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Do patients need to stay in bed all day in the Epilepsy Monitoring Unit? Safety data from a non-restrictive setting

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ABSTRACT

Purpose: To assess whether injuries occur more often in an Epilepsy Monitoring Unit (EMU) where portable EEG amplifiers are used, and where patients can freely move within a large area during the monitoring.
Methods: Patients were monitored at the Danish Epilepsy Center, in an EMU specifically designed for this purpose, and they were under continuous surveillance by personnel dedicated to the EMU. Adverse events (AEs) – including injuries, were prospectively noted, as part of the safety policy of the hospital. Other data were retrospectively extracted from the electronic database, for a 5-year period (January 2012–December 2016).
Results: 976 patients were admitted to the EMU. Falls occurred in 19 patients (1.9%) but none of them resulted in injury. Only one serious AE occurred: a patient had a convulsive status epilepticus, which did not respond to first-line treatment in the EMU and was transferred to the intensive care unit. The rate of AEs were similar or lower than previously reported by other centers, where the mobility of the patients had been restricted during monitoring.
Conclusion: In an EMU specially designed for this purpose, where patients are under continuous surveillance by personnel dedicated to the EMU, injuries can be avoided even when the mobility of the patients is not restricted.

1. Introduction

Long term video EEG monitoring is the best diagnostic tool for characterizing the intricate electro-clinical phenomena that occur during epileptic seizures and other paroxysmal events [1–3]. It requires elective admission to an Epilepsy Monitoring Unit (EMU). Though generally considered a safe investigation, with few possible complications, there have been a number of adverse events associated with the stay in an EMU, ranging from generalized tonic-clonic seizures to status epilepticus or even death [4–8]. In order to avoid injuries, and due to the lack of wireless amplifiers, in many EMUs, the patients' mobility is restricted, and they need to spend the whole time or most of the time in bed [9,10].

There are no generally accepted guidelines about the safety measures in the EMUs, and this has created a great variability in the safety measures adopted by different EMUs [11–14]. These measures can sometimes be very restrictive for the patients, especially when the duration of the stay is longer [13,15–17].

There is no consensus as to what should be the minimum safety requirements in an EMU [11,12,18] and not all of the safety measures being used at present have proven efficient in decreasing the risk of injuries [15,16,19].

In our EMU, specifically designed to decrease the risk of injuries in case of falls, patients are free to move around and perform their daily activities, under continuous surveillance by personnel dedicated to the EMU. This eliminates the need for deep vein thrombosis prophylaxis and increases the degree of comfort for the patients.

As stipulated in the Danish Healthcare Quality Program [20] and the safety policy of the Danish Epilepsy Centre, we have prospectively monitored all serious adverse events that occurred in the EMU, at the Danish Epilepsy Centre. In this study, we present

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the adverse events that occurred in the last 5 years (2012-2016). The major goal was to assess whether the rate of injuries due to falls is higher in our setting, compared to what previously has been reported by centers, where the mobility of the patients was significantly restricted [12,15,17].

2. Methods

2.1. The Epilepsy Monitoring Unit

The EMU described in this paper is situated at the Danish Epilepsy Centre, Filadelfia, the only specialized hospital for comprehensive care of patients with epilepsy, in Denmark. The hospital was founded in 1897, and it is a tertiary referral center. Together with the Copenhagen University Hospital, Rigshospitalet, it constitutes the network for the Danish epilepsy surgery program. The EMU is part of the Clinical Neurophysiology Department, and it was built in 2005, being specially designed for this purpose. The unit comprises four single-patient bedrooms, each with own bathroom. The dining room, the living room and the terrace are shared by all patients, and there is a play room for children. There is a surveillance room and a technical room in the unit, which is physically connected both to the Clinical Neurophysiology and to the Neurology departments. see Appendix 1 in Supplementary material shows the plan and photos of the EMU.

