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Mini Review

Alzheimer's Living with the Disease- Understanding the Brain

Caron Leid*

Aspen University, Aspen, Colorado, USA

***Corresponding Author**: Caron Leid, Aspen University, Aspen, Colorado, USA.

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Understanding the Brain

The brain, my grandmother in her late years, used to say as her body deteriorated, "I am just a brain". She knew every fact, and remembered everything and everybody. I understand the concept more than I want to, as her daughter is quite the opposite. Her brain solely deteriorated and her body is slowly following. The brain is the most powerful organ and the most complex. It is your hard-drive, it makes you who you are and it produces your thoughts, feeling, memories and actions. It weights approximately 3 pounds, and utilized over 100 billion neurons to perceive and analyze incoming information. The brain analyzes incoming information and processes this information and then instructs the body what to do with it.

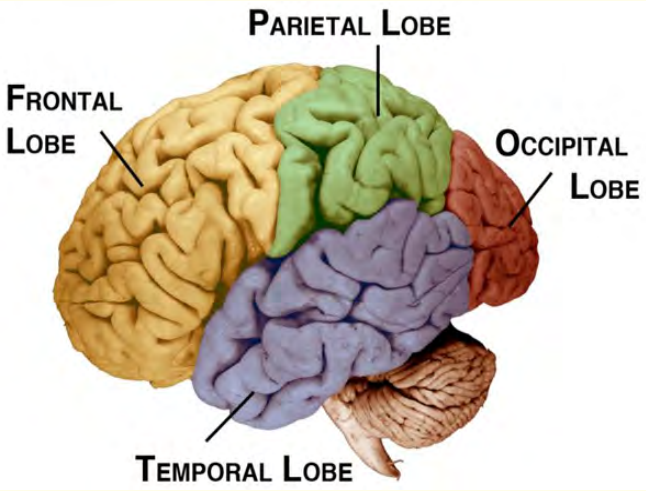
Like other organs, the brain is made of a collection of cells. The primary working cell in the brain is called a neuron or a nerve cell. Like other cells, a neuron has an enclosed membrane and contains a nucleus that contains genetic material, and is powered by energy packs called mitochondria. The difference with neurons, they contain two kinds of extensions from its membrane. One type is called dendrites, they look like bushes. A neuron typically contains several main branches of dendrites. The other kind of extension from the membrane is called the axon. There is usually one axon to a neuron, which branches 10,000 to 40,000 times. Information enters through the dendrites, and outgoing information leaves through the axon. Dendrites and axons can grow and be modified throughout our life, depending on experience [1].

Neurons generate an electrical signal called an action potential, this is the main job of a neuron. It can only perform this action potential if it is excited sufficiently by another neuron. The action potential is like a lightning bolt, and it stimulates other neurons. The stimulated neurons then can generate their own action potentials and travel to other neurons that they are connected to, creating a network of neurons. These neurons perform specific brain functions. Action potentials travel about 60 miles an hour down axons. Myelin is a special protein that is wrapped around the axons. Myelin keeps the axons insulated, the axons that are not insulated either by disease or how they were designed, transmit signals that are 10 times slower [1].

An axon branches somewhere between 10,000 to 40, 00 times, each branch forms an electrical or chemical contact called a synapse, to another neuron. Neurotransmitters are mushroom shaped terminals that are at the end of the axon. Each neuron makes a single type of neurotransmitter, such as glutamate, gamma-aminobutyric acid (GABA), dopamine, norepinephrine, serotonin, acetylcholine, or histamine. The primary excitatory neurotransmitter, glutamate, is released by 75 percent of all neurons in the brain, and the primary inhibitory neurotransmitter, GABA, is released by about 20 percent of all neurons in the brain. When the action potential reaches the end of the axon, it stimulates the release of thousands of neurotransmitter molecules into synaptic space. The neurotransmitters float across this space, and some of them will bind to receptors on the receiving end of neurons and may stimulate or inhibit action of the receiving neuron [2].

