THE VALUE OF THE ELECTROENCEPHALOGRAM IN SELECTED CASES OF SUBDURAL HEMATOMA

RICHARD C. TURRELL, M.D., LEWIS L. LEVY, M.D.,* AND EPHRAIM ROSEMAN, M.D.

Sections of Neurology and Electroencephalography, University of Louisville School of Medicine, and the Louisville General Hospital, Louisville, Kentucky

(Received for publication April 2, 1956)

In a previous communication\(^1\) it was shown that the initial electroencephalogram (EEG) was of no value in differentiating the operative from the nonoperative type of head injury, insofar as unilateral subdural hematomas in adults were concerned. The parameters of reduction in amplitude with or without a slow wave focus in the EEG were present in these two groups of head injuries regardless of whether the initial EEG was taken in the acute, subacute, or chronic stages.

It would therefore seem that the EEG would have only limited value from the standpoint of identification of unilateral subdural hematomas in adults. However, as a corollary its use is much more important from a negative standpoint; that is, given an individual who has had a head injury and who does not present the criteria of reduction in amplitude with or without a slow wave focus, the possibilities are good that there is no subdural hematoma present.

There is an interesting exception to the above, in those instances in which a subdural hematoma is present on the same side as the focal neurologic symptoms and signs. In the previously reported group of 60 cases there were 6 patients who had a subdural hematoma with paresis on the same side as the lesion (here called ipsilateral subdural hematomas). Since that communication we have had an additional 6 cases. In all cases the hematomas and the focal signs were present on the side of the amplitude reduction and delta focus. In brief, it may be stated that given an individual, who has had a head injury and who manifests focal neurological signs such as a hemiparesis, if there is an amplitude reduction in the EEG on the same side the possibilities are good that a subdural hematoma is present on that side. Although this finding may be of limited value in large accident rooms where comatose patients frequently arrive with no history or evidence of trauma, the presence of focal neurologic signs coupled with an ipsilateral reduction of amplitude on the EEG, should make one strongly suspicious about the possibility of subdural hematoma on the side of the decreased voltage.

It is the purpose of this communication to report on the positive value

---

* Dr. Levy is presently Chief of Neurology, Veterans Administration Hospital, West Haven, Connecticut.
of the EEG in the identification of unilateral subdural hematomas in adults. Further, it will be demonstrated that some EEG epochs better exemplify amplitude asymmetry than others.

PRESENT STUDY

In the present studies the EEG findings in 12 proven cases of ipsilateral subdural hematoma were reviewed. Serial EEGs were examined for additional diagnostic clues.

The EEGs were performed on a Grass 8-channel ink-writing oscillograph with a minimum of 13 needle (27 gauge) electrodes inserted into the scalp and ear lobes using the following references:

1. Paired symmetrical electrodes referred to both ears.
2. All electrodes on the left side referred to the left ear and those on the right to the right ear.
3. Similar to (2) above except that the reference point was a common vertex placed in the midsagittal plane halfway between the frontal and parietal electrodes.
4. Bipolar triangulation (here called short intercepts).

RESULTS AND DISCUSSION

Figs. 1–3 demonstrate 2 cases in which ipsilateral hematomas were evacuated subsequent to electroencephalography. In each case there was reduc-

![Diagram](image)

**Fig. 1.** D.F. was found comatose on May 12, 1951. She had left 3rd nerve paralysis, left hemiplegia and bloody CSF. There was initial clinical improvement. EEG shows reduction in amplitude and a delta focus on the left side, maximal in the temporal region. Note also the depression of the sleep spindles on the left side. Because of these findings, and in spite of the left hemiplegia, a left carotid arteriogram was done and demonstrated a picture compatible with a subdural hematoma on this side. The patient remained comatose subsequent to arteriography and a subdural hematoma was evacuated on the left side. She made a complete recovery.
Fig. 2. This demonstrates the importance of taking the various epochs in the EEG. Of particular importance, it shows that the amplitude asymmetries are invariably best marked in short intercepts (homologous triangulation). See Fig. 3 for history. (A-D) Various epochs taken on the same individual prior to any known head injury and offered as a control. Note that there is no remarkable amplitude asymmetry and particularly not in the short intercepts episode. (E-H) A similar series on the same individual, taken 5 days post trauma and 6 days preoperatively. Note that there is a generalized slowing in the EEG and that the decrease in amplitude and minimal slow wave focus is most marked on the right side in the short intercepts episode (Fig. 2E).
FIG. 8. J.E., 14-year-old white male, had osteogenesis imperfecta with a history of numerous fractures to various long bones of the body. He had had syncopal episodes since August 1953. On Feb. 1, 1954 he suffered a head injury, followed by development of a right hemiparesis and decreasing mental awareness. On Feb. 12, 1954 bilateral burr hole exploration was made and a large subdural hematoma
tion in amplitude and a mild to moderate slow wave focus on the side of the hematoma.

