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Review Article

Identification and management of seizures in children

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ABSTRACT

Estimates from epidemiological studies indicate the high global prevalence of seizures in children. They can be associated with different complications that might even be life-threatening. Different risk factors have been reported to increase the risk and severity of seizures, like metabolic disorders, infections, and reduced access to needed care. Therefore, providing appropriate management is essential to enhance the prognosis of these cases. In the present article, we conducted a literature review to shed more light on identifying, diagnosing, and managing seizures in children. The identification process depends on different factors, including obtaining an adequate history from the patient or their caregivers, performing a thorough general and neurological examination, and conducting appropriate investigations whenever needed. It should be noted that in severe cases, these approaches should be made promptly not to delay the management approaches, which can be life-saving. Reassuring family attendants is also recommended. Besides, increasing awareness among these families about the diagnosis, identification, prognosis, reporting, and responding to seizures might reduce the risk of recurrence and enhance the prognosis of seizures. Choosing a treatment strategy is usually based on different factors, including the child's age, epilepsy type, family preferences, the presence of comorbidities, and ability to administer medications. For recurrent seizures, home-based medications, like rectal diazepam or buccal midazolam, might also be used to lower the risk of recurrence and reduce the intensity of seizures.

Keywords: Seizures, Epilepsy, Pediatrics, Children, Diagnosis, Identification, Management

INTRODUCTION

Estimates from epidemiological studies indicate the high global prevalence of seizures in children. The majority of seizure episodes are short and do not usually last for more than five minutes. However, some events might last more than five minutes and are considered prolonged. Moreover, status epilepticus can be defined as the occurrence of more than one seizure without evidence of consciousness between the attacks or prolonged seizures lasting more than 30 minutes.[1] It can be life-threatening

and might induce serious complications and morbidities. Various etiologies have been reported for developing seizures, including. For instance, it has been shown that certain metabolic abnormalities, like hypoglycemic events, can commonly lead to seizures. Another risk factor is infections, which can predispose to acute symptomatic seizures, or febrile convulsions secondary to these infections.[2] It should be noted that evidence from relevant studies shows that the outcomes are usually better in immune-competent patients developing seizures secondary to infections.[3,4] On the other hand, immunocompromised patients, including patients with HIV, have a remarkably increased risk of developing seizures owing to factors related to the infection or due to the adverse events of the administered drugs.[5-7]

Epileptic children might also develop seizures secondary to refractory epilepsy, poor outpatient management, the presence of comorbidities decreasing seizures threshold, reduced access to needed medications, and poor compliance to appropriate treatment modalities. It has been further shown that the risk of seizures is greatly higher among children living in developing countries than in developed countries.[8-10] This might be attributed to the increased incidence of infections, poor perinatal care, and head trauma in these countries.[11-13] Therefore, it is essential to provide management approaches for affected children to enhance their outcomes.

Evidence shows that enhanced seizure outcomes are associated with providing optimal care.[14] Delays in seeking management approaches and reduced seizure awareness might lead to sub-optimal care. Therefore, it is recommended that seizures should be identified early and managed to reduce risk of developing complications, which might be life-threatening.[15,16] Physicians should adopt early and timely management approaches to achieve best quality of care. In present study, conducted literature review to discuss available evidence regarding identifying and managing seizures in children. This might increase awareness among emergency health care physicians about best practice of managing pediatric patients presenting seizures in emergency department.

LITERATURE REVIEW

The current study design is a narrative comprehensive literature review aiming at identifying and discussing articles that investigated the identification, diagnosis, and management of seizures in pediatric population. Accordingly, a comprehensive search conducted on the databases, including Web of Science, Google Scholar, PubMed, Embase and Scopus, to identify all relevant articles. We used MeSh terms to formulate search strategy. Moreover inclusion criteria included articles that investigated diagnosis and management of seizures in children, including observational studies and recruiting human subjects. Accordingly, studies that not original didn't include human individuals and didn't report outcomes of seizures in pediatric population excluded.

