Diffusion Tensor Imaging as a Biomarker for Pediatric Cardiac Arrest Outcomes

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15s-Summary

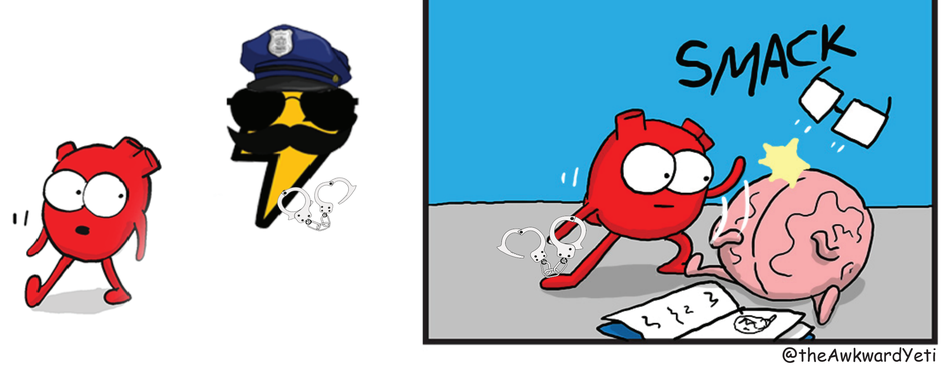
Question: Seek whether DTI and rsfMRI identify vulnerable brain regions and networks associated with neurologic outcome after pediatric cardiac arrest

Task: Tract-wise diffusivity measures (fractional anisotropy, mean diffusivity, etc) were used to assess DTI, and functional connectivity strength(FCS) was used to assess rsfMRI between Favorable vs Unfavorable outcome groups.

Results: Mean, radial, axial diffusivity and FA of varying direction of magnitude in limbic tracts (Cingulum, CorpusCollusum)were associated with unfavorable neurologic outcome. Decreased FCS also correlated regionally with unfavorable outcome, again primarily in limbic regions

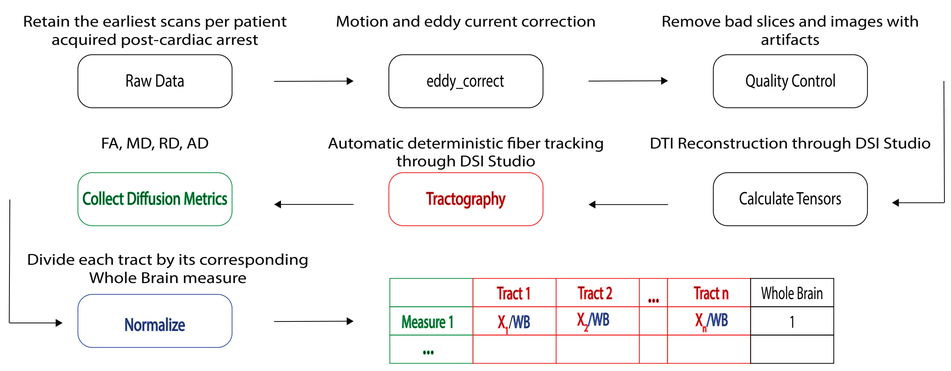
Discussion: Decreased multimodal connectivity measures of paralimbic tracts were associated with unfavorable neurologic outcome. Longitudinal analysis of brain connectivity and neuropsychological outcomes are needed in pediatric cardiac arrest patients pediatric cardiac arrest patients.

Cardiac Arrest

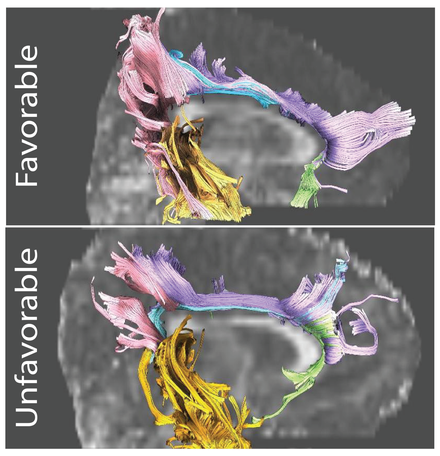


Cardiac arrest is when the heart stops beating. While cardiac arrest is primarily a heart disorder, it can lead to severe neurological damages.

