Resident and Fellow Research Day 2023

Department of Ophthalmology and Visual Sciences
University of Iowa, Carver College of Medicine

Session I

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Session IV

Session I – Paper 1

Caroline Y. Yu MD | *Putting a Lid on Dry Eye*

Primary Supervisor: Erin M. Shriver, MD
Co-authors: Chau M. Pham MD, Keith Carter MD, Erin M. Shriver MD

Purpose: To understand the impact of eyelid malposition and eyelid surgery on dry eye disease.

Methods: An IRB-approved retrospective review was conducted of Veterans Affairs patients age 18 or older seen between January 1, 2022 and January 1, 2023. Inclusion criteria were patients who underwent an eyelid or eyebrow procedure and had preoperative meibomian gland imaging. Data collected included demographic information, type of procedure undergone, margin to reflex distances (MRD1/2), tear breakup time (TBUT), and pre- and postoperative Standard Patient Evaluation of Eye Dryness Questionnaire (SPEED) scores. LipiView® ocular surface interferometer imaging was also analyzed, including tear lipid layer thickness (LLT). Postoperative data, when available, was also included in the analysis.

Results: Of the 44 patients who met the inclusion criteria, the average age was 71.5 years old (range 45 to 86), and 95.3% of patients were male. Preoperative diagnoses included upper eyelid ptosis (54.5%), dermatochalasis (86.4%), brow ptosis (75%), and lower eyelid ectropion (18.2%). Of the patients with upper eyelid or brow malpositions, higher MRD1 was negatively correlated with SPEED score (r= -0.17), and positively with TBUT (r=0.41) and LLT (r=0.40). When comparing all pre and post operative data, there was an overall average decrease in SPEED score of 1.56 points (p=0.29). Notably, patients who underwent upper eyelid ptosis correction had an average decrease in SPEED score by 4.09 (p=0.03) while those who underwent brow and/or dermatochalasis repair did not have a significant change in SPEED score (p=0.86). In one case of bilateral ptosis correction, the patient experienced an increase in LLT from 68 nm to 90 nm and decrease in SPEED score from 16 to 0.

Conclusions: Ptosis was associated with greater objective and subjective signs of dry eye disease, including higher SPEED score, more rapid TBUT, and thinner LLT. Surgical correction of upper eyelid ptosis corresponded to decreased dry eye symptoms as well improved LLT.

Douglas Jin, MD | *Randomized Controlled Study of Cooled versus Room-Temperature Artificial Tears for Reducing Ocular Surface Irritation Following Intravitreal Injection*

Primary Supervisor: Jonathan F. Russell, MD, PhD
Co-authors: Smrithi Mani, BA; Bryce Shonka, BS; Christopher R. Fortenbach MD, PhD

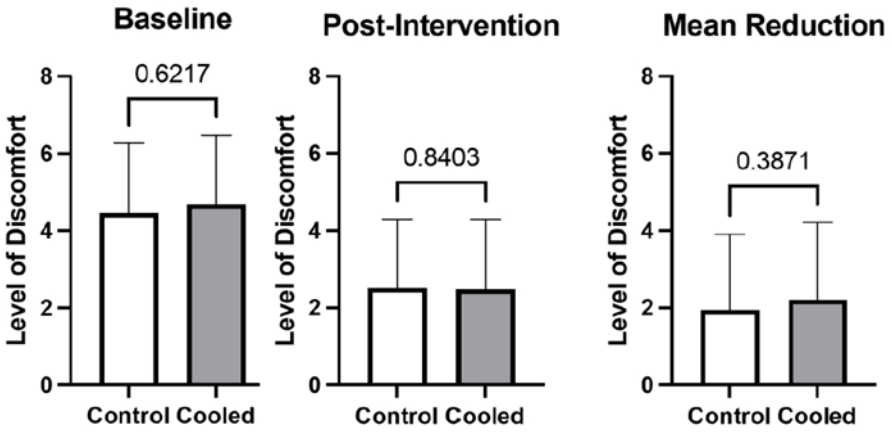
Purpose: To evaluate the efficacy of cooled versus room temperature artificial tears in reducing post intravitreal injection ocular discomfort.

Methods: Patients receiving a standard intravitreal injection in the retina clinic who met eligibility criteria were consented and enrolled in the study. Patients (n=109) were randomized to either cooled (n=48) or room temperature tears (n=61) interventions. Both groups rated their ocular discomfort level following intravitreal injections after administration of cooled or room temperature tears.

Results: No significant difference in the reduction of ocular discomfort following administration of cooled versus room temperature artificial tears was observed (p=0.387). Additionally, there was a similar level of reduction in ocular discomfort following current intervention (p=0.681) regardless of whether the patients routinely used artificial tears after previous injections.

Conclusions: Cooled tears provided no additional benefit in reducing ocular discomfort post-injections compared to room temperature tears. Baseline tear usage following intravitreal injection may have no true benefit outside potential placebo effect and/or recall.

Figure 1. Ocular Discomfort after Intravitreal Injection (IVI) in the Cooled vs. Room Temperature Artificial Tears Groups



Session I – Paper 3

Bilal Ahmed, MD | *Assessment of a Mobile Microsuturing Station for Surgical Skill Development*

Primary Supervisor: Jaclyn M. Haugsdal, MD
Co-authors: Mark A. Greiner, MD; Chris S. Sales, MD

Purpose: To evaluate the potential of microsurgical skills advancement with the use of a mobile surgical dry lab.

Methods: First year (PGY-2) and third year residents (PGY-4) were split into an experimental group in which they were given a mobile surgical microscope and supplies for a 10-week period during the cornea rotation. The control groups for each of these respective experimental groups were the first-year and third-year residents who had 24-hour access to a wet lab at the Iowa City VA for their respective 10-week rotation. All trainees underwent an introductory session at the beginning of the 10-week period where they were independently recorded while performing a single corneal suture in a model eye. At the end of the 10-week rotation, the residents were recorded to evaluate their surgical progress. The videos have been de-identified and are to be evaluated with a numeric rubric by an anterior segment surgeon. A survey for the residents with the mobile microscope was conducted at the end of the 10-week period.

Results: Preliminary survey-based data shows that, of those who completed the survey, all of the respondents strongly agree the mobile microsurgical kit and curriculum is beneficial. In addition, all of the respondents have thus far indicated that they strongly agree access to a microsurgical kit motivated them to practice their surgical skills independently and that implementing the microsurgical kit on other rotations would be beneficial. All respondents reported they spent more time independently practicing their surgical skills compared to other rotations and they were more likely to practice their surgical skills independently with the addition of a mobile microscope. Residents spent an average of 2-3 hours per week practicing with the mobile microsurgical kit. Complex equipment set up was noted as the limiting factor which contributed negatively to using the mobile microscope for independent surgical skills development.

Conclusions: Preliminary survey-based data from this study is encouraging regarding the resident experience using the mobile microsurgical station for independent surgical skills development. While more objective data regarding the degree of skills improvement is still being collected, this is an encouraging phase of our study.

Session I – Paper 4

Zachary Mortensen, MD, MBA and Tirth Shah, MD | *Resident Performed Versus Faculty Performed Cataract Surgery with Toric Intraocular Lens (IOL) Placement: Outcomes and Patient Preferences*

Primary Supervisor: Thomas A. Oetting, MD
Co-author: Wisam Najdawi

Purpose: To report patient preferences, refractive and complication outcomes of resident performed versus faculty performed cataract surgery at the University of Iowa.

