ISSN – 2349-0683

Asian Pacific Journal of Nursing

Journal homepage: www.mcmed.us/journal/apjn

EPILEPSY IN CHILDREN: PATHOPHYSIOLOGY, DIAGNOSIS, MANAGEMENT, AND LONG-TERM OUTCOMES

Dr. Angel Shalini W*

GRT College of Nursing, Tiruttani, Tamil Nadu, India.

ABSTRACT

Epilepsy in children is a long-lasting neurological disease that is caused by repeated and uncontrolled seizures caused by the abnormal work of neurons in the immature brain. It is a major burden of health in the world, especially the low and middle-income countries, and is linked to various etiologies such as genetic, structural, metabolic, infectious, immune and unknown causes. In addition to the recurrence of seizures, epilepsy among children has a significant impact on cognitive development, behavior, emotional well-being, academic performance, social integration, etc. The clinical assessment, electroencephalography, and neuroimaging should be used to diagnose them accurately, classify them thoroughly, and manage them individually. The first-line antiepileptic medications are specific, and pharmacological therapy is the basis of the treatment, whereas non-pharmacological therapies like ketogenic diet therapy, vagus nerve stimulation, and surgical strategies are also employed in the cases of drug resistance. The other component of comprehensive care is medication adherence education, psychosocial support, educational accommodation, and long-term developmental monitoring. The multidisciplinary, child-centered approach is essential to ensure the maximization of seizure control, the improvement of the quality of life, and the benefits related to the neurodevelopmental outcomes in the long term.

Key words: Childhood epilepsy, Antiepileptic drugs, Neurodevelopment, Seizure classification, Pediatric epilepsy management.

Corresponding Author
Dr. Angel Shalini W

Article Info
Received 12/01/2026; Revised 20/02/2026
Accepted 11/03/2026

INTRODUCTION

Epilepsy is not only one of the most prevalent chronic neurological diseases in children in the world but also a major cause of morbidity in infancy and childhood, as well as in adolescence. It is described as a continuous tendency to cause unprovoked seizures as a result of abnormal, excessive and synchronous neuronal activity in the brain. In contrast to febrile seizures or provoked seizures, which are isolated, epilepsy consists of repetitive episodes that in many cases necessitate medical treatment and multidisciplinary care that are lifelong. Since the brain structure and functions of the developing brain are different compared to the adult brain, epilepsy in children has its own problems in terms of diagnosis, choice of treatment, neuro-developmental as well as psychosocial consequences. [1–3] The millions of children with childhood epilepsy are spread across the world, with the most prevalence cases of childhood epilepsy found in low- and middle-income nations because of perinatal complications, infections of central nervous systems, traumatic brain injuries, and lack of access to healthcare services. The epilepsy burden goes beyond the seizure occurrences. Epilepsy can impair cognitive functions, behaviour, learning, lead to social stigma, all which may make a substantial impact on the performance of children with epilepsy, their emotional health and the overall quality of life. Early identification and the subsequent intervention is then crucial not just to help manage the seizures but also reduce the overall developmental implications in the long-term. Epilepsy in children can be caused by various factors that can be genetic mutations, structural brain abnormalities, metabolic, immune mediated, infections, and unknown (idiopathic) causes. The discovery of neuroimaging, molecular genetics and neurophysiology has enhanced a better insight into the mechanisms behind it, which is capable of leading to more

accurate classification and therapeutic interventions. Children are especially susceptible to seizure because the brain is more excitable at the time of developing, and the synapses are also continuing to mature, frequently during the first several years of development. Moreover, some of the epilepsy syndromes are age-specific, i. e. their onset, clinical characteristics and prognosis are directly dependent on a particular stage of brain development. The diagnosis of epilepsy in children is based on a general clinical examination comprising of detailed history taking, seizure semiology description, neurological examination and other auxiliary examination like electroencephalography (EEG) and neuroimaging research. EEG is essential in the detection of typical epileptiform discharge, typing of seizures and informing a treatment choice. This classification should be accurate since management strategies differ based on the type of seizures that can be either focal, generalized, or a part of a particular epilepsy syndrome. Childhood epilepsy is a multidimensional and personalized therapy. Antiepileptic drugs (AEDs) continue to be the foundation of pharmacological therapy and the type of medication depended upon is based upon seizure type and epilepsy syndrome, age, comorbidities as well as the side effects. Although some children can have good seizure management using first-line drugs, a considerable number develop drug-resistant epilepsy, and alternative treatment methods, including ketogenic diet therapy, vagus nerve stimulation, or surgery, are necessary. Timely treatment is important in terms of early and prompt control of seizures as this correlates with better cognitive and psychosocial outcomes. In addition to medical care, total care also incorporates education of medication compliance, first aid of seizure, lifestyle changes, and psychosocial care of the child and family. The presence of stigma, fear, and misconceptions about epilepsy is also capable of impacting social integration and mental health negatively, and counseling and community awareness become important aspects of treatment. To conclude, epilepsy among children is a diverse neurological disease that has both medical, developmental and social implications. Its treatment involves early detection, proper classification, proper therapeutic measures, and a long-term follow-up that can improve the outcomes. An integrated strategy that aims at controlling the seizures and the wellbeing of a child with epilepsy is critical in ensuring that children with epilepsy can record their maximum developmental potential and live full life [4, 5].

