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PRIMARY eyecare

Is artificial intelligence the future of medicine?

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There is a lot of 'buzz' in medicine about applications of “artificial intelligence” (AI) and the related field of “machine learning.” Artificial intelligence (AI) was originally conceptualized in 1956 and uses are increasing throughout medicine for a number of decision-making diagnostic and therapeutic applications. Machine learning refers to the process of training computers to detect digital patterns of a condition using known cases, so the algorithm created can then be used to detect that pattern in fresh (undiagnosed) presentations. Deep learning (DL) is the next generation of AI, made possible by the advent of more powerful computers and the availability of big datasets. In essence, in DL routines, the computer learns "on its own" without the help of a human.

In medicine, the most robust AI algorithms have been demonstrated in image-centric specialties, including radiology, dermatology, pathology and increasingly so in ophthalmology. DL systems have been shown to accurately detect diabetic retinopathy (DR), glaucoma, age-related macular degeneration (AMD) and retinopathy of prematurity (ROP) from clinical images. Last year, in 2018, the first ever FDA approval for a device designed to independently diagnose the presence of diabetic retinopathy from retinal photographs (without clinician involvement) was granted.

However, several challenges still need to be resolved to increase safe adoption of AI as basic healthcare. The ‘black box’ nature of DL systems has come under stronger scrutiny of late, especially under EU regulations.

Privacy and security of patients information in 'big data' is very controversial and 'reidentification' of de-identified data is of particular concern. In terms of patient care there are reservations about substituting comprehensive clinician care with screening approaches without exploring the philosophical shift in levels of care and the potential negative impacts of such a shift.

While technology advances, and image processing and the use of AI to detect features of diabetic retinopathy continues to be refined, there have been only modest gains in specificity and sensitivity. This is interesting since the mere existence of a machine capable of detecting retinopathy is usually used to justify the replacement of actual comprehensive care with a screening approach without exploring the philosophical shift in the paradigm of care and the potential negative impacts of such a shift.

In an 'Eye Care' post by Dr G Timothy Petito FAAO, DNAP the point was well made that the gap in care for known diabetics is getting compliance with the care regimen that preserves their overall health, including vision, and it results from a lack of education more than anything else. Of all visits diabetic patients have, the comprehensive dilated eye exam has the most impact on compliance, and that is why it has been highlighted in all quality-improvement systems (globally).

Dr Petito voiced concerns that by providing false security as to the need for comprehensive eyecare to those judged “healthy” by an AI screening system dedicated to only one aspect of diabetic eye disease may exacerbate the difficulty in achieving compliance and improved overall diabetic outcomes.

Furthermore, single-finding screening programs detecting retinopathy do nothing to detect those with the underlying disease (in this case, diabetes) who have not yet been diagnosed. Screening programs often

reduce the chances of finding those undiagnosed individuals in early stages since a "healthy" designation from a screening program likely decreases that individual's utilization of more comprehensive (and appropriate) options for care from a general practitioner or optometrist.

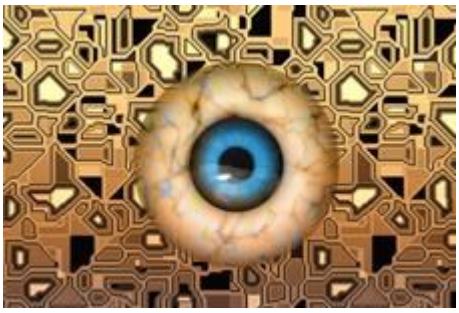

Image Source: Pixabay images

Does familiarity breed contempt for myopia?

How often have you heard people say - "I just have myopia"? Probably more now than ever before since myopia is now the most common ocular disorder worldwide, according to Vision 2020 and the WHO. [4] In their 2018 paper entitled, A Review of Current Concepts of the Etiology and Treatment of Myopia, Dr Jeffrey Cooper and Dr Andrei Tkatchenko note that the prevalence of myopia in the United States has increased from 25% to 44% between 1972 and 2004. [5–7] In urban communities in Asia, the prevalence is greater than 80%. [8,9] However, the prevalence is much lower in underdeveloped areas in the world such as Sherpa in Nepal.[10]

