Oculomics: The Future of Healthcare or Just Another Buzzword?

Dr Joe Pizzimenti

Summary

Definition and Background: An introduction to oculomics (5:40) and the role of the optometrist as a "Sherlock Holmes" for systemic disease (11:20). **The "Omics" Landscape:** Explanation of genomics, epigenomics, proteomics, and phenomics in the context of eye health (12:11). **Technological Hardware:** Evolution of retinal imaging from early ophthalmoscopy to modern OCT and OCT angiography (19:28). **Ocular Biomarkers:** Discussion of biomarkers for ocular diseases like AMD (27:23) and central serous chorioretinopathy (34:21). **Systemic Disease Links:** Identification of ocular signs for hypertension (38:21), diabetes (40:13), sickle cell disease (44:16), giant cell arteritis (46:46), and multiple sclerosis (48:55). **Future Challenges:** Discussion on the need for standardization, data security, and the integration of artificial intelligence (54:35).

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https://www.youtube.com/watch?v=htFg2aCV654

Transcript

All right, welcome everybody to tonight's Woo-U presentation. We're excited to have Dr. Pizzimenti back. How are you tonight? Oh, I'm doing great. How about you? I'm good. We're happy to have you. We can't wait for this presentation. Um, tonight's presentation is Oculomics: Using Retinal Biomarkers to Bridge Eye Care and Systemic Wellness. I'm your host, Dr. Jennifer Stewart. Thank you to Optimmed for exhibiting at tonight's event. Uh just some reminders for a CE certificate, please fill out the survey. The link will be in the chat and also emailed to you after the event. Attendees must be online for a minimum 50 minutes per hour of credit. CE certificates will be delivered by email and sent to Arbo with your OE Tracker number. Please allow up to four weeks for those certificates to be emailed. There will be a QR

code at the end of the event that you can scan with the OE Tracker app. Just some reminders, Q&A and handouts can be found at the right hand side of this page. And to minimize, use the down arrow and to open, use the chat button. So we'll have time for some Q&A at the end. Please feel free to put those questions in the chat throughout and we will get to those at the end. Um, welcome back to Woo. Dr. Pizzimenti received his doctor of optometry degree from the Illinois College of Optometry and completed a residency in ocular disease and rehabilitative optometry at the University of Houston. He's a recognized clinician and educator and a fellow of both the American Academy of Optometry and the Optometric Retinal Society serving as the president of the Optometric Retinal Society from 2012 to 2014. His areas of clinical research include diabetes, age related macular degeneration and vitreomacular adhesion. His scientific articles have appeared in a host of peer-review journals and he regularly lectures on posterior segment disease. He was awarded a fellowship by the world council of optometry in 2006 resulting in an appointment to teach and evaluate optometric education programs in central Europe. He's been a faculty member at Nova Southeastern University and currently at the University of Incarnate Word serving with distinction at both institutions. He enjoys living in Central Florida as well as traveling with his wife and grown children. Welcome back to Woo. We're happy to have you. Here are his financial disclosures which have been mitigated and I am going to turn it over to you and I'll see you at the end. Very good. Thanks so much Dr. Stewart and it's uh wonderful to be here with all of you this evening. Our topic for tonight is oculomics uh using retinal biomarkers to bridge eye care and systemic wellness. I want you to have my email address in case we don't get to your question tonight. It's pretty easy to remember. all things OCT atgmail.com. As I mentioned, um I have no relevant financial relationships to declare and our goal over the next oh 50 minutes or so is to provide you with current clinically relevant information about this emerging field of oculomics. And the course objectives are to define the terms oculomics and biomarker as well as discuss biomarkers of

