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EDITORIAL

Diabetic retinopathy: An often missed window of opportunity

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Type 2 diabetes mellitus (T2DM) is a global pandemic with South-east Asia as its epicentre [1]. Uncontrolled diabetes damages the entire vascular tree, leading to microvascular complications primarily affecting the small vessels of the retina, nerves and kidneys and macrovascular complications that involve the larger vessels of the brain or the heart. Not only do they contribute to increased morbidity and mortality, but they also hugely reduce the quality of life of people with diabetes. The prevalence of these complications varies across different ethnicities. Diabetic retinopathy is the leading preventable cause of blindness amongst working age individuals [2] that affects small vessels of the eye and has a linear relationship with the duration of diabetes and glycemic control. The prevalence of diabetic retinopathy (DR) is lower in Asians compared to their western counterparts [3].

Diabetic retinopathy is a neurovascular complication where neuronal injury as a result of inflammation precedes clinical microvasculopathy. Pathophysiologic mechanisms like inflammation, epigenetic changes and insulin resistance that damage the pancreatic beta-cell also cause organ dysfunction, increasing the risk of diabetic retinopathy and other vascular complications. The quest to detect and predict early damage to the neurovascular tree prior to the development of full blown microangiopathy is ongoing [4]. There is a need to evolve strategies for earlier detection and treatment of diabetic retinopathy with an attempt to not only preserve good vision, but also prevent simultaneous inflammatory and destructive process in other organs [4].

There is proven evidence today that inflammation and retinal neurodegeneration contribute to diabetic retinal damage in the early stages of DR. Numerous recently identified molecular mechanisms may provide direction for the development of new early interventions [5].

An interesting study by Tamer Ibrahiem Salem et al. [6] published in the present issue evaluated the "Expression profile of microRNAs as promising biomarkers in early detection as well as potential targets for management of proliferative diabetic retinopathy". Whole blood samples from 180 diabetic patients (60 without DR, 60 with non-proliferative diabetic retinopathy (NPDR), 60 with proliferative diabetic retinopathy (PDR)) and 60 normal individuals as control were tested for gene expressions of miR-21, miR-181c and miR-1179 using two-step reverse transcription quantitative real-time polymerase chain reaction (RT-qPCR). PDR group had much higher levels of microRNA 181c and miRNA 1179 compared to NPDR and control groups, which can be used to anticipate and follow-up the progression. However, miRNA 21 was similar in PDR or controls. Combination of miRNA 1179 and miRNA 21 improved the accuracy rate to 90%. Combination of miR-181c and miR-1179 increased the accuracy to 100% in discriminating between PDR and NPDR. This study proved that microRNAs may play a role in pathogenesis of diabetic retinopathy. It's likely that in the near future, microRNA antagonists or mimics could be used to modify DR by reducing its progression and subsequent blindness.

Another study by Sincer Abide featured in the current issue has highlighted the role of epicardial fat thickness for prediction of proliferative diabetic retinopathy [7]. Epicardial fat thickness (EFT) and MHR (monocyte to HDL ratio) were analysed in three groups of patients with diabetes namely, 36 without DR (NDR), 35 with proliferative DR (PDR) and 41 with non-proliferative DR (non-PDR). Monocyte counts, HDL, mean MHR and EFT values of NDR, non-PDR and PDR groups were significantly different. Study concluded that MHR and EFT were significantly increased in proliferative DR and negatively correlated with NDR. Authors recommend that increased EFT may be used to predict the presence of PDR in type 2 DM.

A recent large real-world study by Chawla et al. published in Prim Care Diab Europe [8] established relationship between diabetic retinopathy, microalbuminuria and other modifiable risk factors. A significant association between

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presence of microalbuminuria, BMI, glycemic control, diabetes duration, peripheral neuropathy and the degree of retinopathy was highlighted. The study suggested that the presence of microalbuminuria be used as a simple clinical biomarker for the development of proliferative diabetic retinopathy.

Artificial intelligence has come a long way today, aiding healthcare professionals on many fronts. An interesting study by Sangeethaa and Jothimani [9] published in the present issue highlights the importance of artificial intelligence in the detection of exudates from clinical fundus images using machine learning algorithms in diabetic maculopathy. The main aim of this study is to assist in diagnosing DR using a computer-aided technique (AI) by detection of hard exudates. Methodology of the study focuses on the identification of the yellow lipids that include hard exudates. The classifier is provided with images of diseased retina as input, and it produces the output as exudates or non-exudates. Support vector machine (SVM) and multilayer perceptron (MLP) interpret the images to accurately predict the presence of exudates and non-exudates. Fundus images are pre-processed to get the filtered, contrast enhanced image. Then, for the detection of hard exudates, features such as blood vessel segmentation implement morphological operation by measuring the size of the lesion, and optic disc (OD) are measured and eliminated by comparing the parameters with the size of the lesions. Subsequently, segmented images are used as an input to the classifier such as SVM and MLP, which classifies and gives output about the presence or absence of the exudates. SVM and MLP classifiers collected 140 images from real-time databases from Aravind Eye Hospital, Coimbatore, with an accuracy of 88% and 95% respectively.

