Key Points

1. Controversy remains over the best surgical technique to treat Chiari
2. Some surgeons advocate performing only a bony decompression, others advocate opening the dura, others have developed modified techniques
3. This study used intraoperative ultrasound to guide how much decompression was necessary in 130 patients
4. About 70% had abnormal flow after bone removal
5. Overall success rate was 95%, with 6 patients requiring reoperation
6. There were no complications in bone only group, complication rate was 13% in group with duraplasty
7. Bone removal only patients had shorter hospital stays and less pain

Definitions

craniectomy - surgical technique which involves removing a section of the cranium, or skull

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

duraplasty - surgical technique which involves sewing a graft, or patch, into the dura, to create more space

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

laminectomy - surgical technique which involves removing part of one or more vertebrae

pseudomeningocele - a balloon like extension of the subarachnoid space into the surrounding tissue

scoliosis - abnormal curvature of the spine

subarachnoid space - space where CSF circulates

Ultrasound Can Determine Extent Of Surgery Necessary

August 20, 2006 -- Despite the thousands of Chiari decompressions performed each year, controversy still exists over which specific surgical techniques are best. The goals of Chiari surgery are clear: make more room around the cerebellar tonsils to relieve pressure and crowding, and restore the natural flow of cerebrospinal fluid (CSF).

The issue is that neurosurgeons have developed different approaches, techniques, and variations on how best to accomplish this. Part of this is simply the way the neurosurgery system works; surgeons are trained and mentored by individuals, with individual styles ranging from how to interact with patients to preferences for specific operative techniques. As they progress in their training, neurosurgeons incorporate their mentor's ideas, but also develop their own individual style and opinions on how to do things.

Absent strong clinical evidence that demonstrates the clear value of one technique over another, surgeons will rely on how they were trained and their own experience and judgment in deciding how best to approach an operative case. Since there is very little rigorous outcome research in Chiari, it seems natural that surgeons have devised many variations of the general technique as they strive for the best patient outcomes possible.

Currently, one of the biggest controversies in the Chiari surgery arena is whether or not to open the dura, the thick covering of the brain and spinal cord (see To Open or Not To Open The Dura; That Is The Question). Some surgeons advocate, especially for children, performing what is called a bony decompression only, where part of the skull and vertebra are removed to create more space. The advantage to this type of decompression is that it significantly lowers the risk of complications and usually results in a shorter hospital stay and quicker recovery. The downside, according to critics, it that it may not provide enough decompression to truly resolve the problem.

Those who advocate opening the dura stress that scarring and adhesions underneath the dura are often found to interfere with CSF flow and need to be removed. In addition, some surgeons even go a step further and shrink the actual cerebellar tonsils, another controversial move.

Unfortunately for patients, the situation is becoming even more muddled as some surgeons are trying to find a middle ground by advocating techniques such as scoring the dura, but not opening it fully.

While this all seems like a sad state of affairs for patients, and it is tempting to advocate directly comparing one technique to another in a clinical trial, it is important to keep in mind that not all patients are alike. It may be that some people require more extensive decompression than others.

Along these lines, a group from the Cincinnati Children's Hospital (Yeh, Koch, Crone) recently published their experience in using ultrasound during surgery to determine whether to open the dura in 130 Chiari children. Their report appeared in the July, 2006 issue of the Journal of Neurosurgery: Pediatrics.

The patients ranged in age from 9 months to 18 years and were all operated on between 1995 - 2003 by Dr. Crone. All patients had at least a 3mm herniation of the cerebellar tonsils and demonstrated abnormal CSF dynamics.

The surgery itself consisted of removing a 3cm by 3cm piece of skull (craniectomy) and laminectomies of the vertebra to the lowest level of tonsillar descent. At this point, after what was considered a bony decompression, a neuroradiologist used ultrasound to evaluate the CSF space and flow around the tonsils. The doctors also looked for signs of piston-like movement of the tonsils, which would indicate they were still under pressure.

If the ultrasound showed that the decompression was sufficient, the surgery would essentially end there, and the incisions would be closed. If, however, the ultrasound showed there were still problems, the surgery would continue and the dura would be opened.

After the dura was opened, adhesions and scar tissue were removed and the cerebellar tonsils shrunk up to the level of the foramen magnum. In addition, the surgeons would check to make sure there was adequate CSF flow out of the 4th ventricle. The dura was closed with a graft (duraplasty) and the decompression rechecked using ultrasound.

In retrospectively reviewing the outcomes of the surgeries, the authors defined success as a documented clinical improvement with no need for additional surgery (Ed. Note: Yet again, a rather weak definition of success). Using this criteria, independent of whether the dura was opened or not, they achieved a very respectable 95% success rate. Only 6 patients, 4 from the bony decompression group and two from the dura

ultrasound - imaging technology which uses sound waves in order to visualize things inside the body

ventricle - any of several CSF filled spaces in the brain

vertebra - one of 33 individual bony segments that make up the spinal column

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

Yeh DD, Koch B, Crone KR. Intraoperative ultrasonography used to determine the extent of surgery necessary during posterior fossa decompression in children with Chiari malformation type I. J Neurosurg. 2006 Jul;105(1 Suppl):26-32.

opened group, required additional surgery.

The true value of the ultrasound however, may be in identifying patients who for whom a less invasive surgery is sufficient. Overall, using the intraoperative ultrasound, 40 (31%) patients were found to have normal flow after the bony decompression, whereas 90 (69%) were found to still have problems (see Table 1).

Of the 40, one patient ended up undergoing a duraplasty because their dura was accidentally punctured during the procedure. Similarly, not every patient with an abnormal intraoperative ultrasound had their dura opened. Five patients in this group did not, due to other issues such as hydrocephalus.

For those patients who underwent a bony decompression only, there were absolutely no surgical complications. In contrast, the dura opened group experienced a 13% complication rate, with patients having to deal with infection, CSF leaks, and pseudomeningoceles (see Table 2).

In addition, the bone only group, on average, was able to leave the hospital earlier than the other group. The bone only group stayed an average of 4.3 days versus 6.4 days for the dura group. Finally, although it wasn't quantified, the doctors also noted there was significantly less post-operative pain for the bone only group.

The researchers also looked to see whether there were any factors or patient characteristics that could have predicted which operative technique ended up being used. Although age, sex, MRI, etc. did not appear to correlate with the type of surgery, they did find that 87% of patients with spinal type symptoms - such as weakness, abnormal sensations, and scoliosis - required the more extensive decompression.

While it would be ideal for patients to be able to say ahead of time who could get by with a bony decompression only, given the lower risk of complications and shorter hospital stays it does seem beneficial for surgeons to use intraoperative ultrasound to make this determination.

It also appears that the controversy and arguments regarding which surgical procedures are better may be misplaced, and that the best procedure is one that is tailored to the individual patient.

Table 1
Number of Patients By Surgical Procedure & Intraoperative Ultrasound Results (130 Total)

	Bone Only	Bone & Dura Opening
Normal Flow	39	1
Abnormal Flow	5	85

Table 2
Surgical Results By Procedure (125 Patients Total)

	Bone Only	Bone & Dura Opening
Total	40	85
# Successful	36	83
# Complications	0	12

Note: Success was defined as documented clinical improvement without need for additional surgery

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