several ocular diseases and then go on to talk about ocular biomarkers of various systemic conditions including cardiovascular disease, neurodegenerative problems as well as renal issues. And it is my hope that you will gain familiarity with current concepts and evidence in this emerging field of oculomics highlighting progress that's been made. Talk about remaining challenges as well as opportunities for meaningful clinical research. And I this is just a reminder to please uh type your questions into the Q&A widget if you have them. And uh as a a matter of background, let's talk a little bit about the language of health care where there are these sort of buzzwords or common phrases that pop up in the health care literature and um I'd like to concentrate on their true meaning. For instance, you've heard the term precision medicine. Well, this term refers to customized or individualized medicine that is patient-specific and not a cookie cutter model. And then we have social determinants of health. And this refers to any non-medical factors that may influence a person's health and wellness. And these factors may include things like education and income and race, location, as well as access to care. Certainly, you've heard of value based health care, and this refers to health care that centers on patient outcomes and how well we clinicians can improve those visual outcomes and overall health outcomes. And then finally we have integrated health care which refers to a team-based interprofessional model of care uh which is truly the ideal. What then is this this word this phrase oculomics? Uh well the first time I heard of it was about two three years ago at a retina meeting in Europe and it seemed that every other presentation had this word oculomics in the title. So when I leaned over and asked the Italian ophthalmologist next to me what is oculomics? Um this is what he pretty much told me. Oculomics is the study of the eye as a window into overall health. and it is an emerging field that examines the association between ophthalmic biomarkers and systemic health versus systemic disease states. So the concept of oculomics or oculomics is not necessarily new. In fact, this might be a reason that you entered into the field of optometry. It really is the reason that I wanted to

become an optometrist. You know, number one, the idea of studying the eye interested me. Number two, I was also interested in helping patients see better. But when I found out that an optometrist um can look at the retina and determine that a patient has hypertension or diabetes, you know, it really solidified my decision to become uh a doctor of optometry. So the development of this field of oculomics has been accelerated by three major recent advances. Number one, the availability and widespread adoption of high-resolution non-invasive ophthalmic imaging what we'll refer to as the hardware of oculomics. Secondly, the availability of large studies to investigate associations and we'll call this big data. Finally, the development of novel analytical methods including artificial intelligence which will refer to as the software of oculomics. And so it's great to have all this data um that we now collect as part of a 2026 ocular examination. But more data is a double-edged sword. The great thing about it is that we get more information about our patient. But the worst thing about all this new data is that we have so much information now uh that we are are living in a a world a world of data overload. And this is where artificial intelligence can help us because it's virtually impossible for us to scroll through every aspect of every fundus image to manually scroll through volumetric cubes of OCT and OCT angiography data. [snorts] And so this is where AI is going to be uh our friend for sure. And when we talk about oculomics, we're talking about ocular signs of conditions such as coronary heart disease, conditions such as anemia, hypertension, hypoglycemia, dyslipidaemia, ocular signs of diseases of the liver and the gallbladder. ocular signs of chronic kidney disease such as papilledema for instance or diabetic kidney disease. And then finally uh what I'm probably most excited about is the use of oculomics uh to detect at an earlier stage signs of dementia, signs of Alzheimer's disease, Parkinson's disease, multiple sclerosis and other neurodegenerative conditions. So if we go into the history of the term oculomics, it was first introduced in a 2020 publication uh by Wagner and the authors suggested that the eye could serve as a comprehensive window into the health of the whole body by and

by analyzing ocular changes. These could be indicative of diseases or conditions that exist elsewhere within the body. And so with recent advances in technology and research, oculomics has extended beyond simple observation of say hypertensive retinopathy. Now we can use the technologies as well as AI to dive deeper into the combination of imaging, big data and AI to identify ocular biomarkers of systemic disease. And so this whole field of oculomics as we look at a diabetic retina on the right hand side um is based on the premise that the eye is the only part of the body where both neurologic and vascular tissues can be viewed directly simultaneously and relatively non-invasively. And so we'll talk about the eye and systemic disease. I like to think of the optometrist as a sort of Sherlock Holmes looking for clinical signs of inflammatory and infectious diseases. Looking for ocular signs of disorders of the endocrine system and the vascular system. looking and identifying signs of neurologic disease, collagen vascular issues, neoplastic disease, and something that is on the rise, autoimmune disease. And so the suffix 'omics' refers to the large scale study of molecules such as DNA, RNA, proteins, and metabolites and how all of these molecules function together within a system. This the word genomics refers to the study of the genome or an organism's DNA and the way that the genes influence a person's health. So for example, someone with the BA one gene variant might do well to undergo earlier and more frequent screenings for breast cancer. The term epigenomics refers to the study of the complete set of epigenetic modifications or the epigenome on a cell's DNA. And so this regulates gene expression without altering the underlying DNA sequence. So epigenomics is really a combination of genetics plus patient behaviour plus environmental factors. And let's take age related macular degeneration um for example. We've got a sever we've got several key AMD associated gene variants and some of these gene variants for instance those that affect the compliment system um constitute a large chunk of AMD related genes. And then we have the arms 2 gene which affects oxygen metabolism. And then we have a couple of gene variants that affect the integrity of the