The brain has four main lobes and is divided as such, frontal, temporal, parietal and occipital (see Figure 1). The easiest way to generalize it is that the back half of the brain, the parietal lobe, the occipital lobe and the temporal lobe is how we perceive the world. The back part of the brain takes information from the senses and processes it into sound, sight, and physical sensation. This allows perceptual awareness, it is how we perceive the world directly and have concrete images, feelings, facts and data. The front half of the brain allows

for integration of the information that it receives, analyzes it, processes it and decides what to do with the information. Dementia can be involved with all four lobes of the brain.



The frontal lobe

The frontal part of the part of the brain (the front half of the brain) controls important cognitive skills such as memory, language, emotional expression, problem solving, judgment and sexual behavior. It is typically described as the control panel of an individual's personality and provides the ability to communicate. The frontal lobe contains three important areas: the motor cortex, which is responsible for primary motor function, it provides our ability to consciously move our muscles and contains the two key areas related to speech. The second important area in the frontal lobe is the premotor area which is responsible for planning motor movements, and the prefrontal cortex which is closely involved with executive functions such as planning, organizing, making judgments, exercising impulse control and communicating what is on one's mind [1].

The prefrontal cortex is the most evolved part of the human brain and it represents 30% of the total mass. The prefrontal cortex allows us to learn from mistakes and assists us to make plans to reach our desired goals. It allows us to be thoughtful, give us the capacity to be empathetic, organized, thoughtful, provide us with the ability to express our feelings properly. When there are issues with the prefrontal cortex it could result in poor judgement, impulsivity, poor time management, short attention span, issues with learning from experience, confusion, and lack of empathy [1].

The temporal lobes, which is located below your temples and behind your eyes are involved with hearing and reading, reading social cues, moving memories into long term storage, and mood stability. The temporal lobes also assist with distinguishing objects by sight and naming them, including recognizing people's faces. The hippocampus and the entorhinal cortex that is situated on the inside aspect of the temporal lobes, translate incoming information and store it for several weeks. There is an almond-shaped structure named the amygdala. Intense emotions activate the amygdala such as fear, anger, or any other intense experiences. Any strong emptions can improve the encoding process of hippocampal neurons and make it easier to retrieve the experience. This is helpful as it allows us to remember events that were emotionally charged, by the intense emotion. This can be both a good experience that is emotionally charged, or a bad experience that is emotionally charged. The amygdala allows us to retrieve the storage and memory of certain experiences so that we can respond more appropriately and more quickly in the future. When the amygdala is working as it should it allows us to react thoughtfully and logically. When the amygdala is overactive, we may tend to overact to external events. When the amygdala is underactive, it may result in not responding accurately to external events and the response may not match what has happened. An example is laughing inappropriately upon hearing bad news, this may be indicative of your amygdala not working properly [1].

When there is damage to the temporal lobe it can lead to short and long-term memory problems, finding the proper words in conversation, issues with reading social cues, incidents of rage, categorizing and comprehension and moral or religious fixation. The sensory part of the brain is called the parietal lobes, they perceive light touch, temperature, pain, vibration, and pressure. Due to it being the sensory part of the brain it allows us to recognize objects by their feel. The right side of the parietal lobe perceives information from the left side of the body and the left side of the parietal lobe perceives information form the right side of the body. The far side of the parietal lobe processes visual information and tracking the motion of objects. This allows us to know where we are in time and space, knowing what left and right is and direction, therefore reading and creating maps in your mind. The parietal lobes also allow us to understand what we read, perform operations such as adding and subtracting and allow us to mentally move or rotate objects in our mind [1].

