CLINICO-ELECTROENCEPHALOGRAPHIC
STUDY OF EPILEPSY AFTER HEAD INJURY

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INTRODUCTION

Recently the increase of head injuries, traumatic epileptic cases—as one of
the deterious complication—are also increasing and authors now have a growing
number of patients to treat in our outpatient clinic. There have been many out-
standing studies done and papers presented by the eminent authors in the past
and numerous achievements recorded on this clinical disorder. Yet, many ques-
tions still remain unanswered regarding the posttraumatic epilepsy.

In an attempt to find some ways of solution of these questions, in this paper
investigated the head injury patients visiting the outpatient clinic of Neuro-
surgery, Keio University Hospital and studied the clinical and electroencephalo-
graphical findings on those selected cases which showed symptoms of posttrauma-
tic epilepsy. In the course of this survey, also examined cases showing spikes
in the EEG as well without clinical seizure.

MATERIAL AND METHODS

The material used were selected from among the 3,465 cases of head injury
patients who visited the outpatient clinic of Neurosurgery, Keio University Hos-
pital during the period of approximately 3 years from January 1967 to March
1969. Of these, 43 cases were clinically found with epileptic seizures of varying
degress after injury to the brain and 32 cases were those which did not show

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epileptic seizures but had the appearance of epileptic discharges, such as spikes, and spikes and waves, for a long time in the EEG findings.

It is not easy to define posttraumatic epilepsy strictly, but selected for this survey those cases which meet the following criteria: 1) the cases which clinically show symptoms of epileptic seizures, 2) the cases which do not have a history of convulsions before injuries and 3) the cases in which initial seizures occurred not long after injuries. The cases of early posttraumatic epilepsy which show epileptic seizures within 10 days after injuries was excluded. The non-seizure group can hardly be called traumatic epilepsy in the strict sense of the words, but since it is considered that cases in this group can develop clinical epilepsy, treated them as the related disorders of posttraumatic epilepsy. All these cases were investigated by age, sex, the severity of injury, the period from injury to initial seizures, the type of seizure and the EEG findings. A survey tracing the prognosis was also conducted along with a survey on the effect of medicines.

RESULTS

Of the total 3,465 head injury patients surveyed, 2,109 cases were those which had not lost consciousness at the time of injury, 966 cases which had lost consciousness for a lapse of less than 24 hours and 179 cases for more than 24 hours. The remaining 211 cases were recorded as "Unknown." Of these, 43 cases (1.2%) were found clinically with epileptic seizures after injury and 32 cases (0.9%) were those which had not shown epileptic seizures but had the appearance of epileptic discharges for a long duration of time in the EEG tracings. These make the total 75 cases (2.1%).

These 75 cases can be divided into two groups; Clinical Seizure Group and Non-Seizure Group.

1. Clinical Seizure Group

With the 43 cases with epileptic seizures, the distribution of patients by age group revealed that children (1–19 years of age) and adult persons (20–49) accounted for nearly the whole and there were only 2 cases recorded for aged persons. By sex, 37 cases (86.1%) were male.

As for the level of consciousness at the time of injury, 21 cases (48.9%) or about half of the total 43 cases were found in the varying levels of unconsciousness; those with the state of unconsciousness lasting for less than 24 hours were 15 and those more than 24 hours, 6 cases.

The cases which had not lost consciousness (amnesia is not included) num-
bered 14 (32.5%). The patients who had not remembered the circumstances of their injuries well and therefore, had not known whether they had been actually unconscious or only lost memories numbered 8. These cases had to be classified as "Unknown" with regard to the level of consciousness. It was thought that they included several such cases which had lost consciousness for a long period of time.

Examining the degrees of injuries by the two types of disorder, i.e., skull fracture and intracranial hematoma, 8 cases (18.6%) were found having skull fracture, of which two had depressed fracture. Those without skull fracture were unexpectedly large in number, with 33 cases (76.8%) counted. The cases which had intracranial hematoma numbered 4 (9.2%), of which 3 were with subdural hematoma and 1 was with extradural hematoma.

