

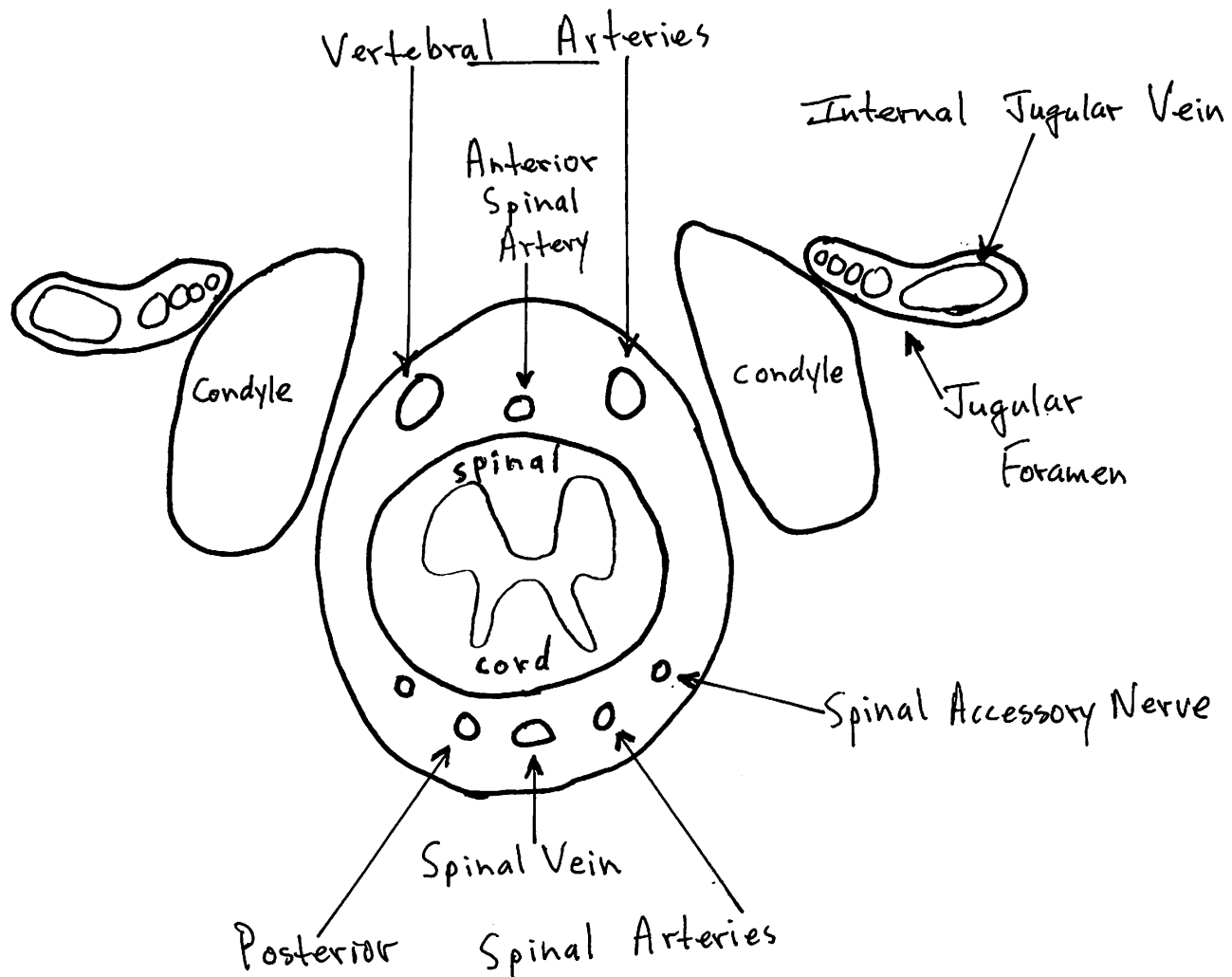
The Role of the Cranio-cervical Junction in Cranio-spinal Hydrodynamics and Neurodegenerative Conditions

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BACKGROUND FROM DAN MURPHY

Axial View of the Foramen Magnum and its Contents, from below:



A new model of the atlas subluxation is emerging: a misalignment between the atlas and occiput could compromise the venous drainage of the brain (spinal vein, internal jugular vein), compromise the flow of cerebral spinal fluid, and/or compromise the arterial supply (anterior and posterior spinal arteries, and vertebral arteries) to the brain. This article explores the probability and consequences of this occurrence.

