The American Ophthalmological Society

ONE HUNDRED AND FIFTY-SEVENTH ANNUAL MEETING

Woodford S. Van Meter ..... **PRESIDENT**
Hans E. Grossniklaus ..... **EXECUTIVE VICE PRESIDENT**
Hans E. Grossniklaus ..... **EDITOR OF THE TRANSACTIONS**

COUNCIL

Edward G. Buckley
Julia A. Haller
William F. Mieler
Preston H. Blomquist
Stephen D. McLeod

MAY 21–23, 2021
VIRTUAL

The American Ophthalmological Society

Office of the Executive Vice President
Atlanta, GA
May 2021

THE ONE HUNDRED AND FIFTY-SEVENTH ANNUAL MEETING
of the Society will be held virtually

Friday through Sunday
May 21–23, 2021

COMMITTEE ON PROGRAMS

Jayne S. Weiss, Chair
Peter A. Netland
Sean P. Donahue
Jennifer I. Lim

The American Ophthalmological Society

THE ONE HUNDRED AND FIFTY-SEVENTH ANNUAL MEETING

TABLE OF CONTENTS

TARGET AUDIENCE

This activity has been designed to meet the educational needs of ophthalmologists across all subspecialties involved in clinical or surgical eye care, academic, and leadership who are actively involved in or previously cared for patients.

MEETING OBJECTIVES

The objectives of the 2021 Annual Meeting are to:

1. Apply newer testing strategies to evaluation of patients with retinal, optic nerve or corneal diseases.
2. Explain and appraise the application of artificial intelligence to the improvement of the clinical practice of ophthalmology.
3. Define and distinguish COVID-19 prevention and management strategies, describe ophthalmic findings, and learn how to evaluate and analyze impact of COIVD-19 in ophthalmic practice.
4. Recognize and describe updates in diagnosis and treatment of various ophthalmic diseases including retinoblastoma, glaucoma, optic nerve disease and external disease such as blepharitis.
5. Formulate optimal prophylaxis/treatment antibiotic regimen for endophthalmitis by application of latest resistance data.
6. Explain the impact of endothelial mesenchymal transition on wet adult macular dystrophy and recognize modifiable factors in disease development.

ACCREDITATION STATMENT

In support of improving patient care, this activity has been planned and implemented by Medical Education Resources (MER) and American Ophthalmological Society. MER is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

PHYSICIAN CREDIT DESIGNATION STATEMENT

Medical Education Resources designates this live activity for a maximum of 10.5 *AMA PRA Category 1 Credits™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

FINANCIAL DISCLOSURE / CONFLICTS OF INTEREST

It is the policy of Medical Education Resources to ensure balance, independence, objectivity, and scientific rigor in all of its educational activities. In accordance with this policy, MER identifies conflicts of interest with its instructors, content managers, and other individuals who are in a position to control the content of an activity. Conflicts are resolved by MER to ensure that all scientific research referred to, reported, or used in a continuing education activity conforms to the generally accepted standards of experimental design, data collection, and analysis.

Relevant financial disclosures of all presenting authors, staff, and members of the Committee on Programs are listed on pages 8–9 in the program book. If the presenter has a financial disclosure related to the specific presentation, the disclosure will be stated verbally and presented on the first slide of their presentation. Audience participants are required to state their financial disclosure before they join a discussion of a paper or poster.

FDA STATUS DISCLAIMER

Some material on recent developments may include information on drug or device applications that are not considered community standard, that reflect indications not included in approved FDA labeling, or that are approved for use only in restricted research settings. This information is provided as education only so physicians may be aware of alternative methods of the practice of medicine, and should not be considered endorsement, promotion, or in any way encouragement to use such applications. The FDA has stated that it is the responsibility of the physician to determine the FDA status of each drug or device he or she wishes to use in clinical practice, and to use these products with appropriate patient consent and in compliance with applicable laws.

The Society provides the opportunity for material to be presented for educational purposes only. The material represents the approach, ideas, statement, or opinion of the presenter and/or author(s), not necessarily the only or best methods or procedure in every case, nor the position of the Society. The material is not intended to replace the physician's own judgment or give specific advice for case management. The Society specifically disclaims any and all liability for injury or other damages of any kind for any and all claims that may arise out of the use of any technique demonstrated or described in any material by any presenter and/or author(s), whether such claims are asserted by a physician or any other person.

PARTICIPATION AND CONSENT TO BE RECORDED

The entire 2021 Annual Meeting will be recorded for subsequent posting on the Society's website, including discussion. Submitting questions to discuss a presentation is considered implicit consent to the participant's discussion being included in this recording. Attendees who do not wish to be recorded should refrain from submitting questions.

BYLAWS

The following Bylaws are published each year in the program as a reminder to the members of the Society:

ARTICLE IX, Section 3 – Any member who shall be absent from meetings for three consecutive years without acceptable excuse shall be dropped from the roll, except for Honorary Members, Emeritus Members, Members of twenty years standing or those then serving in the armed forces. An excuse for absence is acceptable only when a member is ill, or when there is illness of a member of his or her immediate family and may not be considered approved until received in written form and acted upon by the Council. The Council shall have the authority to approve other excuses only upon a finding of exceptional circumstances. This Bylaw shall be printed in every call for the Annual Meeting.

MEMBER THESES ACCEPTED AFTER 2019 ANNUAL MEETING

J. Fernando Arevalo	Baltimore, MD
Mary Louise Collins	Baltimore, MD
Amani Fawzi	Chicago, IL
Suzanne Freitag	Boston, MA
David Gamm	Madison, WI
Neeru Gupta	Toronto, ON, Canada
Dean Hainsworth	Columbia, MO
G. Baker Hubbard	Atlanta, GA
Carol Karp	Miami, FL
John Kempen	Boston, MA
Christopher Leffler	Glen Allen, VA
Thomas Lietman	San Francisco, CA
Michele Lim	Sacramento, CA
Tatyana Milman	Jenkintown, PA
Kouros Nouri-Mahdavi	Los Angeles, CA
Pradeep Ramulu	Baltimore, MD
Karolinne Rocha	Charleston, SC
Srinivas Sadda	Los Angeles, CA
José-Alain Sahel	Pittsburgh, PA
Ursula Schmidt-Erfurth	Vienna, Austria
Justine Smith	Adelaide, SA, Australia
Eric Souied	Creteil, France
Richard Spaide	New York, NY
Michael Stewart	Jacksonville, FL
Donny Suh	Omaha, NE
Jeremiah Tao	Irvine, CA
Fotis Topouzis	Thessaloniki, Greece
Thasarat Vajaranant	Chicago, IL
George Waring, IV	Charleston, SC
Tien Wong	Singapore

IN MEMORIAM

The Executive Vice President has received notice of the deaths of the following members during the past year:

George W. Blankenship, MD	Hilton Head, NC	Joined 1986
Ralph S. Hamilton, MD	Germantown, TN	Joined 1966
Roger L. Hiatt, MD	Memphis, TN	Joined 1973
Edward A. Jaeger, MD	Media, PA	Joined 1980
Frederick A. Jakobiec, MD	Boston, MA	Joined 1984
Arthur Jampolsky, MD	San Francisco, CA	Joined 1970
Malcolm N. Luxenberg, MD	Evans, GA	Joined 1979
Richard P. Mills, MD	Seattle, WA	Joined 1999
Edward Okun, MD	Tesuque, NM	Joined 1972
William C. Owens, MD	Boerne, TX	Joined 1953
Guillermo Pico, Sr., MD	Rio Piedras, PR	Joined 1957
Ellen F. Regan, MD	Tuxedo Park, NY	Joined 1957
Robert B. Welch, MD	Baltimore, MD	Joined 1970

FINANCIAL DISCLOSURES

The following are the relevant healthcare-related financial disclosures of those involved in the preparation or presentation of this AOS event. The AOS Committee on Programs gathered this information to plan the program and has attempted to manage relevant conflicts of interest to present a balanced program. The presenter will indicate on the first slide and verbally at the beginning of the talk, if any of the financial disclosures listed has a relationship to the specific presentation. Participants that might speak from the floor are required to state their financial disclosures before they speak.

CATEGORY	CODE	DESCRIPTION
Consultant/ Advisor	C	Consultant fee, paid advisory boards or fees for attending a meeting (for the past 1 year)
Employee	E	Employed by a commercial entity
Lecture Fees	L	Lecture fees (honoraria), travel fees or reimbursements when speaking at the invitation of a commercial entity (for the past 1 year)
Equity Owner	O	Equity ownership/stock options of publicly or privately traded firms (excluding mutual funds) with manufacturers of commercial ophthalmic products or commercial ophthalmic services
Patents/Royalty	P	Patents and/or royalties that might be viewed as creating a potential conflict of interest
Grant Support	S	Grant support for the past 1 year (all sources) and all sources used for this project

ASBELL, Penny
C – Bausch Health

BROWNING, David
O – Zeiss-Meditec
P – Springer
S – Alcon, Apellis, DRCR Retina Network, Novartis, Regeneron

BUDENZ, Donald
L – Carl Zeiss Meditec

CHEN, Teresa
S – Fidelity Charitable Fund, Department of Defense Small Business Innovation Research DHP15-016

CHIANG, Michael
C – Novartis
O – InTeleretina
S – Genentech, NIH, NSF

DONAHUE, Sean*
C – Gobiquity

FOSTER, William
S – Ipsen

HUANG, David
O, P – Optovue

JONAS, Jost
P – Patent application: European patent application 16 720 043.5 and US patent application US 2019 0085065 A1, Agents for use in the therapeutic or prophylactic treatment of myopia or hyperopia)

KOCH, Douglas
C – Alcorn, Carl Zeiss Meditec, Johnson & Johnson Surgical Vision

LIM, Jennifer*
C – Aura Biosciences, Cognition, Genentech, Iveric, Novartis, Opthea, Quark, Regeneron, Santen
S – Aldyra, Chengdu, Genentech, Graybug, NGM, Regeneron, Stealth

MACSAI, Marian
E – Oyster Point Pharma

OLSEN, Timothy
C – American Academy of Ophthalmology
E – iMacular Regneration LLC
S – NIH/NEI, Novartis

ROSEN, Richard
C, L, P – Optovue

SARRAF, David
C – Amgen, Bayer, Genentech, Novartis, Optovue
L – Bayer, Novartis, Optovue
S – Amgen, Genentech, Heidelberg, Optovue, Regeneron, Topcon

SEDDON, Johanna
O – Gemini Therapeutics

WALLACE, David
P – FocusROP (ROPtool)

NO RELEVANT FINANCIAL RELATIONSHIPS TO DISCLOSE

ADELMAN, Ron
ALABDULJABBAR, Mohammad
AZAR, Dimitri
BAKSH, Brandon
BARTLEY, George
BUCKLEY, Edward
BULLOCK, John
CHAN, Robison
COHEN, Adam
COLLINS, Mary Louise
CRAWFORD, Brooks
CUTOLO, Carlo
DAY, Susan
DUA, Harminder
DUPPS, William
EAGLE, Ralph
ESMAELI, Bita
EVANS, Alissa
FAUCI, Anthony
FAWZI, Amani
FECHTNER, Robert
GALOR, Anat
GOOD, William
GROSSNIKLAUS, Hans
HALLER, Julia
HARTNETT, M. Elizabeth
HO, Joanne
JAGER, Martine
JOHNSON, Mark
LEE, Benjamin
LEVIN, Alex
LISCH, Walter
LUDWIG, Irene
MANSBERGER, Steven
McCULLEY, Timothy
McLEOD, Stephen
MEHRA, Divy
MENDEZ, Amber
MIELER, William
MILMAN, Tatyana
NETLAND, Peter*
NEWMAN, Steven
NIX, G. Conner
SADUN, Alfredo
SCHUBERT, Hermann
SHIELDS, Carol
SUH, Donny
TAYLOR, Hugh
TSANG, Stephen
VAN METER, Woodford
WEISS, Jayne*
WILSON, M. Edward
YU, Angeli Christy

