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EPILEPSY AND ITS MANAGEMENT IN PEDIATRICS, ADULTS AND GERIATRICS

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Abstract:

Epilepsy is a chronic neurological disorder characterized by recurrent, unprovoked seizures due to abnormal neuronal activity. It affects individuals of all ages worldwide, with both genetic and acquired causes. The disorder significantly impacts quality of life by restricting social interaction, education, and employment. Globally, the treatment gap ranges from 10% in developed to 75% in developing nations. The prevalence varies with age—0.8% in children and adolescents, 20–25% onset in adults, and 2.4 per 1,000 in geriatrics, increasing after age 60. Epidemiological studies reveal a prevalence of 6.38 per 1,000 and incidence of 61.44 per 100,000 person-years, higher in low- and middle-income countries due to socioeconomic and healthcare disparities. Epilepsy types include focal, generalized, combined focal-generalized, and unknown onset seizures. Triggers vary by age—febrile illness and genetic predisposition in children, infections, brain injury, or metabolic causes in adults, and cerebrovascular disease or drug-induced seizures in geriatrics. Pathophysiologically, epilepsy involves neuronal hyperexcitability, imbalance between excitatory and inhibitory mechanisms, and structural brain abnormalities such as mesial temporal sclerosis. Genetic, molecular, and epigenetic changes further contribute to epileptogenesis. Treatment approaches include antiepileptic drugs like phenobarbitone and phenytoin, surgical management for drug-resistant cases, and dietary modifications such as ketogenic or low-glycemic diets. Proper lifestyle adjustments, sleep hygiene, and medical supervision help minimize seizure frequency. Despite advancements, access to care remains limited in many regions, highlighting the need for improved awareness, early diagnosis, and comprehensive management to enhance patient outcomes and quality of life.

Keywords : *Epilepsy, seizures, genetics, triggers, pathophysiology, treatment, drugs, diet, surgery, quality of life.*

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INTRODUCTION:

Epilepsy is a chronic brain disorder characterised by an enduring (i.e., persistent) proclivity to create seizures that are not triggered by any immediate central nervous system damage, as well as the neurobiologic, cognitive, psychological, and social implications of seizure recurrences. Epilepsy affects people of all ages and genders, and it is found all over the world. These disturbances can be acquired or genetic.(1) Epilepsy can drastically lower quality of life because it restricts social interactions, everyday activities, and even employment opportunities. Additionally, this illness has resulted in roughly 50 new cases per 100,000 people annually.After having a single seizure, the overall chance of epilepsy reoccurring is between 27 and 71%. About 70% of kids will go through a stage where they don't have any seizures for at least two years. (2)

The percentage of epileptics who need treatment but do not receive it or do not receive it sufficiently is known as the "treatment gap," and it ranges from 10% in underdeveloped nations to 75% in industrialised nations .(3)

Prevalence of epilepsy in different age groups are children and adolescents: 0.8% (with the highest rate of 2.3% in northeastern India).(4) Adult: Adulthood is when 20–25% of epilepsy cases start(5). Prevalence in the geriatric population is approximately 2.4 per 1,000, with a strong increase after age 60.(6)

