CortiCare
The New Wave of EEG Services

Introduction to cEEG Monitoring in Critical Care

White Paper

Neurologic monitoring in the Intensive Care environment involves the use of several different parameters including electroencephalogram (EEG), intracranial pressure (ICP), cerebral oxygenation (PbO2), trans-cranial doppler. A patient's status can be monitored more accurately with cEEG and the only way to detect non-clinical, or non-convulsive seizures (NCSz) that manifest no outward clinical sign to the physician is with a long-term electrographic recording of brain activity.[7]

Continuous EEG monitoring (cEEG) can be a resource intensive activity. It requires that scalp electrodes be correctly placed on the patient's head, an EEG acquisition system is recording the signals and that the EEG data is monitored by an appropriately trained technologist or physician to recognize adverse brain activity.

Due to developments in secure remote access technology the capability to monitor the brain of critically ill patients outside the academic university or teaching hospital is now available. The neurotelemetry services provided by CortiCare allow any hospital, regardless of their size, labor resources, capital budgets, or the availability of on-site neurology staff, to provide continuous remote EEG monitoring to their patients in critical care settings. In addition, the availability of easily placed electrode sets, such as the CortiCap™ from CortiCare facilitates the initiation of the study when EEG Technologist staffing is unavailable to respond.

What is Continuous EEG Monitoring?

The standard EEG is one of the simplest tools for determining cerebral activity. Continuous EEG monitoring provides dynamic information about brain function that permits early detection of changes in neurologic status, which is especially useful in patients with compromised consciousness or for whom a neurological exam is otherwise difficult.

Non-convulsive seizures are common in comatose and critically ill patients and can have multiple negative effects on the injured brain. They are also common in neonates with acute brain injury. Most seizures in these patients cannot be detected without cEEG. cEEG monitoring is used to detect and guide treatment of nonconvulsive seizures. In addition, cEEG provides real time information about changes in brain function at the bedside, making it possible to detect acute brain events such as ischemia, hemorrhage, increased intracranial pressure. It is also increasingly used to guide and monitor therapy and as a prognostic tool.

Why do you need to do Continuous EEG Monitoring?

When a patient arrives in the Intensive Care Unit (ICU), he or she is connected to a pulse oximetry monitor, electrocardiogram monitor, respiration monitor, arterial blood pressure monitor, and, possibly, devices to monitor arterial pressure or cardiac output, all to provide physicians with real-time, continuous information about status of cardiopulmonary function. cEEG should similarly be considered not only in those with acute brain injury and impaired mental status but also in all ICU patients who are higher risk for NCSz and are sedated or given neuromuscular blockade, where assessing neurological function accurately can be difficult. Tools to assess the cerebral function of the critically ill patient have remained unavailable to the physician in many hospitals until recently. Dr. Lawrence Hirsch, past Chair of the ACNS cEEG Monitoring Consortium commented, "Fortunately, advances in computer and networking technology now make it practical to record brain activity continuously in critically ill patients. Thus, continuing to ignore brain function in ICU patients is now difficult to justify."[1]

"NCSzs are common in critically ill patients. In children, total seizure burden correlates with short term outcomes. A delay in the diagnosis and definitive therapy for NCSE is associated with significantly more mortality. [2]

What is the percentage of Non-convulsive seizures in the ICU?

Nonconvulsive seizures (NCSz) and nonconvulsive status epilepticus (NCSE) are increasingly recognized as common occurrences in the ICU, where studies show up to 10% to 59% of comatose patients may have NCSz, depending on which patient populations are studied. [7] NCSz are electrographic seizures with little or no overt clinical manifestations, so EEG is necessary for detection (Anesth Analg 2009;109: Table 2, pg. 508). In addition, studies have shown that a 30-min routine EEG will detect less than half of seizures eventually identified by longer cEEG monitoring. [3]

Who needs to be monitored using cEEG?

The EEG provides a noninvasive way to dynamically assess brain function in conscious, semi-conscious and unconscious patients presenting with cognitive deficits of known or unknown etiology. These potential patients include: [4]

1. Detection of nonconvulsive seizures and characterization of spells in patients with altered mental status with:
   a. A history of epilepsy
   b. Fluctuating level of consciousness
   c. Acute brain injury
   d. Recent convulsive status epilepticus
   e. Stereotyped activity such as paroxysmal movements, nystagmus, twitching, jerking, hippus, autonomic variability
2. Monitoring of ongoing therapy
   a. Induced coma for elevated intracranial pressure or refractory status epilepticus
   b. Assessing level of sedation
3. Ischemia detection
   a. Vasospasm in subarachnoid hemorrhage
   b. Outcome Impact

What is the economic impact of cEEG monitoring?