KEY POINTS FROM THIS ARTICLE:

- 1) Cranio-spinal hydrodynamics refer to the relationship between blood and cerebral spinal fluid (CSF) volume, pressure, and flow in the relatively closed confines of the compartments of the cranial vault and spinal canal.
- 2) “The cranio-cervical junction (CCJ) is a potential choke point for cranio-spinal hydrodynamics and may play a causative or contributory role in the pathogenesis and progression of neurodegenerative diseases such as Alzheimer’s disease, Parkinson’s disease, MS, and ALS, as well as many other neurological conditions including hydrocephalus, idiopathic intracranial hypertension, migraines, seizures, silent-strokes, affective disorders, schizophrenia, and psychosis.”
- 3) “The CCJ links the vascular and cerebrospinal fluid (CSF) systems in the cranial vault to those in the spinal canal.”
- 4) “Malformations and misalignments of the CCJ cause deformation and obstruction of blood and CSF pathways and flow between the cranial vault and spinal canal that can result in faulty cranio-spinal hydrodynamics and subsequent neurological and neurodegenerative disorders.”
- 5) Dural sinuses, facial veins, and vertebral veins have no valves; therefore, the direction of venous blood flow is determined by hydrostatic pressure gradients. Similarly, CSF flow between the subarachnoid space in the cranial vault and spinal canal is also determined by the same pressure gradients.
- 6) Congenital malformations/anomalies of the CCJ can block blood and CSF flow between the cranial vault and spine, pushing the cerebellar tonsils and/or brainstem into the cervical canal, which further blocks the flow of CSF. This causes an accumulation of fluid in the cranial vault (hydrocephalus):
 - Chiari malformations
 - Abnormal clivoaxial angle [**see Article Review 42-15**]
 - Hypoplasia of the posterior cranial fossa
 - Basilar invagination
 - Platybasia
- 7) Other malformations can also affect cranio-spinal hydrodynamics and cause hydrocephalus:
 - Hypoplasia of the foramen magnum
 - Hypoplasia of the jugular foramen
 - Anomalies of the odontoid process
 - Premature closure of cranial sutures (craniosynostosis)
- 8) “Connective tissue disorders, such as rheumatoid arthritis and Ehlers-Danlos syndrome, can cause tears, degeneration, ligament laxity, and cranial settling. Cranial settling causes the skull to rock back on the CCJ and sink onto the upper cervical spine during upright posture.”

- 9) "Misalignments of the CCJ [*atlas-occiput articulation*] can obstruct blood flow through the vertebral arteries and veins that can lead to chronic [brain/cranial] ischemia and edema." **[Key Point For Chiropractors]**
- 10) Chronic brain/cranial edema decreases arterial flow in the brain which can result in [*decreased ATP production*], increased oxidative stress, and brain atrophy.
- 11) "Blockage of blood and CSF flow due to malformations and misalignments of the CCJ may play a role in chronic [*brain/cranium*] ischemia, edema, hydrocephalus, and ventriculomegaly [*enlargement*]."
- 12) "The CCJ is a potential choke point for blood and CSF flow between the cranial vault and spinal canal that can cause faulty cranio-spinal hydrodynamics and subsequent chronic ischemia, edema, and hydrocephalus." **[Key Point]**
 "Upright posture and motion of the cervical spine compound the strains and deformation of blood and CSF pathways of the CCJ further contributing to blockage of flow."
- 13) "Faulty cranio-spinal hydrodynamics may also play a role in neurodegenerative diseases such as Alzheimer's, Parkinson's, multiple sclerosis, dementia, and motor neuron diseases," as well as migraines, silent strokes, seizures, psychosis, depression, and mania. **[see the legal briefs by Judge Ponath and also the Kentucky Houses of Reform papers under the free-stuff tab on my webpage, www.danmurphydc.com].**
- 14) The vertebral arteries provide about 20% of blood flow to the brain. [The vertebral arteries enter the skull through the foramen magnum.]
- 15) The internal carotid arteries supply about 80% of blood flow to the brain.
- 16) The Subclavian Steal Syndrome occurs when:
- The proximal portion of the subclavian artery is obstructed (i.e. stenosis) resulting in decreased blood flow and pressure downstream in the vertebral and axillary arteries.
 - This creates a pressure gradient that causes the arm to draw blood from the ipsilateral vertebral artery, which in turn gets its supply from the contralateral vertebral artery via their connection to the basilar artery.
 - This may in turn steal blood flow from vessels of the brain including the ophthalmic (the first branches of the internal carotid artery) arteries of the eyes, resulting in hypoperfusion of the optic nerve head, causing impairment of vision.
- 17) Reduced posterior blood supply (vertebral artery) may cause migraines. "The vertebral arteries also supply the medial temporal and occipital lobes. Decreased blood flow to the medial temporal and occipital lobes may play a role in the déjà vu and aura symptoms associated with migraines." "Malformations, misalignments, and deformation of the CCJ and dura mater can obstruct blood flow

through the vertebral arteries resulting in ischemia and signs and symptoms associated with of migraine headaches.”