Methods: We conducted a retrospective review of patients undergoing cataract surgery with placement of a toric IOL at the University of Iowa from 1/24/20-3/14/23. Preoperative visual acuity, refractive error, and corneal astigmatism, postoperative visual acuity and residual astigmatism, and complications were gathered. Patients were given the choice of cataract surgery to be performed by a resident or by a faculty. In addition to routine monofocal non-toric options, eligible patients were informed that toric IOLs were not covered by insurance and there would be a premium charge if faculty performed, but there would be no such extra charge if performed by a resident. Surgeries were performed by residents in their final year of training with a faculty assisting.

Results: A total of 142 resident toric IOLs were placed and 22 faculty toric IOLs were placed. 86.5% (142/164) patients elected to have a resident perform the surgery. The mean preoperative corneal cylindrical power was 1.81 D in the resident cohort and 1.82 D in the faculty cohort. The mean postoperative cylindrical power was 0.55 D for resident performed surgeries and 0.54 D for the faculty performed surgeries (p-value <0.05). The mean uncorrected postoperative visual acuity (logMAR) was 0.22 for residents and 0.20 for faculty (p-value <0.05). There were no reported complications of posterior capsular tear, endophthalmitis, or TASS in either group. One IOL was rotated after surgery in the resident performed group (but this was placed and held at the correct axis that the preoperative IOL Master recommended). Zero faculty performed patients returned for postoperative IOL rotation. An average of $923 was the out-of-pocket charge when faculty performed the case.

Conclusion: Patients largely elected to have a resident perform their toric cataract surgery when no premium charge was required. There was no significant difference in complications or postoperative refractive results in toric cataract surgeries performed by residents versus faculty.

Session I – Paper 5

Aaron D. Dotson, MD | *Comparison of Endothelial Cell Loss Between Standard of Care and Prototype Endothelial–In DMEK Device*

Primary Supervisor: Christopher Sales, MD
Co-Authors: Greg Schmidt, Noah Healy, MS

Purpose: The current standard of care (SOC) for DMEK surgery in complex eyes (e.g. eyes that have an ACIOL or history of vitreoretinal or glaucoma surgeries) is to implant preloaded endothelial-in DMEK tissue with an Endoglide (Coronet, UK). The Endoglide passes through a 2.6 mm corneal incision and utilizes a bimanual pull-through technique with an anterior chamber maintainer and micro-forceps. The Iowa Eye Device Lab has developed a prototype device that fits through a 2.2 mm corneal incision, does not require an anterior chamber maintainer, and utilizes a one-handed injection technique. This prospective laboratory study compared the endothelial cell loss (ECL) of the SOC device to the prototype device.

Methods: Research consent was obtained for all corneal tissue used in this study. Pairs of corneas were processed using the standard Iowa Lions Eye Bank DMEK processing protocol by an experienced eye bank technician; right-sided corneas were loaded with micro-forceps into the SOC endothelial-in device; left-sided corneas were loaded with micro-forceps into a prototype endothelial-in device (GS). Preloaded DMEK tissues were stored in Optisol-GS and refrigerated at 4*C. Tissues were unfurled on a bed of hyaluronic acid supplemented with 2.5% ug/mL calcein AM for vital dye staining within 24h of preloading; one image per graft was captured with a fluorescent inverted light microscope to quantify ECL (AD). Images were analyzed using FIJI and Trainable Weka Segmentation (NH). The study was powered to detect a 10% difference in ECL with a confidence level of 90% and an alpha of 0.05. 10% was determined to be the clinically significant threshold for surgical decision-making. An ECL of 15 +/- 5% is the published benchmark for the SOC device using the same calcein-AM assay and was referenced in these calculations (PMID 31996538). Four pairs of corneas were studied; a fifth pair was studied to account for possible learning-curve effects and the first pair was excluded. Paired T-tests were used to compare means.

Results: The average age of the tissues was 65.75 years, and the average death-to-use interval was 4.5 days; 50% were from female donors; 100% were from Caucasian donors. Mean baseline endothelial cell density of the tissues was 2113.75 cells/mm2. There was no statistically significant difference in ECL between the SOC and prototype devices (Endoglide vs. Iowa Prototype: 28.16 +/- 20.99% vs. 29.95 +/- 12.66%, p=0.77). Qualitatively, tissues in the SOC group exhibited more prominent forceps trauma from the surgeon, but otherwise there were no other distinguishing patterns between the groups. The Iowa prototype was easier to load by the eye bank and easier to use by the surgeon.

Conclusions: Our results show no significant difference in ECL between the Iowa prototype tissue injector and the SOC device for endothelial-in DMEK. Smaller corneal incisions may not increase ECL in endothelial-in DMEK. However, the ECL of both devices in our study is almost two times what has been reported for the SOC device by its designers. Further study is needed to verify the results of this study and to simulate transplant surgery with the prototype device in a human cadaveric eye.

Emily Witsberger, MD | *Custom 3-D Scanned Scleral Contact Lens in Pediatric Patients: Primary Indications, Visual Outcomes, and Complications*

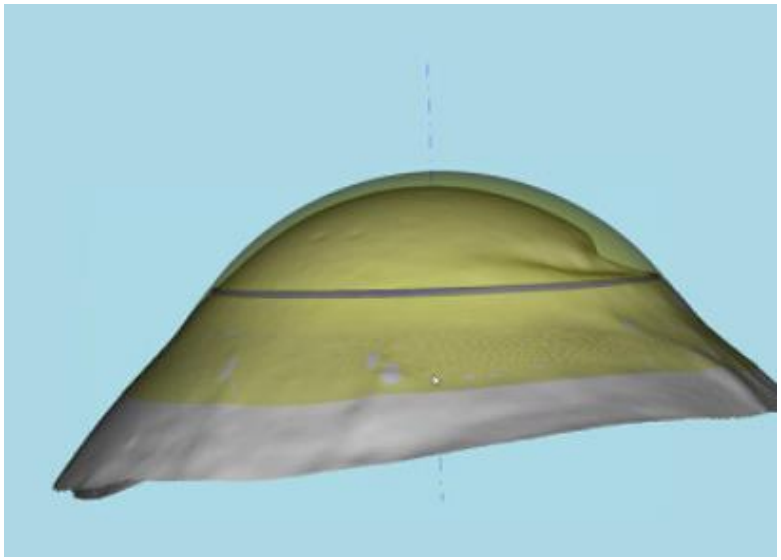
Primary Supervisors: Christine Sindt, OD; Mark Greiner, MD
Co-author: Joanna Silverman, MD

Purpose: Scleral contact lenses (SCLs) are an effective means of treating a variety of ocular surface diseases but have traditionally been underutilized in the pediatric patient population. Our study assesses outcomes in pediatric patients fitted with 3-D scanned SCLs using the streamlined EyePrint impression process.

Methods: All patients under age 18 years at a single center fitted with EyePrint SCLs between December 2020 and February 2023 were identified by retrospective chart review. Best corrected visual acuity (BCVA) at all visits and any complication associated with SCL use were noted for duration of SCL use as primary outcomes.

