

The Effect of Venous Blood Flow on the Retinal Ganglion Cell Complex in Patients with Primary Open Angle Glaucoma

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Table 1. Patient data

Purpose. To study the influence of venous blood flow on the ganglion cell complex (GCC) in patients with preperimetric and perimetric open angle glaucoma.

Materials and Methods. 74 patients were included in the study: 59 eyes with preperimetric and 62 eyes with perimetric open angle glaucoma. GCC and retinal nerve fiber layer thickness (RNFLT) were evaluated by means of optical coherence tomography (RTVue-100 OCT, Optovue, Inc., Fremont, CA). Color Doppler Imaging (CDI) was used to measure hemodynamic parameters (maximum systolic velocity - V_{syst} , end-diastolic velocity - V_{diast} , resistance index - RI) in the central retinal vein (CRV), the vortex vein (VV), and the superior ophthalmic vein (SOV).

Results. The patient data is given in Table 1. FLV showed the only statistically significant difference between the preperimetric group and the control group. Venous blood flow velocity in both glaucoma groups was reduced compared to the control group (Table 2 and Fig. 1). No difference in venous blood flow parameters between two glaucoma groups was found, except for the resistivity index (RI) of CRV (Table 2). A correlation was also obtained between blood flow in vortex vein (V_{mean})

