

How Much Does Chiari Restrict Spinal Fluid Flow?

Most people familiar with Chiari know that the herniated cerebellar tonsils restrict the flow of cerebrospinal fluid (CSF) between the brain and spine. But have you ever wondered how much of the flow is actually blocked? A new study – partly funded by Conquer Chiari – of children with Chiari provides a surprisingly concrete answer. Using a specialized MRI technique, researchers measured the amount of CSF moving through the foramen magnum with each heartbeat – a measurement called CSF stroke volume.

The study included 24 children who underwent posterior fossa decompression surgery and eight healthy children who served as controls. The Chiari patients averaged about 9 years old and 71% were female. Because some children could not complete every MRI scan, 15 had usable scans before surgery, 20 had scans after surgery, and 11 had both.

The researchers used phase-contrast MRI to measure CSF movement at the foramen magnum. Rather than looking only at how fast the fluid was moving at one point in time, they calculated the total amount of fluid that moved during each heartbeat. The idea is similar to cardiac stroke volume, which measures how much blood the heart pumps with each beat.

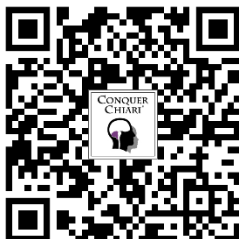
In children without Chiari, the average CSF stroke volume was 0.55 ml per heartbeat. Before surgery, the children with Chiari averaged only 0.26 ml. In other words, the amount of CSF moving across the foramen magnum in the Chiari group was about 53% lower than normal, or less than half what it should be on average. After decompression surgery, however, the average CSF stroke volume increased to 0.44 ml per heartbeat. That represents about a 70% increase compared with the pre-surgical value. Importantly, the post-surgical value was no longer statistically different from the healthy control group. The 11 children who had both a pre- and post-surgical MRI showed the same pattern. In this paired group, the average stroke volume increased from 0.19 ml before surgery to 0.44 ml afterward.

Interestingly, the researchers did not see the same clear differences when they looked at peak CSF velocity, which measures how fast the fluid is moving at its fastest point. Peak velocity was not significantly different between the Chiari and control groups and did not change significantly after surgery. Based on this, the authors believe that stroke volume may provide a more complete picture of CSF obstruction. The study also found that the amount of tonsillar herniation was not related to CSF stroke volume before surgery. This highlights why tonsillar position alone is a poor indicator of Chiari severity.

It's important to note that the study only involved a small number of patients and researchers did not find a relationship between the amount that stroke volume increased and how well the children did clinically after surgery. Nearly all of the patients had good outcomes, however, which made it difficult to study whether larger increases in flow were associated with better outcomes.

Source: Williams B, Uribe B, Loth F, Sarda S, Desai N, Chern J, Oshinski J. CSF stroke volume measured in pediatric Chiari type 1 Malformation subjects before and after posterior fossa decompression surgery compared with healthy subjects. *Fluids Barriers CNS*. 2026;23:96. doi:10.1186/s12987-026-00849-8

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Conquer Chiari is a 501(c)(3) public charity dedicated to improving the experiences and outcomes of Chiari patients through education, awareness and research.