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Electroencephalogram in Intensive Care Unit

ORIGINAL

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Abstract

Introduction: The electroencephalogram (EEG) is the electrophysiological recording of synaptic activation of a lot of pyramidal neurons of the cerebral cortex. The applicability of the EEG in the diagnostic investigation of central nervous system diseases (CNS) such as epilepsy was readily established and widespread.

Objectives: Know the main findings and EEG indications in a intensive care unit, trace the epidemiological profile of ICU patients, and correlate EEG findings to possible changes in therapy.

Method: Descriptive and retrospective study conducted in the ICU of Hospital Medical Center Maranhense analyzing all EEG conducted from October 2011 to October 2012.

Results: 35 EEG were analyzed in 29 patients. Of these patients, 17-58.6% were male and 12-41.4% were female. In our study we found that the cerebrovascular accident was the clinical condition most often observed, corresponding to 28.5% (brain hemorrhagic stroke - 17.1% and ischemic stroke - 11.4%), followed by traumatic brain injury (17.1%), severe sepsis (17.1%), other causes (14.3%), toxic-metabolic encephalopathy (11.4%), and Status epilepticus (11.4%). Coma was present in (11.4%) and only 2.9% had EEG to assess post-PCR. We found a disorganized background activity (35 - 100%), the asymmetrical pattern is found in 21 (60%) and symmetrical in 14 (40%) The presence of epileptiform discharges was identified in 12 (34.2%). A change of therapy occurred in 8 (22.9%) patients who underwent electroencephalographic examination.

Conclusion: We note that the indications responsible for electroencephalographic monitoring on the edge of the bed were frequently

altered level of consciousness and seizures. Before electroencephalographic patterns analyzed by the study, we realized that in all tests the background activity was disorganized and there was a significant incidence of epileptiform discharges.

Keywords
Electroencephalogram; ICU; Electroencephalographic Patterns.

Introduction

The electroencephalogram (EEG) is the electrophysiological recording of synaptic activation of a lot of pyramidal neurons of the cerebral cortex. The German psychiatrist Hans Berger is credited as the first to perform the human EEG records in 1924 [1].

The applicability of the EEG in the diagnostic investigation of central nervous system diseases (CNS) such as epilepsy, was readily established and widespread [2].

The evaluation of the EEG in the intensive care unit (ICU) provides a noninvasive measure the edge of the bed of brain function in critically ill patients [3].

Recently, with continuous EEG monitoring have been indicated in intensive care units (ICU) in patients with subarachnoid hemorrhage (SAH), intracranial bleeding, traumatic brain injury (TBI), epilepticus state, and neurological diagnostic situations inconclusive or the monitoring of sedation in critically ill patients [4].

Abend et al (2010) in a search with doctors neurologists found as the primary indication of the EEG in the ICU epilepticus state detection and non-convulsive. [5]

Garzon conceptualized the status epilepticus as a seizure lasting more than or equal to 30 minutes or repeated shorter duration of crises but without regaining consciousness. [6]

The neurological monitoring of patients with SAH initiated a new strategy for the early detection of cerebral vasospasm, more feared and disabling complication of this disease. Vespa et al (2005) conducted a study in 32 patients with SAH, which found a decrease in quantitative variability relative of alpha waves (AR) in 100% of patients with vasospasm, angiographically confirmed in 10 of 19 patients, a decrease of AR preceded the clinical diagnosis of vasospasm in 2.9 days. [7]

The patient with severe TBI admitted to the ICU has a high rate of morbidity and mortality, with only 20-30% of patients achieving functional independence during its evolution. The prevention of secondary brain injury is one of neuro intensivism pillars and between this the prevention and monitoring of convulsions during its progress in order to reduce and protect the brain through immediate intervention. [8]

Frequent monitoring of electroencephalographic indication in ICU patients is diagnostic confirmation of EEG silence, characterized by a lack of brain electrical activity. [9]

We decided to conduct a study to know the main indications for electroencephalographic monitoring, its possible findings, epidemiological profile of patients undergoing examination, therapeutic changes correlated with EEG findings and clinical outcome of the patient.

Method

This is a retrospective study, through the analysis of medical records of patients who underwent EEG from October 2011 to October 2012. The sample corresponded to the EEG number during the study period. Data collection was performed with the aid of a standardized form, developed by the authors, and consist of the following variables: age, gender,

indications for EEG, ICU admission diagnosis, EEG findings, change of therapy compared to EEG findings and the clinical outcome of the patient.