Once viewed as a benign refractive condition, today myopia, even at low levels, is associated with increased risk for numerous ocular diseases. As Cooper and Tkatchenko note, myopia represents a major risk factor for a number of other ocular pathologies such as cataract, glaucoma, retinal detachment, and myopic maculopathy, which is comparable to the risks associated with hypertension for stroke and myocardial infarction.[11,12] Taking into account pathological complications of myopia and other serious pathologies associated with the disease, myopia not only negatively affects self-perception, job/activity choices, and ocular health,[13–15] but also represents one of the leading causes of blindness in the world.[16] The yearly incidence of retinal detachments is 0.015% in patients with less than 4.74 diopters (D) myopia and it increases to 0.07% in myopia greater than 5 D and 3.2% myopia greater than 6 D.[17,18] Myopic patients also have great risk of developing macular choroidal neovascularization, that is, 2X for patients with 1 D to 2 D of myopia; 4X with 3 D to 4 D of myopia; and 9X for 5 to 6 D of myopia.[19] It is estimated that 4.8 billion people (one half of the world's population) will be affected by myopia by 2050.[20]

Stopping the progression of myopia has the potential to positively affect quality of life and ocular health. Popular control options today include progressive addition lenses (PAL), topical atropine, orthokeratology (OK) lenses, and multifocal contact lenses. Cooper and Tkatchenko provide a comprehensive review of myopia treatment strategies with the goal that ocular health may be preserved.

	Cataract (PSCC)	Retinal detachment	Myopic Maculopathy
-1.00 to -3.00	2.1	3.1	2.2
-3.00 to -6.00	3.1	9.0	9.7
-6.00 to -8.00	5.5	21.5	40.6

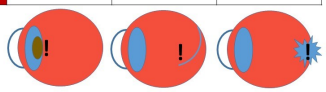

Image source: Myopia Profile

Source: A Review of Current Concepts of the Etiology and Treatment of Myopia Article (PDF Available) in Eye & Contact Lens Science & Clinical Practice 44(4):1 · June 2018 DOI: 10.1097/ICL.0000000000000499. To view the full open access paper use the link below -

https://www.researchgate.net/publication/325747460_A_Review_of_Current_Concepts_of_the_Etiology_and_Treatment_of_Myopia

Can retinal alterations provide an objective biomarker for psychiatric disease?

Research is showing us the possibilities if we really accord the retina its due as a slice of brain tissue according to a study published in Eye late last year. The Spanish research team led by by Dr Polo, of Miguel Servet University Hospital, set out to evaluate the ability of swept source optical coherence tomography (SS-OCT) to detect retinal changes in patients with bipolar disorder (BD). It was a relatively small scale study with 23 patients with bi-polar disorder and 23 controls. All participants underwent

retinal evaluation using SS deep range imaging (DRI) Triton OCT. Full retinal thickness, the ganglion cell layer (GCL), the retinal nerve fiber layer (RNFL), and choroidal thickness were evaluated with automated segmentation software.

The results showed that patients with BD were shown to have significant thinning of the macular full retinal thickness in the center ($p = 0.049$), inner temporal ($p = 0.045$), inner nasal ($p = 0.016$), and inner inferior ($p = 0.016$) of the ETDRS areas. The macular GCL layer was reduced in patients compared with controls (average, $p = 0.002$; superior, $p = 0.009$; superonasal, $p = 0.009$; inferonasal, $p = 0.003$; and inferior, $p = 0.009$). Peripapillary reduction of full retinal thickness (average, $p < 0.001$; superotemporal, $p < 0.001$; superonasal, $p = 0.003$; nasal, $p = 0.005$; and inferotemporal, $p = 0.033$), GCL (nasal, $p = 0.025$), and RNFL thickness (average, $p = 0.002$; superotemporal, $p < 0.001$; and superonasal, $p = 0.045$) was observed in patients compared with controls. No significant differences were observed in choroidal thickness measurements.

Since the BD patients were shown to have quantifiable thinning of full retinal thickness and the GCL in the macular area, as well as a peripapillary reduction of the RNFL and GCL thickness. The researchers suggest that analysis of the retinal sublayers with SS-OCT may be a useful indicator to show degeneration and monitor disease progression in bipolar disorder.

