HYPOTHALAMIC NEWSLETTER

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Endocrine System and the Brain: Digestion

Have you thought about how your body digests food? As you know, it is an involuntary action, a part of the autonomic nervous system. Autonomic functions other than digestion include respiration, body temperature, heart rate, and many more. A large part of digestion includes the movement of smooth muscles, the release of digestive enzymes, and instructions from the endocrine system. The endocrine system is a system of glands and receptors throughout the body that release hormones, chemical messengers, and signalers that are either steroids or some sort of protein. In order to control all of these factors, the body requires input from the brain, specifically from the intrinsic nervous system.

A large factor of the intrinsic nervous system is the vagus nerve, attached to an area of the brain called the Caudal Medulla, with efferent (send signals) neurons in the dorsal motor nucleus, which controls autonomic action of the thorax and abdomen. The vagus nerve, attached to a number of nerves located in the gastrointestinal (GI) tract called the Myenteric Submucosal Plexus help stimulate the release of hormones and enzymes from various glands.

The phases of digestion can be broken into three: the cephalic,

gastric, and intestinal phase. here is when you have just bitten into an apple. Food in the mouth will stimulate the vagus nerve to send signals to your stomach. Here, parietal cells (located in gastric pits) will release hydrochloric acid (HCl) and G-cells (in stomach lining) to release the hormone gastrin, which further stimulates parietal cells to release gastrin. Now the stomach has a low enough pH to begin digestion.

The gastric phase consists of protein digestion, and the killing of any bacteria or harmful organisms in the food (now called chyme) you have eaten using the HCl. Chyme will reach the pyloric sphincter, the thin region separating the stomach and small intestine. Here, the intestinal phase will begin.

The low pH of the chyme is harmful to the small intestine; luckily, the vagus nerve provides a solution; as the chyme enters the duodenum, a special region of the small intestine, the plexi will be stimulated by the low pH. The vagus nerve will hence signal to cells in the lining of the small intestine (mucosa) to produce secretin and cholecystokinin. These are both hormones, and will signal the pancreas to produce digestive enzymes (amylases, lipases, nucleases, and endopeptidases) and the liver to produce emulsifying salts for lipid digestion, respectively. The pancreas will also be triggered by secretion to release bicarbonate, a chemical that naturally will lower the acidity of the solution it is in. Thus the pH of the chyme will rise, thus saving the small intestine from damage. After this, the chyme will move on to the large intestine, where water will be absorbed.

As you can see, the process of digestion is not simple; this is merely a summary of all of the processes that occur. And all of these significant functions are controlled by a significant part of the brain, the autonomic nervous system, specifically the intrinsic nervous system. This shows how interconnected different systems of our body are; in order to function,

the digestive system relies on the endocrine system, which is controlled by the nervous system.

Common Neuromuscular Disorders

Neuromuscular Disorders are diseases that affect how the body's muscles work. This occurs due to issues with the nerves and muscles in one's body. Individual disorders are rare and occur between around 1 to 10 per 100,000 people. As a group, however, these disorders occur twice as high as multiple sclerosis which occurs in every 80 people in a 100,000 population sample pool. In the world, about 14 million people are currently affected by these disorders.

As previously mentioned, these diseases affect the function of the body's muscles. More specifically, when the neurons in the body are unhealthy or die, the communication between the nervous system and muscles falls apart.

This break in communication leads to weakened muscles that waste away. Depending on the disorder, the symptoms expressed can be mild, moderate or fatal. Many of those who suffer from slowly progressive neuromuscular disorders experience chronic pain. Other problems that may arise due to the weakening of muscles include twitching, cramps, aches, pains, joint and, movement issues.

Of these disorders, Myasthenia Gravis is the most common. This autoimmune disease affects about 20 people in a pool of 100,000 people. The disease is characterized by weakness and quick fatigue of any voluntary muscles. Muscles such as the eye muscles, face and throat muscles, and the neck and limb muscles are the groups more affected than others with this condition. This occurs due to a breakdown in the normal communication through nerves and muscles. In those who develop MG, muscles weakness caused by the

disorder gets worse as the affected muscles are used. Although symptoms can improve through rest resulting in weakness coming and going, the symptoms over time usually progress. They reach their worst in a few years after the beginning of their development. As of now, there is no cure for MG, however, there is treatment available to treat the symptoms.

Next on the list of common neuromuscular disorders is Amyotrophic Lateral Sclerosis (ALS) or Lou Gehrig's Disease. ALS affects around 30,000 people in the US with 5,000 new cases every year. Those aged 60 and above are most affected by the disease. This progressive nervous system disease affects nerve cells of the brain and spinal cord leading to loss of muscle control. Typically, it begins with muscle weakness and twitching in a limb or slurred speech. As time progresses, is affects the control of muscles needed to move, eat, breathe and speak. It also leads to other issues such as Dementia and can be expected if there is a history of the disease in one's family. Like MG, ALS has no cure.

Another common illness is Peripheral Neuropathy. It's been estimated to affect 25% to 30% of Americans at some point in their lives. Neuropathy isn't age-specific but does occur more frequently in those ages 55 and older. This condition emerges as a result of damage to the nerves located outside the brain and spinal cord, better known as the peripheral nerves.

Damage to these nerves may result from traumatic injuries, infections, metabolic problems, exposure to toxins, and inherited causes. The damage then leads to weakness, numbness, and pain generally in the hands and feet. Aside from these areas, it also affects one's digestion, urination, and blood circulation. The pain resulting from this is generally detailed as tingling, burning, or stabbing. If caused by a treatable condition, these symptoms can improve, however, in general medication is used to reduce the

pain experienced.

