CONQUER CHIARI®
RESEARCH CENTER

CONQUER CHIARI®
From Knowledge, Strength. Through Research, Hope.

The Relationship Between Cardiac Induced Strain in the Brainstem/ Cerebellum and Imbalance in CMI

Mohamad Motaz Fouad Al Samman, Alaaddin Ibrahimy, Blaise Simplice Talla Nwotchouang, Rafeeque A. Bhadelia, Philip A. Allen, Daniel L. Barrow, Rouzbeh Amini, John N. Oshinski, and Francis Loth

Purpose

The goal of this study was to examine the relationship between cardiac induced strain on neurological tracts related to postural control, balance, and equilibrium and imbalance in CMI patients. The specific tracts examined were the vestibulospinal tract (VST), and the superior and inferior cerebellar peduncles (SCP, ICP). The VST is responsible for reflexive postural adjustment of the head and body. Unconscious proprioception information of the head and body reaches the cerebellum through the SCP and ICP. The cerebellum receives and sends vestibular information regarding the head's position and motion via the ICP.

Methods

15 CMI subjects with imbalance, 20 without imbalance, and 25 healthy controls underwent DENSE MRI scans at Emory University between 2017 and 2022. The strain on each nerve tract was calculated using two regions of interest (ROIs) along the tract in the midsagittal plane based on anatomical landmarks (Figure 1). When appropriate, the strain along the entire tract was also determined using a moving window technique. The strain values of the three groups were compared.

