Key Points

1. CSF continues to be researched and evaluated as a way to measure surgical success
2. Study looked at 18 symptomatic CM/SM patients who underwent surgery
3. Clinical status was evaluated using a scale both pre op and post op
4. MRI flow studies were taken pre and post-op and categorized as sinusoidal pattern or heterogeneous
5. After surgery, 11 patients had good outcomes, 5 were stable, and 2 became worse
6. For the 11 patients with good outcomes the post-op flow for each became sinusoidal
7. For the patients who were stable or worse, the post-op flow remained heterogeneous
8. The same was true with post-op syrinx size; the syrinx for those with a good outcome decreased in size

Definitions

foramen magnum - opening at the base of the skull through which the brain and spine meet

heterogeneous - not uniform in composition

sinusoidal - a pattern of regular waves

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

CSF Flow Used To Evaluate Surgical Success

November 30, 2007 -- Even as its popularity grows, measuring CSF flow via MRI continues to be researched and studied as a means of both identifying symptomatic Chiari and assessing surgical success. Although results to date have been somewhat mixed, a recent study of out Turkey (Koc) found that post-operative CSF flow at the foramen magnum was a good indicator of clinical outcome.

The research involved 18 adult Chiari patients, all of whom also had syrinxes (Table 1). Each patient was evaluated both clinically and by MRI before surgery and six months after surgery. Clinically, patients were scored using a simple system which rated levels of disability (Table 2).

Table 1
Common Symptoms (18 Total CM/SM Patients)

Symptom	% With
Head/neck pain	77%
Sensory Disturbances	44%
Upper Extremity Weakness	44%
Lower Extremity Weakness	38%

Table 2: Clinical Status Scoring System

Functional Disorder	Points
Headache and neck pain	1
Signs of spinal cord disease, but no difficulty using upper extremities and walking	1
Cranial nerve involvement	2
Slight difficulty using upper extremities or walking, but does not prevent full-time employment	2
Moderate inability in using upper extremities	2
Complete inability in using upper extremities	3
Difficulty walking which prevents full-time employment or ability to do household chores but does not require someone else's help to walk	3

Patients with lower scores after surgery were considered to have Good outcomes; those with the same score were classified as Stable; and those with higher scores were classified as worse.

For CSF flow, the MRIs were classified as either sinusoidal at the foramen magnum, representing normal flow, or heterogeneous, representing abnormal flow. In a healthy person CSF flows freely back and forth from the brain to the spine across the foramen magnum in a sine wave pattern. With Chiari, this flow can become blocked which disrupts the rhythmic flow and makes it more irregular, or heterogeneous. Before surgery, all 18 patients exhibited heterogeneous, or abnormal, CSF flow.

Six months after surgery, 11 patients were determined to have Good outcomes, 5 were Stable, and 2 were worse (Table 3). Interestingly for the 11 patients with Good outcomes, each of their post-operative CSF flow patterns had become sinusoidal. In contrast, for the Stable and Worse patients the CSF flow at the foramen magnum remained heterogeneous. Similarly, the patients who had Good outcomes as determined by the clinical scoring system also showed a significant decrease in the size of their syrinxes, whereas the Stable and Worse patients did not.

Table 3
Clinical Outcomes Compared To Post-Op CSF Flow

# of Pat.	Clinical Outcome	Syrinx Size	Post-op CSF Flow
11	Good	Decreased	Sinusoidal
5	Stable	Slight Decrease	Heterogeneous
2	Worse	Same	Heterogeneous

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

Koç K, Anik Y, Anik I, Cabuk B, Ceylan S. Chiari 1 Malformation with Syringomyelia: Correlation of Phase-Contrast Cine MR Imaging and Outcome.Turk Neurosurg. 2007;17(3):183-92.

While these results would indicate that CSF flow patterns at the foramen magnum are a good indicator of surgical outcome, this particular research suffers from a number of limitations. First, a precise definition of how the CSF flow pattern was classified was not provided, so it is not clear what specifically qualified as sinusoidal versus heterogeneous. Further, it was not clear if more than one person read the MRI results as would be commonly done to make sure that the results are consistent among different readers. Finally, it is also not clear if the person reading the MRIs was blinded to the clinical status of the patient in question. This is done to eliminate any potential bias that can be introduced, even inadvertently, by someone who is aware of a patient's status. In other words, if the person reading the MRI is the same person who examined the patient clinically, their MRI reading may be influenced by the clinical exam results.

In addition to the MRI readings, the scoring system used to assess outcomes was pretty simplistic and the authors even acknowledge that determining the pre and post-op scores was difficult. Reliable and easy to implement outcome measure remains a problem for Chiari research in general, not just this study.

In the end, CSF flow patterns may prove to be an effective tool in evaluating surgical success, but this will not occur until well structured research is employed to evaluate its effectiveness.

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