Chronic Stress Creates Depression And Is Improved With Mechanoreceptor Activation

A condition affecting many individuals is depression. Depression is a decrease in the electrical activity of the frontal neurons of the brain. The brain is divided into various sections. There is the frontal area associated with motor activity, cognitive thought and personality. The parietal areas are associated with integration of sensory input, motor control and coordination, eye function. The pathways associated with where an item is in space. The temporal lobe is also associated where items are in space, as well as what items may be observed. The occipital cortex is associated with vision and visual phenomenon integration. Other deeper centers are associated with the emotions and autonomic controls in the amigdala of the limbic tissues.

The importance of the frontal orbital neurons, with respect to depression, is that often there is a co-morbidity of depression and anxiety. When the frontal orbital neurons are firing at a decreased frequency, they are less likely to inhibit the output of the sympathetic system associated with fight or flight mechanisms.

The brain is activated by stimulation of receptors, which are special structures that transduce sensory information to electrical signaling that travel through frequency modulation. For example, visual perceptors are light signals that transform those into electrical signals that travel from the back of the eye through the optic nerve and to the thalamus. From the thalamus they leave the lateral geniculate body and traverse to the occipital pole or Area V-1. From there, the signals travel to various association areas of the brain for vision.

Auditory pathways go from the organ corti through, again, the thalamus and then to the temporal lobe for integration processing of sounds. There are pain receptors that also travel to the thalamus and movement for mechanoreceptor activation travel through the cerebellum, into the thalamus, and up into the cortex.

Of all the sensory information entering into the neuro axis, 90% comes from the activation of mechanoreceptors which would include various touch receptors in the hair cells, skin cells, muscles, connective tissue around joints, and also in the tendons. Also, "90% of the stimulation in nutrition of the brain is generated by the movement of the spine. Kind of like a windmill generating electricity". When one considers the surface area on the skin and the underlying tissues, it is easy to see how there can be such volume of activation of position sensors to the brain. Therefore, it is an accumulation of activation of movement receptor input that literally drives the brain. [1]

We know that arousal of the brain is dependent on external and internal environmental sensory input. The largest portion of the subconscious sensory input passages is between the thalamus, cerebellum, and the dorsal column from slowly adapting receptors found in the muscles. The greatest percentage of the stretch receptors and muscle spindles are found in the anti-gravity postural muscles, especially the muscles of the spine and neck.[2]

The brain is activated by the body's receptors; however, the brain receives the majority of its stimulation from gravity creating a feedback loop that forms the basis of most, if not all, brain function. Sensory input drives the brain, and motor activity drives the sensory system. Without the sensory input the brain cannot perceive or process input. Without the motor activity provided by constant action of the postural muscles, a large proportion of the sensory stimuli are lost to further processing. This loop is referred to as: the somatosensory system.

It has also been shown that higher processing or greater cognitive function is dependent on the baseline sensory functions. It has been shown that when performing a complex task, it is likely that the transfer of motor commands to produce a final output is perceived to some degree by the transfer of information between the various brain association areas. This in turn may perceive the transfer between the sensory regions of the brain, with respect to brain activation and postural control. [3]

The main emphasis of control of balance, posture, and the coordination of head and eye movements is associated with spinal muscles and joints, as a major emphasis secondarily to the vestibular system.

As one looks farther along the phylogenetic tree, there is a significant shift and relative perception and reflexogenic significance of the mechanoreceptors in the labyrinth of the inner ear and those located in the cervical and spinal joints, which favor those in the cervical spinal joints.

This first preference in man, the significance of the mechanoreceptor populations in the muscle joints can be of more significance than that of the vestibular system in man, was suggested by Rudolph Magnus. [4]

Later, J. Puidon-Martin illustrated that the vestibular system in man is of little significance at all when in a static postural situation or in the production of reflex righting actions. [5]

In 1997, Dr. Frederick Carrick contributed to literature the significance of spinal adjustments relative to central integration and brain function during the increase in the thalamocortical activity from spinal joint simulation to improve vision as demonstrated with physiological blinds spots. [6]

When we talk about consciousness, it is important to appreciate recent research concerning the binding effect and the 40 cycles per second significance.

