e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:11/November-2024 Impact Factor- 8.187 www.irjmets.com

EPILEPSY

Sebastian Arockiyasamy Benil Anton*1, Vengadesan Swaminathan*2

*1,2Egs Pillay College Of Pharmacy, India.

DOI: https://www.doi.org/10.56726/IRJMETS63542

ABSTRACT

Epilepsy is a common neurological disorder, affecting around 50 million people worldwide, defined by repeated unprovoked seizures. Even with progression in the clinics to grasp the disorder, its management and treatment continue to be tricky, especially in minimum-source regions. This is a comprehensive review of epilepsy covering its etiology, pathophysiology, clinical features, diagnosis and treatment. Treatment options ranging from pharmacological to non-pharmacological interventions, as well as the role of early diagnosis and tailored management plans are highlighted.

I. INTRODUCTION

Epilepsy is a chronic brain disorder that occurs at any age and is caused by a tendency to develop seizures and it is the result of abnormal electrical activity in the brain. Although it can be debilitating — epilepsy is an intermittent disorder characterized by recurrent seizures, which may significantly reduce quality of life for patients, due to the disorder itself and related neuropsychological comorbidities — with appropriate management, patients can lead fulfilling lives. Still, in some parts of the world, the social stigma for epilepsy persists, but there is a certain kind of education that needs to exist for both the patient and their family.

Epidemiology

About 1% of the world is affected by epilepsy, but probably more people have epilepsy in low- and middle-income countries (LMICs)—possibly due to lack of medical care, infections and perinatal complications. Evidence suggests that while epilepsy can occur at any age, the incidence is highest at the two extremes of life, that is in early childhood (particularly in the first years of life) and in the elderly . Almost 70% of people with epilepsy could become seizure-free with appropriate treatment, making access to effective care essential.

Causes and Mechanisms

Epilepsy originates from various causes, which may be broadly classified into genetic, structural, infectious, metabolic, immune-related, and idiopathic ones. Especially when we are dealing with the childhood epilepsy syndromes, the genetic factors have an important role. Other common causes are structural abnormalities, like traumatic brain injuries, tumors or malformations. Infectious aetiologies include neurocysticercosis, common in low- and middle-income countries (LMICs), and other infectious aetiologies such as encephalitis. Other causes include metabolic disorders or autoimmune encephalitis, although a etiology is often lacking to find. From the perspective of pathophysiology, epilepsy results from disruption of the delicate balance between excitatory and inhibitory forces on the neuronal circuitry, often due to ion channel or neurotransmitter system dysfunction. And this causes hyperexcitability and hypersynchrony in brain networks, and exactly that leads to seizure activity.

Clinical Manifestations Epilepsy may be characterized by multiple types of seizures, ranging from focal to generalized. Focal seizures begin in a specific part of the brain, produce motor, sensory, autonomic or psychic manifestations, with or without impaired awareness. In contrast, generalized seizures come from both sides of the brain at the same time and can be tonic-clonic, absence, myoclonic and atonic.

Seizures can vary significantly from person to person regarding how often, how long, and what causes them. For others, prodromal symptoms or auras may serve as warnings before seizures occur. Moreover, epilepsy is often associated with comorbidities that may also affect the quality of life, including anxiety, depression, cognitive impairment, and increased risk of injury.

Diagnosis

Epilepsy is a clinical diagnosis characterized by a history of at least two unprovoked seizures occurring more than 24 hours apart. Electroencephalography (EEG) is an important diagnostic modality, as it may show interictal epileptiform discharges or ictal patterns to help in localizing seizure foci. However, the use of brain imaging (especially, MRI) is crucial in order to detect structural lesions or abnormalities. Sometimes, however,

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there may be reason to suspect the true diagnosis and more sophisticated neuroimaging, genome testing, or metabolic and autoimmune panels are called for to uncover the inciting process.

Management

Goal of epilepsy treatment is mostly to reduce seizure frequency, lessen adverse effects, and treat other clinical conditions in order to improve quality of life. Therapy is generally individualized according to the type of seizure, underlying etiology, age of patient, and comorbidities.

Pharmacological Therapy Anti-seizure medications (ASM) are considered the mainstay of epilepsy treatment. Examples of ASMs are valproate, carbamazepine, phenytoin, levetiracetam, and lamotrigine. Newer drugs such as brivaracetam and perampanel have increased the number of available drugs, targeting several different mechanisms and offering varied side-effect profiles. One third of patients with epilepsy develop drug-resistant epilepsy, which is defined as the failure of two or more appropriate ASMs to control the seizures and represents an important therapeutic challenge.

Surgery: In resistant focal epilepsy patients, resection of the seizure focus can provide remarkable benefit, often with excellent outcomes in types of epilepsy such as temporal lobe epilepsy. Surgery is usually only an option when the area of focus is localized and the surgery will not affect bodily functions to any large extent, in other words—something such as the thyroid or the lungs where the use of these things is essential to life. **Neurostimulation and diet therapy:** Vagal nerve stimulation (VNS), responsive neurostimulation (RNS), deep brain stimulation (DBS) have been developed as new options for patients with epilepsy not responding to medicines. Ketogenic and modified Atkins diets have also been effective in decreasing the frequency of seizures, especially among children with refractory epilepsy.

Lifestyle Changes and Psychosocial Support : Patients with epilepsy must be educated on trigger factors for seizures like sleep deprivation, stress and alcohol. Psychosocial challenges may be positive avenues for supportive therapies such as cognitive behavioral therapy and support groups to address mental health issues.

Hurdles and way forward

Although there have been breakthroughs in understanding and treating epilepsy, many challenges still pose a problem. Several LMICs have limited access to ASMs and the epilepsy treatment gap has been estimated at >75%. In addition, the social stigma surrounding epilepsy can create discrimination, affecting work, study, and social relationships. Chronic marrow failures also warrant novel ASMs that are safer and more effective, along with diagnostic and predictive biomarkers of treatment response.

Going forward, precision medicine and neurogenetics can be invaluable in personalizing treatments to the individual patient. Some experimental but potentially dizygotic options currently under investigation include gene therapy to introduce new technology into the brain to help permanently treat epilepsy, optogenetics to help modulate brain signals, and more advanced versions of brain-computer interface technology that use signals to treat the brain.

II. CONCLUSION

Epilepsy is a common and complicated neurological disease that requires a multidisciplinary approach to its diagnosis and management. While there are many patients whose seizures are controlled with existing therapies, significant unmet needs still exist, which are compounded by accessibility and public education (see section below). Ongoing research, education and policy action are crucial to meet the challenges of epilepsy and improve the lives of people with epilepsy everywhere.

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