After collection, the data were tabulated in a spreadsheet using Excel 2007 program. Later they were exposed in descriptive tables and statistical analysis was performed using the Statistical 7.0 software, considering a 0.05 significance level. To compare the proportions of qualitative variables, we used chi-square test with Yates correction. The analysis of mean differences between quantitative variables in the qualitative function was performed by ANOVA test "one way".

Results

35 EEG were analyzed in 29 patients, five patients underwent more than one test. Of these patients, 17-58.6% were male and 12-41.4% were female. The average age of the patients was found 64.59 ± 17.91%. With regard to clinical outcome, we observed that 79.3% of the evaluated were discharged and only 20.7% died.

The initial diagnosis of the participants is the diagnosis of admission, which is the reason for hospitalization in the intensive care unit. In our study we found that the cerebrovascular accident was the clinical condition most often observed, corresponding to 28.5% (brain hemorrhagic stroke - 17.1% and ischemic stroke - 11.4%), followed by traumatic brain injury (17.1%), severe sepsis (17.1%), other causes (14.3%), toxic-metabolic encephalopathy (11.4%), and status epilepticus (11.4%). Not occurring statistical significance when correlated diagnosis and mortality.

The electroencephalographic monitoring was asked if the patient had change consciousness level (62.7%), seizures (25.7%) or an association of change of consciousness with convulsion (8.6%), and only 2.9% EEG performed to evaluate post-PCR.

The EEG findings were identified from five electroencephalographic patterns that are: activity, symmetry and attenuation of background activity, epileptiform discharges, periodic patterns, electrographic status and electroencephalographic silence.

In all EEG evaluated found a disorganized background activity (35-100%), the asymmetrical pattern was found in 21 (60%) and symmetrical in 14 (40%). The attenuation of background activity was present in 29 (82.9%) of the reports. The presence of epileptiform discharges was identified in 12 (34.2%), though most did not show this pattern 23 (65.7%). Of the 35 reports, 7 (20%) had electroencephalographic status and between them, 4 (11.4%) had epileptiform pattern, while 3 (8.57%) met periodic pattern.

A marked result of this study was that all patients with electrographic status had resolution of crises and were discharged.

A change of therapy occurred in 8 (22.9%) patients who underwent EEG examination. In one patient he was suspended neuroleptic because it was identified in a standard EEG compatible with lithium intoxication. In two patients with anoxic encephalopathy was adjusted the anticonvulsant dose. Among the three cases of non-convulsive status, two were shown to be refractory to the use of anticonvulsants line 1 and 2 being started Propofol as a therapeutic alternative and in the third adjusted the dose of Topiramate. The last change was the suspension of Propofol, for it was from a patient with EEG silence.

The epileptiform discharge was identified equitably compared the identified pathologies, but curiously was not present in patients who were hospitalized with convulsive status.

Results in **Tables**: **1**, **2**, **3**, **4**, **5** and **6**.

Table 1.

Gender	N	%
Female	12	41.4
Male	17	58.6
Total	29	100.0

Table 2.

Initial Diagnosis	N	%
Brain hemorrhagic stroke	6	17.1
Traumatic brain injury	6	17.1
Severe sepsis	6	17.1
Other causes	5	14.0
Ischemic stroke	4	11.4
Toxic-metabolic encephalopathy	4	11.4
Status epilepticus	4	11.4
Total	35	100.0

Table 3.

Indications	N	%
Changed level of consciousness	22	62.7
Seizures	9	25.7
Association of change of consciousness with convulsion	3	8.6
Post-PCR evaluation	1	2.9
Total	35	100.0

Table 4.

EEG findings		N	%
Background activity	Disorganized	35	100.0
Symmetry background activity	Symmetric	14	40.0
	Asymmetric	21	60.0
Epileptiform discharges	Yes	12	34.3
Periodic pattern	Yes	11	31.4
Electrographic status	Yes	7	20
Electroencephalographic silence	Yes	1	2.9

Table 5.

EEG findings	Indications							
	1		2		3		4	
	N	%	N	%	N	%	N	%
Ictal pattern								
Yes	3	13.6	0	0.0	1	33.3	0	0.0
No	19	86.4	9	100.0	3	100.0	1	100.0
Non-ictal pattern								
Yes	1	4.5	2	22.2	0	0.0	0	0.0
No	21	95.5	7	77.8	3	100.0	1	100.0

Table 6.