In the area of cognition and consciousness, recent research has identified a phenomenon called Gamma-Binding, which involves 40Hz oscillations. They can be recorded over large areas of the surface, the heads of alert subjects. It has further been noticed that when sensory stimuli are presented, these 40 cycles per second oscillations have been shown to demonstrate a phase locking, which is related cognitive processing and temporal binding of sensory stimuli. [7]

How the brain integrates its perceptions, has been referred to as the binding problem. Recently, a group of researchers from France believes that, for the first time, they have been able to measure the binding in a momentary firing in the human brain. “What we are measuring is the integration of the brain,” said Francisco J. Varela, who led the research. “We were, for the first time, able to calculate synchrony between emissions if brain cells widely distributed in the brain.” He went on to indicate that “Different regions of the brain get active when you do anything, look at a face, move your hand, have a memory, any cognitive act implies that working together are very different neurons in the brain that are widely distributed. The hypothesis is that the Gamma oscillation is the medium through which the neurons act together by being synchronous. They time their oscillations together. It is like transitory glue, a transitory pattern.” The research indicated that during their experiment of the gamma oscillation, synchrony would last about a ¼ of a second, would disappear and then reappear in a different pattern using different parts of the brain.”[8]

With respect to a source of the 40Hz, which described as the gamma oscillations, it has been determined that "The rhythmic depolarization observed in thalamic neurons (40Hz oscillations) are not generated intrinsically, but rather represent excitatory post-synaptic potentials of pre-thalamic origin. The neurons of the dorsal column in deep cerebellar nuclei are capable of encoding their output rhythmically. These potentials are not affected by lesions of the internal capsule or cortex, revealing that they are not of cortical origin. The ventral posterior lateral (VPL) responses were affected by limb position or stimulation by slowly adapting receptors. Slowly adapting receptors are characteristically found in slow twitch muscle fibers, which are most densely populated in postural or anti-gravity muscles, which fire continuously against gravity. In other words, the oscillatory 40 hertz activity, which has been noted in the thalamus, appears not to be intrinsic but appears to rise from the cerebellum and from muscle joint afferents, which fire to the thalamus either directly or through the cerebellum. It is possible that decrease firing with dorsal column fibers can decrease or stop thalamic activity since it appears the thalamus may act as a pacemaker through the regular bursts of 40 hertz oscillations and this is thought to be the source of cognition and possibly consciousness itself, interruptions of this input from the cerebellum or dorsal columns could cause gross deficits in cognition and consciousness." [9]

The above information supports the significance the cervical spine and mechanoreceptor activation in the activation of brain function.

The midline cerebellum is critical for posture control. It is important in the activation of the lateral cerebellum, which is linked with cortical function. There are neuro anatomic and electrophysiological studies that indicate that the cerebellum is part of a neuro system that includes the thalamus, basal ganglia, and frontal lobes of the cerebral cortex. [10]

Also, positron emission tomography studies (PET Scans) have shown a correlation between the metabolic rates of the cerebellum and the frontal cortex, when the cerebellum interacts with other sub-cortical and cortical structures that are known to be concerned with cognitive, as well as motor functions. [11]

The cerebellum has an important role in cognitive operations, especially those associated with prefrontal and basal ganglia functions, such as planning. [12]

The newer areas of the cerebral frontal lobes are associated with the newer areas of the thalamus and neocortex, particularly the association areas of the neocortex. The association areas are regions of the brain involved with higher processing of information. The population of nerve cells in the cerebellum exceeds any other part of the nervous system and its input fibers far exceeds the quantity that the cerebral cortex sends to any other part of the nervous system. This would appear to make the cerebellum the most functional active area in the central nervous system.[13]

It should also be noted that intact cerebellar functioning may be required for normal cerebral function or anatomical development in both higher cognitive and motor functions. Therefore, any lesion or dysfunction of the cerebellum would have significant impact on the input and output connections based purely on the sheer volume and frequency of stimulation that receives and transmits. Especially, its input from gravitational receptors from the vestibular system and the proprioceptive muscle and joint receptors.[14]

The above information illustrates the significance of gravity receptors for the purposes of activation of the cerebellum and the involvement of midline and lateral cerebellum in the activation of the thalamus, basal ganglia, and cerebral cortex, particularly, the frontal cortex.

