NEUROLOGY REVIEWS

BEST PRACTICES IN AMBULATORY EEG MONITORING

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Electroencephalography (EEG) technology has progressed from bulky, hospital-based machines to small, wearable ambulatory devices that connect to video and that can be used either in the office, hospital, or in the patient's home. Ambulatory EEG monitoring is particularly advantageous for evaluating spells, events, or seizures that may not occur during a brief routine (20-30 minute) EEG. What are the clinical indications for ambulatory EEG monitoring for diagnosing and/or treating epilepsy? What are the safety considerations? And how can quality be ensured? All three of these questions as they pertain to ambulatory EEG monitoring for epilepsy are equally important, and are discussed here.

Clinical Indications for Ambulatory EEG Monitoring

The purpose of prolonged EEG monitoring for patients with seizures or spells (undiagnosed or diagnosed seizures of any type, and/or time-limited aberrations in speech and other cognitive or motor alterations) is to capture electrical brain activity during an event, and correlate it with (if video is available) the clinical manifestations of an event. Obtaining this information can assist in overall diagnosis, including determining if the spells are epileptic in origin or signify another type of disorder, assessing seizure frequency, and providing information to assist in localization for potential surgical intervention. Regular/routine in-office or hospital-based EEGs may be inadequate to obtain an accurate diagnosis in some patients with seizures or spells for a number of reasons, especially if a spell does not occur during the shorter monitoring period.[1] In these situations, ambulatory EEG monitoring for longer periods while the patient is at home (usually from 24 to 96 hours) can be used. The use of ambulatory EEG monitoring is also valuable when a patient does not wish to or cannot come into the hospital for prolonged video EEG monitoring, which generally necessitates a multi-day inpatient stay.

Ambulatory EEG monitoring can be used to help differentiate among all three general types of events: epileptic seizures, psychogenic nonepileptic episodes/events (PNEE), and physiologic nonepileptic events. All of these can present as discrete paroxysmal time-limited events, with motor, sensory, autonomic, or cognitive signs and symptoms, and therefore the differential diagnosis is difficult and can also include other neurological conditions.[2]

Patients with recurrent seizure-like spells or episodes of an indeterminate nature may have PNEE, and ambulatory EEG monitoring is particularly helpful in this diagnosis. PNEE are a physical manifestation of a psychological disturbance but are generally out of the patient's control and are not due to malingering.[3] The negative consequences of misdiagnosis of PNEE are numerous, including unnecessary drug treatment for presumed epilepsy that can lead to morbidity and unnecessary cost.[2]

The key distinguishing feature of PNEE is the lack of ictal epileptiform brain activity on the EEG, which is what makes ambulatory EEG monitoring so crucial, because the capture and recording of a seizure or seizure-like event on both video and EEG is the ideal confirmation, and a longer time period of monitoring is more likely to capture an event.[2] In fact, diagnosis of PNEE is one of the main advantages of ambulatory EEG monitoring, and video electroencephalography (vEEG) is considered the gold standard.[2] Combined with other diagnostic approaches, including history, witnessed events, and other types of imaging, this will yield the most accurate diagnosis possible.[2] In the past it had taken many years before the diagnosis of PNEE could be made, but with the advent of ambulatory EEG video monitoring, the time to accurate diagnosis can be greatly reduced.[3]

Safety of Ambulatory EEG Monitoring

Ambulatory monitoring offers the advantages of not requiring hospital admission and therefore lower cost, however there is the conundrum of whether the patient should be taken off seizure medication if the monitoring is done at home. For patient safety, the recommendation is for the patient to continue seizure medication during ambulatory monitoring at home, even though that makes it less likely that a spell will be captured on the device.

In-hospital continuous EEG monitoring or prolonged outpatient monitoring in the hospital setting offers the safety advantage of having a technician monitoring the patient during the entire recording session. Generally, someone is physically present 24/7 and can assist the patient during a clinical spell. This setting is recommended if there is a high suspicion of epilepsy and/or if the patient is having many spells each day.

Quality of Ambulatory EEG Monitoring

Ideally, the neurologist performing ambulatory EEG monitoring has had specialized additional training in the interpretation of the video and EEG data generated. While not mandatory, for the best quality recording and the best quality of patient care, the best health care professional to perform ambulatory EEG monitoring is a neurologist who is fellowship trained and board certified in epilepsy.

Ambulatory EEG device monitoring should be accompanied whenever possible by patient self-reporting in the form of a written diary and observations by another person. The American Clinical Neurophysiology Society (ACNS) has published guidelines for long-term EEG monitoring for epilepsy that include detailed recommendations, including placement of electrodes and data storage.[4]

Newer ambulatory EEG systems have video, which can help improve quality. The field of view is important and patients should be instructed on how to get the best field of view in their particular home environment if that is where the monitoring is taking place. If the ambulatory monitoring is being done in the hospital, the cameras are adjusted by a technician to get the best view. The goal in both settings is to get continuous video to correlate patient events and symptoms with the EEG data. Quality is always of great importance in any type or duration of EEG study. With ambulatory EEG monitoring at home, electrodes can become dislodged due to increased patient mobility and activity, and since an EEG technician is not present, immediate replacement/correction of electrode issues is not always possible, and this can decrease interpretability and hence quality. Note that if ambulatory EEG monitoring at home does not come back as good quality, or is inconclusive, then in many cases inpatient EEG monitoring will need to be done.

FIGURE

Purchase of a particular type or brand of ambulatory EEG monitoring system is done by both private practice neurologists and hospital groups. Some newer systems have advanced technology such as fully mobile capability (so the patient is not tethered to the equipment), and infrared lighting for night video recording, as shown in the figure above.[5]

Conclusion

Ambulatory EEG monitoring with video for diagnosis of epilepsy can be done on an outpatient basis in the office, the hospital, or the patient's home. The goal is to capture simultaneous brain activity with video of the patient during an event. This offers the neurologist a superior diagnostic approach, and the advantage for the patient in doing the monitoring at home is avoidance of a hospital stay and the associated higher costs. Safety is a high priority, and quality can be assured by adherence to ACNS guidelines. It is hoped that the information in this article will encourage more frequent and appropriate use of this important diagnostic tool with advanced technology capabilities.

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