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ORIGINAL

Occurrence of seizures in hospitalized patients with a pre-existing seizure disorder

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ABSTRACT

Objective. To assess the frequency of seizures in hospitalized patients with a pre-existing seizure disorder.

Patients and Methods. A retrospective review was conducted on all patients with a documented seizure disorder who were hospitalized between January 1, 2002 and December 31, 2007. Children aged < 2 years and hospital admission for seizure control or surgical or obstetric indications were excluded. The first hospital admission of at least 24 hours was identified for each patient. Patient demographics, details of the seizure disorder, details of the hospital admission, and clinically-apparent seizure activity documented during the inpatient stay were recorded from the medical record.

Results. During the 6-year study period, 720 patients with a documented seizure disorder were admitted for at least 24 hours. Thirty-nine patients experienced seizure activity for an overall frequency of 5.4% (95% CI: 3.8-7.1%). Younger age ($p = 0.001$), greater frequency of baseline seizure activity ($p < 0.001$), recent seizure activity ($p < 0.001$), greater number of chronic antiepileptic medications ($p = 0.01$), and admission for neurological ($p = 0.03$) conditions were associated with increased frequency of seizure activity during hospitalization.

Conclusions. The majority of seizures occurring in hospitalized patients with a pre-existing seizure disorder appear related to the patient's underlying seizure disorder. Because patients with frequent seizures on numerous anti-epileptic medications are likely to experience a seizure while hospitalized, it is essential to be prepared to treat seizure activity regardless of the reason for admission.

Key words: seizure disorder, hospitalization, anticonvulsants

Introduction

In the general population, there is an 8-10% lifetime risk of experiencing a single seizure and a 3% risk of developing a seizure disorder. (1,2) Therefore, a significant proportion of patients with an underlying seizure disorder will present for inpatient treatment of unrelated conditions. Patients admitted to a hospital setting may experience physiologic changes from their normal state of health as well as changes to their usual daily routine (e.g., timing of medications). Many factors may contribute to a change in seizure

risk such as antiepileptic medication noncompliance, altered timing of antiepileptic medication administration, altered gastrointestinal absorption of these medications, electrolyte disturbances, and sleep deprivation. (3-6) These conditions regularly occur while patients are hospitalized. Furthermore, antiepileptic drugs are subject to many drug interactions and fluctuations due to substitution of generic antiepileptics for brand name, or a generic formulation from one manufacturer for the same generic drug produced by a different manufacturer. (7) A recent retrospective review of patients with a pre-existing seizure disorder hospitalized for a surgical procedure demonstrated that

young age, increasing number of antiepileptic medications, a short time span between last seizure and presentation for surgery, and more frequent seizures at baseline increased a patient's risk for in-hospital seizure activity. (8) There are currently no data examining the occurrence of seizures in patients with a pre-existing seizure disorder who are admitted for inpatient treatment of medical conditions unrelated to the seizure disorder. The objective of this retrospective chart review was to investigate the frequency of seizures in this patient population and identify potential risk factors affecting the likelihood of in-hospital seizure. The results of this investigation will allow a more accurate

estimate of the risk for in-hospital seizure in medical inpatients with a history of a pre-existing seizure disorder.

Materials and Methods

After Institutional Review Board approval, we conducted a retrospective query of the Mayo Clinic Life Science System database during the time period January 1, 2002 through December 31, 2007 to identify all patients that met the following inclusion criteria: age \geq 2 years, hospital admission > 24 hours duration, and seizure disorder documented in the medical record prior to hospital admission. Patients with a seizure disorder were identified by searching for International Statistical Classification of Diseases and Related Health Problems (ICD)-9 codes 345.0-345.91 and 780.3-780.39. From the patients identified, the database was limited to those patients with one or more hospital admissions during the study period with a length of stay greater than 24 hours. Patients were excluded if they had one of the following conditions: no confirmed seizure disorder (e.g., febrile seizure in children, acute symptomatic seizure due to trauma, electrolyte disturbance, infection, alcohol withdrawal), underwent a surgical procedure during the admission, admitted for an obstetric indication, or were < 2 years of age. The medical record from the first hospital admission was manually reviewed to collect the following data: date of birth, gender, admitting service, and duration of inpatient stay. In addition, the characteristics and clinical course of the pre-existing seizure disorder were recorded, including type of seizure disorder (simple partial, complex partial, generalized nonconvulsive, or generalized convulsive), seizure frequency, most recent seizure prior to admission, previous surgical management for the seizure disorder, antiepileptic medications, other medications the patient was taking at the time of admission (including as needed and over-the-counter medications), and blood levels of antiepileptic drugs within 2 weeks of admission. If the patient had multiple seizure types at baseline, the most

