HYPOTHALAMIC NEWSLETTER

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The Significance of Brain Scans

In recent years, medical advancements in technologies have made great progress in terms of neurology. Modern brain scans have progressed to a state where it is now able to reveal one's pain levels through chemical indicators, for the first time. Such a method of assessing chronic pain allows doctors to more objectively assess the severity of medical conditions among patients. Instead of having patients rate their pain on a subjective scale of 1-to-10, physicians can now obtain direct measurements from the brain. Instead of dealing with general complaints of stomach or chest distress, doctors may be able to determine if the pain originates from the pancreas, the heart, or any other specific organ.

Furthermore, doctors also gain the ability to ascertain if the symptoms described by the patient are exaggerations or are in fact a real reflection of what they feel.
In the future, such pain evaluations may influence workmen's compensation decisions regarding disability benefits, and could detect if patients are faking their pain just to obtain medical drugs. Borsook says that he is "absolutely confident" that "in three to five years, ordering a (brain) image for pain patients will be as routine as a blood test."

“By defining brain circuitry that’s specific to the type of distress a patients feels, we can determine the best treatment," notes Associate Professor of Radiology David Borsook of Harvard Medical School. As such, one of the primary applications of this discovery could be as a tool to evaluate effects of pain medications in the brain. Usage of morphine and other opiates, for example, may bring about side effects on one's neurology and body that go beyond alleviating pain. These brain scans help us understand and evaluate the impact of such effects. As opposed to producing images of bones, tumors, and other structures, functional magnetic resonance scanning detects what is happening in terms of how the brain functions.

Brain scanning technology also helped scientists make new discoveries about our brains. In frustration that he was unable to ease the relentless pain in some of his patients, Professor Borsook conducted an experiment to get an understanding of precisely what happens in our brains when we feel pain.

Along with Assistant Professor of Radiology Lino Becerra and Hans Brieter, as well as other colleagues at Massachusetts General Hospital, he heated the hands of eight volunteers enough for it to start hurting. First, they were exposed for 25 seconds to a temperature of 106 degrees F, just below the level at which pain fibers in all mammals, from mice to humans, become activated. During subsequent scans, heat was increased to 115 degrees F, which produces a burning feeling without causing skin damage. While this happened, their brains were scanned.

The resulting sensations of heat were expected to activate a few well-known circuits deep in the center of the brain, some of which release natural painkillers. While that did happen, in the seconds before these circuits switched on, the experimenters saw activity in the area that usually responds to pleasurable rewards such as money, food, drugs and sex. That area is

called the nucleus accumbens, located closer to the forefront of the brain. “Discovery of emotional circuits could well be the key to defining new targets for treating chronic pain.” Borsook comments.

Brain scanning technology has revolutionised the way in which we can understand our brains and our thinking. Before long, brain scans will become a common sight in our daily lives, improving our lives for the better.

The Difference Between Human and Animal Brains

It is a known fact that humans are considered to be the most intelligent species. We have higher language capacities, the ability to use complex reasoning, and the sophisticated capability to process things cognitively, all due to the achievement of evolution. In fact, many scientists even refer to the human brain as the “crowning achievement of evolution”. However, humans also have the ability to eat, think, sleep, and communicate, much like animals. So what makes us so different and how does this relate to the functions of our brains?

The sense of smell

When talking about the heightened abilities of humans in comparison to animals, our sense of smell does not make the list. In fact, the olfactory bulb, which is the part of our brain that helps us smell, is relatively small compared to that of other animals. An example of this can be seen through the surprising size of the olfactory bulb of a bear, which is five times the size of ours! This heightened sense of smell does vary from species to species, however.

Navigational prowess

Along with smell, most animals have a better exploratory prowess than us. For navigation, us humans use things like GPS and maps to get around. We most definitely do not sense locations like other animals

do. An example of this can be seen in pigeons, who have specialized cells in their brains that respond to magnetic stimulation which the pigeon is then able to interpret. Pigeons use this power to detect changes in the Earth's magnetic field based on location, and decode said signals to determine their exact geographical position. How cool is that?

Additional differences

On the other hand, there are definitely many reasons why our brain is considered the "crowning achievement of evolution", as mentioned before. For one, humans have advanced planning and decision-making skills, a bigger (relative) brain size, as well as a disproportionately larger cerebral cortex than that of most animals. The coolest difference of all is that humans have an appreciation of mortality, unlike most animals (that we know of). The fact that we have religions, worship, and appreciate the fact that we are alive sets us and our brains apart from many animals.

Similarities

Despite all of these differences, many similarities can also be seen. At the genetic level, humans are similar to other animals. In fact, we share over 90 percent of our DNA with other animals such as chimpanzees, bonobos and gorillas. Scientists use mice as a model to study human diseases for this same reason. Not only that, the main function of the brain stays the same in both animals and humans. Both types of brains control thoughts, memory, and the movement of the body. Also, the brain of both is made up of neurons and supporting cells called neuroglia and is one of the two components of the central nervous system. All in all, though the brains of humans and animals may seem vastly different, they are also related in many ways. The studying of these relations can help scientists develop effective therapies and treatments for disorders and diseases by studying the patterns of brains of other species.

