Overview of neurogenesis

Neurogenesis

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Abstract

Neurogenesis is the growth of neurons in the brain. Many scientists do not believe that new neurons can form naturally in adult mammals. However, new neuron growth could be induced under certain conditions using stem cells. Scientists have found that these new neurons affect the olfactory and hippocampus organs of the brain. It is thought that fish are able to provide neurons that will survive and do well in any region they are transferred to. There are ways to boost the neurons in one’s brain, including meditation and a healthy diet.

Neurogenesis

In order to better understand neurogenesis one has to get an idea of how the brain works. The brain weighs about 1. 5 kilograms and is made up of 100 billion neurons (Pubmedhealth). It is a part of the nervous system along with the spinal cord and sensory organs (Nervous System). There are many sections of the brain that have their own important function. The sections of the brain are cerebrum, diencephalon, brain stem, and cerebellum.

The cerebrum has a left and right hemisphere and each hemisphere is made up of six lobes. The left hemisphere is responsible for speech and abstract thinking and the right hemisphere is responsible for spatial thinking. The right hemisphere controls the left side of the body and the left hemisphere controls the right side of the body.

The diencephalon or the interbrain is locate and is surrounded by the cerebral hemispheres. The interbrain includes the thalamus, hypothalamus, and pituitary gland. The brain stem is the part of the brain that is connected to the spinal cord. The cerebellum is the back portion of the brain which controls balance for walking, standing, and other motor functions.

When the brain communicates with the rest of the body, it has special cells called neurons. The neuron or nerve cells have three parts that helps complete the function of communicating and integrating. The parts are called dendrites, axons, and axon terminals. Dendrites receive information while axon sends information throughout the body.

Neurons have the potential to regenerate but it does not occur as often or as much in order to self-heal individuals with nervous system problems (School of Life Sciences). Neurons can die because of injury or disease. Neurons needs oxygen and glucose to survive and continue functioning as nerve cells (Braindecoder).

Neurogenesis is the growth and development of neurons in the brain. When the word is being broken up, its direct translation would be “ formation of nerves, “ neuro” meaning relating to nerves and “ genesis” meaning the formation of something. This process is highly active while a baby is in the womb and is responsible for the productions of the brain’s neurons (Mandal). As the mammal ages, the process of generating functional neurons occurs in the restricted areas of the brain. (Ming and Song). This was observed that it only occurred during embryonic and perinatal stages in mammals. In the peripheral nervous system, neurogenesis is thought to be active only during

prenatal development, with the exception of the olfactory neuroepithelium (Researchgate). The occurrence of insult-induced neurogenesis, which has been reported by several investigators in the brain, is limited to a few recent reports for the peripheral nervous system. These reports suggest that damage to the adult nervous system induces mechanisms similar to those that control the generation of new neurons during prenatal development. Understanding conditions under which neurogenesis can be induced in physiologically non-neurogenic regions in adults is one of the major challenges for developing therapeutic strategies to repair neurological damage (PubMed)

Adult neurogenesis was then studied after more studies were being shown about the neuron development in the adult's brain which allowed the study of more mammals, including humans (Ming and Song).

Adult mammalian neurogenesis is a controversial topic because scientists did not believe that new neurons are born into the brain. Adult neurogenesis is subject to modulation due to physiological, pathological, and pharmacological stimuli. It is believed to be very limited under physiological conditions and could be induced after injury (Ming and Song). The term " neurogenesis" is often considered as a multistep process comprised of the production of new cells from stem cell progenitors, the differentiation of these cells into neuronal phenotypes, their migration to target brain areas, and their eventual incorporation into existing neural circuits by replacing older neurons that die. Hence, neuron death and replacement are considered to be fundamental components of adult brain plasticity. (Eur J Neurosci 2012)

Within the adult neurogenesis the newborn neurons affects the olfactory organ in the brain and the hippocampus organ of the brain (Deng et al., 2010). The hippocampus is a small organ within the brain primarily associated with memory and spatial navigation. It is an important part of the limbic system, which regulates emotions (Dr Ananya Mandal, MD 2014). The olfactory bulb is located in the forebrain of vertebrates that receives neural input about odors detected by cells in the nasal cavity (Elizabeth Bernays, Reginald Chapman 2010). Scientist have used several techniques to figure out how adult neurogenesis can benefit the brain. The techniques include x-ray irradiation, anti-proliferative drugs and molecular knock downs. As a result the inconsistency of several paradigms, with some experimenters seeing deficits in short-term retention, others in long-term retention, and others no discernable differences at all. Recent studies suggest new neurons may be beneficial to memory consolidation (James B. Aimone et al. 2007).

In birds neurogenesis has been heavily characterized in the higher vocal center area of the birdsong system. The Higher Vocal Center is the area in the bird brain that is necessary for learning and the production of bird song. Although the song system is found in many mammals, neurogenesis is the active field of study because of a bird’s role in well know motor learning process. For example, in the canary brain, there is a high level of seasonal cell death of RA projecting HVC neurons in males – in low-neurogenesis, non-learning periods, the HVC is a fraction of the size of learning seasons. Many of the underlying regulators of this process have been elucidated, including seasonal variations in testosterone. (James B. Aimone et al. 2007).

Fish are thought to be capable of providing neurons to any region. The olfactory bulb and dorsal telencephalon (the fish equivalent of the hippocampus) have robust neurogenesis, though most of the new neurons are found in the cerebellum (James B. Aimone et al. 2007). It has been shown that the rate of neurogenesis appears more in fish than rodents. This is due to the estimated o. 2 percent of total cells in brains of fish that can proliferate at any time.

It is in theory that there are ways to boost the neurons in the brain. One way to maximize the neurons would be to meditate because it works well with neurochemicals and stimulates the brain (The Neurogenesis Guide). A Diet could too promote neurogenesis as well as repair damage done by Huntington’s disease. When put on a dietary restriction which is a strategy where calories are limited to 70% of a normal diet, it is believed that is brings about the beneficial effects by condition the cells to be better at protection themselves (Diet and Neurogenesis). Dietary restrictions stimulates neurogenesis in the hippocampus and increase levels of BDFN which is a protein shown to help newborns survive. There are research that says that several antioxidants do increase neurogenesis in rodent brains. Antioxidants are chemicals that prevent damage from free radicals which might promote neurogenesis by protecting new neurons (Diet and Neurogenesis).

In conclusion, neurogenesis is the growth and development of neurons. It is believed that adult neurogenesis affects learning, memory, emotions, stress, depression and other conditions. The adult brain has the ability to grow and development more neurons rather than have an infinite amount. Through

diet, mediation, and lack of injuries, one can increase the rate of neurogenesis. This topic is controversial primarily because the brain is the most complex organ in the body and there is still a lot of research being conducted as to whether it is effective.

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