Results: 32 eyes from 24 patients (59% female) were followed for a median of 15.7 months (IQR 8.4-25.6). Primary indications included neurotrophic keratitis (34%), corneal scarring (25%), and irregular corneal shape (22%). Mean BCVA improved by 1.20 +0.13 logMAR (p=0.04). Two (6%) patients developed complications though these resolved. No device cessation occurred during the study period.

Conclusions: Single visit fit EyePrint custom SCLs can reduce barriers to pediatric use, and we report outcomes in this unique patient population. Our study suggests that these lenses are well tolerated and low risk across a variety of indications.



Session II – Paper 7

Tina Hendricks, MD, MSC | *Wide Intraocular Pressure Fluctuation and Drop in Ocular Perfusion Pressure in Glaucoma Patients Undergoing Hemodialysis*

Primary Supervisor: Erin Boese, MD

Purpose: Significant fluid shifts are known to occur with hemodialysis, yet prior research has not found significant changes in intraocular pressure (IOP) during hemodialysis sessions, and the effects of hemodialysis on IOP and ocular perfusion pressure (OPP) in patients specifically with glaucoma have not been studied. Given the compromised trabecular meshwork, it is postulated that glaucoma patients may be more affected by intraocular fluid shifts than patients without a history of glaucoma. The aim of this study is to evaluate the relationship between hemodialysis and IOP and OPP changes in patients with and without glaucoma.

Methods: This is a prospective study that included 105 eyes of 54 patients undergoing hemodialysis at UHIC hospital and satellite clinics. Eleven patients (19 eyes) had a diagnosis of glaucoma, glaucoma suspect, or ocular hypertension. Past medical and ocular history were obtained from chart review, and a basic eye exam consisting of measuring IOP (tonopen), CCT (pachymetry), and AC depth (slit lamp) was performed on each patient at the beginning, middle, and end of dialysis. Blood pressure (BP) readings corresponding closest to the IOP measurements were collected at each time point. Ocular perfusion pressure (OPP) was calculated by OPP = 2/3[diastolic BP + 1/3 (systolic BP – diastolic BP)] – IOP.

Results: The average age of all subjects was 61.8 years, and 47.3% were women. There were more females and black individuals in the glaucoma group compared to the control group. Calculations were based on the change during the dialysis session, namely for two differences: middle-before and end-before. Although the mean IOP change was minimal and similar between patients with glaucoma (1.7±7.8 mmHg, range -9 to 25 mmHg) and without (0.7±3.8mmHg, range -7.3 to 11.3 mmHg), the absolute change in IOP was significantly higher in the group with glaucoma when looking at the end-beginning change ($p<0.049$). When looking at the breakdown of IOP swings, more glaucoma eyes had an increase in IOP of more than 10mmHg during the dialysis session (4 total, 28%), and one eye had an IOP increase of more than 25mmHg. Ocular perfusion pressure (OPP) was also significantly different between the groups with glaucoma patients having a more significant drop in OPP at both middle and end time points (middle-before, $p=0.006$; end-before, $p=0.009$).

Conclusions: Patients with glaucoma are more likely to have a larger fluctuation in IOP with hemodialysis sessions, with four patients having asymptomatic IOP spikes to potentially damaging levels. This is thought to be due to fluid shifts into an eye with an otherwise compromised trabecular meshwork. The significant drop in OPP in glaucoma patients compared to controls is also concerning for glaucomatous progression, with lower OPPs corresponding with progression of glaucoma independent of IOP, putting these patients in a particularly vulnerable state with the additional factor of fluctuating blood pressure. Given the IOP and OPP results, hemodialysis may be a risk factor for glaucomatous progression, and these patients may need to have close follow up. Further study is required to determine which glaucoma patients are most at risk for developing an IOP spike during hemodialysis, and whether incisional surgery or dialysis parameters can help to blunt these changes.

Session II – Paper 8

Sean Rivera, MD | *The Effect of Masks on Intraocular Pressure Measurement*

Primary Supervisor: Erin Boese, MD
Co-Authors: Aditya Somisetty, BA, Kai Wang, PhD

Purpose: To quantify the effect of wearing face masks on intraocular pressure (IOP) measurement with Goldmann applanation tonometry (GAT).

Methods: Patients 18 years of age and older were recruited from the UIHC glaucoma department and were excluded with history of ocular surgery within the past 3 months, monocular status, difficulty with IOP measurement, diagnosed COVID-19 within 30 days or active symptoms of upper respiratory infection. IOP was measured using GAT and no mask as a control. The IOP was measured again with a surgical mask, KN95 and 3M trifold N95.

Results: Forty eyes of 20 patients were examined and included in the final analysis. The mean IOP was similar between the groups (15.0 mmHg no mask, 15.4 mmHg surgical mask, 15.9 mmHg KN95, 16.8 mmHg N95, standard deviation 3.85, 4.08, 4.10, 4.24, respectively). A paired non-parametric test was performed to assess the difference between the various mask types and the control. There was a statically significant difference between IOP measured with all mask types and the control (P=0.013, 0.000034, 0.0000071 for surgical mask, KN95 and N95, respectively). Although there was a statistically significant change for all groups, no patients in the surgical mask group had a change in IOP ≥ 3 mmHg, while 3 patients in the KN95 group and 7 in the N95 group did have a change of ≥ 3mmHg, which is the test-retest variability for GAT.

Conclusions: Face masks do affect IOP measurement with GAT, although this is not clinically significant in most cases. Both KN95 and N95 masks have the potential to produce IOP measurement artifact that could influence clinical decision making. We, therefore, recommend no mask or the use of a surgical mask when measuring IOP.

Session II – Paper 9

Mahsaw Mansoor, MD | *Accuracy of Pre-operative Echography in Predicting Intraoperative Findings During Pars Plana Vitrectomy for Secondary Repair after Open Globe Injury*

Primary Supervisor: Jonathan F. Russell, MD, PhD

Objective: To compare diagnostic accuracy of B-scan echography with intra-operative findings in eyes treated with pars plana vitrectomy (PPV) for secondary repair after open globe injury (OGI).

Purpose: Eyes with severe OGIs after primary globe closure usually have no view of the fundus and often have complex posterior segment pathology. Decisions regarding whether and how to attempt secondary repair with PPV are influenced by the extent and types of anatomical damage. In this setting, B-scan has been reported to have 100% positive predictive value for diagnosing retinal detachment (RD) and high diagnostic accuracy for other types of pathology. The purpose of the current study was to validate the reported diagnostic accuracy by comparing pre-operative echographic findings with intraoperative observations during PPV.

Methods: This was an IRB-approved, retrospective cohort study of patients that presented with an OGI and underwent globe closure followed by secondary PPV at the University of Iowa from 2018 to 2023. All patients imaged with B-scan after closure but prior to PPV were included. Patients with intraocular foreign body (IOFB) injuries were excluded. All B-scans were reviewed for the presence of vitreous hemorrhage (VH), retinal detachment (RD), retinal tear (RT), vitreoretinal incarceration, or choroidal detachment. The actual presence of these same characteristics was then ascertained using the gold standard of direct inspection during PPV, as detailed in operative reports. Agreement between pre-operative B-scan and intraoperative findings was then analyzed.