extracellular matrix. And then finally, we have a quartet of gene variants that affect cholesterol metabolism. But for the most part, gene mutations that affect the compliment system are part of the root cause of AMD along with other factors such as the environment and patients personal and health characteristics. Of course, when we think of the word complement, we think of the immune system. So that AMD is truly an immune mediated process. Here's an example of epigenomics. So, smoking interacts with the complement factor H gene variance to increase the risk of a patient developing AMD by five times compared with genetically similar non-smokers. Other important omics of human health. Proteomics the study of the proteome or the entire set of proteins their structure function and interactions. And so for example in the brain certain protein buildup such as amyloid plaques are key indicators of diseases such as Alzheimer's. And then we have transcriptomics, the study of the transcription or all of the RNA messages. The we have the term metabolomics which is the study of the metabolism or the chemical byproducts of metabolism. And so we know that metabolic shifts are often a downstream consequence of altered protein activity. A key example here are elevated branched chain amino acids and altered lipids that may be indicative of the metabolic syndrome. And then finally we have the field of phenomics that bring all of these omics together by studying observable characteristics in patients that result from the interaction of genes, proteins, lifestyle and the environment. And so you know this slide is really describing the metabolic syndrome with type 2 diabetes, hypertension, obesity and dyslipidaemia all coming together and resulting in insulin resistance which can then lead to early cardiovascular disease. microvascular diseases such as retinopathy, kidney disease, and peripheral neuropathy. And then macrovascular diseases that can lead to stroke, coronary artery disease, and amputations. Let's talk about biomarkers. A key to oculomics, a biomarker or biological marker is an indicator that signals the risk of disease or the presence of disease or progression of existing disease. Biomarkers are a broad subcategory of medical signs or objective indicators

that are observed from outside the patient. Ideally, a biomarker is measurable and these measures are accurate and reproducible. And so in 1998, the NIH convened a biomarkers definitions working group. And again, you know, one of the keys here is that a biomarker should be objective and measurable. Examples of biomarkers include everything from pulse and blood pressure to more complex lab tests such as C reactive protein, a test of overall inflammation throughout the body or angiotensin converting enzyme. The key issue with respect to biomarkers is determining the relationship between any given measurable biomarker and rel and relevant clinical endpoints. And so biomarkers in oculomics, you know, we're talking here about structural and vascular biomarkers. And we'll have some examples coming up uh with respect to retinol and choroidal thickness, blood vessel caliber and tortuosity, optic nerve changes. These can all be early indicators of a variety of systemic diseases. So an ideal biomarker offers a cost effective non-invasive real-time method for systemic health screening through ocular evaluation. In fact, there are some programs out there and algorithms that will take a fundus photograph and determine a patient's biological age just by characteristics from the fundus image. I have not had this done on on my eyes maybe because I'm afraid to um but it exists. And so as I mentioned the terminology oculomics is new but the concept is not. You know in the early years we had naked eye observation and then finally the invention of the direct ophthalmoscope by Von Helmholtz. Then that led to the rise of retinal imaging using regular film in some cases fluorescein angiography. Eventually some scanning laser systems were developed and these gave rise to qualitative links between the eye and systemic diseases. Between 1975 and 2000 really we were looking at the emergence of a digital revolution. And this has led to quantitative biomarkers uh that enable large scale epidemiologic studies and large data sets. And this includes digital retinal photography and optical coherence tomography. And now really beginning in two 2016 until today, we have entered the AI era where AI-driven insights unlock the predictive power of retinal imaging for systemic disease prediction and