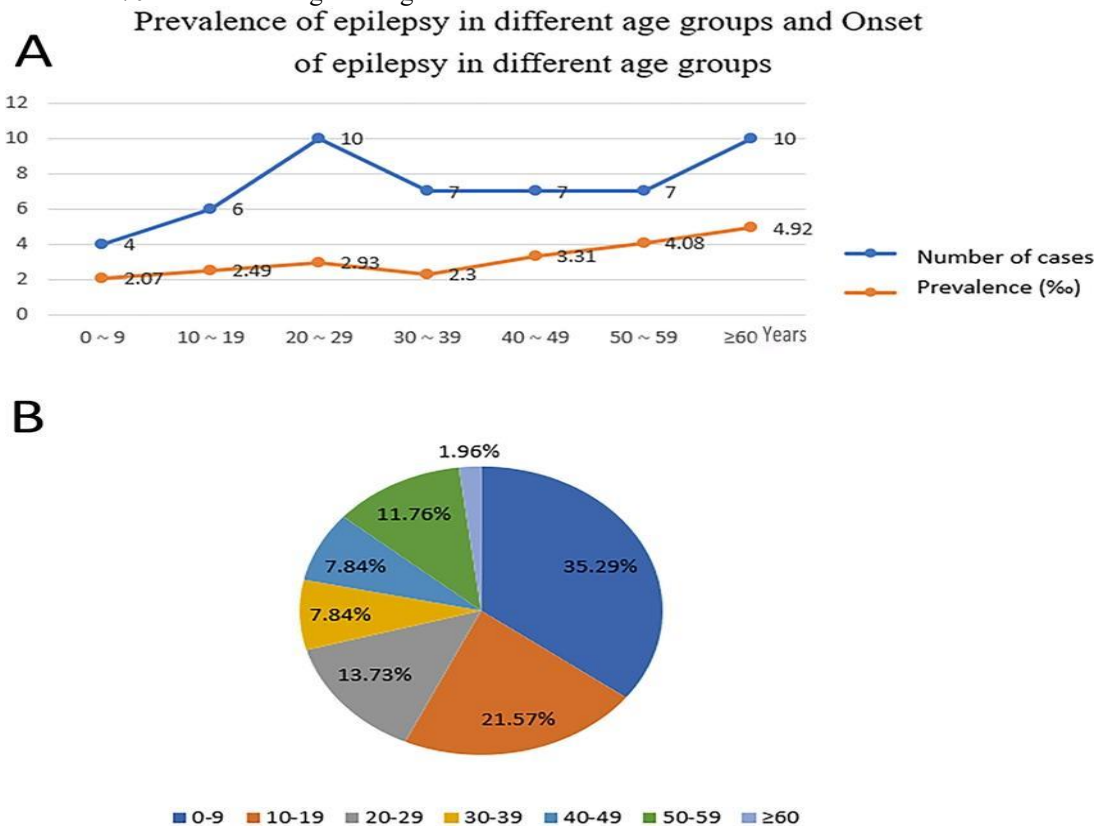

Fig. No. 1:- Prevalence of epilepsy in different age groups

The history of epilepsy is intertwined with the history of human existence; the first reports on epilepsy may be found in Assyrian manuscripts from about 2,000 years ago.Epilepsy was thought to be an idiopathic condition caused by the brain and other inner organs in the early 18th century. William Culen (1710-1790) and Samuel A. Tissot's major work in this discipline, which accurately described distinct kinds of epilepsy, laid the groundwork for current epileptology.(7)

❖ Epidemiology of epilepsy:

- As a long-term neurological condition, epilepsy has a varying incidence and prevalence worldwide (2.7–17.6 per 1000; 16–51 per 100,000). Healthcare, environmental, and socioeconomic factors all affect rates. Most people have generalized seizures, although 20
- 66% have partial seizures. Assessing the effects of cultural, social, and economic factors on epilepsy patterns will require more regional research. (8)

- The prevalence of epilepsy, which is primarily generalised and unclear forms, was found to be 6.38/1,000, the lifetime prevalence to be 7.60/1,000, and the incidence to be 61.44/100,000 person-years in 222 studies. These rates were greater in low- to middle-income nations.(9)
- Although the exact cause of the geographic difference in the occurrence of epileptic syndromes has not yet been determined, it is likely due to both hereditary and environmental factors. We don't know the full spectrum of aetiologies in the general population.(10)
- The frequency of epilepsy varies greatly across the globe, particularly between high- and low-income nations . Most people with epilepsy (PWE) reside in low- and middle-income nations in South-East Asia, Latin America, and sub-Saharan Africa, where the number of new cases is up to twice as high as in high-income nations . (11)

❖ **Types of epilepsy :**

1. **Focal epilepsy :**
   Focal epilepsy is caused by aberrant electrical activity in a single brain region.
   Causes a variety of neurological symptoms that may impair consciousness.
   Common in adults, and has a severe impact on patients and carers. (12)
2. **Generalised epilepsy :_**
   Generalised epilepsy involves the entire brain cortex at once, resulting in a sudden loss of memory and consciousness. (13)

- Types:

A) Generalised tonic-clonic syndrome (GTCS) progression:
   Include aura, cry, unconsciousness, tonic-clonic jerks, profound sleep.
B) Absence seizures
   Absence seizure are brief loss of consciousness that are prevalent in children, with an EEG showing a 3 Hz spike-wave pattern.
C) Atonic seizures
   Atonic seizures are characterised by a sudden loss of muscular tone and consciousness, which results in falls.
D) Myoclonic seizures:
   Myoclonic seizures are characterised by sudden, shock-like muscular jerks.
E) Infantile spasms
   Infantile spasms are seen in newborns who have muscle spasms and developmental delays. (14)

3. Generalised focal epilepsy :

Lennox-Gastaut and Dravet syndromes are examples of generalized-focal epilepsy, when patients have both focal and generalised seizures.