Results: Forty eyes from thirty-nine patients with OGI that underwent secondary PPV were identified. Post-closure, pre-PPV B-scan diagnosed 90% (36/40) with VH, 23% (9/40) with RD, none with RT, 3% (1/40) with vitreoretinal incarceration, and 50% (20/40) with hemorrhagic or serous choroidal detachment. Intraoperatively, 90% (36/40) had VH, 58% (23/40) had RD, 63% (25/40) had RTs, 30% (12/40) had vitreoretinal incarceration, and 40% (16/40) had choroidal detachment. When compared with intra-operative findings, B-scan had a 100% sensitivity for VH, 39% sensitivity for RD, 8% sensitivity for vitreoretinal incarceration, and 93% sensitivity for choroidal detachment. In our cohort, B-scan identified none of the twenty-five operatively confirmed retinal tears. In eight of the cases with RTs there was no concomitant RD identified intraoperatively.

Conclusions: In the current study of post-closure OGIs, B-scan was most reliable in diagnosing VH and choroidal detachment. However, there was poor diagnostic accuracy for RD, RT, and vitreoretinal incarceration. Since the presence of these pathologies can lead to severe vision loss without treatment, rather than relying on serial echography there should be a low threshold for prompt secondary PPV with direct inspection.

Session II – Paper 10

Andrew Goldstein, MD | *Non-Accidental Trauma: An Interdepartmental Quality Improvement Project*

Primary Supervisors: Lindsay De Andrade, MD; Pavlina Kemp, MD
Co-author: Roy Zhou, MD

Purpose: Ophthalmology consultations to evaluate for signs of non-accidental trauma (NAT) in pediatric patients have not been well-characterized at the University of Iowa Hospitals and Clinics (UIHC). This quality improvement project is a collaboration with the child protection team (CPT) to collect and evaluate data with the goal of better understanding current outcomes, identifying weaknesses, and modifying processes to improve patient care.

Methods: A retrospective chart review was performed of all completed CPT consultations in 2022 at UIHC. Data collected included the ophthalmology consultation rate, consult urgency, time to dilated fundus exam (DFE), exam positivity for retinal hemorrhages, RetCam photography rate and proper storage, consultation following CPT guidelines, multidisciplinary team (MDT) formation and subpoena rate, and stratification for determination of abuse.

Results: There were 109 unique CPT consultations in 2022, of which ophthalmology was consulted 63 times (57.8%). Most of the consults were requested as stat/now (43, 68.3%) and the mean time to DFE was 15.68 hours (range 0.17 – 71.75, SD 18.80 hours). Ophthalmology consult outcomes included no retinal hemorrhages (48, 76.2%), rare hemorrhages (4, 6.3%), or multilayered hemorrhages (11, 17.5%). Properly stored RetCam photos were identified for 14 of 15 patients with retinal hemorrhages. Ophthalmology was consulted via CPT guidelines 53 out of 63 times (84.1%). Clustering the ultimate CPT suspicion for abuse (low, medium, high) and presence of multilayered retinal hemorrhages (11 total patients) showed 1 patient each with low and medium suspicion, with the remaining 9 patients having a high suspicion for abuse.

Conclusions: These novel data about ophthalmology consultation to evaluate for signs of NAT at UIHC provide an interesting insight into the patients of the CPT. Current interdepartmental work is ongoing as to how best use these data to modify and refine existing ophthalmology consultation guidelines.

Session II – Paper 11

Maggie Strampe, MD | *Prolonged Duration to Full Retinal Vascularization in Infants Diagnosed with Retinopathy of Prematurity*

Primary Supervisors: Alina Dumitrescu, MD; Scott Larson, MD
Co-authors: Jeffrey Kuziel, Joel VandeLune

Purpose: To determine the timing of reaching retinal maturity and the factors that influence this process in premature infants meeting the screening criteria for retinopathy of prematurity (ROP).

Methods: A retrospective chart review of all patients examined for ROP at University of Iowa Hospitals and Clinics between December 13th, 2007, and December 30th, 2020, was conducted. Data collected included: demographics, gestational age and weight at birth, ROP details, age and weight at which full retinal maturity was reached, surgical procedures, ventilation, antibiotic treatment, positive blood cultures, blood transfusions, and central line placement. Incomplete charts were excluded.

Results: 2141 charts were reviewed. Of those, 1971 charts were complete and included in the analysis. The average age for retinal maturity was 44.63 weeks post-conception. 31% of patients developed stage I to III ROP. 3% required at least one laser treatment, and 13% of those patients required a second laser treatment. Four patients (0.2%) received intravitreal bevacizumab injection, and all also underwent laser treatment. Gestational age at retinal maturity was inversely correlated with gestational age at birth ($p=<0.0001$) and was significantly lower in patients with stage I ROP than those with stage II (45.9 versus 49.6 weeks, $p=2.9x10\text{-}7$) or infants who required laser treatment (45.9 versus 48.2 weeks, $p=0.01$). Gestational age at maturity was higher in patients who had undergone at least one surgery (excluding circumcision) during their initial hospitalization (47 weeks versus 43 weeks 5 days, $p=<0.0001$). The mean gestational age at birth for infants in the stage 0 group was significantly higher than those in stage I to III ROP group (29.1 versus 25.8 weeks, $p=6.3x10\text{-}77$). No significant difference was noted in birth weight between the two groups.

Conclusions: The results of this retrospective study suggest that children who have ROP greater than stage 0 will reach retinal maturity at a later gestational age than those who do not. These results also suggest that those who develop disease more severe than stage I, require treatment, or undergo surgery early in life will reach retinal maturity the latest. These findings can help inform both providers and parents of the expected time to reach retinal maturity in premature infants.

Session III – Paper 12

Salma A. Dawoud, MD | *Does Spasmus Nutans Really Exist?*

Primary Supervisor: Arlene V. Drack, MD
Co-author: Alina V. Dumitrescu, MD

Purpose: Spasmus nutans (SN) is considered a benign self-limited disease, however, there are reports of rare, serious SN mimickers. The aim of this study was to identify patients clinically diagnosed with SN and determine if they had an underlying diagnosis identified.

Methods: IRB-approved, retrospective chart review from 1/1/2008 to 1/1/2021 text-searched for SN. Charts with no formal eye exam, or no nystagmus, were excluded.

Results: There were 4019 charts of patients with nystagmus identified. The SN text search identified 63 charts; 44 met the inclusion criteria for this study. Thirty-two of 44 patients (73%) had a final alternate diagnosis including optic nerve disease (7/32), systemic diseases (7/32), inherited retinal disease (6/32), trisomy 21 (4/32), optic pathway glioma (2/32), Chiari malformation (2/32), neurological disease (2/32), and congenital motor nystagmus (2/31). There were 8/44 (18%) patients who had only a partial workup (6) or were lost to follow-up (2). There were 4/44 (9%) patients who had typical spasmus nutans which we defined as normal vision, resolution of nystagmus, and a normal brain MRI. All 4 patients with typical spasmus nutans had other abnormalities including premature birth (3), developmental delay (3), autism (2), strabismus (2), learning disability (1), and congenital heart defect (1).

