



Yield of emergent neuroimaging in children with new-onset seizure and status epilepticus[☆]



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ABSTRACT

Purpose: To determine the yield of emergent neuroimaging among children with new-onset seizures presenting with status epilepticus.

Method: We performed a cross-sectional study of children seen at a single ED between 1995 and 2012 with new-onset seizure presenting with status epilepticus. We defined status epilepticus as a single seizure or multiple seizures without regaining consciousness lasting 30 min or longer. Our primary outcome was urgent or emergent intracranial pathology identified on neuroimaging. We categorized neuroimaging results as emergent if they would have changed acute management as assessed by a blinded neuroradiologist and neurologist. To ensure abnormalities were not missed, we review neuroimaging results for 30 days following the initial episode of SE.

Results: We included 177 children presenting with new-onset seizure with status epilepticus, of whom 170 (96%) had neuroimaging performed. Abnormal findings were identified on neuroimaging in 64/177 (36%, 95% confidence interval 29–43%) children with 15 (8.5%, 95% confidence interval 5.2–14%) children having urgent or emergent pathology. Four (27%) of the 15 children with urgent or emergent findings had a normal non-contrast computed tomography scan and a subsequently abnormal magnetic resonance image. Longer seizure duration and older age were associated with urgent or emergent intracranial pathology.

Conclusion: A substantial minority of children with new-onset seizures presenting with status epilepticus have urgent or emergent intracranial pathology identified on neuroimaging. Clinicians should strongly consider emergent neuroimaging in these children. Magnetic resonance imaging is the preferred imaging modality when available and safe.

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Abbreviations: ADEM, acute demyelinating encephalomyelitis; CT, computed tomography; ED, emergency department; IQR, interquartile range; ILAE, International League Against Epilepsy; MRI, magnetic resonance imaging.

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1. Introduction

Status epilepticus is one of the most common neurologic emergencies in childhood [1–4]. The primary goals of emergency care are to abate seizure activity and to identify potentially life-threatening or reversible etiologies of the seizure [5]. However, the role for emergent neuroimaging in this evaluation remains controversial.

Evidence around whether to obtain emergent neuroimaging in children with a new-onset seizure presenting with status epilepticus is limited [6]. Previous pediatric series have reported overall neuroimaging abnormalities in 34–49% [6–9] of children with status epilepticus, although many of these radiologic findings did not require urgent or emergent intervention. The American

Academy of Neurology practice parameter states there is insufficient evidence to support or refute recommending routine neuroimaging [10]. Conversely, the International League Against Epilepsy (ILAE) recommends new-onset seizures/epilepsy with a medical emergency such as status epilepticus always merit emergency imaging [10–12].

To further explore the role for neuroimaging, we sought to determine the yield of emergent neuroimaging among children presenting to a pediatric emergency department (ED) with new-onset seizures presenting as status epilepticus.

2. Materials and methods

2.1. Study design and setting

We performed a retrospective cohort study of children age 3 months to 18 years who presented to the ED of a single large urban pediatric tertiary care center between October 1995 and September 2012. The study was approved by the Institutional Review Board with a waiver of informed consent.

2.2. Case identification

We performed case identification in two phases. First, we created a computer-assisted key word screening tool using regular-expression matching to search the electronic medical record and identify potentially eligible ED encounters [13,14]. This technique provides a more comprehensive and inclusive search than key word searching by including misspelled and mistyped variations. Second, we refined the output of the search tool by manual medical record review.

2.3. Study population

We included children with no prior history of seizure and those with only a history of febrile seizure presenting with status epilepticus. Status epilepticus was defined in one of the following three ways: (1) a single convulsive seizure lasting ≥ 30 min, (2) multiple seizures with a cumulative duration ≥ 30 min without a return to neurologic baseline, or (3) a physician diagnosis of status epilepticus (only if neither of the preceding criteria were met and the seizure duration was not specifically documented as < 30 min) [15–18]. We excluded children with: documented head trauma in the preceding seven days, neurosurgery within 30 days, known central nervous system tumor, presence of a ventricular shunt, or known toxic ingestion.

2.4. Data collection and study definitions

We reviewed the complete medical records of all study patients. A document hierarchy was created for the purpose of increasing consistency. We abstracted data in a hierarchical fashion as follows: (1) ED note, (2) neurology consultation note, (3) admission note, (4) discharge summary, and (5) daily progress notes. We utilized documents lower in the hierarchy only to identify data elements that were missing from records given higher priority in the hierarchy. When attending and trainee medical records differed, we abstracted data from the attending documentation.

We collected the following factors: patient demographics, date of visit, duration of symptoms and clinical features, patient management including neuroimaging obtained and disposition. For the purpose of this study, we defined focality to a seizure as unilateral eye deviation, head tilt, or focal motor activity [17]. We defined febrile status epilepticus as status epilepticus with documented fever greater than or equal to 38.0°C obtained at home or by a medical provider [10]. We reviewed all available records to obtain available long term clinical follow-up. We included all cranial computed tomography (CT) and magnetic resonance imaging (MRI) imaging studies performed within 30 days of initial ED evaluation for status epilepticus. Because some children are too unstable to undergo imaging in the Emergency Department, we defined emergent neuroimaging as neuroimaging performed during the initial hospital visit. We included imaging 30 days after the index visit as well to identify any cases of urgent or emergent pathology that may have been missed had neuroimaging not been performed emergently.

2.5. Outcome measures

Our primary outcome was urgent or emergent intracranial pathology identified on neuroimaging (CT or MRI), which we defined as findings requiring emergent or urgent changes in patient management. In 2009, the ILAE defined 5 categories for neuroimaging abnormalities in recent onset epilepsy (Table 1) [11]. We utilized this classification scheme to categorize neuroimaging results. We classified categories 4 and 5 as urgent or emergent intracranial pathology as they were conditions that would change management beyond seizure control. Importantly, sinusitis was not considered a clinically significant abnormality.

A single study neuroradiologist (SBP), blinded to the clinical history, reviewed the neuroimages, interpreted each study and classified the results according to the ILAE system. In ambiguous cases, an ED physician (AAK), a pediatric neurologist (TL) and a neuroradiologist (SBP) came to a consensus classification.

Table 1
International league against epilepsy classification of neuroimaging results.

Abnormality	Definition	Examples
(1) Non-specific	Lesions not requiring immediate intervention that may be responsible for seizure	Periventricular leukomalacia, generalized cerebral atrophy
(2) Static-remote	Non-progressive lesions of the central nervous system that occurred remotely in time	Porencephaly, other malformations of cortical development
(3) Focal	Focal lesions responsible for seizure but not requiring immediate intervention	Focal cortical dysplasia, mesial temporal sclerosis
(4) Sub-acute or chronic ^a	Process responsible for seizure that does not require immediate intervention but has important therapeutic or prognostic implications	Brain tumor or mass, adrenoleukodystrophy
(5) Emergent ^a	Acute process requiring immediate, urgent intervention ^a	Ischemic stroke, cerebral hemorrhage, hydrocephalus, encephalitis, meningitis, metabolic cytopathy, cerebral edema, acute cerebral herniation, cerebral abscess, skull fracture with intracranial hemorrhage, new hypoxic injury

^a Referred to in our manuscript as urgent or emergent intra-cranial pathology.

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