Early seizures after mild closed head injury

SHIH-TSENG LEE, M.D., AND TAI-NGAR LUI, M.D.

Department of Neurosurgery, Taipei Municipal Chung Hsiao Hospital, and Division of Neurosurgery, Department of Surgery, Chang Gung Memorial Hospital, Taipei, Taiwan, Republic of China

The occurrence of seizure immediately (within 24 hours) or during the 1st week after head injury has been well recognized both in the literature and in daily neurosurgical practice. Most of the previous studies of posttraumatic seizures have included head injuries of varying severity, with computerized tomography (CT) usually performed before the occurrence of the seizure.1,11,24 For patients with mild closed head injury displaying no neurological deficit, CT has seldom been considered as part of the initial management. Close observation is usually recommended for these patients.

Computerized tomography was not performed routinely for patients with mild closed head injury in our departments and no prophylactic anticonvulsant agents were given to these patients unless there was evidence of posttraumatic seizure. These protocols have offered us a unique opportunity to identify the incidence and several other important features of seizures developing within 24 hours or up to 1 week after mild closed head injury.

KEY WORDS • posttraumatic seizure • early seizure • closed head injury

Clinical Material and Methods

This study is based on adult patients with mild closed head injuries managed by the authors between July, 1984, and August, 1990. The patients were treated at either Taipei Municipal Chung Hsiao Hospital or Chang Gung Memorial Hospital. The Glasgow Coma Scale35 (GCS) score, determined when the patient arrived at the emergency room, was used to assess the level of consciousness and the severity of head injury. Patients with documented mild closed head injury (GCS scores 13 to 15) were included in this study if they had one or more of the following: a blow to the head, loss of consciousness, or posttraumatic amnesia less than 30 minutes in duration. Patients with injuries involving only the scalp and soft tissue of the face with none of the above were excluded, as were patients with compound depressed skull fractures (308 cases), penetrating injuries (five), or a history of seizure before injury (23). No prophylactic anticonvulsant agents were given to these patients unless there was evidence of seizure.
A CT scan was not obtained unless the patient developed focal neurological deficits, exhibited signs of increased intracranial pressure, or displayed further deterioration in neurological condition. Blood gas levels, blood sugar content, and serum electrolytes were measured in patients who developed early posttraumatic seizures; CT was performed immediately after the seizures were controlled in order to exclude the possibility of a surgically correctable etiology. Intravenous phenytoin was administered to control the seizures.

Outcome was measured at 6 months after injury and classified using the Glasgow Outcome Scale.17 Outcomes are classified as: good recovery; moderate disability; severe disability; vegetative state; and death.

Results

Patient Population

This study included 4232 consecutively treated adult patients who had apparently sustained mild closed head injury. They ranged in age from 16 to 88 years (mean 32.82 years); the male:female ratio was 3.8:1. The most common causes of injury were motorcycle accidents (53.78%) and pedestrian injury (28.89%). Motor-vehicle accidents accounted for 3705 injuries (87.54%) in this series. Table 1 summarizes the presentation of 100 patients with mild closed head injury who developed early posttraumatic seizures.

Seizure Incidence

In 100 patients (2.36%) who developed seizures within the 1st week after head injury, the male:female ratio was 2.7:1 and the mean age was 29.74 years. Forty-three (43%) of these developed seizures within 24 hours after head injury, accounting for 1.02% of the total study population. Most of the seizures (84%) that occurred during the 1st week after injury were of the generalized tonic-clonic type. The incidence of generalized tonic-clonic seizures was higher than that of partial seizures with motor symptoms, both within the 1st 24 hours (59.91%) of 43 cases vs. four (9%) of 43 cases) and during the Day 2 to 7 period (45.79%) of 57 cases vs. 12 (21%) of 57 cases).

Computerized Tomography Findings

Computerized tomography findings are summarized in Table 2. No definite intracranial pathological findings could be detected on the CT scan in 53% of patients with early posttraumatic seizures. Six patients had intracranial hemorrhage (three with epidural hematoma and three with subarachnoid hemorrhage) without intracranial parenchymal damage. The most common positive findings on the CT scans among patients with early posttraumatic seizures were intracerebral hemorrhage (24%), followed by acute subdural hematoma with intracerebral hemorrhage (17%). Intracerebral parenchymal damage was detected on CT scans in 41 (48.8%) of 84 patients with generalized tonic-clonic seizures and five (31%) of 16 patients with partial seizures with motor symptoms. The incidence of intracerebral parenchymal damage was found to be higher in patients with seizures developing between Day 2 and Day 7 (47.4%) than in those with seizures developing within 24 hours (32.6%). During the seizures, blood chemistry and electrolyte balances showed no definite abnormalities.