With regard to the period from injury to initial seizures, 14 cases (32.7%) developed seizures in less than 3 months and 6 cases (13.8%) between 4 to 6 months after injury. Combined, 46.5% showed initial seizures within 6 months. Also, 33 cases (77.0%) showed initial seizures within one year. Those which had shown initial seizures after one year numbered 7 (16.1%), while 3 cases (6.9%) had no correct record of the date of initial seizures in their past histories (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Period from head injury to initial seizure</th>
<th>Count</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Within 3 months</td>
<td>14</td>
<td>32.7%</td>
</tr>
<tr>
<td>4-6</td>
<td>6</td>
<td>13.8%</td>
</tr>
<tr>
<td>7-12</td>
<td>13</td>
<td>30.5%</td>
</tr>
<tr>
<td>1-2 years</td>
<td>2</td>
<td>4.6%</td>
</tr>
<tr>
<td>2-3 years</td>
<td>4</td>
<td>9.2%</td>
</tr>
<tr>
<td>over 3 years</td>
<td>4</td>
<td>9.2%</td>
</tr>
<tr>
<td>unknown (no correct period was available)</td>
<td>3</td>
<td>6.9%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100%</td>
</tr>
</tbody>
</table>

Reviewing the EEG findings on these cases, this study employed the first EEG records taken after initial seizures. These records showed that 10 cases (23.4%) were normal, 2 cases (4.6%) on the borderline and 31 cases (72.0%) abnormal. Classifying them by the type of clinical seizure (See Table 2), 16 cases (37.2%) showed either tonic clonic or tonic seizures of the grand mal type and 13 cases (30.5%) Jackson's focal epilepsy. These two types of seizure combined accounted for more than two thirds of the total. In comparison, only 3 cases (6.9%) were of the type of temporal lobe epilepsy which is commonly called psychomotor seizure and 6 cases (13.8%) were of the petit mal type (minor seizure). Also 5 cases (11.6%) were of the type of unclassified seizure be-
cause, while they showed clinical seizures, they could hardly be assigned to any of the seizure types mentioned.

As for the relationships between the type of seizure and age, focal epilepsy occurred more frequently among children and adult persons than aged persons. Grand mal seizures were found mostly with adult persons and children, while petit mal seizures occurred primarily with children, with only a single adult case recorded. Cases of the unclassified seizure type were more frequent among adult persons than at any other age, with only one case recorded for an aged person and none for children. The relationships between the type of seizure and the EEG findings are shown in Table 2.

2. Non-Seizure Group

Examining the 32 cases which clinically had not shown epileptic seizures but manifested epileptic discharges, such as spikes, and spikes and waves, 29 cases (90.7%) were children, 2 cases (6.2%) adult persons and one case (3.1%) an aged person, indicating that children are predominantly large in number. By sex, 20 cases (62.5%) were male and 12 cases (37.5%) female. As for the period of impairment of consciousness at the time of injury, 11 cases were with the state of unconsciousness lasting less than 24 hours and 5 cases more than 24 hours. Combined, 16 cases (50.0%) lost consciousness. Thirteen cases (40.5%) had not lost consciousness and 3 cases (9.4%) were recorded as “Unknown.” Also, 8 cases (24.8%) were with skull fracture, of which one was with depressed fracture, while 24 cases (75.2%) were without skull fracture.

Table 2

<table>
<thead>
<tr>
<th>Relationship Type</th>
<th>Number of cases (%)</th>
<th>EEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Partial epilepsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jacksonian type</td>
<td>13 (30.5%)</td>
<td>Normal</td>
</tr>
<tr>
<td>(children 7, adults 5, aged 1)</td>
<td></td>
<td>Borderline 1</td>
</tr>
<tr>
<td>Temporal lobe type</td>
<td>3 (6.9%)</td>
<td>Abnormal 3</td>
</tr>
<tr>
<td>(children 2, adult 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Generalized epilepsy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major seizure</td>
<td>16 (37.2%)</td>
<td>Normal 2</td>
</tr>
<tr>
<td>(children 6, adults 10)</td>
<td></td>
<td>Borderline 1</td>
</tr>
<tr>
<td>Minor seizure</td>
<td>6 (13.8%)</td>
<td>Abnormal 13</td>
</tr>
<tr>
<td>(children 5, adult 1)</td>
<td></td>
<td>Normal 1</td>
</tr>
<tr>
<td>3. Unclassified seizure</td>
<td>5 (11.6%)</td>
<td>Abnormal 5</td>
</tr>
<tr>
<td>(adults 4, aged 1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examining the 32 cases which clinically had not shown epileptic seizures but manifested epileptic discharges, such as spikes, and spikes and waves, 29 cases (90.7%) were children, 2 cases (6.2%) adult persons and one case (3.1%) an aged person, indicating that children are predominantly large in number. By sex, 20 cases (62.5%) were male and 12 cases (37.5%) female. As for the period of impairment of consciousness at the time of injury, 11 cases were with the state of unconsciousness lasting less than 24 hours and 5 cases more than 24 hours. Combined, 16 cases (50.0%) lost consciousness. Thirteen cases (40.5%) had not lost consciousness and 3 cases (9.4%) were recorded as “Unknown.” Also, 8 cases (24.8%) were with skull fracture, of which one was with depressed fracture, while 24 cases (75.2%) were without skull fracture.
3. A Detailed Study of the EEG Findings and Prognosis

