

Epilepsy: Etiology, Epidemiology, Diagnosis, Treatment and Present Scenario.

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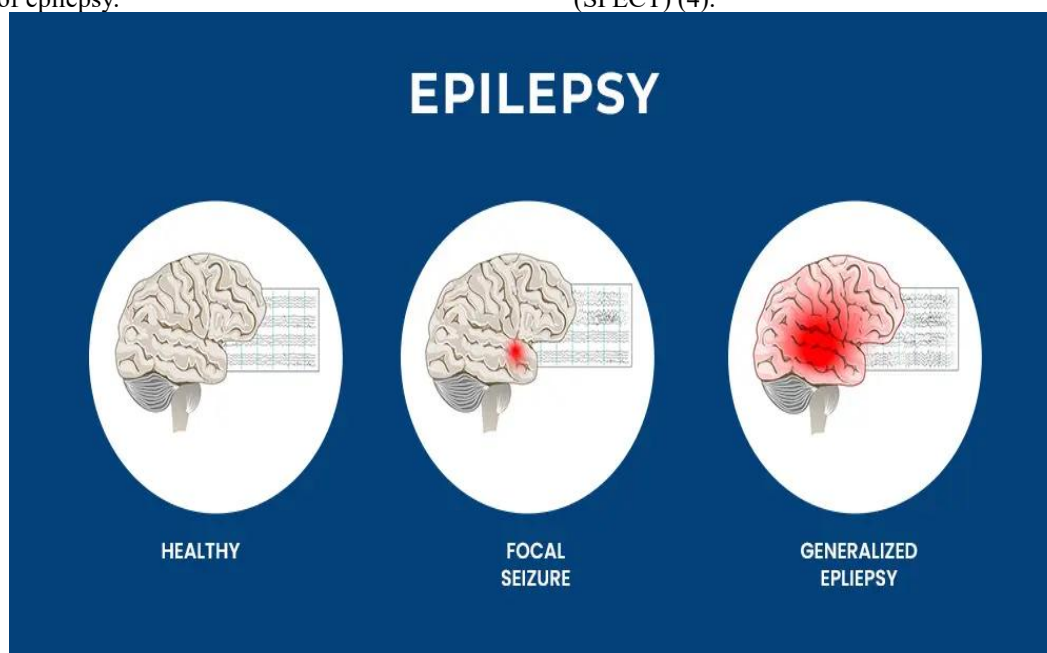
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ABSTRACT:

Introduction: Epilepsy is the major neurological disorder; it is controllable and preventable to some extent. The epilepsy is defined as the condition characterized by the frequent epileptic seizures (2 or more) (1). This epilepsy affects people of all ages, races, social classes and geographical locations (2). This epilepsy is seen more in developing countries, about 50million people are suffering from this epilepsy worldwide in which 90% of people are from developing countries (3).

Purpose: The purpose of this review is to provide an overview of epilepsy's etiology, epidemiology, diagnosis, treatment and present scenario. Provides a detailed information on diagnosis and treatment of different epilepsy types. This review shows the spreading of epilepsy over worldwide and different cases of epilepsy.

Approach: The most significant importance in diagnosis of the epilepsy is the early subjective and objective examination by an epileptologist and video recordings of the seizure, if they exist. It is very important to obtain information about the type of seizure from eye witness account. In the children and adults with the first unprovoked seizure, it is reasonable to perform the EEG (Electron Encephalogram) which determines the risk of recurrence and possible diagnosis to epilepsy. The International League Against Epilepsy (ILAE) has emphasized the need of considering the etiology at every stage of diagnosis, which includes structural etiology. This is also assessed by brain MRI helps to classify the possible epileptic syndrome, upon obtaining the negative result it indicates as single-photon emission computed tomography imaging (SPECT) (4).



I. INTRODUCTION:

Epilepsy is a significant neurological disorder that can be managed and prevented to some extent. Epilepsy is defined as a condition marked by frequent (2 or more) epileptic seizures that are not caused by any immediate identifiable factor (5). This disorder affects approximately 0.5-1% of children worldwide (6).

Globally, around 50 million people are suffering from this epilepsy, and nearly 90% of them are from developing countries. The epilepsy is considered as a common chronic neurological disease in which the normal balance between excitation and inhibition in the brain is disrupted, which leads to excessive and uncontrolled neuronal activity. As a result, the person experiences repeated unprovoked seizures (7).