Methods



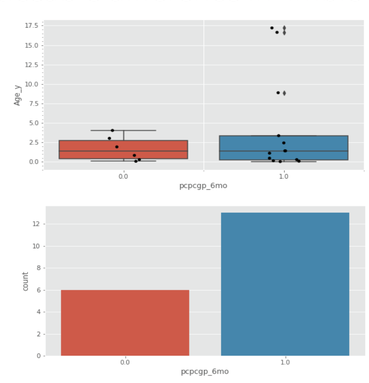
Each diffusivity measure was self normalized per patient's whole brain measure to account for the large age range and small sample size.



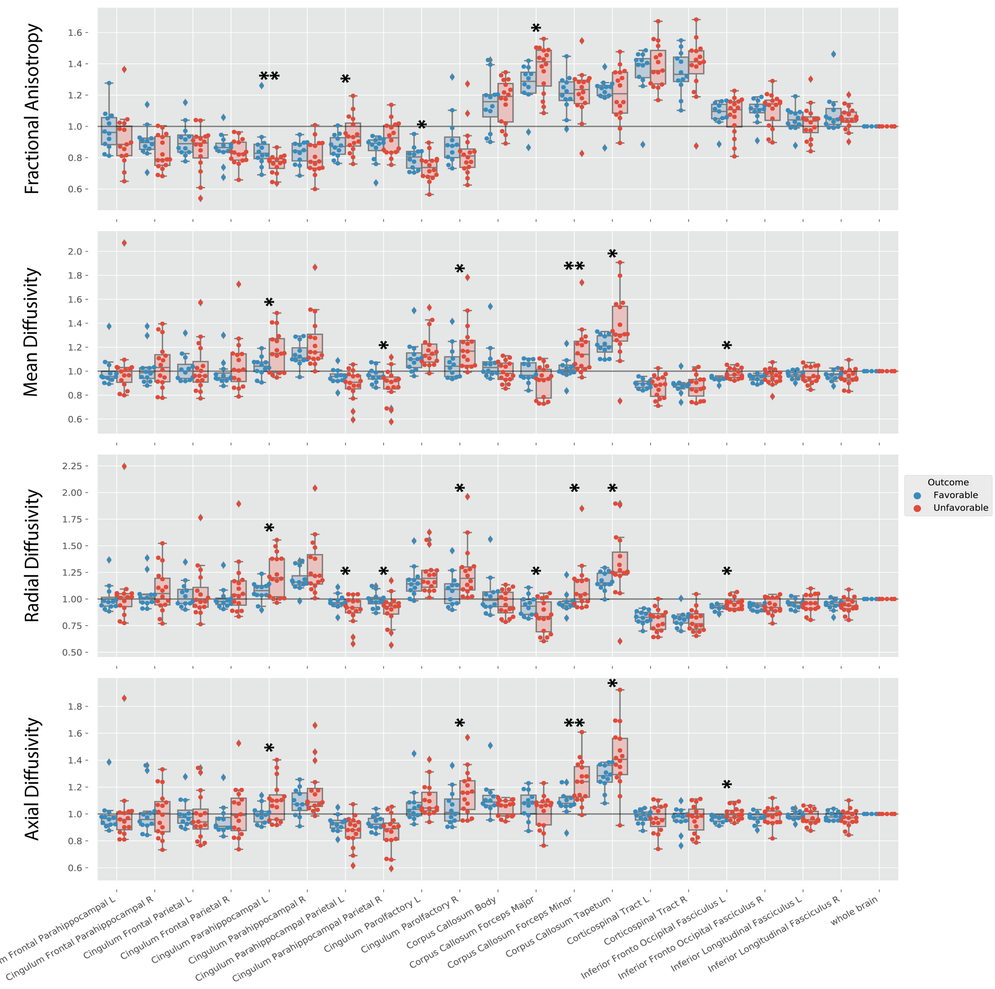
Key: Gold: Cingulum Parahippocampal, Blue: Cingulum Frontal Parahippocampal, Purple: Cingulum Frontal Parietal, Red: Cingulum Parahippocampal Parietal, Green: Cingulum Parolfactory.

Cingulum Frontal Parahippocampal and Cingulum Parahippocampal Parietal bundles in favorable outcome appear thicker and more numerous. Overall, there are more consistently dense fiber bundles in patients with favorable outcome, with a noticeable difference in limbic fibers.