18) The vertebral arteries provide a significant portion of the blood supply to the spinal cord via the anterior and posterior spinal arteries. “Malformations, misalignments, and deformations of the CCJ can obstruct blood flow through the anterior and posterior spinal arteries resulting in decreased blood flow to the cord.”

19) Amyotrophic Lateral Sclerosis (ALS) may be due to progressive ischemia in the intraparenchymal territory of the anterior-ventral spinal arteries and/or the anterior spinal artery. The anterior-ventral spinal arteries are branches of the inferior thyroid and ascending cervical arteries that stem from the thyro-cervical trunk, which arises from the subclavian artery distal to the vertebral artery. The anterior spinal and anterior-ventral spinal arteries supply the ventral aspect of the cord.

20) Possible causes of some Parkinson’s and ALS is vascular comprise of the distal vertebral and basilar arteries.

21) ALS may be related to trauma, especially head trauma: “Trauma can tear ligaments of the cranio-cervical junction resulting in joint instability and misalignments.” “Trauma superimposed on malformations, anomalies, and degenerative changes in the arteries and spine may further compromise circulation in the distribution of the vertebral-basilar arteries. It is possible that obstruction to blood flow through the anterior and posterior spinal arteries due to malformations and misalignments of the CCJ may play a causative or contributory role in neurodegenerative conditions of the cord such as ALS.”

22) The most favored and well developed venous outlets used to drain the brain during upright posture in humans “pass through the foramen magnum and hypoglossal and condylar canals of the CCJ.”

23) “Blood flow in the epidural vertebral veins is affected by motion, respiration, Valsalva maneuvers, abdominal pressure, upright posture, and inversion. It is also affected by spondylosis, scoliosis, and stenosis in the lower spine.”

24) “Malformations and misalignments of the CCJ cause strains and deformation of the dura mater and suboccipital cavernous sinus, which can affect circulatory pathways and blood flow in the brain.” **[Key Point]**

25) “Spondylosis, stenosis, and scoliosis in the lower spine cause deformation of the epidural space of the spinal canal, as well as deformation of the dura mater (thecal sac) that can similarly affect blood flow in the vertebral veins and cord.” **[Key Point]**

- 26) Cervical kyphosis causes both strains of the dura of the CCJ and also causes the internal jugular vein to bend around the transverse process of the atlas, reversing its normal course, compressing the vein and increasing resistance to blood flow. **[Key Point]**
- 27) "Malformations and misalignments of the CCJ may play a role in chronic [brain/cranial] ischemia and edema, which may in turn lead to neurodegenerative processes and subsequent diseases."
- 28) Cerebral Spinal Fluid (CSF) is an extra-fine filtrate of the blood. The production of CSF uses hydrostatic pressure gradients. Changes in these pressure gradients alter the production of cerebral spinal fluid.
- 29) Trauma can cause dural tears resulting in CSF leaks and coning of the brain stem and cerebellum. Connective tissue disorders such as Ehlers-Danlos appear to be predisposed to CSF leaks.
- 30) Proper CSF volume is essential to the regulation of intracranial pressure.
- 31) There is a possible connection between cerebellar tonsillar ectopia and structural strains due to trauma. Other structural strains occur from an abnormal clivo-axial angle (cranio-cervical angulation), including retroflexed odontoid. "An abnormal clivo-axial angle or retroflexed odontoid can cause cervicomedullary kinking and compression of the ventral epidural space of the neural canal of the CCJ." **[Important]**
- 32) "Structural strains of the CCJ affect the dura mater, which can cause displacement (ectopia) of the brainstem and deformation of the neurovascular and CSF tunnels and pathways."
- 33) "Chiari malformations and coning of the brainstem cause blockage of CSF flow through the CCJ." "They also compress the epidural space which contains the vertebral veins that connect to the emissary veins and dural sinuses used to drain the brain during upright posture."
- 34) "Malformations, misalignments, and deformation of the CCJ compress the vertebral veins, which may affect CSF flow." "An increase in CSF volume in the brain can compress veins and decrease drainage."
- 35) CSF flows along cranial nerve roots, especially the olfactory and optic nerves. Enlargement of the optic nerve sheath is a sign of increased CSF volume.
- 36) The CCJ is a choke point for CSF flow between the cranial vault and spinal canal. **[Very Important]**