frequently occurring seizure type was recorded.

The primary outcome variable was the presence of clinically-apparent seizure activity anytime during the hospital admission. Clinically-apparent seizure activity was defined as seizures that were documented in the nursing notes or daily progress notes of the primary service or medical consultation team(s). For all patients identified as experiencing a seizure, the circumstances surrounding the event were collected, including the date and time of seizure, type of seizure, antiepileptic medications, medications administered at the time of the seizure, and antiepileptic drug blood levels within 14 days prior to hospital admission. The probable cause of the inpatient seizure activity was determined based on the frequency of pre-admission seizures, antiepileptic drug levels, electroencephalogram results, radiographic imaging obtained, results from neurology consultation, and documentation detailing seizure activity.

Baseline patient and procedural characteristics were summarized using mean \pm SD for continuous variables and frequency percentages for categorical variables. The frequency of seizures while hospitalized was summarized using a point-estimate and exact 95% CI. Baseline characteristics were compared between those who did and did not experience seizures using the Fisher's exact test. In all cases, a two-tailed p-value < 0.05 was considered statistically significant.

Results

During the 6-year study period, 720 patients were identified that met the inclusion criteria. The mean \pm SD age of these patients was 54.6 ± 23.3 years. Patient characteristics and hospital admission details are provided in table 1. Thirty-nine (5.4%; 95% confidence interval [CI] 3.8-7.1%) patients experienced seizure activity while admitted to the hospital during the study period. Factors associated with an increased risk of seizure during hospitalization included: younger age ($p = 0.001$), more

frequent baseline seizure activity ($p < 0.001$), more recent last seizure prior to admission ($p < 0.001$), and admission for neurologic ($p = 0.03$) illnesses (table 2). Patients admitted for cardiac illnesses were less likely to experience seizure activity during hospitalization ($p = 0.03$).

Details of the 39 inpatient seizures are summarized in tables 3 and 4. Of the 39 patients who experienced seizure activity while hospitalized, 38 patients had a seizure that was consistent with their usual seizure type. Five patients had a documented subtherapeutic antiepileptic drug level near the time of their seizure. Although they did not have drug levels assessed, an additional five patients likely had subtherapeutic antiepileptic drug levels in the setting of these medications being held or acutely changed. One patient with a vagus nerve stimulator had it turned off at the time of admission.

One patient experienced a seizure that was inconsistent with his typical seizure type. At baseline, this patient had simple partial seizures affecting his left upper extremity. While hospitalized for bowel obstruction, he experienced a generalized convulsive seizure consisting of coarse bilateral upper extremity tonic-clonic motion associated with altered consciousness, oxygen desaturation, and hypotension. This occurred while tube feedings were being initiated, with concomitant electrolyte disturbances. The seizure resolved spontaneously and no further seizure activity was noted throughout the hospitalization.

Discussion

By definition a seizure is the clinical manifestation of abnormally hyperexcitable cortical neurons. Isolated seizure activity is not uncommon over the period of a lifetime (e.g. febrile seizures in children, acute symptomatic seizures due to trauma, electrolyte disturbances, infection, alcohol withdrawal, etc.). However, individuals experiencing an isolated seizure are not regarded as having a seizure disorder. The cumulative incidence of epilepsy through age 74 years in Rochester, MN is 3.0%,