IDENTIFICATION

Clinical presentation

Evidence shows that the onset of seizures is significantly variable based on its type. For instance, a previous study showed that children aged 4-10 years usually develop childhood absence seizures. In contrast, individuals aged 10-20 usually have juvenile myoclonic epilepsy.[17] However, a first epileptic seizure is more likely to develop in childhood, and estimates show that children less than ten years are the most affected group of the population by these events.[13] There are two main types of seizures, including generalized and partial (focal). Although there might be other types of seizures, evidence shows that determining the type of seizures is remarkably useful in predicting the prognosis and recurrence rates, choosing the most appropriate treatment modality, and identifying the underlying cause.[18] Estimates furtherly demonstrated that generalized seizures involving the whole brain usually occur at a lower incidence than partial seizures involving a focal part of the brain.

Diagnosis and investigations

The differential diagnosis of seizures in children is hugely variable. Therefore, the initial management approach for children presenting to the emergency department should include obtaining a thorough history from the patient or their family, conducting an appropriate physical examination, and determining the needed investigations to establish a proper diagnosis. Since presenting patients might not be able to deliver a full history of their condition (being too young, unable to remember similar previous events, or in a postictal confused state), the physician should approach the parents and/or child caregivers, which are usually more aware of the child's condition.[19,20] Taking a history should necessarily include obtaining information that can differentiate between epileptic seizures and non-epileptic attack disorders (Figure 1).[20,21] According to previous investigations, the time of the first seizure, the presence and type of warning signs "aura" before the beginning of the seizure, and the characteristics and warning signs of seizures.[22,23]

Breath-holding spells	» Involuntary breath holding, precipitated by an upsetting or painful event (for example frustration, anger, fright or crying) » Most commonly seen between ages 6 months to 18 months
Syncope/simple faint	» Loss of consciousness preceded by dizziness, pallor, sweating » May be associated with abnormal movement or tonic contractions » Uncommon before 10 years of age
Migraine	» Intense headache, can be associated with an aura, nausea or vomiting » More common in females
Benign paroxysmal vertigo	» Characterised by recurrent episodes of vertigo associated with unsteadiness » Resolves spontaneously » Consciousness is always preserved
Long QT interval	» Sudden loss of consciousness associated commonly with exercise » More common in females
Motor tics	» Sudden, involuntary movements or sounds, intermittent in nature » Worsen with stress and fatigue

Figure 1: Seizure-like non-epileptic events.[20,21]

Based on the type of seizures, after conducting adequate history and physical examination, conducting proper investigations are needed to confirm the diagnosis and determine the underlying cause. General examination should be thorough and include gender-and age-appropriate weight and height assessment, together with observing cutaneous manifestations and petechiae that might be suggestive of neurocutaneous syndromes. A neurological examination should be followed using the Glasgow coma scale and looking for meningeal manifestations like neck stiffness and photophobia.[24] Evidence shows various causes of non-epileptic conditions for seizures, including metabolic, febrile, infections affecting the central nervous system, drugs/toxins, anoxic reflex seizures, and non-epileptic pseudoseizures.[21,24] The attending physician should also conduct a further assessment in the emergency department with a nursing team that includes emergency nurse practitioners to identify the child's health with previous episodes of seizures and other relevant information that can be helpful with the diagnosis and management of the condition.

These practitioners should observe the presence of related symptoms, like breathing difficulties, vomiting, diarrhea, headache, fever, recent illnesses, and urinary symptoms.[19,20] Anticonvulsant medications should also be sought if parents or caregivers have used anticonvulsant medications as an initial management approach. The physician should also assess whether metabolic hematological or neurological conditions are associated with the event. Other important events might also include central nervous system infections and perinatal complications. Obtaining the history should also include asking for previous febrile or epileptic seizures, family history of epilepsy, febrile seizures, or seizure disorders, and the administration of related medications and compliance with them. Following this, advanced life support should be conducted whenever needed, and the AVPU and ABCDE approaches should be considered not to flare the risk of any underlying condition that might complicate the case and increase morbidities.