- 37) Hydrocephalus is a pathologic increase in CSF volume, a cerebral edema. "Idiopathic intracranial hypertension has further been associated with a decrease in the capacity and compliance of the vertebral veins in the spinal canal." "Hydrocephalus might be due to insufficient venous drainage of the brain by the dural sinuses." "Hydrocephalus in children may be due to insufficient venous drainage of the brain."
- 38) "One of the primary causes of hydrocephalus due to blockage of CSF flow is stenosis or mass effects causing compression of the cerebral aqueduct that links the third and fourth ventricle."
- 39) "Neurodegenerative diseases may be due to obstruction and back pressure in the accessory drainage system of the brain as it passes through the CCJ to connect to the vertebral veins." "Obstruction can occur due to many types of malformations and misalignments of the CCJ."
- 40) "Multiple Sclerosis (MS) can be caused by venous insufficiency due to stenosis or faulty valves in jugular veins."
- 41) "The vertebral veins are the primary drainage routes used to drain the brain during upright posture."
- 42) "Chiari malformations cause blockage of CSF flow through the CCJ resulting in dissociation of CSF flow in the cranial and spinal compartments."
- 43) "Obstruction of venous blood and CSF outflow in the CCJ may cause increased pulsatility and pressure waves in the cisterns, playing a role in neurodegenerative disorders."
- 44) Prolonged periventricular ischemia eventually results in myelin degeneration and irreversible axonal loss.
- 45) The brain has no lymphatic vessels or glands and instead uses the perivascular spaces to move nutrients in and wastes out. Sluggish CSF flow may play a role in the pathology of neurodegenerative diseases to remove breakdown byproducts, viruses, bacteria, and heavy metals such as aluminum, etc.
- 46) A spinal cord syrinx (syringomyelia), is enlargement of a portion of the central canal of the cord. It is the homolog of hydrocephalus and sometimes referred to as hydromyelia. It may occur as a consequence of dissociation of cranio-spinal hydrodynamics.
- 47) "The CCJ is the critical link between hydraulics in the cranial vault and spinal canal that can affect CSF flow and pulsatility in the brain and cord." **[Key Point]**

48) The cranial vault is a closed container with little room for expansion or compliance. CSF volume and pressure in the cranial vault “increases exponentially with increases in volume.”

49) Summary Model:

- An increase in brain, blood, or CSF volume in the cranial vault can cause compression of the bridging veins and venous hypertension.
- Venous hypertension decreases cerebral arterial inflows.
- Chronic decreases in arterial flow can lead to oxidative stress, ischemia, and subsequent atrophy resulting in a compensatory increase in CSF volume.
- Enlarged ventricles and cisterns are a sign of hydrocephalus and an increase in CSF volume that can be caused by atrophy or chronic strains and deformation of the brain and brainstem.

50) “Faulty cranio-spinal hydrodynamics may play a role in neurodegenerative diseases such as Alzheimer’s, Parkinson’s, multiple sclerosis, dementia, and motor neuron diseases, as well as other neurological conditions including migraines, silent-strokes, seizures, psychosis, schizophrenia, depression, and mania.”

51) “Manual and surgical methods for correcting obstructions, as well as manipulation of blood and CSF flow, may help to restore or improve faulty cranio-spinal hydrodynamics in certain cases and decrease the prevalence, progression, and severity of neurodegenerative and other neurological conditions.”

52) Misalignments of the CCJ may cause faulty cranio-spinal hydrodynamics, resulting in neurodegenerative and neurological conditions.

53) Malformations, spondylosis, stenosis, scoliosis in the lower spine, increase the incidence of faulty cranio-spinal hydrodynamics. These problems are compounded when a misalignment is present.

54) This author believes that manual, mechanical, and surgical correction of CCJ structural problems will improve faulty cranio-spinal hydrodynamics and improve patient pathology and symptomatology.

Another supportive study for this article is:

Article Review 07-14:

The Possible Role of Cranio-Cervical Trauma and Abnormal CSF Hydrodynamics in the Genesis of Multiple Sclerosis