Hypothesis and Health History

Epilepsy is a long-lasting neurological condition that is marked by a consistent propensity to produce repeated, unprovoked seizures caused by irregular, uncontrolled and asynchronized electrical sensations within the brain. The International League against Epilepsy (ILAE) defines epilepsy as the presence of at least two unprovoked (or reflex) seizures, at least 24 hours apart, one unprovoked seizure, when the likelihood of other similar seizures occurring is high, like that following the occurrence of two unprovoked seizures, or presence of an epilepsy syndrome[6,7]. Epilepsy in children constitutes a wide range of types and syndromes of seizes that differ depending on age, etiology, clinical presentation, and prognosis. The seizures can be characterized as focal, generalized, or unknown in onset, and some of the syndromes of pediatric epilepsy are age related and changing according to the evolving brain. The young brain has a high level of neuronal excitability and constant synaptic restructuring, which may predispose the infants and young children to seizures. Epidemiologically, epilepsy is among the most prevalent serious neurological disorders in childhood with 0.5-1 percent prevalence in children all over the world. It is estimated that, the global prevalence of epilepsy is between 50 and 100 per 100,000 people per year, with the highest prevalence being in the first year of life and at early childhood. In most cases, prevalence is higher in the low- and middle-income countries than in the high-income countries, mostly because of higher exposure to perinatal brain, central nervous system infections, malnutrition, traumatic brain injuries and minimal access to preventive and medical care. Some of the common neonatal seizure disorders and epilepsy syndromes that result in a significant pediatric burden include infantile spasms, childhood absence epilepsy, and benign epilepsy with centrotemporal spikes. Also, genetic factors are significant in most forms of childhood epilepsy, and recent developments in the molecular genetics field have been able to find a large number of gene mutations in relation to particular syndromes. Deaths due to epilepsy among children are more than those experienced by the general pediatric population as it is associated with status epilepticus, accidents and sudden unexpected death in epilepsy (SUDEP). In addition to clinical manifestations, epilepsy has significant psychosocial and economic consequences, including educational level, family performance, and quality of life. All in all, epilepsy is an important worldwide health issue in the pediatric population, and it must be questioned at an early stage, properly regulated, and a complex system of assistance to decrease the burden of the issue and its associated long-term outcomes [8–10].

Impact on Child Development

The effects of epilepsy are significant and quite multifaceted on the development of children, as they affect cognitive, behavioral, emotional, social, and academic outcomes. Since the growing brain is experiencing rapid development, synaptic organization, and myelination in the infancy and childhood period, frequent seizures and underlying neurological anomalies can impair the development of important processes. The effects are different according to the type of seizure, frequency, age of onset, etiology underlying, and treatment responses[11–13]. Epilepsy that starts at an early age and specifically in

infancy is also linked to increased risk of developmental delay, intellectual disability, and language impairment because the seizures during sensitive stages of brain development may disrupt the development of the neural networks. Also, some epilepsy syndromes are inherently connected with cognitive regression/stagnation. Even without clinical seizures, frequent seizures, as well as prolonged episodes as status epilepticus, interictal epileptiform discharges detected on electroencephalography (EEG), can further affect attention, memory, executive functioning and speed of processing. Even though these antiepileptic drugs are crucial in the control of seizures, they can also cause cognitive retardation, behavioral changes, or fatigue in certain children which increases the developmental problems. In addition to the cognitive impacts, epilepsy has a great impact on the development of emotions and behavior. Epileptic children experience elevated rates of anxiety, depression, attention-deficit/hyperactivity disorder (ADHD) and conduct disorders than their counterparts. The restriction of normal childhood activities by social stigma, fear of seizure in sociable environments, and overprotective parenting may reduce the chances of social interaction and independence. The performance of a school can be influenced not only by cognitive impairments but also by the regular visits of doctors, absences, and poor knowledge of teachers in terms of seizure disorders. As a result of this, children with epilepsy can develop a low self-esteem, be socially isolated, and experience problems establishing peer social relations. It may also affect family dynamics, because caregivers have a tendency to become stressful, anxious, and financially strained due to the constant medical attention and the lack of control of the seizures. However, with these difficulties, early diagnosis, effective management of the seizure, educational accommodation, and psychosocial support have the potential to enhance the developmental pathways to a great extent. Such complex needs of these children require multidisciplinary intervention that incorporates the contribution of neurologists, pediatricians, nurses, psychologists, educators, and social workers. One-on-one educational interventions, behavioral interventions, and counseling may assist in reducing learning and emotional problems, whereas proper control of seizures will improve functioning. Notably, a number of children showing good control of epilepsy without any appreciable underlying neurological deficiency are able to experience normal developmental milestones and live normally. Hence, the concept of developmental effects of epilepsy helps to make the need of holistic, child-centered treatment justified by the goal not only to suppress the seizures but also to ensure the best cognitive evolution, emotional stability, social adaptation, and overall quality of life[2,14].

