The Utility and Feasibility of Telemetry EEG in the Emergency Department

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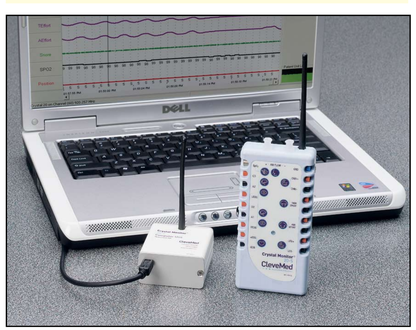
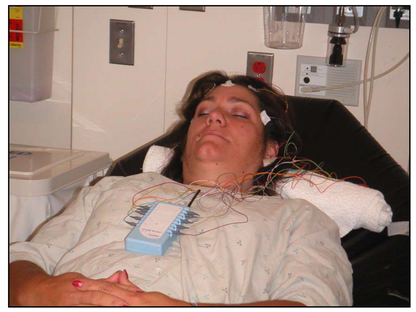
Rationale

There are 14 million yearly visits to the Emergency Department (ED) by patients with a potential for undiagnosed seizure disorder. Due to the cost and expertise required to test and read an electroencephalogram (EEG), most hospitals cannot provide EDs with real-time EEG coverage. Thus, patients are often admitted to the hospital for work-up with their potential seizure disorder undiagnosed and untreated for days. A portable, wireless multi-channel EEG device (Crystal Monitor) was developed to provide a screening EEG in the ED. The Crystal Monitor utilizes a four-channel montage to minimize set-up time and maximize brain area coverage. The data is digitized allowing a neurologist with internet access to interpret the EEG and provide immediate feedback. The objective was to evaluate the feasibility of a wireless, four-channel screening system on selected patients in the ED.

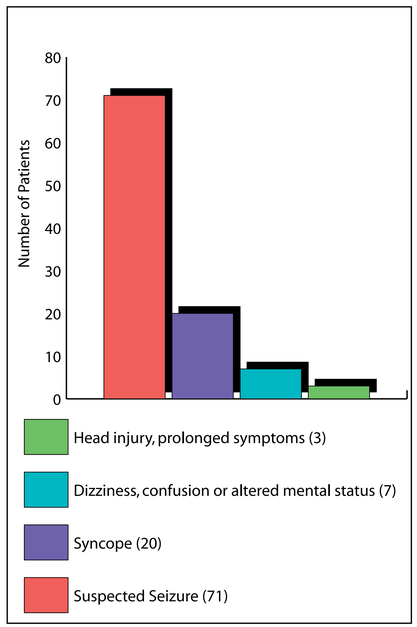


Crystal Monitor 20

Patient with Crystal Monitor® 20 attached:



"Crystal Monitor" is a registered trademark of Cleveland Medical Devices Inc. of Cleveland, Ohio.



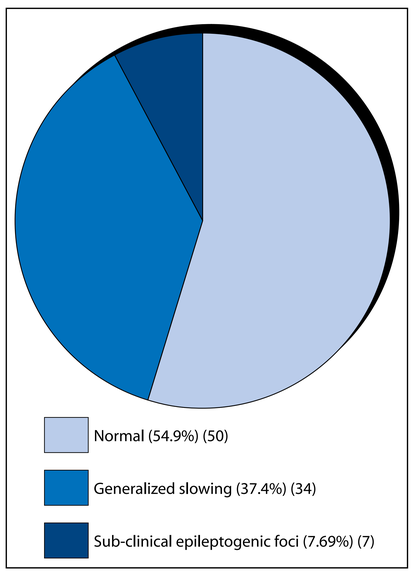
ED Patient Types

Methods

We conducted a prospective observational study on patients presenting to William Beaumont Hospital's Troy location ED, a 279 bed community hospital located just north of Detroit, MI with a yearly ED census of 65,000 patients. Adult patients (age > 18 years) with a preliminary diagnosis of syncope, potential partial-complex or generalized seizure disorder, head injury with prolonged symptoms or acute undiagnosed altered mental status were eligible for enrollment. Patients with a confirmed non-neurologic diagnosis for their presenting complaint were excluded. Eligible patients were then asked to complete an informed consent and had a four-channel EEG performed by a trained ED research assistant with no prior EEG experience during the ED stay. The EEG data was then encrypted and transmitted over the internet for interpretation by the study neurologist. The ED physicians were blinded to the result; therefore, treatment plan was not altered. Primary outcome measures were EEG quality and EEG diagnosis. EEG quality was evaluated using the following criteria: 1 = poor quality, unusable, 2 = fair quality, acceptable, 3 = good quality, acceptable 4 = excellent quality, acceptable.

Results

A total of 101 patients have been enrolled in the trial with 39.6% female and a mean age of 59.5 years. The indication for a screening EEG was: 1) witnessed or suspected seizure disorder (71/101); 2) syncope (20/101); 3) dizziness, confusion or other altered mental status (7/101); and 4) head injury with prolonged symptoms (3/101). The EEG quality was acceptable in 91/101 of the performed EEGs. The EEG interpretation for all acceptable EEGs was: 1) normal (50/91) with 2 of those patients diagnosed as having a pseudoseizure, 2) generalized slowing (34/91) with 11 of those patients being post-ictal patients, and 3) sub-clinical epileptogenic foci (7/91).



ED EEG Results

Study Results

EEG Quality	*Total*
1 = poor quality, unusable	*10 (9.90%)*
2 = fair quality, acceptable	*41 (40.6%)*
3 = good quality, acceptable	*44 (43.6%)*
4 = excellent quality, acceptable	*6 (5.94%)*
	101 (100%)

EEG interpretations (10 unusable EEGs were not included):

- 50/91 (54.9%) EEGs were interpreted as normal
- 34/91 (37.4%) EEGs were interpreted as slowing
- 7/91 (7.69%) EEGs identified a sub clinical epileptogenic foci

Correlation with Standard Inpatient EEG:

- 32/91 (35.2%) patients with EEG had an inpatient EEG
- 25/32 (78.1%) were equivalent to the study EEG

Phase II Changes

For the Phase II study, we will be testing more patients using 8 channels strategically placed over areas with a high probability of showing itcal discharges but easy for ER staff to consistently place without full scalp measurements (i.e., T1, T2).

Discussion and Future Considerations

Understanding that EEG is a time-sensitive modality, it is important that we perform EEGs when they can be most useful, i.e. in the acute setting.

No enrolled patient failed to complete an EEG. Only 10 of 101 patients had poor quality EEGs primarily due to a combination of muscular artifact, gaps in the data per interference during wireless transmission (earlier generation radio only) and technical error following staff change.

Based on this data we believe that ED EEG provides valuable information to the ED physician, which can expedite safe medical care. We do not assert that a four-channel EEG is superior or equivalent to the standard EEG.

We do believe its use as a screening tool in the ED provides the ED physician with the additional information necessary to make a more appropriate disposition from the ED.

Conclusions Simplified

Four-channel telemetry EEG used in the ED is feasible, provides good quality screening EEGs and was able to diagnose underlying seizure in a significant number of patients.

Acknowledgments

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