

Effects of craniosynostosis on cerebral blood flow

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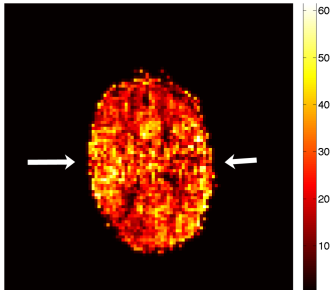
Introduction

Craniosynostosis presents in infancy, when it is treated with surgery to normalize the shape of the cranial vault. Left untreated, it can result in restricted brain growth, disfigurement, and neurological complications, and is associated with elevated intracranial pressure (ICP) [1]. Although ICP elevations can restrict cerebral blood flow (CBF) by decreasing cerebral perfusion pressure, the behavior of CBF is not well understood in these patients. Arterial spin labeling (ASL) allows determination of CBF without requiring either invasive procedures or ionizing radiation.

Methods

We acquired MRI data in five children with non-syndromic craniosynostosis, with ages from 3 weeks to 9 years on a Siemens Trio 3T MRI scanner (Siemens Healthcare, Erlangen, Germany). High resolution (0.9 mm³ isotropic voxels) T1-weighted images were acquired with an MPRAGE sequence. ASL data was acquired using a pseudocontinuous ASL sequence [2] with acquisition parameters: TE/TR = 29/4000 ms, acquisition matrix = 96 x 96, FOV = 22 cm, slice thickness = 5 mm, number of measurements = 40 label/control pairs.

CBF maps were created using MATLAB (Mathworks, Natick, MA). Segmentation or partial volume correction was not performed due to poor gray matter/white matter contrast due to the young age of the participants. Regions of interest were drawn for CBF measurement in brain regions adjacent to the skull defect. In addition, control regions were determined: a contralateral region was used if possible, but for bilateral compressions an unaffected region in the same cerebral lobe was used.



Results

In all subjects, focal hyperemia was observed in regions of brain tissue that were restricted by craniosynostosis (Fig). The average CBF in hyperemic regions was 27 mL/min/100g, while the average CBF unaffected regions was 19 mL/min/100g ($p < 0.05$).

Discussion

Craniosynostosis has localized effects on CBF in the area being pressed by the skull. The measured CBF was significantly higher in the compressed regions than in the control regions, which may represent increased cerebral metabolism in these regions. Alternatively, because the data was not corrected for partial volume effects, the CBF increase may represent an increase in brain tissue in each voxel due to a reduction in CSF volume around the growth restriction.

References

- [1] D Marchac, et al. *Plast Reconstr Surg.*, 122(6):1827-1838. 2008.
- [2] D Garcia, et al. *Proc Intl Soc Mag Reson Med*, 2005