In a review of the early cEEG experience at University of California, Los Angeles, Dr. Paul Vespa and Dr. Marc Nuwer, a member of CortiCare's Board of Directors, found that cEEG accounted for only 1% of the total hospital costs in a study of 100 patients with TBI and helped guide clinical decisions in 90% of the patients. In the time period that cEEG was used, there was also a reduction in total costs and length of stay for these patients compared with historical controls. [5]

Dr. Lawrence Hirsch, Professor of Neurology at Columbia University and now at Yale Comprehensive Epilepsy Neuroscience Institute reported that cEEG was judged to make important contributions to clinical decisions in over 50% of the patients studied. [6] These decisions included initiating or changing anticonvulsants in patients found to have Non-Convulsive Seizures, obtaining additional testing or adjusting mean arterial blood pressure in patients with evidence of cerebral ischemia.

Accurate Diagnosis Related Group (DRG) coding is important in obtaining appropriate reimbursement in critically ill inpatients. A DRG code is assigned a relative weight reflecting the severity of illness and cost of care, which determines the reimbursement. CMS adopted the Medicare Severity DRG system (MS-DRGs) to improve classification of the associated cost of care from complications. The coder

determines an MS-DRG principal diagnosis and then secondary comorbidities (CCs) or major comorbidities or complications (MCCs). Seizures are a major CC or MCC for many DRGs in the ICD-10 Procedural Coding System. Adding seizures identified by cEEG as CC or MCC to the patient's primary diagnosis can increase the relative weight of the DRG by 25% to 75% or more.

Conclusion

The pressure to continuously monitor ischemic and traumatic brain injury patients electrographically is mounting as peer reviewed studies continue to document the evidence that monitoring leads to better detection, opportunities to modify therapy with less morbidity, mortality, and improved functional outcomes. Several experts believe that cEEG monitoring will drive down costs by decreasing utilization of ICU resources and the overall length of stay (LOS). Hospitals are beginning to understand the medical-ethical risks associated with not monitoring. Today, many large teaching hospitals are providing 24-hour continuous EEG monitoring. As cEEG continues to gain traction as a uniquely useful non-invasive tool in assessing brain function in critical care patients, hospital administrators seek to implement a comprehensive long-term continuous monitoring program efficiently and cost effectively.

Many hospitals have made the leap to implement a cEEG monitoring program only to be consumed by the overwhelming avalanche of data per session that a neurologist needs to read and review. Data management and expert bottlenecks aside, the real difficulty in starting and maintaining a cEEG monitoring program is the constant advertising, interviewing, offering, hiring, training and managing the ever-increasing EEG staff required to support the effective utilization of clinical resources and quality patient care.

Managing and staffing a true 24/7/365 video-cEEG monitoring program with registered EEG technologist around the clock requires hospital management and the allocation of scarce human resources that are typically stretched already. Out- sourcing monitoring services to a 3rd Party organization with experienced and qualified technologists and physicians makes economic and medical sense and can be justified solely on liability risk mitigation.

What CortiCare can provide and what we do?

CortiCare provides Neurotelemetry or remote neurological patient monitoring. This service utilizes the Internet, or cloud-based telemetry to continuously monitor video- EEG recorded at the patient bedside from remote locations. We use the existing hospital EEG equipment (or we can supply equipment), and we link remotely to that device at the bedside. This connectivity allows us to provide a continuous set of eyes on the EEG waveforms 24/7/365 and alert the neurologist of any remarkable events within a 30-minute window. If the physician is not onsite, they can connect to the live cEEG montage through our HIPAA compliant service and review the patient monitoring history from any Internet-connected device (PC, iPad, or Smartphone) and make the necessary therapeutic changes. From the ICU and NICU to the ED and EMU.

CortiCare offers the only nationwide network of remote EEG reader services, including long term, stat and routine studies. Our board-certified neurophysiologists and epileptologists can see up-to-the-second patient brain activity and interpret potential seizure risks. Discover a real-time EEG solution that can help you make quicker decisions on patient management for what's most important – better outcomes.

Reading is available 24/7/365 and includes:

- Integration with your existing readers to ensure full coverage.
- Comprehensive final reports for every study.
- Remote connection via your system or through CortiCare's HIPAA compliant software.
- All patient data remains with the hospital – right where it should be.
- A full credentialing department to ensure seamless documentation.

Going beyond the read: Consultation: Once a seizure has been identified, what's next? Our services don't just stop at monitoring and reading for potential seizure risks. Our team of Readers also provide seizure management consultation on therapeutic pathways – helping patients live healthier, always.

About CortiCare

CortiCare is a provider of technology and EEG monitoring solutions to neurology and neuro-critical care areas within the hospital.CortiCare employees have years of experience providing EEG monitoring services. Our expertise includes EEG equipment development, sales, operations and of course hands-on monitoring to ensure the highest standard of quality service. We work diligently with our clients to establish protocols, practices, and processes which have become an industry standard for cEEG monitoring.

CortiCare offers immediate monitoring services with registered EEG technologists who are on-call and available for real-time EEG monitoring. We are ready to provide support part-time, full-time or anytime that real-time EEG information is needed to help manage your critical care patients.

References

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