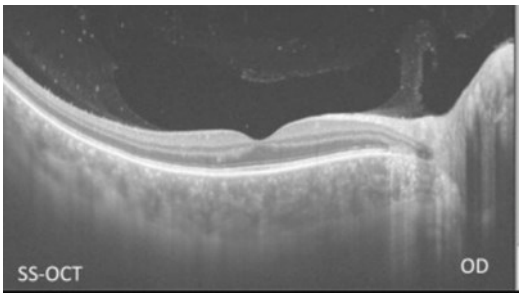

Image source: Elsevier

Source: Ability of Swept Source OCT to Detect Retinal Changes in Patients With Bipolar Disorder

Eye (Lond) 2018 Oct 31;[EPub Ahead of Print], V Polo, M Satue, A Gavin, E Vilades, E Orduna, M Cipres, J Garcia-Campayo, M Navarro-Gil, JM Larrosa, LE Pablo, E Garcia-Martin

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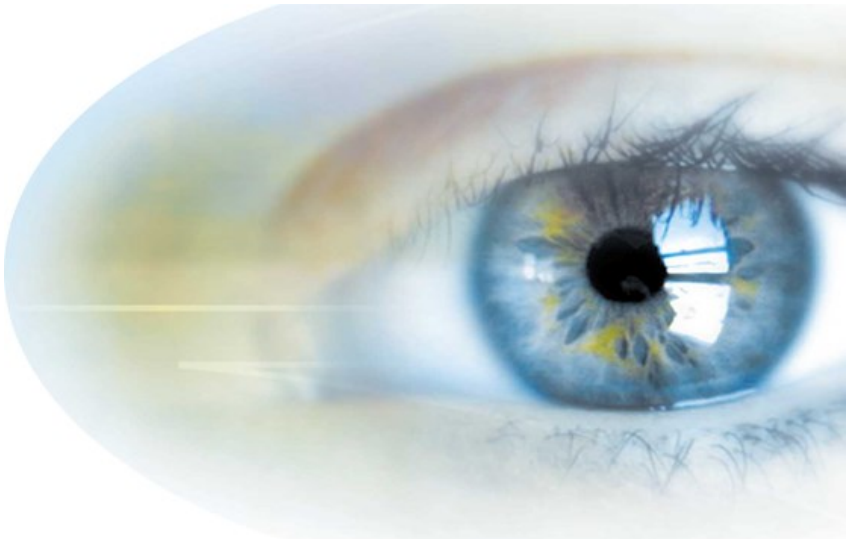
Should uveitis be considered as the initial presenting complaint of sarcoidosis?

Earlier this year Rogers et al. published a paper in the American Journal of Ophthalmology in which they document the clinical presentation, treatment and visual outcome of sarcoid uveitis and outline the timing and potential risk factors of sarcoidosis progression to symptomatic systemic disease from the time of sarcoid uveitis diagnosis.

The researchers undertook a retrospective review of 143 patient records from the Royal Victorian Eye and Ear Hospital and Eye Surgery Associates in Melbourne, Australia between October 1990 and April 2014 coded with the dual diagnoses of uveitis and sarcoidosis. Only patients with uveitis, and presumed or biopsy-proven sarcoidosis (N=113) were included. The main objectives were to: (a) ascertain rate and time (months) to the development of symptomatic systemic sarcoidosis from uveitis onset; and (b) compare and contrast the patient demographics, characteristics of uveitis, treatment and visual outcome between those who developed systemic sarcoidosis and those who remained systemically asymptomatic.

Results showed that uveitis was the initial presenting complaint of sarcoidosis in 78.8% (n=89). Twenty-three patients had concurrent undiagnosed systemic disease at presentation and 29 subsequently developed symptomatic sarcoidosis in an organ uninvolved at uveitis onset. The median time to the development of symptomatic systemic sarcoidosis was 12 months. No statistically significant association was ascertained between any particular uveitis characteristic and extra-ocular sarcoidosis progression.

The researchers concluded that “uveitis was the initial presentation of sarcoidosis in the vast majority of our subjects. Concurrent undiagnosed systemic sarcoidosis was common at the time of uveitis onset. A high index of suspicion for subsequent systemic progression should also be maintained, especially within the first 5 years of the uveitis diagnosis.”



Source: Sarcoidosis Related Uveitis: Clinical Presentations, Disease Course and Rates of Systemic Disease Progression After Uveitis Diagnosis. Am J Ophthalmol 2019 Feb 01;198(xx)30-36, S Ma, SL Rogers, AJ Hall, L Hodgson, J Brennan, R Stawell, LL Lim

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