The frontal orbital regions are important for inhibition and integration of the mescencephalon and the limbic system. The limbic system is typically the term used collectively for the functions of the limbic lobe. Functionally, the limbic system is thought to be concerned with visceral functions, especially those associated with emotional status of the individual. This limbic system is associated with the cingulate gyris, the hippocampus, and dente gyris, the subiculum, the presubiculum, the parasubiculum, the enterohinal area, the prepiriform cortex, the septum, the olfactory tubercle, and the medial and cortical amygdaloid nucleus. The limbic system has further been described as a set of inter-connective structures, which have intimate multi-synaptic connections with the hypothalamus and mescencephalon. [15]

The most anterior region of the frontal lobe, the prefrontal cortex, is responsible for higher aspects of motor control, planning, and in the execution of behavior. The prefrontal cortex has two main areas: the dorsolateral prefrontal cortex, which is found on the lateral surface of the frontal lobe anterior to the premotor regions, and the orbitofrontal cortex. The orbitofrontal cortex is located on the frontal lobe's anterior ventral surface and is more medial. The orbitofrontal cortex includes limbic lobe structures and is connected to them. The frontal lobe is the largest lobe in humans and the prefrontal cortex constitutes approximately 50% of the size of the frontal lobes. The prefrontal cortex is included in a neuronal system that includes the basal ganglia, the thalamus, and the cerebellum. Most of the higher and more complex motor cognitive and emotional behavioral functions are thought to be found primarily in the frontal lobes. This area of the neocortex has expanded more than any other in the human brain.

Humans need normal frontal lobes to accomplish goals, make decisions, express creativity, and navigate through complex social situations. [16]

It has been shown that the cerebral cortex plays a significant role in the regulation of autonomic function. The existence of direct projections to subocortical structures regulating autonomic functions, as well as neurophysiological studies showing autonomic changes with stimulation or inhibition of these structures, substantiates their contribution to the control of autonomic function. These areas include the medial prefrontal cortex, the singular gaurus, the insula, the temporal lobe, and the primary sensory in motor cortices. [17]

From the neocortex, collosal fibers are primary inhibitory to the sympathetic activation as well as the frontal-hypothalamic fibers.[18] [19] [20] [21]

Due to the inhibiting capacity of the frontal cortex on the autonomic system, decreased neocortical frontal lobe activation may result in primarily ipsolateral decreased inhibition of the sympathetic nervous system. This may be accomplished by at least two pathways. The first, would be a lost of direct inhibition of the hypothalamus. The second would be a loss of stimulation by the brain stem vagal centers that inhibit the sympathetic activity. Thus, the decrease in cortical activation of the frontal lobes may result in an escape of the sympathetic nervous system.

In our bodies, the sympathetic nervous system is associated with a fight or flight response or a protective response, while the parasympathetic nervous system is associated with a growth response. These growth and protection behaviors are essential for the survival of multi-cellular organisms such as humans. It is significant that the mechanisms that support growth and production cannot operate optimally at the same time, "In other words, cells cannot simultaneously move forward and backward".

In his special studies between the blood vessels, Bruce Lipton at Stanford University noted, "They exhibited one microscopic anatomy for providing nutrition and completely different microscopic anatomy providing a protection response. What they couldn't do was exhibit both configurations at the same time".[22]

In response similar to that display by the cells, humans unavoidably restrict their growth behaviors when they shift from a protective mode. For example, if you're running from a mountain lion it's not a good idea to spend energetic growth in order to survive, that is escaping the lion. You summon all your energy for your fight or flight response redistributing energy reserves to fuel the protection response.

It should also be noted the reverting the energy to support tissues and organs and associated muscles for a protection response, diverts that energy from growth to protection. Inhibiting this growth process is also debilitating in that growth is a process that not only expends energy, it is also required to produce energy. As a consequence, a protracted sustained protection response results in the inhibition of the creation of production of life-sustaining energy. Therefore, the longer one stays in protection response or fight or flight mode and increase sympathetic dominance, the more we interfere with growth, rehabilitation and healing. Because our bodies are composed of trillions of cells, some are in growth mode while others are in protection mode at the same time. The force of cells in protection mode response depends on the severity of the perceived threats.

