Childhood absence epilepsy | case study

Childhood absence epilepsy [CAE] is a common form of epilepsy which manifests in ten to seventeen percent of all epilepsy cases (Matricardi, Verrotti, Chiarelli, Cerminara, Curatolo; 2014). The disease is idiopathic making the disease complex to treat. The purpose of this paper is to examine the mode of action of anticonvulsants in order to understand the therapeutic effects they have on clients with CAE.

Etiology, Signs, Symptoms

Epilepsy is a condition in which a person experiences at least two spontaneous seizures occuring 24 hours or more apart (Lewis , Dirksen, Heitkepmper, Bucher, & Camera, 2014). The seizures can be divided into generalized and partial epilepsy. Generalized epilepsy affects the whole brain primarily causing loss of consciousness while partial epilepsy affects only one side of the brain resulting in varied neurological disturbances (Lewis et al., 2014). The client is a 12 year old male diagnosed with CAE which is a subset of generalized epilepsy, at age 5. CAE has unknown genetic causes, multiple factors, an onset between the years of 4 – 10, frequent brief seizures and electroencephalogram [EEG] spike waves at 3Hz (McCance, Heuther, Brashers, & Rote, 2014; Uyal-Soyer, Yalnizoglu, & Turanli, 2012; Tenney & Glauser, 2013).

CAE is characterized by rapid onset and sudden termination of impaired consciousness or a lack of response and memory. The duration of unresponsiveness lasts fewer than 10 seconds with accompanying eyelid fluttering, and upward deviation of the eyes (McCance et al., 2014; Nordli, 2005). The symptoms have been linked to the abnormal firing of over excited neurons, which originate in the Thalamus, spread to one of many

cortical areas of the brain then to other regions. CAE is idiopathic and one possible reason for the over excited neurons has been linked to the dysregulation of gamma-amniobutyric acid receptors [$GABA_A$] (Macdonald & Kang 2009; Mccance et al., 2014). The dysregulation has been attributed to mutations of the $GABA_A$ receptors. Under normal circumstances, the receptors bind to $GABA_A$ chemical messengers and allow primarily chloride and bicarbonate ions to pass through the membrane of neurons (Briggs & Galanopoulou, 2011). The increased chloride which has a negative charge creates a larger difference in membrane potential resulting in less depolarization and less firing of the neuron (Briggs & Galanopoulou; Mccance et al., 2014; Macdonald & Kang, 2009). When the $GABA_A$ receptors malfunction the nerve cell becomes hyperpolarized and fires more frequently (Briggs & Galanopoulou; Mccance et al., 2014; Macdonald & Kang, 2009). The client who was diagnosed at age 5 displayed symptoms of short brief periods of impaired consciousness, a focused gaze or staring, and rapid eye opening or fluttering, which are common manifestations consistent with CAE. The symptoms result from over and under stimulation of neurons in the thalamus, medial lobes, frontal lobes, parietal lobes, and cortex (Blumenfeld, 2012).

Risk Factors

CAE develops in normal children with no previous history of dysfunctional neurological manifestations. Factors that are known to increase risk of the epilepsies in children include malformations of the central nervous system [CNS], head trauma, CNS infections, and certain inherited abnormalities to metabolic conditions or genetic factors (Lewis et al., 2014; Crunelli &

Leresche, 2002). However, the aforementioned factors account for only 25% to 45% of all epilepsy cases, and thus, the etiology remains obscure (Cowlan, 2002).

Diagnostic and Assessment

The client had an electroencephalogram [EEG] which measures the voltage levels of the brain recording the variances of electrical potential over 20 to 40 minutes. The EEG is used to evaluate the origin and patterns of neural conductivity within the brain. The EEG uses the cortical surface of the brain to measure the sudden onset and completion of 3 to 4 Hz spike signals indicative of CAE seizure activity. In conjunction with the EEG, the client was instructed to hyperventilate to induce the seizures (McCance et al, 2014; Tenney & Glauser, 2013). The exact reason why hyperventilation induces seizures is unknown, but according to Nordli (2005), it is 95% effective in initiating the attacks and is commonly used in diagnosing CAE. The EEG measures the synchronous, bilateral, and symmetrical electrical patterns which are used to identify CAE based on the wave impulses, patterns and frequencies generated. The patterns radiate out from the thalamus through thalmacotrical neuropathways then further spread out to the cortex (Matricardi et al., 2014). The symptoms are a result of the thalmacortical pathways stimulating or disrupting a different area of the brain. CAE primarily disrupts signals to the medial lobes, frontal lobes, parietal lobes, frontal cortex and somatosensory regions of the brain producing symptoms such as the eyelid fluttering, lack of response to stimuli and no memory recall (Crunelli, 2002; Matricardi et al. 2014).

