

Resident and Fellow Research Day 2022

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

Session I

Salma Dawoud, MD <i>The True Cause of Spasmus Nutans</i>	2
Margaret Strampe, MD <i>Variability of 3-Channel Visual Evoked Potential in Albinism</i>	3
Caroline Yu, MD <i>Impact of Eyelid Malposition on Meibomian Gland Function</i>	5
Jamie Keen, MD <i>Trends in Management of Pediatric Orbital Cellulitis</i>	7
Karam Alawa, MD <i>Wave-Guiding (Sclerotic Scatter) in the Cornea Using a Novel 3D-printed Polyethylene Glycol Hydrogel Light Pipe Attachment: A Laboratory Study</i>	8
Aaron Dotson, MD <i>Comparison of a Prototype “Corneal Cufflink” Plug vs. Standard of Care Plastic Patch for the Emergent Management of Non-Traumatic Corneal Perforations: A Pilot Laboratory Study</i> ..	9
Andrea Blitzer, MD <i>Tissue Injector Size and DMEK Graft Scroll Conformation: Do Narrower Injectors Increase the Likelihood of Upside-down Graft Insertion?</i>	10
Tina Hendricks, MD, MSC & Tyler Quist, MD <i>Intraocular Pressure Changes During Dialysis</i>	11
Edward Linton, MD <i>AI New Diagnostic Sign of Carotid-Cavernous Fistula Using Laser Speckle Flowgraphy</i>	12
Adriana Rodriguez Leon, MD <i>Relationship of Papilledema Severity to Presence and Frequency of Transient Visual Obscurations and Pulsatile Tinnitus</i>	13

Session II

David Ramirez, MD <i>Career or Identity: Investigating LGBTQ+ Medical Student Specialty Selection Using a National Survey</i>	14
Christopher Fortenbach, MD, PhD <i>The Economic Burden of Vision Loss Falls Disproportionately on Inhabitants of Low-Income Nations</i>	15
Sean Rodriguez <i>Free Ophthalmology Clinic Advancements and the Health Disparities Grant</i>	16
Zachary Mortensen, MD, MBA <i>Operation HawkEyeSight: Part 2 of Free Clinic Advancements</i>	17
Tirth Shah, MD <i>Outcomes of an Abrupt Switch to a Fixed Interval Injection Protocol in Patients with Neovascular Age-Related Macular Degeneration due to the COVID-19 Pandemic: An Academic Tertiary Center Experience</i>	18
Razek Georges Coussa, MDCM <i>Visual Acuity Course and Correlation with Systemic Manifestations in Mitochondrial DNA A3243G Variant-associated Retinopathy</i>	19
Chirantan Mukhopadhyay, MD, MS <i>Pentosan Maculopathy as a Masquerade Syndrome for Macular Degeneration</i>	20
Mahsaw Motlagh, MD <i>The Role of Choroidal Neovascularization in Best Disease</i>	21
Matthew Field, MD, PhD, MPH <i>Autosomal Dominant Progressive Vision and Hearing Loss: TUBB4B-related Tubulinopathy</i>	22
R. Christopher Bowen MD, MS <i>Grading Ocular Disease Severity in Patients with von Hippel-Lindau Disease</i>	23

Salma Dawoud, MD | *The True Cause of Spasmus Nutans*

Primary Supervisors: Alina Dumitrescu, MD; Arlene Drack, MD

Purpose: Spasmus nutans (SN) is a rare, acquired nystagmus clinically diagnosed based on the classic triad of small-amplitude high-frequency nystagmus, head nodding, and torticollis. SN has been considered a benign self-limited disease; however, there are several case reports of SN mimickers. We aimed to identify patients previously diagnosed with SN and determine if they had a final underlying diagnosis after further workup was performed.

Methods: An IRB-approved, retrospective electronic chart review from January 1, 2008 to January 1, 2021 for the following ICD 9 and 10 codes was performed: [F98.4] Stereotyped movement disorders, [H55.00] Unspecified, and [H55.01] Congenital nystagmus. To further narrow the review, the charts were text searched for “spasmus nutans” and common misspellings. Charts were excluded if they had no formal eye exam, no nystagmus, and if “spasmus nutans” appeared in the chart but was not considered in the diagnosis of the patient.

Results: A total of 4019 charts were identified with the initial search. The “spasmus nutans” text search identified 63 charts and 47 met inclusion criteria. The final diagnoses of patients with an initial diagnosis of SN included optic nerve disease (8/47, 17%), inherited retinal disease (7/47, 15%), syndromic diseases (7/47, 15%), trisomy 21 (3/47, 6%), optic pathway gliomas (2/47, 4%), neurological disease (2/47, %), congenital motor nystagmus (1/47, 2%), and one patient was multifactorial (2%). Of these patients with a final alternate diagnosis, six had improvement or resolution in their nystagmus. There were 6 patients (6/47, 13%) with partial work-up that were lost to follow-up. An additional 4 patients (4/47, 9%) had an active pending work-up. There were 6 patients (6/47, 13%) noted to have an improvement in their SN with limited work-up.

Conclusions: Most cases of spasmus nutans-type nystagmus were caused by underlying optic nerve, inherited retinal, and systemic diseases. Patients diagnosed with spasmus nutans should receive a full diagnostic workup including eye examination, OCT, ERG, brain MRI, and genetic testing.

Margaret Strampe, MD | *Variability of 3-Channel Visual Evoked Potential in Albinism*

Primary Supervisor: Arlene Drack, MD

Co-authors: Alina Dumitrescu, MD; Wanda Pfeifer, OC(C), COMT, CO; Megan R. Smith

Purpose: 3-channel visual evoked potential (VEP) has been reported in the literature to demonstrate diagnostic asymmetric optic nerve decussation in patients with albinism, with most fibers crossing to the contralateral hemisphere rather than symmetric crossing as seen in controls. In clinical practice, results may be more variable. This study aims to analyze the incidence and directionality of asymmetric decussation detected on 3-channel VEP in albinism patients presenting to a pediatric genetic eye disease clinic for clinical care.

Methods: A retrospective chart review was performed to identify all patients with a diagnosis of albinism who had undergone 3-channel VEP testing between 1/1/2010 and 1/30/2022. Data collected included patient age at time of testing, sex, VEP findings, other ocular examination findings, visual acuity, ancillary ocular testing, clinical diagnosis, molecular diagnosis, genetic testing results related to ocular disease, and ocular treatment. VEP findings including P120 amplitude (μV) and latency (ms) and were compared for right (O2) and left (O1) hemispheres of the visual cortex after stimulation of right (OD) and left eyes (OS).

Results: Charts from 46 patients were identified. Preliminary data analysis revealed several cases of patients with clinically and/or molecularly confirmed oculocutaneous albinism who have abnormal decussation on 3-channel VEP, with greater ipsilateral cortical responses on VEP than contralateral (**Figure 1**). Four patients had higher ipsilateral, 19 had higher contralateral, and 2 had symmetric amplitudes. The remaining 21 patients had some combination thereof (e.g., higher ipsilateral with flash OD but higher contralateral with flash OS).

Conclusions: In several cases at UIHC, patients with albinism have demonstrated abnormal decussation with higher ipsilateral cortical responses on VEP rather than contralateral. This conflicts with previously reported data that showed overwhelmingly higher contralateral cortical responses in patients with albinism when testing with 3-channel VEP and functional magnetic resonance imaging (**Figure 2**). Next steps of this project will be to identify distinguishing clinical and molecular findings in patients with albinism who have more ipsilateral rather than contralateral cortical responses, and to look for signs of petalia, which have been reported to be associated with unusual directionality in 3-channel VEP.