We can survive while under stress from these threats but chronic inhibition of growth mechanisms will substantially compromise our overall bigger vitality. It is important that we understand that to fully benefit from our capacity of function, "It is important to note that to fully experience your vitality it takes more than just getting rid of life stressors. In a growth/ protection continuum, eliminating stressors only puts you at a neutral point in the range. To fully thrive, you must not only eliminate the stressors, but also actively seek joyful loving fulfilling lives that stimulate growth processes". [23]

In humans, the balance between the sympathetic and parasympathetic nervous system is integrated and regulated through central neurological processes. It is the nervous system's job to integrate the sensory signals from the environment and organize an appropriate behavioral response. The human body has two separate protection systems.

The mobilized protection against external threats has been called a hypothalamus-pituitary/adrenal axes. When there are no threats, the hypothalamus- pituitary/adrenal axes are inactive and growth flourishes. However, when our central nervous system perceives an environmental threat, it engages the hypothalamus-pituitary/adrenal axes by sending signal to the pituitary glands. It then sends a signal to the adrenal glands, which activate the fight or flight response.

In response to the perception of stress, the hypothalamus secretes corticotrophin releasing factor (CRF), which travels to the pituitary gland. The CRF activates special pituitary hormones secreting cells causing them to release adrenocorticotrophic hormone (ACTH) into the blood. The ACTH then makes its way into the adrenal glands where it serves as a signal to turn on the secretion of the fight or flight hormones. These stress hormones coordinate the function of the body's organs providing us with great energies to power and fend off or flee danger. As a consequence to this stress-releasing hormone, the blood vessels constrict in the area of the digestive tract, forcing energy providing blood to be routed to nerves and tissues of the arms and legs, enabling us to get out of harms way. Because of the blood being redistributed from the digestive tract area into the extremities, the visceral organs do not function as well. Therefore, these visceral organs stop doing their life-sustaining work; digestion, absorption, excretion, and other functions that provide for the growth of the cells and the production of the body's energy reserves. Hence, the stress response inhibits growth processes and further compromises the body's survival interfering with generation of vital energy reserves.

The second protection system is the immune system, which protects us from threats originating under the skin such as those caused by bacteria and viruses. When the immune system is mobilized, it can consume much of the body's energy supply. The hypothalamic-pituitary/adrenal axes mobilizes the body for a fight or flight response. The adrenal hormones directly repress the action of the immune system to conserve the energy reserves. In fact, these stress hormones are so effective in curtailing immune system function, that in medical practice, these stress hormones are provided to recipients of transplants so that their immune system will not reject the foreign tissues.

In the ideal world, this is only a temporary situation in which we are under stress. However, chronic stress over time can impair health.

Also, activating the hypothalamic-pituitary/ adrenal axes interferes with our ability to think clearly. Processing information in the forebrain prefrontal areas centers of exclusive reason or logic is significantly slower than the reflex activity controlled by the parietal cortex. In an emergency, the faster information processing is the more likely the organism will survive. Adrenal stress hormones constrict blood vessels in the frontal areas of the brain, reducing its ability to function. Additionally, the hormones suppress activity in the brain's prefrontal cortex. Instead of conscious action in an emergency, the vascular flow and hormones serve to activate the hind brain, a source of life-sustaining reflexes that most effectively control fight or flight behavior. While it is necessary that the stress signal repress the slower processing conscious mind to enhance survival, it comes at a cost that of diminished conscious awareness and reduced intelligence.[24]

This hypothalamus-pituitary/ adrenal axes system is effective for handling acute stresses. However, this protection system was not designed to be continuously activated. In our modern world, we have stresses that are not in the form of acute concrete threats so we can easily identify, respond to, and move on. We are constantly surrounded by numerous challenges, unresolved fears and worries, stresses at work and in our personal lives, and threats relative to our economy. These worries do not threaten our immediate survival but they nevertheless, activate the stress mechanism resulting in the chronically elevated stress hormones. These daily stressors are constantly activating our stress coping mechanism, thus, priming and prepping our bodies for action. Without some physical release from the pressures generated by chronic fears and concerns, the hormone activation causes a significant damaging effect on our body. Almost every major illness that people acquire has been linked to chronic stress.[25]

A common held theory for depression is that it comes as a consequence to a chemical imbalance. Challenging that perspective was a study published in 2003. Researchers were considering why patients, on SSRI anti-depressants such as Prozac or Zoloft, did not have immediate improvements. There is usually a two-week lag between starting the medications and the time the patient's feel they're improving. The study found that the depressed people exhibited a surprising lack of cell division in the region of the brain called the hippocampus, a part of the nervous system involved with memory. The hippocampus cells renewed cell division at the time the patients first began to experience a mood shifting effect of the SSRI drugs, weeks after the onset of the drug regimen.

