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Case Report

Novel method for detecting brain abnormality in a patient with epidural hematoma: a case report☆,☆☆

Abstract

An estimated 1.5 million head injuries occur in the United States each year, with approximately 2% resulting in epidural hematomas. Epidural hematomas can be difficult to recognize clinically because the patient may not have a loss of consciousness or may have a brief loss of consciousness with a normal neurological examination. It is important to recognize patients with epidurals because the reported mortality for unrecognized epidural hematoma is as high as 40%. We report a novel method of identifying brain abnormality in a patient with a normal neurological examination result using a bedside handheld automated electroencephalogram device.

An estimated 1.5 million head injuries occur in the United States each year, with approximately 2% resulting in epidural hematomas [1]. An epidural hematoma is an accumulation of blood that occurs between the dura and the skull bone, resulting in increasing intracranial pressure. Often, in adults, this is associated with a skull fracture and bleeding from the middle meningeal artery. Bleeding of this type can progress rapidly to death, even though the initial examination result of the patient can be normal [2]. There are frequent descriptions of cases of a "lucid interval" [3] in which the patient seems normal after injury and yet rapid clinical deterioration occurs. It is important to recognize patients with epidurals because the reported mortality for unrecognized epidural hematoma is as high as 40% [2]. We report a novel method of identifying abnormalities in brain electrical activity using a new handheld device currently in research development, the BrainScope (BrainScope, Co, Inc, Washington, DC), in a patient presenting with an epidural hematoma.

A 60-year-old female jogger collided with a skateboarder in a park at 11:00 AM. The woman was knocked to the ground and experienced a brief loss of consciousness. On arrival to the emergency department at 11:17 AM, she complained of a headache that was mild (4/10) and a lip laceration. She had amnesia regarding the details of the accident. Physical examination revealed a 1-cm lower lip laceration and a tender area over the left parietal area. The remainder of the results of physical examination was normal, with a Glasgow Coma Scale score of 15. The patient was alert and oriented × 3 deep tendon reflexes (DTRs) were 2+, and there was no pronator drift. Her gait was normal. A computed tomography (CT) scan of the head and neck was ordered at 11:25 AM and results were obtained at 12:15 PM. The CT scan was read at 12:20 PM as showing an epidural hematoma, and neurosurgery was consulted. With the consent of the patient's husband, she was enrolled in a concussion study approved by the institutional review board to evaluate a new automated electroencephalogram (EEG) device for evaluation of head injury. Ten minutes of data was recorded at 12:25 PM. When the patient was evaluated by neurosurgery, her neurological examination result was again normal.

At 13:30 PM, she became somnolent, and the decision was made to take her to the operating room, where a left-sided epidural hematoma was evacuated at 14:15 PM (Fig. 1). Operative report indicated that the hematoma had increased 3-fold in volume from the initial hematoma on the CT scan. She had an uneventful recovery and was discharged on postoperative day 6.

Epidural hematomas can be difficult to detect and can lead to significant mortality if unrecognized. The estimated mortality for epidural hematoma is 15% to 40%, varying on the location of the bleed [1,4]. In this case, a new device from BrainScope uses features of brain electrical activity to calculate an index of abnormality by comparing the signals obtained from the patient to age-expected normal values. The device contains a mathematical algorithm that compares the patient's brain electrical activity to features of normal EEGs, including symmetry, power spectrum, and coherence. The BrainScope automatically determines the degree of abnormality by mathematically comparing the results of the patient to expected patterns of normal brain electrical activity. It then computes the probability that the patient's data are not different from that of a normal population. The BrainScope algorithm was developed using features (linear and nonlinear descriptors of the electrical signal) extracted from standard EEGs. Discriminant algorithms distinguish between electrical brain activity likely to occur in "normal" vs "abnormal"

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☆☆ This study was approved by the Human Studies Committee of Washington University, study 08-0107.

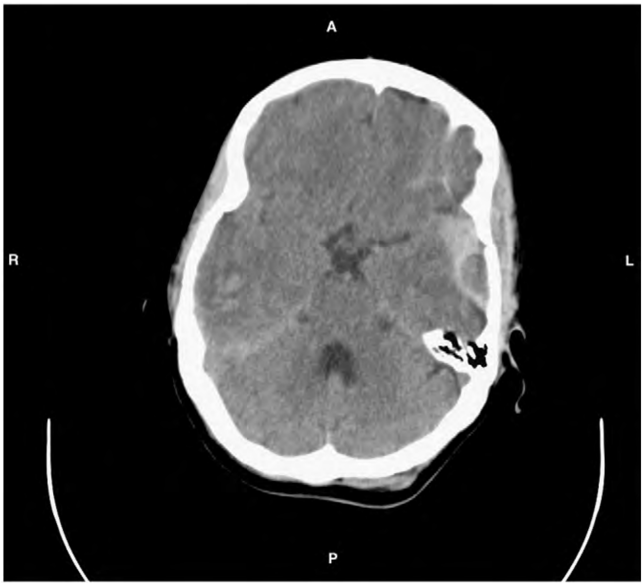

Fig. 1 Left-sided epidural hematoma with skull fracture right-sided subarachnoid hemorrhage.

populations. The EEG has long been known to be abnormal in head injury [5], often with an increase in slower, theta waves. This is one of multiple features evaluated by the BrainScope and incorporated into the algorithm.

In this particular case, the BrainScope determined that the patient had a 99% probability of brain abnormality. This means that the chance of the patient being abnormal was exceedingly high and could alert health care providers of the severity of the patient's injury even when the neurological examination result was normal.

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