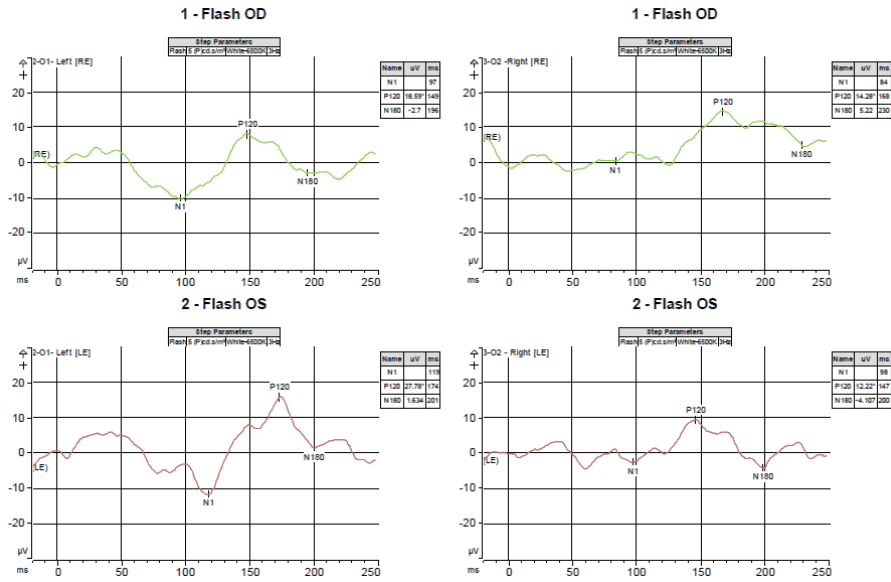


Figure 1: 3-channel visual evoked potential (VEP) in a patient with molecularly confirmed oculocutaneous albinism type VI (OCA6) demonstrating greater ipsilateral (O1 with flash OS, O2 with flash OD) than contralateral (O1 with flash OD, O2 with flash OS) cortical responses.

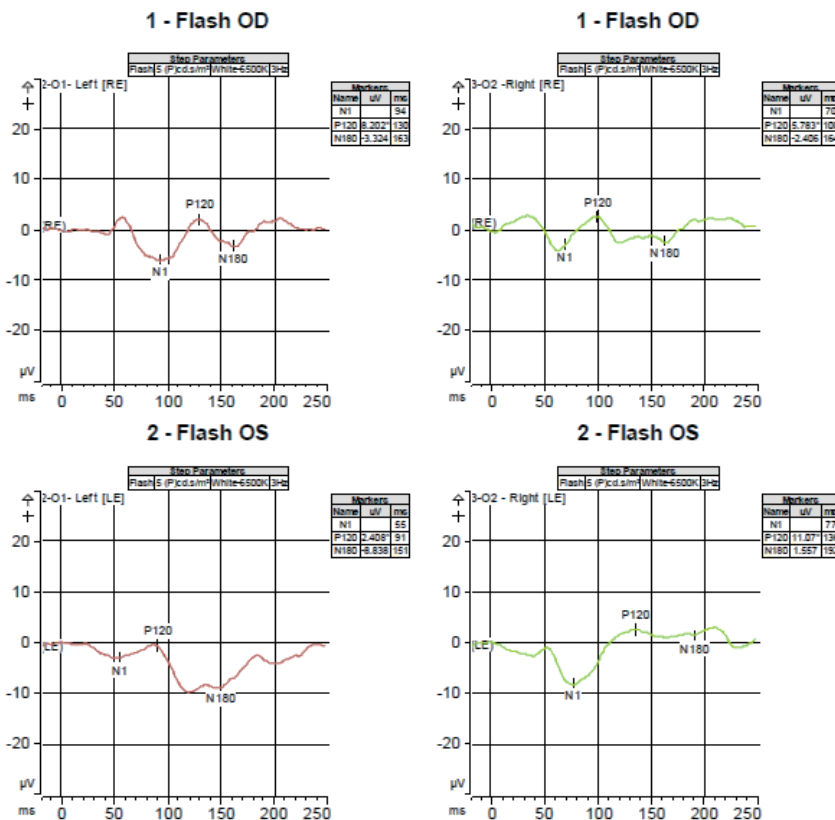


Figure 2: 3-channel VEP in a patient with molecularly confirmed oculocutaneous albinism type II (OCA2) demonstrating greater contralateral (O1 with flash OD, O2 with flash OS) than ipsilateral (O1 with flash OS, O2 with flash OD) cortical responses.

Caroline Yu, MD | *Impact of Eyelid Malposition on Meibomian Gland Function*

Primary Supervisor: Erin Shriver, MD

Co-authors: Chau Pham, MD; Keith Carter, MD

Purpose: To understand how the ocular surface and meibomian glands are affected by eyelid malposition.

Methods: This was an IRB-approved, prospective cohort study conducted between June 1, 2018 to December 31, 2018. Adult patients presenting to a single center oculoplastics clinic for elective periocular surgical procedures were enrolled. Exclusion criteria were pregnancy, history of prior ophthalmic procedure in the last 6 months, prior treatment for ocular infection, and contact lens use in the last 30 days. Subjects were asked to complete an Ocular Surface Disease Index (OSDI) questionnaire. Oculus Keratography 5M videokeratoscope was used to take a series of non-invasive measurements, including tear meniscus height and ocular surface redness as well as images of the upper and lower meibomian glands. Meibography grading was performed using the Jenvis scale. Analysis of variance (ANOVA) was used to compare OSDI scores, tear meniscus height, and ocular surface redness.

Results: Of the 20 patients enrolled, 11 patients were being treated for upper lid malpositions (UL), 4 for lower lid malpositions (LL), 3 for eyelid lesions (EL), and 2 for floppy eyelid syndrome (FES). Average OSDI was highest in patients with lower eyelid malpositions and floppy eyelid syndrome (UL 6.82, LL 25.75, EL 0, FES 12; $p=0.040$). For all conditions, meibomian gland dropout was more frequently observed in the lower eyelid. Lower eyelid patients had the greatest degree of meibomian gland dropout, exhibited higher tear meniscus (mm) (UL 0.40, LL 0.73, EL 0.43, FES 0.56; $p=0.040$), and limbal redness (UL 0.80, LL 1.41, EL 0.55, FES 1.13; $p=0.033$).

Conclusions: Lower eyelid malpositions and floppy eyelid syndrome are more frequently associated with signs and symptoms of ocular surface disease, as well as a greater degree of lower eyelid meibomian gland dropout. Better understanding of the role of eyelid malposition on ocular surface health is important for improving patient outcomes.

