4(3):228–229, Raven Press, New York

Topographic Brain Mapping in Head Injuries

H. Hooshmand, Kenneth Director, Eleanor Beckner, and Farideh Radfar
(Vero Beach, Florida)

Topographic brain mapping (TBM) may be quite useful in the evaluation of head injury, cerebral vascular disease, and the neuropsychiatric illnesses.

The following is our experience with such patients in the past 2 years. One-hundred thirty-five consecutive head-injury patients were included. In addition, the other major categories consisted of cerebral vascular disease (32 patients), neuropsychiatric patients, especially patients with problems due to depression and manic–depressive disorders (48 patients), Gille de la Tourette syndrome (4 patients), and childhood schizophrenia (3 patients).

The study was undertaken after a standardization of normal volunteers was done on 80 adults and 20 children.

In the normal population, the many EEG artifacts cause diagnostic problems. Specifically, the electrocardiogram (EKG) and eye-movement artifacts may be problematic but can be identified and differentiated from focal EEG abnormalities. Simultaneous, proper EEG and brain mapping recording and proper correlation of the standard EEG artifacts with what is seen on brain mapping are essential in differentiating artifacts from true abnormalities.

The presence of any abnormality is not considered significant unless it is present in over 50% of statistical averaging of each frequency analysis.

The abnormal finding is not considered reliable unless it is noted in more than one frequency (e.g., alpha and beta frequencies, or theta and delta frequencies). The abnormality being present only in theta frequency is not as reliable as abnormalities seen in other frequencies because of artifacts or state of consciousness.

A study of 135 consecutive patients with mild-to-moderate head injuries was done. The physiological tests, EEG and TBM, were compared to anatomical tests, magnetic resonance imaging (MRI) and computer-assisted tomography (CAT). All patients underwent Halstead Reitan, other detailed neuropsychological tests, and neurological examination. TBM was normal in 75 patients. EEG abnormalities were seen in 40 patients. These consisted mainly of mild non-specific generalized slowing. The CAT and MRI abnormalities were noted in 11 of 135 patients, 3 of whom had unrelated cerebral atrophy.

The most common symptoms in the left-hemispheric abnormalities on TBM were headache, depression, short-term memory loss, and visual disturbances. They were associated with disturbances of verbal communication and neuropsychological function (history- and English-learning disability, verbal memory disturbance). The right-hemispheric TBM abnormalities were most commonly associated with headache, auditory disturbances, personality changes (schizoaffective tendency), and poor arithmetic performance. See Table 1.

Independent psychological and brain mapping interpretations showed over 96% lateralization accuracy.

TBM was limited in that it failed to show epileptiform discharges or other rhythmic activities such as periodic lateralized epileptiform discharges or frontal intermittent rhythmic delta activity, which are best recorded on standard EEG.

In cerebral vascular disease, TBM was applied to the patients who were diagnostic problems. These were the patients who had a normal EEG and CAT or MRI in the face of what was suggestive of transient ischemic accidents or partial resolving stroke. TBM was quite helpful, showing two main features. One was the presence of abnormality in the distribution of certain arteries, such as the middle cerebral artery or vertebral basilar artery distribution; the second was con-

TABLE 1. *Topographic brain mapping in head injuries*

Neuropsychological changes in mild-to-moderate head injuries (right hemispheric)	Neuropsychological changes in mild-to-moderate head injuries (left hemispheric)
1. Withdrawn, introverted personality change, schizoaffective	1. Depression
2. Flat affect, abulia	2. Agitated depression, severe anxiety
3. Attacks of inappropriate agitation (delirium tremens without alcohol)	3. Poor motor coordination
4. Tendency to deny or minimize symptoms (frontal)	4. Poor verbal performance (reading, recall, dysnomia, History and English subjects in school)
5. Poor performance in mathematics—dyscalculia (temporal)	5. Personality changes: poor inhibition, irritability
6. Poor counting backward (temporal)	6. Speech disturbance: poor expression, poor communication, inability to compose
7. Poor visual memory–facial recognition (temporal)	7. Poor verbal memory and recall
8. Poor copying and construction (nonverbal)	8. Visual disturbances (blurred vision, headache with reading)
9. Spatial confusion (e.g., hospital next door to home)	9. Poor depth perception (e.g., difficulty with driving)
10. Poor eye contact	
11. Body gesture flat	

centric triple halo of lower-voltage to higher-voltage abnormality in the distribution of the artery involved. This was in contrast to the circumscribed abnormality noted in the head-injury patients.

In the psychiatric group of patients, the manic–depressive patients had normal TBM as did other patients with depressions due to menopause or endocrine problems.

Brain mapping was consistently abnormal, showing focal abnormalities in the frontal temporal regions on one side or the other in the cases of Gille de la Tourette syndrome and childhood schizophrenia. These abnormalities were associated with abnormal psychological test results similar to the findings noted in the head injury group. Such brain mapping findings bring up the suggestion of the probability of focal brain dysfunctions in such patients.