Epilepsy & Behavior 58 (2016) 102–105

Contents lists available at ScienceDirect

Epilepsy & Behavior

journal homepage: www.elsevier.com/locate/yebeh

Brief Communication

Epilepsy monitoring unit length of stay

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ARTICLE INFO

Article history:
Received 2 December 2015
Revised 18 February 2016
Accepted 21 February 2016
Available online 9 April 2016

Keywords:
Video-EEG monitoring
Epilepsy monitoring unit
Length of stay
Quality metrics

ABSTRACT

With an increasing focus on quality metrics, hospital length of stay (LOS) in the U.S. has garnered significant scrutiny. To help establish evidence-based benchmarks for epilepsy monitoring unit (EMU) metrics, we evaluated the impact of multiple variables on LOS through a retrospective analysis of 905 consecutive inpatient adult EMU admissions. The most common reasons for admission were event characterization (n = 494), medication adjustment (n = 189), and presurgical evaluation (n = 96). Presurgical evaluations experienced a longer average LOS (aLOS) of 7.1 days versus patients admitted for other indications ($p < 0.001$). Patients with symptomatic generalized epilepsy (n = 22) had a longer aLOS (6.9 days) than patients with other types of epilepsy/events ($p < 0.001$). Patients admitted on two or fewer antiepileptic drugs (AEDs) had a shorter aLOS than patients admitted on three or more AEDs (4.3 days vs 6.3 days, respectively; $p < 0.001$). A history of previous invasive epilepsy management was associated with a longer aLOS than those without (6.2 days vs 4.7 days, respectively; $p < 0.0001$). Epilepsy monitoring unit aLOS is influenced by admission indication, epilepsy classification, medication burden, and having had prior invasive management. Multiple variables should be considered when analyzing LOS EMU metrics, arguing against a "one size fits all" approach.

1. Introduction

The efficiency of health care delivery is a priority for hospitals, and admission length of stay (LOS) has surfaced as a primary metric used to measure hospital efficiency. While medical centers typically review LOS data and compare them with benchmarks, the relevance of such administrative data can be limited; this is particularly true when data from hospital-wide admissions are grouped and analyzed en masse, reducing the applicability to individual EMUs.

The video-EEG (vEEG) monitoring provided by epilepsy monitoring units (EMUs) at level 3 and 4 epilepsy centers is critical in epilepsy diagnosis and management [1–5]. However, the paroxysmal nature of seizures makes EMU LOS standardization challenging. For fiscal year 2014, the arithmetic mean LOS for epilepsy admissions ranged from 3.3 to 5.7 days (D) depending on clinical complexity, yet with a relative lack of large scale EMU metric publications, evidence-based EMU admission guidance is limited [6].

The time needed to record a patient's first seizure/event has been previously reported, with the average time to first seizure/event ranging from one to two days [7–9]. Mean LOS for vEEG monitoring was five days, and 35% of patients required EMU admission for three or more days [7,8]. Patients with psychogenic nonepileptic seizures (PNES) have events more quickly than patients with epileptic seizures, although not all EMUs have replicated these findings [8–11].

Many EMU admissions are associated with risk, thus emphasis must be placed on patient safety; status epilepticus, postictal psychosis (PIP), and vertebral compression fractures have been previously reported [7]. A multicenter consortium of five U.S. EMUs found that, out of 169 patients with seizures over a one-year period, five (3.0%) experienced status epilepticus (SE), 30 (17.8%) experienced 4-hour seizure clusters, and 82 (48.5%) experienced 24-hour seizure clusters [10]. Risk avoidance commonly factors in to how quickly antiepileptic drugs (AEDs) are tapered. While AED reduction rates may impact LOS, the goal to efficiently record seizures should be balanced with a desire to avoid complications.

Multiple variables including the reason for EMU admission and patient-specific characteristics likely impact EMU LOS. Our study examined the LOS in a tertiary care EMU to determine which factors most impact LOS. Such information could ultimately be used to guide data-driven EMU LOS expectations.

2. Material and methods

Institutional Review Board study approval was obtained. Inpatient medical records of 905 consecutive patient admissions to the New York University Langone Medical Center Adult Epilepsy Monitoring Unit (January 1, 2011–December 31, 2011) were reviewed. Patients undergoing intracranial EEG monitoring were excluded. Reasons for admission, number of AEDs on admission, and other patient characteristics were obtained.

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http://dx.doi.org/10.1016/j.yebeh.2016.02.031
1525-5050/

Patients experiencing seizure exacerbations were included in the medication adjustment category because AEDs were changed to stabilize their epilepsy. Urgent patient admissions including patients in convulsive SE and patients directly admitted to an intensive care unit (ICU) were not included in this category. A separate analysis excluding patients in focal (partial) SE admitted directly to our EMU was performed. Status epilepticus was defined as continuous seizure activity or failure to return to clinical baseline between seizures, ranging from over 5 min to hours in duration.

Epilepsy surgery was defined as any intracranial electrode implantation with or without resection, a single stage resection, or a corpus callosotomy. Vagus nerve stimulator (VNS) implantation was analyzed separately.

Psychiatric diagnoses were grouped into three categories: (1) mood disorder: depression, bipolar, anxiety, panic disorder, and mood disorder NOS; (2) psychosis: schizoaffective disorder, schizophrenia, and psychosis NOS; and (3) other: conversion disorder, posttraumatic stress disorder, substance abuse, and eating disorders.

