Optical Coherence Tomography Can Detect Intracranial Hypertension in Young Children with Craniosynostosis

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Background

Detecting intracranial hypertension (ICH) in children with craniosynostosis may enable timely intervention to prevent neurocognitive impairment, but is invasive and often equivocal with conventional methods. Optical coherence tomography (OCT) can noninvasively quantify retinal thickness using high-resolution ultrasound. We study whether OCT can reliably measure retinal thickness in children with craniosynostosis, and whether findings correlate with intracranial hypertension.

Methods

Children with craniosynostosis were prospectively evaluated with OCT immediately before cranial vault expansion and again at any later operative procedures. Negative control (without cranial pathology) and positive control patients (with known ICH) were similarly evaluated. When indicated by the neurosurgical team, patients underwent direct intracranial pressure (ICP) measurement.

Results

Sixty-six retinas in 33 children with craniosynostosis underwent OCT prior to cranial vault remodeling, at a median age of 9.6 months (range 3 months-13 years.) ICP was directly measured in 12 patients. An additional 16 retinas were evaluated in 6 negative and 2 positive control patients. We determined that anterior retinal deviation and retinal nerve fiber layer (RNFL) thickness were both significantly associated with elevated ICP (each $p<0.001$). Increasing RNFL thickness was also associated with increasing patient age ($p=0.003$), although when controlling for age in a multivariate analysis, increasing RNFL thickness was still independently associated with increasing ICP ($p<0.001$). All patients treated under 1 year of age exhibited ICP below 15mmHg, which we considered the upper limit of normal, whereas 63% of older patients had elevated ICP ($p = 0.04$.) After craniectomy, ICP decreased by a mean 9.9mmHg ($p<0.0001$). Patients without ICH had maximum RNFL thickness of 80μ; setting this as the high normal cutoff point yielded 77% sensitivity and 100% specificity. When this test was applied to our craniosynostosis cohort, 6 (18%) showed evidence of ICH. Preoperative diagnosis of papilledema was only 50% sensitive for retinal thickening on OCT.

Conclusion

Optical coherence tomography can objectively identify retinal thickening in young children with craniosynostosis, and may enable earlier detection of ICH.