

### Ocular Blood Flow Velocity in Newly Diagnosed Primary Open Angle Glaucoma Patients Using Colour Doppler Imaging Technique

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**Background:** While aetiology of open angle glaucoma has not been fully understood, elevated IOP has been identified as significant and currently only treatable risk factor.<sup>1</sup> Nevertheless, many patients develop glaucoma progression despite reduced IOP, whereas others do not develop glaucoma in the presence of elevated IOP.<sup>2</sup> This implies that other factors<sup>3,4</sup> are involved in open-angle glaucoma (OAG) onset and progression, including compromised vascular health. Several studies, performed with various techniques including colour Doppler imaging (CDI), have established that glaucoma is linked with decreased ocular blood flow (OBF), especially OBF in posterior pole of the eye.<sup>5-7</sup> The aim of the study is to compare ocular blood flow (OBF) in newly diagnosed primary open-angle glaucoma (POAG) patients, with normal controls, using colour Doppler imaging (CDI) technique at the Lagos University Teaching Hospital (LUTH), Idi-Araba, Lagos.

**Methods:** A case-control study carried out on 50 newly diagnosed POAG patients (Glaucoma group) and 50 control subjects (control group). The participants were consecutive, consenting glaucoma patients (Glaucoma Group) attending

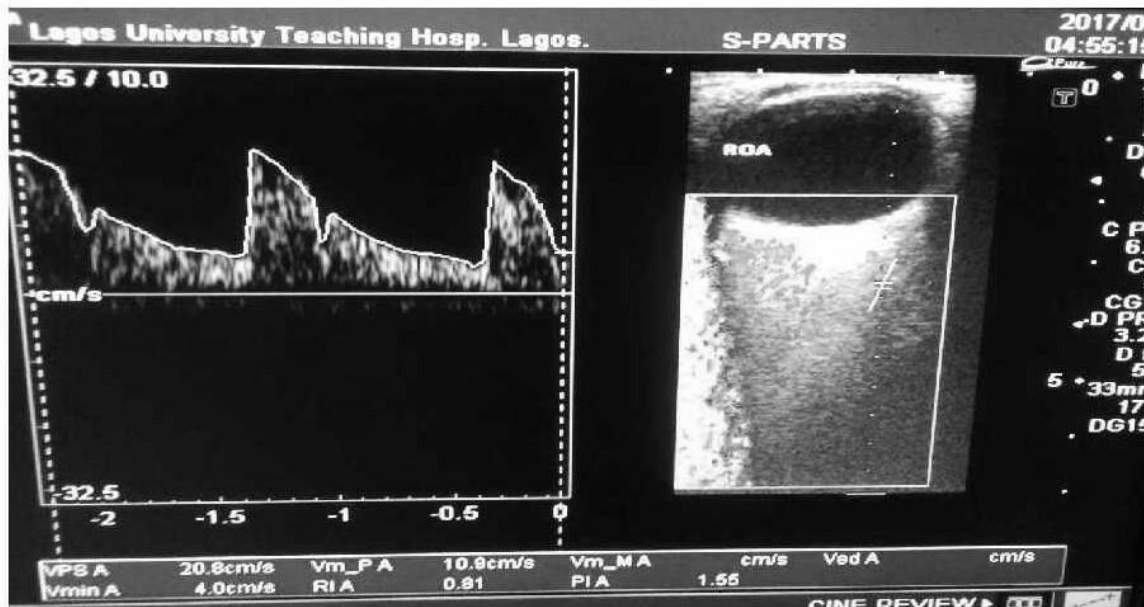
the Ophthalmology Clinic, Lagos University Teaching Hospital, Idi-Araba. These were compared with age-sex matched consenting healthy volunteers (Control Group). Approval from the Health Research Ethics Committee of the Lagos University Teaching Hospital (LUTH), Idi-araba, Lagos, was obtained. Routine eye examinations were done. Ocular blood flow of all participants was measured using CDI. In addition, post medication OBF assessment was performed after reduction of IOP in the glaucoma group. The main outcome measures of Peak systolic velocity (PSV), End diastolic velocity (EDV) were obtained. Resistance index (RI) was calculated using the formula  $RI = (PSV - EDV) / PSV$ . Data analysed with Statistical Package for Social Sciences (SPSS) version 20.0 and P value set at  $<0.05$ .