**Members of the Committee on Programs*

American Ophthalmological Society

Virtual Event Schedule

**Times are listed in Pacific Time*

FRIDAY, MAY 21

6:50 AM–7:00 AM	**Welcome to AOS 2021**
7:00 AM–7:30 AM	**Inaugural Marilyn T. Miller Lecture** *COVID-19 in 2021: Lessons Learned and Remaining Challenges*, Presented by Dr. Anthony Fauci
7:30 AM–9:00 AM	**Knapp Symposium** *COVID-19: What We Thought We Knew, What We Learned and Future Strategies*
9:15 AM–10:35 AM	**Scientific Program: Paper Presentations I** (Retina)
10:50 AM–12:30 PM	**Scientific Program: Paper Presentations II** (Cornea)

SATURDAY, MAY 22

7:00 AM–7:30 AM	**Executive Session** (Members Only)
7:45 AM–9:20 AM	**Saturday Symposium** *I Wish I Hadn't Done That, I Wish I Hadn't Thought That, or I Wish I Had Thought That!*
9:30 AM–11:15 AM	**Scientific Program: Paper Presentations III** (Retina)
11:25 AM–12:00 PM	**7th Annual Artistic Soiree**
12:00 PM–12:30 PM	**AOS Medal Presentation**

American Ophthalmological Society

Virtual Event Schedule

**Times are listed in Pacific Time*

SUNDAY, MAY 23

7:00 AM–9:00 AM	**Scientific Program: Paper Presentations IV** (Neuro / Glaucoma)
9:00 AM–9:15 AM	**Closing Remarks**

ON-DEMAND

ON-DEMAND	**Scientific Posters**
ON-DEMAND	**New Member Spotlight Presentations**
ON-DEMAND	**Renaming of the AOS Lucien Howe Medal**

FRIDAY, MAY 21

Marilyn T. Miller Lecture

COVID-19 IN 2021: LESSONS LEARNED AND REMAINING CHALLENGES

Anthony S. Fauci, MD
National Institute of Allergy and Infectious Diseases
Bethesda, MD

Herman Knapp Symposium

COVID-19: WHAT WE THOUGHT WE KNEW, WHAT WE LEARNED, AND FUTURE STRATEGIES

GLOBAL CLINICAL OPHTHALMOLOGY AND COVID-19 – WHAT WE CAN LEARN FROM AUSTRALIA AND NEW ZEALAND

Hugh R. Taylor, AC, MD, FRAC
University of Melbourne
Carlton, VI, Australia

MANAGING AN OPHTHALMOLOGY DEPARTMENT/OPHTHALMOLOGY PRACTICE DURING A PANDEMIC

Stephen D. McLeod, MD
University of California, San Francisco
San Francisco, CA

THE POST COVID VIRTUAL WORLD – TELEMEDICINE, CME, AND CERTIFICATION

Michael F. Chiang, MD
National Eye Institute
Bethesda, MD

EYE FINDINGS IN COVID-19

Anat Galor, MD MSPH
University of Miami
Miami, FL

SATURDAY, MAY 22

Saturday Symposium

I WISH I HADN'T DONE THAT, I WISH I HADN'T THOUGHT THAT, OR I WISH I HAD THOUGHT THAT!

NEURO

Steven Newman, MD
University of Virginia
Charlottesville, VA

RETINA

William F. Mieler, MD
University of Illinois, Chicago
Chicago, IL

GLAUCOMA

Peter A. Netland, MD
University of Virginia
Charlottesville, VA

PEDIATRICS

Sean P. Donahue, MD, PhD
Vanderbilt Medical Center
Nashville, TN

CORNEA

Douglas D. Koch, MD
Cullen Eye Institute
Houston, TX

PLASTICS

George B. Bartley, MD
Mayo Clinic
Rochester, MN

AOS 2021
Paper Abstracts

The following abstracts of papers selected to be presented at the meeting are printed in presentation order. The order of presentations has been arranged as follows by the Committee on Programs.

Papers presented at this meeting may be published in other medical journals after this meeting PROVIDED THE AUTHORS ADHERE TO THE STRICT GUIDELINES IN THE AUTHOR INSTRUCTIONS LISTED AT aosonline.org AND CONSULT WITH THE EDITOR OF THE TRANSACTIONS.

Papers are limited to 7 minutes and the first discussant to 3 minutes.
General discussion will be limited to 10 minutes.

Please note the following program key:

Bold = *AOS Member*
* = *Presenter*
♦ = *Financial Disclosure*

(Presenters will indicate their financial disclosure verbally and in their first slide.)

PA-01 9:15–9:35 AM

LIKELIHOOD OF GERMLINE MUTATION WITH SOLITARY UNILATERAL RETINOBLASTOMA BASED ON PATIENT AGE AT PRESENTATION

Carol Shields*, Philip Dockery, Megan Ruben, Antonio Yaghy, **Jerry Shields**

Purpose: To evaluate the likelihood of germline retinoblastoma in patients presenting with solitary unilateral retinoblastoma, based on age at presentation.

Methods: Retrospective case series of 482 consecutive patients presenting with solitary unilateral retinoblastoma. Analysis for likelihood of germline retinoblastoma, defined as family history of retinoblastoma, germline retinoblastoma mutation documented on genetic testing, and/or development of bilateral disease and/or additional new tumors. This analysis was based on age at presentation (0-12 months versus (vs.) >12-24 months vs. >24-36 months vs. >36 months) and a sub-study was conducted on infant age at presentation (0-3 months vs. >3-6 months, vs. >6-9 months vs. >9-12 months).

Results: Of the overall group (n=482 consecutive patients) with solitary unilateral retinoblastoma, there were significantly different findings in the youngest age group (0-12 months old) with greater family history of retinoblastoma (10% vs. 2% vs. 1 vs. 2%, p=0.004), smaller median basal diameter (18.0 vs. 20.0 vs. 20.0 vs. 20.0 millimeters (mm), p=0.014), smaller median tumor thickness (8.7 vs. 10.0 vs. 11.5 vs. 10.0 mm, p=0.002), greater macular tumor location (33% vs. 16% vs. 10% vs. 8%, p<0.001), and greatest likelihood of germline mutation (29% vs. 17% vs. 8% vs. 9%, p=0.001). By comparison, patients ≤1 year (vs. >1 year) demonstrated 2.96 odds ratio (OR) (p=0.001) for likelihood of germline retinoblastoma. For those classified as infants (≤1 year) (n=132 consecutive patients), the youngest patients (0-3 months old) demonstrated greatest likelihood for germline mutation (61% vs. 20% vs 24% vs 22%, p=0.009) and greatest odds ratio (5.52, p=0.002) compared to >3-12 months old.

Conclusion: The youngest patients with solitary unilateral retinoblastoma showed greatest likelihood of germline disease when evaluating all patients (≤1 year vs. >1 year of age) (OR 2.96) and sub-study of infants (≤3 months vs. >3-12 months of age) (OR 5.52).

Discussant: **Timothy W. Olsen♦**

PA-02 9:35–9:55 AM

EVALUATION AND APPLICATION OF A DEEP LEARNING-BASED QUANTITATIVE SEVERITY SCALE FOR RETINOPATHY OF PREMATURITY

Michael Chiang*♦, Jayashree Kalpathy-Cramer, Sang Jin Kim, Stanford Taylor, Kishnan Gupta, **R.V. Paul Chan**, J. Peter Campbell

Purpose: Retinopathy of prematurity is a leading cause of childhood blindness worldwide, but clinical diagnosis is subjective and qualitative. This study describes a quantitative vascular severity scale derived using deep learning, determines the relationship between this quantitative scale and clinical exam findings, measures clinician agreement using this scale, and evaluates the application of this quantitative scale to disease progression and regression.

Methods: This study utilized data collected by the Imaging and Informatics in ROP (i-ROP) consortium and was IRB-approved at each center. Deidentified images (RetCam; Natus Medical Incorporated) captured after clinical examinations between July 2011 and December 2016 were assessed. Each exam was assigned a reference standard diagnosis (plus, pre-plus, normal) using published methods. A deep learning system was used to classify the probability of an image having a reference standard diagnosis of plus disease and converted to an automated 1 (most benign) to 9 (most severe) scale. Inter-observer agreement among 5 clinicians using this scale was assessed. Quantitative scale values were analyzed for 5255 clinical examinations in 871 infants and reported using descriptive statistics.

Results: A higher vascular severity score was associated with more posterior disease ($p<0.001$) and higher disease stage ($p<0.001$). For inter-observer agreement of clinicians using this scale, mean (±standard Deviation [SD]) weighted kappa was 0.67 (±0.06) and Pearson correlation coefficient was 0.88 (±0.04). When long-term differences in the median severity scores across time between the eyes progressing to treatment and those who did not eventually require treatment were compared, the median score was higher in the treatment group by 0.06 at 30-32 weeks, 0.75 at 32-34 weeks, 3.56 at 34-36 weeks, 3.71 at 36-38 weeks, and 3.24 at 38-40 weeks postmenstrual age ($p<0.001$ for all comparisons). Mean (±SD) vascular severity scores significantly increased 2 weeks prior to treatment (4.19 [±1.75]), peaked at treatment (7.43 [±1.89]), and decreased for at least 2 weeks after treatment (4.00 [±1.88]) (all $p< 0.001$).

Conclusion: A deep-learning derived vascular severity scale for ROP appears feasible for clinical adoption, corresponds with current clinical classification of severity, and may have benefits regarding accuracy and consistency of disease classification.

Discussant: **David K. Wallace**♦

PA-03 9:55–10:15 AM

RETINAL HEMORRHAGE PATTERNS: A NEW PARADIGM

Alex Levin*, Gil Binenbaum, Brian Forbes

Purpose: The current paradigm for interpretation of retinal hemorrhages (RH) focuses on diagnosis of abusive head trauma based upon severity of RH, for which classifications have been published. While RH severity has value, there is overlap in severity between accidental and abusive injuries; some patterns are diagnostic even if RH are not severe, and medical diagnoses are not addressed. We sought to develop a new paradigm for RH interpretation using patterns that distinguish medical from traumatic causes of RH.

Methods: Three masked ophthalmologists reviewed 188 fundus photographs of RH from many causes in an iterative process to identify patterns that distinguish medical from traumatic causes. Based upon these patterns, a new framework for interpreting retinal findings in child abuse evaluations was developed.