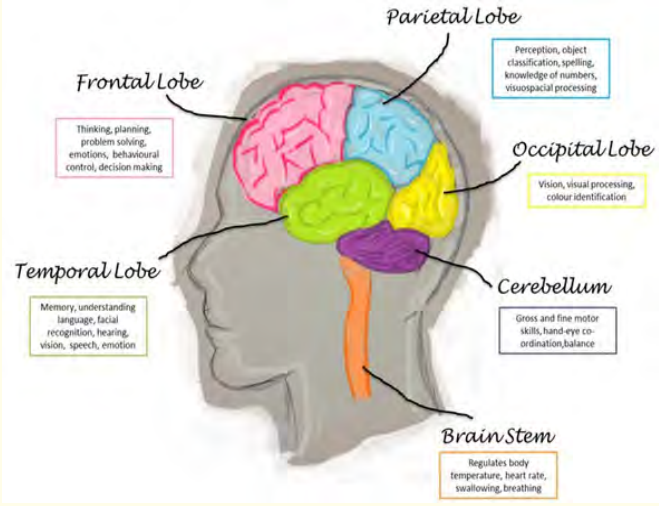
In Alzheimer's disease after the temporal lobes are damaged it spreads to the parietal lobes. Therefore, in Alzheimer patients, they struggle with directions, driving, and getting lost. When damage occurs to this part of brain, visual tracking is lost, therefore there may be difficulty in parking a car. Which is why, when there is a diagnosis of Alzheimer's disease immediately your driver's license is suspended. Dexterity issues are typically the result of parietal lobe damage. In addition, there is issues with dressing, left and right confusion, trouble with math, impaired copying, and drawing, or cutting. Another symptom of parietal lobe damage, is denial or neglect of problems, which also prevents individuals from even recognizing that there is a problem with driving or communicating and therefore will not get help or ask for help [1].

Located at the back of the brain, is the occipital lobes, which is responsible for processing visual information. The occipital lobes process colour, size, lines, and depth. Light enters the retina of the eye, that immediately stimulates the optic nerve. The left half of your vision crosses to the right side of the brain to the primary visual cortex located in the occipital lobes. Light and shade are then organized, colour and basic elements of vision are then perceived. Once the visual information is perceived, it moves to the temporal lobes. Anything that involves motion of objects goes right from the occipital lobes to the parietal lobes.

When there is damage to the occipital lobes it can cause changes in sight and perceptions and therefore can lead to visual hallucinations, illusions and even blindness. If one side of the occipital lobe is damaged, it prevents you to see the opposite side of your environment. Therefore, if the right side of your occipital lobe is damaged, you will not have the ability to see the right side. The side effects from damage to the occipital lobe is blind sight. When and individual has Blindsight they can recognize moving objects in their visual field that is apparently blind. Lewy type dementia often begins with symptoms of occipital lobe damage, particularly hallucinations [1].

Brain Functions

Prefrontal Cortex	Temporal Lobes	Parietal Lobes	Occipital Lobes
Judgement	Hearing/Listening	Direction Sense	Sight
Impulse Control	Reading	Sensory perception	Colour perception
Attention Span	Reading social Cues, include speech tone	Spatial processing, sees motions	Lines
Organization	Short-term memory	Visual guidance, such as to grab objects	Depth
Self-Monitoring	Long-term memory	Recognize objects by touch	
Critical thinking	Anger Control	Know right from Left	
Empathy	Naming things	Reading and creating Maps	



Brain Problems

Prefrontal Cortex	Temporal Lobes	Parietal Lobes	Occipital Lobes
Poor Judgement	Short term memory loss	Impaired direction sense	Sight
Impulsivity	Reading Problems	Trouble dressing or putting objects together	Can't see outlines of objects
Short attention	Word finding problems	Left-right confusion	Visual simple hallucinations
Disorganization	Trouble reading social cues	Denial of illness	Visual illusions
Trouble learning from experience	Episodic rage	Impaired position sense	Blindsight
Confusion Poor time Management Lack of Empathy	Poor object recognition	Trouble with math or writing Neglect or unawareness of what you see	Functional blindness Objects appear larger or smaller than they are

Understanding the four brain functions and how they operate is as important as what happens when the brain is atrophied. My mother was diagnosed 17 years ago with "atypical Alzheimer's disease because at the time, I suppose it was not important to diagnose what specific type of dementia it was. Her MRI's showed plaque in the frontal temporal area of her brain. It is important to understand the disease and if I paid closer attention to how the brain functions, it would have saved me a lot of guessing work. When you are dealing with the day to day disease, it is so challenging, you react to the behavior of the individual, so you react to the disease, but not what is happening. Unlike other diseases, where it can be studied and biopsied, Alzheimer's disease can only be studied post mortem. The only assistance you can have been understanding how a healthy brain functions and then how the disease affects the brain. If I thoroughly understood how the brain functioned upon my mother's diagnosis, it would have assisted me in understanding what was going on. Hindsight as they say is 20/20 and I understand I was in severe denial at the beginning of her disease, hoping that her diagnosis of Atypical Alzheimer's disease, I would be the genius that would cure it.

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