Limitations

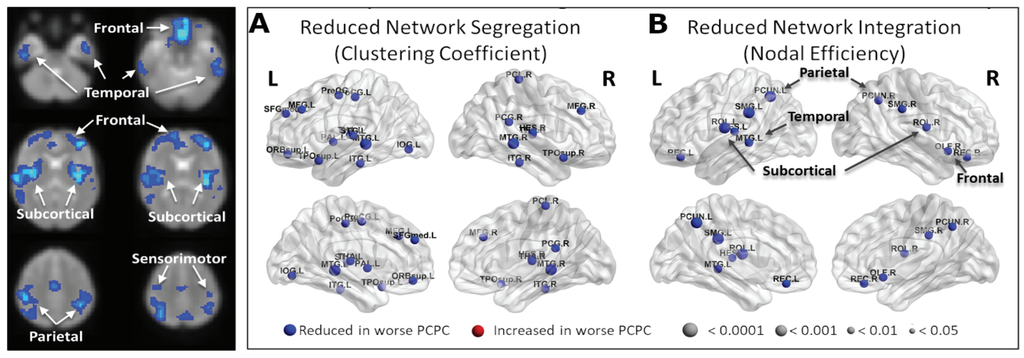


DTI Results



Dichotomized distribution of mean and standard deviation of normalized diffusion metrics for each tract of interest. Each measure quantitates how each individual tract diffusivity is proportionally above or below the whole brain tractography value. * = $p < 0.05$,** = $p < 0.01$

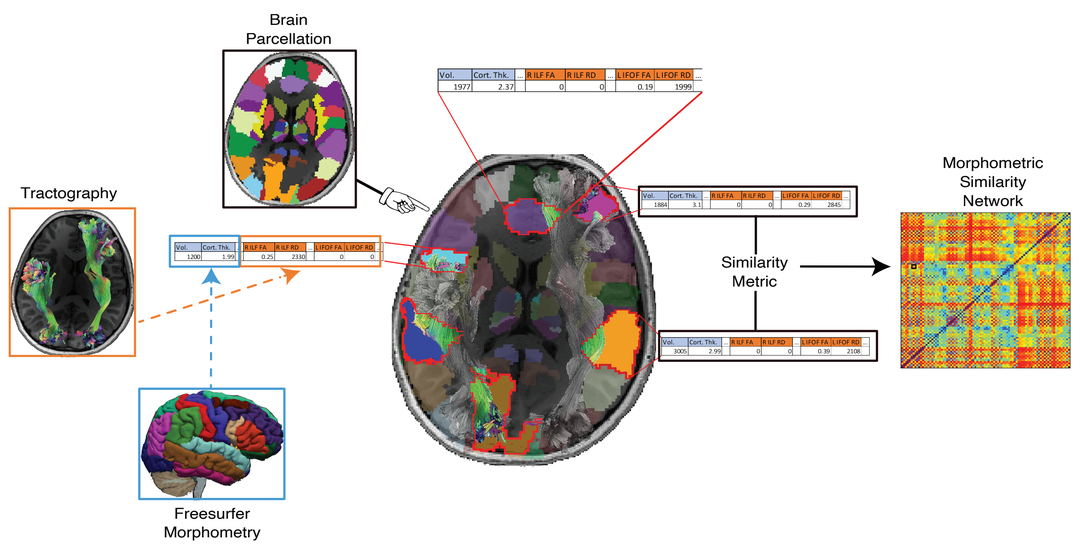
fMRI Results



Unfavorable outcome was correlated regionally with decreased FCS in the default mode network. 3-D glass brain representation showing A) decreased clustering coefficient and B) decreased nodal efficiency in the unfavorable outcome cohort compared to the favorable cohort.

Future Directions

Work is underway recruiting more patients to repeat these studies. Later, to merge fMRI and DTI images in the same anatomical space, we will use Morphometric Similarity Networks (MSNs). We also plan to develop a publically available pipeline that automates MSN development.



Acknowledgements

A paper detailing this work has been submitted for publication. News of its acceptance and access will be uploaded to our PIRC website! Take a look! This project was supported by National Library of Medicine (5T15-LM007059-3 [to J.R.]).

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