Head injuries due to falls caused by seizures: a group at high risk for traumatic intracranial hematomas


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This prospective review of adult patients with head injuries examines the incidence of head injuries due to falls caused by seizures, the incidence and severity of intracranial hematomas, and the morbidity and mortality rates in this patient population. A head injury was attributed to a fall caused by a seizure if the seizure was witnessed to have caused the fall, or the patient had a known seizure history, appeared postictal or was found convulsing after the fall, and no other cause for the fall was evident.

A total of 1760 adult head-injured patients were consecutively admitted to the authors’ service between 1986 and 1993. Five hundred eighty-two head injuries (33.1%) were due to falls and 22 (3.8%) of these were caused by seizures. Based on the prevalence rates for epilepsy in the general population of 0.5 to 2%, these results indicate that epileptics are several times more likely to suffer a head injury due to a fall. Mass lesions were found in 20 (90.9%) of these 22 patients and the remaining two patients suffered mild diffuse head injuries. There was a high incidence of extraaxial mass lesions: 17 (85%) of the 20 intracranial hematomas were either epidural (five cases) or acute subdural (12 cases) hematomas. Eighteen (81.8%) of the 22 patients required evacuation of a hematoma. Both the incidence of intracranial hematomas (90.9% vs. 39.8%; $p < 0.001$, chi-square analysis) and the rate of hematoma evacuation (81.8% vs. 32.3%; $p < 0.001$) was significantly greater in patients injured in falls due to seizures (22 cases) than in the group injured in falls from all other causes (560 cases). The higher incidence of hematomas and the need for evacuation were not explained by differences in age, severity of head injury, or incidence of alcohol intoxication. Despite the greater incidence of mass lesions and the need for operative treatment in patients injured because of seizures, their mortality rate was similar to that of patients injured in falls from other causes.

On the basis of their review of patients admitted to a neurosurgical center with complaints of head injury, the authors conclude that patients with head injuries due to a fall caused by a seizure should undergo computerized tomography scanning early in their management. Until a mass lesion has been excluded, any decrease in level of consciousness or focal neurological deficit should not be attributed to the seizure itself.

Key Words • head injury • seizure • fall • intracranial hematoma • epilepsy

It is estimated that 0.5 to 2% of the population have seizure disorders. Epileptics have a two to three times increased mortality rate compared to age-matched controls in the general population, which is not due to an increase in neoplasia or cardiovascular diseases. The major causes of death in epileptics are status epilepticus, suicide, accidents, and an entity known as sudden unexpected death in epilepsy. Accidental death is usually caused by falls, drownings, and motor vehicle accidents.

In a review of 298 epilepsy patients, 28,000 seizures were documented in a 1-year period and 45% of these seizures resulted in falls causing 766 head injuries. In this population of patients with severe epilepsy, 2.7% of all seizures (6.1% of seizures that caused a fall) resulted in a head injury that required medical attention. In another study, 11% of documented seizures resulted in an injury involving the head or scalp.

It would be natural to assume that individuals with generalized seizures, who are prone to repeated falls, would have a greater risk of head injury. This can be difficult to prove because of the uncertainty in some cases as to whether the seizure was the primary event or secondary to a head injury from another cause. In addition, there is substantial variability in reported prevalence rates for seizures in the general population. In a previous report, the incidence of head injuries due to seizures was reported to be three times greater than expected; however, this may have been inaccurate because of an underestimate of the prevalence of epilepsy in the study population. Another study found that the number of epileptics admitted with head injuries was not greater than would be expected, whereas a third reported a slightly increased risk, with 3.6% of patients admitted with a head trauma due to a seizure.

Most head injuries due to seizures are mild; however, more serious injuries, such as skull fractures, intracranial hematomas, and diffuse shear injuries have been reported. Due to the rapid loss or alteration in consciousness,
generalized tonic–clonic seizures, atomic drop attacks, and complex partial seizures are associated with the highest risk of injury. In addition, head injuries due to falls (from all causes) have a higher incidence of intracranial hematomas and greater rates of morbidity and mortality. This, together with the very rapid loss of consciousness in patients with seizures that cause falls, would suggest that head injuries due to seizures might have a higher risk of intracranial hematomas and greater rates of morbidity and mortality.

As part of a prospective review of 1760 adult head-injured patients consecutively admitted to the hospital, we examined the incidence of head injuries due to falls caused by seizures as well as the incidence and severity of intracranial hematomas and the morbidity and mortality rates in this patient population.