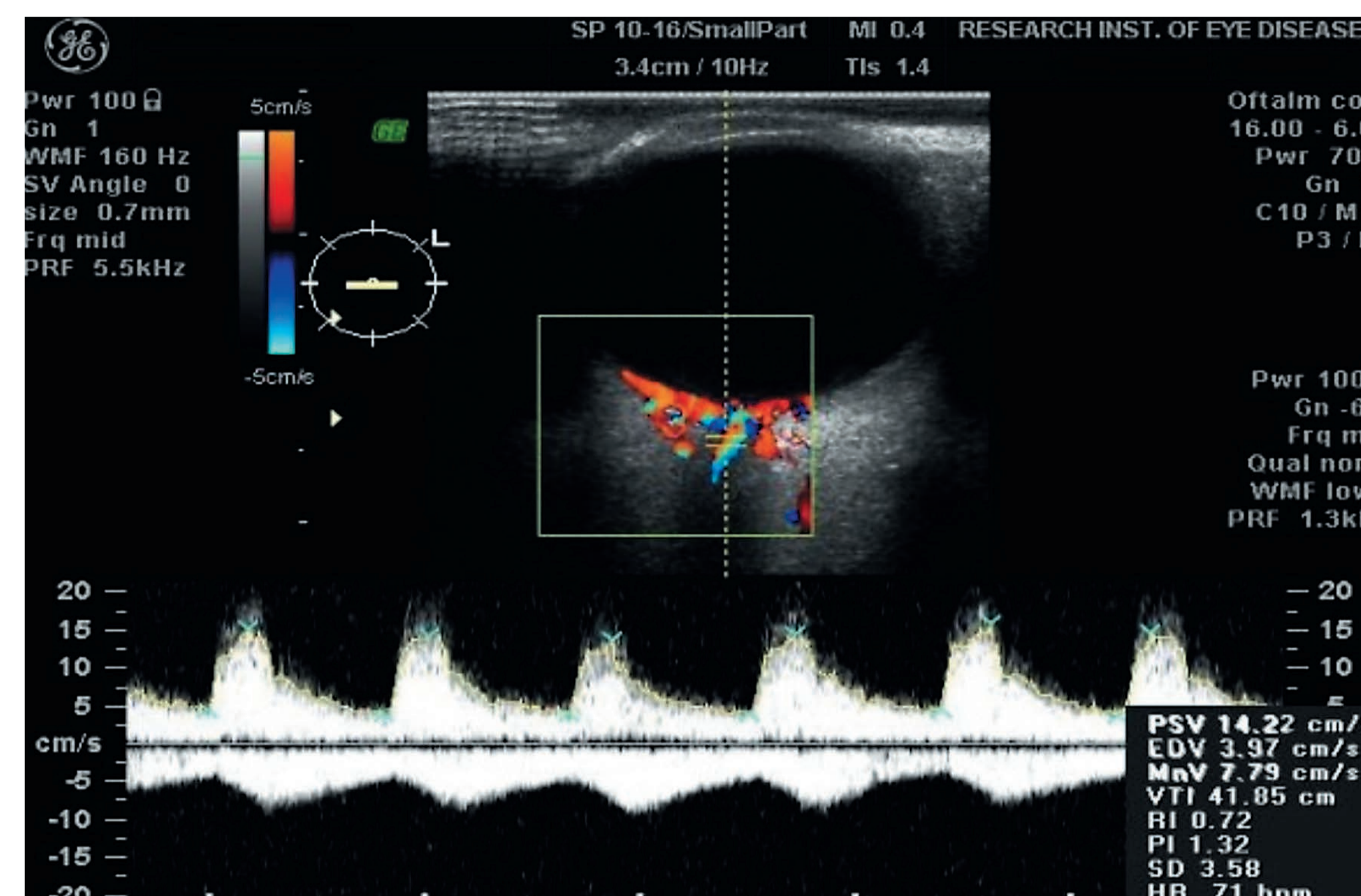


Fig. 1a. Normal Doppler spectrum of blood flow in CRA and CRV in a control group patient

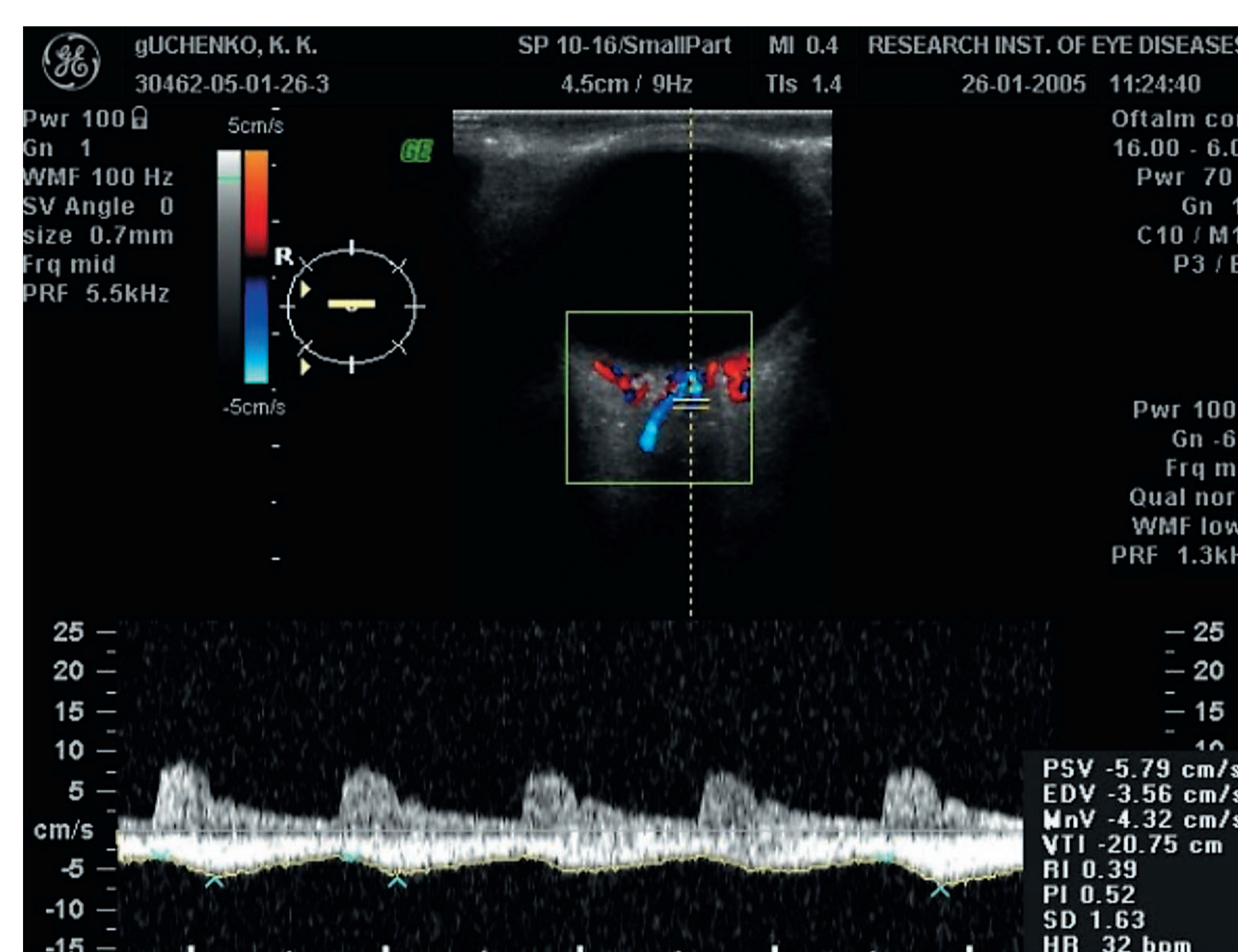


Fig. 1b. Doppler spectrum of blood flow in CRA and CRV in patient with glaucoma (CDI demonstrates reduced blood flow velocity)