diagnosis. Now, you'll be pleased to learn that we still teach all of these techniques in optometry school. Okay? Uh because as much as wide field and ultra-wide field retinal imaging, OCT, OCT angiography, as much as I love all of those techniques, really it starts with a traditional dilated retinal examination. And so let's take hypertensive retinopathy for example. So here we have the evolution of retinal images in hypertensive retinopathy over time starting in the 1970s onto the 2000s and the 2010s and beyond from simple fundus observation to much more advanced imaging technologies. And the digital age, which we are in the middle of, has enabled quantitative oculomics. And so now we're looking at various parameters, including blood vessel caliber. Artificial intelligence with deep learning technology now is commonly used in diabetic retinopathy screenings. And so this now enables rapid automatic analysis of retinal images and has the potential to really revolutionize clinical care as well as research between the eye and systemic disease. And again, this is just a reminder to type your uh questions into the Q&A widget. Uh here are a couple of examples of biomarkers of degenerative myopia. Right? We we talk quite a bit about you know the rise in myopia among children and adolescents and high myopia in particular. And so high myopia is considered by some health organizations as a disease because of its potential to result in myopic traction maculopathy which we see on the left and retinal tears and lattice degeneration as a result of high myopia that we see on the right hand side. And of course uh with the emergence of OCT and OCT angiography which starts with the two-dimensional B-scan and then when we combine a bunch of lateral B scans we end up with the three dimensional volumetric cube of data and the OCT instrumentation can use that data to generate all kinds of thickness maps and perform *en face* OCT at various levels. So you may have guessed that the level that we're looking at here is the retinal nerve fiber layer because this is the papillomacular bundle and *en face* OCT is used to develop these OCT angiograms a non-invasive way for us to do vascular studies of the the retina and blood vessels. vessels that supply the optic nerve. And so from 2000 until

present really we are now into the era of OCT and OCT angiography. One of the things that I do want to mention uh is that every time we perform OCT, we get a near infrared image. And many of us ignore these and I stopped ignoring these because they really could be quite useful along with colour fundus photography in identifying signs of retinal disease as well as biomarkers of systemic disease. So don't sleep on these near infrared images. And so as we look at the milestones in retinal imaging, we've gone all the way from plain film fundus photography in the 1920s all the way to swept source OCT and OCT angiography today. And we can divide retinal imaging or the hardware of oculomics into invasive technologies where we're injecting a dye into the arm and non-invasive technologies. You know real quick on the invasive technologies what you need to know is that fluorescein angiography is specific for retinal disease whereas indocyanine green angiography is more specific for diseases that originate in the choroid. Non-invasive technologies include from the bottom up the near infrared as well as multicolour imaging including simple red-free photography, fundus autofluorescence imaging, wide field and ultra-wide field imaging, standard fundus photography, A and B scan ultrasound and then of course the big dog uh OCT and OCT angiography. AI represents the software of OCT. It started with deep learning neural networks and that led to machine learning algorithms and now we've got the artificial intelligence uh that is becoming more and more commonly used today as many people like to say you know you the doctor I don't believe will be replaced by artificial intelligence but you may be replaced by other optometrists that understand how to use artificial intelligence to our advantage. Let's talk about some biomarkers of ocular disease. And so going back to our example earlier of age- related macular degeneration, if we look at the fundus image, we really have two types of drusen. We have typical soft macular drusen which we know indicate more widespread contamination of Brooks membrane. If we were to compare soft drusen to hard drusen and histologically the difference between these large fluffy confluent soft drusen and smaller more well