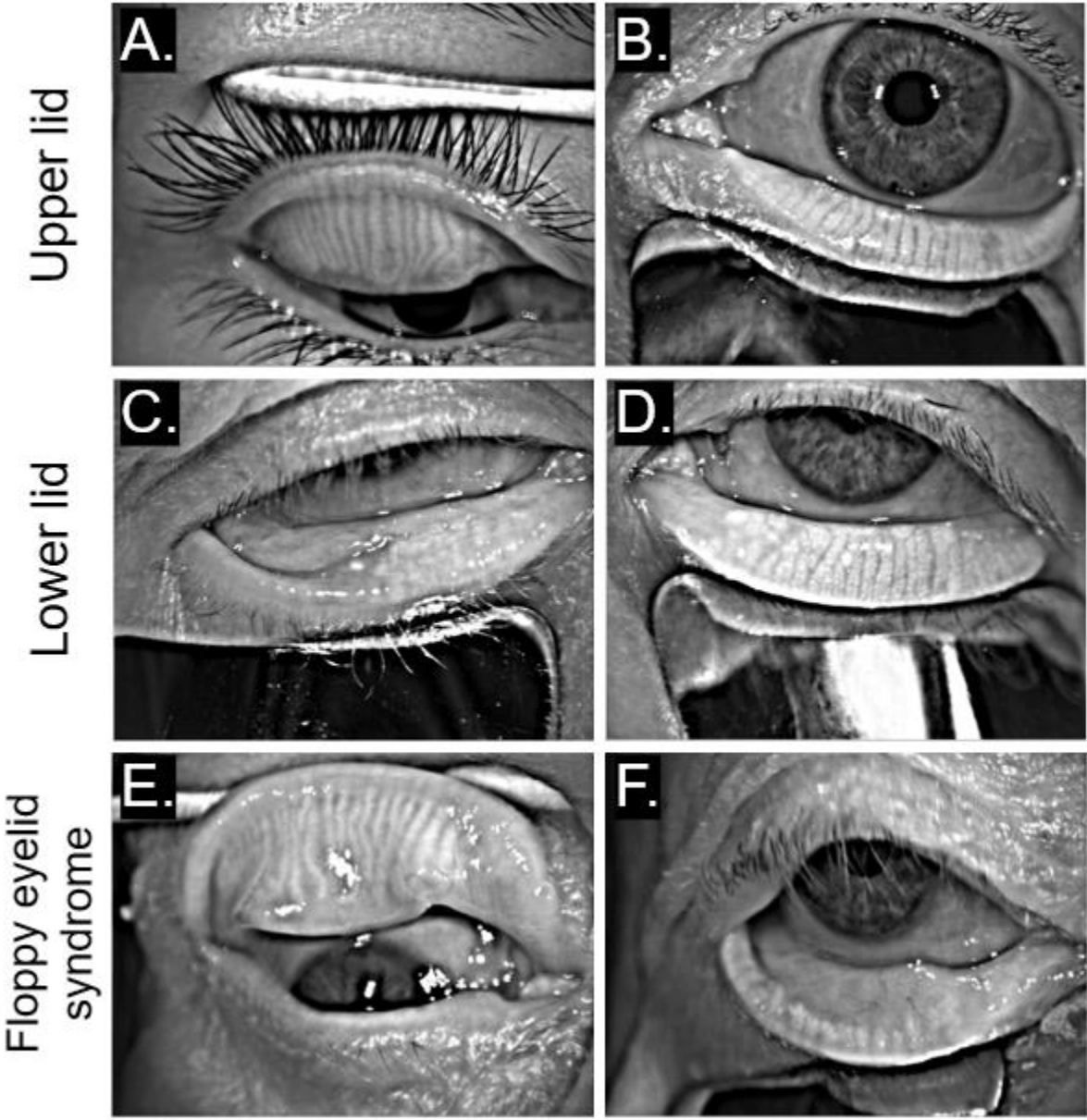


Figure. Representative meibography images from patients with (A) bilateral upper eyelid dermatochalasis, (B) right lower eyelid senile entropion, and (C) floppy eyelid syndrome of the right eye.

Jamie Keen, MD | *Trends in Management of Pediatric Orbital Cellulitis*

Primary Supervisors: Erin Shriver, MD; Keith Carter, MD; Cham Pham, MD

Purpose: To establish trends in the management of pediatric patients with orbital cellulitis. The literature on the management of these patients is controversial. We hope to analyze cases in our institution and identify clinical characteristics of the patients and how that affects their disease management.

Methods: Retrospective case series looking at pediatric patients diagnosed with orbital cellulitis at our institution between 2002-2022. Data collected include patient demographics, vital signs, laboratory values, exam findings and course of treatment. Exam findings and imaging results recorded include abscess size and location, if they had a history of sinus disease, and their CRP level at presentation.

Results: Initial data analysis of 40 patients showed that all patients had sinus disease and 63% had medial subperiosteal abscesses on imaging. Approximately 38% of the patients went to surgery and the average time until surgery from admission was 1.3 days. Approximately 26% of patients who went to surgery were under the age of 9 specifically, all were age 6 or younger. 100% of the patients received IV Vancomycin at some point during their treatment. The next most common antibiotic treatment was IV Unasyn which 75% of the patients received. Approximately 38% of patients received steroids at some point during their inpatient treatment and steroids were started on an average of 1.1 days from admission.

Conclusions: The study is ongoing. Based on the initial results, above, we will be analyzing factors that lead to patients needing surgical treatment for orbital cellulitis. Regarding management, we will be focusing on how many patients failed medical management, the medical treatment they received during this time and the length of observation before surgery.

Karam Alawa, MD | *Wave-Guiding (Sclerotic Scatter) in the Cornea Using a Novel 3D-printed Polyethylene Glycol Hydrogel Light Pipe Attachment: A Laboratory Study*

Primary Supervisor: Christopher Sales, MD, MPH

Purpose: The standard of care for illuminating the anterior segment under a surgical microscope is with a combination of oblique and coaxial lighting projected several inches above the ocular surface from the microscope itself. For the vast majority of operative cases, i.e. cataract surgery, this form of lighting is excellent. However, standard ophthalmic surgical lighting can be insufficient in complex anterior segment cases involving intracameral suturing and tissue manipulation, especially with cloudy corneal media. The extraocular use of vitreoretinal light pipes for illumination of the anterior segment in the setting of corneal edema has been previously described. The Iowa Anterior Segment Device Lab has developed a novel modification to this lighting technique that employs viscoelastic as an optical grading agent to smooth the transition of light waves from the light source into the cornea to make light propagate throughout the stroma, a phenomenon termed sclerotic scatter and known in photopic physics as wave-guiding. We conducted a feasibility study to evaluate different approaches to reproducing this phenomenon more consistently and hands-free with two prototypes.

Methods: This was a prospective experimental laboratory study. 3D models were designed to optically couple a light pipe to two optical-grading materials while holding shape constant (prototype A: viscoelastic hyaluronic acid; prototype B: polyethylene glycol hydrogel [PEG]). Prototype A was comprised of a dome-shaped cup made from 3D printed ABS plastic; its concavity was then filled with hyaluronic acid. Prototype B was comprised of 3D printed PEG in the same shape and dimensions as the dome-shaped concavity of the ABS plastic. The prototypes were tested on the ocular surface using a xenon light source and 20 G light pipe on a human cadaveric globe for their ability to achieve sclerotic scatter compared to viscoelastic.

Results: Sclerotic scatter by viscoelastic alone was comparable to that seen with the PEG hydrogel. The plastic prototype performed moderately well.

Conclusions: Coupling a high intensity light source to a PEG hydrogel represents a promising development pathway for developing a hands-free surgical device that can reliably create the favorable illumination rendered by sclerotic scatter.

Aaron Dotson, MD | *Comparison of a Prototype “Corneal Cufflink” Plug vs. Standard of Care Plastic Patch for the Emergent Management of Non-Traumatic Corneal Perforations: A Pilot Laboratory Study*

Purpose: Progressive tissue loss caused by non-traumatic infectious or sterile corneal melts can result in corneal perforation. The standard of care for managing a < 2 mm corneal perforation is to stabilize the eye with a patch by gluing a disc of plastic punched from a sterile surgical drape to the corneal surface with cyanoacrylate tissue adhesive; definitive management is subsequently rendered with a vision-restoring, wider diameter keratoplasty and/or contact lens. Glued plastic patches are frequently unsuccessfully applied because cyanoacrylate glue dries nearly instantly on-contact, making it difficult to achieve good apposition. Successfully applied patches begin to leak or completely fail within days of application. We conducted a pilot study to compare the efficacy of a prototype corneal plug – the “Corneal Cufflink” – fabricated by the Iowa Anterior Segment Device Lab from preserved corneal stroma. We hypothesized that the corneal-plug+glue would equal or exceed the efficacy of standard of care plastic-disc+glue.