This study and others challenge the theory that depression is simply the result of the chemical imbalance affecting the brain's production of monoamine signaling chemicals, especially seratonin. If it were a simple as that, the SSRI drugs would likely restore the chemical imbalance more immediately. More researchers are pointing to the inhibition of neuronal growth by stress hormones as the source of depression. It has been shown that in chronically depressed patients, the hippocampus and the prefrontal cortex, which as discussed above are associated with centers for higher reasoning and cognitive functioning, are physically shrunken or atrophied.

"Over taking the monoamine hypothesis in recent years has been the stress hypothesis which posits that depression is caused when the brain's stress machinery goes into overdrive. The most prominent player in this theory is the hypothalamic-pituitary/ adrenal axes". [26]

Another activating effect of the sympathetic system is the activation of nociceptors or pain receptors. High levels of pain or multiple sites of low levels of pain can result in activation of the sympathetic system, which can activate the cascade of hormones associated with stress and shutting down of the growth capacity. An extreme example would be post-traumatic shock, which is effectively managed by stabilizing the patient, allaying their fears, and providing a comfortable environment for recovery.

In summary, the brain receives information through receptors. These receptors have a role of providing environmental clues with respect to location in space and surrounding sounds, sites, smells, and pain sources. The majority of input into the central nervous system comes as a consequence to the activation of mechanoreceptors and muscle spindle activity associated with spinal function. Decrease in activation of spinal function would result in decreased activation overall brain function, which can result in a decrease in cortical excitation. As a consequence to a decrease in cortical excitation, there is a decrease in the ability of the brain to inhibit the sympathetic system, which is activated by pain and stresses. The sympathetic system, unchecked, impairs the blood flow and the growth factors associated with brain function, resulting in depressed or decreased brain electrical activity and the sequella is a depressed brain.

Common treatments for depression in America seem to lean towards pharmaceutical intervention. However, based upon the normal function of the nervous system, it seems that activities which would promote movement and stimulation of higher cortical centers, which result in appropriate inhibition of sympathetic systems. These include movement, specific spinal adjustments, therapeutic spinal exercises, postural integrative procedures, in conjunction with specific strategies for dealing more appropriately with individual stresses in a person's life through cognitive training, therapeutic counseling, and other life skill training sessions, would be advantageous. That is as a first line of approach.

The nervous system works as a positive feedback system such that activation of movement receptors activates through cerebellar thalamocortical pathways, the cortex, which in turn increases the cerebral cortex's ability to modulate and coordinate higher functions that allow for more appropriate motions from a reflex standpoint and also from a volitional standpoint. This allows for activation of specific muscles, which cause more movement, which causes more activation, which causes more movement. This resulting positive feedback encourages and sustains appropriate neurological integrity and higher frequencies of firing of motion. On the contrary side, decrease in movement which results in a decrease in activation, which then results in a decrease in stimulation of the cortex, and further results in a less frequency of firing of brain structures, results in a decrease of integrative movement and less muscle activity. The less muscle activity results in less movement, which results in less integration in a downward spiral. We frequently refer to the downward spiral as subluxation/ degeneration or degenerative joint disease where it affects joint function as a consequence to appropriate activation.

It has been demonstrated that muscles not used atrophy at a significant rate. It has also been well established that the half-life of muscle protein is six to ten days. Therefore, it is critical that spinal joints and the associated muscles be used on a regular basis, such that disuse for a week and a half to two weeks would result in significant losses of muscle protein in the muscles. This would contribute to less stabilization, hence, less activation and decreased function.

Serious consideration should be given to a specific therapeutic involvement, which encourages spinal motion through exercise and specific adjustments to increase cortical activation in the management of depression.

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