Clinical Material and Methods

Patient Population

The study population was obtained from a pool of adult head-injured patients consecutively admitted to a neurosurgical teaching hospital between January 1, 1986 and December 31, 1993. Head injuries of all degrees of severity (Glasgow Coma Scale scores of 3–15) were included. Admission of these 1760 patients was based on the presence of one or more features that are known to correlate with the presence of a more serious underlying brain injury. These included: persistent decrease in GCS score; focal neurological deficits; skull fracture (especially if depressed or compound); cerebrospinal fluid rhinorrhea or otorrhrea; posttraumatic seizures; or an abnormal computerized tomography (CT) scan. On admission, the presence or absence of any witnessed or suspected seizure before, during, or immediately after the head injury was entered into the database for each patient. The charts of all patients who had evidence of a seizure around the time of the head injury were retrospectively reviewed. A head injury was attributed to a fall caused by a seizure if the seizure was witnessed to have caused the fall, or the patient had a known seizure history, appeared postictal or was found convulsing after the fall, and no other apparent cause for the fall was evident.

Patients with other causes of injury were excluded even if there was evidence that a seizure may have caused the accident.

Statistical Analysis

Statistical comparisons of groups were performed using chi-square analysis. Differences in age were compared with Student’s t-test for groups with different variances.

Results

A total of 1760 adult head-injured patients were admitted over an 8-year period. There were 582 head injuries (33.1%) from falls and 22 (3.8%) of these were caused by seizures (Table 1). Patients injured as a result of seizures were between the ages of 22 and 74 years (mean 44.8 years); there were 16 men and six women (Table 2). A seizure was witnessed to have caused the fall in 12 cases (55%) and strongly suspected to have preceded the fall in 10 (45%).

Intracranial Mass Lesions

Mass lesions were found in 20 (90.9%) of the 22 patients injured during a seizure, and the remaining two patients suffered mild diffuse head injuries (Table 2). Acute subdural hematomas (12 patients) were the single most common type of hematoma. Eighteen (81.8%) of the 22 patients required evacuation of a hematoma. Both the incidence of intracranial hematomas (90.9% vs. 39.8%; p < 0.001) and the rate of hematoma evacuation (81.8% vs. 32.3%; p < 0.001) were significantly greater in patients injured during a seizure than in the non-seizure group (Table 1). The differences in the incidence of hematomas and the need for evacuation were not explained by differences in GCS (GCS scores of 9.7 vs. 10.6) or injury severity scores (ISSs of 21.8 vs. 23) between the seizure and nonseizure groups (Table 1). The discrepancy in ages between the two groups does not account for these differences: patients who fell because of a seizure were significantly younger than those who fell because of all other causes (44.8 years vs. 52.6 years, Student’s t-test, p < 0.01; Table 1). Patients over the age of 60 years who suffered a head injury caused by a fall from any reason had a significantly increased incidence of intracranial hematoma (56.6% vs. 32.8%; p < 0.001) and hematoma evacuation (41.6% vs. 29.8%; p < 0.005),
Head injuries due to falls caused by seizures

## TABLE 2

### Clinical characteristics of 22 adult patients with head injuries due to falls caused by seizures*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Seizure</th>
<th>Presence of Alcohol†</th>
<th>GCS Score</th>
<th>Type of Injury</th>
<th>Management</th>
<th>Discharge</th>
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</thead>
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<tr>
<td>1</td>
<td>30, M witnessed</td>
<td>positive</td>
<td>12 ASDH OR</td>
<td></td>
<td></td>
<td></td>
<td>home</td>
</tr>
<tr>
<td>2</td>
<td>39, M unwitnessed</td>
<td>negative</td>
<td>14 EDH OR home</td>
<td></td>
<td></td>
<td></td>
<td>home</td>
</tr>
<tr>
<td>3</td>
<td>39, F witnessed</td>
<td>negative</td>
<td>11 ASDH OR home</td>
<td></td>
<td></td>
<td></td>
<td>home</td>
</tr>
<tr>
<td>4</td>
<td>50, M unwitnessed</td>
<td>negative</td>
<td>9 ASDH OR home</td>
<td></td>
<td></td>
<td></td>
<td>home</td>
</tr>
<tr>
<td>5</td>
<td>52, M witnessed</td>
<td>negative</td>
<td>12 ICH OR alive</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>54, M witnessed</td>
<td>negative</td>
<td>10 ASDH OR home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>60, F unwitnessed</td>
<td>negative</td>
<td>9 ASDH OR home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>52, M witnessed</td>
<td>positive</td>
<td>14 EDH OR home</td>
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<td></td>
</tr>
<tr>
<td>9</td>
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<td></td>
<td>11 EDH OR home</td>
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<td></td>
</tr>
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<td></td>
<td>15 ASDH obs home</td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td>22, M unwitnessed</td>
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<td>5 ASDH OR home</td>
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<td></td>
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<tr>
<td>12</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>13</td>
<td>37, F unwitnessed</td>
<td></td>
<td>4 ASDH OR dead</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>14</td>
<td>46, M witnessed</td>
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<td>7 ICH OR dead</td>
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<td>16</td>
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<td></td>
</tr>
<tr>
<td>17</td>
<td>58, M witnessed</td>
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<td>3 ASDH OR home</td>
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</tr>
<tr>
<td>18</td>
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</tr>
<tr>
<td>19</td>
<td>33, M witnessed</td>
<td></td>
<td>15 EDH OR home</td>
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</tr>
<tr>
<td>20</td>
<td>34, M witnessed</td>
<td></td>
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</tr>
<tr>
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<td></td>
<td>13 ASDH obs home</td>
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</tr>
<tr>
<td>22</td>
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<td></td>
<td>14 DHI obs home</td>
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</tr>
</tbody>
</table>