Results: Distinguishing patterns were defined. Traumatic patterns included "peri-macular," "central macular sparing," "mid-peripheral sparing," "cherry hemorrhages," "too numerous to count hemorrhages with non-radiating areas," and "carpeting". Medical patterns included sectoral distribution, numerous RH in radiating pattern, superficial peripapillary RH with disc swelling, and primarily peripapillary preretinal or vitreous hemorrhage. Presence of focal white lesions, lipid, or disc swelling also supported a medical cause.

Conclusion: In a newly developed paradigm, diagnostic interpretation of RH should first involve ophthalmologist identification of these patterns to distinguish between a medical and traumatic cause, not to diagnose abuse. Once a traumatic pattern is identified, the severity of RH and non-ocular injuries can be used by the child abuse team to evaluate the plausibility of the history provided by caregivers.

Discussant: **R.V. Paul Chan**

PA-04 10:15–10:35 AM

IN VITRO ANTIBIOTIC RESISTANCE AMONG BACTERIAL ISOLATES COLLECTED FROM THE AQUEOUS AND VITREOUS HUMOR IN THE ARMOR STUDY

Penny A. Asbell[*♦], Christine M. Sanfilippo, Heleen H. DeCory

Purpose: Endophthalmitis is a rare but potentially serious complication of ocular surgery and intraocular injections. Antibiotics are used as prophylaxis against and/or treatment of endophthalmitis but can be compromised by antibiotic-resistant bacteria. We examined in vitro resistance profiles among intraocular isolates collected from 2009 through 2020 to date in the Antibiotic Resistance Monitoring in Ocular micRoorganisms (ARMOR) study, the only ongoing nationwide surveillance study tracking resistance among ocular pathogens.

Methods: Presumed endophthalmitis isolates from the aqueous humor (AqH) and vitreous humor (ViH) were collected each year from multiple sites across the USA as part of ARMOR. Minimum inhibitory concentrations (MICs) for various antibiotics were determined by broth microdilution according to Clinical and Laboratory Standards Institute guidelines and isolates were interpreted as susceptible or resistant (intermediate and full resistance) based on established systemic criteria.

Results: A total of 290 isolates were obtained (n=87 AqH; n=203 ViH) from 42 sites in 22 states. Among S. aureus (n=61) and coagulase-negative staphylococci (CoNS; n=172) respectively, resistance to oxacillin/methicillin (46% and 49%), azithromycin (57% and 59%), and ciprofloxacin (44% and 48%) was observed; 41% and 48% were multidrug-resistant (MDR; ≥3 classes) with MDR >70% in methicillin-resistant strains. For S. pneumoniae isolates (n=30), resistance was observed to azithromycin, penicillin (37% each), and chloramphenicol (7%); 1 isolate demonstrated intermediate gatifloxacin resistance. No H. influenzae (n=13) or P. aeruginosa (n=14) exhibited resistance to the tested antibiotics, with the exception of 3 ciprofloxacin-resistant P. aeruginosa isolates.

Conclusion: In this analysis of presumed endophthalmitis isolates, in vitro antibiotic resistance was prevalent among staphylococci, a high proportion of which were MDR, and among pneumococci. These data should be considered when selecting antibiotics for infection prophylaxis and/or treatment of intraocular infections.

Discussant: **Dimitri T. Azar**

PA-05 10:50–11:10 AM

ROLE OF TOPICAL 5-FLUOROURACIL IN DEMODEX-ASSOCIATED BLEPHARITIS

Joanne Ho*, Despoina Theotoka, Sarah Wall, **Anat Galor**, Anny Cheng, **Carol Karp**

Purpose: To report the effect of topical 5-fluorouracil (5-FU) in Demodex-associated blepharitis.

Methods: Twelve eyes from 11 patients (10 patients were male) with ocular surface squamous neoplasia or papilloma requiring treatment with topical 5-FU and concomitant bilateral Demodex lash infestation were identified. Seven patients were white and the remaining were of Hispanic ethnicity. Patients (mean age of 67 +/- 15 years, range 30-83 years) were treated with cycles of topical 5-FU 1% eye drops four times daily for one week with a 3-week drug holiday. Clinical photos were taken at baseline and at each follow up visit.

Results: Clinical evidence of Demodex blepharitis was incidentally noted to be markedly reduced after 5-FU treatment compared to the untreated eye. There was reduction in cylindrical collarettes and improved lid margin inflammation in all eyes treated with 5-FU (4 +/- 2 cycles). The one patient who had bilateral topical 5-FU treatment exhibited dramatic reduction in Demodex infestation in both eyes compared to pre-treatment.

Conclusion: These observations are the first, to our knowledge, to suggest the efficacy of 5-FU in treating Demodex-associated blepharitis. A systematic evaluation with ex and in vivo analysis is needed in the future to evaluate the mechanism of action of 5-FU on this disease, and its potential use in the treatment of Demodex blepharitis.

Discussant: **Marian S. Macsai♦**

PA-06 11:10–11:30 AM

VALIDATION OF THE NEWLY PROPOSED WHO CLASSIFICATION SYSTEM FOR CONJUNCTIVAL MELANOCYTIC INTRAEPITHELIAL LESIONS: A COMPARISON WITH THE 'C-MIN' AND 'PAM' CLASSIFICATION SCHEMES

Tatyana Milman*, Maya Eiger-Moscovich, Roger Henry, Robert Folberg, Sarah Coupland, **Hans Grossniklaus**, Hardeep Mudhar, Charles Eberhart, Steffen Heegaard, Claudia Aud-Hädrich, **Carol Shields**, **Ralph Eagle**

Purpose: To compare the sensitivity, specificity, accuracy, and inter-observer agreement of the two most commonly used classification systems for conjunctival melanocytic intraepithelial lesions with the new WHO classification.

Methods: Retrospective review and evaluation of classification systems. Pathology and medical records of all patients, who underwent primary biopsy for conjunctival primary acquired melanosis (PAM) at Wills Eye Hospital between 1974 and 2002, with at least 36 months follow-up were reviewed. Data collected included age, sex, clinical findings, recurrence, and progression to melanoma. Twelve ophthalmic pathologists analyzed scanned hematoxylin-and-eosin stained virtual microscopic slides using three classification systems: PAM, conjunctival melanocytic intraepithelial neoplasia (C-MIN) and the World Health Organization (WHO) 4th edition classification of conjunctival melanocytic intraepithelial lesions (CMIL). Observer agreement, sensitivity, specificity, and diagnostic accuracy of each classification system were assessed.

Results: There were 64 patients who underwent 83 primary excisions with cryotherapy for conjunctival PAM, with adequate tissue for histopathologic evaluation. The inter-observer percent agreement in distinction between the low-grade and high-grade lesions was 76% for PAM, 67% for C-MIN, and 81% for WHO classification system. Low-grade lesions provided the greatest interpretative challenge with all three classification systems. The three classification systems had comparable accuracy of 81%-83% in their ability to identify lesions with potential for recurrence.

Conclusion: This study highlights the comparable strengths and limitations of the three classification systems for conjunctival melanocytic intraepithelial lesions and suggests that the simplified WHO classification scheme is appropriate for evaluation of these lesions.

Discussant: **J. Brooks Crawford**

PA-07 11:30–11:50 AM

CLASSIFYING CORNEAL EPITHELIAL IRREGULARITIES AS PRIMARY DEFORMATION VERSUS SECONDARY MODULATION ON OCT MAPS

David Huang[*♦], Elias Pavlatos, Yan Li

Purpose: OCT is the only non-contact imaging modality with sufficient resolution to map corneal epithelial thickness. Epithelial irregularity is a sensitive indicator of many corneal pathologies. We aim to classify these pathologies as either primary deformation or secondary modulation (compensatory epithelial smoothing over primary stromal irregularity).

Methods: A spectral-domain OCT system (Avanti, Optovue) was used to map the cornea over the central 6 mm. The epithelial pattern standard deviation (PSD) was calculated by root-mean-square of thickness pattern deviation relative to the normal population average. The epithelial modulation (EM) index was calculated based on the covariance between epithelial thickness deviation and anterior topographic mean curvature deviation.

Results: 89 eyes from 63 keratoconus patients (Kmax 57.6 ± 7.3 D, mean ± standard deviation; range 44.5– 88.0 D), 18 eyes from 9 contact lens-related warpage patients, and 32 eyes from 16 normal subjects were prospectively enrolled. The epithelial PSD was abnormal for all keratoconus eyes and a subset of the warpage eyes (8/18). Topographic curvature deviation was weakly correlated with epithelial thickness deviation in warpage cases (EM index = 1.5 ± 4.1) and strongly negatively correlated in keratoconus cases (EM index = -103.0 ± 82.9). Repeated 5-fold cross-validation of a logistic regression model revealed that the EM index had an average classification accuracy of 100 ± 0% for the keratoconus eyes and 98.9 ± 2.2% for the warpage group.

Conclusion: Primary epithelial deformation, represented by warpage, and secondary epithelial modulation, represented by keratoconus, could be accurately distinguished by comparing OCT topographic mean curvature and epithelial thickness map patterns. Further work could extend this analysis to the classification of other primary epithelial deformations (dry eye, epithelial basement membrane dystrophy) and secondary epithelial modulations (ectasia, stromal dystrophy, scar, surgery).

Discussant: **William J. Dupps, Jr.**

PA-08 11:50 AM–12:10 PM

REVISITED CORNEAL ANATOMY: STROMAL PEELING OF PENETRATING KERATOPLASTY GRAFTS THROUGH A NEWLY IDENTIFIED NATURAL SURGICAL PLANE OF SEPARATION

Angeli Christy Yu*, **Massimo Busin**

Purpose: To describe the outcomes of 9mm deep anterior lamellar keratoplasty (DALK) in post-penetrating keratoplasty (PK) eyes with recurrent stromal disease and evaluate the ultrastructural morphologic features of the surgical plane of separation in grafts that required conversion to PK.

Methods: Stromal peeling was attempted in 67 consecutive eyes with recurrent stromal disease (keratectasia (n=56), granular corneal dystrophy (n=6), herpetic keratitis (n=5)). Partial-thickness trephination of the recipient bed was performed outside the PK graft at 9mm. From the base of the trephination, a partial anterior flap was created across the PK wound. Using blunt scissors, the stromal component of the PK wound was opened until a smooth, translucent plane of separation was identified. After severing the attachment of the PK scar to the recipient host, the stroma of the PK button was peeled off from the underlying bed without performing any pneumatic, hydro-, or viscoelastic-assisted dissection. The 9mm donor lamella was sutured onto the host cornea.

Results: Of 67 eyes, stromal exchange succeeded in 57 cases (85.1%). After complete suture removal, average logMAR BSCVA improved significantly to 0.18±0.11 ($p<0.001$). Refractive astigmatism was >4.5 D in 4 eyes (7%). Mean keratometric astigmatism was 2.2±1.5 D. Mean ECL at 1 year was 5%. Transmission electron microscopy demonstrated posterior portions of the anterior lamella were lined with an uninterrupted layer of keratocytes with modified morphology. The posterior lamella consisted of posterior stroma, pre-Descemetic layer, Descemet membrane and endothelium.

Conclusion: Postoperative changes in stromal microarchitecture after PK allow stromal exchange through simple peeling along a natural plane of separation without the need of any type of deep anterior lamellar dissection in eyes that have undergone PK. Large diameter (9 mm) keratoplasty through stromal peeling can be successfully performed in post-PK eyes with recurrent stromal disease, yielding excellent visual outcomes with minimal endothelial cell loss.