Investigations should be carefully conducted, and only needed ones should be requested. This is recommended, especially in patients presenting with life-threatening conditions. Therefore, radiologic exposure and painful procedures should be avoided to allow for life-saving approaches to be conducted. At first, the nursing team should conduct all non-invasive procedures, including comprehensive observations, temperature measurements, and glucose measurements.[24] Further laboratory investigations should only be conducted for patients with seizures with a history of toxic, infective, or metabolic encephalopathies. Disturbances in electrolytes and biochemical parameters are important factors that should be considered in developing seizures.[25] Obtaining a thorough history can significantly highlight these disturbances and associated morbidities. According to the underlying specific clinical scenario, physicians should follow the local guidelines, individualized and adequate assessments, and conduct appropriate investigations.

Investigating infections should also be conducted when the patient is febrile. Lumbar puncture is recommended in these children. Moreover, it can be used in children with afebrile seizures less than six months of age. However, when increased intracranial pressure is suspected, conducting a lumbar puncture should be avoided.[25] When central nervous system infections are suspected, a full septic profile should be conducted in children below one year.[24] Moreover, neuroimaging is recommended in patients when acute neurological illness is suspected. In this context, different indications have been reported for using CT in the emergency department. These include persistent altered mental status, suspected head injury, focal neurological signs, features of increased intracranial pressure, and first focal onset seizures.[25]

MANAGEMENT

The initial management approaches, including triage, are usually conducted by emergency physicians and the attending nursing team. Since most patients usually present after the seizure episode ends (and do not usually present convulsing), the management team must obtain adequate information and history about the patient's health condition.[26] Providing the ABCDE approach for managing the vital functions of convulsing patients in the emergency department might be life-saving.[24] However, according to a previous investigation, the authors demonstrated that recognizing atypical seizures might be difficult for emergency physicians in the emergency department. Observing children should also be done to intervene against status epilepticus, which the seizure duration can significantly define. However, attending healthcare physicians should not use anticonvulsants when managing convulsing children (for any durations more than five minutes) to reduce the risk of developing status epilepticus.[27]

A time-critical and urgent management approach is needed for managing status epilepticus.[24] In this context, according to Hunter et al.,[26] the authors showed that significant healthcare problems and complications might develop secondary to delaying the administration of appropriate anticonvulsant therapeutics. Besides, it has been shown that poor treatment outcomes might be associated with longer seizures, indicating healthcare physicians' timely imperative roles in establishing the best treatment modality. Various medications have been reported for administration by patients presenting with generalized, tonic-clonic seizures in the emergency department (Figure 2).[17,28,29]

Choosing a treatment strategy is usually based on different factors, including the child's age, epilepsy type, family preferences, the presence of comorbidities, and ability to administer medications. A comprehensive management approach might be needed in cases with

recurrent convulsive seizures. Moreover, specific management protocols might be needed for patients having a history of sensitivities to certain anticonvulsant medications. In these events, rectal paraldehyde might be needed to manage prolonged seizures. Moreover, emergency physicians should know the local guidelines for managing patients presenting with recurrent epileptic, febrile, or first-time seizures. For epileptic seizures, evidence indicates that the administration of benzodiazepines is preferred. On the other hand, paramedics should initially use rectal diazepam or buccal midazolam in the emergency department when approaching a seizure before being transferred to the hospital. Intravenous administration of lorazepam, if available, is also another option recommended for patients with ongoing seizures in the emergency department.