Table 1. Patient characteristics*

	Total (N=720)
Gender	
Female	359 (49.9%)
Male	361 (50.1%)
How long ago was last seizure?	
0-7 days	85 (11.8%)
8-28 days	56 (7.8%)
29-180 days	73 (10.1%)
181-365 days	29 (4%)
> than 365 days	433 (60.1%)
Not Documented	44 (6.1%)
Average frequency of seizures	
1 or more/day	28 (3.9%)
1 or more/week	37 (5.1%)
1 or more/month	60 (8.3%)
1 or more/year	85 (11.8%)
< 1/year	473 (65.7%)
Not Documented	37 (5.1%)
Type of seizure	
Simple partial	87 (12.1%)
Complex partial	190 (26.4%)
Generalized nonconvulsive	24 (3.3%)
Generalized convulsive	383 (53.2%)
Other	36 (5%)
Duration of hospital stay, days	
Mean (SD)	5.3 (6.11)
Median (IQR)	4 (2-6)
Range	0-84
Number of Pre-Admission Anti-seizure Medications	
None	92 (12.8%)
1	440 (61.1%)
2	153 (21.3%)
3 or more	35 (4.9%)
Admitting service†	
Cardiac	102 (14.2%)
Endocrine	14 (1.9%)
Gastroenterology /Liver	91 (12.6%)
Hematology/Oncology	29 (4%)
Infectious Disease	53 (7.4%)
Nephrology	10 (1.4%)
Neurologic	124 (17.2%)
Orthopedic	51 (7.1%)
Other Disease	85 (11.8%)
Psychiatric	104 (14.4%)
Pulmonary	94 (13.1%)

* Unless otherwise specified data are reported as number (%)

† The percentages do not sum to 100% because 31 had 2 admitting services and 3 had 3 admitting services.

with an incidence of any seizure episode near 10%. (9) This translates into a relatively large segment of the population diagnosed with a seizure disorder. Similarly, a significant proportion of

patients presenting for inpatient treatment of medical illnesses will have a seizure disorder.

Recent data suggests that the occurrence of postoperative seizure in pati-

ents with a seizure disorder undergoing regional anesthesia is infrequent (5.8%), and that regional anesthesia in such patients is not contraindicated. (10) In a follow-up study including all anesthesia types, the frequency of perianesthetic seizures in patients with a pre-existing seizure disorder was also low (3.4%), and unrelated to anesthetic technique. (8) This study also identified factors associated with perioperative seizure, including young age, increasing number of antiepileptic medications, shorter time period between last seizure episode and hospital admission, and more frequent seizures at baseline. Another much smaller retrospective manuscript examined the incidence of seizures in patients with epilepsy undergoing general anesthesia. (11) Seizures were observed in 2% of these patients, and no adverse effects after receiving general anesthesia were reported. The overall incidence of perioperative seizure is low as well, estimated an incidence of postoperative seizure of 3.1 per 10,000 as reported in a multicenter prospective cohort study in Thailand. (12) Patients undergoing all surgical (including neurosurgical) procedures and anesthesia types were included in this study; however the incidence of postoperative seizure in patients with an underlying seizure disorder was not reported.

A number of factors may increase the possibility of seizure activity in patients with a seizure disorder, including changes in antiepileptic drug levels, fatigue, stress, sleep deprivation, menstruation, electrolyte disturbances, and excessive alcohol intake. (3,4,13) There are multiple circumstances that may arise in the inpatient setting that would affect antiepileptic drug levels, including medication noncompliance, changes in dosing schedule or amount, addition or withdrawal of concomitant medications, and changes in gastrointestinal motility leading to delayed absorption and reduced bioavailability. (4,6) In particular, patients who do not take their usual oral medications due to tests and procedures or are unable to tolerate oral intake due to nausea and vomiting may be at particular risk,

as decreased antiepileptic drug serum levels may contribute to increased seizure activity. (5)