Discussant: **Harminder S. Dua**

PA-09 12:10–12:30 PM

AGE MATTERS! COMPARING CLINICAL TRIAL OUTCOMES OF CATARACT SURGERY AT SURGERY AGES 1-7 MONTHS (IATS & TAPS), TO OUTCOMES AT 7-24 MONTHS (TAPS) AND 2-7 YEARS (STORM DATABASE)

M. Edward Wilson*, Rupal Trivedi, Carolina Adams, Anastasia Alex

Purpose: To compare outcomes after pediatric cataract surgery at 3 age categories: 1-7 months, 7-24 months and 2-7 years.

Methods: Six groups were formed, 3 unilateral: Gr1U (Infant Aphakia Treatment Study – IATS), age 1-7 months; Gr 2U (Toddler Aphakia Treatment Study -TAPS, age 7-24 months; Gr 3U (STORM database, age 2-7 years) and 3 bilateral: Gr 1B (TAPS, age 1-7 months), Gr 2B (TAPS, age 7-24 months), Gr 3B (STORM database, age 2-7 years)

Results: Median VA was 20/159, 20/125 and 20/40-2 for Gr1U, 2U and 3U respectively. Median VA in the better seeing eye was 20/45, 20/30 and 20/22 for Gr 1B, 2B and 3B respectively. Median VA in the worse seeing eye was 20/60, 20/66 and 20/30 for Gr 1B, 2B and 3B respectively. Surgery for removal of a postoperative visual axis opacification (VAO) was required in 44.7%, 14.3% and 4% for GR1U, 2U and 3U respectively. Based on the first surgical eye, % of eyes requiring surgery for VAO was 13.5%, 7.5% and 8.6% for Gr 1B, 2B and 3B respectively. Glaucoma was diagnosed in 23% of eyes in Gr1U and 19.8% in Gr1B, while none in the other groups. Additional unplanned intraocular surgery was required in 78.1%, 14.3% and 6% eyes in Gr1U, 2U and 3U respectively. Based on the first surgical eye, % of eyes requiring unplanned intraocular reoperation was 28.1%, 15.0%, and 13.8% for Gr 1B, 2B and 3B respectively.

Conclusion: Age matters. Surgeons have sometimes generalized the results of IATS to children operated at ages beyond 7 months. Cataract surgery in toddlers and young grade-school children carries less risk for vision-threatening complications or events and better visual acuity compared to infants studied in the IATS randomized trial.

Discussant: **Mary Louise Z. Collins**

PA-10 9:30–9:50 AM

RELATIONSHIP OF HYDROXYCHLOROQUINE RETINOPATHY PROGRESSION TO STAGE AT CESSATION OF THERAPY

David Browning*♦, Rhett Koonce

Purpose: To determine the relationship of progression of hydroxychloroquine retinopathy (HCR) after drug cessation to the stage of retinopathy at cessation.

Methods: Charts and images of 17 patients with hydroxychloroquine retinopathy who had follow-up after cessation of drug were reviewed. Four ancillary studies were investigated: 10-2 visual fields (10-2 VF), multifocal electroretinography (mfERG), spectral domain or swept source optical coherence tomography (SD/SS OCT), and fundus autofluorescence (FAF) imaging. Retinopathy was graded as none, mild, moderate, and advanced for each modality.

Results: Of the 17 patients, the numbers with at least two follow-up studies to allow comparison for progression were 16, 8, 14, and 7 for 10-2 VF, mfERG, SD/SS OCT, and FAF, respectively. Median follow-ups were 25, 34, 33, and 75 months for 10-2 VFs, mfERGs, SD/SS OCTs, and FAFs, respectively. Values in the table represent the number with progression by the ancillary study column (numerator) by the number with that row stage of retinopathy at drug cessation (denominator).

Proportion with Progression

Stage	*HVF 10-2*	*MfERG*	*SD/SS OCT*	*FAF*
None	1/1	0/1	0/1	0/2
Mild	1/8	1/1	0/7	2/2
Moderate	2/4	3/3	0/1	1/1
Advanced	3/3	0/3	4/5	2/2

Not all ancillary studies show retinopathy at the time of diagnosis of HCR. mfERG shows a floor effect. Once response densities are low, detecting further progression of toxicity by this modality is not possible. A greater breadth of retinopathy progression is possible with 10-2 VF, SS/SD OCT, and FAF.

Conclusion: If hydroxychloroquine is stopped at the earliest sign of retinopathy by SD/SS OCT, the least subjective and most reliable ancillary test for retinopathy, the probability of retinopathy progression is low. The relationship of mfERG progression to stage at diagnosis is the inverse of the relationship of 10-2 VF, SD/SS OCT, and FAF to stage at diagnosis.

Discussant: **Amani Fawzi**

PA-11 9:50–10:10 AM

PENTOSAN POLYSULFATE MACULOPATHY: PREVALENCE, SPECTRUM OF DISEASE, AND CHOROIDAL IMAGING ANALYSIS BASED ON PROSPECTIVE SCREENING

David Sarraf*♦

Purpose: To report the prevalence and spectrum of disease findings in patients treated with pentosan polysulfate (PPS) on the basis of prospective multimodal retinal imaging screening of PPS users and to report the results of choroidal vascularity index (CVI) analysis and to recommend screening guidelines to best detect toxicity.

Methods: A total of 741 users of PPS were identified in the UCLA database. All of these 741 patients were contacted to arrange prospective multimodal retinal imaging including near infrared reflectance (NIR), fundus autofluorescence (FAF) and spectral domain optical coherence tomography (OCT). CVI analysis was also performed. Affected and unaffected cohorts were compared.

Results: A total of 100 PPS users agreed to participate in this study. The prevalence of PPS maculopathy was 16%. FAF and OCT displayed a wide spectrum of retinal findings. Mild PPS maculopathy was characterized by hyperreflective and hyperautofluorescent punctate lesions scattered around the fovea and in some cases, also around the optic disc. More severe cases displayed retinal pigment epithelial atrophy and even geographic atrophy. CVI was significantly greater in the affected versus the unaffected group. The affected cohort exhibited significantly greater average cumulative dosage and average duration of exposure of PPS therapy.

Conclusion: The prevalence of PPS toxic maculopathy is 15 to 20%. Multimodal retinal imaging is essential to screen for this disorder and to differentiate this common form of maculopathy from age related macular degeneration and macular dystrophy.

Discussant: **Mark W. Johnson**

PA-12 10:10–10:30 AM

RARE AND COMMON GENETIC VARIANTS AND BEHAVIORAL MODIFIABLE FACTORS ARE ASSOCIATED WITH EARLIER AGE OF PROGRESSION TO ADVANCED STAGES OF AMD IN A PROSPECTIVE ANALYSIS

Johanna Seddon[x♦]

Purpose: Genes and non-genetic factors influence progression from non-advanced to advanced age-related macular degeneration (AAMD). We determined whether genetic and lifestyle factors are associated with age of progression to AAMD prospectively, and quantified the effect on age.

Methods: Longitudinal progression to AAMD was based on the severity scale in the Age-Related Eye Disease Study database. Progression was defined as an eye that transitioned from non-advanced dry AMD without any evidence of geographic atrophy (GA) (levels 1-8) to any GA or evidence of neovascularization (NV) or both (levels ≥9) during 13 years follow up. Genotyping was performed. A stepwise selection of genetic variants with the eye as the unit of analysis, using age as the time scale, yielded 11 genetic variants associated with overall progression, adjusting for sex, education, smoking history, BMI, baseline severity scale, and AREDS treatment. Multivariate analysis was performed to calculate the effect of these genetic variants and behavioral factors on age of progression.

Results: Among 5421 eyes, 1206 progressed. Genetic variants associated with progression to AAMD were in the complement, immune, inflammatory, lipid, extracellular matrix, DNA repair and protein binding pathways. Three of these variants were significantly associated with earlier age of progression, adjusting for other covariates: CFH R1210C (P=0.019) with 4.7 years earlier age at progression among carriers of this mutation, C3 K155Q (P=0.011) with 2.44 years earlier for carriers, and ARMS2/HTRA1 A69S (P=0.012) with 0.67 years earlier per allele. Subjects who were smokers (P<.001) or had high BMI (P=0.006) also had an earlier age at progression (4.1 years and 1.4 years, respectively).

Conclusion: Carriers of rare variants in the complement pathway and a common risk allele in ARMS2/HTRA1 develop advanced disease at an earlier age, and unhealthy behaviors lead to earlier progression to AAMD, with up to 11.5 years earlier burden of disease for combined risk.

Discussant: **Martine J. Jager**

PA-13 10:30–10:50 AM

MECHANISM OF FIBROSIS IN EXPERIMENTAL MODEL OF AGE-RELATED MACULAR DEGENERATION

M. Elizabeth Hartnett*, Haibo Wang, Aniket Ramshekar, Eric Kunz

Purpose: Oxysterols accumulate in Bruch's membrane and drusen in age-related macular degeneration (AMD). The effects of these compounds on AMD pathophysiology are unknown. We tested the hypothesis that the predominant oxysterol, 7-ketocholesterol (7KC), affected choroidal endothelial cell (CEC) activation in AMD.

Methods: Human CECs were stimulated with 7KC (10 μM) or control and analyzed for markers of endothelial cells (VEGF receptor 2 [VEGFR2], CD31, VE-cadherin) and mesenchymal cells (alpha smooth muscle actin [αSMA], fibroblast activation protein [FAP]), Rac1GTP, cell migration, and activation of signaling through TGFβ or VEGFR2. Inhibition of TGFβ with SB431542 or Rac1GTP with a Rac1 inhibitor were compared to respective controls. C57Bl/6J mice received bilateral intravitreal 7KC (1 μL of 5 μM) one week before laser injury. SdOCT images (PhoenixLab) prior to harvest of eyes for lectin and αSMA-labeled choroidal flat mounts were performed one week later. Some RPE/choroid sections were analyzed for collagen 1 or TUNEL labeling two weeks after laser.

Results: Compared to control-injected, 7KC-injected eyes had 40% larger lectin-stained lesions but 86% larger lesions by OCT at one week ($p<0.01$) and 70% larger αSMA-labeled lesions ($p<0.05$) with more collagen-labeling at 2 weeks and no changes in TUNEL staining between 7KC and control groups. 7KC increased CEC migration and Rac1GTP over control, but surprisingly reduced VE-cadherin, CD31 and VEGFR2 ($p<0.01$), and increased FAP and TGFβ ($p<0.001$). Compared to respective controls, SB431542 abrogated 7KC-induced loss of VE-cadherin and VEGFR2, and increase in FAP in CECs. The Rac1 inhibitor reduced 7KC-induced CEC migration ($p<0.001$).

Conclusion: 7KC changed CECs from endothelial to mesenchymal cells through a process involving TGFβ signaling, consistent with endothelial-mesenchymal transition (EndMT). EndMT of CECs caused an increased migratory phenotype through the activation of Rac1. This process may account for the formation of fibrosis in neovascular AMD that is poorly responsive to anti-VEGF agents.

