# Macular OCT characteristics in a cohort of preterm infants



# Cynthia A Toth

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1. I will discuss investigational pediatric SSOCT systems

2. All use of investigational devices in human subjects was with prior consent and under IRB approved protocols.



# Summary

- OCT is an alternative method of analyzing neurovascular retina in ROP
- First report of the full BabySTEPS 36 week data in infants screened for ROP
  - Macular edema severity is associated with ROP Stage but not pre-Plus/Plus disease
  - Choroidal thickness is associated with pre-Plus/Plus disease but not ROP Stage
- Different retinal and choroidal thickness response to ROP may reflect their different location relative to the blood-eye barrier

Retinal Vessel Shadow View



**Retinal Thickness** 



3-D view of Neovascularization





# To improve preterm infant health care via novel bedside ocular neurovascular imaging

# AND

Characterize from imaging, the early indicators of ROP, poor vision and neurological development

# FOR FUTURE USE

to determine disease and development and monitor response to treatment.

# 65% of infants in Early Treatment of ROP Study had subnormal visual acuity at school age



- 50-70% of VPT infants worldwide develop significant neurodevelopmental impairment
- ROP may represent only one striking vascular aspect in a continuum of delayed, diseased and abnormal neurovascular development of the brain and retina



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Characterize from imaging, the early indicators of ROP, poor vision and poor brain/neurological development

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# Site:Duke Intensive Care Nursery and Duke Regional NurseryStudy Design:Prospective, longitudinal, observational study in preterm infantsInclusion Criteria:≤1500 g birthweight or ≤30 weeks gestational age; eligible for ROP screening



#### Data collection and work flow





### BabySTEPS cohort





## Demographics of the study cohort

Demographic information	Preterm N=85
Gestational Age (wks), mean (SD)	28 (2)
Birth Weight (gm), mean (SD)	976 (269)
Age at imaging for cross-sectional analysis (wks, PMA), mean(SD)	36 (0.6)
Sex, n (%)	
Male	43 (51)
Race, n (%)	
African-American	38 (45)
Caucasian	5 (6)
Asian	3 (3)
More than one	39 (46)
Ethnicity, n (%)	
Hispanic	7 (8)
Non-Hispanic	78 (92)



	OD N=84* (%)	OS N=85 (%)
ROP stage at the time of imaging		
Stage 0	47 (56)	48 (57)
Stage 1	14 (17)	15 (18)
Stage 2	22 (26)	20 (23)
Stage 3	1 (1)	2 (2)
Plus disease at the time of imaging		
None	80 (95)	80 (94)
Pre-Plus	1 (1)	4 (5)
Plus	3 (4)	1 (1)
ROP Zone at the time of imaging		
Zone I	8 (10)	9 (11)
Zone II	57 (68)	58 (68)
Zone III	16 (19)	15 (18)
Fully Vascularized	3 (4)	3 (3)
Subsequent ROP Therapy**		
Bevacizumab & laser	4 (5)	5 (6)
Laser	3 (3)	3 (3)
No Therapy	77 (92)	77 (91)



\*One eye of one infant excluded for analysis due to early treatment for ROP

### **Evolution of Infant OCT Imaging**



Duke investigational SSOCT hand-held devices (compact, lighter & high-speed)

OCT hand-piece does not contact the eye Near infrared light is comfortable to view Pupil dilation is not mandatory

Scott AW et al AJO 2009 Chong GT et al Arch Ophthalmol 2009 Chavala SH et al Ophthalmol 2009 Maldonado RS, et al IOVS 2010 Tran-Viet et al Retina 2017 Viehland et al BOE 2019

# BabySTEPS novel image data

# OCT is an alternative method for imaging and analyzing neurovascular retina in infants with ROP

We extracted thickness data from the eyes at 36 weeks PMA



Conventional Exam or Photograph





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Seely et al, TVST 2020 in press

Retinal Vessel Shadow View

#### Retinal Thickness

Mangalesh et al, Graefes Arch Clin Exp Ophthalmol 2019



# Foveal OCT was successfully captured in both eyes for all 85 infant OCT imaging sessions.

# Quality of OCT volumes of the fovea:

# n = 129 eyes

- Excellent = 19%
- Acceptable = 67%
- Poor (but useful for some grading) = 14%
- Unusable = 0%



Qualitative & Quantitative OCT image analysis



#### **Qualitative OCT features:**

- Vitreous pathologies: Opacities, clumps, foci
- Macular edema: Presence and severity
- Severity of edema: Mild, Moderate, Severe
- Photoreceptor development: ELM & EZ presence
- Retinoschisis & retinal detachment

#### Layer Thicknesses at fovea and across foveal center (DOCTRAP Program)

- Retinal thickness
- RNFL+ GCL+IPL
- Inner nuclear layer
- Outer retina
- > Choroid

# Macular Edema in infants at 36±1 week PMA





# Association between retinal layer thickness at foveal center and ROP stage



Retinal thickness, RNFL+GCL+IPL, INL and outer retinal thicknesses were associated with ROP stage **but not with plus disease** 



### Association between choroidal thinning & Plus disease





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Analysis of Retinal Microanatomy in Retinopathy of Prematurity to Improve Care: Study of eye-brain development in preterm infants (Baby STEPS) Group



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