Ten patients in our study experienced perioperative seizure activity that was influenced by fluctuations in antiepi-

leptic levels. Five of these patients had documented subtherapeutic antiepileptic levels. The other five patients can be presumed to have had altered antiepileptic levels. Two of these patients had their antiepileptics deliberately discon-

tinued – one for a rash and one due to intentional medication overdose. A third patient was transitioning from valproate to carbamazepine in the setting of neuroleptic malignant syndrome. Another patient had her carbamazepine decreased and clonazepam discontinued due to delirium, and one patient had her phenytoin dose inadvertently decreased while hospitalized. Determination of a therapeutic level for antiepileptic medications is complex, and depends on individual patient factors and the timing of the blood draw. For some patients, their individual therapeutic level lies outside of the therapeutic range determined by the laboratory standard. In the cases included in our study, the neurologists consulting on these cases felt that the levels obtained were below the therapeutic range for these particular patients, which contributed to their seizure activity. Thus, maintaining an inpatient dosing regimen as close as possible to what the patient is accustomed to as an outpatient is an important step in minimizing the risk of seizure activity. However, a number of antiepileptics do not have a parenteral formulation which limits the ability to maintain outpatient medications in patients that are unable to take their usual oral preparations. In addition, the interpretation of blood levels may be challenging for practitioners unfamiliar with these medications. Patients who require more than one medication for seizure control present a particular challenge, as they are at an increased risk of seizure recurrence when medications are withdrawn or their dosage reduced. (8,14) Consultation with a neurologist may be necessary to formulate the most effective plan for these patients while they are hospitalized.

Patients that experienced seizure activity while admitted to the hospital were significantly younger than patients that did not. Importantly, the incidence of epilepsy is higher in the intellectually and developmentally disabled population, and there is increased morbidity and mortality in children with seizures and neurologic deficits. (15,16) Also, this group of young patients tends to have more frequent seizures and often require

Table 2. Characteristics associated with hospital seizure*

	No Seizure (N=681)	Seizure (N=39)	P-Value ¹
Age category, years			0.0014
Under 18	52	9 (14.8%)	
18-30	58	8 (12.1%)	
31-45	117	8 (6.4%)	
46-60	147	4 (2.6%)	
61-75	142	5 (3.4%)	
Over 75	165	5 (2.9%)	
How long ago was last seizure?			<0.0001
0-7 days	64	21 (24.7%)	
8-28 days	53	3 (5.4%)	
29-180 days	69	4 (5.5%)	
181-365 days	29	0 (0%)	
> than 365 days	423	10 (2.3%)	
Not Documented	43	1 (2.3%)	
Number of pre-admission anti-seizure medications			0.0138
None	90	2 (2.2%)	
1	421	19 (4.3%)	
2	140	13 (8.5%)	
3 or more	30	5 (14.3%)	
Type of seizure			0.5717
Simple partial	80	7 (8%)	
Complex partial	179	11 (5.8%)	
Generalized nonconvulsive	22	2 (8.3%)	
Generalized convulsive	364	19 (5.1%)	
Other	36	0 (0%)	
Average frequency of seizures			<.0001
1 or more/day	20	8 (28.6%)	
1 or more/week	30	7 (18.9%)	
1 or more/month	54	6 (10%)	
1 or more/year	81	4 (4.7%)	
< 1/year	461	12 (2.5%)	
Not Documented	35	2 (5.4%)	
Admitting service			
Cardiac	101	1 (1%)	0.0313
Endocrine	13	1 (7.1%)	0.5448
Gastroenterology/Liver	85	6 (6.6%)	0.6182
Hematology/Oncology	28	1 (3.4%)	1.0000
Infectious Disease	52	1 (1.9%)	0.3505
Nephrology	9	1 (10%)	0.4291
Neurologic	112	12 (9.7%)	0.0286
Orthopedic	49	2 (3.9%)	1.0000
Other Disease	79	6 (7.1%)	0.4456
Psychiatric	97	7 (6.7%)	0.4857
Pulmonary	91	3 (3.2%)	0.4618

* Unless otherwise specified data are reported as number (%)

¹ P values are according to Fisher Exact Test analysis

Table 3. Hospital seizure summary*

	Total (N=39)
Days from hospital admission to seizure	
0	9 (23.1%)
1	9 (23.1%)
2	6 (15.4%)
3	5 (12.8%)
4 or more	10 (25.6%)
Duration of seizure	
<1 minute	12 (30.8%)
1-5 minutes	14 (35.9%)
> 5 minutes	3 (7.7%)
Unknown	10 (25.6%)
Status epilepticus	
No	38 (97.4%)
Yes	1 (2.6%)
More than one seizure?	
No	15 (38.5%)
Yes	21 (53.8%)
Unknown	3 (7.7%)
Type of seizure	
Partial	17 (43.6%)
Generalized	22 (56.4%)
Was this a typical seizure for patient?	
No	1 (2.6%)
Yes	38 (97.4%)