In the recent times, digital innovations include 5th generation (5G) telecommunication networks, Internet of Things (IoT), and artificial intelligence (AI), with immense potential for creating an inter-dependent ecosystem. These digital innovations have revolutionized the model of eye care [10].

A recently published study by Chawla et al. [11] "Trained nurse–operated tele ophthalmology screening approach as a cost-effective tool for diabetic retinopathy" highlighted the role of teleophthalmology for economical screening for diabetic retinopathy in developing countries. The photographs taken on a dilated fundus using an approved imaging camera by a trained health care provider and streaming them through the Internet to a specialty eye centre or ophthalmologist for reporting enabled basic screening for the presence of diabetic retinopathy on a large scale. Telescreening for diabetic retinopathy is fast emerging as a cost-effective, accurate, and reliable method for diabetic retinopathy screening and could be the way forward in developing countries like India where the delivery of cost-effective eye care to patients with diabetes in a practical and viable mode is a huge challenge. The study proposed that large scale adoption of tele ophthalmology should be encouraged as a means towards providing low-cost access to DR screening for timely detection as well as management of DR to reduce the menace of this devastating, vision-threatening condition.

Diabetic retinopathy is an often-overlooked microvascular complication of diabetes, essentially because of its silent asymptomatic course in early disease. Regular screening and early detection is a key factor that can attempt to change the trajectory of its progression to prevent eventual blindness. Advancements in technology and biosciences have opened a wide vista of diagnostic as well as management approaches. Molecular biology has thrown up new biomarkers that can serve as not only effective screening tools but also treatment targets for future strategies aimed at preventing progression from NPDR to PDR and vitreous haemorrhage, diabetic maculopathy and vision loss. Digital innovations incorporating artificial intelligence have brought forward teleophthalmology as an important means for screening and diagnosis of diabetic retinopathy aiding in its optimal management. It's time that we take proactive steps in incorporating newer advancements into our clinical practice and more research needs to be encouraged in this rapidly emerging arena.

References

1. Ramachandran A, Snehalatha C, Shetty AS, et al. Trends in prevalence of diabetes in Asian countries. World J Diabetes. 2012;3:110–7.
2. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. Lancet. 2010;376:124–36.
3. Lee R, Wong TY, Sabanayagam C. Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. Eye Vis. 2015;2:17.
4. Sinclair SH, Schwartz SS. Diabetic retinopathy–an underdiagnosed and undertreated inflammatory, neuro-vascular complication of diabetes. Front Endocrinol. 2019;10:843. https://doi.org/10.3389/fendo.2019.00843.
5. Wang W, Lo ACY. Review-diabetic retinopathy: pathophysiology and treatments. Int J Mol Sci. 2018;19:1816. https://doi.org/10.3390/ijms19061816.
6. Salem TI, Eldin NB, Alhusseini NF, Abdullah OA, Ahmed NE. Expression profile of microRNAs may be promising in diagnosis of proliferative diabetic retinopathy: an Egyptian study. Int J Diabetes Dev Countries. 2022. https://doi.org/10.1007/s13410-022-01044-9.
7. Abide S, Tuba K, Yunus A, Mehmet C, Umit D, Fatih U, Yilmaz G, Sincer Isa. Role of epicardial fat thickness for prediction of proliferative diabetic retinopathy. Int J Diabetes Dev Countries. 2022. https://doi.org/10.1007/s13410-021-01040-5.
8. Chawla S, Trehan S, Chawla A, Jaggi S, Chawla R, Kumar V, Singh D. Relationship between diabetic retinopathy microalbuminuria and other modifiable risk factors. Prim Care Diabetes Eur. 2021. https://doi.org/10.1016/j.pcd.2021.01.0121751-9918/©.

9. Sangeethaa SN, Jothimani S. Detection of exudates from clinical fundus images using machine learning algorithms in diabetic maculopathy. Int J Diabetes Dev Countries. 2022. https://doi.org/10.1007/s13410-021-01039-y.
10. Li JO, Liu H, Ting DSJ, Jeon S, Chan RVP, Kim JE, Sim DA, Thomas PBM, Lin H, Chen Y, S. Digital technology, tele-medicine and artificial intelligence in ophthalmology: a global perspective. Prog Retin Eye Res. 2020;Sep 6:100900. https://doi.org/10.1016/j.preteyeres.2020.100900. Epub ahead of print.
11. Chawla S, Chawla A, Chawla R, Jaggi S, Singh D, Trehan S. Trained nurse–operated teleophthalmology screening approach as a cost-effective tool for diabetic retinopathy. Int J Diabetes Dev Countries. 2022. https://doi.org/10.1007/s13410-021-01037-0.

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