Conclusions: Most patients presenting with SN-type nystagmus were found to have a pathologic cause after a complete workup (32/44,73%). In this cohort, patients with typical spasmus nutans were noted to have other abnormalities. We propose that shimmering asymmetric nystagmus be renamed “spasmus-nutans-like” and that patients must have a complete workup including eye examination, OCT, ERG, brain MRI, and genetic testing before receiving a diagnosis of spasmus nutans.

Session III – Paper 13

Farzad Jamshidi, MD, PhD | *Choroidal Changes in Horner's Syndrome and Third Nerve Palsy*

Primary Supervisor: Ian Han, MD

Purpose: Current, prevailing dogma is that the choroid, unlike the retinal vasculature, has a relative lack of autoregulation. However, some have suggested that the choroidal blood flow is regulated independently of the ocular perfusion pressure and that this regulation is compromised in pathologic states. Sympathetic and parasympathetic regulation of the choroidal blood flow by the ciliary ganglion and ciliary nerves has been shown in birds and mammals, but the exact mechanisms of regulation in humans remain unknown. Using third nerve palsy and Horner's syndrome as disease models, we investigated the hypothesis that the choroidal thickness is unaffected by autonomic dysregulation.

Methods: This was a single-center, IRB-approved, retrospective study evaluating choroidal changes in patients with third nerve palsy and Horner's syndrome. We identified patients with these diagnoses using an ICD-10 search and analyzed available optical coherence tomography to measure choroidal thickness in the fovea and parafovea at 500-micron intervals (5 measurements per scan). The oculomotor nerve palsy patients were also divided into ischemic vs. aneurysmal subgroups. Exclusion criteria included refractive asymmetry of greater than 1 diopter between the eyes. The average choroidal thickness was then compared between the affected and unaffected eyes, as well as before and after the onset of disease. 95% confidence intervals and Student's t-test were used to compare the affected and unaffected eyes.

Results: There were 30 patients in the third nerve palsy group and 10 patients in the Horner's syndrome group meeting the inclusion criteria as above. Preliminary data showed no statistically significant difference in average choroidal thickness difference (3.3 microns; p=0.4) between the affected vs. unaffected eyes in oculomotor nerve palsy, but there was a wide range (range -30 to 98 microns). Similar findings were seen in Horner's syndrome patients, with no statistically significant difference in mean choroidal thickness (9.6 microns; range -23 to 60 microns). Subgroup analysis of ischemic vs. aneurysmal third nerve palsies trended towards a greater thickness in the aneurysmal subgroups; however, the results were not statistically different.

Conclusions: While we did not observe a statistically significant difference between the eyes in the studied groups, there were individual cases with prominent choroidal thickness asymmetry, as evidenced by the range of differences encountered in each group. Whether these are within the realm of normal variability between eyes, or a result of additional subgroup or confounding pathologies, is to be determined. Future directions include expansion of the cohort as well as assessment of choroidal vasculature (e.g., choroidal vascularity index) as potential indicators of choroidal regulation changes.

Session III – Paper 14

Guneet J. Mann, MBBS, MS | *Bilateral Superior Oblique Palsy - Surgical Planning and Long-Term Outcomes*

Primary supervisor: Alina Dumitrescu, MD
Co-authors: Eli Perez MD, Scott Larson MD

Purpose: Bilateral superior oblique palsies represent a small percentage (0.5-0.7%) of the cases of strabismus. They are not only a diagnostic dilemma but also require careful surgical planning for successful outcomes. The purpose of our study was to evaluate the factors involved in surgical planning and the long term outcomes in patients of bilateral superior oblique palsy.

Method: A retrospective analysis of 59 patients of bilateral fourth nerve palsy, seen in the pediatric ophthalmology clinic of University of Iowa between 1995 and 2023, was done. A careful review of the symptoms, head posture, torsion and sensory motor examination was conducted. Choice of surgery, post operative alignment, degree of oblique muscle action and binocular sensory fusion was analyzed.

Results: 59 charts of patients with bilateral superior oblique palsy, that met the inclusion criteria, were analyzed. There were 33 males and 26 females between the ages of 0.2 to 78 years. Of the patients who could be measured, torsion was present in 65.30%. Abnormal head posture was seen in 42.85%. Horizontal strabismus was present in 96.61% patients with a pattern deviation seen in 68.42% of them. Hypertropia in primary gaze for distance ranged from 0-25 PD. Inferior oblique over action ranged from 0 to +4 and superior oblique under action ranged from -1 to -4. Preoperatively, 56.52% of those who could perform Worth's 4 dot test had fusion.

In our case series, the most frequently performed surgery on the cyclovertical muscles was weakening of the inferior oblique muscle (69.11%), followed by surgery on the superior oblique muscle (30.88%). The least frequently performed surgery was on the vertical recti (10.29%). Post operatively, successful alignment (orthophoria +/- 3 PD) in primary gaze was seen in 63.79% cases. Resolution of symptoms of diplopia was seen in 66.66% of the patients and 67.39 % patients had fusion on Worth's 4 dot test. 25.86% patients underwent repeat surgery.

Conclusion: A careful preoperative assessment, with measurement of misalignment in all cardinal positions of gaze and head tilts, quantification of action of the oblique muscles and patterns is the key to correct diagnosis and management. Surgical planning for successful outcomes is guided by the amount of deviation in primary, superior and inferior gaze, over and under action of the obliques and vertical recti, presence or absence of torsion, A/ V patterns and patient preference of which eye to be operated. It is very important to counsel the patient/ parents about the risk of re surgery.

Adriana C. Rodriguez Leon, MD | *Quantifying the Grimace Response as an Objective Assessment of Photophobia in Migraine and Non-Migraine Patients*

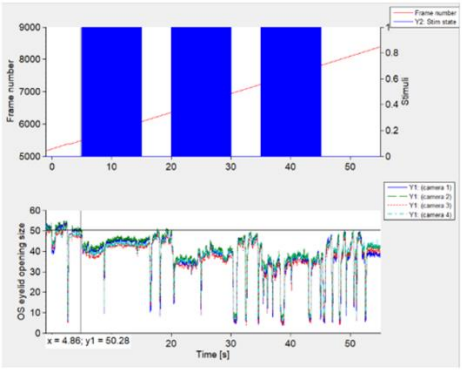
Primary Supervisor: Randy Kardon, MD, PhD
Co-authors: Noor-Us-Sabah Ahmad, MD, Pieter Poolman, PhD

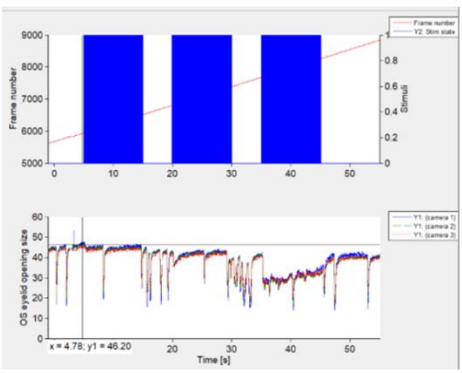
Purpose: Migraine headache is a highly prevalent condition worldwide and presents as a substantially disabling disease. There is a myriad of somatosensory and ancillary symptoms besides pain, that accompany a migraine; photophobia is one of them. Photophobia can be defined as an abnormal sensitivity to light, associated to many ophthalmologic and neurological conditions, but it is also present in the normal population. It is a highly subjective symptom, often difficult to measure by clinicians. The pathophysiology of light sensitivity remains poorly understood. We propose a way to objectively quantify the degree of light sensitivity using video-based facial recognition software.