Discussant: **Hans E. Grossniklaus**

PA-14 10:50–11:10 AM

AUTOMATED CELL DENSITY MAPPING OF MACULAR SURFACE MACROPHAGES IN RETINAL VASCULOPATHIES USING CLINICAL OCT

Richard B. Rosen[*♦], Oscar Otero, Maria V. Castanos Toral, Davis Zhou, Rishard Weitz, Justin Migacz, Toco Chui

Purpose: Using a clinical OCT, we examined the relationship between surface macrophages density and perfused capillary density in the maculae of healthy eyes and with retinal vasculopathies.

Methods: 49 patients with various stages of diabetic retinopathy (DR) (49 eyes), 12 patients with SCR (12 eyes), 10 patients with RVO (10 eyes) and 14 controls (14 eyes) were imaged using clinical SD-OCT (Avanti RTVue-XR; Optovue). Ten 3x3mm scans centered at the fovea were acquired and averaged. Ocular magnification of each image was corrected for axial length. FAZ border was outlined manually on the OCT-A scan. Automated surface macrophage cell density measurements within the FAZ were performed on the 3µm OCT-R slab above the ILM surface using MATLAB. Surface macrophage cell density maps were also generated for each subject. OCT-A full vascular slab, from the ILM to 9µm below the posterior boundary of the OPL, was used to measure capillary density.

Results: Surface macrophage cells within the FAZ were found in 31% of controls, 80% of diabetic eyes, 86% of SCR eyes and 90% of RVO eyes. Statistically significant differences were observed between control and vasculopathy groups in surface macrophage cell density (Kruskal-Wallis tests, P= 0.0005) with mean±SDs of 1±1, 5±5 6±7 and 13±10 cells/mm2 in the controls, SCR, DR and RVO groups, respectively. Linear regression showed significant correlation between surface macrophage cell densities within the FAZ and perifoveal perfused capillary densities (R= -0.22, P= 0.037).

Conclusion: Clinical OCT is capable of detecting and mapping the density of macular surface macrophage cells in control and diabetic eyes. Higher surface macrophage cell density within the FAZ appears to correlate with progressive reduction of perfused capillary density as ischemic burden worsens. Density mapping of surface macrophage cells may provide a useful clinical biomarker of progressive retinal vascular disease or response to therapy.

Discussant: **Hermann D. Schubert**

PA-15 7:00–7:20 AM

BILIRUBIN-INDUCED VISUOCORTICAL DAMAGE: EVIDENCE OF A SPECTRUM OF CORTICOVISUAL IMPAIRMENT

William Good*, Chuan Hou, Anthony Norcia, Vinnod Bhutani, Cynthia Montiel, Ronald Wong, Terri Slagel

Purpose: In clinical practice, corticovisual impairment (CVI) is frequently diagnosed as a binary condition. Using the sweep visual-evoked potential (sVEP), we investigated whether visual cortex injury occurs proportionally to total serum bilirubin (TSB) levels in healthy term and preterm infants.

Methods: 99 infants (91 healthy and 8 preterm mean gestational age of 30 weeks), had TSB, indirect bilirubin, and unbound bilirubin (UB) levels measured at 24–48h after birth. For term infants (n=91) TSB levels were plotted on the Bhutani hour-specific bilirubin nomogram to assess risk for neurological morbidity and guide treatment. Using the sVEP technique, grating acuity, vernier acuity, and contrast sensitivity were measured at both 6 and 12 months of age for full-term infants, and at 5-months corrected age for preterm infants. Visual acuity thresholds and signal amplitudes were evaluated and compared with TSB levels.

Results: For term infants, significant and similar correlations at the 6- and 12-month exams were found between TSB levels and sVEP contrast ($r=0.33$; $p<0.001$ at 6 months) and vernier thresholds ($r=0.25$; $p<0.01$ at 6 months), but not for grating threshold, indicating worsening contrast and vernier thresholds in infants with increasingly higher TSB levels. Term infants in the highest TSB nomogram quartile (n=25) had significantly worse vernier thresholds than those infants whose TSB values were in the lowest 3 quartiles. Preterm infants showed remarkably worse vernier thresholds, despite having lower peak TB levels than term infants.

Conclusion: Term infants with TSB levels in the highest quartile on the bilirubin nomogram and preterm infants should be monitored closely for visual and neurological development. Visual acuity declines with increasing TSB levels, which demonstrates that visuocortical damage occurs along a continuum. The effect of bilirubin was more pronounced in preterm infants, presumably caused by their more porous blood-brain barrier.

Discussant: **Susan H. Day**

PA-16 7:20–7:40 AM

EARLIER DETECTION OF GLAUCOMA PROGRESSION USING OPTIC NERVE VOLUME SCANS WITH THREE-DIMENSIONAL SPECTRAL-DOMAIN OPTICAL COHERENCE TOMOGRAPHY

Kitiya Ratanawongphaibul, Edem Tsikata, Michele Zemplenyi, Hang Lee, Milica Margeta, Courtney Ondeck, Janice Kim, Billy Pan, Paul Petrakos, **Anne Coleman**, Fei Yu, Johannes DeBoer, **Teresa Chen**[*♦]

Purpose: To determine whether three-dimensional (3D) spectral-domain optical coherence tomography (SD-OCT) neuroretinal rim measurements can detect glaucoma disease progression earlier than current standard of care clinical testing i.e. disc photography, visual field (VF) testing, and two-dimensional (2D) retinal nerve fiber layer (RNFL) thickness measurements.

Methods: In this 5-year prospective longitudinal cohort study, 124 eyes of 124 open angle glaucoma patients had yearly disc photography, VFs, SD-OCT RNFL thickness scans, and optic nerve volume scans (Spectralis, Heidelberg Engineering, Heidelberg, Germany) which were performed on the same day. From high-density optic nerve volume scans, custom-built software calculated the minimum distance band (MDB) thickness, a 3D neuroretinal rim parameter, which quantifies the amount of tissue in the neuroretinal rim. Patients were classified as glaucoma progressors or non-glaucoma progressors using event-based analysis. Progression by disc photography and VFs were determined when 3 masked glaucoma specialists unanimously concurred. Progression by RNFL and MDB thickness was determined if there was change greater than test-retest variability. Kaplan-Meier curves were constructed to analyze time-to-progression data.

Results: Global MDB neuroretinal rim thickness detected glaucoma progression earlier than either disc photography (23 versus 44 months; $P<0.001$) or global RNFL thickness (23 versus 33 months; $P<0.001$). Global MDB thickness also detected progression slightly earlier than VFs (23 versus 32 months), but the difference was not statistically significant ($P=0.15$).

Conclusion: High-density 3D SD-OCT neuroretinal rim measurements detected glaucoma progression approximately 1 to 2 years earlier than current clinically available structural tests (i.e., disc photography and 2D RNFL thickness measurements).

Discussant: **Donald L. Budenz**[♦]

PA-17 7:40–8:00 AM

DETERMINING THE TRACTIONAL FORCES ON VITREORETINAL INTERFACE IN ABUSIVE HEAD TRAUMA USING COMPUTER SIMULATION AND ANIMAL MODELS

Donny Suh*

Purpose: Abusive head trauma (AHT) is the leading cause of infant death and long-term morbidity from injury. The ocular consequences of AHT are controversial, and the pathophysiology of retinal research findings is still not clearly understood. It has been postulated that vitreoretinal traction plays a major role in the retinal findings. A computer simulation model was developed to evaluate the vitreoretinal traction and determine whether the distribution of forces in different layers and locations of the retina can explain the patterns of retinal hemorrhage (RH) seen in AHT.

Methods: A computer simulation model of the pediatric eye was developed to evaluate preretinal, intraretinal, and subretinal stresses during repetitive shaking. This model was also used to examine the forces applied to various segments along blood vessels.

Results: Calculated stress values from the computer simulation ranged from 3-16 kilopascal (kPa) at the vitreoretinal interface through a cycle of shaking. Maximal stress was observed at the periphery of the retina, corresponding to areas of multiple vessel bifurcations, followed by the posterior pole of the retina. Stress values were similar throughout all three layers of the retina (preretinal, intraretinal, and subretinal layers).

Conclusion: Ocular manifestations from abusive head trauma reveal unique retinal characteristics. Our model predicted stress patterns consistent with the diffuse retinal hemorrhages (RH) typically found in the posterior pole and around the peripheral retina in AHT. Our computer model demonstrated that similar stress forces were produced in different layers of the retina, consistent with the finding that retinal hemorrhages are often found in multiple layers of the retina. These data can help explain the RH patterns commonly found in AHT.

Discussants: **Julia A. Haller**, **Ralph C. Eagle, Jr.**

PA-18 8:00–8:20 AM

RESULTS OF AN EXPERIMENTAL MODEL OF TRAUMATIC OPTIC NEUROPATHY

Timothy McCulley*, Eric Singman

Purpose: The mechanism of indirect traumatic optic neuropathy, based on laser interferometer study of cadaver crania, is presumed to occur by force transmission through bone. We propose an alternate mechanism, i.e., the amplification of a soft tissue shock wave within the orbit. When travelling through the conical orbital space in an anterior to posterior direction, amplification theoretically occurs with a magnitude inversely proportional to cross sectional area. This study investigates the mechanism and location of tissue damage in indirect traumatic optic neuropathy.

Methods: Accelerometers placed on the optic nerve in the intracranial space adjacent to the optic chiasm and on the optic nerve adjacent to the orbital apex recorded movement during a series of impacts directed at 0, 45, 90 and 180 degrees relative to the forehead. The velocity of the impactor was 2 m/s for all impacts, with a calculated impact energy around 5 Joules Waveforms from the first 100 milliseconds following impact were generated from 1 test at the stated angles.

Results: The two most notable findings were as follows. 1) At the orbit apex, the magnitude of acceleration was highest with a frontal impact, with a progressive decrease as point of impact moved posteriorly. 2) The difference in absolute velocity at the orbital apex versus the intracranial location (1.1 vs 0.2 meters/second) was higher than any other comparison suggesting tethering of the nerve at the optic canal.

Conclusion: Our findings are consistent with orbital soft tissue shock wave amplification with frontal impact, related to the conical shape of the orbit, and may explain why indirect traumatic optic neuropathies are seen almost exclusively with frontal impact. The marked difference seen between measures at the orbit apex and the intracranial optic nerve also support the hypothesis that the optic canal is the most common site of damage.

Discussant: **Bita Esmaeli**

PA-19 8:20–8:40 AM

REOPERATIONS FOR COMPLICATIONS WITHIN 90 DAYS AFTER GEL STENT IMPLANTATION OR TRABECULECTOMY

Carlo A. Cutolo*, Carlo Catti, Michele Lester, Chiara Bonzano, Chiara Pizzorno, **Carlo Traverso**

Purpose: To describe reoperations in the operating room for complications that occurred within the first 90 days after gel stent implantation or trabeculectomy at a single institution over five years.

Methods: A retrospective chart review of adult patients who have undergone gel stent implantation with mitomycin C (MMC) or trabeculectomy with MMC from March 1, 2016, to December 31, 2020, at Clinica Oculistica, Genoa, Italy, was performed. Postoperative complications that required reoperations within the first 90 days were evaluated.

