between arterial hypotension and a low GCS score, indicating that one factor could be used as a proxy variable for the other. As it is necessary to take such correlations into account in developing the most relevant clinical model to predict fatal outcome, all nine variables along with the treatment hospital were entered into the logistic equation. This multivariate analysis identified only two variables, the GCS score and pupillary response, as significantly associated (p < 0.05) with fatal outcome.

The fatality rates for these two variables are presented in Fig. 2. The rates range from a high level of 93% in patients with the lowest GCS score (of 3) and bilaterally nonreactive pupils to a low rate of 20% in patients with the highest initial GCS score (of 6 or 7) and reactive pupils. Note the additive effect of pupillary response above that of the GCS score in probability of fatal outcome. For example, at a GCS score of 3 the fatality rate in patients with reactive pupils (45%) is much less than that in cases with nonreactive pupils (93%).

Long-Term Survivors

The outcome of patients surviving the acute postinjury phase, excluding those who died in the first 2 weeks without regaining consciousness, is presented in Table 2. Of the 78 survivors at 2 years, 65 were interviewed in their homes at a mean of 35 months postinjury. Of the 13 not interviewed, 10 could not be reached but were known to be alive, one refused an interview, and two had subsequently died of other causes. The best estimate of Glasgow Outcome Score was made from hospital separation and rehabilitation reports for these cases.

Of the 78 long-term survivors, 38% had a good outcome with minimal disruption of preinjury occupational or recreational pursuits. Forty-eight percent of people were classified as having made a moderate recovery, regaining personal independence but being unable to pursue full occupational and recreational activities. A further 14% of cases were severely disabled and required daily care and supervision.

The association of length of coma with the quality of survival seen in Table 2 proved to be statistically significant (p < 0.05). Of patients emerging from coma within the initial 14-day period, 89% made a good to moderate recovery, while only 31% in coma beyond this point had a similar outcome; the remainder were severely disabled (38%) or died (31%).

International Comparisons

The Sydney data on 143 IDB-compatible cases (excluding 16 deaths within 6 hours of injury) were compared to five other published series.7,9 Cases were similar to the other studies with respect to mean age, frequency of surgically treated lesions, abnormal motor response, and absent pupillary reaction. A fatality rate of 45% and a recovery rate in the good and moderate categories of 46% in the present study is within the range of 40% to 50% fatality rates and 31% to 46% good to moderate recovery rates in the other studies.

<table>
<thead>
<tr>
<th>Recovery Status*</th>
<th>Days in Coma</th>
<th>Total Cases</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>&lt;7</td>
<td>7-14</td>
</tr>
<tr>
<td>good/moderate recovery</td>
<td>51</td>
<td>10</td>
</tr>
<tr>
<td>severe disability</td>
<td>0</td>
<td>1</td>
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<tr>
<td>vegetative</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>death</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>54</td>
<td>14</td>
</tr>
</tbody>
</table>

* Status evaluated according to the Glasgow Outcome Scale.7
† Early postinjury deaths excluded.
Discussion

Although the clinical data in this study were recorded in a prospective manner, they were obtained from the assessment of medical records and, consequently, bias could occur because of missing or incomplete data, or through variation in assessment despite the use of two independent observers. Nonetheless, comparison with the data of other studies suggests that the outcome from severe head injury at our two centers is similar to that experienced overseas.

Most fatalities occurred early within a 2-week period directly following the injury, nearly two-thirds of these in the first 3 days. Fatal outcome was shown to be a function of the severity of the initial injury assessed by the GCS score and pupillary reactivity. At one extreme, the combination of a low GCS score (of 3) and bilaterally nonreactive pupils carried with it a death rate of 93%, while at the other extreme, GCS scores of 6 or 7 indicated a much better prognosis with the death rate falling to 20%. However, some patients died after more than 2 weeks posttrauma.

Another significant finding in the present study was the importance of duration of coma as a predictor of quality of survival. A good to moderate recovery rate of 89% in cases emerging from coma up to the end of the 2nd week was in direct contrast to the much-reduced rate of 31% for those comatose beyond the 2 weeks. Reports in the literature confirm this association. Bricolo, et al., in a 10-year review of hospitalized head-injured patients likewise found that only one-third of patients who were unconscious for prolonged periods (longer than 2 weeks) achieved a good to moderate outcome 1 year after injury. There was, however, a discrepancy in the relative rate of prolonged unconsciousness between the studies; the rate in this study was three times that observed in the Bricolo study. This difference can be only partially explained by variation in definitions used for case selection.

Nearly two-thirds of the severely disabled patients were in coma for a prolonged period. It could be that prolonged coma simply reflects the severity and type of the initial injury. However, the suggestion that duration of coma and initial severity may be independent predictors of outcome casts some doubt on this hypothesis. Given the high percentage of poor outcomes (severe disability) associated with prolonged coma, benefits that may be derived from more appropriate interventions should be explored (such as a restructuring and intensification of early rehabilitation).

The study of prolonged coma has been hampered by imprecise terminology and the lack of generally accepted assessment schedules. The widespread use of the GCS has led to greater reliability and uniformity in the early assessment of head-injured patients. The capability of this scale to accurately reflect clinical improvement diminishes as the observation period extends from days to weeks. In most cases of prolonged coma, spontaneous eye opening occurs after 2 to 4 weeks irrespective of ultimate recovery. This can lead to improvement of up to 25% in the GCS (eye opening alone increasing its score from 1 to 4) without a concomitant change in general responsiveness. Therefore, the GCS is not sufficiently precise to be used as a good indicator of the recovery process. The need to develop more comprehensive methods of assessment of chronically head-injured patients is fundamental to the study of prolonged coma. A more detailed description of the recovery process is currently being undertaken.

The findings of the present study stress the possible importance of prolonged coma as a predictor of poor outcome. In addition, they emphasize the need for further study in this area to unravel some of the uncertainty presently associated with the prediction of outcome in individual cases. These findings also suggest the need for further research to identify the role of more intensive early interventions in the groups with poor prognosis.

References


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