Statistical analyses were performed with STATA V.11.0 software. Continuous data were analyzed utilizing either a t-test (two groups) or ANOVA (more than two groups). Age was analyzed using a dichotomous cutoff (40 years and below, 41 years and above).

3. Results

Patient demographics and EMU admission indications are presented in Fig. 1(A–B).

The correlation between aLOS and admission indication is shown in Fig. 2A; patients admitted for presurgical evaluation had the longest aLOS (7.1 D). Fig. 2B illustrates the relationship between aLOS and epilepsy/event type.

Average LOS for patients on two or fewer AEDs ($n = 666$) was shorter compared with that for patients on three or more AEDs ($n = 239$) (4.3 D vs 6.3 D; $p < 0.001$).

The aLOS was longer for patients who had undergone prior invasive epilepsy management (including epilepsy surgery, VNS implantation, or both) compared with that for patients who had not undergone invasive management (6.2 D vs 4.7 D; t-test pairwise comparison $p < 0.0001$). This difference was reproduced when stratifying based upon the type of previous procedure(s) (ANOVA $p = 0.0001$; Fig. 2C).

Coexisting psychiatric illness impacted aLOS (Fig. 2D). Patients with a psychosis subgroup diagnosis ($n = 48$; 5.4 D) had a longer aLOS ($n = 48$; 5.4 D) than others (ANOVA $p = 0.0096$); more specifically, patients with a psychosis subgroup diagnosis trended toward a longer aLOS when compared directly to those without any psychiatric comorbidities (5.4 D vs 4.5 D; t-test $p = 0.06$). Postictal psychosis occurred in 26 patients during admission; aLOS was significantly longer for patients with PIP than for those without (7.6 D vs 4.7 D; $p < 0.0001$).

Seven patients experienced SE (focal or absence semiologies); 3 were admitted in SE, and 4 (0.4% of admissions) developed SE during admission. Status epilepticus was associated with an increased aLOS of 11 D versus 4.8 D when SE did not occur ($n = 898$; $p < 0.0001$). No cases of convulsive SE occurred.

Five patients were treated for infections during admission: 4 urinary tract infections (UTIs) and 1 pneumonia. The aLOS was 11.5 D for patients with UTIs and 8 D for the patient with pneumonia. Two cases of UTIs and the case of pneumonia were community-acquired. None of these patients experienced SE during admission.

Twenty patients experienced problems involving other organ systems during admission, including: hypertension, chest pain, pericarditis, bradycardia, supraventricular tachycardia, felbamate-related leukopenia, valproic acid-related transaminitis, rash, GI distress, and vaginal bleeding. In this group, aLOS was 7.2 D versus 4.8 D for those patients without perturbations of other organ systems ($n = 885$; $p = 0.0006$).

4. Discussion

This study represents the largest consecutive series of EMU admissions analyzed for LOS and is the first to examine specific patient characteristics that impact LOS, to our knowledge. Similar studies have been conducted in the field of stroke; one Canadian study revealed a shorter LOS when stroke patients were admitted to a stroke unit versus a general neurology/medical ward [12]. Our data demonstrate that admission indication, epilepsy syndrome, AED burden, presence or absence of psychiatric comorbidities, and a history of invasive management all impact EMU LOS.

Patients admitted for presurgical evaluation experienced longer aLOS than patients admitted for other indications. This likely relates to the need to record multiple seizures for a presurgical assessment, especially if dealing with multifocal ictal onsets [13]. Likewise, patients

(A)

Demographics:		
Age (N = 905)	13-96 years	
Male	N = 419	
Female	N = 486	
LOS:		
Mean LOS	4.8 D	
Median LOS	4.0 D	
Female (mean)	4.8 D	*t-test p = 0.9222
Male (mean)	4.8 D	
Age 40 years and below (mean)	4.7 D	*t-test p = 0.3
Age 41 years and above (mean)	4.9 D	

(B)

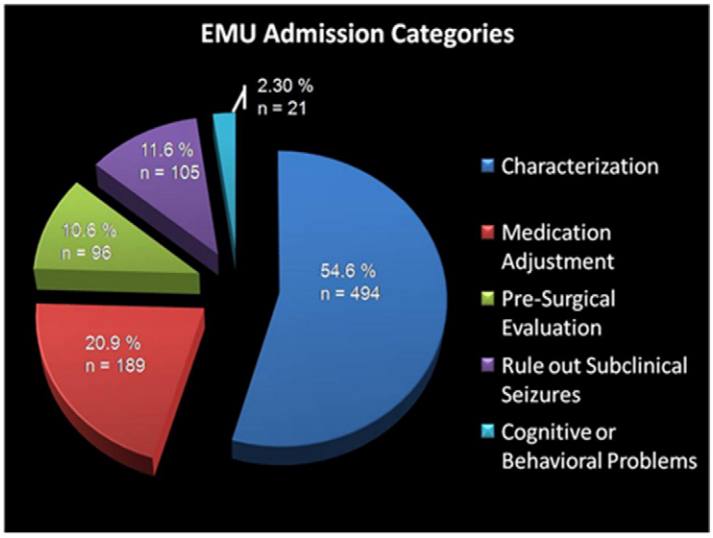

Fig. 1. Admission indication and average length of stay. Patient demographics (1A) and distribution of EMU admission categories (1B). 1A: *No statistically significant differences in LOS related to either gender (t-test $p = 0.9222$) or age (t-test $p = 0.3$) were found.