* ASDH = acute subdural hematoma; DHI = diffuse head injury; EDH = extradural hematoma; ICH = intracerebral hematoma; obs = observation; OR = craniotomy for evacuation of intracranial hematoma.
† Presence of alcohol was detected clinically and/or biochemically.

The incidence of alcohol intoxication was similar in both the seizure group (10 [45.5%] of 22; Table 2) and the patients who fell from other causes (230 [41.1%] of 560). Of the 582 patients injured due to falls, 41.2% were intoxicated; however, compared to the seizure group, these patients did not have a significantly increased incidence of intracranial hematomas (41.7% vs. 41.8%; Table 1) or operable mass lesions (37.1% vs. 32.2%). A previous study also did not find an increased incidence of intracranial hematomas in head injuries associated with alcohol.15

### Mortality and Morbidity Rates

Despite the greater incidence of both intracranial hematomas and the need for operative treatment of these hematomas, only seven (31.8%) of the 22 head-injured patients with seizures died and that group’s mortality rate was not significantly different than that of the nonseizure group (161 [28.8%] of 560; Table 1). All seven patients who died had an initial GCS score less than 8. Fourteen of the 15 survivors were discharged home (Table 2).

### Discussion

#### Incidence of Head Injuries Due to Seizures

In our study of 1760 consecutive head-injured patients, 582 were injured due to falls, and in 22 of these (3.8%) a seizure was either witnessed or strongly suspected to have caused the fall. Based on the prevalence rates of epilepsy in the general population (0.5–2%2,10,26), these results indicate that patients with epilepsy are several times more likely to suffer a head injury due to a fall. These 22 cases account for 1.3% of the 1760 head injuries from all causes. This is not the true incidence of seizure-related head injuries from all causes because seizure-related head injuries caused by something other than a fall, such as a motor vehicle accident caused by a driver having a seizure, were excluded from this review. However, these are likely to be very few in number: in a previous review, only one in every 10,000 traffic accidents was caused by seizures, and the injuries sustained in such an accident were less severe than those that occur in accidents due to other causes.19 Therefore, on the basis of a pool of patients with head injuries who required admission to the hospital, this review indicates that, although patients with epilepsy do not have a higher incidence of head injuries in general, they are at increased risk for head injuries due to falls.

It is possible that some of the 10 patients, in whom the seizure was unwitnessed, could have fallen as a result of other causes, with the seizure or a postictal appearance due to the head injury itself. However, many more charts were reviewed of patients who had falls of unknown causes and suffered immediate posttraumatic seizures. Only these 10 were included because they had a well-documented history of a seizure disorder and no other obvious cause for the fall. In addition, if only the 12 patients who were witnessed to have fallen because of a seizure are included in the statistical comparisons, the results would be the same, given that 11 of these 12 patients had intracranial hematomas and all 11 required surgery.