EEG findings were examined on each of the two groups in detail (Table 3).

First, the convulsive group revealed that the largest in number was the focal slow waves such as delta and theta waves, among both children and adult persons, with 5 cases of delta waves and 8 cases of theta waves counted for children and 4 cases of delta waves and 5 cases of theta waves for adult persons. This was followed by the focal sharp wave group, with 4 cases counted for children and
2 cases for adult persons. The cases showing typical spikes, and spikes and waves, were unexpectedly few, with 3 cases of diffuse spikes, one case of focal spikes and one case of diffuse spikes and waves, recorded for children. One case each of diffuse spikes and focal spikes was found for adult persons. Also, the cases which showed focal abnormality during and after hyperventilation numbered 2 each for children and adult persons, which were primarily the focal slow wave group. No apparent trend was found with aged persons as there were very few cases available.

With the non-seizure group, in children cases 4 cases of focal spikes, 8 cases of diffuse spikes, 3 cases of focal spikes and waves, and 14 cases of diffuse spikes and waves were counted. There were more diffuse types found than focal types. Along with that, bursts such as delta waves and theta waves were found, with 7 cases of delta waves and 4 cases of theta waves recorded. Others included 2 cases which showed focal sharp waves and 2 cases which showed a prolonged hyperventilation effect.

The prognosis of posttraumatic epilepsy and the effect of medicines administered were investigated (Table 4). The medicines used were primarily Aleviatin (Dilantin) and phenobarbital for grand mal and Jackson's type seizures, and

<table>
<thead>
<tr>
<th>Seizure group</th>
<th>Decreased frequency of clinical seizure</th>
<th>25 (58.6%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Unchanged</td>
<td>12 (27.6%)</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>6 (13.8%)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seizure group</th>
<th>Improvement in the EEG</th>
<th>17 (39.3%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No change</td>
<td>8 (18.6%)</td>
</tr>
<tr>
<td></td>
<td>Deterioration</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fructuation</td>
<td>13 (30.5%)</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>5 (11.6%)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-seizure group</th>
<th>Improvement in the EEG</th>
<th>8 (25.8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deterioration</td>
<td>4 (12.8%)</td>
</tr>
<tr>
<td></td>
<td>No change</td>
<td>6 (18.8%)</td>
</tr>
<tr>
<td></td>
<td>Fructuation</td>
<td>10 (38.4%)</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>4 (12.4%)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>
Mino-aleviatin (Tridione) and phenobarbital for petit mal seizures. First, with the convulsive group, 25 cases (58.6%) were found having a decreased frequency of seizures after administration of the medicines. There was none which had an increased frequency of seizures, while 12 cases (27.6%) remained unchanged. Six cases (13.8%) were unknown. Thus, it was found that the anti-convulsant had a favorable effect on approximately 60% of the total cases investigated. Tracing in the EEG findings for these cases (this group underwent about 4.2 EEG tests on the average during two years), it was found that 17 cases (39.3%) showed improvements in the EEG findings, 8 cases (18.6%) no change and 13 cases no deterioration but fluctuations (30.5%). Five cases (11.6%) were unknown. Thus, in general, the frequency of seizures had decreased, but no corresponding improvements were observed in the EEG findings. With the non-seizure group, comparatively few 8 cases (24.8%) showed improvements, 4 cases (12.4%) deteriorations, 6 cases (18.8%) no change, and 10 cases (31.6%) fluctuations. Four cases (12.4%) were unknown. Consequently, it was concluded that the anti-convulsant had considerable effect on the convulsive seizure group, but improvements of the EEG findings would require a certain period of time.