Table 3 summarizes the location of intracranial parenchymal damage in this series. This was most commonly detected in the frontal lobe (21%) and the temporal lobe (19%). Seven patients with early posttraumatic seizures were found to have multiple intracerebral hemorrhage.

Treatment and Outcome

Seven patients with early posttraumatic seizures underwent craniotomy to remove an intracranial hematoma (three epidural and four subdural and intracerebral) because of mass effect which caused a significant midline shift on the CT scan. Thirty-two patients with small intracranial hematomas and 61 patients without intracranial hematoma were observed at the hospital for 1 week and received medical treatment only.

There were no surgically related deaths and the mortality rate during hospitalization was 3%. Two patients died due to massive upper gastrointestinal tract bleeding and one died due to sepsis from severe pulmonary infections.

At 6 months postinjury, follow-up examination of the surviving 97 patients showed that 8.25% of them had mild neurological deficits but could perform daily activity without assistance and 91.75% had no neurological deficit. Ninety-two patients were seizure-free and five patients had experienced one seizure (four generalized and one partial) while receiving oral anticonvulsant agents during the 6-month period. One patient

---

TABLE 1
Incidence of early seizures in patients with mild closed head injury

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total Series</th>
<th>Early Seizure No.</th>
<th>% of Total</th>
<th>Statistical Significance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of cases</td>
<td>4232</td>
<td>100</td>
<td>2.36%</td>
<td>NS</td>
</tr>
<tr>
<td>sex (M:F)</td>
<td>3.8:1</td>
<td>2.7:1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean age (yrs)</td>
<td>32.82</td>
<td>29.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cause of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>motorcycle†</td>
<td>2276</td>
<td>47</td>
<td>2.06%</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>automobile†</td>
<td>206</td>
<td>2</td>
<td>0.98%</td>
<td></td>
</tr>
<tr>
<td>pedestrian</td>
<td>1223</td>
<td>47</td>
<td>3.36%</td>
<td></td>
</tr>
<tr>
<td>fall</td>
<td>162</td>
<td>3</td>
<td>1.85%</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>365</td>
<td>1</td>
<td>0.27%</td>
<td></td>
</tr>
<tr>
<td>Glasgow Coma Scale score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>2992</td>
<td>69</td>
<td>2.3%</td>
<td>NS</td>
</tr>
<tr>
<td>14</td>
<td>699</td>
<td>12</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>541</td>
<td>19</td>
<td>3.5%</td>
<td></td>
</tr>
</tbody>
</table>

* Calculated by chi-squared test and Fisher's exact test; NS = not significant.
† Includes both drivers and passengers.
Early seizures after mild closed head injury

**TABLE 2**

*Computerized tomography (CT) findings in patients with early posttraumatic seizures after mild closed head injury.*

<table>
<thead>
<tr>
<th>CT Findings</th>
<th>Day 1 Group§</th>
<th>Day 2–7 Group§</th>
<th>Both Groups</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generalized</td>
<td>Partial</td>
<td>Generalized</td>
<td>Partial</td>
</tr>
<tr>
<td>without intracerebral parenchymal damage</td>
<td>26</td>
<td>3</td>
<td>22</td>
<td>8</td>
</tr>
<tr>
<td>normal</td>
<td>23</td>
<td>2</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>epidural hematoma</td>
<td>2 (2)</td>
<td>0</td>
<td>1 (1)</td>
<td>0</td>
</tr>
<tr>
<td>subarachnoid hemorrhage</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>with intracerebral parenchymal damage</td>
<td>13</td>
<td>1</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>intracerebral hemorrhage</td>
<td>7</td>
<td>1</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>subdural with intracerebral hemorrhoma</td>
<td>6 (1)</td>
<td>0</td>
<td>11 (3)</td>
<td>0</td>
</tr>
<tr>
<td>total cases</td>
<td>39 (3)</td>
<td>4</td>
<td>45 (4)</td>
<td>12</td>
</tr>
</tbody>
</table>

* Figures represent numbers of patients. Numbers in parentheses represent patients who underwent craniotomy.

§ Day 1 denotes patients experiencing seizures within 24 hours of injury; Day 2–7 denotes patients experiencing seizures after 24 hours up to 7 days postinjury. Groups are further subdivided into those with generalized tonic-clonic seizures and those with partial seizures with motor symptoms.

with an initially normal CT scan developed a chronic subdural hematoma 3 months postinjury; subsequent burr-hole drainage cured the patient.

**Discussion**

Most patients who sustain a mild head injury eventually achieve a good recovery and need little or no medical attention. However, a small percentage of patients with apparently mild head injury subsequently deteriorate due to various causes. During the immediate postinjury period (< 24 hours) or 2 to 7 days posttrauma, seizures may cause impairment of consciousness or postictal paresis that mimics neurological deterioration from other causes. This complication may make evaluation of the level of consciousness in patients with mild head injury more difficult.