Methods: Using a stimulus of diffuse LED light at different intensities and duration, we recorded subjects using four infrared video camera viewpoints, and analyzed the dynamics of blinking and the grimace response with facial recognition software (FaceX). We divided our study subjects into five groups: patients with migraine with photophobia currently being treated with first line migraine medications, patients with migraine with photophobia with no treatment, non-migraineurs with photophobia, patients with photophobia without any headache disorder and an age-matched control group.

Results: In patients with photophobia, regardless of migraine status, the degree of eyelid closure during light-induced blinking was more pronounced than in normal subjects, 30% compared to 15% respectively. There was also a higher blinking rate during inter-stimulus intervals in photophobic patients, compared to controls. There was self-reported increased tearing and pain in migraine patients even at the lowest intensity stimulus compared to controls.

Conclusions: We propose an objective and reproducible way to assess photophobia, that can be quantified beyond a patient's subjective experience of a symptom. This tool can be used to assess effectiveness of medical treatment interventions.





1.1 Photophobia w/o migraine **1.2 Control subject**
Top: blue boxes are 10 second duration light stimuli; Bottom: tracings of eyelid movement

Session III – Paper 16

Jamie Keen, MD | *Frequency and Patterns of Hearing Dysfunction in Patients Treated with Teprotumumab*

Primary Supervisors: Keith D. Carter, MD; Chau Pham, MD; Erin M. Shriver, MD
Co-authors: Tatiana Correa, MD, MPH; Alexander D. Claussen, MD; Marlan R. Hansen, MD

Purpose: To better characterize the frequency and patterns of hearing dysfunction in patients who have received teprotumumab to treat thyroid eye disease.

Methods: A retrospective review of patients who underwent audiology testing before and after completion of teprotumumab infusions. Additional mid-treatment audiogram testing was included when available. Hearing function was analyzed using audiogram data measuring threshold hearing levels at specific frequencies. Basic demographic data as well as information regarding otologic symptoms were also obtained and analyzed.

Results: Twenty-three patients (46 ears) were included in the study, with baseline and most recent post-treatment audiology testing ranging from 84 days before to 496 days after treatment. Sixteen patients (32 ears) also had mid-treatment testing starting after the second infusion up until the day of but before the eighth infusion. Post-treatment hearing loss met criteria for ototoxicity in 17 of the 46 ears (37%). The pure tone average (PTA) decibel hearing levels (dB HL) across all 46 ears demonstrated post-treatment hearing loss ($p=0.0089$) specifically at high ($p=0.0011$) and mid frequencies ($p=0.0158$), but not at lower frequencies ($p=0.5138$). Patients who were older were also more likely to experience post-treatment hearing loss ($p=0.0008$).

Conclusions: Audiometric data demonstrates that teprotumumab influences hearing function, most significantly at higher frequencies and in older patients. Audiometric testing is critical for counseling patients regarding teprotumumab treatment. A protocol for monitoring hearing during treatment is needed to detect and manage hearing changes associated with teprotumumab.

Session III – Paper 17

Natasha Gautam MBBS, MS, FRCS | *Laser Speckle Blood Flow Differentiates Acute AAION from NAION*

Primary Supervisor: Randy Kardon MD PhD
Co-Authors: Jui-Kai Wang, PhD, Sophia Chung MD, Matthew J Thurtell MBBS MSc, Julie K Nellis RN

Purpose: Differentiating AAION from NAAION can be challenging, especially when levels of ESR and C-reactive protein are equivocal or elevated by inflammatory, infectious or malignant comorbidities prior to definitive results of temporal artery biopsy. Laser Speckle Flowgraphy (LSFG) provides non-invasive quantification of retinal, choroidal and optic nerve blood flow. This is the first study to critically compare blood flow differences in acute AAION, NAAION and age-matched control subjects using LSFG.

Methods: 11 acute, biopsy-proven AAION patients (12 eyes), 37 acute NAAION patients (38 eyes), and 21 control subjects (21 eyes) were studied by LSFG. A 4-second LSFG video (25 x 20 degrees) was recorded which included the optic nerve, choroid and retina. The average blood flow at each pixel during approximately 4 heart beats was analyzed as a composite color blood flow map. LSFG composite blood flow maps were segmented into superpixels, each associated with a Mean Blur Rate (MBR), corresponding to a blood flow value. The distribution of blood flow was quantified by the percentage of superpixels having blood flow in discrete ranges of flow and displaying them in the blood flow maps. We evaluated which range(s) of blood flow best differentiated AAION from NAION using a receiver operator characteristic (ROC) analysis, evaluating sensitivity and specificity.

Results: There was a significantly higher percentage of pixels with lowest blood flow having MBR<5 (primarily mapping to choroidal blood flow) in the acute AAION group compared to acute NAAION ($p<0.0001$) and control group ($p=0.002$). The percentage of pixels with the highest blood flow having MBR>20 (primarily mapping to retinal vessels) was significantly lower in the acute AAION group compared to acute NAAION ($p=0.005$) and control group ($p<0.0001$). A statistically significant area of 0.969 under the receiver operating characteristic curve (ROC curve) was obtained for the percentage of pixels with MBR<5 for differentiating between Acute AAION and Acute NAION ($p<0.0001$). Biopsy-proven giant cell arteritis patients without ocular involvement had normal neuroretinal rim and peripapillary choroidal blood flow.

Conclusion: LSFG is a promising non-invasive complementary tool for differentiating AAION from NAAION based on blood flow characteristics.

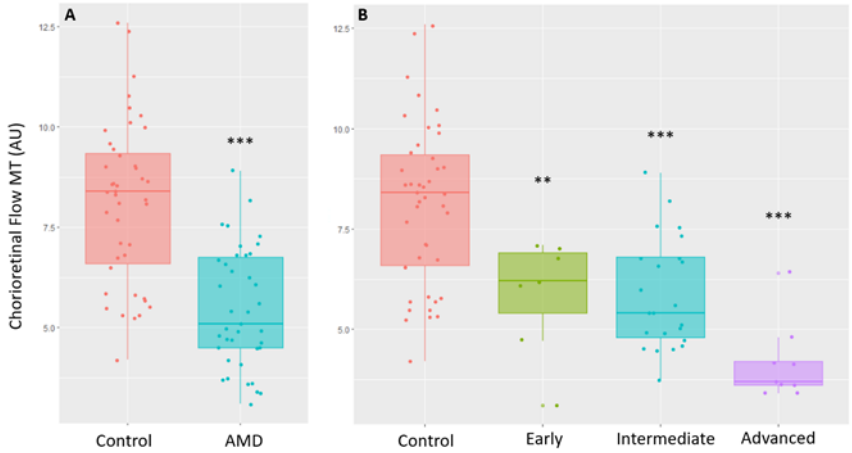
Edward F. Linton, MD | *Laser Speckle Blood Flow Shows Reduced Ocular Blood Flow in Age-related Macular Degeneration*

Primary Supervisors: Randy Kardon MD, PhD and Elliott Sohn, MD
Co-authors: Noor Ahmad, MD, Julie Nellis, RN, Riley Fillister, Jui-Kai Wang, PhD

Purpose: To determine whether eyes with dry age-related macular degeneration have lower blood flow velocity than normal controls using laser speckle flowgraphy. Historical studies have found reduced ophthalmic artery flow, and recent work highlights ultrastructural flow deficits in the choroid and retina.
Methods: Retrospective case-control design. Subjects with non-exudative age-related macular degeneration who had undergone laser speckle flowgraphy were compared to age-matched control subjects. Main outcome measure was the odds ratio for AMD diagnosis given blood flow, controlling for demographic and disease characteristics by logistic regression.

