Dynamic Chiropractic

HEADACHES & MIGRAINES

The Potential Effects of Mechanical Faults of the Spine on Cerebrospinal and Interstitial Fluid Flow in the Brain

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Chiropractors commonly encounter spinal conditions associated with autonomic concomitants attributable to somatovisceral or, conversely, viscerosomatic reflexes. Autonomic reflexes affect all the organs and blood vessels of the body including the brain. This relationship is easy for chiropractors to understand. After all, the first chiropractic patient was a deaf man. However, degenerative conditions of the spine may have an even greater impact on brain physiology than just mechanical irritation of nerve fibers.

The spatial orientation of the brain within the cranial vault is maintained by the dural compartments and by a water jacket formed by the meninges and filled with cerebrospinal fluid (CSF). This water jacket cushions the brain from the hard walls of the cranial vault and its foramen and fissures, as well as from the dural sheaths of the falx cerebri and the tentorium cerebelli. In fact, the brain floats in CSF and its weight is thus reduced to 20 percent of its dry weight. However, since the cranial vault has a limited capacity, the volume of CSF must be maintained within certain critical limits. Too much CSF compresses the brain while too little causes it to sink in the vault.

Pressure conus is a serious condition in which the brainstem is squeezed down into the foramen magnum. It can be caused by increased intracranial pressure or concussion. Pressure conus can be fatal because the increased pressure on the brainstem depresses respiration, circulation, and heart rate. What is interesting about this is that the human brain is precariously positioned in way that predisposes the brainstem to prolapse into the foramen magnum. That is, the combined effects of erect posture, large brain size, and the angulation of the basicranium, which puts the foramen magnum under the brain and makes the human brain more susceptible to pressure conus. In the other mammals, the foramen magnum is located more at the posterior inferior corner of the skull, the basicranium is relatively flat, and the weight of the brain is more above the basicranium and less over the foramen magnum.

As an added protection against compression of the brainstem against the foramen magnum, there are several large expansions in the subarachnoid space, called cisterns, which are stratigically located around the brainstem and cerebellum. In order to function correctly, however, these cisterns require the proper volume of CSF in the subarachnoid space.

The production of CSF is primarily by active secretion into the ventricles. Active secretion requires ATP expenditure.

Because of this, it is my opinion that the CSF production system is fatigued by the end of the day and CSF production slows down. The slight reduction in CSF production causes the brain to prolapse slightly into the foramen magnum which would result in depressed respiration, circulation, and heart rate, and muscle flaccidity which is what happens when we first fall asleep. Although the horizontal position used for sleep reduces the efficiency of the diaphragm, heart valves, circulation, and even brain circulation, it does allow the energy using CSF production system a chance to recover and takes the weight of the brain off of the basicranium and foramen magnum.

Since the volume of CSF is critical, its rate of formation must be balanced by its rate of absorption and subsequent egress from the cranial vault. There is a condition called normal pressure hydrocephalus in which CSF volume increases in the brain but CSF pressure remains normal or low. This condition remains an enigma and has been seen in conjunction with Alzheimer's disease, schizophrenia, multiple sclerosis, Parkinson's disease, rheumatoid arthritis, Padget's disease, among others. There has been considerable interest as to whether or not normal pressure hydrocephalus is due to venous obstruction or obstruction of the arachnoid granulations found in the superior sagittal sinus. Unfortunately, the vast majority of these cases do not show signs of either type of obstruction that would lead to a decrease in CSF absorption rate and an increase in CSF volume in the vault.

There is one piece in the puzzle which has yet to be considered; that is, the effects of mechanical faults and degeneration of the axial skeleton on brain physiology. Degeneration of the cervical spine affects the dimensions of the neural canal, which not only contains the spinal cord, but also the spinal veins and arteries. Mechanical faults also change the normal postural and functional relationships between the head and cervical spine which is where arteries and veins of the brain pass through the skull.