**Incidence of Early Posttraumatic Seizure**

The reported incidence of early posttraumatic seizure is highly variable and depends on the patient's age and the overall severity and type of injury studied. In previous reports, a higher incidence of posttraumatic seizure was found among pediatric patients and those with other features such as intracerebral hemorrhage or penetrating injury. Jennett indicated that fewer than 2% of patients with mild head injury but no other neurological signs have seizures within the 1st week after injury. Dacey, et al., and Feuerman, et al., reported no immediate or early posttraumatic seizure after mild head injury in their series. Annegers, et al., found that 0.4% of mildly head-injured adult patients in their series had early posttraumatic seizure. Of the adult patients with mild closed head injury reported by Desai, et al., 0.7% had seizures during the 1st week after trauma.

None of the previous reports have indicated the incidence and significance of immediate posttraumatic seizure in adult patients with mild closed head injury, and most did not relate the incidence to different causes of mild head injury. A review of the literature shows that 35% to 60% of the head injuries reported are caused by motor-vehicle accidents, while injury to motorcyclists or pedestrians account for only 5% to 10% of reported head injuries. However,

**TABLE 3**

*Location of intracranial parenchymal damage in 100 patients with early posttraumatic seizures following mild closed head injury.*

<table>
<thead>
<tr>
<th>Location of Damage</th>
<th>Day 1 Group§</th>
<th>Day 2–7 Group§</th>
<th>Both Groups</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Generalized</td>
<td>Partial</td>
<td>Generalized</td>
<td>Partial</td>
</tr>
<tr>
<td>frontal lobe</td>
<td>8</td>
<td>1</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>temporal lobe</td>
<td>4</td>
<td>1</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>parietal lobe</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>occipital lobe</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>multiple</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>none</td>
<td>26</td>
<td>3</td>
<td>22</td>
<td>8</td>
</tr>
</tbody>
</table>

* Data are expressed as percentages. Day 1 denotes patients experiencing seizures within 24 hours of injury; Day 2–7 denotes patients experiencing seizures after 24 hours up to 7 days postinjury. Groups are further subdivided into those with generalized tonic-clonic seizures and those with partial seizures with motor symptoms.

J. Neurosurg. / Volume 76 / March, 1992
both in our previous report and in this series, motorcycle accidents and pedestrian injury were the most common causes of head injury. The results of our series indicate a higher incidence of early posttraumatic seizure among patients with injuries from these two causes. The overall incidence of early posttraumatic seizure in our report is also higher than in other studies; this might be due to the different demographic features studied, as indicated by Desai, et al. 

Onset and Type of Early Posttraumatic Seizure

The definition of early posttraumatic seizure is not clear in some studies, as the interval between the injury and the occurrence of seizure is either not stated or ranges between 1 and 28 days. In recent studies, an early posttraumatic seizure occurs within the first 24 hours and one-third occur within 2 to 7 days of injury. Rish and Caveness reported that early posttraumatic seizure is recorded most frequently on the first postinjury day. In our patients with mild head injury, early posttraumatic seizure occurred within 24 hours postinjury in 43%, with 84% of seizures being the generalized tonic-clonic type. As in other series, none of our patients with early posttraumatic seizure after mild head injury were in status epilepticus.

Computerized Tomography Findings

That the presence of intracranial hemorrhage significantly increases the possibility of early posttraumatic seizure is a well-known phenomenon. However, whether CT should be performed on all patients with mild head injury but without abnormal mental status or hemispheric neurological deficit is still controversial. None of the previous reports has indicated that early posttraumatic seizure presents as the initial symptom of intracranial hemorrhage. However, some of the studies did not include CT in the management of patients with mild head injury and early posttraumatic seizures. In our series, 53% of such patients had a normal CT scan and 7% of patients had life-threatening intracranial hematomas requiring surgical intervention. The most common abnormal findings on the CT scans of our early posttraumatic seizure patients were intracerebral hemorrhage and acute subdural hematomas with an intracerebral component, mainly in the frontal and temporal lobe areas. None of the intracerebral hematomas occurred in the deep basal ganglion or brain stem in our cases. We found no statistical difference between patients with generalized versus partial seizures in terms of the presence of an intracerebral parenchymal hemorrhage on CT scans; however, CT might not be sensitive enough to detect small cortical lesions. Jenkins, et al. compared CT and magnetic resonance (MR) imaging in mildly head-injured patients and found that cortical and subcortical contusions were more common on MR images than on CT scans.

References

Early seizures after mild closed head injury


Manuscript received March 25, 1991.
Accepted in final form August 6, 1991.
Address reprint requests to: Shih-Tsing Lee, M.D., Department of Neurosurgery, Taipei Municipal Chang Hsiao Hospital, 87 Tung-Teh Road, Nonkang, Taipei, Taiwan, Republic of China.