Results: 24 eyes of 24 subjects with AMD and 21 eyes of 21 controls were included. Blood flow was reduced outside the major retinal vessels [5.3±0.3AU vs 7.9±0.5AU, p=0.00005] as well within them [12.5±0.6 vs 15.6±0.5 AU, p=0.004]. Controlling for other subject and eye characteristics, for every one-unit increase in chorioretinal mean blur rate, the odds ratio of AMD diagnosis was 0.36 in our population (95% CI 0.1-0.70, p=0.027). Intermediate and advanced AMD stage were significant predictors of lower blood flow after controlling for other covariates with mixed effects linear regression [intermediate: β -2.5±0.9, p=0.01; advanced: β -4.4±1.0, p=0.0003], and flow in advanced stage was related to choroidal thickness [slope=0.01AU/um, r=0.71, p=0.03] but not in intermediate stage.

Conclusions: Laser speckle flowgraphy suggests that AMD patients have lower ocular blood flow than age-matched controls, with areas of low flow appearing to exceed the territory of manifest pathology.



Mean blur rate in control subjects and cases. Disease status and stage were each a significant predictor of blood flow in the tissues (MT, panel A) by mixed effects linear regression. [MT: Early β = -2.4±0.83, p=0.005; Intermediate β = -2.3±0.55, p=0.0001; Advanced β = -3.87±0.73, p=2.9E-6]. After controlling for age, sex, smoking, diabetes, HTN, HL, BMI, OPP, and refractive error, intermediate and advanced stage remained significant predictors of chorioretinal flow [intermediate: β -2.5±0.9, p=0.01; advanced: β -4.4±1.0, p=0.0003].

Beau J. Fenner, MD, PhD | *Long-term Functional and Structural Outcomes in X-linked Retinoschisis: Implications for Clinical Trials*

Primary Supervisor: Ian Han, MD
Co-authors: Jonathan F. Russell, MD, PhD; Arlene V. Drack, MD; Alina V. Dumitrescu, MD; Elliott H. Sohn, MD; Stephen R. Russell, MD; H. Culver Boldt, MD; Jeaneen L. Andorf; Edwin M. Stone, MD, PhD

Purpose: X-linked retinoschisis (XLRS) is an inherited retinal disease (IRD) caused by pathogenic mutations in the retinoschisin gene, *RS1*. Affected individuals develop separation of the retinal layers, leading to loss of visual acuity (VA). Several XLRS gene therapy trials have been attempted. However, to date, none have met their primary outcomes, and an improved understanding of XLRS natural history and clinical outcomes may better inform future clinical trials. Here, we report the long-term functional and structural outcomes of XLRS and the relevance of *RS1* genotypes to the visual prognosis of affected individuals.

Methods: We conducted a retrospective chart review of patients with X-linked retinoschisis and molecularly confirmed pathogenic *RS1* variants. Clinical and genetic findings were aggregated, and the long-term visual outcomes were assessed.

Results: Fifty-two patients with XLRS from 33 families were included in the study. Median age at symptom onset was 5 (range 0–49) and median follow-up was 5.7 years (range 0.1–56.8). Macular retinoschisis occurred in 103 of 104 eyes (99.0%), while peripheral retinoschisis occurred in 48 of 104 eyes (46.2%), most often in the inferotemporal quadrant (40.4%). Initial and final VA were similar (logMAR 0.498 vs. 0.521; p = 0.203). Fifty of 54 eyes (92.6%) developed detectable outer retinal loss by age 20, and 29 of 66 eyes (43.9%) had focal or diffuse outer retinal atrophy (ORA) by age 40. ORA but not central subfield thickness (CST) was associated with reduced VA. Inter-eye correlation was modest for VA (r-squared = 0.03; p = 0.08) and CST (r-squared = 0.15; p = 0.001). Carbonic anhydrase inhibitor (CAI) use improved CST (p = 0.026), but not VA (p = 0.380). Eight of 104 eyes (7.7%) had XRLS-related retinal detachment (RD) with poorer outcomes compared to eyes without RD (median final VA 0.875 vs. 0.487; p <0.0001). *RS1* null genotypes had greater odds of at least moderate visual impairment (OR 7.81; 95% CI 2.17, 28.10; p = 0.002) which was independent of age at onset, initial CST, initial ORA, or previous RD.

Conclusions: Long-term follow-up of XLRS patients demonstrated relatively stable VA until at least the fourth decade of life, and foveal ORA (but not CST) was associated with reduced VA. There was minimal inter-eye correlation of both VA and CST, suggesting that clinical trials of RS1 gene therapies involving a fellow-eye control might depend upon eye-specific outcome measures. The presence of null RS1 mutations was associated with poorer long-term visual outcomes, indicating a clinically relevant genotype-phenotype correlation in XLRS.

Session IV – Paper 20

Araniko Pandey, MBBS | *Investigating Treatments for Juvenile X-linked Retinoschisis Using Rs1 Knockout Mouse Model*

Primary Supervisor: Arlene Drack, MD
Co-authors: Jacob Thompson, Ying Hsu PhD

Purpose: Juvenile X-linked Retinoschisis (JXLR) causes cystic retinal lesions that reduce vision. A literature review reveals that retinal cysts in RP are improved by intravitreal (IVT) anti-VEGF; in a mouse model of JXLR, caspase 1 was found to be upregulated. We used an Rs1-KO mouse model of JXLR to test the hypotheses that neutralizing mouse VEGF or decreasing caspase 1 ameliorates schisis.

Methods: Four Rs1-KO mice eyes received a single dose of IVT anti-VEGF (1µl, 6.2 µg: InVivoMAb anti-mouse VEGFR-2 aka DC-101); 2 eyes received IVT buffer, and 3 eyes were treatment naïve. Spectral Domain OCT was done before injection and 1, 2, 3, and 4 weeks post injection (PI). An adapted standardized method was used to quantify cyst severity.5 Electroretinogram (ERG) was performed at 5 weeks PI. To test our second hypothesis, we generated double knockout (DKO) mouse model by breeding Rs1-KO mice with Casp1-/- (caspase 1 deficient) mice. We performed ERG and OCT at 2 and 4 months of age.

bIn the IVT anti-VEGF treated Rs1-KO mice there was a trend toward reduced cyst severity at all time points, but without statistical significance. Comparing the DKO vs Rs1-KO mice, there was a trend for lower ERG amplitudes in all testing conditions in the DKO. The difference was statistically significant at 2 months for LA 3.0 Flash a-wave. Electronegative DA 3.0 standard combined response (SCR) was seen in 3/6 eyes of DKO (avg. b/a 1.106), and 0/10 eyes of Rs1-KO mice (avg. b/a 1.223) at 2 months. At 4 months of age this was 2/10 eyes of DKO (avg. b/a 1.224), and 3/22 eyes of Rs1-KO mice (avg. b/a 1.189).

