Factors Affecting the Clinical Course of Patients with Severe Head Injuries

Part 1: Influence of Biological Factors

Part 2: Significance of Posttraumatic Coma

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The clinical developments that follow closed head injuries can be described in accordance with the flow chart in Fig. 1, which focuses on loss of consciousness. The inconstant "epiphenomena" related to brain concussion, such as focal lesions and hematomas, have not been considered in this approach to the problem.

Some of the injured will die from the immediate or delayed effects of the cerebral damage, usually without regaining consciousness. Those who survive can remain in coma or eventually regain consciousness after some time. Psychic functions are presumably always disturbed to a variable degree during the initial phase after awakening from coma, but mental restitution is possible in time. In some cases, however, persistent dementia may be the final outcome. Thus it is possible to delimit three alternative clinical courses in the evolution of events, namely, the lethal course, the coma course, and the course that leads to a mental recovery. The physiological mechanisms that determine these developments are essentially unknown, even though it may be possible to identify some probable components. This paper reports an analysis of a series of severe brain injuries resulting from blunt head trauma according to the three categories above. Its purpose is to define some of the characteristics of the underlying biological factors and pathophysiological processes.

Material and Method

The material consists of data from a series of 496 patients with closed head injuries treated at the neurosurgical clinic in Göteborg during the period 1953–63. Only those patients who died from injuries without having regained consciousness or who survived after a posttraumatic coma of more than 12 hours duration have been included. This limits the group under study to those who received a brain concussion of critical magnitude. The patient has been classified unconscious until he responded verbally, however inadequately, to the spoken word. Cases with surgically oriented complications such as intracranial hematoma, depressed fracture, lacerations of the brain, and localized space-occupying cerebral contusion have been discarded.

The patients have received fairly uniform treatment regarding airways, fluid balance, and general care. More specialized techniques involving the use of moderate hypothermia, dehydrating agents, or corticosteroids have been used to a limited extent. Distribution of the cases by age and sex is summarized in Table 1. The trauma was caused by traffic accidents in 73.2%, fall from a height in 21.2%, and miscellaneous accidents in 5.6%. The classification of the material in accordance with the scheme outlined in the introduction appears in Fig. 2. Each of the clinical groups is then analyzed individually. The data in this study have been obtained from clinical case records and autopsy reports. The follow-up of the survivors varies from 1 to 10 years.

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Clinical Factors in Severe Head Injuries

TABLE 1
Age and sex of patients

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>0–10</th>
<th>11–20</th>
<th>21–30</th>
<th>31–40</th>
<th>41–50</th>
<th>51–60</th>
<th>61–70</th>
<th>71–</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>46</td>
<td>50</td>
<td>59</td>
<td>63</td>
<td>70</td>
<td>63</td>
<td>35</td>
<td>24</td>
<td>410</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>11</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>7</td>
<td>6</td>
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<tr>
<td>Total</td>
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<td>61</td>
<td>65</td>
<td>71</td>
<td>80</td>
<td>75</td>
<td>42</td>
<td>30</td>
<td>496</td>
</tr>
</tbody>
</table>

The statistical analysis of lethal, coma, and restitution courses has been carried out on the total series as well as the subgroups according to the method for estimation of survival rates. Comparisons between groups have been carried out by covariance analysis utilizing exponential functions. In those instances where the number of cases has been too small for the methods above to be applicable, as in analysis of the sex factor, the median time of the various courses has been calculated. By median time is meant that time after which 50% of the cases have either died, regained consciousness, or recovered mentally. All tests have been carried out with 5% level of significance.

Lethal Course

The mortality in this series was 34.5% (171 cases), with no significant difference between women and men. Not unexpectedly, age was found to be of great importance. In Fig. 3 the dotted line gives mortality as a function of age; a marked increase of mortality is observed among those over 40 years old.

The probable cause of death was the primary cerebral injury in 28.5% of the total cases. Various types of usually extracranial complications accounted for 6%; these secondary deaths were attributed to pneumonia (15 cases), thromboembolism (4 cases), myocardial infarction (4 cases), gastrointestinal hemorrhage (3 cases), uremia (2 cases), and purulent meningitis (2 cases). These complications occurred almost exclusively and increasingly in the higher age groups. The solid line in Fig. 3 shows the mortality due to primary cerebral injury in age groups over 10 years; it was obtained by subtraction of the secondary deaths. This primary mortality actually was constant, and independent of the age of the individual. In the youngest age group (0–10 years) the mortality was only 50% of that in older age groups.

![Fig. 2. Ultimate fate of 496 patients with severe brain concussion. The restitution figures apply only to mental functions.](image)

![Fig. 3. Relationship between mortality and age. Open circles signify total mortality in respective age groups. Filled circles indicate the mortality caused by the primary cerebral damage (deaths due to extracerebral complications have been subtracted).](image)