Quick Hits | 05.09

Definitions

cadaver - dead body

computational fluid dynamics - field of study within mechanical engineering which simulates fluids by using mathematical models

conus medullaris - the bottom of the spinal cord

extension - when the neck or spine is bent back

filum terminale - small thread of tissue at the bottom of the spinal cord; if abnormal can result in TCS

flexion - when the neck or spine is bent forward

occult TCS (tethered cord syndrome) - controversial condition where the spinal cord is tethered due to a tight filum terminale, but the conus is in a normal position making it difficult to diagnose with MRI

otology - branch of medicine which specializes in and studies the ear

cerebellar tonsils - portion of the cerebellum located at the bottom, so named because of their shape

cerebellum - part of the brain located at the bottom of the skull, near the opening to the spinal area; important for muscle control, movement, and balance

cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

Chiari malformation I - condition where the cerebellar tonsils are displaced out of the skull area into the spinal area, causing compression of brain tissue and disruption of CSF flow

decompression surgery - general term used for any of several surgical techniques employed to create more space around a Chiari malformation and to relieve compression

syringomyelia - condition where a fluid filled cyst forms in the spinal cord

Flexion, Occult TCS; Fluid Dynamics, Ear Patients...

Ed. Note: *Sometimes research and medical publications don't have enough detail or substance to warrant a full article. Quick Hits is a feature which provides a short summary of several such publications at once.*

Study of the effects of flexion on the position of the conus medullaris: follow-up study using MR imaging in non-human primates.

Occult tethered cord syndrome (TCS) is a controversial condition where it is believed that the spinal cord is put under tension due to a tight filum terminale at the bottom of the cord. The filum is a threadlike structure, so if it is tight, it can pull down on the cord and essentially put it into traction. TCS is a recognized clinical entity which causes weakness in the legs, pain, and bowel and bladder problems. The controversy comes into play because TCS is normally diagnosed with an MRI based on the position of the conuse medullaris (at the bottom of the spine). The thinking is that if the cord is being pulled down then the conus should be lower - relative to the bony vertebra - in people with TCS. Based on this, radiologists have developed standards for TCS due to a tight filum.

However, in recent years some physicians have raised the notion that some patients can have tethered cord with their conus in a normal position. Since this is not visible on MRI, it is referred to as occult TCS. These physicians base their diagnosis more on patient symptoms that are consistent with TCS rather than MRIs.

To solve this dilemma, one idea has been to use MRIs where the spine is put into flexion and/or extension. The thinking is that if in a healthy person bending the spine moves the position of the conus, in a person with occult TCS, the conus would not move as much (or at all) because the cord is under tension. However, anatomical studies have historically produced mixed results when looking at whether flexing the spine moves the conus.

Now, a group out of Birmingham, Alabama has shown with two different studies that the conus does not move when the spine is bent, thus casting doubt on the utility of this to diagnose occult TCS. In the first study, the researchers used cadavers to directly visualize the position of the conus as the spine was put into flexion and extension. They did not find any significant movement of the conus as compared to when the spine was in a neutral position.

In the second study, published recently on-line in Child's Nervous System, the group used adult Rhesus monkeys. Specifically, they sedated three male monkeys and used MRIs to study the position of the conus with the spine in different positions. Again, they found no real change in the position of the conus.

Based on these findings the authors believe it is unlikely that flexion and extension will be useful in diagnosing occult TCS, but do say that additional studies involving either people or primates with known TCS would be beneficial.

Characterization of CSF hydrodynamics in the presence and absence of tonsillar ectopia by means of computational flow analysis.

Computational fluid dynamics [CFD] is a branch of mechanical engineering which uses mathematical models to simulate and study how fluids behave. CFD has been used extensively to study blood flow and design catheters and other medical products. In the Chiari world, over the past several years, the use of CFD in studying the CSF system has steadily grown.

Recall that CSF flows underneath the dura in essentially a closed space. The flow of CSF between the brain and spinal areas is driven by the heart beating. This system, although very complex, is ideal for analysis using CFD techniques, and indeed, Conquer Chiari has been pivotal in promoting and funding this type of work from the very beginning, especially as it applies to syrinx formation. In fact, Conquer Chiari has sponsored an ongoing study using advanced techniques such as these to try to develop an objective, diagnostic test for symptomatic Chiari.

Now it appears a group from Wisconsin has joined the growing number of people pursuing this research. They published results of preliminary CFD work in a recent issue of the American Journal of Neuroradiology. In their research, they used MRIs and CFD modeling to examine the CSF flow in both a Chiari patient and a health volunteer.

Although they did not find any breakthrough results, the significance of this work is the fact that there are now multiple research groups, around the world, pursuing this type of work. As they continue, one can hope that this new research community will continue to expand and produce more results which shed light on Chiari and syringomyelia.

Chiari Malformation in otology practice. Levo H, Tapani E, Karppinen A, Kentala E. Auris Nasus Larynx.

Sources

Study of the effects of flexion on the position of the conus medullaris: follow-up study using MR imaging in non-human primates. Bauer DF, Tubbs RS, Chambers MR. Childs Nerv Syst. 2009 Mar 27. [Epub ahead of print]

Characterization of CSF hydrodynamics in the presence and absence of tonsillar ectopia by means of computational flow analysis. Roldan A, Wieben O, Haughton V, Osswald T, Chesler N.
AJNR Am J Neuroradiol. 2009 May;30(5):941-6.

Chiari Malformation in otology practice.
Levo H, Tapani E, Karppinen A, Kentala E. Auris Nasus Larynx. 2009 Apr 29. [Epub ahead of print]

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A study from Finland found that 1% of patients undergoing an MRI ordered through an otology practice turned out to have Chiari. Otologists are ear doctors and the effects Chiari has on the ear can include hearing loss and more commonly balance and vertigo problems.

After coming across two Chiari patients in their practice, the authors decided to retrospectively review the records of the entire otology clinic for patients who had had an MRI ordered in a single year. In total, there were 439 such patients and 4 of them turned out to have symptomatic Chiari.

While in general, the most common reason for the otologists to order an MRI was hearing loss (72%), the Chiari patients had originally sought help for facial numbness, vertigo, and in once case sudden deafness.

This study highlights how the many different symptom manifestations of Chiari (in this case the cranial nerves were affected) can make it difficult to diagnose. If these doctors hadn't ordered MRIs, the Chiari patients might have gone a long time before being properly diagnosed.

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