Results: A total of 510 surgeries were performed on 392 patients over a 57-month period by 2 glaucoma surgeons. Of these, 284 were gel stent implantation, and 226 were trabeculectomy. Combined phacoemulsification was performed in 52/284 (18.3%) in the gel stent group and in 26/226 (11.5%) of eyes in the trabeculectomy group (p=0.03). Reoperations took place in 13/510 (2.5%) eyes, including 4/284 (1.4%) in the gel stent group, 9/226 (4.0%) in the trabeculectomy group (p=0.07). In the gel stent group, indications for reoperation were bleb failure (2), suprachoroidal hemorrhage (1), bullous keratopathy (1). In the trabeculectomy group, indications for reoperation were bleb failure (3), overfiltration (2), persistent wound leak (2), aqueous misdirection (1), vitreous loss (1).

Conclusion: The rates of reoperation for early postoperative complications after gel stent or trabeculectomy was low and comparable with previous studies. A slightly higher number of reoperations within 90 days was observed in the trabeculectomy group than the gel stent group despite the more significant number of combined procedures in the latter group. Bleb failure was the most common indications for reoperation in both groups, whereas complications associated with excessive outflow were a cause of reoperation mostly in the trabeculectomy group.

Discussant: **Robert D. Fechtner**

PA-20 8:40–9:00 AM

VISUAL FIELDS II: PERICENTRAL DEFECTS ARE NOT DISEASE SPECIFIC

Steven Newman*

Purpose: During the 19th century it was hoped that specific VF patterns would give a specific disease diagnosis. Although MacKenzie's observation (1835) of bitemporal VF defects with chiasmal pathology was localizing it wasn't specific. As we previously demonstrated most central scotomas are related to macular pathology. Work at the NIH demonstrated the toxic effects of Chloroquine could produce pericentral VF defects.

Methods: Retrospective review of 55 patients coded for pericentral VF defects.

Results: Ten did have a history of hydroxychloroquine use, but an additional 10 had maculopathies. Four patients had low tension glaucoma (LTG). Other miscellaneous causes included BRAO, Purtcher's, neuroretinitis, MS, papilledema, migraine, parafoveal telangiectasis, and DOA. Four were felt to artifact and etiology was unknown in 7.

Conclusion: Hydroxychloroquine is the most common cause of pericentral desaturation (always ask about history). Maculopathies (ARMD) are possible as is LTG. Other rare causes are possible. Autofluorescence is particularly useful. OCT (line scan of the macula) may be helpful

Discussant: **Alfredo A. Sadun**

AOS 2021 Poster Abstracts

Posters will be displayed on-demand in the virtual platform
Friday, May 21 through Sunday, May 23.

Please note the following program key:

Bold = *AOS Member*
* = *Presenter*
♦ = *Financial Disclosure*

(Posters will indicate relevant financial relationships.)

PO-01

OPHTHALMIC MANIFESTATIONS OF COVID-19

Ron Adelman*

Purpose: To describe ophthalmic manifestations of SARS COVID-19.

Methods: Literature review and meta-analysis.

Results: There are over 1200 manuscripts on PubMed with keywords of COVID-19 and eye. Over 110 of these manuscripts describe ocular manifestations of COVID-19. Angiotensin-converting enzyme 2 (ACE2) is the receptor, and transmembrane serine protease 2 (TMPRSS2) is the protease for the infection of human cells with SARS-CoV2. The ocular surface and retina have the necessary proteins to be infected with SARS-CoV-2 and the virus has been isolated from the conjunctiva. Casagrande detected SARS-CoV-2 viral RNA in the retina of three out of 14 COVID-19 subjects. Reported ocular manifestations in patients with COVID-19 include conjunctivitis, chemosis, pseudomembrane, optic neuritis, cranial nerve palsy, nystagmus, visual field defect, flame-shaped retinal hemorrhage, cotton wool spots, retinal sectorial pallor, central retinal vein occlusion, vitritis, paracentral acute middle maculopathy, acute macular neuroretinopathy, and papillophlebitis.

Conclusion: SARS COV2 has been isolated from the conjunctiva and retina of patients with COVID-19 infection. The most common manifestation of COVID-19 in the eye is conjunctivitis. A variety of neuro-ophthalmic and retinal manifestations have been reported in patients infected with COVID-19. However, a direct causal relationship has not been established.

PO-02

HISTOLOGIC PHENOTYPE ALTERATIONS IN RECURRENT ORBITOFACIAL NEUROFIBROMAS: A CLINICO-PATHOLOGIC STUDY

Mohammad Alabduljabbar*, Diego Strianese, Osama Al-Sheikh, Hind Alkatan, Hailah Al-Hussain, Azza Maktabi, Rajiv Khandekar, Malak Abedalthagafi, **Deepak Edward**

Purpose: To evaluate and compare the clinical and histopathological profile of primary and recurrent neurofibroma in patients with orbitofacial neurofibromatosis type 1.

Methods: We retrospectively evaluated 41 primary or recurrent neurofibromas (NFs) from 26 patients (2002 to 2018) at the King Khaled Eye Specialist Hospital, Saudi Arabia. Demographics, clinical presentation, and surgical intervention data were collected. Histopathological specimens were studied with hematoxylin-eosin, Alcian blue, and immunohistochemical markers; S-100, CD44, CD117, smooth muscle actin (SMA), neurofilament, and Ki-67.

Results: Of the 41 NFs, 18 were primary and 23 recurrent tumors. For primary NF, the ratio of plexiform to the diffuse type was 13:5, however in recurrent tumors was 4:8 after the first recurrence, and 2:9 after multiple recurrences. The odds of a tumor having a diffuse pattern in recurrent NF was significantly higher than the plexiform pattern [OR=7.37 (95% confidence interval 1.84;29.55) P=0.005]. Recurrent NFs had significantly higher CD44, CD117, and neurofilament labeling (P=0.02, P=0.01 and P<0.001 respectively) but had significantly decreased Alcian blue, and S-100 labeling (P=0.03, and P=0.02 respectively) compared to primary tumors. SMA and Ki-67 proliferation index were not different between primary and recurrent NFs (P=0.86, and P=0.3 respectively).

Conclusion: There appears to be a high risk for primary plexiform NFs to develop a diffuse histologic pattern when they recur. Immunohistochemical staining suggests a role of mast cells (CD117) and expression of infiltration makers (CD44) in the transformation of plexiform tumors to the diffuse phenotype.

PO-03

CORNEAL MECHANICAL SENSITIVITY IN INDIVIDUALS WITH CHRONIC PAIN USING A MODIFIED BELMONTE AESTHESIOMETER

Brandon Baksh*, Caroline Lieux, **Anat Galor**

Purpose: To examine corneal mechanical thresholds in individuals with chronic pain using a Belmonte aesthesiometer.

Methods: We performed a cross-sectional study of South Florida veterans with chronic pain conditions (>3 months duration) seen at an eye clinic. Individuals were split into two groups: Group 1 included individuals with chronic pain conditions that involved the trigeminal system (e.g. migraine, burning mouth syndrome, trigeminal neuralgia, and trigeminomandibular disorder) while Group 2 included individuals with chronic pain conditions that did not involve the trigeminal system (e.g. back pain, knee pain). Dry eye symptoms and signs and quality of life indices were also assessed via standardized questionnaires. Corneal mechanical thresholds were assessed using a modified Belmonte aesthesiometer. Our main outcome measure was comparison of mean corneal mechanical thresholds between our two groups via the independent t-test. Multivariable linear regression analysis was also performed to evaluate predictors of corneal mechanical threshold (dependent variable) while considering multiple independent variables (e.g. demographics, pain location, dry eye symptoms, signs, co-morbidities, quality of life). All reported

Results: The mean age of the 577 individuals included in the study was 61+/-10.5 years; 89% were male, 45% self-identified as white, and 25% as Hispanic. Mean corneal mechanical threshold was lower among individuals with chronic trigeminal pain (n=123) compared to those without (n=454), 75+/-43 vs 86+/-43 mL/min, p=0.015. Multivariable analysis on 320 individuals with data for all variables demonstrated quality of life questionnaire scores (standardized β= -0.49, p=0.002), dry eye symptoms (β= -0.30, p=0.039), and presence of chronic trigeminal pain (β= -0.44, p=0.002) remained significant predictors of corneal mechanical detection threshold, with an overall R2=0.34 for the model.

Conclusion: These results suggest a link between chronic trigeminal pain, worse quality of life, and increased corneal sensitivity.

PO-04

QUANTITATING CONFLICT OF INTEREST IN THE CHOICE OF ANTI-VEGF AGENTS

David Browning*, Paul Greenberg

Purpose: To quantitate the economic incentives associated with choice of anti-VEGF drugs for retinal diseases.

Methods: An economic model was created based on the distribution of use and number of injections of bevacizumab (B), versus aflibercept or ranibizumab (AR) in a 5-person retina service; published Medicare reimbursement rates; published rebates; estimated unreimbursed drug use; estimated use of drug company samples; and published costs-of-drugs. Differential economic incentives associated with choice of drugs were calculated.

Results: The splits in drug choice ranged from 92% AR/ 8% B to 31% AR/69% B, and in annual injection numbers from 2000 to 6000 with a median of 4000. Assumed values for rebates were 1% for drug company rebate, 1% for group purchasing organization rebate, and 5 for number of unreimbursed injections per year. The differential economic incentive of a 92% AR/8% B split compared to a 31% AR/ 69% B split for the median annual number of injections was $266, 894.

Conclusion: Using real- world data, the economic incentive associated with a choice of more expensive anti-VEGF drugs is large. Accounting for unreimbursed drug use and the cost of additional staff required to manage expensive drug inventory does not nullify the incentive. To what degree this financial incentive influences ophthalmologists' choice of drugs is unknown, but not trivial. Drug company rebates are not illegal, but whether they are ethical is controversial. Financial disclosure to patients of the conflicts of interest in the drugs recommended for treatment seems consistent with American Academy of Ophthalmology guidelines regarding financial disclosures before talks at meetings, is rarely discussed, but should be.

PO-05

VITRECTOMY FOR SEVERE DIABETIC COMPLICATIONS: A POOLED ANALYSIS OF RANDOMIZED CONTROLLED TRIALS UTILIZING MODERN TECHNIQUES AND EQUIPMENT

David Browning*, Ryan Rush

Purpose: To report updated clinical outcomes in subjects undergoing pars plana vitrectomy (PPV) using modern techniques and equipment for the treatment of severe complications secondary to proliferative diabetic retinopathy (PDR).

Methods: The data from subjects prospectively enrolled and treated with PPV for PDR-related complications during 5 randomized clinical trials performed by the same surgeons were pooled for analysis. All subjects underwent small-gauge PPV with anti-vascular endothelial growth factor (VEGF) pretreatment and completed 6 months of follow up during the trial period. The primary outcome was logMAR visual acuity. Secondary outcomes included intraoperative and postoperative complications, and the rate of unplanned secondary PPV.

Results: There were 943 subjects included in the pooled analysis. The visual acuity of the overall study population improved from median 2.00 (IQR 1.3, 2.3) at baseline to median 1.00 (IQR 0.5, 1.3) at 6 months One hundred eighty-four patients (19.5%) achieved 20/50 or better acuity, and 652 patients (69.1%) achieved 20/200 or better acuity at 6 months. The vision improved or remained stable in 901 patients (95.5%) , and 11 patients (1.2%) developed no light perception at 6 months. Intraoperative complications occurred in 343 cases (36.4%) of cases, and 199 cases (21.1 %) experienced a postoperative complication. The most common postoperative complication was vitreous hemorrhage in 124 cases (62.3% of all complications). Unplanned secondary PPV was necessary in 86 cases (9.1 %).

