Assessing Macular Findings in Infants Screened for Retinopathy of Prematurity with Spectral-Domain-Optical Coherence Tomography

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Summary

Adults and children with a history of retinopathy of prematurity (ROP) have highly variable visual acuity despite a normal appearing macula on clinical exam. Optical coherence tomography (OCT) has proven a useful modality to identify potential subclinical, macular anatomic changes that lead to these outcomes. Studies have shown that patients with a history of ROP have an abnormal foveal preservation, preservation of multiple inner retinal layers within the fovea, and increased central retinal thickness.1-2

Handheld devices facilitate OCT imaging of infants with and without sedation, and have provided new insights into ROP and retinal development.1 OCT images, of which four participants have ROP have shown retinohypoplasia, pre-retinal structures, and retinal detachments not seen on clinical exam.1-2 Interestingly, reports have shown the presence of cystoid macular edema (CME) in both infants with ROP and perceived normal infants.3 These findings have important implications for defining “normal development,” as well as management and treatment of neonatal and pediatric patients.

1 Handheld SD-OCT imaging

Forty-two subjects were imaged using Biopiren Hand Held Probe SD-OCT (HID-EDDCT) (Biopiren, Research Triangle Park, NC). Subjects ranged in age from 33 to 58 weeks postmenstrual age (Wk PMA). Over hundred twenty-three imaging sessions were performed in the NICU at Children’s Hospital of Wisconsin. Informed consent was obtained from the parent/legal guardian of each subject. A plotters dipped in “sweet-ease” sucrose solution was used to help calm the infants imaged in the NICU. Consistent with some reports,1 data depaturing from others, a lid speculum was used for imaging after ROP examination. Shown here are images of the system used during imaging and a sample dataset obtained.

2 Grading Neonatal SD-OCT Images

We included images in which the entire foveal region was visible, and image quality was sufficient for three graders to assess the presence of inner retinal layers and CME. Shown are OCT images illustrating the different severities of CME detectable with OCT.

Images were graded for presence of inner retinal layers at the foveal center. Some individuals exhibited complete excavation with no retinal nerve fiber layer (1 layer present), while other subjects also had the inner plexiform layer (2 layers). Less developed retina had residual ganglion cell layer (3 layers) and one subject had retinal nerve fiber layer present at the foveal center (4 layers).

Continued observation of CME after discharge from the NICU was not found to be clinically significant. However, two subjects returned and multiple inner retinal layers were acquired. Shown are images of ROP and retinal phenomena from a subject (DC_0845), taken at two time points roughly three months apart. The OCT images of CME present, but fully resolved with observation without intervention. This observation is consistent with other reports.4-5 Whether this is the trend for CME in the images presented can yet to be determined.

3 Repeatability of Neonatal Imaging

To ensure tracking of development and disease progression, repeatability must be ensured. Repeatability is difficult in a neonatal population due to the subjects’ inability to focus and peer cooperation. It is however, a surmountable challenge. Three examples of repeated imaging are shown below.

4 Resolution of Cystoid Macular Edema

It has long been appreciated that biologic nasal cast shadows through the retinal layers. However, other shadows have been observed while imaging a number of subjects in the NICU. We believe these shadows are an artifact caused by interference between the subject’s crying and the resonant frequency of the OCT scanner.

5 Artifacts Observed in Pediatric Imaging

A larger study population is needed to evaluate this further. In addition, longer follow-up is needed to determine if and when CME resolves, and its effect on visual outcome.

References

1. Hand-held SD-OCT imaging is a viable technique for evaluating subclinical macular findings in premature infants, though much larger datasets are needed from multiple centers to develop a better understanding of what is “normal” and what truly represents subclinical pathology.

2. Consistent with previous reports,1 subclinical CME is seen in premature infants; moreover, CME does not appear to be correlated with ROP stage. This suggests that there may be other strategies for the CME seen in this patient population. It is possible that concurrent systemic diseases may account for this phenomenon. Continued observation of CME is important as intervention may be required for treatment. Subjects were placed in the CME group if the graders identified CME in any images from the subject.

6 Conclusions

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