4. Unknown Onset Epilepsy:

Occurs when the seizure's onset point is not observed or known, such as during sleep or unobserved bouts.(14)

❖ **Triggers of epilepsy :**

A) Pediatrics:

The most common cause of febrile seizures is a rapid rise in body temperature above 38°C, which is determined by hereditary sensitivity to heat.

Viral infections can account for up to 82% of febrile seizures; frequent viruses include HHV-6, influenza, adenovirus, and parainfluenza.

Family History 25-40% of affected children have a low seizure threshold, which is inherited.

Genetic Factors: Fever or small stressors can cause Dravet and FIRES syndromes, which are genetically connected.(15)

B) Adults :

CNS infections including meningitis and encephalitis can cause seizures.

Sepsis is a severe systemic illness that can produce sudden symptomatic seizures owing to inflammation.

Brain tumours are a major cause of new-onset epilepsy in adults because they affect brain shape and activity.

Electrolyte imbalance disturbs the electrical stability of the brain, resulting in seizures even in the absence of prior epilepsy. Certain drugs or chemical overdoses can cause seizures. (16)

Brain Injury/Hypoxia: Neuronal loss and convulsions result from oxygen deprivation (cardiac arrest, CO poisoning).(17)

C) Geriatrics

In geriatrics drug-Induced Epilepsy: Certain medications, such as antihypertensives, diuretics, and antidepressants, can cause hyponatraemia, leading to seizures.

Genetic Generalised Epilepsy: As people live longer lives, inherited epilepsy may recur.

Cerebrovascular Disease: The most prevalent cause in the elderly; an ischaemic or hemorrhagic stroke affects brain tissue, resulting in seizures.

Chronic disorders like diabetes and hypertension damage brain arteries and increase the risk of seizures.(18)

❖ **Pathophysiology :**

- Epileptogenesis is the transformation of a normal brain into one capable of inducing repeated spontaneous seizures.
- Imbalance: Excess excitatory or inhibitory neural activity that causes hypersynchronous firing. Network Engagement: Generalised epileptic seizures: Thalamic and cortical networks that are bilateral.
- Focal epilepsy is defined by limbic or neocortical circuits in one hemisphere. Abnormal Inhibition: In some circumstances (for example, absence epilepsy), excessive inhibition can lead to seizures.

- Genetic Factors: Both inherited and acquired mutations contribute to generalised and focal epilepsies.
- Cellular Mechanisms: Neuronal hyperexcitability is the primary cause, with contributions from glial cells and axons.
- Mesial Temporal Sclerosis is a common lesion with neurone loss, axonal sprouting, and synaptic reorganisation. Hippocampal injury causes an imbalance between excitement and inhibition, which results in spontaneous seizures.
- Molecular Pathways: adenosine/ADK, BDNF/TrkB, β-amyloid, tau, IL-1β, TGF-β, and mTOR are all involved. There is currently no effective anti-epileptogenic medication.
- Epigenetic Changes: Epileptogenic shocks change the expression of genes.(19)