* Unless otherwise specified data are reported as number (%)

hospitalization for routine procedures (e.g. radiology exams, dental exams and treatment) or injuries related to trauma incurred during a seizure. (17) The current study identified patients admitted for neurologic diagnoses who were at increased risk for seizure activity while a hospital inpatient. Twelve patients admitted for neurologic diagnoses experienced clinically apparent seizure

activity, and 7 of these 12 patients had an intracranial tumor or a current stroke. This parallels previous findings that perturbations of the central nervous system, including hemorrhagic and ischemic stroke, intracranial tumors, infections, and traumatic brain injury are common causes of seizure. (18-21) The current retrospective study has several limitations. Although this study

represents one of the largest such studies to date, the statistical power for assessing risk factors is limited due to the low number of seizures that were observed. The potential for missing data or undocumented events as well as the lack of continuous electroencephalogram (EEG) monitoring in our study may have underestimated the overall seizure frequency. Furthermore, the study included patients with a wide range of underlying medical issues, acute illnesses, and therapies. While our results are broadly applicable to patients admitted for medical management, we are unable to comment about the relative individual risk during specific illnesses or treatments.

Conclusion

Patients with an underlying seizure disorder infrequently experience seizure activity while admitted to the hospital for a nonsurgical condition. Young age, a greater number of antiepileptic medications, frequent seizures at baseline, and recent seizures prior to hospital admission are risk factors for inpatient seizure activity. Admission for neurologic and cardiac reasons also increased the risk of inpatient seizure. Most patients that have a seizure while hospitalized experience their typical seizure type. The patient's usual antiepileptic medication regimen should be followed as closely as possible while hospitalized. Health care providers should be prepared to treat seizure activity, particularly in those patients who have frequent seizures at baseline and those who have experienced seizure activity close to the time of admission.

