



The Kids Aren't All Right

Nonconvulsive Seizures Are Common in Critically Ill Children

Abend NS, Gutierrez-Colina AM, Topjian AA, Zhao H, Guo R, Donnelly M, Clancy RR, Dlugos DJ. *Neurology* 2011;76:1071–1071.

BACKGROUND: Retrospective studies have reported the occurrence of nonconvulsive seizures in critically ill children. We aimed to prospectively determine the incidence and risk factors of nonconvulsive seizures in critically ill children using predetermined EEG monitoring indications and EEG interpretation terminology. **METHODS:** Critically ill children (non-neonates) with acute encephalopathy underwent continuous EEG monitoring if they met institutional clinical practice criteria. Study enrollment and data collection were prospective. Logistic regression analysis was utilized to identify risk factors for seizure occurrence. **RESULTS:** One hundred children were evaluated. Electrographic seizures occurred in 46 and electrographic status epilepticus occurred in 19. Seizures were exclusively nonconvulsive in 32. The only clinical risk factor for seizure occurrence was younger age ($p = 0.03$). Of patients with seizures, only 52% had seizures detected in the first hour of monitoring, while 87% were detected within 24 hours. **CONCLUSIONS:** Seizures were common in critically ill children with acute encephalopathy. Most were nonconvulsive. Clinical features had little predictive value for seizure occurrence. Further study is needed to confirm these data in independent high-risk populations, to clarify which children are at highest risk for seizures so limited monitoring resources can be allocated optimally, and to determine whether seizure detection and management improves outcome.

Commentary

Have you ever had a problem with your house that wouldn't go away on its own, and a quick fix wouldn't work, and you tried to ignore it, and when you finally got somebody in to look at it he told you that the problem was much bigger than you ever expected and it would take many hours of work and a great sum of money to fix it? Then you're ready to read EEGs in the intensive care unit.

First, we found that patients presenting with convulsive status epilepticus stood a high chance of remaining in nonconvulsive status epilepticus (NCSE) by EEG even after convulsions had been controlled (1). In the neurologic intensive care unit, patients suffering from a variety of acute neurologic conditions also have a high incidence of NCSE (2), and these findings are echoed in the medical intensive care unit (3). Next we discovered that if we looked with intracranial electrodes, there were subclinical ictal discharges in many patients of which we had previously, presumably, been unaware (4).

Now, courtesy of Abend et al., our worst fears have been realized: no, the kids aren't all right either. Their series of 100 consecutive continuous EEGs in the pediatric intensive care unit (PICU) yielded subclinical seizures in 46 children—70% of whom had not had seizures that were clinically apparent—with frank NCSE in 19 of the 46.

We can't explain this away, either. The study was prospective, not a retrospective scan of an EEG lab database. The authors did not undertake EEG in every PICU patient, but their indication criteria were both broad and reasonable and included unexplained alteration of mental status, which made their criteria highly generalizable to the patient population and to standard clinical practice. And their numbers are not inflated by counting periodic discharges as seizures, as some researchers controversially do; only evolving rhythmic discharges of greater than 10 seconds were considered ictal.

It is not necessary to get an EEG on every PICU patient with brain disease, is it? Surely there must be some subgroups more likely to have subclinical seizures than others? Alas, the data from this cohort say otherwise. Electrographic seizures occurred in little kids and big kids, in kids who had a frank convulsion and kids who hadn't, in kids with MRI lesions and kids with normal imaging, in kids with preexisting epilepsy and those without, in kids in coma and kids who were merely lethargic, and in kids with every flavor of neurologic lesion. Not one significant and clinically useful predictor of electrographic seizures emerged from this prospective survey. About the most informative thing we did learn from this study was to leave the machine running: half the children with seizures did not show them in the first hour, and a substantial percentage required more than 12 hours of EEG for seizures to be caught.

If there is something to question here, it's that the numbers are very different from those of a previous prospective study of continuous EEG in critically ill children, which found that only 7 of 100 had electrographic seizures (5). Abend et al. suggest a couple of major differences that might explain this difference.



One is the study population, of which 50% had primary neurologic disease in the earlier investigation (and the remainder, systemic medical illness) versus 90% of patients who had primary neurologic disease in the present investigation. Another reason, likely related to the first, is the protocol: in the former study, all children with a Glasgow Coma Scale less than 8 underwent EEG, whereas in the latter study, unexplained altered mental status, abnormal movements, or fluctuation of vital signs were required. Both of these differences might have been expected to enrich the population for electrographic seizure detection in the more recent investigation.

But even if both studies are equally off target, and the truth is in the middle, we are still likely looking at a circumstance in which at least a quarter of neurologically critically ill children are having seizures, mostly undetectable by any means other than EEG. At a minimum, this means application of the lumbar puncture rule—if you think about it, do it—to EEG monitoring for PICU patients with neurologic conditions. At most, we are looking at a large new infrastructure for any tertiary care center to support the technical and clinical effort needed to review continuous EEGs on an entire ICU of patients, with all the attendant costs.

Thinking more broadly, the issue of nonconvulsive seizures in the critically ill of all ages can no longer be ignored. What that means, more than anything, is determining whether detection and treatment of these seizures impacts clinical outcomes. True believers quote chapter and verse regarding the harms of status epilepticus to the brain, but that does not always square with the observations of those of us in the trenches, who occasionally see patients with days or weeks of unstoppable seizures who improve clinically nonetheless and even recover normal neurologic function. So is there a danger-

ous kind of status epilepticus and a non-dangerous kind? Are electrographic seizures a cause of neurologic impairment or merely a marker for the underlying condition? Is the treatment, which often involves potent sedatives, intubation, and cardiovascular suppression, better or worse than the disease? It is hard to imagine this can be settled in any fashion other than a randomized, controlled trial.

That is a daunting job, but at this point, we may not have a choice. Quick fixes and wishful thinking have proven inadequate to the task of determining which is worse, the disease or the treatment. It's time to call someone in to get to the bottom of this.

by Scott Mintzer, MD

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