circumscribed hard drusen. Histologically the difference is inflammation. There are many more inflammatory components or inflammatory biomarkers in a soft drew versus a hard drew. But then in this particular patient outside of the soft drusen we also see this sort of honeycomb appearance to the pigment epithelium and these are known as reticular pseudo drusen and high definition OCT has made these finger-like projections or reticular pseudodrusen which the smaller arrows are pointing to much more visible. We also see in this patient with AMD a relatively thin choroid. The choroid only goes from here to about here because this is the sclera. Again, the choroid in this part of the t area goes from here to here. The choroid should be about as thick as the overlying sensory retina. So patients with age- related macular degeneration tend to have a relatively thin choroid. And these reticular pseudodrusen which are similar but not exactly the same as these larger true drusen in their histology. These reticular pseudo drusen have been found to be a consistent risk factor or biomarker of progression to both geographic atrophy and macular neovascularization or the advanced stages of AMD. Again when we look at the OCT the reticular pseudo-drusen invade the sensory retina whereas the soft macular drusen stay below the pigment epithelium. And here's another example of combination or multimodal imaging. Here we combine fundus autofluorescence a non-invasive way to evaluate the metabolic status of the pigment epithelium. When we have bright areas on our fundus autofluorescence such as the areas that I'm pointing to these areas of hyper autofluorescence indicate that the pigment epithelium is stressed. These areas that are jet black on fundus autofluorescence indicate that the pigment epithelium has died. And we can correlate that to our OCT-B scan overlying it. As you can see, this biomarker known as choroidal enhancement correlates with the areas of atrophy or geographic atrophy or hypo autofluorescence. And if you're thinking that you're seeing some reticular pseudo drusen in addition to your standard drusen, you are correct. So we've got reticular pseudo drusen. Here is the ellipsoid zone band that's present on one side of the phobia, but it

drops out as we get to the foveal center on this particular B scan. And so the integrity of the ellipsoid zone band is yet another biomarker. This one a biomarker of visual function. When we have contamination of that ellipsoid zone band or even the pigment epithelial band below it and it's subfoveal or even juxtafoveal, visual function will suffer. Here's a patient that underwent photobiomodulation therapy for their intermediate dry AMD. And again on OCT we could see it on our near infrared image what the Drusen look like. Here are a few unusually large soft drusen and then a smaller soft Drews next to it. And now Brook's membrane becomes visible right now that the RP has been separated from Brooks by this by this um homogeneous material. We also notice a hyper reflective spot superior to these RP detachments. It is thought that these hyperreflective spots intraretinally represent either inflammation or migration of pigment epithelium. We can also use our OCT to derive these RP thickness maps. And so we could compare the thickness maps before therapy and after several sessions of photobiomodulation therapy. We have a reduction in our RP uh morphology map and clearly we have a reduction in these drusenoid RP detachments and even these hyperreflective spots are not nearly as bright. So again, we can use OCT and the quantification of OCT to gauge a patient's response to therapy. Here's a fundus autofluorescence image of a patient with central serous chorioretinopathy and we see this kind of speckled appearance in a vertical form formation. We have some hyper and hypo autofluorescence. And this clinical sign sometimes called the guttering sign has become pathognomonic for central serous chorioretinopathy. You know the standard color image is not nearly as revealing on this patient. Imaging the choroid. So thanks to OCT and OCT angiography, the choroid has never been more accessible to eye care providers. And what we notice here is an unusually thick choroid. So we would measure the choroid. We can use callipers on our OCT to measure the choroidal thickness from here all the way down to this the choroidoscleral junction down here. And clearly this patient's choroid is much thicker than their sensory retina. So central serous chorioretinopathy