Initial Diagnosis	Outcome				
	Discharge		Death		Chi-square*
	N	%	N	%	
	29	82.9	6	17.1	
Brain hemorrhagic stroke					
Yes	5	13.6	1	16.7	0.5748
No	24	86.4	5	17.2	
Traumatic brain injury					
Yes	5	83.3	1	16.7	0.5748
No	24	82.8	5	17.2	
Severe sepsis					
Yes	4	66.7	2	33.3	0.5748
No	25	86.2	4	13.8	
Ischemic stroke					
Yes	3	75.0	1	25.0	0.7935
No	26	83.4	5	16.6	
Status epilepticus					
Yes	3	75.0	1	25.0	0.7935
No	26	83.4	5	16.6	

Discussion

The electroencephalogram is a noninvasive method, easy to perform the bedside, and brought precious information regarding brain electrical activity in critically ill patients with altered consciousness, making possible the diagnosis of non-convulsive status. [10, 11]

In our study, the most common indications for performing the EEG were respectively changed level of consciousness (51.4%) and the presence of seizures (25.7%). Seo et al [12] states that the changed level of consciousness is not the best predictor of patient prognosis, since there are various levels of consciousness, so we must keep in mind that early detection of seizures, and appropriate treatments are important to reduce mortality and improve the prognosis.

Kamel et al [13] asserts that seizures occur after neurological injury and are strongly implicated in the pathogenesis of altered state of consciousness and

possible worsening of the injury neurológica. Mullen (2012) reports that early seizures occur in 4-18% of patients with accident vascular brain hemorrhage and patients who had seizures were associated with greater number of craniotomy and high hospitalization rates. [14] Vespa et al 2003 in an elegant study evaluating 109 patients with stroke (hemorrhagic stroke - 63, ischemic stroke - 46) identified 27.8% of seizures in patients with hemorrhagic stroke and only 6% in ischemic stroke. And 19% with clinical seizures without identification EEG, 76% only with electrographic status [15]. Similar findings were observed in our study when evaluating convulsive status not identified electrographic seizures. What can be explained by the time of the examination and the institution of appropriate therapy.

In a recent review, Friedman draws attention to patients with changed level of consciousness to arrive at the ICU are readily monitored for cardiac and respiratory function, but no monitoring of brain activity as a probable source of organ dysfunction is performed. Claasen et al analyzed 110 patients at the time of his first crisis, identifying seizure activity on EEG in more than 50% within the first hour monitoring. [17]

Seo et al proposes that EEG patterns give important clues in the elucidation of mental status changes, however it emphasizes the lack of specificity of these standards in determining the prognosis and is essential to correlate these findings with the clinical context in which they are. [12]

Kamel, studying 105 patients with EEG in the ICU where 89% were clinical, found that 27% had a history of seizures, 29% sepsis, 17% metabolic disorders, and 11% respiratory failure. In our research we found 11.4% with convulsive status, 17.1% with sepsis, but most patients who underwent EEG were neurological 45.6% (hemorrhagic stroke -17.1%, ischemic stroke - 11.4%, traumatic brain injury - 17.1). Corroborating our findings Hirsh found 40% of neurological disorders in which underwent electroencephalography. [18]

An extremely important aspect is the time of the EEG, because according to Young et al, when non-convulsive status were diagnosed within 30 minutes of the start of the event, mortality was 35% compared to 75% of diagnosed after 24 hours. In our sample we found 17% of deaths not being related to the EEG findings, but the severity the base disease. [19]

In a prospective, multicenter study comparing the use of PRO versus barbiturates, Rossetti et al stated that the status epilepticus that does not respond to anticonvulsant drug of 1st and 2nd line is termed refractory epileptic state, and their mortality reaches 16-39%. Once diagnosed, we must start a new therapeutic strategy as Propofol, Midazolam or Barbiturates. The author concluded that the control of refractory evil states were more frequent after the use of Propofol. In our research, we could not determine any differences in efficacy between drugs since only in two cases refractory Propofol was started as an alternative to ACD (1st and 2nd line); and none was used barbiturates.

Conclusion

In our study we conclude that the public admitted to our ICU was composed mainly of elderly people who had the most common admission diagnosis acute neuronal injury. The most prevalent clinical entity hemorrhagic stroke.

We note also that the indications responsible for electroencephalographic monitoring on the edge of the bed were frequently changed level of consciousness and seizures.

Before electroencephalographic patterns analyzed by the study, we realized that in all tests the background activity was disorganized and there was a significant incidence of epileptiform discharges, standard higher predictive value in the diagnosis of status epilepticus non-convulsive.

A strong point of our study was the correlation between the presence of non-convulsive status and

clinical outcome of the patient. We have detected all patients who developed status epilepticus non-convulsive were discharged from hospital.

Our research, due to the size of the sample had no strength to correlate the findings and possible changes in therapy, since only eight patients had changes in therapy.

Therefore, completion of the EEG at the bedside is very important for early diagnosis of status epilepticus non-convulsive, and may improve the clinical outcome of these patients.

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