In children, epilepsy is caused by a multifigured interaction of genetic, structural, metabolic, immune, infectious, and unknown factors that cause disruption in normal balance between neuronal excitation and inhibition in the developing brain. In healthy physiological states, excitatory neurotransmitters like glutamate and inhibitory neurotransmitters like gamma-aminobutyric acid (GABA) ensure that electrical communication in neural networks is controlled. This balance is changed in epilepsy resulting in the appearance of hypersynchronous and excessive neuronal firing, which is clinically expressed in the form of seizures[15–17]. The immature brain of a child is likely to fall prey to hyperexcitability especially through the continuing synaptogenesis, incomplete myelination, developmental differences in receptor expression and ion channel activity. Directly increasing neuronal excitability An gene mutation can be in the ion channels, neurotransmitter receptors or synaptic proteins or structural abnormalities, including cortical dysplasia, brain tumors, hypoxic-ischemic disease or traumatic brain injury can produce epileptogenic foci. The factors that contribute to the production of seizures can also be metabolic disturbances, central nervous system infections, and autoimmune processes. The pathophysiology can be focal or generalized as the abnormal electrical activity can be generated in a particular area of the cortex (focal onset) or in extensive bilateral networks (generalized onset). The epilepsy observation system has undergone a change and the modern-day systems are directed by the International league against Epilepsy (ILAE) that focuses on seizure type, epilepsy type and epilepsy syndrome. Seizures are mainly focal, generalized or unknown onset. Focal seizures start in one hemisphere and can be the motor, sensory, autonomic, and/or cognitive in nature accompanied or lacking impaired awareness. Generalized seizures are bilateral in the presentation and contain absence, tonic-clonic, myoclonic, tonic, clonic and atonic seizures. In addition to the type of seizure, epilepsy is further classified under either focal epilepsy, generalized epilepsy, combined generalized and focal epilepsy or unknown epilepsy. Epilepsy syndromes are a form of clusters of clinical characteristics such as age at onset, type of seizures, EEG, imaging, and prognosis, such as self-limited epilepsy with centrotemporal spikes, childhood absence epilepsy, and developmental and epileptic encephalopathies. Etiologically, epilepsy can be divided into structural, genetic, infectious, metabolic, immune, or unknown, and a combination of several of them may be found in one patient. Correct categorization is essential since it determines the kind of treatment to be chosen, determines prognosis and genetic counseling where necessary. This knowledge of both the pathophysiological workings of the illness and the well-organized system of classification allows clinicians to offer specialized, personalized care and enhances the possibility of the best seizure management and pro-developmental results in other children with the condition [18, 19].

Electroencephalography (EEG)

Electroencephalography (EEG) is one of the inherent diagnostic tools used in examination and the treatment of epilepsy in children and it offers a noninvasive technique of measuring the electrical activity inside the brain with the help of the electrodes positioned on the head. EEG records changes in voltages produced by synchronous postsynaptic potentials of neurons, and clinicians can observe abnormal patterns of EEG indicators, which are linked to a disorder of seizures. EEG is also very important in pediatric epilepsy to confirm the diagnosis, to categorize the seizure type, to recognize a particular epilepsy syndrome, to make the therapeutic choices and to evaluate the prognosis. It is completely safe, painless, and is readily available, which is why the procedure is of particular use with infants and children[20–22]. The electrical signals are amplified, during the recording as waveforms which have different frequencies, amplitudes, and morphologies. EEG in children with epilepsy can demonstrate typical epileptiform discharges which can include spikes, sharp waves, spike-and-wave, or polyspike. They may also be interictal (between seizures) and give significant diagnostic hints even in cases where clinical seizures were not recorded at the time of recording. Some syndromes in epilepsy have characteristic patterns on the EEG; such as generalized 3-Hz spike-and-wave discharges in the absence seizures, or focal spikes in a particular area may be indicative of focal epilepsy. Subclinical seizures and electrical status epilepticus can also be diagnosed using EEG, and this condition may also play a role in cognitive or behavioral deterioration without noticeable convulsions. The activation process of hyperventilation, photic stimulation, sleep deprivation are commonly practiced during EEG experiments to increase the chances of recording epileptiform activity since certain abnormalities are more intense during sleep, or in the presence of a special stimulus. Besides standard EEG, lengthy video-EEG can be used in cases that are complicated to compare clinical events with electrical alterations, draw the line between epileptic seizures and non-epileptic ones, and to assess the eligibility to epilepsy surgery. Although it has a diagnostic utility, normal EEG does not rule out epilepsy because epileptiform discharges are occasionally intermittent and do not occur during recording. Thus, the EEG results should be reviewed in combination with clinical history and examination. The EEG has been enhanced in the field of pediatric neurology with advancements in digital technology and neurophysiological interpretation to make it more sensitive and specific in the interpretation of EEG. Altogether, EEG has become an essential study of childhood epilepsy and this has enabled proper classification, medical intervention and enhanced clinical recovery due to early and accurate diagnosis [19, 23, 24].