Conclusion: This pooled analysis reports better clinical outcomes compared to results reported in the older literature on patients undergoing PPV for PDR-related complications. Advancements in surgical techniques, equipment and anti-VEGF pretreatment are probably responsible for this improvement. Further studies in more conventional surgical settings are needed to determine if these suggested improvements are widespread.

PO-06

DR. DAVID W. SIME: THE WORLD'S FASTEST HUMAN

John D. Bullock*

Purpose: Dave Sime was born in Patterson, NJ on 07/25/1936. He was an outstanding, multi-sport athlete à la Jim Thorpe. After high school he rejected numerous professional offers, preferring to attend Duke University on a baseball scholarship. He was soon recognized by Duke's track coach for his blistering speed. During his career he set or tied 9 world records and appeared on the cover of Sports Illustrated, dubbed "Superman in Spikes." Because of a horseback-riding injury he was unable to make the 1956 Olympic track team.

Methods: While a medical student at Duke he participated in the 1960 Rome Olympics, winning a silver medal in the 100-meter dash, losing gold by less than one inch. In Rome he served as a CIA operative attempting to facilitate the defection of a top Soviet athlete. He anchored the 4x100 meter relay; the team won in a world-record- setting time but, because their first exchange happened outside the changeover box, they were disqualified.

Results: He concluded his athletic career and concentrated on his medical studies. He graduated in the top 10% of his medical school class and interned at Duke Hospital. His Duke mentor, neuro-ophthalmologist J. Lawton Smith, steered him away from neurosurgery and into ophthalmology. He completed his residency at the Bascom Palmer Eye Institute in 1966. He practiced in Miami and his patients included Richard Nixon, Mickey Mantle, Don Shula, Sugar Ray Leonard, Ted Williams, and Bob Griese. He served as the team physician for the Miami Dolphins during their 1972 "perfect season." Because of Griese's amblyopia, diplopia, dizziness, and headaches, Sime designed new glasses for him which greatly improved his playing vision. Sime's grandson, Christian McCaffrey (now a Carolina Panther) was runner-up for the 2015 Heisman Trophy.

Conclusion: The personal characteristics making Sime a superior sprinter also made him a superior clinical ophthalmologist.

PO-07

EPIPREMNUM AUREUM KERATOPATHY: CASE REPORT AND REVIEW OF THE LITERATURE

Adam Cohen*, Despoina Theotoka, **Anat Galor**

Purpose: To report a novel case of Epipremnum aureum (Araceae) toxicity masquerading as bilateral infectious keratitis and review the literature on ocular manifestations of Epipremnum exposure.

Methods: Case report and literature review

Results: A 70-year-old male with a history of photorefractive keratectomy presented with a 3-day history of pain in both eyes. The patient reported exposure to plant debris while performing yard work and also water exposure, while cleaning his coral fish tanks. Clinical examination revealed bilateral epitheliopathy which progressed to frank epithelial defects with underlying stromal necrosis six days post exposure. Initially referred for possible acanthamoeba keratits, multiple cultures, corneal biopsy, and confocal microscopy were all negative for an infectious agent. Empiric topical antibiotic drops were initiated. Over a 2-week period, the epithelial defects continued to worsen and suspicion for a toxic etiology was raised. On further questioning, the patient reported rubbing his eyes after exposure to Epipremnum aureum (Golden Pothos/Devils Ivy) sap. Given this history, he was treated conservatively with artificial tears, topical steroids, and amniotic membrane. Both eyes healed with conservative treatment at three months albeit with resultant corneal scarring. He eventually underwent a penetrating keratoplasty in the left eye and at last follow up, 5 years after presentation, best corrected visual acuity with a hard contact lenses were 20/25 in the right eye and 20/20 in the left.

Conclusion: Epipremnum aureum toxicity is a rare cause of keratitis. It can mimic acanthamoeba keratitis or anesthetic abuse and should be considered in cases of culture negative non-healing corneal ulcerations. Eliciting a history of plant sap exposure can facilitate prompt treatment and resolution of this toxic keratitis.

PO-08

A PHASE I, DOUBLE-MASKED, VEHICLE-CONTROLLED STUDY TO ASSESS SAFETY, TOLERABILITY, AND PHARMACOKINETICS OF ASCENDING DOSES OF PALOVAROTENE OPHTHALMIC SOLUTION IN HEALTHY ADULTS

William J. Foster*, Andrew L. Strahs, **Kent W. Small**, James M. Roach

Purpose: Palovarotene ophthalmic solution (POS), a selective retinoic acid receptor [gamma] agonist, is under investigation for the treatment of dry eye disease (DED). The purpose of this study was to determine the ocular and systemic safety, tolerability and pharmacokinetics (PK) of ascending doses of POS in healthy adults.

Methods: This was a single center, randomized, double-masked, vehicle-controlled phase I study in healthy adults. Participants were randomized 3:1 to receive either POS (at 0.025, 0.05 or 0.10 mg/mL) or vehicle (placebo-to-match POS) once daily (QD) or twice daily (BID) sequentially for seven consecutive days. Escalation to the next dose required Review Committee approval. Six cohorts of eight participants were planned for evaluation (six participants in the POS group and two in the vehicle group). Healthy adults, 18–55 years of age, were eligible for this study. Safety was assessed by physical examinations, vital signs, ECGs, clinical laboratory parameters, ocular assessments, adverse events (AEs) and treatment emergent ocular AEs (TEOAEs).

Results: 36 participants were randomized to POS and 12 to vehicle. Overall, 89 TEOAEs were reported by 22 participants (61%) receiving POS and 10 TEOAEs were reported by 5 participants (42%) receiving vehicle. Erythema, irritation and skin dryness of the eyelid were the most common TEOAEs in participants receiving POS. Overall, the incidence of TEOAEs and eyelid-related findings in participants treated with POS increased with ascending dose and frequency compared with participants treated with vehicle. All TEOAEs were mild (96.6%) or moderate (3.4%) and resolved without sequelae. There were no serious AEs. Similar PK profiles were observed for the QD and BID regimens following multiple ascending doses of POS.

Conclusion: The administration of POS was generally well tolerated, with the majority of TEOAEs recorded as mild. These data support further investigation of the safety and efficacy of POS in patients with DED.

PO-09

LONGITUDINAL FUNDUS CHANGES IN MYOPIA: THE BEIJING EYE STUDY 2001/2011

Jost B. Jonas*♦, Qi Zhang, Yan Ni Yan, YaXing Wang, Rahul A. Jonas

Purpose: To assess longitudinal changes in macular features in myopia.

Methods: The study included all highly myopic eyes with assessable fundus photographs and a randomized group of non-highly myopic eyes examined in the population-based Beijing Eye Study in 2001 and re-examined in 2011. Using fundus photographs and optical coherence tomographic images of the optic disc and fovea, we assessed changes in the disc-fovea distance (DFD), parapapillary gamma zone, angle kappa (angle between the temporal vascular arcades), and the course of papillo-macular retinal vessels.

Results: The study included 89 highly myopic eyes and 86 randomly selected non-highly myopic eyes. DFD elongation, gamma zone widening, angle kappa decrease and straightening of papillo-macular retinal vessels were detected more often (all P<0.001) in the highly myopic group than in the non-highly myopic group (63/89 versus 9/86;75/89 versus 18/86;61/89 versus 9/86; and 58/89 versus 7/86, respectively). Gamma zone enlargement, angle kappa reduction and papillo-macular retinal vessel straightening were significantly (all P<0.001) associated with the DFD elongation. The length of the macular Bruch´s membrane on the disc-fovea line (distance between foveola and gamma zone border), and the vertical distance between the temporal superior and temporal inferior arterial arcade did not change during follow-up. The disc-fovea-angle (mean:7.50±4.00°; range: -6.30° to -23.25°) was significantly (P=0.003) higher (i.e. fovea located more inferiorly) in eyes with the widest gamma zone inferiorly (8.46±4.37°) than in eyes with the widest gamma zone temporally (6.71±3.46°). A choroidal shift in relationship to the retinal vessels in direction to the fovea on the disc-fovea line was detected in 51% of the highly myopic eyes and in 9% of the non-highly myopic eyes. The choroidal vessel system shifted centrifugally in incident or enlarging patchy atrophy regions.

Conclusion: These anatomical findings may be helpful to further elucidate the process of axial elongation in myopic eyes.

PO-10

THE COVID-19 PANDEMIC, TELEMEDICINE, AND ACADEMIC OPHTHALMOLOGY

Benjamin Lee*, **Jayne Weiss**, Maria Reinoso, Zhide Fang

Purpose: To understand the early shift of academic ophthalmology into telemedicine during the COVID-19 pandemic lockdowns.

Methods: A 6 question survey on telemedicine was distributed to ophthalmology residency program directors and department chairs across the United States between April and May 2020. The survey asked respondents for their clinical specialty and percentage of clinical time used for teleophthalmology before and during the pandemic. Following, using Medicare telemedicine billing codes, it assessed the level of teleophthalmology services performed by the respondent and those of their department faculty peers. Lastly, it asked about the exposure that their residents have to teleophthalmology.

Results: A total individual response rate of 109/237 (46.0%) was obtained, representing 85/124 (68.5%) of all United States academic ophthalmology departments with a residency program. While 99.1% of respondents used at most 5% of their clinical time for teleophthalmology prior to the pandemic, during the pandemic 28.4% of respondents used 25% or more of their clinical time for teleophthalmology. Most respondents started to routinely perform real-time audio video visits (62.4%) during the pandemic, while only a single respondent routinely did so prior to the pandemic. There were significant positive linear trends between respondent clinical time for teleophthalmology during the pandemic and the usage of E-visits ($p = 0.0012$) and hybrid tele-visits ($p = 0.0205$). Prior to the pandemic, many departments already had faculty who offered phone call visits (35.3%), doctor-doctor consultations (40.0%), and video-image review (41.2%). During the pandemic, some departments had residents actively providing patient care using teleophthalmology to screen for ophthalmic disease (25.9%) and for patient visits (37.6%).

Conclusion: During the COVID-19 pandemic lockdowns, academic ophthalmology expanded its capacity to deliver patient care through teleophthalmology. However, the numerous challenges unique to ophthalmology as an exam-based discipline precluded transitioning a majority of patient care to teleophthalmology.

PO-11

BACK TO FUTURE: IDEAS THAT FORESHADOWED MODERN SLIT LAMP EQUIPMENT WITH REGARD TO CORNEAL DIAGNOSIS AND DOCUMENTATION

Walter Lisch*, **Jayne S. Weiss**

Purpose: To demonstrate the ophthalmologist`s challenges using the existing slit lamp equipment to formulate a precise description of corneal findings in distinct areas using an exact focusing by direct and indirect illumination.

Methods: Eight patients were examined through a pharmacologically dilated pupil with corneal pathology only evident on indirect ophthalmoscopy:

- Two patients suffered from painful eye attacks and diplopia, two from visual reduction. The correct diagnosis was only possible through indirect illumination.
- A 16-year-old female suffered from painful eye attacks with stromal opacities only evident with indirect illumination.
- Two 32-year-old females had specific endothelial and Descemet changes in indirect illumination.
- A 49-year-old female showed a large, peripheral corneal opacity. A direct panorama computer generated picture, fused together five adjacent slit images into one photograph.

