

DOPPLER IMAGING IN GLAUCOMA WITH ASYMMETRIC VISUAL FIELD DEFECT

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Abstract: With color Doppler imaging we attempted to quantify the retrobulbar hemodynamics in glaucoma patients with asymmetric visual field losses. The peak systolic and end-diastolic blood flow velocities and resistivity indices of the ophthalmic, short posterior ciliary and central retinal arteries were measured. We performed visual field examination, intraocular pressure (IOP) and blood pressure measurements. The study revealed reductions in the flow velocities and increases in the resistance indices of the retrobulbar vessels, despite similar intraocular pressure (IOP) curves in both eyes. These changes correlate with disease severity and asymmetry of visual field losses and illustrate a compromised retrobulbar hemodynamics.

Cuvinte cheie: ultrasonografie Doppler, alterare perimetrică, flux sanguin

Rezumat: Studiul reflectă evaluarea ultrasonografică Doppler a hemodinamicii retrobulbare în glaucomul cu alterare perimetrică asimetrică. Parametrii determinați la nivelul arterei oftalmice, arterelor ciliare scurte posterioare și arterei centrale retiniene : viteza maximă sistolică- VmaxS, viteza diastolică- VtD, indicii de rezistență. Rezultatele evidențiază reducerea vitezei fluxului sanguin și creșterea indicilor de rezistență la nivelul arterei oftalmice și arterei centrale retiniene, aspecte corelate cu alterarea perimetrică asimetrică, în condițiile unei curbe tonometrice simetrice bilateral.

INTRODUCTION

Doppler investigation in ophthalmology, remains a promising perspectives opened definite diagnosis, plausible or merely hypothetical.

THE AIM OF THE PAPER

To assess the correlation between retrobulbar flow velocities and asymmetric visual field defects in glaucomatous patients, despite similar intraocular pressure values in both eyes.

MATERIAL AND METHODS

The study included 15 patients with clinical diagnosis of Primary Open Angle Glaucoma (POAG) with asymmetric visual field loss.

Inclusion criteria: ≥ 40 years of age; asymmetric visual field defect; visual acuity ≥ 0.3 in both eyes; IOP < 20 mm Hg, equal in both eyes; the same topical antiglaucomatous therapy; normal flow velocity of the carotid artery

Exclusion criteria: any ocular media opacities; high myopic patients; intraocular surgery or laser surgery; progressive retinal or optic nerve disease due to any cause; medical diseases with ocular perfusion impact; smokers patients; systemic medication affecting blood flow

Color Doppler imaging (CDI) was performed with Acuson Antares System (Siemens), using a phased array transducer type VFX 13-5 (7.5 MHz frequency) in the pulsed Doppler mode.

The Doppler parameters - the peak systolic velocity (PSV), the end-diastolic velocity (EDV) and the resistive index (RI) - were measured:

- in the ophthalmic artery OA - close to its crossing of the

optic nerve (Fig. 1).

- in the central retinal artery CRA- along its course through the optic nerve.
- in the short posterior ciliary arteries SPCA- before entering the sclera (Fig. 1).

Figure no. 1. Color Doppler image of the ophthalmic artery and short posterior ciliary arteries

IOP was determined by Goldmann applanation tonometry. Visual field examinations were performed using a Humphrey analyser, program 30-2 full threshold strategy. Asymmetric visual field loss was defined as a difference of the global index mean deviation (MD) > 6 Db between the two eyes.

RESULTS AND DISCUSSIONS

Patients with POAG (mean age 64 ± 11 years) and asymmetric visual field defects showed significant differences in cup-to-disc-ratio between the two eyes(1), despite similar

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CLINICAL ASPECTS

intraocular pressure values (IOP) in both eyes – Table 1.

Table no. 1. Clinical data of the patients with POAG

Characteristic	Eyes with less visual field defect	Eyes with advanced visual field defect	<i>p</i> value
Mean deviation (dB)	- 5.3	- 18.2	<0.0001
Pattern standard deviation (dB)	5.0	10.4	0.05
Vertical cup-to-disc ratio	0.62	0.85	<0.0001
IOP (mm Hg)	17.0	17.0	0.19
Systolic blood pressure (mm Hg)	142	140	0.18
Diastolic blood pressure (mmHg)	82	80	0.19
Data are expressed as median values.			

The correlation between retrobulbar flow velocities and asymmetric glaucomatous visual field defects – Table 2.

Table no. 2. The Doppler variables - comparison of eyes with lesser and advanced visual field defects

Doppler variables		Glaucomatous eyes (no.=30)		<i>p</i> value
		Lower MD index value	Higher MD index value	
OA	PSV (cm/s)	29.1	26.8	0.019
	EDV (cm/s)	6.3	5.4	0.13
	RI	0.79	0.79	0.47
CRA	PSV (cm/s)	8.5	6.9	0.042
	EDV (cm/s)	2.6	2.0	0.007
	RI	0.71	0.72	0.48
SPCA	PSV (cm/s)	6.9	6.8	0.62
	EDV (cm/s)	2.5	2.4	0.84
	RI	0.66	0.65	0.34
Data are expressed as median values. OA- ophthalmic artery, CRA-central retinal artery, SPCA - short posterior ciliary arteries.				

The study shows:

- a significant difference between eyes for the PSV of the OA and for the PSV and EDV of the CRA.(Fig. 2 and Fig. 3)
- no differences for the resistive indices of the OA, CRA or SPCA.
- no significant difference between eyes for the SPCA velocities.

Simultaneous reductions of PSV and EDV of the CRA may reflect a chronic decrease in perfusion of the inner retinal layers secondary to nerve fibre loss(2,3).

This study could not detect significant differences in flow velocities of the SPCA - the only vessels that supply the laminar and pre-laminar regions(4).

We suppose the conexions of ophthalmic artery with branches of external carotid artery - conferring the composite aspect of Doppler wave ("low resistance" and "high resistance" wave) - can be an explanation of the variability in measuring the impedance indices of OA in glaucoma(5).

Figure no. 2. Flow velocities of the OA – pulsed Doppler

Figure no. 3. Flow velocities of the CRA – pulsed Doppler

CONCLUSIONS

1. The PSV of the OA and the PSV and EDV of the CRA were significantly lower in the eyes with advanced glaucomatous visual field loss than in the less affected eyes.
2. Doppler imaging provides details on flow velocity, but no accuracy in determining vascular diameter and quantitative assessment of blood flow.
3. Reduced flow velocities have been shown to be predictive for future damage to the nerve fibres in glaucoma.

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