Pharmacological Management

The main treatment of epilepsy in children is pharmacological management which is a practice that is meant to ensure that full control of the seizures is achieved with minimum side effects in addition to ensuring normal growth and development. Antiepileptic drug (AED) therapy is usually indicated when the diagnosis of epilepsy has been confirmed and various factors such as the location and frequency of the seizures, the chances of recurrence, and the potential effect of the condition on the safety and quality of life of the child are put into consideration[5,25]. The choice of a suitable drug is extremely personalized and it can vary on whether the seizures are focal, generalized or belong to a particular epilepsy syndrome as some medications can be effective toward some types of seizures but not towards others or even harmful. The majority are initiated on monotherapy, i.e., on a single AED at the minimum effective dose and progressively increased to the highest proportion with the aim of controlling the seizures at the least adverse side effects. The medications that are commonly used are sodium channel blockers, GABA-enhancing agents and the broad-spectrum antiepileptic drugs with multiple actions to stabilize neuronal membranes and decrease excessive electrical discharges. Although most children react to the initial treatment and attain long-term remission, about 20-30 percent will develop drug-resistant epilepsy, which is unable to control the seizures with proper doses of two suitable drugs. Under these circumstances, combination therapy or other treatment options can be taken into consideration. Close observation should be observed during pharmacology to measure response to therapy, adverse effects, and make changes in dosage based on changes in weight and the developmental stage. The side effects are contingent on the drug and may be drowsiness, dizziness, change in behavior, gastrointestinal disturbances, allergic reactions, or in extreme cases, like when side effects become life threatening. In long-term therapy, the patient should be followed up regularly and they should be assessed on the frequency of seizures, adherence to medications, laboratory parameters where necessary and the general development progress. Infants and adolescents require special considerations, drug metabolism varies with age, and adolescent females have problems with hormonal variations and teratogenic risks that have to be addressed. Parent / caregiver education is important in maintaining compliance with the prescribed regimens since one of the main causes of breakthrough seizures is missed doses. Moreover, antiepileptic drugs should not be abruptly stopped because of the probability of seizure re-emergence or the status epilepticus; in case of this, withdrawal should be gradual and monitored by a medical specialist. In general, the pharmacological treatment is a complex, patient-centered procedure that needs to strike a balance between the seizure control and safety, tolerability, and the

long-term neurological and psychosocial health of the child [25,26].

First Line Anti-Epileptic Drugs

Antiepileptic drugs (AED) are chosen as first-line and follow a hierarchical system of choice and depend on the type of seizure, the syndrome of epilepsy, the age of the child, the side effects, and overall safety, and, preferably, monotherapy is aimed at optimal seizure control. In the case of focal seizures, carbamazepine, oxcarbazepine, and lamotrigine are the most common first-line drugs and are mostly used because of the ability to prevent voltage-gated sodium channels as well as stabilize neuronal membranes in order to reduce the excessive electric release. First-line Levetiracetam is also a common preference in focal and generalized seizures because it has a broad-spectrum effect, good safety profile, limited drug interactions and drug is easily administered[27,28]. Generalized epilepsies, especially tonic-clonic, absence or myoclonic seizures, are the conditions in which broad-spectrum antiepileptics like valproate, levetiracetam or lamotrigine are often taken into consideration. Valproate is very effective in various forms of generalized seizures, though, it should be used with caution on female adolescents as it may cause teratogenic effects as well as weight gain, and abnormal metabolism. In the case of childhood absence epilepsy, ethosuximide is considered the drug of choice due to its effect specificity, i.e. acting on T-type calcium channels, and high level of effects in the suppression of absence seizures with low side effects. The first-line therapy is also determined by the tolerability and comorbidity; lamotrigine can be preferred in children with comorbid mood disorders because of its favorable effects on cognitive and behavioural outcomes, and drugs which have a sedative effect should be avoided whenever possible in school-aged children. The therapy normally commences with a low dosage that is gradually increased to therapeutic level to reduce adverse effect and close follow-up must be done to observe clinical outcome and safety. The majority of children attain seizure-free control with the right first-line monotherapy but failure to respond despite sufficient dosage and duration can prompt the use of a second first-line therapy agent or the combination of the two. Side effects differ according to the medicine and can be drowsiness, dizziness, gastrointestinal, changes in behavior, allergic reactions, or, in extreme cases, hepatic dysfunction or severe skin reactions. Consistent observation of growth, development and where necessary, laboratory parameters are aids to safe long-term usage. Finally, better outcomes of children with epilepsy are possible through evidence-based, individualized, age-specific, and efficacy-safety-quality of life-based selection of first-line antiepileptic drugs [5, 25, 29].

