Key Points

1. Cerebrospinal fluid (CSF) is a clear liquid which bathes the brain and spinal cord
2. The pressure of CSF in the skull area is called intracranial pressure, which is measured in mm of mercury (Hg) or water
3. With every heartbeat, CSF is pushed out of the skull area into the spinal area and then flows back
4. Some Chiari symptoms are thought to be related to the disruption of the normal flow of CSF
5. Study used continuous ICP monitoring to measure CSF pressure in people with and without Chiari while they were lying down and then sitting up
6. Found that ICP drops quickly when people sit up; but this drop is not as large in people with Chiari
7. The Chiari malformation blocks a large outflow of CSF, likely causing noticeable problems for patients

Definitions

craniovertebral junction - where the skull and spine meet

dura - thick, outer covering of the brain and spinal cord

epidural - refers to the space just below the dura, where CSF circulates

hydrocephalus - condition where an abnormal amount of CSF accumulates in the brain

idiopathic intracranial hypertension (IIH) - condition characterized by a sustained increase in ICP, due to unknown reasons

intracranial pressure (ICP) - the pressure of CSF in the skull area

median - the middle number in a group of numbers, such that half the group are higher and half are

With Chiari, Sitting Up Can Cause Problems

August 20, 2006 -- Cerebrospinal fluid (CSF), a clear fluid which bathes the brain and spinal cord, is a central player in the Chiari drama. CSF circulates in what is known as the subarachnoid space, which lies between the dura and the actual tissue of the brain and spine cord.

With every heartbeat, blood is pumped into the brain which in turn forces CSF out of the brain and into the spinal area. During the second phase of the cardiac cycle, this is reversed and CSF flows back into the brain from the spine.

The transit point for CSF to flow back and forth from the brain and spine is the craniovertebral junction, where they meet. It is here where Chiari can cause a problem with the natural flow of CSF. Normally, the cerebellar tonsils are positioned above the opening from the skull to the spine and there is sufficient room for CSF to flow freely around and underneath the brain tissue.

However, with Chiari the cerebellar tonsils are essentially jammed down into this opening, in effect plugging it like a cork in a bottle. Because of this, the natural back and forth flow of CSF is restricted and sometimes blocked completely. While the physical effects of restricted CSF flow are not completely understood, it is assumed that at least some Chiari symptoms are due to this disruption.

By restricting the outward flow of CSF, one thing Chiari may due (at least in some people) is cause an increase in pressure of the CSF. As a liquid in essentially a confined space, CSF has a natural pressure, just like the air around us, or water at different depths. The pressure of CSF in the skull/brain is known as intracranial pressure (ICP) and is measured in millimeters of mercury (Hg) or water. If a person's ICP gets too high, as can happen with a head trauma, the results can be catastrophic.

In addition to trauma, diseases other than Chiari where ICP plays a critical role are hydrocephalus and idiopathic intracranial hypertension. Both disease involve an increase in ICP and can be treated with shunts to divert CSF. If shunts malfunction or get blocked, there can be a dangerous elevation of ICP.

Because of its importance to trauma, diseases, and proper shunt function, ICP is a focus area for some researchers. Recently, a group from Spain (Poca et al.) published the results of a study which looked at how ICP changes when people move from a supine position (lying down) to sitting up. While the focus of their work was to shed light on shunt functioning and whether to elevate a person's head after a trauma, what they found may help explain something that many Chiari patients are familiar with.

Any Chiari patient that suffers from headaches can tell you that sitting up, or changing position quickly, can trigger intense pain in the back of the head. Interestingly, the study referenced above, and published in the May, 2006 issue of the journal Neurosurgery, may help explain why this occurs.

Over the course of 10 years, the Spanish researchers used continuous ICP monitoring on hundreds of patients to study the effects of sitting up. Since they were interested in studying shunt blockages, they also decided to study people with and without flow restrictions at the craniovertebral junction, namely Chiari.

Specifically, the team evaluated 376 patients with either hydrocephalus or idiopathic intracranial hypertension. Each person was given an MRI, and 97 patients with at least a 5 mm Chiari malformation, and evidence of abnormal CSF flow, were identified.

Over the course of two days, each patient was monitored using an epidural transducer (see Figure 1 & 2), in both the supine and sitting up positions. Recordings were made for at least one hour while the patients were lying still on their backs and then, without removing the monitor, for at least 3 hours as they sat up and moved into a chair.

They found, as has been hypothesized earlier by others, that sitting up resulted in a quick and significant drop in intracranial pressure in almost every patient. Once they were in the seated position, their pressure slowly started to increase, but never returned to the level it was at when lying down.

While this is interesting from a theoretical point of view, what is interesting to the Chiari community was that the researchers also found that this drop in ICP was different for those with Chiari than those without. Specifically, while the ICP of patients with Chiari did go down when they changed position, it did not drop nearly as much as those without Chiari.

The authors believe that the act of sitting up (or shifting the head) results in a sudden displacement of a large

lower

supine - lying flat on your back

transducer - a device which converts one type of energy into an electrical signal; used as a way to measure different parameters

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

Source

Poca MA, Sahuquillo J, Topczewski T, Lastra R, Font ML, Corral E. Posture-induced changes in intracranial pressure: a comparative study in patients with and without a cerebrospinal fluid block at the craniovertebral junction. Neurosurgery. 2006 May;58(5):899-906

amount of CSF from the skull area to the spinal area, resulting in a quick drop in pressure. With Chiari however, the CSF which is trying to move out of the skull is blocked. Not only does this mean the pressure doesn't drop as much, but it also means that Chiari patients are likely feeling the effects of CSF trying to escape.

So the next time you are sit (or stand) up too quickly and your head starts to pound, take a moment to think about what is going on inside.

Figure 1
Intracranial Pressure Monitoring In Supine Position

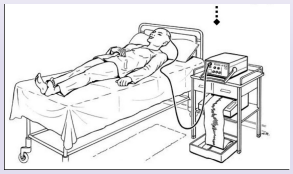
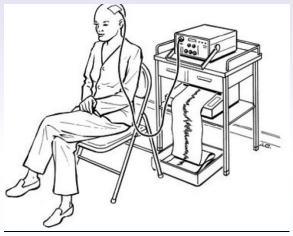


Figure 2
Intracranial Pressure Monitoring In Sitting Position



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