

Association Between Resistance to CSF Flow Near the Foramen Magnum and Cough Associated Headache in Adult CMI

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Purpose

When the heart beats, blood is pumped into the brain and cerebrospinal fluid (CSF) is pushed out of the brain and into the spinal area. During the second phase of the cardiac cycle, CSF moves back from the spine into the brain area. In CMI patients, this natural sloshing of CSF is partially blocked by the herniated tonsils. Longitudinal impedance (LI) is a way to quantify the resistance to this pulsatile flow of CSF. Previous research has shown that CMI patients have larger LI than healthy controls.

Cough associated headache is considered to be the signature symptom of CMI and is believed by some to be due to disruption of CSF flow at the junction of the brain and spine. The purpose of this study was to compare the LI of CMI patients with cough headaches compared to patients without cough headaches.

Methods

51 symptomatic CMI patients with tonsillar herniation > 5mm were included in the study and divided into two groups (cough headache and no cough headache) based on medical records. MRI images were used to model the CSF space of each patient and computational fluid dynamics was used to calculate the LI of each.

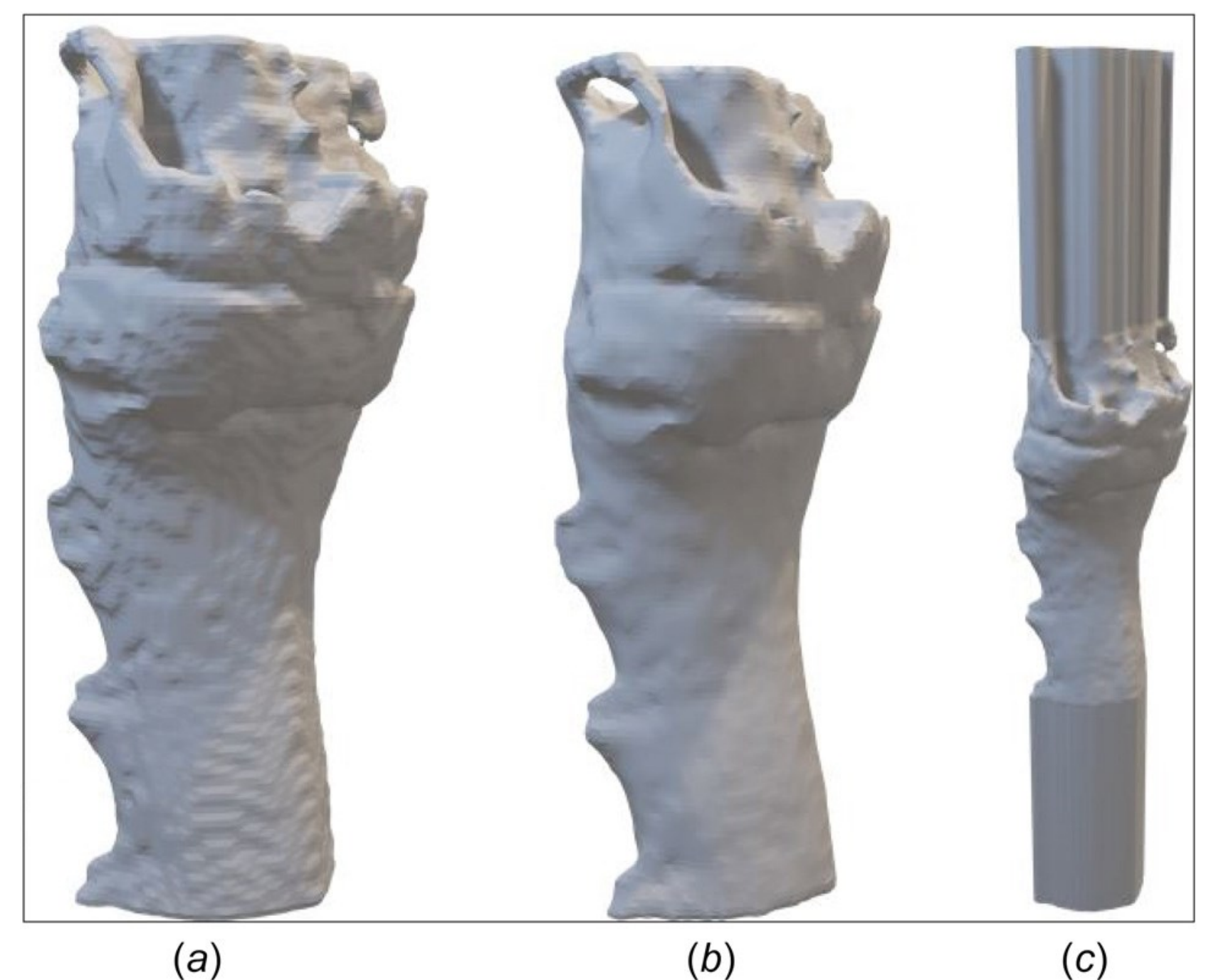
Results

The median LI for the cough headache group was 2.7 times larger than for the non cough headache group. A cut-off LI value of 750 was extremely specific in identifying patients with cough headaches (meaning someone with an LI above 750 is very likely to have cough headaches) but missed quite a few subjects (meaning some subjects with cough headaches had LI values less than 750).

Conclusions

This study showed cough headaches are likely related to the disruption of the natural flow of CSF at the skull spine junction. It also showed that LI can be used to a certain extent to identify patients with cough headaches. However, the LI calculations used in this study relied on a number of simplifications. Further research to refine the LI calculation technique (for example taking into account tonsil motion) may reveal stronger link between LI and cough headache, or may prove to be useful in assessing surgical outcome.

CSF Space Modeling Using a Three Step Process



Example of a Mesh Used to Model the CSF Space Anatomy for LI Calculation