Table 1. Classification of Seizures and Common Pediatric Epilepsy Syndromes

Category	Subtype/Examples	Key Clinical Features	Typical EEG Clues	First-line/Preferred Approach (examples)
Focal seizures	Focal aware; focal impaired awareness; focal to bilateral tonic–clonic	Motor/sensory/autonomic symptoms; may include behavioral arrest; possible aura	Focal spikes/sharp waves (regional)	Levetiracetam, carbamazepine/oxcarbazepine, lamotrigine (based on child profile)
Generalized seizures	Absence; tonic–clonic; myoclonic; atonic; tonic	Sudden bilateral onset; brief staring spells (absence), jerks (myoclonic), falls (atonic)	Generalized spike-and-wave; polyspike-and-wave	Ethosuximide (absence), valproate/levetiracetam/lamotrigine (generalized—caution with valproate in adolescent females)
Unknown onset	Unclassified/uncertain onset	Insufficient data or mixed features	Variable	Further evaluation (video-EEG, imaging)
Age-related epilepsy syndromes	Infantile spasms; childhood absence epilepsy; self-limited epilepsy with centrotemporal spikes (SeLECTS)	Syndrome-specific seizure types and prognosis	Hypsarrhythmia (spasms); 3-Hz spike-wave (absence); centrotemporal spikes (SeLECTS)	Syndrome-based therapy (e.g., absence: ethosuximide; others per guideline/etiology)
Drug-resistant epilepsy	Failure of 2 appropriate AED trials	Persistent seizures affecting safety/developmen	Variable	Consider ketogenic diet, VNS, surgical evaluation (epilepsy center referral)

Table 2: Comprehensive Management Plan for Childhood Epilepsy

Domain	Key Components	Practical Actions in Care	Expected Benefit
Diagnosis & monitoring	Detailed history, seizure semiology, EEG,	Use routine EEG ± sleep/activation; MRI	Accurate classification; avoids inappropriate AED choice

	neuroimaging	when indicated; consider video-EEG for unclear events	
Pharmacological therapy	Monotherapy first; individualized AED selection	Start low, titrate gradually; monitor adverse effects; adjust dose with weight/age; avoid abrupt stopping	Better seizure control with fewer side effects
Non-pharmacological therapy	Ketogenic diet/modified diets; lifestyle measures; psychosocial care	Diet under specialist supervision; optimize sleep, reduce triggers; CBT/counseling for anxiety/depression/ADHD	Reduced seizure frequency; improved function and coping
Surgical/advanced options	Resection, disconnection, neuromodulation (VNS/RNS)	Early referral for drug-resistant cases; presurgical workup (video-EEG, MRI, neuropsych tests)	Seizure freedom or major reduction; better long-term development
Education & safety	Seizure first aid, adherence, school planning	Train caregivers/teachers; emergency plan; medication reminders; IEP/academic accommodations	Fewer emergencies; improved school and social participation
Long-term follow-up	Developmental, cognitive, behavioral screening	Regular assessments; address learning needs; manage comorbidities and family stress	Improved quality of life and adult outcomes

Figure 1: Impact of Epilepsy on Child Development: Cognitive, Emotional, Academic, and Social Outcomes