Conclusions: Intravitreal anti-VEGF injection in Rs1-KO mice did not significantly improve retinal cysts, however a trend was present and longer follow up is needed. Caspase-1 deficient DKO mice tended toward lower ERG amplitudes compared to Rs1-KO. While caspase 1 was found to be upregulated in JXLR murine model retinas, ablating it does not improve the phenotype with electronegative ERG occurring more often in caspase deficient Rs1-KO, suggesting upregulation may be a result of schisis rather than a cause. Caspase 1 may be beneficial in murine JXLR.

Session IV – Paper 21

Rupak Bhuyan, MD | *Retinal Degeneration in Patients with Intermediate Uveitis or Retinal Vasculitis*

Primary Supervisor: Timothy Boyce, MD

Purpose: Uveitis is not usually associated with retinal degeneration. In some uveitis patients, however, dramatic retinal degeneration has been observed for unknown reasons. We sought to better characterize these uveitides and learn to better manage or prevent the degeneration.

Methods: We performed a case series of uveitis patients from the University of Iowa retina clinic who also exhibited retinal degeneration. Uveitis diagnoses were limited to pars planitis and idiopathic retinal vasculitis. Medical records were identified using EPIC, which also contained scans of written notes from prior to EPIC integration. Images were reviewed using Zeiss Forum software. Statistics were calculated using Microsoft Excel.

Results: 6 patients (12 eyes) were identified. All patients had binocular involvement. 5 patients had pars planitis, and all 6 had idiopathic retinal vasculitis. Mean age of symptom onset was 25±7 years. 33% were male and 66% were female. Mean duration of follow-up was 13±11 years. There was no known family history of inherited retinal disease, though 2 patients were sisters. No patients shared home medications. No patients had systemic conditions associated with uveitis. Mean baseline visual acuity [logMAR] was 0.153 ±0.275. Mean final visual acuity was 0.141±0.198—no significant change. Exam findings included anterior vitreous cell (91% eyes), vessel sheathing (66%), snowbanking (58%), bone spicule-like pigmentation (58%), and disc edema (33%). OCT findings included epiretinal membrane (66%), cystoid macular edema (42%), baseline central subfield thickness (CST) 300±microns, final CST 290±64 microns, outer retinal or retinal pigment epithelial atrophy in the macula (42%), and subretinal fluid (17%). Fluorescein angiography revealed vascular leakage (100%), capillary hypoperfusion (100%), disc leakage (50%), but no peripheral neovascularization. Treatment included local steroids (66%), oral steroids (100%), immunomodulatory therapy (66%), cryotherapy (52%), vitrectomy (25%), and Retisert (17%).

Conclusions: Retinal degeneration in patients with pars planitis and idiopathic retinal vasculitis may be associated with active retinal vascular leakage and capillary hypoperfusion, anterior vitreous cell, vessel sheathing, snowbanking, bone spicule-like pigmentation, and epiretinal membranes. Polytherapy is often required to control inflammation, including local and oral steroids, cryotherapy, and immunomodulatory therapy. Even then, long-term control may remain a challenge, and retinal degeneration may represent inadequate control.

Session IV – Paper 22

Sean Rodriguez, MD | *Edge Creep: Increased Pigmentation at the Border of Choroidal Melanomas Treated with Plaque Brachytherapy*

Primary Supervisor: Elaine Binkley, MD
Co-authors: Daniel Hyer, PhD; Connie Hinz; H. Culver Boldt, MD

Introduction: There is an increase in pigmentation that occurs in many tumors following plaque brachytherapy for choroidal melanoma. Correctly distinguishing between increased pigment at the tumor border versus true growth is imperative. We performed a retrospective review of patients treated with I-125 brachytherapy for choroidal melanoma at our institution to study this phenomenon.

Methods: Records were reviewed for all patients undergoing plaque brachytherapy for uveal melanoma for a five-year period (N=195). Patients with iris and anterior tumors were excluded. Tumors treated more than 31 days after presentation were excluded. Fundus images for patients with increased pigmentation at any of the borders of the tumor at 6-month follow up that extended beyond the initial pigmented margin were included (N=20; 8 F, 12 M). Imaging at last follow up was reviewed and it was confirmed that all tumors involuted appropriately with no evidence of local recurrence. The date of initial exam, time to treatment, and follow up interval were recorded for each included patient.

Results: 20 patients (10%) exhibited increased pigment deposition at any of the borders of the tumor at 6-month follow up that extended beyond the initial pigmented margin. Average tumor thickness was 3.2 mm (1.3-5.1), average largest tumor basal diameter was 11.6 mm (7-15.5). Average time from diagnosis to treatment was 25 days (17-31). Average length of follow up was 35 months (16-68). No patient developed recurrence during the duration of follow up, and one patient had developed metastasis.

Conclusions: We describe the phenomenon of increased pigment deposition, “edge creep,” at the borders of choroidal melanomas treated with plaque brachytherapy that gave the appearance of initial tumor growth, but then subsequently remained stable over time. It is important treating ocular oncologists be aware of this phenomenon to avoid unnecessary diagnosis of local recurrence.

Session IV – Paper 23

Christopher Fortenbach, MD, PhD | *Vision Loss Disproportionally Drives Millions of Inhabitants of Low-Income Nations into Poverty*

Primary Supervisor: Michael Abramoff, MD, PhD

Purpose: Over 300 million people worldwide suffer from visual impairment. Few quantitative measures exist to evaluate the impact of vision loss with most studies relying upon lost earnings. While hundreds of billions of US dollars per year are lost due to visual impairment, lost income occurs disproportionately in wealthy nations and may not therefore convey the impact of lost sight on lower income countries. As no suitable measures exist to compare the effect of vision loss across countries with disparate incomes, we propose a new method to estimate how many people around the world are driven into poverty by vision loss.

Methods: National income distribution data (2019) were obtained from the United Nations and income-adjusted national poverty thresholds were obtained from the World Bank for all available countries. Country-level data for moderate visual impairment, severe visual impairment, and blindness were as well as causes obtained from the Global Burden of Disease Study 2019. Moderate visual impairment was assumed to carry an 8.9% loss, severe visual impairment a 31.4% loss, and blindness a 33.8% loss of earnings. The relative number of inhabitants driven into poverty were estimated by comparing income distribution data relative to the poverty threshold following adjustment for lost earnings from visual impairment.

Results: Over four million people globally are driven into poverty as a result of vision loss. While the absolute number of lost dollars globally occurs predominately among high income nations, the impact of those lost dollars is disproportionately experienced by low-income countries (Figure 1 shows country area scaled to number of inhabitants driven into poverty per capita). Uncorrected refractive error, cataract, and glaucoma remain the most common causes of vision loss and resultant poverty. Similar trends were observed in the United States with lower income states bearing a higher burden.

Conclusions: The risk of poverty due to vision loss is greatest in lower-income countries. The method described here may serve as a useful tool in advocacy, resource allocation, and in other fields beyond ophthalmology studying the impacts of disability and poverty.