Key Points

1. Electrical monitoring, known as BAEP is routinely used in neurosurgery to make sure the surgery itself is not harming the patient
2. Researchers used BAEP monitoring to try determine the beneficial effects of different stages of Chiari surgery
3. Reviewed the records of 80 Chiari patients, some of whom had bone only decompression, and some of whom had duraplasty
4. Found that among patients whose BAEPs improved, the majority of the improvement was seen after the bony decompression rather than the duraplasty
5. However, the relevance of BAEP times to clinical outcomes is not clear
6. A much more rigorous study involving BAEPs would be needed to draw any real conclusions

Definitions

auditory - having to do with sound and hearing

BAEP - brainstem auditory evoked potential; electrical monitoring used to assess the functioning of certain brain segments, including the brainstem

bilateral - both sides

brainstem - part of the brain which connects with the spinal cord and controls many automatic functions, such as breathing

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

duraplasty - surgical technique where the dura is opened and expanded with a patch

intraoperative - during surgery

neurophysiology - the study of how the nervous system functions

PFD - posterior fossa

Main Benefit Of Decompression May Come From Bone Removal

March 31st, 2009 -- A study published on-line in the Journal of Clinical Neurophysiology (Zamel et al.) has found that most of the benefit of decompression surgery may come from bone removal, as opposed to opening the dura. The work, undertaken by a group from Ohio State, used electrical monitoring known as brainstem auditory evoked potentials (BAEP) during surgery to compare the effect of bony decompression to the effects of opening the dura.

BAEPs, which were first used in the 1960's, measure the electrical response of the brain to specific noises. To do this, electrodes are placed on the patients scalp and electrical waveforms are recorded. From this, response times - in milliseconds - can be determined to sounds presented to each ear. This in turn is supposed to reflect the functioning of the brainstem.

BAEPs are used routinely in neurosurgery to make sure that no damage is being done to the patient during surgery; however the Ohio State team used them to measure the response times at specific points during Chiari decompression surgery. Specifically, they took a baseline measurement after the patients had been positioned for surgery, again after bony decompression, and then finally during the closing phase of the surgery.

The purpose of taking these measurements was to see if they could find any evidence as to whether opening the dura is a necessary part of Chiari surgery. As has been reported extensively by this publication, there is a debate in the surgical community on when (and whether) the dura should be opened, especially in children.

Those in favor of bony decompression point out that complication rates when the dura is opened are much higher and much more serious. However, this argument is countered by research which shows that the reoperation rate for bone only decompression is higher than when duraplasty is used. This debate is far from over, and currently it is a matter of individual surgical (and patient) preference, and many surgeons believe that the presence of a syrinx is an automatic indicator that the dura should be opened.

The study was done retrospectively, meaning that the researchers went back and reviewed patients' medical records and test results in order to perform their analysis. In all, they reviewed the BAEP results from 80 Chiari patients who had been operated on by a single surgeon. The patients were fairly representative of Chiari in general, in that headache and neck pain were the most common symptoms, but symptoms also included trouble swallowing, numbness, tingling, and weakness. Most of the patients were children, and there were slightly more females than males.

Most patients without a syrinx underwent a bone only decompression, but there were two exceptions (Figure 1). Similarly, most patients with an accompanying syrinx underwent duraplasty (using their own tissue) in addition to the bony decompression. Five patients with syrinxes, however, did not, due to dural abnormalities. For statistical analysis, the researchers grouped the patients into those who underwent bony decompression only (50 total) and those who received a duraplasty (30 total).

When they looked at the BAEP response times, the researchers found a significant difference between the groups, namely that the response times of the patients in Group B (who predominantly had syrinxes) improved much more than those in Group A. However, this improvement occurred mostly after the bony decompression, with very little improvement after opening the dura.

While this finding does match a previous study (see Related Articles), and clearly says that bone removal improves the brainstem response time more than opening the dura, it is difficult to determine how applicable these results really are. For example, how well do BAEP improvements correlate to clinical improvement in patients. Surprisingly, only 64% and 73% (Group A and B respectively) of the patients actually had improved BAEP scores at all, yet their clinical outcomes were, thankfully, much better than that (Figures 2&3). In fact, at the 4 month mark, 100% of the patients experienced significant improvement in their major symptoms, although this did decrease somewhat over time. Still one has to question how good of a marker the BAEP improvement is when clearly some patients improved symptomatically but did not show any improvement on the electrical tests. Perhaps the discrepancy stems from the fact that not all Chiari patients have symptoms involving brainstem compression, so one would have to ask if BAEPs would pick up improvement in those symptoms.

Similarly, it is difficult to apply these results to the dura debate in general, when the study itself shows such a good outcome when the dura was opened. Although they do not report on the statistical significance of this, it is certainly interesting to note that the long term improvement was higher among patients with a duraplasty than those with a bone only decompression. Also absent is any mention of significant complications among the duraplasty group, which of course is the main argument against opening the dura in the first place.

decompression; general term used for any of several surgical techniques used to treat Chiari

unilateral - one side

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

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

Source

Intraoperative Neurophysiologic Monitoring in 80 Patients with Chiari I Malformation: Role of Duraplasty. Zamel K, Galloway G, Kosnik EJ, Raslan M, Adeli A. J Clin Neurophysiol. 2009 Mar 12. [Epub ahead of print]

Taken in this context, these results are unlikely to change many, or any, minds when it comes to opening the dura during surgery. Further, they highlight the limitations that can be encountered when trying to answer research questions by retrospectively going back and looking at data. If BAEP response times are to be considered useful in determining surgical improvement, they first must be shown to correlate with clinical outcomes and their sensitivity and accuracy clearly established.

Figure 1: Patient Breakdown Into Groups

	Group A	Group B	Total
CM no syrinx	45	2	47
CM with syrinx	5	28	33
Total	50	30	80

Figure 2: BAEP Improvement By Group

	Group A	Group B
Unilateral Improvement	38%	33.3%
Bilateral Improvement	26%	40%
Total Improved	64%	73.3%

Notes: Group A was bone only decompression, Group B received duraplasty

Figure 3: Clinical Improvement In Major Symptoms By Group and Time

Time	Group A	Group B
0-4 months	100%	100%
9-12 months	93%	86%
> 12 months	88%	95%

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