Epilepsy can affect people of all ages, races, social classes, and geographical location.

Epilepsy is characterized by an enduring predisposition to generate spontaneous epileptic seizures and has numerous neurobiological, cognitive, and psychosocial effects that can impact an individual's quality of life (8).

People with epilepsy who become seizure free on taking anti-seizure medications (ASMs) can usually lead a normal life. The International League Against Epilepsy (ILAE) has given guidelines for treatment and managing of depression and anxiety in individual with epilepsy. In addition, people with epilepsy are more likely to have chronic somatic (physical) conditions, which include stomach/intestinal ulcers, stroke, urinary incontinence, bowel disorders, migraine, Alzheimer's disease (7).

Epilepsy has many possible causes which include illness, brain injury, and abnormal brain development in many cases that cause is unknown (5).

Mortality and risk

Many human beings will be having a high risk of the death rate compared to the unaffected people. Most of the common causes for epilepsy

including the sudden unexpected death in epilepsy (SUDEP), accidents and suicide. In the countries where there are high-income death rates are moderately increased. In the middle- and low-income countries there is high risk due to insufficient health care access, injuries and untreated condition.

Burden of epilepsy

Epilepsy is a major global issue and it comes with notably to disability and reduced quality of life. A large portion of people with epilepsy live in lower income countries, where both the occurrence and impact of the condition are greater. So, some improvements have been observed in death rates decreased due to better access to healthcare and treatment. Epilepsy among older individuals is increasing even in the cases of younger age groups may decline due to the better prevention of causes of infection or birth related complications. The future progress depending upon improved data collection, better treatment and development of more effective medications. (3)

Prevalence and incidence of epilepsy

Around 50 million people globally live with the epilepsy i.e., based on the estimation from the world-wide population and the World Health Organization. Nearly 80% of cases are in the low- and middle-income countries. About 70% of people with epilepsy could become seizure free, if properly diagnosed and treated. (9)

How many are cured?

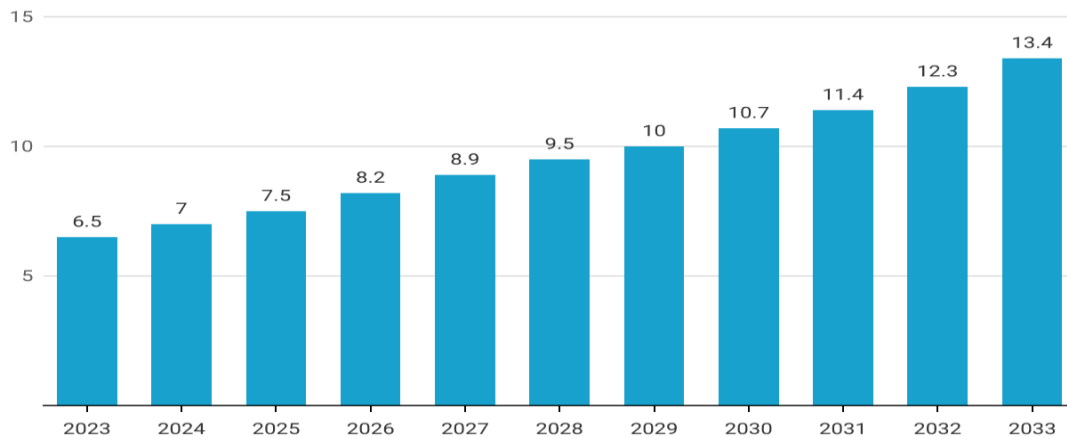
Epilepsy is usually considered as controlled rather than the permanently used but-

- 70% (35 million people) can be lived without treatment.
- People may outgrow epilepsy which becomes cured.
- However, 30% (15 million) of people have drug resistance epilepsy meaning seizures continue with the despite treatment. (10)

Global Epilepsy Treatment Market Revenue

Market Revenue in USD billion

■ Market Revenue



(Market Revenue in USD billion)