which is what this patient has is one of the pachychoroid syndromes or thicker choroid syndromes that is quantifiable. So we can use choroidal thickness as a biomarker. Now this is a patient with resolving central serous chorioretinopathy. As you could see, the subretinal fluid is rather shallow, whereas on first presentation, it was a big mound of serous fluid. Also, I want to draw your attention to the photo receptors that look like they're just flapping in the wind. And so, we call this in retina the shaggy photo receptor sign. And this is a sign of chronicity in conditions like central serous chorioretinopathy. We know that the longer these photo receptors are separated from the pigment epithelium, the more likely it is that visual function will be damaged. And so the shaggy photo receptor sign and the choroidal thickness two biomarkers of central serous chorioretinopathy. Yet another patient with pachychoroid syndrome. This one actually developed um macular neovascularization probably in here somewhere and we see it on fluorescein angiography as well. So this patient has subretinal fluid. It also has some subretinal heme. So there is some substance to this area underneath the retina. Whereas here we have serous fluid which is jet black. Remember black equals fluid on OCT. That's why the vitreous which is 99% water is jet black. But then it becomes more turbid in this part of the subretinal space probably because blood is leaking from this macular neovascular membrane which is small. And here we have a serous detachment of the pigment epithelium that is juxtapapillary. Now let's move on and talk about some ocular biomarkers of systemic diseases starting with an easy one hypertensive retinopathy. So here we have a blood vessel that is still fairly narrow in its calibre which is common in early hypertensive retinopathy and then becomes so thin that it becomes virtually undetectable. So here we have focal narrowing of the arterial and here we have arterial venous nicking. And these are fairly elementary signs or biomarkers of hypertension. But I want to point them out because when I have an intern that is able to identify subtle narrowing of the arterials and s and fairly subtle arteriovenous nicking. Now I know that I have an honor student on my hands because

anybody could find a branch retinal vein occlusion which is really what this is. This is an impending BRVO. Anybody could find that. But it's truly the honors student and the honors clinician that can find focal narrowing of the arterials and early AV nicking. Now hopefully AI algorithms will be able to identify some of these changes as well. So looking at this fundus and doing a careful history on this patient, a 28-year-old man with sudden fatigue as well as blurry vision, you know, leukemia [clears throat] needs to be at the top of our list of differential diagnosis, especially with these multiple Roth spot hemorrhages. Diabetes, another systemic condition. And as we look at the fundus, we may see clinical signs on OCT angiography such as a misshapen foveal avascular zone. And these areas of reduced capillary perfusion indicate some degree of macular or foveal ischemia. And we can clearly see a microaneurysm right there. There is the outpouching of the blood vessel. So we look at this OCT angiography and we can tell that there is foveal ischemia most likely due to diabetes. Here on our B scan we have pre-retinal proliferation and when we run an *en face* OCT angiography of the peripapillary tissue we can clearly see this neovascularization of the disc. On the lower left, we do a macular cube scan. And on anatomic OCT, once again, we see pre-retinal neovascular development. And we can bring our cross-section or our *en face* lab up to this pre-retinal zone and clearly identify neovascularization elsewhere on the retina in two separate spots on this patient. Now, you know, I said earlier that automated imaging uh really is is part of the goal of oculomics, and we're not quite there yet. So, here the segmentation of the scan on OCT angiography is just a bit off. We could still see the neovascularization and we could see some um capillary non-perfusion in the neighbourhood but all we but we manually move it up maybe 30 or 40 microns and clearly this pre-retinal neovascularization comes into view. Eventually this will all be automated. Let's talk about neuroanatomic disease and its biomarkers. You know, we talked about hypertension and some of the vascular signs when well, when we get to the later stages three and four of hypertensive retinopathy, now we're getting into some of the neuro

ophthalmology of systemic hypertension. And this may include ischemic cranial nerve pauses. It may include the non-arteritic form of anterior ischemic optic neuropathy and it may include internuclear ophthalmoplegia either unilateral or a binocular INO or bino in hypertension all the presence of any one of these are a risk factor or a biomarker for impending stroke. And let's talk about some other common systemic conditions in neural disease. So this is by no means a comprehensive list, you know, but I just went ahead and pulled from the literature some of the more common systemic conditions that may present with neural disease. we're really going to zero in on uh conditions like giant cell arteritis, multiple sclerosis, Alzheimer's disease, and Parkinson's disease. And so here's a patient uh an African-American woman in her late 40s with haemoglobin SS disease who presented uh for her annual eye wellness examination. She was visually asymptomatic. Her acuity in the right eye was 2030 did not improve with pinhole. There was no afferent pupillary defect and she was correctable to 2020 in her left eye. Anterior segment and dilated fundus examination appeared relatively normal in both eyes without any visible signs of uh sickle cell retinopathy. As we look at our OCT findings, look at our thickness map on the right eye. First of all, we have a sort of enlarged foveal avascular zone or enlarged thinning of the foveal avascular zone. And then next to that we have some central macular thinning. You know, much more visible in the right eye than in the left eye. Okay. And then if we skip down to the to the B scan, one of the B scans, remember this is just one B scan. We would want to click and drag this blue arrow up and down in order to see all of the B scans in this area. Eventually AI will do this for us. The left eye relatively normal morphology. the right eye. Note the displaying of this foveal depression and the overall thinning. And so this patient has macular ischemia, foveal ischemia due to non-perfusion as a result of sickle cell disease. Okay. And so this might be a case of old pam in sickle cell disease. So if we go up here to our nine zone ETDRS thickness map, the the numbers inside each of these nine zones represent the average retinal thickness and clearly we have central and parafoveal um thinning as

