



COGNITIVE AND AFFECTIVE EFFECTS IN CHIARI MALFORMATION



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IMPORTANCE FOR CHIARI PATIENTS

This project will provide new understanding about the cognitive and emotional consequences of Chiari malformation I. Past preliminary research (e.g., Frim, 2008; Kumar et al., 2011) has suggested cognitive effects in Chiari malformation I, but the present study will be the first comprehensive test of this hypothesis.

ABSTRACT

We will use neuropsychological assessment (used by Lacy et al., 2009, for hydrocephalus patients), event-related potentials (ERPs, see Pollock et al., 2012, for a study applied to human aging), diffusion tensor imaging (DTI, see Kumar et al., 2011), and structural MRI (Loth et al., 2001) to link behavioral, electrophysiological, and neuro-imaging data so that we can compare the results from Chiari patients and age-matched controls. Our hypothesis is that Chiari patients will show changes in memory, attention, threat perception, and emotional decision-making relative to controls, and that these results will be correlated with decreased white-matter integrity (as measured by DTI) and increases in cerebrospinal fluid dynamics (as measured by structural MRI) in Chiari patients relative to controls. These results would be significant for a better understanding of Chiari malformation Type I because it would provide conclusive evidence that cognitive and affective symptoms are present in this syndrome. These results may also provide a potential framework for additional clinical interventions.

METHODS

We will use the RBANS neuropsychological assessment test as well as the Iowa Gambling Task test to obtain objective measures of cognitive and affective performance across our Chiari and control groups. We will also use summed EEG methods (ERPs) to test whether the portion of the brain associated with emotional arousal modulates visual perception. Additionally, DTI methods will be used to test the white-matter integrity of brain fiber tracts associated with episodic memory, attention, and emotional perception and decision making (using fractional anisotropy, or FA) for Chiari patients and controls (Figure 1). Finally, we will link these other methods to structural MRI scans that will look at various measures of cerebrospinal fluid dynamics known to change in Chiari patients (Yiallourou et al [6] and Loth et al. [4]) to see if these results will be correlated with cognitive performance. Study design is in Figure 2.

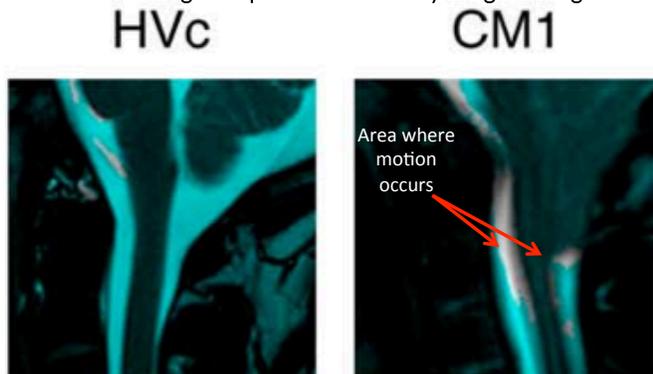


Figure 1. Example of brain motion analysis for a healthy volunteer (HV) and Chiari I malformation patient (CM1) MRI scan (sagittal plane near craniocervical junction) [6]. Areas where brain motion does not occur are masked in teal color.

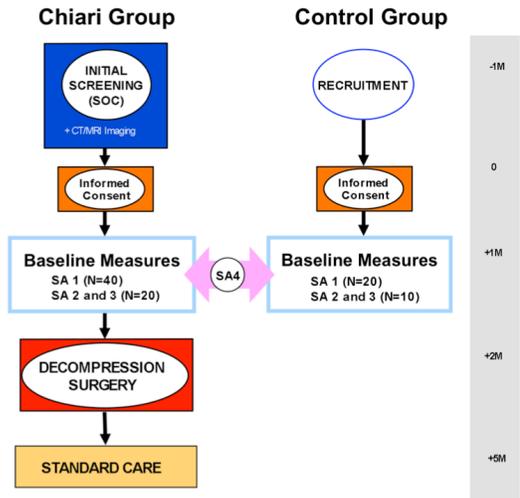


Figure 2. Study workflow diagram.

RESULTS AND DISCUSSION

As noted earlier, we predict that Chiari patients will show changes in cognitive and affective performance (relative to age-matched controls) that will be correlated with losses in white-matter integrity in the brain and increases in CSF dynamics. For many years, Chiari patients have given subjective complaints of cognitive consequences for Chiari malformations. The present study is designed to be the first objective test of this phenomenon. We will also collect information on headache pain, anxiety, and sleep insomnia so that we can also examine how these variables are related to cognitive and emotional processing in Chiari malformation type I. We will be testing CM patients that have not undergone decompression surgery.

The limitations to this study will be the relatively small sample size (20 Chiari patients and 10 controls for the imaging portion) and the inability to attribute causality (we will need to collect longitudinal data for this). However, the present study will likely provide us with objective descriptive data on the cognitive and affective consequences of CM.

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