**Results:** Ages of all participants ranged between 40-70 years. The mean age of patients with Normal Tension Glaucoma (NTG) was  $51.3 \pm 9.8$  years and for High Tension Glaucoma (HTG)

**Table 1:** Ocular blood flow (OBF) velocities and vascular resistance (RI) measurement by colour Doppler imaging (CDI) of normal-tension glaucoma (NTG) high-tension glaucoma (HTG) primary open angle glaucoma (POAG) patients and normal controls

Arteries	Haemodynamic parameters	Laterality	NTG (n=25)	HTG (n=25)	CONTROL (n=50)	p-value
OA	PSV(cm/s)	RE	28.3 ± 3.3	30.6 ± 8.3	42.3 ± 6.8	0.01
		LE	28.2 ± 3.4	29.8 ± 9.5	38.2 ± 6.1	0.01
	EDV(cm/s)	RE	5.2 ± 2.3	6.9 ± 3.7	16.1 ± 3.6	0.01
		LE	6.0 ± 2.5	7.2 ± 4.8	16.0 ± 3.5	0.03
	RI	RE	0.83 ± 0.06	0.81 ± 0.08	0.64 ± 0.05	0.01
		LE	0.82 ± 0.07	0.84 ± 0.06	0.65 ± 0.05	0.01
CRA	PSV(cm/s)	RE	16.5 ± 5.0	17.1 ± 3.8	21.2 ± 6.3	0.01
		LE	15.8 ± 4.1	17.6 ± 4.1	20.0 ± 7.4	0.02
	EDV(cm/s)	RE	2.9 ± 1.7	3.3 ± 2.4	7.8 ± 1.6	0.01
		LE	2.3 ± 1.3	2.9 ± 1.3	7.6 ± 2.0	0.01
	RI	RE	0.80 ± 0.08	0.78 ± 0.09	0.66 ± 0.06	0.01
		LE	0.81 ± 0.06	0.79 ± 0.09	0.67 ± 0.05	0.01
SPCA	PSV(cm/s)	RE	13.7 ± 3.7	14.3 ± 4.3	18.1 ± 4.9	0.01
		LE	14.1 ± 2.9	15.9 ± 4.1	17.9 ± 6.5	0.02
	EDV(cm/s)	RE	1.8 ± 0.8	1.9 ± 0.9	4.5 ± 1.2	0.01
		LE	1.7 ± 0.8	1.9 ± 0.5	4.7 ± 1.2	0.02
	RI	RE	0.76 ± 0.08	0.78 ± 0.07	0.65 ± 0.04	0.01
		LE	0.80 ± 0.08	0.79 ± 0.08	0.65 ± 0.05	0.01

OA- Ophthalmic artery, CRA- Central retinal artery, SPCA- Short posterior ciliary arteries, PSV- Peak systolic velocity, EDV- End diastolic velocity, RI- Resistance index, RE- Right eye, LE- Left eye



**Fig. 1:** Transverse triplex Doppler scan of the right ophthalmic artery (ROA) in a POAG patient showing a reduced PSV of 20.8cm/s, a reduced EDV of 4.0cm/s and an increased RI of 0.81

patients was  $52.0 \pm 9.8$  years while control group has a mean age of  $51.3 \pm 9.4$  years. Each group (glaucoma and control) consisted of 24 (48%) males, 26 (52%) females. Mean intraocular pressure (IOP) of the groups was as follows: NTG Right eye (RE) =  $13.7 \pm 2.6$ , Left eye (LE) =  $14.1 \pm 2.7$ ; HTG (RE) =  $28.4 \pm 4.5$ , (LE) =  $28.7 \pm 5.3$ ; Control (RE) =  $11.6 \pm 1.4$ , (LE) =  $11.5 \pm 1.1$  ( $P < 0.01$ ). The PSV and EDV for the various arteries were significantly lower in the glaucoma group compared to the control group. On the other hand, the RI in glaucoma group was higher than control group. (Table 1 and Figure 1). Positive Pearson correlation was seen between the IOP and the RI. Negative Pearson correlation was seen between the IOP and the PSV and EDV. With reduced IOP (post medication) Doppler parameters improved but were still significantly poorer compared to controls.

**Conclusion:** CDI is a useful tool in the overall management of glaucoma.<sup>8</sup>Ocular blood flow changes such as reduction in PSV/EDV and increased RI of retrobulbar vessels occur in POAG suggesting that vascular factors with/without elevated IOP may play a vital role in pathogenesis of glaucoma.

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