#### Traumatic Intracranial Hematomas

In our review, 20 (90.9%) of the 22 patients with a head injury due to a fall caused by a seizure had intracranial hematomas on a CT scan and eighteen (81.8%) required operative management. Injury due to a fall from any cause is known to increase the incidence of intracranial hematomas.1,6,9 In our patient population, falls due to seizures appeared to be especially associated with operable mass lesions: compared to patients injured in falls from other causes, patients injured in a fall during a seizure had a significantly higher incidence of intracranial hematomas that required evacuation. This was not explained by any differences in age, severity of head injury, or incidence of alcohol intoxication, but may result from the absence of protective responses caused by the loss of consciousness preceding the fall in grand mal seizures. Gennarelli and Thibault6 have shown experimentally that the propensity to develop acute subdural hematomas is related to the strain rate (rate of acceleration or deceleration) imparted by the injury. Falls are associated with a higher strain rate than vehicular injuries, possibly because of objects or protective mechanisms within a vehicle that may decrease the strain rate. Patients who fall while conscious may be able to reduce the strain rate by protecting themselves reflexively (for example, outstretched arm and/or tension of neck and torso muscles). Such responses would be absent if the person was already unconscious at the time of the head injury.
Previous studies indicate that when one considers all head injuries due to falls caused by a seizure (that is, including minor injuries that involve very transient loss of consciousness or consist mainly of scalp injuries and are not referred for neurosurgical management), there is a low incidence of operable mass lesions and low mortality. In a study by Desai et al., 25 patients suffered a head injury due to a seizure, but only two (8%) of these patients had radiological evidence of an intracranial hematoma and only one (4%) required an operation. This may be an underestimate of the frequency of mass lesions in seizure patients because only 12% of these 25 patients had a CT scan or an angiogram. In addition, the discrepancy between the study by Desai and colleagues and ours is likely because of a difference in the severity of head injuries in the overall patient population from which these cases were obtained. In their study, the population was an unselected group of patients with head injuries (702 patients) seen in the emergency department. The 1760 consecutive head injuries, from which our 22 seizure-injured patients were obtained, was a select population of more serious head injuries that were referred for neurosurgical management, either from other hospitals or from the emergency department of our hospital. This difference in severity is confirmed by the higher incidence of operable mass lesions (23.8% vs. 7.2%) and the higher mortality rate (22.7% vs. 2.3%) in the entire patient population in our study (1760 patients) compared to that in Desai and colleagues’ study (702 patients).

With the select patient population in our study, the results and conclusions of this study may not be attributable to all seizure-induced head injuries in the general population. However, for the subgroup of more significantly head-injured patients that are referred for neurosurgical management, patients with head injuries due to falls caused by seizures are at increased risk for operable intracranial hematomas compared to patients injured in falls due to all other causes.

Patient Outcome

Despite the greater incidence of intracranial hematomas and the need for operative treatment in patients injured in falls due to seizures, their mortality rate was similar to that of patients injured in falls from other causes (31.8% vs. 28.8%, respectively). This is surprising given that head injuries with an associated intracranial mass lesion are known to have a higher mortality rate than diffuse brain injuries. 4, 13, 14 Outcome in head injuries is known to be influenced by the type of intracranial hematoma. The ranking of hematoma type from the highest to lowest rates of mortality and morbidity is intracerebral, subdural, and epidural. 14, 15 There was a high proportion of extraaxial mass lesions in the 22 seizure patients in our study: 17 of the 20 intracranial hematomas were either epidural (five cases) or acute subdural (12 cases) hematomas. Indeed, of the three patients with intracerebral hematomas, two died and the lone survivor remained institutionalized (Table 2). The better-than-expected outcome for the seizure group could also be attributable to the patients’ significantly younger age (mean 44.8 years) compared to those in the nonseizure group (mean 52.6 years). Finally, despite the greater incidence of operable mass lesions, patients in the seizure group did not have a significantly different admission GCS score from those in the nonseizure group (9.7 vs. 10.6). This might be explained by the greater likelihood that patients who have had a seizure associated with a head injury both seek medical attention early and are admitted to hospital.

Conclusions

In our patient population of adult head-injured patients admitted to a tertiary trauma center, the proportion of patients injured in falls caused by seizures (3.8%) was greater than expected based on the prevalence rates of epilepsy in the general population (0.5–2%). Compared to patients with head injuries due to falls from all other causes, patients injured during a seizure had a significantly higher incidence of intracranial hematomas that required evacuation. This higher incidence of operable mass lesions was not explained by any differences in age, severity of head injury, or incidence of alcohol intoxication. Despite the greater incidence of intracranial hematomas and the need for operative treatment in patients injured due to seizures, their mortality rate was similar to that of patients injured in falls from other causes. Based on this review of head-injured patients who were admitted to a neurosurgical center, patients with a head injury due to a fall caused by a seizure should undergo CT scanning early in their management. Until a mass lesion has been excluded, any decrease in level of consciousness or focal neurological deficit should not be attributed to the seizure itself.

References

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