Editorial to 'Triple Vessel Coronary Artery Disease and Retinal Nerve Fibre Layer Thickness'

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The retina provides a "window" to examine both neurological and vascular manifestations of systemic diseases.[1] A common eye disease is glaucoma, a progressive optic neuropathy characterised by gradual degeneration of retinal ganglion cells (RGCs). A major advance in diagnosis of early glaucoma and in monitoring glaucoma progression is the use of non-invasive spectral-domain optical coherence tomography (OCT), a device that images 3-dimensional layered retinal structure within seconds non-invasively. Eyes with glaucoma typically show a significant reduction in the retinal nerve fibre layer (RNFL), an indicator of RGC axonal damage.[2] Quantification of RNFL thickness is widely available using OCT built-in software, and detection of RNFL thinning is currently a sensitive tool to detect and monitor glaucomatous optic neuropathy in clinical practice.[3]

While glaucoma is thought to be largely due to raised intraocular pressure (IOP)—the most common form of glaucoma—there is a "vascular theory" of glaucoma.[4] In this theory, glaucoma begins as a neuronal disease as a consequence of insufficient blood supply that may be generalised to other parts of the body. This form of glaucoma is particularly important in people without the classical feature of high IOP. Thus, cardiovascular disease (CVD) risk factors have been linked with glaucoma, with studies showing associations of glaucoma with higher blood pressure, diabetes, migraine, and CVD.[5] For example, studies have reported that ischaemic heart disease and stroke[6-8] are associated with glaucoma, particularly in patients with low-pressure glaucoma. A large population-based study also showed that subjects with a previous glaucoma diagnosis are associated with increased odds of cardiovascular mortality compared with a control group.[9] However, the link between major markers of CVD and glaucoma has not been robustly demonstrated.

In this issue of the journal, Neoh YL et al reported an interesting finding that patients with severe CVD, reflected by triple vessel coronary artery disease (3VCAD), have a significant RNFL thinning measured with OCT, compared with normal subjects.[10] The authors speculated that the RNFL thinning is related to extensive systemic atherosclerosis in these patients that affects not only the coronary arteries but also other circulatory systems including the optic nerve circulation. Thus, it is possible that these high risk CVD patients may develop clinical glaucoma in the future, supporting the "vascular theory" of glaucoma.

There are other evidence supporting the "vascular theory" of glaucoma. Imaging of the retinal vasculature also allows a non-invasive visualisation of the human microcirculation, offering a unique biological model to study the relationship between vascular changes and glaucoma in the last 2 decades.[11] For example, numerous studies have reported an association between glaucoma and quantitative retinal vasculature as measured with computer-assisted software from retinal fundus photographs.[12] Persons with narrower retinal arterioles are more likely to have glaucoma and larger cup-to-disc ratio, after controlling for age, blood pressure, IOP, and other risk factors. Newer retinal geometrical vascular parameters—including fractal dimension, tortuosity and branching angle—have also been linked to glaucoma.[13,14] Importantly, the Blue Mountain Eye Study has shown that retinal arteriolar narrowing (as measured from baseline photographs) is associated with 10-year incident glaucoma, independent of IOP and ocular perfusion pressure.[15] These studies hypothesised that changes in retinal vasculature may indicate impaired optic nerve blood flow autoregulation and result in reduced nutritional support to the RGCs.

There are several areas for future research. First, replication of the findings and further longitudinal evaluations to clarify the causal link between CVD and development of glaucomatous optic neuropathy will be essential. Second, there are new retinal imaging technologies now being studied to further measure and analyse the detailed structure and functions of the retina—including non-dye-based mapping of retinal capillary network by

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OCT-angiography, laser speckle flowgraphy, dynamic vessel analyser and blood flow by Doppler OCT—offering a new means of studying the influence of CVD on optic nerve and retinal circulation. Third, the biological mechanisms which underlie the associations of CVD with RNFL thinning are not understood. Experimental research using animal models to investigate the specific underlying pathophysiological mechanisms will be interesting.

In conclusion, this observational study suggests that 2 common age-related chronic diseases, CVD and glaucoma, may be interlinked early in its course. Studying this relationship may provide new insights into common pathophysiology and possibly preventative strategies for both conditions.

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