Drug Name	Route	Dose	Frequency	Maximum dose	Indication
Lorazepam	Intravenous (IV) or intraosseous (IO)	0.1mg/kg	Repeat 10 minutes after first dose if necessary	4mg	First line treatment in hospital if IV access available
Diazepam	IV/IO	0.25 mg/kg	Repeat 10 minutes after first dose if necessary	10mg	Use in hospital if IV lorazepam unavailable
	Rectal	0.5mg/kg	Repeat 10 minutes after first dose if necessary, if in care plan	10mg	Use in community/by ambulance staff
Midazolam	Buccal	0.5mg/kg	Repeat 10 minutes after first dose if necessary	N/A	First line treatment for prolonged/repeated seizures in community Use in hospital if unable to secure IV access
Phenytoin sodium	IV	20mg/kg	2.5 to 5mg/kg twice daily if necessary	N/A	Second-line treatment in hospital
Thiopental sodium	IV	4mg/kg	After loading initial dose, start intravenous infusion	8mg/kg/hour	Rapidly induce anaesthesia in refractory status epilepticus
Flumazenil	IV	0.01mg/kg	Repeat at 1 minute intervals if necessary (maximum 50micrograms/kg per course)	200micrograms per dose	To reverse sedative effects or accidental overdosing from benzodiazepines

Figure 2: Emergency medications for pediatric patients presenting with convulsive status epilepticus.[17,28,29]

It should be noted that it is contraindicated to give two doses of benzodiazepine medications, including lorazepam, midazolam, or diazepam, whether in the emergency department or by paramedics administered anticonvulsants. Phenytoin sodium might be indicated in cases when convulsing children are resistant to benzodiazepines. This treatment modality might also be used with thiopental sodium to induce a pharmacological coma in severe cases until they are managed in the intensive care unit.

Reassurance of attending family by healthcare physicians is also recommended in these events.[20] However, in some situations, like cases presenting with neurological emergencies, adequate communication might not be feasible with these families because of the needed timely management of children.[26] After providing the initial management, healthcare physicians should have adequate information about whether to admit the child for further investigations or discharge them secondary to observing the healthy status of the child. Moreover, it is recommended that emergency physicians advise families to follow up on the status of their children with a neurology/epilepsy expert. Increasing awareness among families about the diagnosis, identification, prognosis, reporting, and responding to seizures is recommended.[21,30] Moreover, some advice regarding the best treatment modality can be offered to parents of children with recurrent seizures. For instance, parents might be trained on administering rectal diazepam or buccal midazolam to these children. Appropriately administering these medications can significantly reduce the frequency of emergency department visits and lower the risk of prolonged seizures.[31]

The prognosis of seizures is important to determine the risk of recurrence. Therefore, healthcare physicians should provide relevant information about the risk of future episodes and how to intervene against them. Different factors determine the risk of recurrence, including child age, first-time seizure, the presence of an underlying cause, and the type of seizure. For instance, estimates show that, based on the frequency of relevant risk factors, there is a 3-55% increase in the risk of developing a second seizure in children presenting with unprovoked first seizures within five years of this episode. Various risk factors have been reported in the literature. They include abnormal EEG readings with epileptiform discharges, prominent nocturnal seizures, disturbed neuroimaging findings, abnormal neurological examination, and having an underlying relevant etiology of seizures.[17] The management of seizures in children is crucial since it can significantly lead to serious events that might impair the quality of life of the affected child. Some of these events might include stigma, depression, anxiety, impacting social relationships, and lifestyle restrictions.[32,33] Therefore, the main aim of administering anticonvulsant medications is to reduce the risk of these events and enhance the quality of life of affected children.

CONCLUSION

The identification process depends on different factors, including obtaining an adequate history from the patient or their caregivers, performing a thorough general and neurological examination, and conducting appropriate investigations whenever needed. Choosing a treatment strategy is usually based on different factors, including the child's age, epilepsy type, family preferences, the presence of comorbidities, and ability to administer medications. Reassuring family attendants is also recommended. Besides, increasing awareness among these families about the diagnosis, identification, prognosis, reporting, and responding to seizures might reduce the risk of recurrence and enhance the prognosis of seizures.

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