Source: Market.us Media

Epidemiology

Epilepsy is a chronic neurological disorder characterized by recurrent unprovoked seizures. It affects 50 million people worldwide with no sociodemographic boundaries. According to the previous studies are demonstrated the point prevalence of epilepsy to be between 4 to 10 per 1000 persons, making it one of the most prevalent neurological conditions. The estimated incidence of epilepsy is 50-60 per 100,000 persons-years, up to 8% people having at least one seizure in their entire lifetime. Antiseizure medications (ASMs) are the primary treatment option for epilepsy and render to two-third of treated patients' seizure-free. However, about 30% of newly diagnosed epilepsy patients will not attain seizure freedom during the treatment of and may have drug resistance, it is defined as failure to achieve seizure freedom after trials of 2 suitable and tolerated ASM regimes, whether as monotherapy or combination. In these patients, surgical interventions, such as resective surgery.

Treatment gap in epilepsy have long highlighted as public health concern. Studies have shown that about 80% of people with epilepsy live in low and middle income countries, where the treatment gap contributes substantially to global burden of epilepsy, about 90% of epilepsy in these areas is untreated, due to factors such as limited healthcare resources, cultural beliefs, social stigma use of traditional treatments and these are involved in the poor health outcomes, life threatening conditions such as status epilepticus. (11)

Causes of epilepsy

Seizures can have many causes and are not always related to epilepsy. They are classified as provoked or unprovoked. Provoked seizures result from temporary brain disturbances like injury or metabolic issues, while unprovoked seizures occur without a clear cause. Epilepsy is characterized by repeated unprovoked seizures. Common triggers of provoked seizures include alcohol withdrawal, low blood sugar, and drug overdose. (12)

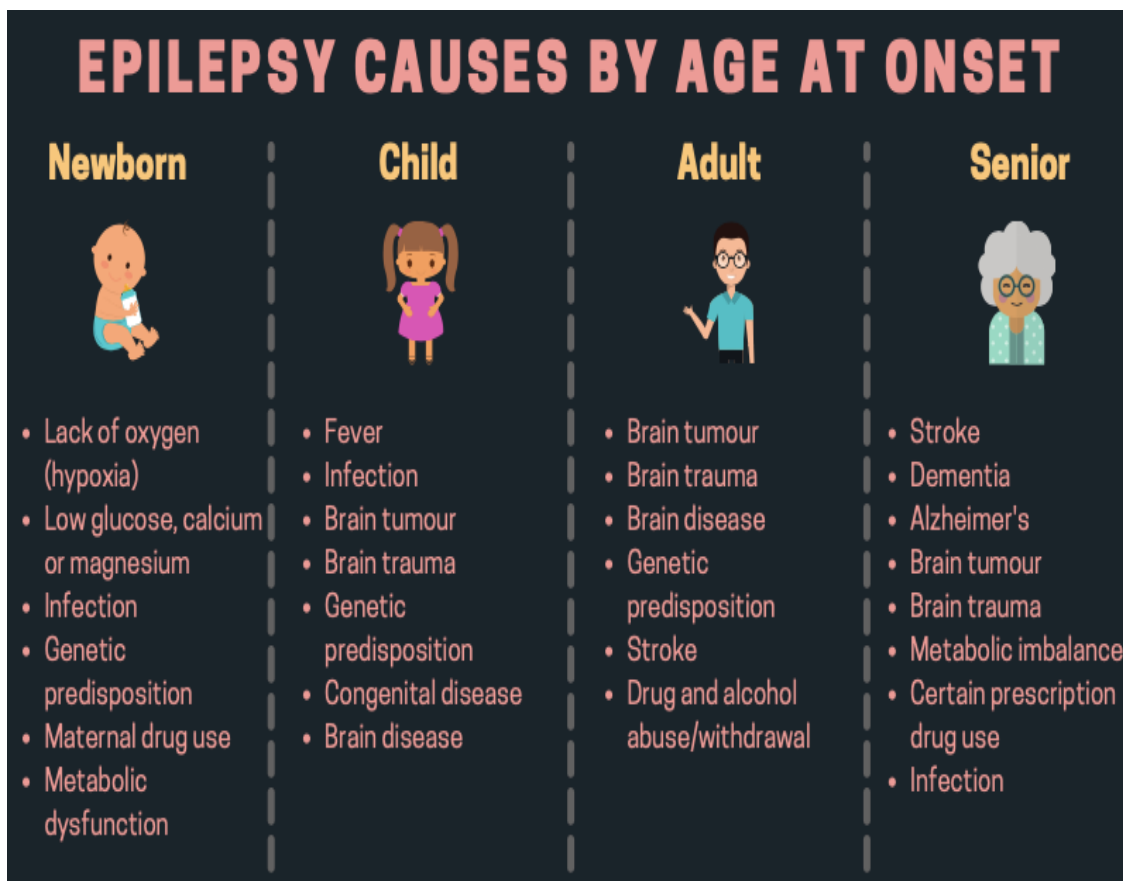
Only a few epilepsy cases have a known cause, and most are related to brain damage. Common causes include lack of oxygen at birth, head injuries, brain tumors, genetic disorders, infections, and stroke. (13) Epilepsy happens when the brain's electrical signals become abnormal, causing nerve cells to fire too quickly or all at once, which leads to seizures. It can result from different causes, such as brain injury, tumors, genetic factors, infections, chemical imbalances, or immune-related inflammation, though sometimes the exact cause is unknown. (14)