DISCUSSION

What counts much in the diagnosis of posttraumatic epilepsy is the question of whether or not the epileptic seizures is really the result of brain injuries. That is, there is the question of whether the affliction is due more to genetic factors than to head injuries or whether it should be assumed that seizures can occur even without injuries. According to Lennox,1 genetic factors for organic (symptomatic) epilepsy alone are 1.8 times larger than the average and on the contrary, there are such cases which are considered to have been caused by outward factors rather than by genetic factors.

Lennox1 reports, from the statistics of the 2,500 cases he surveyed, 35% of the total are of the hereditary nature, 16% of the acquired nature, 11% of the both causes and 38% of unknown origin. Thus, it is known that 38% of the cases diagnosed as epilepsy are of unknown etiology and if 35% of the hereditary nature is added to this, a greater part of the cases surveyed do not have well-defined findings that can be made the basis of etiological diagnosis.

On the other hand, in his study on identical twins, Lennox also points out that genetic factors as well as outward factors greatly influence the epileptic seizures and that whether a given case is symptomatic or genetic cannot be determined immediately.1,2
From the viewpoint of etiology, it is known that serious cerebral injuries provoke a high percentage of epilepsy after injury. It is also known, on the other hand, that there are close relationships between the disturbance of brain circulation and epileptic seizures.\textsuperscript{3,4}

When viewed from the point of preparation for convulsions, age factors, too, cannot be overlooked. Children, especially infants, tend to cause seizures more frequently than adult persons. In other words, preparation for convulsions is higher in childhood. It is well known that even in such cases in which adult persons are not attacked by convulsions, infants and young children often provoke convulsions. An example is convulsions seen during the attack of fever.\textsuperscript{5,6,7} How do head injuries work in such cases? Even if injuries are slight ones, they may often work as a trigger to epilepsy.

Related to the above and equally important is the problem of the definition of posttraumatic epilepsy. Nakamura, in summing up and quoting the papers presented by Walker since 1958, said that the following criteria are well-defined to determine posttraumatic epilepsy: 1) Seizures are certainly characteristic of all epileptic cases. 2) They all have no history of convulsions before injury. 3) They have no other brain or generalized disease. 4) Injuries were serious enough to cause cerebral injuries. 5) Initial seizures occurred not quite long after injury. 6) They are all in accord with each other in regard to the type of seizure, EEG findings, and injured cerebral region or area. Of these six criteria, there seems to be no problems about (1), (2) and (3), however, (4) and (6) appear to be not quite appropriate. Also, (5) has some problem with regard to the length of period. With (4), it is not necessarily clear how serious the injuries quoted were to cause cerebral injuries. In other words, this criterion is not sufficiently adequate to establish the degree of external force, the type of injury and others.

On this problem, Walker\textsuperscript{9} gives the cases which are with abnormal neurological findings, such as the loss of consciousness, hemiplegia and hemiparesis, and aphasia. His statement is based on the demonstration of the fact that there certainly existed cerebral injuries. This is not sufficient, however, because while it may clarify a part of the causes of posttraumatic epilepsy, many other cases still remain unexplained.

As mentioned before injured cerebral tissue are not the only cause of epileptic seizures; there are cases of vascular origin. On the part of the injured, the problem of immaturity of the brain by the patient’s age and the problems relating to the causes of convulsions are intricately entangled with each other. Consequently, authors concluded that it is not appropriate to select cases by applying other persons, subjective criteria of judgement such as (4), and did not include (4) in our
criteria for the diagnosis of posttraumatic epilepsy. Also did not attach too much importance to the nature of external force, its severity and duration of unconsciousness, and neurological finding.