Methods: This was a prospective, experimental, laboratory study. Full thickness corneal wounds were created in human donor corneas to simulate perforated corneal melts and measured with anterior segment OCT. 5 corneas in Group A received the standard of care with a 2.5 mm plastic disc with cyanoacrylate adhesive. 5 corneas in Group B received the experimental 2.5 mm corneal plug with cyanoacrylate adhesive. Burst pressure was quantified by mounting the corneas to an artificial anterior chamber pressurized with air from a syringe pump. Burst pressure was defined as the maximum pressure observed on the monitor before directly observed air leakage and/or directly observed decline in the pressure value. Successful application was defined as attainment of a pressure greater than 0 mmHg.

Results: Corneal holes measured on average 2.39 mm in the widest dimension. Group A (standard plastic-disc+glue) had a lower mean burst pressure than Group B ($p < 0.05$) (A: mean, 51.4 mmHg [range: 0 – 178 mmHg; median 63 mmHg; mode 0 mmHg]; B: mean, 374.75 mmHg [range: 253 – 484 mmHg; median 381 mmHg]).

Conclusions: In this limited pilot laboratory study, the prototype “Corneal Cufflink” failed less frequently than standard of care and measured a markedly higher burst pressure with air.

Andrea Blitzer, MD | *Tissue Injector Size and DMEK Graft Scroll Conformation: Do Narrower Injectors Increase the Likelihood of Upside-down Graft Insertion?*

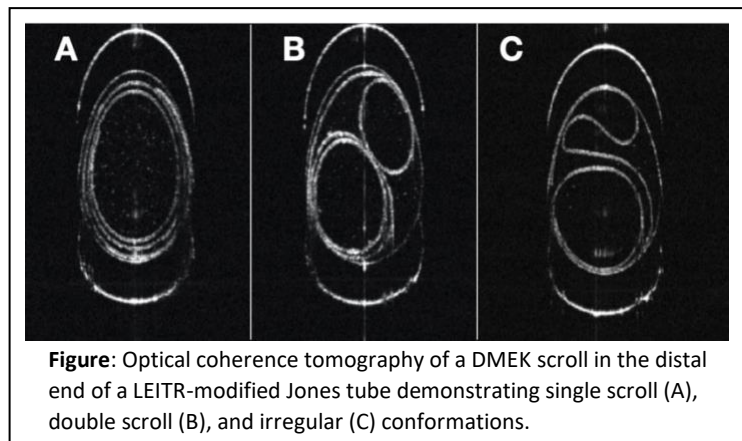
Primary Supervisor: Christopher Sales, MD, MPH

Co-authors: Gregory A. Schmidt, MBA, CEPT; Mark A. Greiner, MD; Jennifer J. Ling, MD

Purpose: The number of Descemet membrane endothelial keratoplasty (DMEK) insertion devices is increasing, with a trend toward narrower injectors that allow for smaller incisions. Observation of the DMEK scroll within the insertion tube allows the surgeon to insert the graft in the correct orientation, minimizing surgical time and graft manipulation. Clinically, we observed an increased number of upside-down insertions after switching to a narrower insertion device. We hypothesize that the likelihood of irregular scroll conformations increases in narrower insertion devices, thus increasing the likelihood of upside-down graft insertion.

Methods: DMEK tissues not suitable for transplantation (n=3, 8.0mm diameter) were alternately loaded into a Straiko-modified (1,200 μ m lumen) and LEITR-modified (860 μ m) Jones tube. Tissues were ejected to the distal end of each tube and imaged with external photography and optical coherence tomography to determine scroll conformation. The DMEK tissues were then inserted into an artificial anterior chamber using standard techniques to predict orientation. We measured the frequency of scroll conformations (single, double, or irregular), and the percentage of upside-down insertions.

Results: The narrower LEITR tube resulted in irregular scrolls that were not seen in the Straiko tube (5/30, 16.7% vs 0/30, 0%). The likelihood of irregular scroll conformation was much higher in older tissue with a naturally wider scroll (3/10, 30.0% in tissue >65 years old vs 2/20, 10.0% in younger tissue). Qualitatively, irregular scrolls were difficult to differentiate from double or single scrolls by external evaluation alone. Irregular scrolls were more likely to be inserted in an upside-down orientation (3/5, 60.0%) compared to single (1/10, 10.0%) or double scrolls (0/5, 0%).



Conclusions: As the lumen of the DMEK tissue inserter decreases, scroll conformation becomes more atypical and orientation is harder to predict. While the use of narrower insertion devices allows surgeons to perform DMEK through increasingly smaller incisions, the potential for upside-down insertion and thus longer surgery times increases. Surgeons using narrow insertion devices should be aware of the possibility of inverted insertion, particularly when using older tissue. Further studies are needed to determine the intraoperative and postoperative impact of these less predictable scroll conformations.

Tina Hendricks, MD, MSC & Tyler Quist, MD | *Intraocular Pressure Changes During Dialysis*

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. However, the effect of hemodialysis on IOP specifically in patients with glaucoma has not been studied. Individual patients in our clinic have demonstrated IOP spikes during dialysis with use of the Home iCare (Figure 1). The aim of this study is to evaluate the relationship between hemodialysis and IOP changes in patients with and without glaucoma.

Methods: This is a prospective study that included 106 eyes of 54 patients undergoing hemodialysis at UHIC hospital and satellite clinics. The average age was 61.8 years, and 47.3% were women. Eleven 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.

Results: In both groups, the largest difference in IOP occurred between the start and middle of dialysis sessions. Although the mean IOP change was minimal and similar between patients with glaucoma (1.9 ± 8.4 mmHg, range -9 to 25 mmHg) and without (0.8 ± 0.8 mmHg, range -7.3 to 11.3 mmHg), the absolute change in IOP was significantly higher in the group with glaucoma (5.3 mmHg) compared to patients without (2.9 mmHg) ($p < 0.01$). Four eyes (18%) with glaucoma experienced a significant spike during dialysis (range 11.7 to 25 mmHg). There was also a significant difference in pachymetry between the start of dialysis and at the midway point of patients undergoing hemodialysis ($+17.0 \mu\text{m}$) with and without glaucoma ($7.5 \mu\text{m}$) ($p < 0.05$).

Conclusions: Most patients do not experience spike in IOP related to dialysis. However, patients with glaucoma are more likely to have a larger fluctuation in IOP with hemodialysis sessions, with two patients having asymptomatic IOP spikes to potentially damaging levels. Further study is required to determine which glaucoma patients are most at risk for developing an IOP spike during hemodialysis, and whether incisional surgery can help to blunt these changes.

Edward Linton, MD | A New Diagnostic Sign of Carotid-Cavernous Fistula Using Laser Speckle Flowgraphy

Primary Supervisor: Randy Kardon, MD PhD

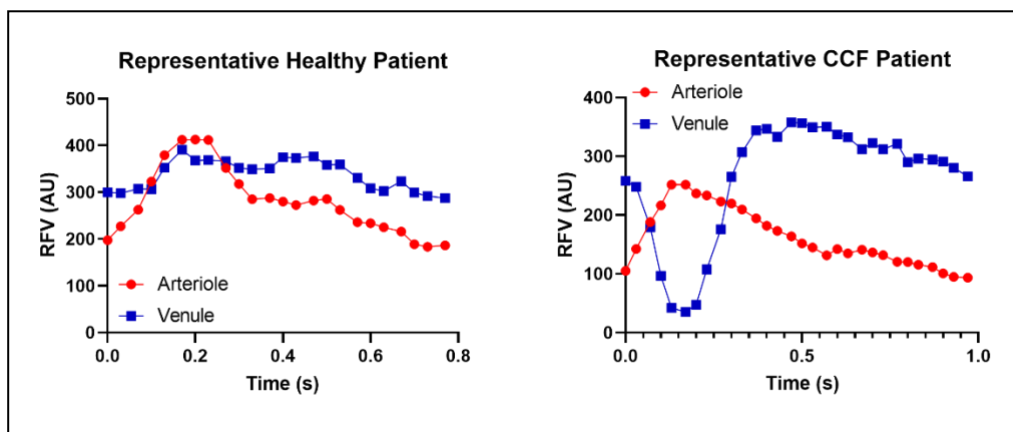
Co-author: Thomas Tedeschi

Purpose: Carotid-Cavernous Fistulas (CCF) may be difficult to diagnose without classic anterior ocular signs. Laser speckle flowgraphy is a non-invasive imaging technique that allows assessment of ocular blood flow with high enough temporal resolution to resolve changes in flow within a single cardiac cycle. We hypothesized that eyes affected by a CCF would have disturbed arterial and/or venular flow detectable within the eye.