Clinical parameters	Groups		
	Preperimetric glaucoma 36 patients / 59 eyes	Perimetric glaucoma 38 patients / 58 eyes	Control group 22 patients / 44 eyes
Gender	Female 23 (63.9%) Male 13 (36.1%)	Female 18 (47.4%) Male 20 (52.6%)	Female 12 (54.5%) Male 10 (45.5%)
Age	61.44 (40 - 83)	66.22 (29 - 82)	64.27 (31 - 79)
Central corneal thickness (μm)	546.32 (495 - 600)	531.98 (417 - 593)	538 (529 - 657)
IOP (mm Hg)	22.00 (11.8 - 33.8)	21.30 (10.2 - 42.8)	19 (16 - 22)
RNFL (μm)	99.10 (74 - 118.1)	77.54* (52.4 - 116.8)	101 (98.3 - 110.2)
	P<0.05		
GCC avg. (μm)	89.00 (72.2 - 107.6)	73.97* (53.9 - 107.7)	92.3 (87.34 - 95.32)
	P<0.2		
FLV (%)	1.54** (0.03 - 6.9)	7.55** (0.09 - 25.17)	0.49 (0.21 - 1.067)
	P<0.001		
GLV (%)	9.18 (0.54 - 23.7)	23.42* (0.4 - 44.5)	4.56 (3.81 - 8.12)
	P<0.05		
MD (dB)	-1.66 (-1.91 - 1.79)	-9.05* (-26.36 - -2.3)	-1.36 (-1.84 - 0.23)
	P<0.05		
PSD (dB)	1.73 (1.06 - 1.19)	5.96* (1.18 - 12.9)	1.53 (1.09 - 2.03)
	P<0.2		

RNFL - retinal nerve fibre layer, GCC avg - average ganglion cell complex thickness, FLV - focal loss volume, GLV global loss volume (FLV and GLV show the loss of GCC).

* - statistical significance of the difference between the study and the control group $p < 0.05$; ** $p < 0.01$.

