Difficulty in Clinical Identification of Neonatal Seizures: An EEG Monitor Study

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Seventeen newborns were monitored for 24 hours using a three-channel ambulatory EEG (A/EEG). All newborns were thought to be having subtle seizures by the nursery staff. Fifteen of the 17 newborns were recorded as having 1–30 clinical seizures during the time of monitoring.

Only one newborn had clinically identified seizures associated with A/EEG discharges. The seizures were characterized by eye rolling. Fifty-two episodes (thought to be seizures) of lip smacking, bicycling, jerking, fist ing, staring, stiffening, or any combination of the above occurred in eight newborns without an associated discharge on A/EEG. However, two of the eight had seizure discharges at other times, not associated with any clinical manifestation. Seventy-four apnea spells, thought to be possible seizures, occurred in seven newborns. None was associated with discharges on A/EEG, but one of these newborns had 50 A/EEG discharges unrelated to apnea or other clinical manifestations.

INTRODUCTION

Subtle seizures, in which tonic and clonic movements of the limbs are lacking, are commonplace in newborns. Seizures may be characterized by apnea, tonic deviation of the eyes, repetitive jerking of the eyelids, fluttering of the lids, drooling, sucking, and chewing. Complex motions of the arms and legs sometimes resemble swimming or bicycling. Even experienced observers may have difficulty identifying these movements. We therefore monitored newborns suspected of seizures to determine the accuracy of clinical observation.

METHODS

A commercial ambulatory EEG (A/EEG) (Oxford Medilog) that records four channels of data and stores the information on a miniature cassette tape was used. Twenty-four hours of data may be stored on one cassette and then displayed for analysis on a video playback unit. Scalp electrodes, secured with collodion, were placed using a modification of the 10–20 international system because two electrodes were needed at the F7 and F8 positions. Channel 1 recorded from T5 to F7; channel 2 recorded from F7 to F8; channel 3 recorded from F8 to T6; and channel 4 was used as a time and event marker [1]. The time and event marker, when activated by a nurse or other caretaker, allows the person reviewing the cassette to know the moment when a clinical seizure was observed. In newborns suspected of having seizures because of apneic spells, the following montage was used: channel 1 recorded EKG; channel 2 recorded T5 to F7; channel 3 recorded T6 to F8; and channel 4 was a time and event marker.
Seventeen newborns selected by the neonatologists because they were having clinical seizures were monitored for 24 hours (Table 1). During the time of monitoring, nurses indicated the clinical seizures by activating the time and event button on the cassette, and by describing the seizure activity in a diary.

**RESULTS**

Only one newborn (case 4) had clinically identified seizures associated with A/EEG discharges (Fig. 1). The seizures were characterized by eye-rolling. Fifty-two episodes thought to be seizures (lip smacking, bicycling, jerking, fisting, staring, stiffening, or any combination of the above) were observed in eight newborns (cases 1, 3, 6, 7, 9, 10, 14, 16) without any seizure discharge on A/EEG. However, two of the eight (cases 1 and 3) had seizure discharges on A/EEG at times other than the clinical events. Seventy-four apnea spells were thought to be possible seizures in seven newborns (cases 2, 4, 8, 11, 12, 13, 15). None were associated with seizure discharges on A/EEG; one (case 2) had 50 seizure discharges on A/EEG that were not associated with apnea or other clinical abnormalities (Fig. 2). Two newborns (cases 5 and 17) had no clinical or A/EEG seizures during the time of monitoring.

Ten newborns had 12 EEGs performed by standard techniques prior to use of the A/EEG monitor. These were recorded at the time of an acute hypoxic-ischemic encephalopathy. Five had previously demonstrated seizure discharges on EEG, two associated with clinical seizures. Two of these five also demonstrated seizures on the A/EEG. The A/EEGs were recorded after the acute encephalopathy was over for the purpose of identifying continuing seizure activity.
DISCUSSION

The clinical expression of convulsive activity in the newborn is less organized than in older infants. This is especially true in the premature, whose convulsive manifestations are fragmentary and frequently indistinguishable from normal activity. Even in older infants, the identification of seizures in the absence of tonic-clonic movements can be
difficult. When tonic convulsions were recorded in 120 infants using concomitant EEG and visual analysis, epileptiform activity accompanied the tonic posturing in only 18 [2]. A/EEG is a useful and considerably less expensive method for monitoring than cable or radio telemetry systems. When A/EEG was done simultaneously with an intensive cable telemetry monitoring system in adults, the A/EEG detected 100 percent of generalized interictal abnormalities and all seizures noted with the telemetry system [3]. A/EEG should be especially accurate in detecting neonatal seizures, which tend to be widespread over one or both hemispheres. It is possible, however, that the discharges associated with subtle seizures are too focal to be displayed on the small number of channels used.

A/EEG proved to be accurate in identifying the absence of seizures. Several of these children had a history of definite seizures and an abnormal standard EEG at the time of an acute hypoxic-ischemic encephalopathy; however, it was not appreciated that the seizures had stopped and that the continuing behavioral changes noted in the newborns were not convulsive in origin. Following the normal A/EEG, anticonvulsant therapy was discontinued without subsequent seizure activity. A similar experience has been reported by Bridgers et al. [4].

The workup and management of apneic spells is particularly vexing and such spells are frequently misinterpreted as seizures. None of our patients who were monitored because of apneic spells was having seizure discharges at the time of apnea. This finding is in agreement with the experience of others [5]. One child referred because of apneic spells had frequent seizure discharges at other times that were unrelated to apnea or any other clinical manifestation. Because simultaneous video monitoring was not performed, however, we cannot be certain that there were no clinical changes.

It is usually the nursing staff, not physicians, who make minute-to-minute observations of seizures in a newborn intensive care unit. Clearly, it is difficult for nurses, and probably for physicians as well, to distinguish subtle seizures from normal activity. EEG monitoring is a safe and easy method of making that distinction and may also be useful to identify newborns who are having electrical seizure activity without clinical manifestations. The latter may be important if the prevention of seizures is shown to influence outcome beneficially in term newborns with hypoxic-ischemic encephalopathy.

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