Methods: Four patients with an indirect CCF underwent non-invasive measurement of retinal blood flow using Laser Speckle Flowgraphy (LSFG). Blood flow parameters were compared to normal subjects (n=32). Choroidal blood flow was quantified by measuring the Mean Blur Rate (MBR) in the fundus after masking out retinal vessels. Relative Flow Volume (RFV) waveforms over an average cardiac cycle were measured for retinal arteriole and venule companion pairs. Timing of peak venular blood flow velocity relative to the companion arteriole (venular delay) was expressed as a percent phase delay relative to the cardiac cycle duration (Δ ATI). RFV range (max-min) in companion arterioles and venules was compared between each group.

Results: Choroidal MBR was reduced in unilateral CCF, consistent with prior literature. RFV Venular delay was significantly greater in eyes with CCF ($10.8\% \pm 2.2$) compared to unaffected fellow eyes ($1.8\% \pm 0.2$) or control eyes of normal subjects (mean $2.7\% \pm 0.3$). This arteriole-venule delay disappeared after fistula thrombosis. In the presence of a CCF, there was a negative deflection of venule RFV during systole and the artery:vein ratio of RFV range was inverted.

Conclusions: A novel hemodynamic signature of carotid cavernous fistula, venular delay with expanded RFV range compared to the companion arteriole, was discovered in eyes with and without overt ocular signs, which immediately resolves after treatment. Our study is limited by sample size but changes in venous flow parameters within a given eye over time may be a sensitive biomarker for diagnosis and treatment response.



Adriana Rodriguez Leon, MD | Relationship of Papilledema Severity to Presence and Frequency of Transient Visual Obscurations and Pulsatile Tinnitus

Primary Supervisor: Randy Kardon, MD, PhD

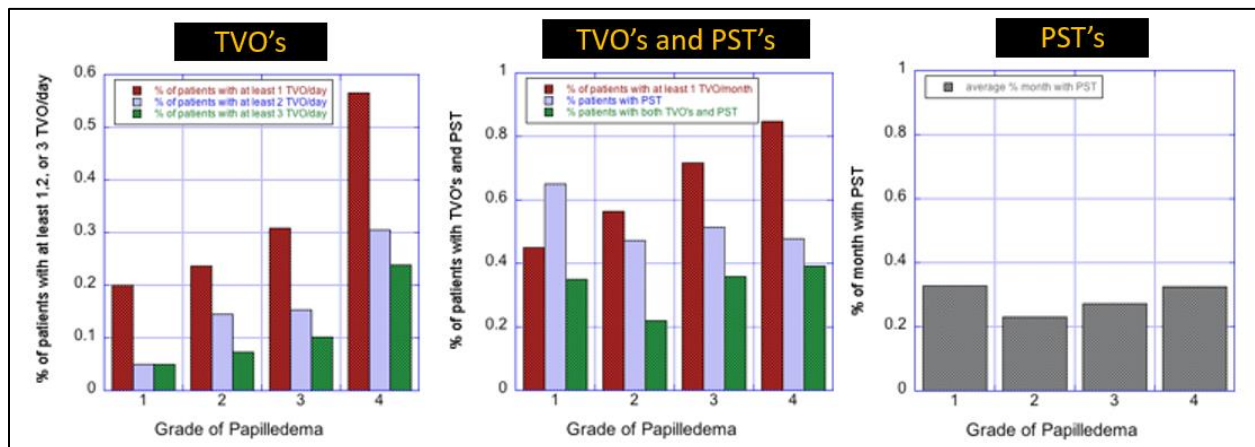
Co-author: Michael Wall, MD

Purpose: Common symptoms of Idiopathic Intracranial Hypertension (IIH) are transient visual obscurations (TVO) and pulse synchronous tinnitus (PST). It is currently not known how frequently TVO's and PST's occur as a function of papilledema severity. The purpose of this study was to determine the frequency of TVO's and the prevalence of PST in IIH as a function of Frisen grade of papilledema.

Methods: An analysis of the frequency of TVO's and PST's as a function of grade of papilledema was performed using the Idiopathic Intracranial Hypertension Treatment Trial (IHTT) data set from 165 patients questioned at the time of study entry.

Results: A high correlation was found between grade of papilledema and percent of patients with at least 1, 2 or 3 TVO's/day (correlation coefficient $R=0.92, 0.94, 0.90$, respectively). There was also a significant correlation between the number of TVO's/day and the grade of papilledema ($r=0.32, p<0.001$). No correlation was found between papilledema grade and PST. Patients with no disc edema reported having PST about 30% of the month. The percentage of patients with both TVO's and PST's with grade 1 disc edema was 35%; with grade 3 it was 35.9%.

Conclusions: We found a significant correlation between the severity of optic disc edema and the percent of IHTT patients with at least 1,2 or 3 TVO's/day, as well as the frequency of TVO's. No significant correlation was found between grade of optic disc edema and percent of IHTT subjects having PST. Since PST is likely related more to turbulence in the jugular bulb and degree of transverse sinus stenosis, it may not correlate well to the level of intracranial pressure and may also be related to an individual patient's venous sinus anatomy. One limitation identified was that TVO's were defined in the IHTT questionnaire as transient episodes of blurred vision. We propose a new questionnaire for assessing TVO's that is more specific (e.g., transient episodes of darkening of vision).



David Ramirez, MD | *Career or Identity: Investigating LGBTQ+ Medical Student Specialty Selection Using a National Survey*

Primary Supervisor: Erin Shriver, MD, FACS

Co-authors: Alexis Warren, MD; Patrick Barlow, PhD; Anthony Rossi, MD; Scott Chalet, MD, MBA; Chris Alabiad, MD

Purpose: To identify factors associated with surgical subspecialty career selection among lesbian, gay, bisexual, transgender, and queer/questioning/other (LGBTQ+) medical students in their final year.

Methods: We conducted a multi-institutional, cross-sectional survey which was distributed to medical students through a combination of institutional email and social media posting. The survey was distributed 2 weeks prior to match day and closed the day following match day. Only medical students in their final year of training were eligible to participate. Survey respondents were asked to rate the importance of specific considerations for choosing a particular specialty.

Results: 314 students responded to the survey, of which 286 were medical students in their final year of training. 43 respondents (18%) identified as LGBTQ+. LGBTQ+ students were 55% less likely to cite extremely high importance of having a mentor in the same field compared to non-LGBTQ+ students (OR 0.45, $p=0.040$) when considering a career path. More LGBTQ+ students cited competitiveness as a reason to avoid pursuing Dermatology compared to their heterosexual peers (70.7% vs. 51.7%, $p=0.027$), and more LGBTQ+ students cited an increased concern for finding same sexual orientation role models as a reason against pursuing Otolaryngology compared to non-LGBTQ+ students (9.8% vs. 2.8%, $p=0.043$).