In regard to (6), too, authors did not take count of agreements in the type of seizure, EEG findings and injured cerebral region or area. If apply these criteria strictly, it would be necessary for us to clinically determine the localization of focus of seizure and make an electroencephalographical search in greater details. Even if do so, however, it will not always be possible to obtain absolutely reliable data. Also, there are some papers which indicate disagreements in the type of seizure and injured cerebral region. Thus, the criterion (6), too, is considered not necessarily indispensable and can be regarded as only substantiating the criterion (4) for cerebral injuries.

Since authors have doubt about the criterion (4) which is considered not quite practical, decided to omit (6) also. As to (5), for slightly injured cases, we excluded the period of 10 days during which time it is thought some intracranial acute process have occurred in the brain after injury. For serious cases, we decided that it will require a minimum of one month or more for the acute process in the brain caused by injury to stabilize. The cases selected for this survey were, therefore, those which, after a lapse of over one month, had discharged hospital with their symptoms stabilized and become able to attend hospital from home.

The same applies to the cases of intracranial hematoma and examined only those patients who had discharged hospital after getting rid of surgical damages and become able to attend hospital from home. Thus, our survey dealt with the cases of late epilepsy only; authors take the stand that only late epilepsy should be called posttraumatic epilepsy.

Concerning the frequency of occurrence of posttraumatic epilepsy, there are a number of reports by other authors. Sargent\textsuperscript{11} gives a value of 4.4\%, Credner\textsuperscript{10} 4.9\%, Behaue 12.1\% (all these values represent the frequency of occurrence after open cerebral injury), Rowbotham\textsuperscript{11} 2.5\%, Russel\textsuperscript{12} 3.5\% and Phillips\textsuperscript{13} 6\%. The values thus vary in a wide range. Generally speaking, however, open cerebral injuries appear to provoke seizures more frequently than closed cerebral injuries.

In our statistics, which deal with closed cerebral injuries, the value is 1.2\%. Including the cases which showed epileptic discharges for a long period in the EEG findings, the value is only 2.1\%. Ohe,\textsuperscript{14} reviewing the reports of various authors, states that approximately 3\% will be a reasonable value as the frequency of attacks after head injury for average citizens. However, Walker\textsuperscript{9} reports that
the frequency of seizures is directly related to the severity of cerebral injury and therefore, the material will be of importance.

As in these statistics, when there are many slightly injured cases with a short period of impairment of consciousness, the frequency of occurrence is naturally low. Also, examining the relationships between depressed fracture—as an example of skull fracture showing the degree of injury—and posttraumatic epilepsy, we have 28 cases of depressed fracture, for which the value is 7.4%.

Mori, investigating 283 cases of depressed fracture, reported that 31 out of them or 10.9% had seen the occurrence of late epilepsy. Miller gives a value of 9.5%. Viewed from the reports of various authors, a value of 10% or thereabouts will be reasonable. Our value is a little low compared to that.

As for the period from injury to initial seizures, Jannett says that 50% of the patients he surveyed have shown initial seizures within one year after injury and 70% within 2 years. Nakamura, on the other hand, reports that regardless of the type of injury, open or closed, two thirds of posttraumatic epileptic patients show initial seizures within two years after head injury (These cases include early epilepsy and are different from posttraumatic epilepsy as it is commonly called). Ando investigated 13 cases which had the attack of epileptic seizures after frontal injury and reported that of the 13 cases surveyed, 10 cases (77%) show initial seizures within one year and the remaining 3 cases within two years. Examining the reports of various authors, many say that 80% of the cases surveyed show initial seizures within about two years. In our statistics, too, 46.5% showed initial seizures within six months, 77% within one year and 81.6% within two years.

With regard to the EEG findings of posttraumatic epilepsy, Jung, Meyer and others report that about one third of the cases surveyed shows findings characteristic of the disease, another one third shows rather normal findings and the remaining one third abnormal EEG findings, which are not characteristic of the disease with abnormal waves seen as in the cases of genuine epilepsy and other cerebral diseases. Gibbs reports that even by including slightly abnormal cases, only 70% of the grand mal epilepsy cases he surveyed show brain waves of the intermittent phase in the EEG findings. In our cases, 23.4% were normal, 4.6% were on the borderline and 72% abnormal, thus indicating the existence of quite a large percentage of normal cases.