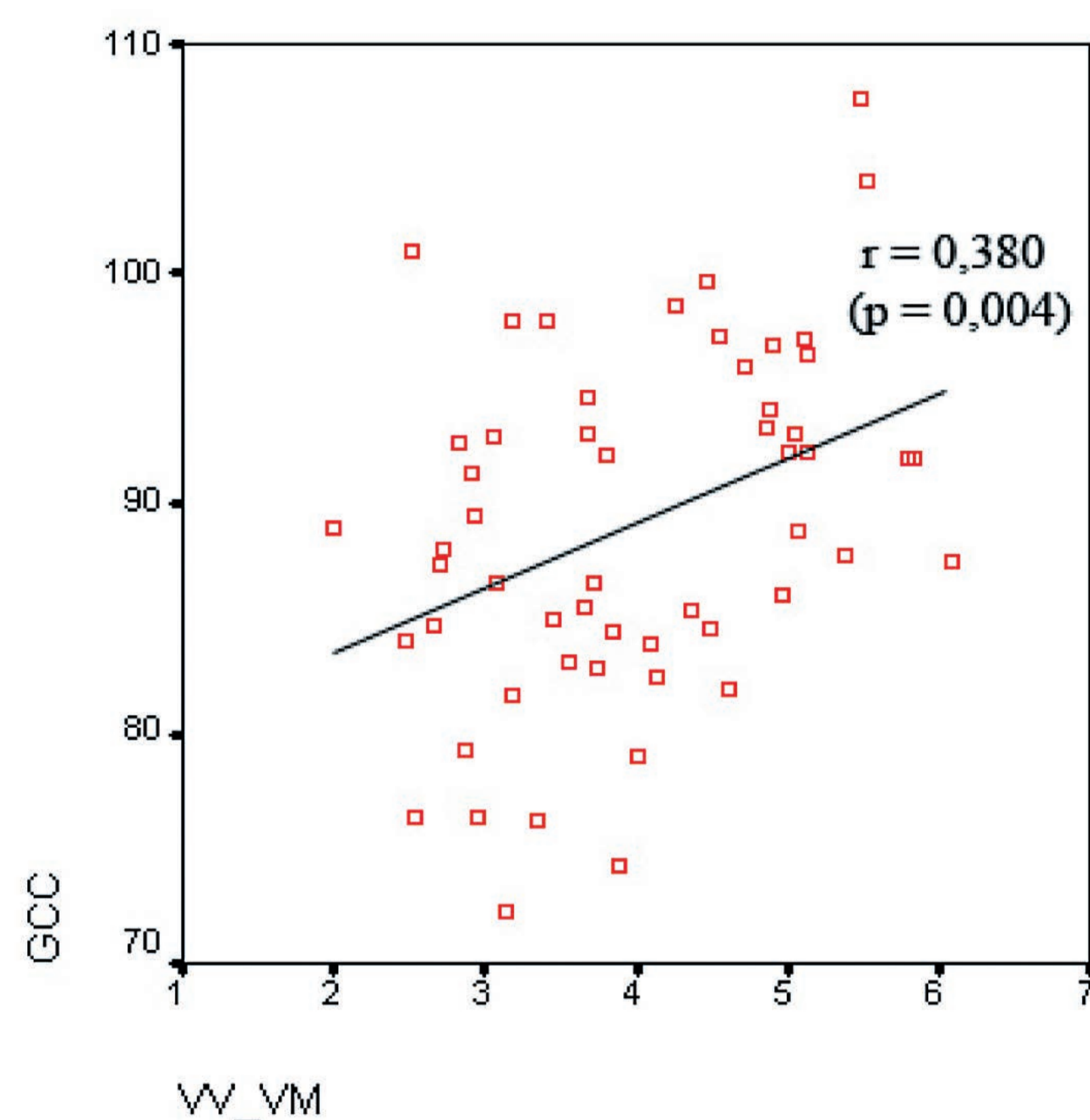


Fig. 2. Correlation between ganglion cell complex (GCC) thickness and mean VV blood flow velocity in the preperimetric glaucoma group. Y-axis: mean GCC thickness, X-axis: V_{mean} in the vortex veins

and GCC ($r=0.38$, $p=0.004$) and between V_{mean} in CRV and RNFLT ($r=0.332$, $p=0.017$) as shown in Fig.2 and Fig.3.

Conclusion. GCC analysis is an important tool in glaucoma diagnostics and FLV is the most sensitive in early glaucoma detection. Among other debatable reasons for early GCC damage is venous blood flow reduction.