Conclusions: LGBTQ+ students trended towards being less likely to find mentorship as important than their non-LGBTQ+ peers. Possible reasons include lower access to LGBTQ+ mentors due to less mentor and mentee visibility; fear of reprisal for being “out” at work; and motivation to find knowledge without LGBTQ+ mentorship to avoid “coming out” at work. Further research to identify factors affecting LGBTQ+ student interest in other specialties is needed.

Christopher Fortenbach, MD, PhD | *The Economic Burden of Vision Loss Falls Disproportionately on Inhabitants of Low-Income Nations*

Primary Supervisor: Michael Abramoff, MD, PhD

Purpose: Over 200 million people worldwide suffer from moderate-to-severe vision impairment (MSVI) and 40 million from blindness with an estimated global cost of hundreds of billions of US dollars per year in treatment, rehabilitation, and lost income. In absolute terms, most of the cost occurs in high income countries. However, this absolute cost does not fully convey the real-world impact of lost income, for example whether an individual's vision loss implies poverty, as poverty levels differ dramatically across countries. As no suitable measures exist to compare such normalized cost and impact, we propose two new metrics by which to estimate and compare the impact of lost income due to vision loss globally.

Methods: Gross national income data per capita (adjusted to purchasing power parity in current international \$, GNI-PPP) for 2020 as well as national poverty thresholds (in GNI PPP) were obtained from the World Bank for all available countries. National income distribution data were obtained from the World Bank and the Organization for Economic Cooperation and Development. MSVI was assumed to carry a 30% average loss of income and blindness a complete loss of income at the national level (Eckert et al., 2015; Marques et al., 2021). To estimate the number of individuals driven into poverty by vision loss, the relative percentage of people below the poverty line was compared before and after adjusting for vision-loss associated income. The relative degree of poverty was estimated via the percentage of income required to meet the national poverty threshold (Visual Impairment Poverty Risk or VIPR).

Results: Among the Global Burden of Disease super regions, high-income countries are home to approximately ten percent of the world's visually impaired population but account for thirty percent of the lost income. When determining the number of individuals driven into poverty by vision loss however, lower income countries suffer the greatest burden with China and India having the greatest number of people falling below the poverty threshold. The VIPR was low in many countries with the greatest absolute losses in GNI-PPP due to MSVI (e.g., 19% in the United States), meaning that individuals in these countries required a lower proportion of income in order to meet the poverty threshold. Central (51%) and East (58%) Sub-Saharan Africa, and Oceania (49%) had the most with Burundi (135%), the Central African Republic (102%), and the Democratic Republic of Congo (94%) requiring the greatest proportion of income to meet the poverty threshold.

Conclusions: Despite higher-income countries having the greatest absolute amount of lost earnings, the risk of poverty due to vision loss is greatest in lower-income countries. These first estimates provide a quantitative measure of the impact of lost income due to vision loss across countries where income and cost of living can vary dramatically.

Sean Rodriguez | *Free Ophthalmology Clinic Advancements and the Health Disparities Grant*

Faculty Mentors: Ian Han, MD; Thomas Oetting, MD; Pavlina Kemp, MD; Andrew Pouw, MD

Co-authors: Zachary Mortensen, MD, MBA; Salma Dawoud, MD, David Ramirez, MD, Stephen Russell, MD, Keith Carter, MD

Purpose: To identify and treat preventable blindness in a primarily uninsured, low socioeconomic status patient population seen through the Iowa City Free Medical and Dental Clinic (FMC), and to demonstrate the impact of these interventions on visual function and quality of life for at-risk patients.

Methods: The first step is to identify the FMC with treatable causes of vision loss or preventable blindness. The second step is to establish a mechanism to provide free treatment for selected patients (discussing diabetics and PRP only).

1. Identify patients (FMC Needs Assessment 2020 good baseline) and collect patient information and demographic information (IRB obtained for this).
2. Purchase equipment to help in assessment and monitoring of diabetic disease.
3. Identify barriers to performing laser at Free Clinic and find a solution to each barrier.
4. Create multiple safety nets to ensure optimal care of FMC patients and give the same privileges as UIHC ophthalmology patients.
5. Track patient visual acuity, disease stage and activity, and continue to treat as appropriate.
6. Administer post-treatment surveys and work with statistician to determine cost-effectiveness of treatment long term to healthcare system and to patient when compared to expected cost if no treatment were to occur.

Results: FMC Needs assessment 2020: 17 patients (31 eyes) have visually significant cataracts (32% with visual acuity between 20/30-20/40; 58% had visual acuity between 20/50-20/100). Five eyes met panretinal photocoagulation criteria. Five eyes met PRP criteria, and the first PRP treatment day was on 4/28/22.

Purchased: Topcon 3D OCT-1 Maestro2 (~\$24,500 negotiated).

Findings of PRP patients so far: First post-laser check coming 5/28.

Cataract surgery date: expected July – August.

Conclusions: We anticipate that a front-end investment in ophthalmic equipment at the Free Medical Clinic along with definitive laser management of severe diabetic retinopathy will be cost effective in the long run for both for the healthcare system and for the individual patients.

Zachary Mortensen, MD, MBA | *Operation HawkEyeSight: Part 2 of Free Clinic Advancements*

Primary Supervisor(s): Jaclyn Haugsdal, MD; Andrew Pouw, MD; Pavlina Kemp, MD; Keith Carter, MD; Ian Han, MD; Thomas Oetting, MD

Co-authors: Sean Rodriguez, MD

Purpose: To create a charitable outreach program, *Operation HawkEyeSight*, at the University of Iowa Hospitals and Clinics (UIHC) that provides free cataract surgery and diabetic retinopathy care for uninsured patients at the Iowa City Free Medical Clinic (FMC).

Methods: Coordinate FMC leaders, UIHC ophthalmology residency program, UIHC administration, volunteers, and more to execute procedures free of cost to FMC uninsured patients.

Results: Thus far, five patients have been treated with panretinal photocoagulation. An additional five patients have been consented for future cataract surgery. Agreements with UIHC billing are in process. Funding gaps will be filled by UIHC Health Care Disparities grant.

Conclusions: Under collaborative efforts by UIHC and FMC, *Operation HawkEyeSight* will address local health care disparities by treating FMC patients with preventable blindness. Future directions include efforts to ensure perpetuity.

Tirth Shah, MD | *Outcomes of an Abrupt Switch to a Fixed Interval Injection Protocol in Patients with Neovascular Age-Related Macular Degeneration due to the COVID-19 Pandemic: An Academic Tertiary Center Experience*

Primary Supervisor: Elliott Sohn, MD

Purpose: To examine the impact of switching from treat-and-extend protocol to fixed-interval treatment with anti-vascular endothelial growth factor therapy (VEGF) and reduced imaging on patients with neovascular age-related macular degeneration (AMD) during the coronavirus disease 2019 (COVID-19) pandemic.

Methods: Retrospective analysis of patients with neovascular AMD at the University of Iowa evaluating functional and anatomic parameters of the last visit prior to March 25, 2020 and the first visit after July 1, 2020. We also examined the cancellation rates of various outpatient clinics and the COVID-19 infection prevalence in our neovascular AMD population.

Results: A total of 289 eyes from 198 patients met the inclusion criteria and were included in our analysis. Of these patients, there was a slight decline in mean best corrected visual acuity in log MAR before (0.356 +/- 0.329) and after (0.396 +/- 0.344) the pandemic restriction interval, which was considered statistically significant (p-value = 0.0031). We found that 8 eyes had improvement of intraretinal fluid (IRF), 17 eyes had worsening of IRF, and 24 eyes had stable IRF before and after pandemic restrictions. We also found a statistically significant decrease in the average central macular thickness. Moreover, there was a 34% increase in cancellations in all outpatient specialty clinics for those who were older than 60 years, a 64% increase in cancellations in all outpatient ophthalmology clinics and an 18% increase in cancellations in patients with neovascular AMD during this interval. Lastly, 11 patients tested positive for COVID-19 and 6 of these patients died from COVID-related complications. There were zero patients who were diagnosed with COVID-19 within seven days of their last clinic appointment during the pandemic restriction interval.