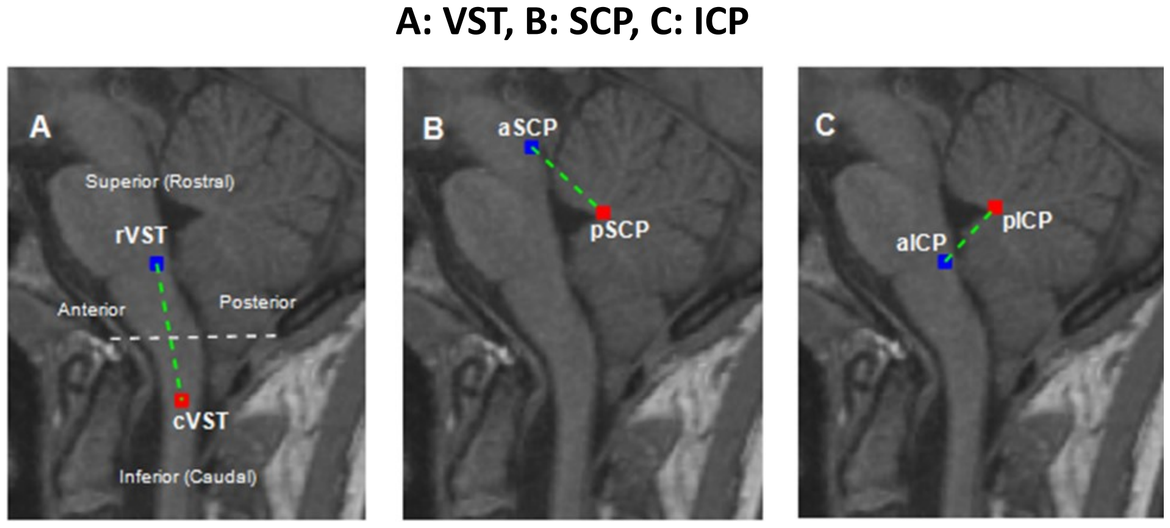
Results

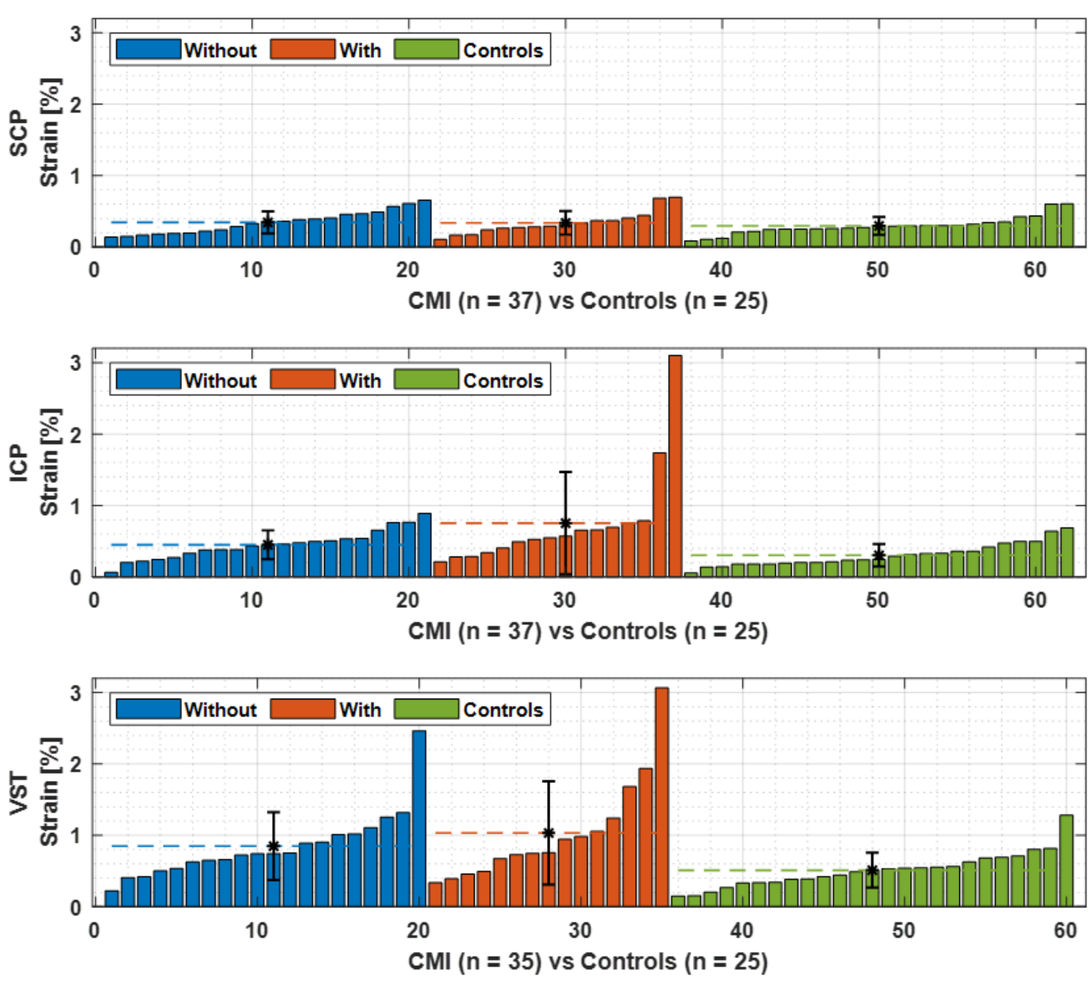
The mean strain of the ICP and VST tracts of the CMI group were 91% and 81% higher than the control group respectively. The mean strain on the SCP in the CMI group was not significantly different compared to the controls (Figure 2). There was not a significant difference in the strain of any of the tracts between the CMI imbalance and CMI no imbalance groups.

Conclusions

This study used a special MRI sequence to quantify cardiac induced strain on nerve tracts responsible for balance, equilibrium, and reflexive postural controls. Although the strain was significantly higher on the SCP and VST tracts in CMI than controls, the strain did not correlate with the imbalance. This could be because balance problems were not tested and quantified, but rather patient reported as either present or not present. It is also possible the since balance is a complex function, that more anatomical areas need to be examined. Finally, it is possible that the magnitude of cardiac induced strain (~ 1%) is not enough to cause damage, but that other activities, such as cough and Valsalva, may produce a higher magnitude of strain on these regions.

Regions of interest (blue and red boxes) on MRI of a CMI patient. A: VST, B: SCP, C: ICP





Strain on SCP, ICP, and VST. CMI with imbalance is shown in red, and without is in blue. Controls is shown in green. Dashed line represents the mean and error bar represents the standard deviation.