As for the type of clinical seizure, Rüksen reports that 27% of the early epileptic cases are Jackson's epilepsy and 43% grand mal epilepsy. Baumm says that with the Jackson's type epilepsy, 55% of the cases developed initial seizures within one week after injury and only 22% showed initial seizures after
two years. In the case of petit mal epilepsy, Rusken\textsuperscript{21} says that absence is 6%. Feuchtwanger\textsuperscript{22} gives 6% and Credner\textsuperscript{19} 2%. In the case of psychomotor seizure, Baumann\textsuperscript{22} states that 2.5% showed this type of seizure. At any rate, grand mal epilepsy and Jackson's type epilepsy account for a greater part of clinical seizures, followed by petit mal epilepsy and a very few cases of temporal lobe epilepsy. In our statistics, 37.2% of the cases surveyed are grand mal epilepsy (major seizure) and 30.5% Jackson's type epilepsy. Combined, they accounted for two thirds of the total. Petit mal epilepsy (minor seizure) represented 13.8% and temporal lobe epilepsy 6.9%. These values indicate similar trends to those reported by other authors.

On the EEG findings of posttraumatic epilepsy, Hori\textsuperscript{23} states that the case showing spikes, including diffuse spikes, is an epileptic EEG pattern by itself, but seizures can easily occur in the focal slow wave group as indicated by the appearance of high voltage alpha waves, high voltage beta waves and irregular beta waves in its preceding stage. He also states that the growth of cerebral hyper-function-type spikes from the focal slow wave group, which is the EEG pattern showing deterioration of cerebral function, is attributable to the fact that the intermediate band around the brain tissue which has caused deterioration in brain function has successively formed preepileptic conditions for compensation or through the stimulation of abnormal metabolism.

In the course of our examination of the EEG findings in detail, we also recognized a number of cases which had shown focal slow waves in addition to spikes, and spikes and waves. Of the 32 cases which were found clinically without epileptic seizures, but showed epileptic discharges in the EEG findings, children accounted for a larger percentage. It is thought that this is the result of the immaturity of brain of children sharply responding to external force. In other words, head injuries often work as a trigger to provoke epileptic discharges.

Of the prognosis of posttraumatic epilepsy, there are many different views on this and wide discrepancies observed among the reports of various authors. Walker\textsuperscript{24} says that the prognosis of late epilepsy which cause the affliction within 5 years of injury is good, while Wada\textsuperscript{25} reports that some of the cases with few seizures and few focal symptoms often cease of appear with the lapse of time. Generally speaking, seizures which tend to become habitual have the tendency to resisting to anti-convulsants.

Regarding the degree of response of posttraumatic epilepsy to anti-convulsants, Wada\textsuperscript{27} reports that whereas with common type epilepsy, approximately 50% of the cases treated have the effect of completely preventing the recurrence of seizures and 0 to 30% are medication resisting, the reverse is the case with
posttraumatic epilepsy, with over 50% having the effect of only reducing the
attack of seizures and the disease is generally medication resisting. In the cases
stated in this paper, reduction of the frequency of attacks was seen in about 60%
of the total, while some 40% showed improvements in the EEG findings. Thus,
some degree of medication resisting characteristics is indicated. Of this matter,
further investigation may be performed in the future.

CONCLUSIONS

1. This study covered 43 cases of patients who had been afflicted with the
attack of clinical seizures after head injury and 32 cases of patients’ who had
experienced the appearance of epileptic discharges in the EEG findings.

2. The frequency of occurrence of seizures after injury was 1.2%. It was
0.9% with the non-seizure group. Combined, the frequency of occurrence was
2.1%.

3. Approximately 80% of the total number of cases surveyed showed initial
seizures in two years after injury. Seventy-seven percent and initial seizures
within one year.

4. In the EEG findings on the clinical seizure group, 72% of the cases sur-
veyed were abnormal, 4.6% on the borderline and 23.4% abnormal.

5. As for the type of seizure, 37.2% were of the grand mal type (major
seizure) and 30.5% were of the Jackson's type. Combined, the two types ac-
counted for two thirds of the total. Petit mal type (minor seizure) accounted
for 13.8% and temporal lobe epilepsy a low 6.9%.

6. The non-seizure group was mostly children.

7. As for the effect of medicines, 58.6% of the cases administered with anti-
convulsant showed a decreased frequency of seizures, while only 39.3% showed
improvements in the EEG findings.

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