a result of the sickle cell disease really invisible. So PAM this acronym stands for paracentral acute middle maculopathy. It's a diagnosis made possible by OCT in the past few years. It has also been found and here's the publication um as a high to be a highly specific biomarker of temporal artery biopsy positive giant cell arteritis. And so very very helpful are OCT and OCTA in patients that we might suspect have giant cell arteritis either due to various symptoms or certain ocular signs. And so once again, OCT and OCT angiography, non-invasive biomarkers that may now support early therapeutic decisions in suspected cases of giant cell arteritis. biomarkers here in giant cell you know so the set of clinical criteria that are most strongly associative or suggestive of giant cell arteritis are a symptom of jaw claudication. So, it's really important for us to ask patients about, you know, the scalp pain. Does it hurt to chew and get worse the more you chew? Of course, another biomarker is a pale swollen disc in an eye with profound vision loss. This is the arteretic form of AI. A C reactive protein greater than 2.5. Neck and scalp pain a set rate greater than or equal to 47. Other neuro ophthalmic manifestations in neuro degenerative disease. Now we're moving on to multiple sclerosis and we know some of the common neuro ophthalmic signs in MS starting with demyelinating optic neuritis but we can also have brain stem motility disorders. We can have nystagmus and we can have lesions of the medial longitudinal fasciculus resulting in an internuclear ophthalmoplegia. And so the cranial neuropathies that we might see in multiple sclerosis, these can be nuclear or fascicular and they can involve nerves three, four and six. MS related optic neuritis. This is a focal inflammatory or demyelinating event of the nerve. It may be idiopathic or it may be or be may become associated with MS. We know that 90% of all optic neuritis is due to multiple sclerosis. I want to acknowledge Dr. Messner who was kind enough to share this case. So this is the typical scenario. This is a patient whose um whose acuity is down and we look at the nerve but it looks normal. There's an APD in this eye. There's dischromatopsia in this side. There's some pain with eye movement. But this is an optic neuritis that is retro bulbar.

And this is the rule rather than the exception in demyelinating disease. About 35% of the time you will have a papillitis um as a result of demyelination. But note the absence of blood or absence of a hyperemic disc. OCT findings, right? Acute optic neuritis in one study was associated with RNFL plus the ganglion cell complex thinning of up to 40% over three months in optic neuritis due to MS and thinning of the same structures occurs over time in patients with MS that even that do not even have an optic neuritis And this is a thinning of about 12%. So again these biomarkers right of RNFL and ganglion cell complex thinning as well as low contrast VA reduction and vision specific quality of life measures. These are all now incorporated into clinical trials for multiple sclerosis. Here's a 37 year old 31-year-old woman with the history of remitting/ relapsing MS patients suffered a prior episode of optic neuritis recovered to 2020 minus one and this case is quite a bit more subtle. You know, if you look very carefully, you'll notice some degree of temporal power in that right eye and some to a lesser extent of temporal power in the left eye. And again once we perform OCT retinal nerve fiber layer analysis we can identify these temporal areas in the more obvious right eye and the less obvious left eye and so thinning of retinal nerve fiber layer increased latencies on VP testing these are biomarkers of MS S the retinal nerve fiber layer thinning is greatest temporally and inferior temporally and here is another example. So the key points visual and OCT biomarkers can be used to gauge the disease activity and also to gauge a patients response to treatments. So in the last two minutes who will use oculomics the answer is everybody from us in eye care to other subspecialists throughout the health care system. you know the future you know we're looking at advancements in retinal imaging multimodal data leading to multi-disciplinary or interprofessional really partnerships novel technologies such as AI using big data to work to our advantage expanding research we need more research evidence more validation and a better understanding ing of these concepts. Now, rapid gains in retinal imaging, AI, and healthcare informatics so far are encouraging and will likely continue. And Oculomics holds immense promise