Figure 2: First-Line Antiepileptic Drug Selection in Pediatric Epilepsy

Non-Pharmacological Management

The non-pharmacological management is important in the overall management of the children with epilepsy especially those who fail to control their seizures with drugs or who suffer a lot of adverse effects with the antiepileptic drugs. These methods are normally employed as supplements to pharmacological treatment but can be used as an alternative treatment in some instances, particularly in drug-resistant epilepsy. The ketogenic diet is one of the best-established non-pharmacological interventions, a high-fat, low-carbohydrate, and sufficient amount of protein diet that causes ketosis and changes the metabolism of energy in the brain, which makes neurons less excitable and decreasing the frequency of seizures[30]. Atkins diet adoptions like modified atkins diet and low glycemic index therapy have also proven to be effective with a more flexible and tolerable nature. Medical care is necessary in dietary therapy, nutritional education, and follow-up on the occurrence of adverse effects of gastrointestinal, hypoglycemia, and nutritional deficiencies. Vagus nerve stimulation (VNS) is another important intervention, which is a form of neuromodulation that is based upon the implantation of a device that stimulates the vagus nerve periodically by means of electrical impulses that, in turn, controls the activity of the brain and the severity and frequency of seizures. VNS is usually a procedure used in children with refractory epilepsy that cannot be treated by having surgery. Non-pharmacological management also includes behavioral and lifestyle changes. Sleep deprivation can be managed by ensuring white individuals get enough sleep, manage stress, steer clear of the triggers of the condition like flashing lights in photosensitive epilepsy, and routine habit to prevent the occurrence of seizures. Comorbidities like anxiety, depression, attention-deficit/hyperactivity disorder, which often occur with epilepsy, are important to provide psychological support, cognitive behavioral therapy, and counseling, and necessitate considerable modification of quality of life. Educational interventions, such as the use of individualized education plans and school-based assistance are useful in assisting children to overcome academic and social integration difficulties. Education in the family is also valuable since the caregivers should be trained on first aid during seizures, safety, and identification of seizure patterns. In some situations, it can be considered using complementary therapy, including mindfulness methods or biofeedback, although the efficacy of these practices is not consistent. On the whole, non-pharmacological care focuses on a holistic and multidisciplinary model that is aimed not only to reduce seizure but also cognitive, emotional, social and functional welfare, thus improving the overall developmental outcomes and quality of life of children with epilepsy[31].

Surgical Management

One of the significant treatments used in children with drug-resistant epilepsy is surgical management especially when the patient has continued to experience seizures despite giving proper trials of at least two antiepileptic drugs which are of the right kind and tolerable. The overall aim of epilepsy surgery is to obtain total cessation of seizures or major reduction of the seizures and maintain the neurological functioning with general overall quality of life improvement. This is best treated through surgical intervention in children who have focal epilepsy in which a well-defined epileptogenic zone, the particular part of the brain that produces seizures, is localizable as a result of thorough pre-surgical assessment[32]. This assessment is usually provided with elaborate clinical examination, video-electroencephalography (video-EEG), with high-resolution magnetic resonance imaging (MRI), neuropsychological tests, and in some cases with functional imaging tests to determine accurate fociation of seizure onset and functional areas of the brain. Focal resection, the excision of the epileptogenic tissue in the brain, is the most common operation, whereby the seizure focus can be a focal lesion in the cortex (temporal lobectomy or lesionectomy) due to a local structural anomaly, like cortical dysplasia, or an innocent tumor. Resective surgery may lead to permanent seizure control in a significant percentage of patients with carefully chosen patients, and especially in patients with a well-defined lesion. In children who have not yet been considered as candidates of focal resection since they are experiencing multiple or generalized seizures, a palliative surgical procedure is an option. These are the corpus callosotomy that entails disconnection of the cerebral hemispheres to curtail the propagation of seizures, particularly of drop attacks, and functional hemispherectomy or hemispherotomy when there is severe unilateral brain pathology like hemimegalencephaly or large cortical malformations. Moreover, the neuromodulation methods like vagus nerve stimulation or responsive neurostimulation can be treated as an adjunctive surgery to reduce the frequency of the seizure in case of the inability to resect. Even though the epilepsy surgery is associated with risks, such as the possible neurological deficit, infection, or bleeding, technological progress in neuroimaging, surgical methods, and intraoperative monitoring greatly enhanced safety and results. Epilepsy centers referral should be done early because sustained unchecked seizures may compromise cognitive development and psychosocial functioning. Surgical management may significantly benefit the overall quality of life of a child, allowing him or her to experience much-improved cognitive and behavioral outcomes, particularly when used in combination with an appropriate medication, and thus, it constitutes a crucial part of the complex process of epilepsy management [33].

Medication Adherence Education

Education on medication adherence is one factor that contributes to successful management of epilepsy in children because non-adherence to antiepileptic drugs (AEDs) is one of the major factors contributing to breakthrough seizures, more hospitalizations, and poor seizure control in children. Educating families and caregivers on the importance of accurate and consistent medication administration assists in ensuring maintenance of therapeutic levels of the drug and minimizes the chances of a seizure recurrence as well as complications encountered when the drug is abruptly discontinued [5, 25]. Such education should start with the diagnosis and progress in treatment of the child and be provided to the maximum of his or her care involving personalized teaching based on the age and development stage of the child and the family comprehension and habits. Among the most vital aspects are explicating how the prescribed AEDs work, the significance of schedules, possible side effects, and the management of missed doses, with the fact that even a slight disruption of the schedule that is being prescribed is known to undermine the control of the seizures. Empirical education about medication structuring, use of pill organizers or electronic reminder, and incorporation of dosing into their daily habits may play an important role in enhancing medication adherence, especially among school-aged children and adolescents who might feel more responsible about medication. Caregivers should also be instructed in the identification and reporting of the adverse effects in time, since promptly preventing discontinuation because of side effects and establishing a cooperative relationship with healthcare providers could be achieved. Such issues as cultural beliefs, socioeconomic determinants, and health literacy should be also talked about because the lack of understanding of medications or distrust to healthcare may adversely affect adherence to medications. Also, health professionals must engage the child in age-related conversations to foster self-management and responsibility in adulthood as a continuum procedure of facilitating the relationship between regular medication intake and the frequency of seizures, enhanced safety, and cognitive and psychosocial performance. The educational process should also be continued into the school setting, where the teacher and school personnel may require advice on how to recognize seizures, act in an emergency and administer medication in case the need arises during school hours. The application of multidisciplinary assistance (nurses, pharmacists, and social workers) will improve adherence education delivery, which will reinforce and supply resources and provide family-specific counseling. Through follow-up visits, clinicians can evaluate adherence levels by self-report, pill counts or by measuring the level of therapeutic drugs, and can modify the educational strategies when difficulties are recognized. Generally, a holistic medication adherence education does not only optimize seizure management, but also enhances the overall quality of life of epileptic children, alleviates stress of the caregivers, minimizes healthcare usage, and empowers families to play an active role in long-term management, which constitutes a fundamental foundation to a successful pharmacological therapy and long-term developmental outcome[33].