Mode of Action for Anticonvulsant

To help manage the symptoms of CAE, the client was prescribed Carbamazepine in an attempt to reduce the number of neural discharges. Carbamazepine is an anticonvulsant that reduces nerve conduction by blocking sodium channels increasing the potential membrane differential and reducing the ability to depolarize (Lehe, 2010; Drugbank. com, 2015). This reduces the number of available sodium channels and prevents an over excited nerve cell from firing in rapid succession. In addition, Carbamazepine acts as a GABA $_A$ receptor agonist which allows chloride to pass through the neural membrane, increase the difference in membrane potential, and reduce the ability to depolarize the nerve cell (Briggs & Galanopoulou, 2011).

Prescriptions and Evaluation

The client was prescribed Carbamazepine 400 mg twice a day. Carbamazepine is a common first choice for treating partial seizures such as temporal or frontal lobe epilepsy and is not often prescribed for CAE (McCance et al, 2014; S Skrijelj & Mulie, 2014). Skrijeli and Mulie (2014) note that Carbamazepine can lead to aggravation of symptoms in both partial and generalized epilepsies.

The client was also prescribed 10 mg of Clobazam which is a benzodiazepine class of drug that also has anticonvulsant properties (Hanks, 1979). Clobazam partially binds with the GABA $_A$ receptor opening the channel to allow more chloride ions to enter the cell. The increase chloride ions create a hyperpolarized state preventing excessive depolarization, leading to reduced firing of neurons (Drugbank. com, 2015). While Carbamazepine which is a GABA $_A$ receptor agonist, is the primary drug for the client’s epilepsy,

Clobazam is used as an adjuvant due to its partial GABA $_A$ receptor agonist properties (Lehe, 2010; Drugbank. com, 2015). There is conflicting evidence on whether Carbamazepine is more effective than Clobazam as comparative studies have shown Clobazam to be effective in treating CAE with fewer side effects (Fraught, 2003).

Conclusion

Both Carbamazepine and Clobazam are effective in managing epilepsy by opening chloride channels that create a hyper polarized state which prevents neurons from firing rapidly. The reduction in rapidly firing neurons reduces the symptoms associated with CAE. Controlling the symptoms of CAE through drugs can alter the way individuals live with the disease and prevent further physical, mental, and cognitive damage. CAE is idiopathic and there are still many unknowns on proper diagnoses and effective medications.

References

Blumenfeld, H. (2012). Impaired consciousness in epilepsy. *Lancet Neurology. (11)* , 9, 814 – 826

Briggs, S., Galanopoulou, A. (2011). Altered gaba signaling in early life epilepsies. *Neural plasticity (2011)* . 527 – 605

Crunelli, V., Leresche, N. (2002). Childhood absence epilepsy: Genes, channels, neurons, and networks. *Neuroscience. (3)* . 371 – 382

Cowlan, L. (2002). The epidemiology of epilepsies in children. *Mental retardation and developmental disabilities research review. (8)* , 3. 171 – 181

Drugbank. ca. (2015). Carbamazepine. Retrieved from: http://www. drugbank. ca/drugs/DB00564

Drugbank. ca. (2015). Clobazam. Retrieved from: http://www. drugbank. ca/drugs/DB00349

Fraught, E. (2003). Clinical trials for treatment of primary generalized epilepsies. Epilepsia. (44), 7, 44 – 50

Hanks, J. (1979). Clobazam: Pharmacological and therapeutic profile. British journal of pharmacology. (7), 151 – 155

Lehne, R. A. (2010). Pharmacology for nursing care (8 th ed.). St Louis, MO: Elsevier Saunders

Lewis , S., Dirksen, S., Heitkepmper, M., Bucher, L., & Camera, I. (2014). Medical-surgical nursing in Canada: Assessment and management of clinical problems (3 rd ed.). Toronto, ON: Elsevier Canada

Macdonald R., Kang, J. (2009). Molecular pathology of genetic epilepsies associated with gaba a receptor subunit mutations. *Epilepsy currents (9)* . 1. 18 – 23

Matricardi, S. Verrotti, A., Chiarelli, F., Cerminara, C., Curatolo, P. (2014). Current advances in childhood epilepsy. *Pediatric neurology (50)* , 3, 205 – 212

McCance, K., Heuther, S., Brashers, V., & Rote, N. (2014). Pathophysiology: The biological basis for disease in adults and children. Maryland Heights, MO: Mosby Elsevier

Nordli, D. (2005). Idiopathic generalized epilepsies recognized by the international league against epilepsy. *Epilepsia. (46)* , 9, 48 – 56

Skrijelj, J., Mulie, M. (2014). Aggravation of symptomatic occipital epilepsy of childhood by carbamazepine. *Vojnosanit pregl. (71)* , 4, 404 – 407

Tenney, J., Glauser, T. (2013). The current state of absence epilepsy: Can we have your attention?. Epilepsy Currents (13), 3. Retrieved March 10 2015 fromhttp://www. ncbi. nlm. nih. gov/pmc/articles/PMC3697883/

Uyal-Soyer, O, Yalnizoglu, D., Turanli, G. (2012). The classification and differential diagnosis of absence seizures with short term video – eeg monitoring durng childhood. *The Turkish journal of Pediatrics. (54)* . 7 – 14