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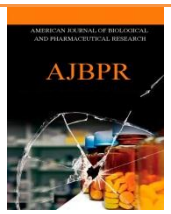

OCULAR BLOOD FLOW & ITS REGULATORY MECHANISM- A SHORT REVIEW

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ABSTRACT

Ocular blood flow supplies oxygen and nutrients to the eye. Normally blood flow and perfusion pressure in eye is auto regulated. Any dysregulation in this Ocular blood flow can act as an independent risk factor to many ocular diseases like glaucoma and diabetic retinopathy. In this review article, various techniques of measuring ocular blood flow and its regulatory mechanisms are being discussed.

INTRODUCTION

Ocular blood flow regulates changes in ocular activity hence maintains ocular temperature and retinal perfusion pressure [1]. Ocular blood flow Autoregulation can be classified as dynamic & static according to the responding rate [2]. Dynamic autoregulation of outer ocular vascular system reveals a rich sympathetic innervation in the outer ocular vessels while the Static autoregulation involves several diverse factors like myogenic, neurogenic and metabolic factors [3]. In the present review article the present knowledge of autoregulatory mechanisms in regulation of ocular blood flow and its relevance with ocular diseases is examined with scope for further research in exploring the vast patho-physiology associated with retinal blood flow.

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Literature Review: A total of 65 articles were downloaded & examined using the following meshwords ocular blood flow, auto-regulation, retina, eye, perfusion searching pubmed & science direct data bases. 09 articles were finally selected and analysed as per the requirement of the present review article on Ocular Blood Flow.

Ocular Blood Flow and Anatomy: Researchers have divided retinal blood flow as high level of oxygen extraction and low level of blood flow. The choroidal vascular beds supply nutrition to the optic nerve. The interplay among them may be essential for maintaining a healthy optic nerve. Various studies have indicated that the auto-regulatory mechanism may be less effective to retina but better to choroid [4].

Techniques for Ocular Blood Flow Evaluating: It is a well known proven fact that no single vascular indicator can completely evaluate ocular blood flow. Every technique has its limitations studying ocular hemodynamics. For example; Pulsatile Ocular Blood Flow is a possible indication of choroidal blood flow; Color Doppler Imaging (CDI) is a widely used assessment to evaluate retro-bulbar vascular circulation; Scanning Laser Doppler Flow Meter for quantifying superficial layers of ONH and retinal vascular circulation & Optical Coherence Tomography (OCT) for detecting non-invasive vascular mapping at the microcirculation level [5].

Color Doppler Imaging: CDI has been widely used to investigate retro-bulbar vascular parameters including blood velocity, pulsatility index, and resistive index, in both health and disease. But CDI technology has its own major limitation. CDI quantifies the vascular velocity rather than vessel diameter. However, the consistent correlation between blood flow and vascular velocity has been identified; moreover, the measurements of blood flow are viewed to be reproducible. CDI may be particularly useful in cases with media opacities [6].

Doppler Fourier Domain Optical Coherence Tomography (Doppler FD-OCT): There are some limitations to this technique which must be addressed in the future. One advantage of this technique is its ability to rapidly provide total retinal blood flow (TRBF) by adding all the measures around optic nerve head rather than a single point within the retinal vascular tree. These include complete elimination of eye motion which can resolve possible errors in Doppler angle measurement & full automation of software for objective & detection of the vessel area [7].

Split-Spectrum Amplitude-De correlation Angiography- (SSADA) OCT: Researchers have developed a new method using 3D angiography algorithm to image ophthalmic microcirculation known as split-spectrum amplitude-de correlation angiography (SSADA). It measures optic disc perfusion and is helpful in evaluation of OBF [8]. A limitation of OCT angiography is that it yields a flow index in arbitrary units instead of absolute volumetric flow. Various methods are there which are capable of evaluating ophthalmic hemodynamics like Heidelberg Retinal Flowmeter (HRF) and Laser Doppler Flowmetry (LDF) but still the direct evaluation of microcirculation is the most promising method in need.

Angiography: The gold standard for evaluation of retinal circulation is Fluorescein angiography. It investigates the superficial ocular nerve head vascular while its limitation is on the deep ocular nerve head circulation. Although the passage time of fluorescent dyes through ocular vessels may not be highly correlated with OBF but still it gives some useful information on ocular perfusion [9].

Mechanism and Modulation of Ocular Blood Flow Regulation: Auto regulation keeps blood flow constant with modification in response to metabolic demands in the eye. However, a defective auto regulation may prove its importance in terms of its role in patho-physiology of ophthalmic vascular diseases. There is no neuronal innervation in retinal vascular beds. The mediators of these mechanisms include carbon dioxide, oxygen, angiotensin-II, adenosine, nitric oxide (NO) & endothelin-1.

Among these factors, the role of angiotensin-II and endothelin-1 in regulating the blood flow of retina and ONH is disputable. Angiotensin-II and endothelin-1 cannot directly be transported to smooth-muscle cells and therefore do not participate in retinal blood flow regulation in healthy persons. However, sympathetic innervation plays an important role in choroidal blood flow regulation. Recent research revealed that the choroid mainly controlled by the sympathetic nervous system and metabolic factors can be auto regulated in response to an increase or decrease in OPP.

Future Perspective: Future considerations regarding the present review topic on Ocular blood flow demands a critical appraisal on the development of blood flow regulation and further study is needed on the relationship of ocular blood flow regulation with the incidence and progression of glaucoma and diabetic retinopathy specially. If relevance to this retinopathy risk is established, then the clinical implications for patient management can be considered in individuals with ocular vascular circulation malfunction. Hence more studies are required on OBF in the future.

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