CONCLUSION

In conclusion, pediatric epilepsy requires a holistic, multidisciplinary, and child-centered approach that extends beyond seizure control to encompass overall developmental and psychosocial well-being. Accurate diagnosis, individualized pharmacological therapy, and timely use of advanced treatment options are essential for effective management. Equally important are non-pharmacological interventions, family education, and adherence support to optimize outcomes. Addressing cognitive, behavioral, and social challenges through coordinated care and long-term follow-up further enhances quality of life. Ultimately, with early intervention and comprehensive support, many children with epilepsy can achieve optimal development and lead healthy, productive lives.

REFERENCE

1. Van Der Poest Clement, E., Jansen, F. E., Braun, K. P. J., & Peters, J. M. (2020). Update on drug management of refractory epilepsy in tuberous sclerosis complex. *Pediatric Drugs, 22*, 73–84.
2. Gogou, M., & Cross, J. H. (2022). Seizures and epilepsy in childhood. *Continuum: Lifelong Learning in Neurology, 28*, 428–456.
3. Li, C., Wang, X., Deng, M., Luo, Q., Yang, C., Gu, Z., et al. (2025). Antiepileptic drug combinations for epilepsy: Mechanisms, clinical strategies, and future prospects. *International Journal of Molecular Sciences, 26*, 4035.
4. Khalili, B. F., Chojnacki, M. R., Dixit, K., Gururangan, K., Horbinski, C., Rosenow, J. M., et al. (2025). Surgical treatment of brain tumor-related epilepsy: Current and emerging strategies. *Cancers, 17*, 3539.
5. Sołowiej, E., Sołowiej, W., & Blecharz-Klin, K. (2025). The impact of antiepileptic drug therapy on oral health in children with epilepsy: Current evidence, mechanisms, and management strategies. *Prospects in Pharmaceutical Sciences*.
6. Reilly, C., Jette, N., Johnson, E. C., Kariuki, S. M., Meredith, F., Wirrell, E., et al. (2023). Scoping review and expert-based consensus recommendations for assessment and management of psychogenic non-epileptic (functional) seizures