In nearly half of epilepsy cases, the cause is unknown, but genetics may be involved. Seizures can also result from brain damage due to injury, stroke, infections, tumors, brain disorders, substance use, or chemical imbalances in the body. (15)

Epilepsy is a chronic brain disorder that causes repeated unprovoked seizures and affects millions of people worldwide. It has many possible causes, including genetic, structural, metabolic, and immune factors, leading to varied symptoms and treatment

outcomes. Complex brain networks are involved, making treatment difficult in some cases, but ongoing

research is helping develop new therapies for drug-resistant epilepsy.(16)



Diagnosis for Epilepsy

1) EEG Monitoring

Electroencephalogram (EEG) monitoring is highly valuable for diagnosing various seizure disorders. It may appear normal in some patients with confirmed epilepsy, and even many without epilepsy show unusual brain activity. Video-EEG monitoring is often combined with standard EEG to clarify the nature of suspicious events.

2) Brain Scans

Brain imaging is a vital diagnostic tool for detecting tumors, cysts, and other structural brain abnormalities. Commonly used scans include CT, PET, MRI, and SPECT.

3) Medical History

A detailed medical history, including seizure symptoms and duration, helps determine the presence and type of epilepsy

4) Laboratory Investigation

Seizures can occasionally be triggered by acute toxic insults or stressful metabolic disorders. In such cases,

medical intervention must target the underlying systemic abnormality (e.g., treating hypocalcemia).

5) Physical Examination

A thorough neurological exam is essential to identify focal deficits or signs of Todd's Paralysis (temporary post-seizure weakness), which can help localize the seizure's origin in the brain.

6) Emergency Diagnostic Work-up

To rule out immediate metabolic or systemic triggers, the following should be assessed:

Vital Signs: Pulse oximetry.

Biochemistry: Serum glucose, electrolytes, and calcium levels.

Haematology: Complete Blood Count (CBC).

Organ Function: Renal (kidney) and hepatic (liver) function tests.

Toxicology: Toxicology screen and Blood Ethanol (EtOH) levels.

7) Smartphone Videography

Video footage captured by witnesses on smartphones serves as a valuable adjunct to clinical history. This is particularly useful when the verbal description of the

event is vague or limited. With over 6.8 billion smartphones in use globally as of 2023—and presence in more than 80% of households—this technology provides a nearly ubiquitous diagnostic tool.

8) Genetic Testing

Certain epilepsy syndromes are caused by specific genetic variants, or underlying metabolic and structural conditions that are impossible to diagnose without targeted genetic screening.

9) Advanced Neuro-Diagnostics

Advanced modalities such as Magnetoencephalography (MEG) and Transcranial Magnetic Stimulation (TMS) are typically utilized in specialized, high-resource settings. These tools are primarily used to:

Assess a patient's suitability for epilepsy surgery.

Evaluate individuals who remain refractory (continue to have seizures) despite optimized antiseizure medication (ASM) regimens(17).

Primary Treatment for epilepsy :

1) Antiseizure Medications (ASMs)

These represent the most common first-line treatment. They function by stabilizing abnormal electrical activity in the brain. Achieving optimal seizure control often requires a period of trial and error to identify the specific medication and dosage that works best for the individual.