Conclusion: We found that our patients on average had a slight decline in visual acuity and worsened exudative disease during the pandemic restriction. This is likely an underestimate of total visual loss since it does not account patients who were lost to follow up. Fortunately, the safety measures and protocols we had in place helped control the spread of the virus to our patients and ophthalmic personnel.

Razek Georges Coussa, MDCM | Visual Acuity Course and Correlation with Systemic Manifestations in Mitochondrial DNA A3243G Variant-associated Retinopathy

Primary Supervisor: Ian Han, MD

Co-authors: Elliott Sohn, MD; Sumit Parkih, MD; Elias Traboulsi, MD

Purpose: The mitochondrial DNA A3243G (m.3243A>G) variant causes a wide spectrum of phenotypes, with pigmentary retinopathy as the most common ocular finding. We undertook this meta-analysis to investigate the clinical course of visual acuity (VA) in patients with m.3243A>G variant and provide key clinical correlations with systemic manifestations.

Methods: A PubMed literature search was performed and studies were selected after satisfying pre-set inclusion criteria. Demographic and clinical data, including retinal findings and systemic manifestations were recorded. Cross-sectional and linear regression analyses were used to investigate the relationship between VA and age, as well as between the age at diagnosis of retinopathy and the mean ages at diagnosis of sensorineural hearing loss or diabetes. The age and prevalence of systemic manifestations among patients with and without retinopathy were studied using *t*-tests and Mann–Whitney U-tests (performed on binarized data). Likelihood ratios were computed.

Results: The mean VA (average of both eyes) of 90 patients (72.2% female; 65/90) were collected from 18 studies published between 1990 and 2018. The baseline mean age was 45.2 years (range 17 to 92). The mean logMAR VA was 0.10 (- 0.12 to 1.39). There was a statistically significant linear correlation between the logMAR VA and age ($p = .008$). The VA of patients less than or equal to 50 years of age was significantly better than that of patients older than 50 years (0.06 vs.0.18 logMAR, $p = .002$). 67 patients (74.4%) showed a characteristic pigmentary retinopathy with a mean age at diagnosis of 47.9 years (17 to 92) and VA of 0.14 logMAR (- 0.12 to 1.24). Age at diagnosis of retinopathy was linearly correlated with age at diagnosis of hearing loss or diabetes ($p < .001$). Patients with retinopathy were more likely to have hearing loss (83.6% vs. 56.5%, $p = .03$) or diabetes (56.7% vs. 17.4%, $p = .001$) than those without retinopathy. Those with both hearing loss and diabetes had an earlier onset of retinopathy than those without (46.4 vs. 60.4 years, $p = .01$). Patients without both hearing loss and diabetes were 5.3-fold less likely to develop a retinopathy.

Conclusions: Patients with m.3243A>G variant pigmentary retinopathy maintain highly functional VA until around the fifth decade of life, after which significant visual decline ensues. Patients without hearing loss and diabetes have a lower likelihood of exhibiting a retinopathy, which tends to appear about one decade after hearing loss and diabetes are diagnosed.

Chirantan Mukhopadhyay, MD, MS | *Pentosan Maculopathy as a Masquerade Syndrome for Macular Degeneration*

Primary Supervisor: Elliott Sohn, MD

Co-authors: Chad Lewis, MD, MPH

Purpose: Pentosan polysulfate sodium (PPS) is the only FDA-approved medication to treat interstitial cystitis, a debilitating bladder condition. The drug has recently been associated with a visually significant pigmentary retinopathy which can masquerade as other more common retinal conditions. The purpose of this project is to identify patients at our institution with pentosan maculopathy (PPSM) who were given a diagnosis for a similar condition.

Methods: Using the TriNetX platform we queried all 1,372,990 patients seen at the University of Iowa Hospitals and Clinics between 2000 and 2021 to identify all patients who had a history of exposure to PPS or carried a diagnosis of interstitial cystitis and simultaneously carried a diagnosis of “age-related macular degeneration (dry or wet)” or “unspecified macular degeneration” or “retinal neovascularization” or “degenerative drusen” or “degenerative myopia with neovascularization.” Patient records matching these search criteria were then reviewed and several data points extracted from each chart, including cumulative dose of PPS. For patients who had any relevant imaging data - optical coherence tomography (OCT), infrared imaging, fundus autofluorescence (FAF), and fundus photos – these modalities were analyzed for signs of PPSM based on previously published case criteria. The relevant findings are: fundus photography revealing macular hyperpigmented spots, yellow-orange deposits, patchy RPE atrophy, or a combination thereof, FAF showing a densely packed array of hyperautofluorescent and hypoautofluorescent spots involving the posterior pole, and OCT showing focal thickening or elevation of the RPE with associated hyperreflectance, and absence of typical drusen. The patients were stratified into different categories based on how many of these criteria were met.

Results: Our search identified 60 patients who met the inclusion criteria. Of these, 24 carried a diagnosis of non-exudative or exudative age-related macular degeneration, 29 were exposed to PPS, and 11 carried a diagnosis of interstitial cystitis but no exposure to PPS. 37 of the records identified had optical coherence tomography and 13 had fundus autofluorescence. Based on previously-published imaging criteria, we stratified the patients according to likelihood of having have PPSM. Our search yielded five patients who were very likely to have it, five who were possible, one with suspicious imaging findings, and five with significant pentosan exposure but insufficient imaging findings to make a conclusion either way. Within the “very likely” group, all the patients had suspicious findings on at least two imaging modalities and three patients had suspicious features on OCT, photos, and FAF. In the “possible” group, all five patients had OCT imaging, four had photos, and one had FAF. The patients in this group had suspicious features but they were milder than in the “very possible” group. The remainder were deemed to be unlikely to have the diagnosis, were never on PPS, or had insufficient imaging studies.

Conclusions: Our study shows that the prevalence of PPSM may be higher than previously believed. Clinicians should have a high index of suspicion for this condition in their existing patient populations for those patients with a known or possible history of PPS exposure.

Mahsaw Motlagh, MD | *The Role of Choroidal Neovascularization in Best Disease*

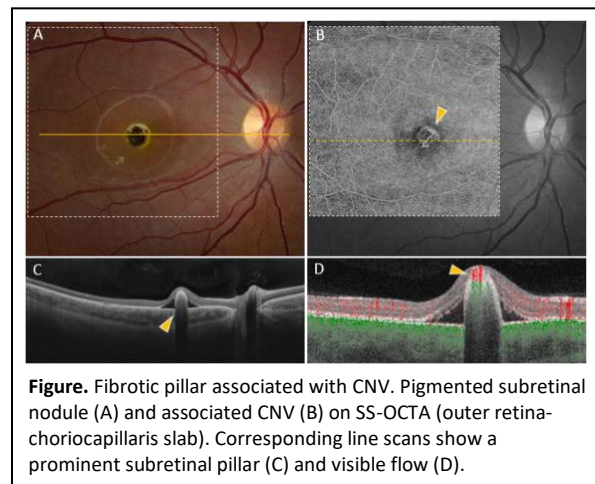
Primary Supervisor: Ian Han, MD

Co-authors: Razek Coussa, MD; D. Brice Critser, BS, CRA; Elliott Sohn, MD; Jonathan Russell, MD, PhD; Edwin Stone, MD, PhD

Purpose: Best vitelliform macular dystrophy (BVMD) is one of the most common causes of inherited macular dystrophy affecting about 1 in 70,000 in the United States. Choroidal neovascularization (CNV) is traditionally thought to be a manifestation of advanced stage BVMD. However, detection of CNV-related leakage is difficult using fluorescein angiography. In this study, swept-source optical coherence tomography angiography (SS-OCTA) is used to identify CNV in patients with BVMD and to correlate the presence of CNV with structural features seen on SS-OCT.