Results: Indirect illumination demonstrated Bron blebs and dense central fingerprints in the first two and dense fingerprints and severe CL- induced side effects in the two other patients; Stromal lattice lines suggesting lattice corneal dystrophy in the 16-year-old; Mooncrater-like alterations in the endothelium and tears in the Descemet of the two 32-year olds; Panoramic view of the eighth patient representing the entire peripheral band-like corneal opacity into one photo.

Conclusion: Use of indirect illumination of the cornea, through a dilated pupil, is required for correct diagnosis. We propose automatic focusing and movement of newly developed slit lamps to provide a methodical corneal examination. We also propose an automatic installation of a direct and indirect panoramic corneal image. Our suggestions are summarized in a 2019 patent application.

PO-12

LAMELLAR NON-ATTACHMENTS OF THE MEDIAL RECTUS: A NEW APPROACH

Irene Ludwig*, Christiaan Heersink

Purpose: The application of the orbital pulley system model of the EOMs to strabismus surgery has been a slow process since its proposition in the last millennium. One area of potential improvement is the recognition and repair of lamellar non-attachments of the orbital layer of medial rectus muscles. This paper aims to elucidate the surgical anatomy of this defect, proposes a corrective procedure, and provides some anecdotal evidence at its efficacy.

Methods: The study is a retrospective case series, where all patients who had the defect operated on by the describing surgeon were included. A total of 42 patients were included, on average 31.5 years old. The defect can be detected surgically by careful dissection. Once found, this connective tissue must be freed of any adhesion to surrounding structure, and then can be reattached to the rest of medial rectus muscle by sutures. The main outcome measure for this study is improvement in diopters of exotropia.

Results: Average pre-operative measurement was 39 diopters of exotropia. Average post-operative measurement was 7.3 diopters of exotropia was at one month.

Conclusion: The limitations of this study design include the inherent lack of external validity of a retrospective case series. Additionally, the small sample size paired with the fact that most patients had previous or multiple interventions is a limitation. Also, that all interventions were done by a single, uniquely skilled surgeon poses a limitation. Nonetheless, the fact many of these patients had intractable exotropia that was greatly improved in a single surgery calls for further investigation to this defect and ways of correcting it.

PO-13

GEOSPATIAL ANALYTICS AND EYE CARE PROVIDER AVAILABILITY CAN PREDICT BLINDNESS WITHIN RURAL AND URBAN COUNTIES

Steven Mansberger*, Facundo Sanchez, Stuart Gardiner, Jack Rees

Purpose: To determine whether geospatial analytics can identify rural and urban counties with higher-than-expected rates of blindness and their associated risk factors.

Methods: We used the Oregon Commission for the Blind registry to determine the prevalence and demographic characteristics of those with blindness, Census data for county-level population socioeconomics and demographics, and licensure data to determine the density of eye care providers (optometrists and ophthalmologists) within each county of the State of Oregon. We used geospatial statistics, analysis of variance, and logistic regression to determine the explanatory variables associated with blindness.

Results: We included 8350 individuals who were blind, representing 0.21% of the state's population. The observed prevalence of blindness ranged almost 9-fold from 0.04% to 0.58% among counties ($p<.001$). In univariate models, blindness within counties was associated with increasing median age ($p=.027$), racial/ethnic composition ($p<.001$), decreased median household income ($p<.001$), increased poverty within a county ($p<.001$), and higher density of ophthalmologists ($p=.003$). Density of optometrists was not associated with prevalence of blindness ($p=.89$).

Conclusion: Geospatial analytics identified socioeconomic, demographic and provider density variables that predicted a higher prevalence of blindness between counties. Clinicians and researchers may use this information and similar methods to identify underserved areas within states to design public health care interventions.

PO-14

LONG-TERM TRIGEMINAL NERVE STIMULATION AS A TREATMENT FOR OCULAR PAIN

Divy Mehra*, Simran Mangwani, Kelly Acuña, Jodi Hwang, Elizabeth Felix, **Anat Galor**

Purpose: Ocular pain symptoms (e.g. hypersensitivity to light and wind, "burning" sensations) can be debilitating and difficult to treat. Neuromodulatory therapies targeting sensory trigeminal and central pain pathways may help treat chronic ocular pain refractory to traditional therapies. The current study evaluates long-term effects of Cefaly® (Cefaly Technology, Herstal, Belgium), a trigeminal neurostimulator (TNS) used for the treatment of migraine, on ocular pain.

Methods: Retrospective review of 18 individuals at the Miami Veterans Affairs Eye Clinic with chronic, severe ocular pain who were prescribed and used Cefaly® at home for ≥3 months. Main outcome measures were 1) frequency/duration of TNS use, 2) ocular symptom intensity over a 24-hour recall period (dryness, pain, light sensitivity, wind sensitivity, burning; rated on 0-10 scales) captured pre-TNS and at monthly follow-up intervals, and 3) side effects.

Results: The mean age of the population (n=18) was 57.5 years (range 34-85 years) with a male majority (67%). Two individuals discontinued use due to lack of efficacy and one due to confounding health issues. Initial mean weekly frequency of TNS use was 3.7±1.9 sessions of 25.8 minutes at month 1 and 2.7±2.3 sessions of 28.0 minutes at month 6. At six months, pain intensity (31.4%), light sensitivity (36.3%), wind sensitivity (32.6%), and burning sensation (53.9%) were all decreased compared to baseline ($p<0.01$ for all); greater decreases in ocular pain were noted in individuals with migraine (n=10) than those without migraine (n=8). No significant change was noted in mean dryness scores. Fifteen subjects experienced sedation with TNS use, persisting throughout the follow-up visits. No other adverse effects were communicated by any subjects.

Conclusion: Our study suggests TNS is a safe, adjunctive treatment option in individuals with severe, chronic ocular pain. Individuals demonstrated gradual, continual improvement in pain symptoms over time within a multimodal approach.

PO-15

PEDIATRIC OPTIC DISC DRUSEN: A RETROSPECTIVE STUDY OF 63 CHILDREN

Barrett Thompson, G. Conner Nix*, Lauren Ditta, Mary Ellen Hoehn, **Natalie Kerr**

Purpose: To analyze clinical characteristics of children with optic disc drusen (ODD).

Methods: After IRB approval, children were identified by searching electronic medical records (EMR) for ODD and pseudopapilledema billing codes. Exclusion criteria: presentation predating EMR or after 2019, unconfirmed diagnosis, presenting age ≥18 years.

Results: Of 63 children (57% female, 81% Caucasian, 109 eyes, 73% bilateral ODD) ages 4 -17 years (mean 11.35 ± 3.35), 49 (84%) were referred by a medical professional for suspected papilledema; five presented for unrelated diagnoses. At presentation: 18 children (29%) were asymptomatic; 34 (54%) reported headache and 10 (16%) reported blurred vision; 64 eyes (59%) had optic disc elevation and 35 (32%) had blurred disc margins. Average presenting BCVA was 20/23 (±30.4). Seventy eyes (64%) had 24-2 Humphrey visual field (HVF) performed at presentation. Thirty-three eyes had at least one reliable Humphrey visual field; 14 (42%) were full. The most common HVF abnormalities were generalized/nonspecific (nine eyes) and paracentral defects (three eyes). Three children had confirmed comorbid idiopathic intracranial hypertension. Thirty children had magnetic resonance imaging (MRI) performed; 15 were reported as normal. MRI abnormalities included abnormal optic nerve (five), arachnoid cyst (two), sinusitis (two), pineal cyst (two). B-scan was performed at least once on 80 eyes (48 children, mean age 11.2 ± 3.08 years); all B-scanned eyes were positive for ODD. Fundus autofluorescence (FAF), performed on 41 eyes which were also positive for ODD on B-scan, was positive in 15 (37%). Nine of 11 eyes (82%) with enhanced depth imaging optical coherence tomography (EDI-OCT) performed were positive for ODD.

Conclusion: Pediatric ODD can appear similar to papilledema, a condition requiring urgent diagnosis and treatment. This is the largest pediatric ODD cohort whose findings have been reported. B-scan was the most sensitive modality and may be preferable in children who cannot cooperate with EDI-OCT or comparable testing.

PO-16

AAV GENE THERAPY RESCUES CELL DEATH IN A PATIENT-DERIVED RPE MODEL OF BIETTI CRYSTALLINE DYSTROPHY

Yao Li, Chun-Wei Hsu, Yang Kong, Joseph Ryu, Sarah R. Levi, Zhechao Ruan, Yong-Shi Li, Janet R. Sparrow, Richard R. Yang, **Stephen H. Tsang***

Purpose: Bietti crystalline dystrophy (BCD) is an autosomal recessive disease that causes progressive vision loss. Its pathology is caused by retinal pigment epithelium (RPE) atrophy due to mutations in the Cytochrome P450 family 4 subfamily V member 2 (CYP4V2) gene. As a member of superfamily cytochromes P450, CYP4V2 is predicted to be an omega-hydroxylase for photoactive lipids. We hypothesized that the CYP4V2 deficiency in BCD might increase oxidative stress from light-induced lipoprotein adducts, thereby inducing phototoxicity in RPE cells.

Methods: To test our hypothesis, we subjected BCD patient-iPSC-derived RPE cells (BCD iRPE) and their isogenic controls to blue light exposure. To quantify the effects of this exposure, we measured reactive oxygen species (ROS)/superoxide and phototoxicity levels by fluorescence microscopy and high-performance liquid chromatography.

Results: After blue light exposure, the BCD iRPEs showed significantly increased levels of ROS and strong phototoxicity. Importantly, isogenic cell lines with CRISPR-corrected CYP4V2 and BCD iRPEs treated with AAV2- and AAV5-mediated CYP4V2 gene supplementation therapy exhibited significantly lower levels of both ROS and light-induced cell death.

Conclusion: Our results in the iRPE model suggest that BCD pathology is indeed caused by defective lipid metabolism and increased susceptibility to photoinjury, demonstrated by their photosensitivity and oxidative stress-induced death. Furthermore, our study is the first to identify light as a significant risk factor for BCD disease progression and to propose AAV gene therapy as a potential treatment for this pathology.

Notes

CLAIM YOUR CME CREDITS ONLINE!

Visit **www.cmesurvey.site/AOS2021** to complete the post meeting evaluation.
Upon completion, you may download and save your CME certificate.
Scan this QR code with your mobile device for quick access to the evaluation:

FUTURE ANNUAL MEETINGS

2022 AOS Annual Meeting

The Broadmoor
Colorado Springs, Colorado
May 19–21

2023 AOS Annual Meeting

The Omni Grove Park Inn
Ashville, North Carolina
May 18–20

2024 AOS Annual Meeting

The Lodge at Torrey Pines
La Jolla, California
May 16–18

2025 AOS Annual Meeting

The Ritz-Carlton, Naples
Naples, Florida
May 15–17

The American Ophthalmological Society
Established 1864

American Ophthalmological Society
655 Beach Street, San Francisco, CA 94109
T: (415) 561-8578 · F: (415) 561-8531 · E: admin@aosonline.org
Website: aosonline.org · Facebook: @aosonline · Twitter: @aostweets