Table 4. Patients with reported seizure activity while hospitalized

Gender age (years)	Admitting diagnosis	Seizure disorder	Time of last seizure prior to hospitalization	Frequency of seizures	Pre-admission anticonvulsant medications	Timing of seizure	Comments
Male (2)	Emesis Dehydration	Generalized convulsive	0-7 days	1+ per day	Topiramate Felbamate	Day one of hospitalization	<ul style="list-style-type: none"> Multiple medical problems Many seizures per hour Typical of patient's usual seizure Duration of seizure 1-5 minutes
Male (3)	Emesis Failure to thrive	Generalized convulsive	0-7 days	1+ per week	Lamotrigine	Day one of hospitalization	<ul style="list-style-type: none"> Multiple medical problems Typical of patient's usual seizure Duration < 1 minute
Male (7)	Vomiting Dehydration	Generalized convulsive	0-7 days	1+ per day	Felbamate	Day 6 of hospitalization	<ul style="list-style-type: none"> Multiple medical problems (Pretzel syndrome) Typical of patient's usual seizure Duration not documented
Female (3)	Pneumonia	Generalized convulsive	0-7 days	1+ per day	Clonazepam Lamotrigine Phenobarbital	Day one of hospitalization	<ul style="list-style-type: none"> Multiple medical problems (Miller-Dieker syndrome) Typical of patient's usual seizure Duration 0-2 minutes
Female (5)	Rash	Generalized convulsive	0-7 days	1+ per week	Carbamazepine Phenytoin	Day two of hospitalization	<ul style="list-style-type: none"> Developmental delay Patient status post corpus callosotomy Stopped Tegretol due to rash Typical of patient's usual seizure History of panhypopituitarism
Female (9)	Hypoglycemia	Complex partial	> 1 year	< 1 per year	Valproate	Day one of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Seizure lasted 3 minutes Seizure due to hypoglycemia (glucose 58)
Male (13)	Kidney stone	Generalized non-convulsive	8-28 days	1+ per week	Valproic acid	Day two of hospitalization	<ul style="list-style-type: none"> Cerebral palsy Typical of patient's usual seizure Duration < 1 minute
Female (17)	Suicidal ideation	Simple partial	8-28 days	< 1 per year	Valproate	Day two of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Valproate level low 3 days prior
Female (19)	Pneumonia	Generalized convulsive	0-7 days	1+ per day	Phenobarbital	Day three of hospitalization	<ul style="list-style-type: none"> Multiple medical problems (Static encephalopathy) Typical of patient's usual seizure Duration of seizure unknown
Female (17)	Sickle cell crisis	Simple partial	Not documented	Not documented	None	Day one of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Myoclonic jerks with a duration < 1 minute Seizures occur when sleep deprived and felt she was sleep deprived during hospitalization
Male (20)	Major depression Psychosis/catatonia	Complex partial	> 1 year	< 1 year	Dilantin	Day four of hospitalization	<ul style="list-style-type: none"> Traumatic brain injury from MVA at age 7 Typical of patient's usual seizure Duration > 5 minutes
Male (22)	Expressive aphasia	Simple partial	0-7 days	1+ per month	Levetiracetam Phenytoin	Day three of hospitalization	<ul style="list-style-type: none"> Oligoastrocytoma status post chemotherapy and radiation Neurology felt this was a progression of patient's typical seizures 4 seizures, all 2 minutes or less in duration
Male (23)	Crohn's ileocolitis	Complex partial	> 1 year	< 1 per year	Valproate	Day two of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Low Valproate level in setting of vomiting and diarrhea
Female (23)	Depression Paranoid delusions	Complex partial	0-7 days	1+ per week	Levetiracetam Zonegran	Day four of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Duration unknown Therapeutic antiepileptic levels
Female (24)	Hypertensive crisis	Generalized convulsive	0-7 days	< 1 per year	Valproic acid	Day of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Low Valproic acid level on admission
Male (34)	Dizzy spells Fall	Generalized convulsive	0-7 days	1+ per day	Phenytoin Valproic acid	Day three of hospitalization	<ul style="list-style-type: none"> Oligodendroglioma status post radiation Low phenytoin level Typical of patient's usual seizure Static encephalopathy
Male (28)	Plugged J-tube	Complex partial	0-7 days	1+ per month	Diazepam Phenobarbital	Day two of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Several seizures while hospitalized