for the future of health care. And so, it is our hope that in the next few years, we will continue this drive. Now, as you could see, we do have several challenges, including standardization of retinal imaging, particular among the different brands or platforms of OCTs. Data security and privacy must be ensured. Large data sets are needed to develop and train the AI algorithms. Infrastructure needs to improve as does operation and workflow as well as cost effectiveness and reimbursement issues. Data infrastructure and other advancements like 6G networks and linking of medical records are essential steps in order to broaden research and deployment opportunities. and future research can focus on a number of parameters. Um the real potential is more efficient pre-screening of patients for clinical trials but also expanding the scope of disease prediction. We have a lot of requirements for oculomics to become a reality. We spoke about the automation of ophthalmic imaging the the need for it and the big issue is communication and collaboration among health care professionals. This is critical for unlocking the full potential of oculomics. So this has become a catchy buzzword but one that reflects the fact that the eye is an extension of the brain and the central nervous system. Just as Von Helmholtz with his ophthalmoscope revolutionize the eye examination. The advent of AI and large scale data along with retinal imaging. This is beginning to transform how we interpret ophthalmic information. So indeed the eye does offer a uniquely accessible view into systemic health. Uh I can send you this short bibliography or make it available um uh to Woo University in case you would like to look things up. uh and in the remaining couple of minutes I will be glad to take a couple of questions. Thanks for spending your Tuesday evening with me. My email address once again is allthingsOCT@gmail.com. And so um I would like uh for Dr. Stewart if you don't mind uh reading a um reading some of the Q&As's for me. Absolutely. Thank you so much. What a unique presentation. It's so nice to hear something completely different. So, I see some great comments in there about uh a unique different type of learning tonight versus what we typically hear.

Link for Questions: https://forms.gle/7wtF82PPxcaT1Xw77

Questions

1. What is oculomics?

A. The study of ocular pharmacology

B. The study of the eye as a window into overall health

C. The study of genetic eye diseases

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2. Which three developments accelerated the field of oculomics?

A. Contact lenses, pharmaceuticals, and surgery

B. High-resolution imaging, large datasets, and artificial intelligence

C. Visual fields, tonometry, and keratometry

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3. Why is the eye particularly useful in oculomics?

A. It is the only organ that can be examined without magnification

B. Neurologic and vascular tissues can be viewed directly and relatively non-invasively

C. Ocular tissues regenerate rapidly

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4. According to the lecture, a biomarker should ideally be:

A. Subjective and patient-reported

B. Expensive and highly specialized

C. Objective, measurable, accurate, and reproducible

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5. Which systemic diseases did the presenter identify as potential targets for early detection using oculomics?

A. Alzheimer's disease and Parkinson's disease

B. Appendicitis and gallstones

C. Asthma and eczema

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6. Which ocular finding was described as a consistent risk factor for progression to advanced age-related macular degeneration?

A. Cotton wool spots

B. Reticular pseudodrusen

C. Retinal tears

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7. On fundus autofluorescence imaging, areas of hyperautofluorescence indicate:

A. Retinal detachment

B. Dead retinal pigment epithelium

C. Stressed retinal pigment epithelium

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8. Central serous chorioretinopathy was described as belonging to which group of disorders?

A. Pachychoroid syndromes

B. White dot syndromes

C. Retinal dystrophies

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9. Which OCT finding was described as a sign of chronicity in central serous chorioretinopathy?

A. Hyperreflective foveal scar

B. Shaggy photoreceptor sign

C. Epiretinal membrane

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10. Which retinal changes were identified as biomarkers in multiple sclerosis?

A. Corneal thinning and keratoconus

B. Retinal nerve fibre layer and ganglion cell complex thinning

C. Increased lens thickness