In our experience the epoch that best shows the amplitude asymmetry (unilateral reduction in voltage) is the one that we call short intercepts (Fig. 2A). The episode that seems to show this next best is the one in which all electrodes on one side are referred to the ipsilateral car and compared to the opposite side. The epoch of least value from the standpoint of amplitude asymmetry is that in which the vertex is used as a common reference point. However, this latter epoch shows seizure activity better than any of the other episodes.

As regards amplitude asymmetry it should be noted that reference is being made only to the reduction of background activity. Occasionally medium voltage slow waves will be seen which when measured from trough to crest actually exceed the voltage on the opposite side. However, the faster background activity is always reduced when compared to the opposite side. Amplitude reductions are usually best seen in the temporal and occipital areas. Sleep spindles are definitely reduced on the side of the subdural hematoma (Fig. 1).

Seizure activity, when present, may be confusing in cases of acute subdural hematomas. It is usually most prominent on the opposite side (Fig. 1).

Serial EEGs may be of value in the diagnosis of ipsilateral subdural hematomas, in instances in which the patient, after an initial period of coma, may improve for hours or even days. Occasionally this improvement may be paralleled by improvement in the EEG. However, the persistence of an ipsilateral reduction in amplitude with or without a slow wave focus would still point very strongly to the possibility of a subdural hematoma (Fig. 3B, C, D).

The voltage reduction follows a pattern similarly described in other conditions such as ruptured aneurysms and thromboses.\textsuperscript{2,3} The initial effect following injury is a reduction in amplitude on the side of the lesion. Once the irritating substance is removed several courses may be followed. In the

was evacuated from the right side. No abnormalities were noted on the left. Subsequently he completely recovered. Note the following:

1. 3A, taken on Sept. 25, 1953, appears as pretraumatic control and is considered to be a normal EEG.
2. 3B, taken 3 days post trauma, shows a decrease in amplitude on the right side, generalized slowing of the EEG, and a delta wave focus on the right.
3. There was subsequent improvement in both the clinical status and the EEG, although the decrease in amplitude and slow wave focus on the right side persist (3C and 3D).
4. Worsening of the patient’s condition began on Feb. 8, 1954 and continued until the time of operation on Feb. 12, 1954 when he became comatose. The increase in generalised slow activity is noted but the persistent decrease in amplitude on the right side is emphasized (3E).
5. There was subsequent improvement in the EEG during the next 16 months. 3F shows that the record is still slow 4 days postoperatively and the amplitude on the right side is quite markedly reduced. 3G, taken 4 months later, now shows the amplitude is increased on the right side, particularly in the temporal-occipital electrodes. 3H, taken 16 months postoperatively, shows the permanent reduction in amplitude on the right side.
first place, the amplitude may remain reduced indefinitely. Secondly, the initial reduction of amplitude, which may persist for only 10 to 14 days, is replaced by an ipsilateral increase in amplitude for a similar period of time and then reverts to reduction. Thirdly, the EEG may go through several amplitude fluctuations before a final permanent reduction (Fig. 3E, F, G, H).

SUMMARY

Twelve cases of unilateral subdural hematomas in adults are presented in which there was the unique finding of ipsilateral hemiparesis, that is, hemiparesis on the side on which the subdural hematoma was located. The electroencephalographic picture showed a reduction in amplitude and a delta wave focus on the side on which the subdural hematoma was located.

It is stressed that, given the criteria of an individual in coma with or without the history of a head injury, the presence of reduction of amplitude and slow wave focus on the same side as the focal neurologic signs, suspicion should be strong for the possibility of an extracerebral lesion such as a subdural hematoma.

Evidence is given that the amplitude asymmetry shows up in some epochs better than in others and the best combination is one in which symmetrical areas are triangulated.

In spite of an improving EEG, from the standpoint of disappearance of generalized delta activity, persistence of ipsilateral reduction in amplitude and slow wave focus in an individual who has had a head injury, points strongly to the possibility of a subdural hematoma on the side of the amplitude reduction.

The authors are indebted to Wilma Shaw for technical assistance and to the Department of Visual Education for the reproductions.

REFERENCES