(PNES) in children: A report from the Pediatric Psychiatric Issues Task Force of the International League Against Epilepsy. *Epilepsia, 64*, 3160–3195.
7. Ayoub, D., Jaafar, F., Al-Hajje, A., Salameh, P., Jost, J., Hmaimess, G., et al. (2024). Predictors of drug-resistant epilepsy in childhood epilepsy syndromes: A subgroup analysis from a prospective cohort study. *Epilepsia, 65*, 2995–3009.
8. Lin, S., Schwartz, T. H., & Pitt, G. S. (2024). Sudden unexpected death in epilepsy: Respiratory vs. cardiac contributions. *Cardiovascular Research, 120*, 2385–2394.
9. Whitney, R., Keller, A., Li, S.-A., Datta, A. N., Macdonald, M., Nabavi Nouri, M., et al. (2025). Circumstances surrounding sudden unexpected death in epilepsy in children: A national case series. *Epilepsia, 66*, 1988–2000.
10. Jiang, R. Y., Varughese, R. T., & Kothare, S. V. (2025). Sudden unexpected death in epilepsy: A narrative review of mechanism, risks, and prevention. *Journal of Clinical Medicine, 14*, 3329.
11. Knight, D., Mahida, S., Kelly, M., Poduri, A., & Olson, H. E. (2023). Ezogabine impacts seizures and development in patients with KCNQ2 developmental and epileptic encephalopathy. *Epilepsia*, *64*.
12. Surdi, P., Trivisano, M., De Dominicis, A., Mercier, M., Piscitello, L. M., Pavia, G. C., et al. (2024). Unveiling the disease progression in developmental and epileptic encephalopathies: Insights from EEG and neuropsychology. *Epilepsia, 65*, 3279–3292.
13. Zhao, T., Chen, F., Cao, B., Yang, L., Yin, J., Li, Y., et al. (2025). Case report: Unraveling clinical heterogeneity in DEPDC5-related epilepsy: A genotype–phenotype correlation study in eight pediatric cases. *Frontiers in Neuroscience, 19*.
14. Kadish, N. E., Bast, T., Reuner, G., Wagner, K., Mayer, H., Schubert-Bast, S., et al. (2019). Epilepsy surgery in the first 3 years of life: Predictors of seizure freedom and cognitive development. *Neurosurgery, 84*, E368–E377.
15. Wang, Y., Tan, B., Wang, Y., & Chen, Z. (2021). Cholinergic signaling, neural excitability, and epilepsy. *Molecules, 26*, 2258.
16. Van Van Hugte, E. J. H., Schubert, D., & Nadif Kasri, N. (2023). Excitatory/inhibitory balance in epilepsies and neurodevelopmental disorders: Depolarizing γ-aminobutyric acid as a common mechanism. *Epilepsia, 64*, 1975–1990.
17. Sumadewi, K. T., Harkitasari, S., & Tjandra, D. C. (2023). Biomolecular mechanisms of epileptic seizures and epilepsy: A review. *Acta Epileptologica, 5*.
18. Flammer, J., Neziraj, T., Rüegg, S., & Pröbstel, A.-K. (2023). Immune mechanisms in epileptogenesis: Update on diagnosis and treatment of autoimmune epilepsy syndromes. *Drugs, 83*, 135–158.
19. Nariai, H. (2025). Frontiers in EEG as a tool for the management of pediatric epilepsy: Past, present, and future. *Epilepsia Open*.
20. Luo, T., Wang, Y., Lu, G., Zhou, Y., & Wang, Y. (2021). Vagus nerve stimulation for super-refractory status epilepticus in febrile infection-related epilepsy syndrome: A pediatric case report and literature review. *Child's Nervous System, 38*, 1401–1404.
21. Pizzo, F., Collotta, A. D., Di Nora, A., Costanza, G., Ruggieri, M., & Falsaperla, R. (2022). Ketogenic diet in pediatric seizures: A randomized controlled trial review and meta-analysis. *Expert Review of Neurotherapeutics*, 169–177.
22. Abdennadher, M., Rohatgi, P., & Saxena, A. (2024). Vagus nerve stimulation therapy in epilepsy: An overview of technical and surgical method, patient selection, and treatment outcomes. *Brain Sciences, 14*, 675.
23. Huang, Z., Yang, Y., Ma, Y., Dong, Q., Su, J., Shi, H., et al. (2025). EEG detection and recognition model for epilepsy based on dual attention mechanism. *Scientific Reports, 15*.
24. Chen, Y., Ou, Z., Zhou, D., & Wu, X. (2025). Advancements and challenges of artificial intelligence-assisted electroencephalography in epilepsy management. *Journal of Clinical Medicine, 14*, 4270.
25. Moosa, A. N. V. (2019). Antiepileptic drug treatment of epilepsy in children. *Continuum, 25*, 381–407.
26. Laue-Gizzi, H. (2021). Discontinuation of antiepileptic drugs in adults with epilepsy. *Australian Prescriber, 44*, 53–56.
27. Balagura, G., Iapadre, G., Verrotti, A., & Striano, P. (2019). Moving beyond sodium valproate: Choosing the right anti-epileptic drug in children. *Expert Opinion on Pharmacotherapy, 20*, 1449–1456.
28. Hakami, T. (2021). Neuropharmacology of antiseizure drugs. *Neuropsychopharmacology Reports, 41*, 336–351.
29. Reimers, A., & Ljung, H. (2019). An evaluation of zonisamide, including its long-term efficacy, for the treatment of focal epilepsy. *Expert Opinion on Pharmacotherapy*, *20*, 909–915.
30. Borowicz-Reutt, K., Krawczyk, M., & Czernia, J. (2024). Ketogenic diet in the treatment of epilepsy. *Nutrients, 16*, 1258.
31. Muthaffar, O. Y., Alyazidi, A. S., Alsowat, D., Alasiri, A. A., Albaradie, R., Jad, L. A., et al. (2024). Short-term effectiveness and side effects of ketogenic diet for drug-resistant epilepsy in children with genetic epilepsy syndromes. *Frontiers in Neurology, 15*.
32. Haridas, B., Testino, A., & Kossoff, E. H. (2024). Ketogenic diet therapy for the treatment of pediatric epilepsy. *Epileptic Disorders, 27*, 144–155.
33. Duda, P., Granat, M., Czuczwar, S. J., & Miziak, B. (2025). Non-pharmacological treatment methods of Lennox–Gastaut syndrome—Review of the literature. *Biomedicines, 13*, 2247.