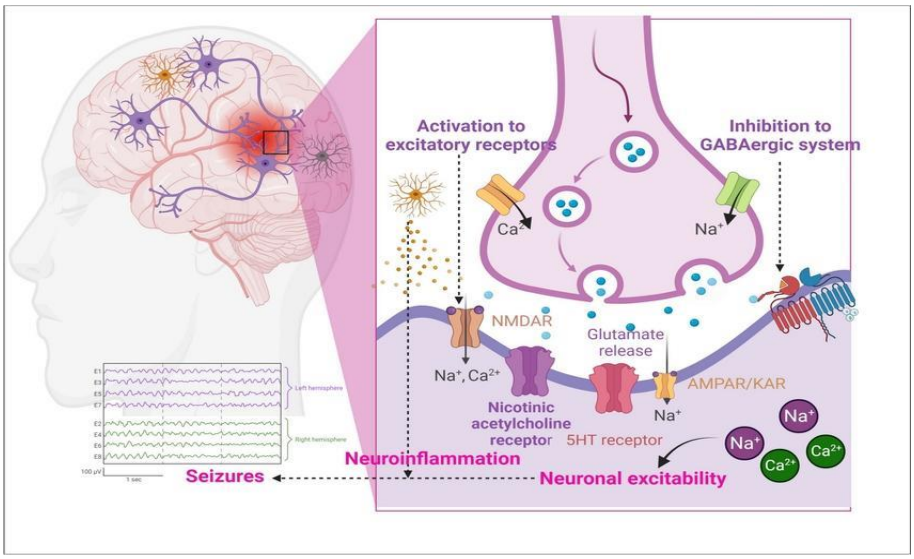

Fig no. 2 : Pathophysiology of epilepsy

❖ **Treatment of epilepsy :**

- **Surgical Management:**
  Every patient with epilepsy who is not responding to medication should have their surgical options assessed. (20)
- **Changes to Diet and Lifestyle:**
  The most well-known dietary treatment for epilepsy is the ketogenic diet, which is low in carbohydrates and high in fat but difficult to follow. The diet with a low glycemic index is more easily tolerated. Reducing distractions, avoiding heavy meals or exercise right before bed, and maintaining a regular sleep schedule are all components of good sleep hygiene that can help lower the frequency of seizures.(21)
- **Antiepileptic drugs :**

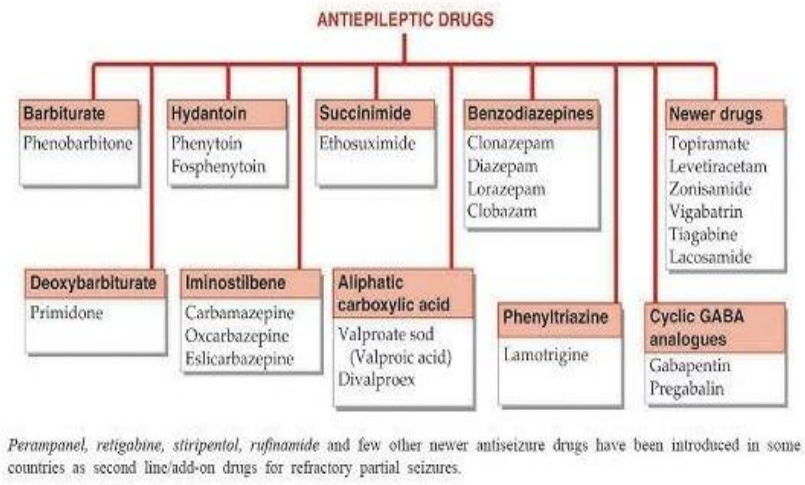

Fig No. 3 : Antiepileptic drugs

1. Barbiturate –
   Phenobarbitone :
   Phenobarbitone is the first effective anti-seizure drug.
   Absorption: Mainly oral.
   Bioavailability: 80–100%.
   Distribution: Widely distributed in body tissues.
   Metabolism: In liver.
   Excretion: By kidneys.
   Half-life: 80–120 hours.
   Mechanism of Action: Depresses CNS by reducing Ca^{2+}-dependent neurotransmitter release and enhancing GABA-mediated chloride ion conductance.(22)
2. Hydantoin –
   Phenytoin:
   Phenytoin is effective for partial and tonic-clonic seizures, not absence seizures.
   Absorption: Slow and incomplete orally.
   Bioavailability: 70–100%.
   Distribution: Widely in body tissues.
   Metabolism: In liver.
   Excretion: Mainly by kidneys.
   Half-life: ~22 hours (variable).
   Mechanism of Action: Stabilizes neuronal membranes and blocks voltage-gated Na^{+} channels, reducing excessive synaptic transmission.(23)

CONCLUSION:

Epilepsy is a chronic brain illness characterised by recurring seizures caused by aberrant neural activity. It affects people of all ages, especially those living in low-income communities. Seizures are better controlled with proper medicine, surgery, diet, and lifestyle changes. Early detection and awareness can lead to better treatment and quality of life.

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