Female (39)	Psychosis Overdose	Generalized convulsive	0-7 days	1 + per week	Carbamazepine Levetiracetam Phenytoin	Day two of hospitalization	<ul style="list-style-type: none"> Overdose of Levetiracetam Left temporal lobectomy in 1995 Typical of patient's usual seizure Medications on hold due to overdose
Male (42)	Gastrointestinal bleed	Generalized convulsive	0-7 days	1 + per week	Carbamazepine Levetiracetam	Day two of hospitalization	<ul style="list-style-type: none"> Global static encephalopathy Vagus nerve stimulator in place Typical of patient's usual seizure
Male (43)	Out of hospital arrest due to choking	Generalized convulsive	> 1 year	< 1 per year	Carbamazepine	Several days after admission	<ul style="list-style-type: none"> Severe mental retardation PEA arrest after choking on an apple Seizure in setting of anoxic brain injury
Male (40)	Lower extremity deep venous thrombosis	Generalized convulsive	8-28 days	1 + per month	Phenytoin	Day two of hospitalization	<ul style="list-style-type: none"> Oligodendroglioma status post chemotherapy and radiation Typical of patient's usual seizure
Female (44)	Frequent falls Headaches	Complex partial	0-7 days	1 + per month	Levetiracetam	Day two of hospitalization	<ul style="list-style-type: none"> Grade 1 pilocytic astrocytoma status post resection, chemotherapy and radiation in the 1970's Two seizures with a duration of 1-5 minutes Typical of patient's usual seizure
Female (44)	Depression	Simple partial	0-7 days	1 + per day	Clonazepam Levetiracetam Oxcarbazepine	Day one of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Vagus nerve stimulator placed in 2001, turned off at time of admission
Male (45)	Gram negative sepsis	Generalized convulsive	29-180 days	1 + per year	None	Day two of hospitalization	<ul style="list-style-type: none"> T-cell lymphoma Typical of patient's usual seizure Refractory seizures in setting of sepsis
Male (44)	Opioid withdrawal	Generalized convulsive	0-7 days	1 + per month	Carbamazepine Gabapentin Levetiracetam Phenytoin	Day three of hospitalization	<ul style="list-style-type: none"> Several seizures during hospitalization Typical of patient's usual seizure
Female (53)	Right hemiplegia with aphasia	Generalized convulsive	0-7 days	1 + per day	Levetiracetam Phenobarbital	Day one of hospitalization	<ul style="list-style-type: none"> Oligodendroglioma status post resection, chemotherapy and radiation in the early 1990's Typical of patient's usual seizure
Male (52)	Mental status changes	Simple partial	0-7 days	< 1 per year	Phenytoin	Day one of hospitalization	<ul style="list-style-type: none"> Multiple posterior circulation infarcts Typical of patient's usual seizure
Female (52)	Neuroleptic malignant syndrome	Complex partial	> 1 year	< 1 per year	Valproate	Day two of hospitalization	<ul style="list-style-type: none"> Severely mentally retarded Typical of patient's usual seizure Seizure in setting of transition from Valproate to Carbamazepine
Female (58)	Gait instability	Complex partial	0-7 days	1 + per month	Levetiracetam Phenobarbital Phenytoin	Day two of hospitalization	<ul style="list-style-type: none"> Right parietal occipital craniectomy Dilantin level high on admission Typical of patient's usual seizure Multiple seizures during admission
Female (60)	Right parietal stroke	Generalized convulsive	> 1 year	< 1 per year	Gabapentin	Several days after admission	<ul style="list-style-type: none"> Typical of patient's usual seizure History of drop attacks unrelated
Female (65)	Right lower extremity ischemia	Generalized convulsive	29-180 days	< 1 per year	Phenytoin	Several days after admission	<ul style="list-style-type: none"> Typical of patient's usual seizure Inadvertently decreased phenytoin dose while hospitalized
Male (68)	Dizziness	Complex partial	29-180 days	> 1 per year	Phenobarbital Phenytoin Primidone	Day two of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Phenobarbital level slightly high on admission
Female (69)	Delirium	Generalized convulsive	> 1 year	Not documented	Clonazepam Carbamazepine	Day three of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Decreased carbamazepine and discontinued the clonazepam prior to seizure
Male (70)	Dementia	Simple partial	29-180 days	1 + per year	Phenytoin	Day after admission	<ul style="list-style-type: none"> Several focal seizures lasting 1-5 minutes Typical of patient's usual seizure
Female (77)	Tense abdominal ascites	Generalized convulsive	0-7 days	1 + per week	Levetiracetam	Day two of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure
Male (79)	Acute polyarticular arthritis Gout	Generalized convulsive	> 1 year	< 1 per year	Phenobarbital Phenytoin	Day two of hospitalization	<ul style="list-style-type: none"> History of parietal occult arteriovenous malformation Low phenytoin level
Male (80)	Bowel obstruction	Simple partial	> 1 year	1 + per year	Zonisamide	Several days after admission	<ul style="list-style-type: none"> Initiation of tube feeds with electrolyte disturbances Seizure with desaturation and coarse tremor in upper extremities, different than usual per wife History of cerebrovascular accident
Male (82)	Vertebral insufficiency	Complex partial	> 1 year	< 1 per year	Carbamazepine	Several days after admission	<ul style="list-style-type: none"> Typical of patient's usual seizure In the setting of electrolyte disturbances and acute illness
Male (90)	Methicillin resistant staphylococcus aureus pneumonia	Complex partial	0-7 days	1 + per month	Carbamazepine Phenytoin	Day 5 of hospitalization	<ul style="list-style-type: none"> Typical of patient's usual seizure Elevated phenytoin level on admission Seizure in setting of multi organ system failure

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