2) Surgical Intervention

If pharmaceutical options prove ineffective (refractory epilepsy), surgery may be considered. This involves targeting or removing the specific area of the brain responsible for seizure activity. A surgical recommendation is only made following comprehensive diagnostic testing.

3) Neurostimulation Devices

These are implanted medical devices that deliver controlled electrical impulses to the brain or specific nerves (such as the Vagus nerve) to inhibit seizures. These devices are typically used as an adjunct to medication rather than a replacement.

4) Lifestyle and Dietary Modifications

Specific dietary interventions, most notably the ketogenic diet, have shown effectiveness in reducing seizure frequency, particularly in pediatric patients. Additionally, managing lifestyle triggers—such as ensuring adequate sleep and practicing stress reduction—is a critical component of care(18).

5) Anti-epileptic medications (AEDs)

Medical professionals often categorize medications based on when they were developed and their side-effect profiles:

Older Agents (First Generation)

- * Phenytoin
- * Carbamazepine
- * Phenobarbital
- * Primidone
- * Valproic Acid
- * Ethosuximide

Newer Agents (Second/Third Generation)

- * Lamotrigine
- * Levetiracetam
- * Topiramate
- * Oxcarbazepine
- * Lacosamide
- * Zonisamide Acute(19)

6) Acute Management of Seizures

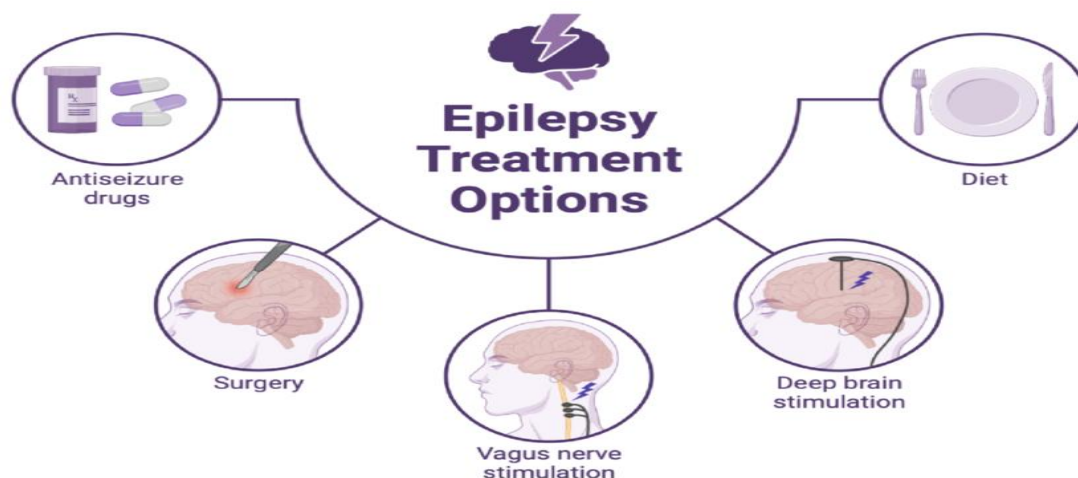
Initial Observations and Immediate Care

Spontaneous Resolution: Statistically, approximately 90% of seizures resolve independently within 5 minutes without medical intervention.

Emergency Intervention: If a seizure persists beyond the 5-minute mark, pharmacological intervention is required. Benzodiazepines, specifically Lorazepam or Diazepam, are the standard medications administered to terminate prolonged activity.

Patient Safety & Stabilization:

Monitor ABCs: Prioritize the assessment of Airway, Breathing, and Circulation. Injury Prevention: Ensure the environment is safe to prevent physical trauma and take precautions to avoid aspiration (20).



II. Conclusion

we have given a detailed information of epilepsy about its causes, diagnosis, treatment and how to overcome the epileptic seizures. By this we can clearly see that the epilepsy can be affected to any age group around 50 million people live with epilepsy. One of the causes of the epileptic seizure is the brain electrical signal become abnormal which causes nerve cells to fire too quickly or all at once which leads to seizures. There are also many diagnosis tests like ECG monitoring, brain scan, laboratory investigation etc. Anti-seizure medications are most common first line treatment.

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