**Anatomy and Physiology of Epilepsy**

**Introduction**

Epilepsy is a neurological condition with a long history that can date back to 2000 B.C as evidenced by the ancient Assyrian texts. At the time, most scholars linked epilepsy with superstition and relied on non-scientific remedies to manage the condition. Fortunately, the last three decades have revealed massive factual information about epilepsy through research and experimentation. This has greatly facilitated a revolution in the diagnosis, treatment and management of epilepsy. The most notable discoveries include the invention of the electroencephalogram, development of antiepileptic drugs and improvement of neurological practice (Emmanouil Magiorkinis, 2014). Despite this, epilepsy remains a major healthcare problem. The World Health Organization (WHO) estimates that almost 50 million people in the world have epilepsy. Besides, epilepsy affected all people equally without consideration of the age, sex or race. Further, the WHO suggests that epilepsy can be sustained with proper diagnosis and treatment (World Health Organization, 2019). This provides the rationale for the need to understand the anatomy and physiology surrounding epilepsy. It is the ultimate way of creating a firm foundation for understanding the technicalities of this chronic condition.

**Anatomical Concepts Relevant to Epilepsy**

It is worth noting that understanding the anatomy of epilepsy has been enhanced by the development of better analytical methodologies and solid scientific research in the 20th and 21st centuries. Researchers and scholars have invested a significant amount of time to dive in the study of epilepsy, an aspect that has had a tremendous improvement in its management. To the core of this paper, epilepsy is a chronic neurological disorder that is characterized by recurrent seizures. Simply put, a seizure is an episodic violent involuntary contraction of a group of muscles often propelled by excessive neuronal discharges. It is a heterogeneous condition that can be caused by interference of a wide range of neurological parts. Therefore, the anatomy of epilepsy is primarily inclined to neuroanatomy especially the brain.

Needless to say, the pathology of epilepsy involves alteration of numerous anatomical sites in the brain. To begin with, the cerebral cortex has a significant contribution to a better understanding of epilepsy. The cerebral cortex has several functions that include memory, perception, thought and control of various processes. The motor cortex of the cerebrum is the primary center that coordinates and controls various motor functions. Through coordination with other brain areas, the cerebral cortex is the origin of the thought to execute a particular movement. This implies that individuals with normal cerebral cortex functioning are not likely to experience epileptic seizures. Thus, epileptic seizures can arise from a disruption in the cerebral cortex through conditions such as tumors and meningitis. This emphasizes the heterogeneous nature of epilepsy. Studies have established the specific regions of the cerebral cortex that are most associated with epilepsy. The common ones are the frontal and temporal lobes. This has led to the rise of temporal lobe epilepsy and frontal lobe epilepsy (Qian Wu, 2018). The structure of this parts is modified which reflects the internal workings thus breeding epilepsy.

When narrowing down to the temporal lobe, studies have revealed a crucial link of the hippocampus to epilepsy. The hippocampus is situated in the hippocampal sulcus and its gross anatomy reveals its head, body and tail. The hippocampus is a relay center for many neural circuits which makes it critical in the regulation of various brain activities such as the execution of motor functioning (Qian Wu, 2018). Various brain imaging techniques for patients with epilepsy have revealed an alteration in the structure of the hippocampus. This led to the revelation that seizures can cause aberrant neurogenesis in the hippocampus thus disrupting the various circuits. Besides, cortical thinning has also been witnessed in areas that have connections with the hippocampus such as the entorhinal cortex and the amygdala.

Besides, studies have revealed the significant involvement of the white matter of the brain in the pathology of epilepsy. The white matter is an integral constituent of the brain that has fibers for signal transduction between different areas of the brain cortex (Qian Wu, 2018). Structural abnormalities in the white matter of the brain alter the structural integrity of the brain which may lead to epileptic seizures. Other lower areas of the brain may also influence the pathology of epilepsy. For instance, structural modifications in the brainstem may contribute to epilepsy. The brainstem is comprised of the midbrain, the pons and medulla oblongata all of which are crucial in the relay of motor commands from the cerebellum, cerebrum and other brain parts to the spinal cord and eventually to muscles. Therefore, any condition such as the presence of tumors in the brainstem may alter the relay of this information leading to seizures due to lack of control of muscle movements.

**Physiological Concepts Relevant to Epilepsy**

Physiology of epilepsy complements the anatomy but is heavily inclined to the functioning of the body systems. To effectively understand the science behind epilepsy, it is crucial to understand the normal physiology of the body. This provides ground to deal with pathophysiology, which is simply the altered physiological functioning that is altered during a diseased state like epilepsy. Advancement in physiological knowledge about epilepsy has enhanced a better understanding of epilepsy and eventual development of effective management approaches.

The physiology of epilepsy will be less meaningful without mentioning the electroencephalogram (EEG). EEG is a brain monitoring method that indicates the electrical activity in the brain. It is important to note that the EEG is unique from other brain imagining techniques which tend to focus on structural abnormalities in the brain. It is primarily focused on projecting the functioning of the brain (Prior, 1994). An EEG test involves placing sensitive electrodes on the scalp to record electrical signals that are produced in the brain. The electrodes then collect data that is processed and presented in form of pattern like waves. There is a standard of what a normal EEG looks like. This indicates the normal functioning of the brain. However, an EEG of an epileptic patient exhibits unusual differences especially during the occurrence of an epileptic seizure. This concept emphasizes the vital role that physiology plays in diagnosis and assessment of epilepsy.

At the primary level, epilepsy is caused by an imbalance of between excitatory and inhibitory signals in various parts of the brain (Hall, 2016). Normal physiology dictates that there should be a balance between excitatory and inhibitory signals for optimal functioning of the body. However, some disorders such as epilepsy alter the regulatory systems leading to an imbalance. To be more specific, epileptic seizures happen when there is more excitation than inhibition. Many approaches have been used to explain this mechanism. One of the approaches is that of focal epileptic seizures. In these approaches, excitatory signals arise from one area of the brain. They face little or no inhibition. This contributes to an increasing progression. The signals progressively spread to other parts of the brain. Eventually, they reach the motor cortex where they trigger involuntary muscle movements that are exhibited during seizures (Hall, 2016). Another approach is that of generalized epileptic seizures. Unlike focal epileptic seizures, generalized epileptic seizures don’t have a specific origin in the brain.

Worth noting also is the fact that epilepsy involves an imbalance is the secretion and release of various chemicals in the body. Researchers have established the strong link between epilepsy and abnormal voltage-gated sodium, potassium and chloride channels (Kim E. Barrett, 2010). This may be primarily as a result of mutations that can be inheritable. These channels tend to malfunction by either releasing too much or too little of their respective ions. In epilepsy, too much of excitatory ions like sodium we released which leads to a state of hyperpolarization. Besides, inhibitory ions like chloride are released in minute amounts that are overwhelmed by the excitatory ions. This implies that there will be excessive excitation which eventually results in uncontrolled muscle movements during seizures.

**Conclusion**

The strong connection between the anatomy and physiology of epilepsy cannot be gainsaid. These two disciplines are interrelated as they complement one another to enhance better understanding of epilepsy hence the development of plausible actions to manage it. Anatomy dwells on the body structures that are affected by epilepsy and the modifications that take place. Physiology on the other hand focuses on the functioning of these body structures. It is the basis of identifying any malfunctioning. Despite the overlap that is exhibited between these disciplines, understanding them builds the foundation to a better understanding of epilepsy.

# References

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