Four patients are simultaneously monitored in the EMU – usually two children and two adults. Children are admitted together with one of their parents. The portable EEG amplifiers are wirelessly connected to access points located in the EMU and the patients are not restricted in their mobility within the unit. Patients can use exercise bikes, a home video game console with a handheld controller device which detects movements (Nintendo Wii) allowing the patients to play games involving physical activity, and children have access to a broad spectrum of toys, matching their age and development. The rooms are specially designed for epilepsy monitoring: besides electric shielding, this includes measures to prevent injuries in case of falls: soft material of the flooring, rubber tiles on the terrace, avoiding sharp edges of the furniture, placing soft, protective materials on edges and hard surfaces. Patients with suspected hypermotor seizures, sleep on a mattress directly placed on the floor. Only the mobility of patients with severe physical and intellectual disability is restricted to their rooms, and an extra personnel is continuously present in their room. In this setting only non-invasive monitoring is done. Patients with implanted electrodes are monitored at another EMU facility (Rigshospitalet). The lower age-limit in the EMU is 4 months.

There is continuous surveillance of the patients in the EMU. The personnel in the EMU consists of: two neurophysiology technicians and one nurse from 8 am to 4 pm, one technician and one nurse from 4 pm to 12 pm, and two nurses (one in the EMU and the other in the video surveillance room) from 12 pm to 8 am. The personnel is specifically trained for the tasks in the monitoring unit, and the hospital has a program for continuous professional education, including aspects relevant for the EMU. Three consultant physicians (board certified neurologists, with sub-specialty training in clinical neurophysiology) are responsible for the EMU, and they take shifts of one week each. During their shift in the EMU, these physicians do not have other duties. Each morning, a multidisciplinary team including adult and pediatric neurologists, clinical neurophysiologists and the personnel in the EMU discuss the seizures that occurred during the previous day, and they decide on continuing or stopping the monitoring, for each patient. Within two hours after the discharge of the patient from the EMU, a preliminary report is issued, while the final, detailed report is issued latest two weeks after the monitoring.

EEG is recorded using electrode arrays including the inferior temporal chain. Polygraphic channels include ECG (for all patients), surface electromyography (patients with motor seizures), respiration monitors (for PSG and in patients suspected for ictal apnea). A standardized behavioral testing battery has been used in the EMU since 2012, and during the last two years, this was replaced by the European standardized testing battery [21]. Totally 31 video-cameras are located in the EMU. The staff in the surveillance room chooses the optimal camera for each patient, and makes sure the patients are always in focus.

The monitoring is tailored to the individual needs of each patient: see Appendix 2 in Supplementary material shows the flowchart of the monitoring process, the list of items in the electronic referral system, and the items discussed during the planning of the monitoring for each patient. This included a risk assessment, as evaluated at the pre-monitoring multidisciplinary team meeting (see Appendix 2 in Supplementary material). When AED tapering is planned, this is started before the video-EEG monitoring, but in the hospital, under continuous video surveillance. Patients sign an informed consent before admission to the EMU.

At the annual patient-safety audit, adverse events and the potential adverse events are analyzed and then measures to avoid them are developed. The safety-team includes the staff in the EMU and external auditors.

2.2. Adverse events

Severe adverse events (AEs) were monitored prospectively. Other data were extracted retrospectively from the electronic database.

We considered the following to be AEs: status epilepticus (SE), seizure cluster, falls, serious cardiac abnormalities (asystolia, severe brady- or tachycardia), psychiatric symptoms (post-ictal psychosis, panic attacks, post-ictal aggression). When we calculated the total number of generalized tonic-clonic seizures (GTCS), we included both the primarily and the secondarily generalized ones. We did not consider these as AEs, unless they were in clusters or were prolonged over 5 minutes.

The following were considered severe AEs: death (including SUDEP), injury to the patient or the personnel, status epilepticus that could not be resolved with first-line AEDs in the EMU, and any other condition that lead to the discharge of the patient from the EMU earlier than planned. Injury was considered in the case it needed any medical intervention (diagnostic or therapeutic) or any additional care.

We collected demographic data (age, gender), data regarding the clinical history (reason for referral, a history of SE, post-ictal psychosis or falls) and the stay in the EMU (length of stay, drug tapering, number, type and time of occurrence of seizures, adverse events). All of the recording and medical records were reviewed by at least two of the authors.

The period of the survey was between January 2012 and December 2016.

For statistical analysis, we used Chi square or Fisher's exact test for categorical data, and for univariate analysis we used a parametric test (t test).

3. Results

In total 976 patients (528 were female, 428 male) were monitored in the EMU in the 5-year period. Their mean age was 24.57 (SD = 17.9, range 1-80 years), 384 patients under 16 years of age and 592 above 16 years. The mean duration of the stay was 3.2 days (range 1–5 days). Eighty of the patients (8.1%) had severe