There are of course many other neuromuscular diseases and disorders such as Botulism, Congenital Myopathies, Mitochondrial Myopathy, Polymyositis, and Lambert-Eaton Syndrome. While these can't be prevented, simply keeping up a healthy lifestyle can prolong one's life and improve their quality of life.

Importance of Sleep

Sleep is a vital aspect of our lives — in fact, humans spend about a third of their lives sleeping! But why is sleep so important to keep our brains healthy? Firstly, according to recent findings, sleep allows the brain to remove toxins that accumulated when you were awake. As we sleep, the space between our brain cells considerably increases, which expedites the clearing of the "gunk," or harmful toxins, via the glymphatic system. The glymphatic system consists of a group of vessels that run beside the blood vessels in the scalp and evacuate the "gunk-filled" cerebrospinal fluid from the brain.

Surprisingly, this "gunk" is actually the β-amyloid protein, most commonly known for being a precursor to the plaques in Alzheimer's Disease. According to a research paper released in the *Proceedings of the National Academy of Sciences*, β-amyloid levels increased in the right hippocampus and the thalamus by 5% after only one sleepless night. It is important to note that these two areas of the brain are affected early on during the progression of Alzheimer's Disease. In short, prolonged periods of poor sleep hygiene can result in a buildup of "brain gunk," or the β-amyloid protein, and can make an individual more susceptible to Alzheimer's Disease, as well as other diseases caused by sleep deprivation.

Furthermore, it does not come as a surprise that sleep deprivation can take a toll on cognitive function,

especially multitasking. Take driving, for example. An individual must utilize their hands, feet, eyes, and brain (to be aware of what is going on on the road). And according to past research, about 20% of fatal car accidents in the United States are caused by drowsy driving.

So, getting sleep is not only crucial to your health but also life-saving! Why is it a common saying in schools to "get a good night's rest" every night of the week leading up to a big test? According to a study conducted by researchers from Ghent and KU Leuven Universities on higher-education students, students who had gotten at least seven hours of sleep every night during the testing period had scored approximately 10 percent higher than those who slept for a shorter period of time. But why does a restful night of sleep correlate with improved academic performance? By sleeping, we are allowing our brains to consolidate and process the information that we have received throughout the day. And because sleep deprivation hurts our brains' short-term memory, you will not be able to retain any of the material that you have learned, leading to lower test scores. However, many students prefer to stay up until after midnight to intensively study and "cram" any bits of information into their memory, in the hopes of retaining any of that material for the next day's exam. The conventional belief that staying up until the early hours to cram for a test will result in better test scores is false. Research has actually shown that a restful night of sleep is considerably more important and beneficial than vigorously studying.

In addition, although cramming might help you in the short-term, such as a test in a few hours, in the long term, it is truly not helpful. Without enough quality sleep to retain crucial information, your brain can only remember so much. Consequently, this information is only saved in the short-term memory, which, ultimately, in the long run, is not valuable. The main takeaway? Make sure to get a good night's rest every night!

Treatment for Scoliosis

An ideal spine has 3 curves in the sagittal plane, kyphosis in the thorax and lordosis in lumbar and neck. Scoliosis is deformity in the spine marked by horizontal translation of the vertebrate from the midline coupled with vertebral rotation.

Unlike the coupled motion of a normal spine, the vertebrates which are deformed are also stuck in their rotational imbalances, often rotated to the same side as the lateral curve they are a part of. This is visible in the coronal plane. Very rarely does anyone have a perfect spine structure with no slight imbalances, so scoliosis is defined as a lateral curvature exceeding ten degrees using the Cobb angle method. The popular treatments for scoliosis are physical therapy, bracing and surgery.

Physical therapy can mitigate minor scoliosis where the translation is more pronounced than the rotation. Although this will not cause any structural changes, this will help the patient hold a straighter spine while consciously thinking about it due to postural correction. However, this form of treatment is most effective in small, flexible, curves. For curves approaching the severe range, physical therapy's effectiveness gradually decreases and mainly provides pain relief. Some PT methods like the Schroth Method are well established and even helped reduce the largest of curves.

The bracing form of treatment is only used in kids, whose growth plates are still growing and can be remodeled, so early detection is imperative. By the time the brace treatment is done (when the patient is done growing), there can be some significant structural changes. Some adults with scoliosis may opt for bracing for cosmetic correction, but the effect will disappear once the brace is removed.

Spinal fusion surgery is the main method when it comes to drastically reducing the most severe of curves.

However, due to the risk of instrument failure and a greatly restricted range of motion, this procedure is only recommended on patients who will actually benefit more than they lose from this operation.

Since this treatment involves fusing multiple vertebrates into a solid bone, it should be done after the patient is done growing, ideally as a last resort following the brace treatment. Complications include infection and instrumentation failure, both requiring additional surgery. It will take six months for a full recovery.

The common surgical procedure either includes anterior fusion, posterior, or both. After derotating and straightening the lateral curves of the spine, the surgeons insert bone grafts connecting the vertebrate together. The surgeons carefully utilize tools to perform this derotation, and sometimes have to cut parts of the deformed ribs in order to preserve space in the thoracic cavity. The bone grafts are anchored in place using surgical instruments like screws and rods. When the spine heals, the bone grows along the instrumentation, permanently remaining in a fixed position.

Sources

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