The sigmoid sinuses, which pass through the jugular foramen and empty into the jugular veins, are the primary routes for venous drainage of the brain. However, human brains, unlike other mammals, also use accessory veins called emissary veins which pass though emissary foramen in the base of the skull and empty into the vertebral venous plexus inside the spinal canal. The vertebral venous plexus is an extensive system with a very large capacity and, unlike the veins in the rest of the body, the veins of the vertebral venous plexus have no valves. Similarly, the emissary veins, diploic veins, and craniofacial veins, as well as the dural sinuses, have no valves and are all interconnected to form on large valveless venous network. Since the basicranium contains the primary outlets for both venous drainage routes of the brain, it seem logical that changes in craniocervical relationships may affect these drainage ports. In addition, stenosis of the neural canal may compress the spinal veins.

Dean Falk, a physical anthropologist, suggests that the emissary veins help to drain the human brain while in the upright posture. In this regard, the vertebral venous plexus serves to modulate intracranial hydrodynamics. What's more, other mammals may use the vertebral venous plexus in a similar way. For example, it has been suggested that whales use the rete mirabile, an extensive valveless venous network inside the neural canal, as a reservoir for blood which has been translocated from the compressed abdomen and thorax during a deep dive. Furthermore, it is my opinion that bats use emissary veins which pass through the cribiform plate to translocate blood to the craniofacial veins and away from the brain during prolonged periods of inversion. Lastly, it is my opinion that giraffes use emissary veins to translocate blood away from the brain and into their exceptionally large diploic space and accessory horns during periods of prolonged inversion as when drinking.

CSF flow is determined by a very small pressure gradient which is the difference between CSF pressure and pressure in the superior sagittal sinus (SSVP.) The Valsalva maneuver increases SSVP. Likewise, inversion and the Quekenstedt test, which is done by compressing the jugular veins also increases SSVP. Whatever the cause, an increase in SSVP decreases the CSF pressure gradient which decreases CSF absorption rate.

Inversion and the Valsalva maneuver increase SSVP by increasing pressure in the valveless vertebral venous plexus which is then transmitted to the superior sagittal sinus. In this regard, it is interesting to note that researchers have shown that stenosis and scoliosis can increase pressure in the vertebral venous plexus.

With the above in mind, the first question that needs to be addressed is: Can stenosis, scoliosis, lordosis or kyphosis affect SSVP? If they can, then spinal conditions can affect CSF flow. But besides just increasing CSF volume in the vault (normal pressure hydrocephalus), a reduction of CSF flow would also cause a retention of metabolites in the interstitial fluids. This is because, unlike the rest of the body, the brain has no lymph vessels to move interstitial fluids. Instead, interstitial fluids in the brain mix with CSF and leave via the same pathway. Therefore, a decrease in the bulk flow of CSF will cause a concomitant retention of metabolites. These retained metabolic waste products may play a role in neural degeneration and demyelination.

The next question that needs to be asked is: Can chiropractic care prevent, improve or otherwise affect degenerative conditions of the spine? More and more evidence seems to indicate that it can. In the book, Managing Low Back Pain by Kirkaldy-Willis, the author often refers to the facet-disc interrelationship and the effects of chronic subluxations on disc and joint degeneration and subsequent stenosis. The book also leads one to postulate that early intervention with chiropractic care may prevent or limit the degeneration cycle.

Alzheimer's disease accounts for 70 percent of all the cases of dementia. The incidence of Alzheimer's disease increases rapidly after the age of 80. It is the fourth leading cause of death in the elderly after cancer, heart disease, and stroke, and it is predicted to reach epidemic proportions in the near future due to increased life expectancy. Alzheimer's disease is extremely costly to society and can bankrupt families. What's even worse is that it is increasing at a time when the Medicare system is already in a financial crisis. The effects of lifetime chiropractic care on limiting both the direct and indirect health care costs associated with the effects of aging and degenerative conditions of the spine needs to be explored. The condition of the axial skeleton is vital to health. In addition to causing pain and autonomic dysfunction, degenerative conditions of the spine may play a significant role in diseases of the brain.

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