Methods: This was an IRB-approved retrospective review of consecutive patients with molecularly confirmed BVMD imaged with SS-OCTA (PLEX Elite 9000, Carl-Zeiss Meditec Inc, Dublin, California) from September 2017 to July 2020. Clinical data including age, gender, best-corrected visual acuity (BCVA), and prior clinical diagnosis of CNV were recorded. Structural features including the presence of intraretinal fluid, subretinal fluid, nodular subretinal pillar, focal choroidal excavation (FCE), or outer retinal atrophy were identified, and the presence of CNV was also assessed using 6 mm x 6 mm fovea-centered scans by expert graders. Structural features were correlated with the presence of CNV on SS-OCTA using Pearson correlation with p-value <0.05 considered statistically significant.

Results: A total of 53 eyes from 27 patients (14 male, 13 female) with molecularly confirmed BVMD were included in the study. Average age at initial visit was 45 years old (median 49 years, range 8-79). Mean BCVA at initial visit was LogMAR 0.38 (median 0.3, range 0-1). About half of the eyes (50.9%; 27/53 eyes) had a visible CNV on SS-OCTA; the majority (63.0%; 17/27 eyes) had a typical vitelliform lesion with subretinal fluid, and only 40.7% (11/27 eyes) had a known clinical diagnosis of CNV with traditional imaging modalities other than SS-OCTA. Structural features associated with CNV included FCE (29.6%; 8/27 eyes, p=0.002) and subretinal pillar (29.6%; 8/27 eyes, p=0.003).



Conclusions: CNV is common in BVMD and is readily detected using SS-OCTA imaging. Subretinal nodular pillars and FCE are distinct features of BVMD, and SS-OCTA demonstrates a correlation with these structural features and associated CNV. Further studies with longitudinal OCTA imaging are needed to further elucidate the relationship between CNV and structural changes in BVMD.

Matthew Field, MD, PhD, MPH | Autosomal Dominant Progressive Vision and Hearing Loss: *TUBB4B*-related Tubulinopathy

Primary Supervisor: Alina V. Dumitrescu, MD

Purpose: Autosomal recessive Usher syndrome is the leading cause of syndromic childhood onset retinitis pigmentosa and congenital deafness. Recently, pathogenic variants in *TUBB4B* have similarly been shown to cause early onset progressive hearing and vision loss but in an autosomal dominant manner. The purpose of this study was to identify patients with *TUBB4B* pathogenic variants and to characterize the disease phenotype in these individuals.

Methods: A retrospective chart review was conducted of patients seen in the adult and pediatric retinal inherited disease clinics at the University of Iowa between 2012 and 2022 to identify patients with retinal changes, hearing loss, and a likely causative mutation in *TUBB4B*.

Results: Six patients with likely causative heterozygous mutations in *TUBB4B* were identified from three different families. In Family 1, Patient 1 had a *de novo* Arg262His mutation that was passed to her three daughters. Patient 5 had a Val60Leu mutation and Patient 6 had a mutation in Arg391His. The Val60Leu and Arg262Gln mutations have not been previously described and were predicted pathogenic by multiple algorithms. All patients had mild to moderate hearing loss that required hearing aids in the first years of life, which usually preceded vision loss. Visual symptoms and disease progression were quite variable, ranging from 20/25 to 20/200 vision in the first decade of life with more severe and earlier-onset disease associated with the Arg391His variant. In patients with mild disease, macula OCT demonstrated hyperreflective irregularities in the ellipsoid zone and photoreceptor outer segments within the fovea. More advanced disease demonstrated outer retinal atrophy of the macula and peripheral retina.

Conclusions: Pathogenic variants in *TUBB4B* should be considered in patients with early onset, progressive, hearing and vision loss, especially in those with an autosomal dominant inheritance. Correct and complete diagnosis impacts prognosis and family planning. As hearing loss often precedes visual symptoms, *TUBB4B* is also now included in most hearing loss gene panels.

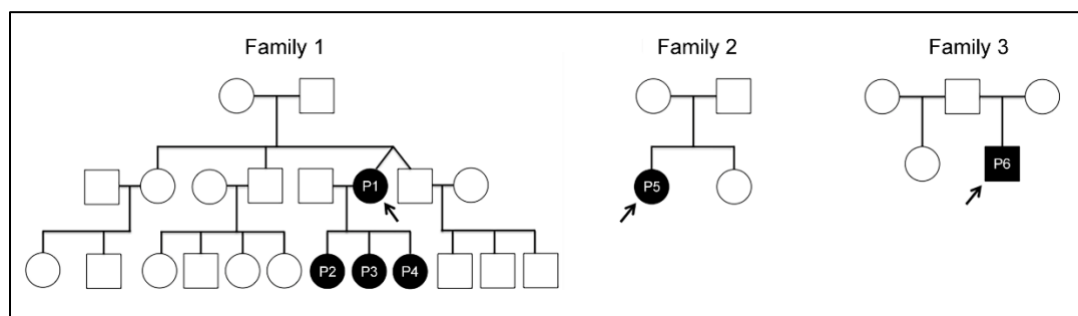


Figure. Genetic pedigrees of six patients (black) in three families with *TUBB4B*-related tubulinopathy. Arrows indicate proband.

R. Christopher Bowen MD, MS | Grading Ocular Disease Severity in Patients with von Hippel-Lindau Disease

Primary Supervisor: Elaine Binkley, MD

Co-authors: Lola P. Lozano, H. Culver Boldt, MD, Budd A. Tucker, PhD

Purpose: Autosomal recessive Usher syndrome is the leading cause of syndromic childhood onset retinitis pigmentosa and congenital deafness. Recently, pathogenic variants in *TUBB4B* have similarly been shown to cause early onset progressive hearing and vision loss but in an autosomal dominant manner. The purpose of this study was to identify patients with *TUBB4B* pathogenic variants and to characterize the disease phenotype in these individuals.

Methods: A retrospective chart review was conducted of patients seen in the adult and pediatric retinal inherited disease clinics at the University of Iowa between 2012 and 2022 to identify patients with retinal changes, hearing loss, and a likely causative mutation in *TUBB4B*.

Results: Six patients with likely causative heterozygous mutations in *TUBB4B* were identified from three different families. In Family 1, Patient 1 had a *de novo* Arg262His mutation that was passed to her three daughters. Patient 5 had a Val60Leu mutation and Patient 6 had a mutation in Arg391His. The Val60Leu and Arg262Gln mutations have not been previously described and were predicted pathogenic by multiple algorithms. All patients had mild to moderate hearing loss that required hearing aids in the first years of life, which usually preceded vision loss. Visual symptoms and disease progression were quite variable, ranging from 20/25 to 20/200 vision in the first decade of life with more severe and earlier-onset disease associated with the Arg391His variant. In patients with mild disease, macula OCT demonstrated hyperreflective irregularities in the ellipsoid zone and photoreceptor outer segments within the fovea. More advanced disease demonstrated outer retinal atrophy of the macula and peripheral retina.

Conclusions: Pathogenic variants in *TUBB4B* should be considered in patients with early onset, progressive, hearing and vision loss, especially in those with an autosomal dominant inheritance. Correct and complete diagnosis impacts prognosis and family planning. As hearing loss often precedes visual symptoms, *TUBB4B* is also now included in most hearing loss gene panel.