Alzheimer-Like Brain Changes in COVID-19 Pateints

A recent study at Columbia University Vegelos College of Physicias and Surgeons shows that some patients that died of COVID-19 had changes in their brain similar to those with Alzheimer's disease. The question of what the long-term changes among COVID survivors are still hangs in the air, but this study might help answer part of it.

Some common symptoms among COVID survivors included experiencing foggy brains and cardiac related problems, which led the researchers to conduct this study. One major cause of Alzheimer's disease is the presence of phosphorylated tau protein. Tau protein is actually an important protein present in neural cells. Its primary function is to stabilize microtubules, which has functions such as giving cells shape and play a role during cell division as well. However, when the tau protein is phosphorylated (which means that phosphate is added), it leads to aggregation where the protein is abnormally clumped together. This tau propagation causes it to become pathological and leads to various neural diseases, in this case as an early form of Alzheimer's.

The researchers conducting this study found defective ryanodine receptors in the late patients with COVID-19. Ryanodine receptors are responsible for releasing calcium from organelles. There are three types: one in skeletal muscles, one in heart muscles, and the other in the brain called RyR3. These receptors were found in the heart, lungs, and brains of the deceased. Defective ryanodine receptors are known to be related to an increase in pathological tau, which explains why there was a high amount of phosphorylated tau found in their brains, hearts, and lungs. In addition, the aggregated tau was found in the same regions of the brain where it is in people with Alzheimer's. This led the team of researchers to hypothesize that COVID-19 might cause some patients to develop

Alzheimer's disease later in their lives. They believe that the way the immune system fights COVID causes the inflammation of the brain, leading to ryanodine receptors becoming defective and thus increasing pathological tau. This phenomenon explains why some individuals complained about their foggy brains since they showed signs of developing Alzheimer's and it is related to memory issues.

Andrew Marks, the lead researcher of this project at Vegelos College of Physicians and Surgeons, says that "long COVID could be an atypical form of Alzheimer's." But of course, there needs to be more extensive research on this topic to be precisely sure.

This study reveals how there are still many unknowns about the coronavirus disease. There are continuously new variants being created and each might have different long-term effects. Although many people are recovering and restrictions are easing up, there is still no definite answer of what people might experience years down the line after contracting the virus. Hopefully as more research is done scientists get closer to the answer.

Link Between Brain Cell Development and Schizophrenia

New links have been discovered between certain psychiatric disorders like schizophrenia and brain cell development. It suggests that the disruption in brain cell development, ascertaining to genetic factors serves as a causative factor and disease risk for psychiatric disorders.

The study is led by Cardiff University researchers, and published in the journal Nature Communications.

As quoted from one of the researchers, Dr. Pocklington, from the Division of Psychological Medicine and Clinical Neurosciences at Cardiff University, stated that "Genetic factors play a

significant role in determining a person's risk of developing psychiatric disorders. Uncovering biological processes impacted by these genetic risk factors is a major step towards understanding the causes of disease."

The study can serve the understanding for how some individuals respond to certain treatments only. The process of neurogenesis was studied and observed in vitro using human pleuripotent cells. During the observation, several sets of genes that are switched on during neurogenesis were identified. This inturn helped in deriving the role of genetic factors contributing to psychiatric disorders, like schizophrenia, particularly for this study set were highly concentrated.

Disorders linked to disruption of these genes included early onset conditions such as developmental delay, autism and ADHD; as well as later onset conditions such as bipolar disorder and major depression.

This research led by Cardiff university is one of the very first, that links genetics and the risk of developing psychiatric disorders.

Earlier studies showcased that the genes active in mature brain cells are enriched for common genetic variants contributing to schizophrenia. This is conclusive of the prevalence of activation of some biological pathways that may remain active in later life. Due to genetic variations occurring in these pathways, they contribute to psychiatric disorders by disrupting both developmental and mature brain function.

The findings from this research provide insight into the developmental origins of psychiatric disorders such as schizophrenia.

The genetic factors influencing the psychiatric disorders are often glitches in genes that disrupt brain cell development. Another study

suggests that, people suffering from schizophrenia have less “gray mater” i.e the part of brain that contains nerve cells over time. The individual tends to have smaller volume in the hippocampus, amygdala, thalamus, nucleus accumbens; and larger pallidum and ventricle volumes.

These differences in volume are consistent in with previous studies conducted.

The gene, called ZNF804A, influences the translation of genetic instructions into proteins and the growth and migration of nerve cells in the brain. It affects brain structure and function during early fetal development. ZNF804A interacts and alters the expression of several other genes, including the ones that have been linked with schizophrenia.

Several other genes have been identified that are associated with schizophrenia risk. However the study on their neural functions still remains unknown. Further studies will be targeted on the genetic interaction and possibly provide for a treatment modality or target.

The research from Cardiff university is the first to demonstrate the link between the two. Further work is needed to map out the full range of developmental processes disrupted in the psychiatric disorders and explore their longer-term effects on the brain.

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