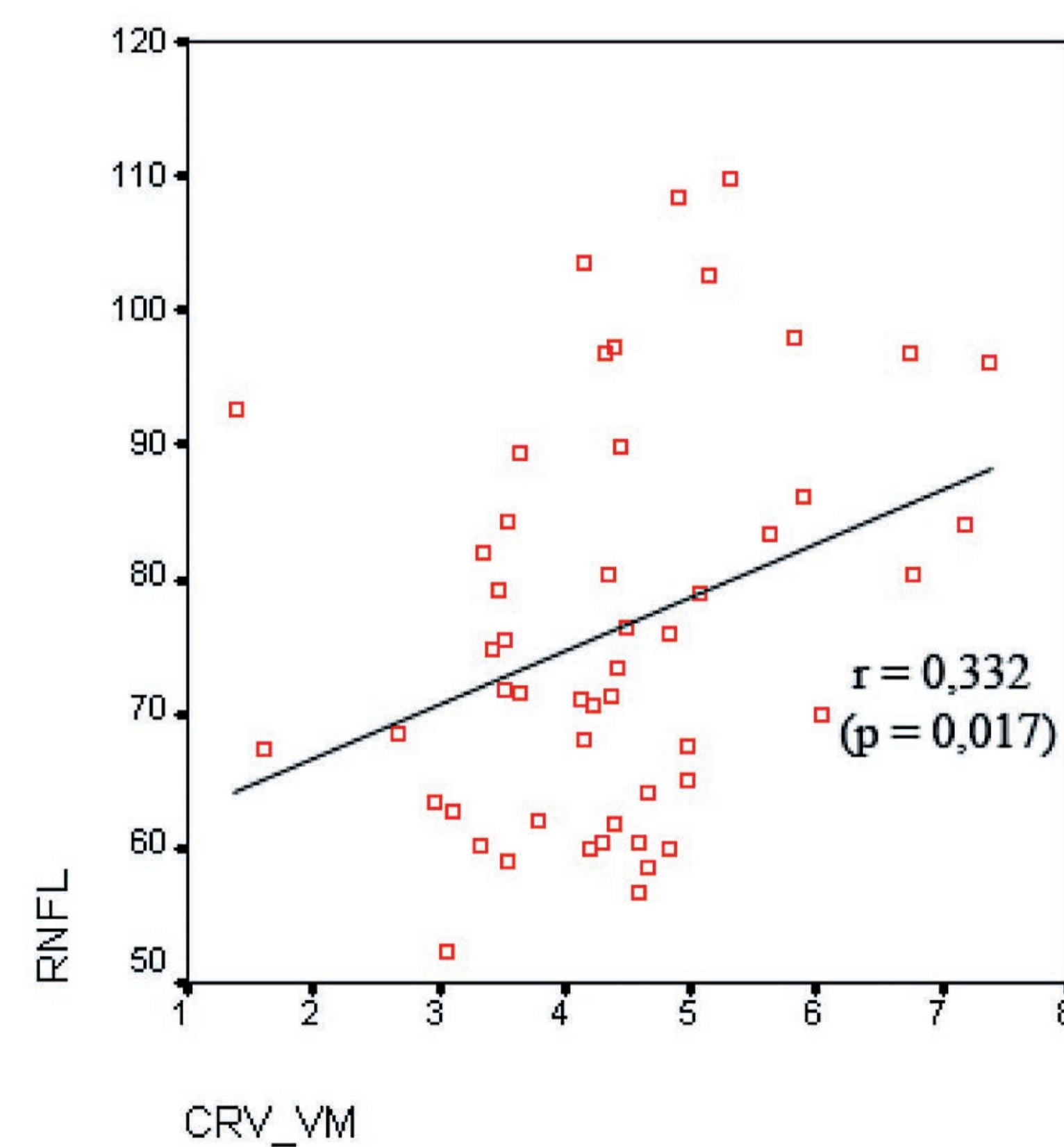


Fig. 3. Correlation between mean RNFLT thickness and mean CRV blood flow velocity in the perimetric glaucoma group

References

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Table 2. Venous blood flow parameters in patients with primary open angle glaucoma

Blood flow parameters	Preperimetric glaucoma	Perimetric glaucoma	Control group
CRV V_{syst} (cm/s)	6.50 \pm 1.63	6.64 \pm 2.13	6.92 \pm 1.14
CRV V_{diast} (cm/s)	3.94 \pm 1.07*	3.60 \pm 1.49**	5.22 \pm 0.96
CRV V_{mean} (cm/s)	4.68 \pm 1.03*	4.41 \pm 1.20*	5.58 \pm 0.92
CRV RI	0.63 \pm 0.40*	0.75 \pm 0.69**	0.28 \pm 0.11
VV V_{syst} (cm/s)	5.72 \pm 0.92**	5.82 \pm 0.76**	7.1 \pm 1.09
VV V_{diast} (cm/s)	2.86 \pm 1.66*	3.20 \pm 1.48*	4.33 \pm 1.43
VV V_{mean} (cm/s)	3.99 \pm 1.03**	4.11 \pm 0.89*	5.24 \pm 1.29
VV RI	0.50 \pm 0.26**	0.45 \pm 0.23*	0.39 \pm 0.16
SOV V_{syst} (cm/s)	9.00 \pm 1.85	8.84 \pm 1.41**	10.41 \pm 1.82
SOV V_{diast} (cm/s)	5.40 \pm 2.25	5.31 \pm 1.81*	6.44 \pm 2.77
SOV V_{mean} (cm/s)	5.56 \pm 1.90	6.02 \pm 1.79*	7.99 \pm 2.88
SOV RI	0.42 \pm 0.20	0.42 \pm 0.18	0.41 \pm 0.23

* - statistical significance of the difference between the study and the control group $p < 0.05$; ** $p < 0.01$.

A statistically significant difference between the study groups is given in red font ($p=0.003$).

CRV - central retinal vein, VV - vortex vein, SOV - superior ophthalmic vein.