

Key Points

1. Not all Chiari patients suffer from cough headaches
2. Researchers used PC MR to study the CSF flow in Chiari patients with cough headaches and without
3. Found that in patients with cough headache, the amount of time CSF flowed from spine to brain was much longer as a fraction of the cardiac cycle

Definitions

CAH - cough associated headache; in Chiari patients, a short duration headache in the back of the head triggered by coughing

cardiac cycle - the heartbeat

cine PC MRI - type of imaging which can show, and measure, the flow of cerebrospinal fluid

diastole - in the cardiac cycle, after systole, where the heart chambers relax and fill with blood

foramen magnum - opening at the bottom of the skull through which the spinal cord connects to the brain

systole - the part of the cardiac cycle where the heart muscles contract and force blood through the arteries

Valsalva - straining

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

CSF Flow Different In Patients With Cough Headaches

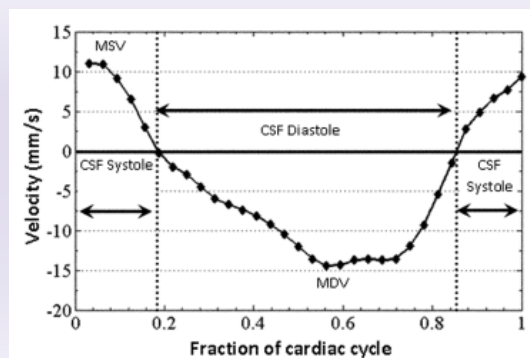
March 31st, 2011 -- While a cough triggered headache in the back of the head is often considered to be the signature symptom of Chiari, some Chiari patients get different kinds of headaches, and some don't get headaches at all. In a recent on-line publication in the journal, AJNR, a group of Boston researchers (Bhadelia) showed that the CSF flow of Chiari patients who get cough associated headaches (CAH) were significantly different than Chiari patients who do not get those types of headaches as measured by MRI.

The natural flow of CSF between the brain and spinal areas is driven by the cardiac cycle. During the systole phase of the cardiac cycle, the heart muscles contract and push blood out through the arteries. When this blood flows in the brain, because it is essentially a fixed space, CSF is forced out from the brain and down into the spinal area. During the second phase of the cardiac cycle, diastole, this process is reversed and CSF flows from the spine back into the brain.

Based on theories that Chiari cough headaches are due to CSF pressure differences in the brain and spine, the Boston research team decided to use cine PC MRI to study the CSF flow in Chiari patients both with and without cough headaches. Specifically, they retrospectively looked at 30 Chiari patients, ranging in age from 5 - 64 years, who had been scanned on a single MRI machine. Patients with prior Chiari surgery or who moved too much during the scan were excluded. Patients were considered to suffer from CAH if they made specific note of it during their clinical visit, which 9 of the 30 did.

Based on the PC MRI scans, the researchers measure the CSF velocity throughout the cardiac cycle at two different locations: just below the foramen magnum and between the second and third cervical vertebrae. Figure 1 below shows what a CSF velocity plot might look like:

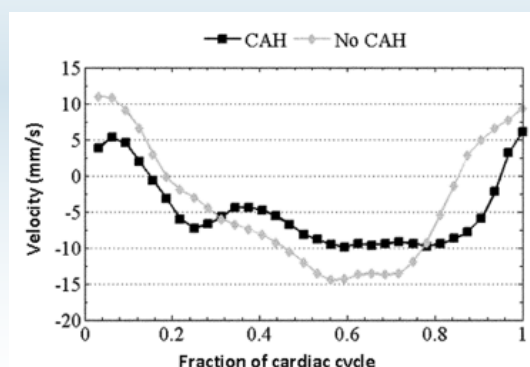
Figure 1: Representation of CSF Velocity Plot



When the velocity has a positive value, CSF is flowing from the brain to the spine, and when it has a negative value, it is flowing from the spine to the brain. In this fashion, the authors defined CSF systole and diastole graphically as a fraction of one cardiac cycle.

When the scientists looked at the CSF plots of the CAH patients versus the no CAH patients, they did not find much difference in the actual velocities of the CSF, but they did find a significant difference in the relative time of CSF diastole (Table 1). Specifically, the average CSF diastole - where the CSF is flowing from the spine to the head - took up much more of the cardiac cycle as a fraction in the CAH patients as opposed to the non-CAH patients (78% vs 59%). This is shown graphically in Figure 2 below:

Figure 2: CSF Waveform CAH vs No CAH



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

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

Source

[Cough-Associated Headache in Patients with Chiari I Malformation: CSF Flow Analysis by Means of Cine Phase-Contrast MR Imaging.](#)
Bhadelia RA, Frederick E, Patz S, Dubey P, Erbay SH, Do-Dai D, Heilman C. AJNR Am J Neuroradiol. 2011 Feb 17. [Epub ahead of print]

It should be noted that this difference was only found with the measurements just below the foramen magnum, and that the measurements taken further down the spine in the cervical region showed no significant differences between the groups. It is also interesting to note that the systole/diastole composition of the cardiac cycle was not related at all to whether patients had a syrinx.

While the true clinical implications of this study are not clear, it does provide strong evidence of a physiological difference between Chiari patients with cough headaches and those without. The researchers disclose that a drawback of this work is that the acquisition time to get these types of MRI measurements is quite long which makes it difficult from a practical point of view.

However, Conquer Chiari is funding a pilot study designed by Dr. Bhadelia to use a new type of MRI technique to perform a similar study in Chiari patients during Valsalva.

Table 1: CSF Flow Differences in Patients with CAH (9) vs No CAH (21), Measured Just Below Foramen Magnum

	No CAH	CAH	Sig
Max Systolic CSF Velocity (mm/s)	22.8	23.6	No
Mas Diastolic CSF Velocity (mm/s)	16.4	20.5	No
CSF Systole Fraction of Cardiac Cycle	41%	28%	Yes
CSF Diastole Fraction of Cardiac Cycle	59%	72%	Yes

Note: Sig refers to whether the difference between groups is statistically significant and *not* likely due to chance

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