OPTIC DISC DRUSEN AND HAEMODYNAMICS

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SUMMARY

Purpose: The problem of optic disc drusen (ODD) has been described in detail in several publications. However, less attention has been devoted to real haemodynamic parameters (HP) in ODD. It has been clinically demonstrated that the occurrence and progression of changes in the visual field in ODD are closely linked with the haemodynamics of the vascular supply of the eye – the optic nerve. ODD may visually overlap excavation of the disc of the optic nerve, on the basis of which it is more difficult to evaluate changes (scotomas) in the visual field in the case of glaucoma.

Methods: Haemodynamic parameters were prospectively evaluated in 54 patients with compensated intraocular pressure and with optic disc drusens. Drusens in the head of the optic nerve were demonstrated by a fundus examination and B-scan ultrasonography (USG). The drusens were divided into 3 groups according to the size of the individual drusens or drusen complex. Group I: area size up to 1.9 mm. Group II: area size: 1.9-3.9 mm. Group III: area size > 4.0 mm. Flow (haemodynamic) parameters – maximum systolic velocity (MSV), minimum diastolic velocity (MDV), and resistivity index (RI) and pulsatility index (PI) were recorded in the central retinal artery (CRA), in the central retinal vein (CRV), in the temporal and nasal ciliares posteriores arteries breves (CPAb) and in the ophthalmic artery (OA). The values were divided into 1. Physiological: CRA: 8.7 ± 0.9 / 2.9 ± 0.6 cm/s, or RI: 0.70 ± 0.05, 2. Slightly impaired: CRA: 6.6 ± 0.8 / 2.0 ± 0.5 cm/s, or RI: 0.75 ± 0.04. 3. Significantly impaired: CRA: 5.2 ± 1.2 / 1.9 ± 0.7 cm/s, or RI: 0.79 ± 0.03.

Results: No linear relationship was demonstrated between the size of the drusens and flow parameters. Slight impairment of HP in the CRA was present in 28.6% of drusens in group I, 48.3% in group II and 62.4% in group III. Significant impairment of HP in the CRA was present in 28.6% of drusens in group I, 48.3% in group II and 62.4% in group III. HP in the CPAb and OA were not of significant importance with regard to the presence and size of the drusens. The relationship between the individual variables was evaluated with the aid of a Pearson correlation coefficient: 0.213, group I P: 0.354, group II P: 0.073, group III P: 0.287.

Conclusions: HP are more often impaired in "large" optic disc drusens (group III), rarely in group I ODDs – though this is not an absolute rule. It is not possible to predict haemodynamic parameters according to the size of the drusen formation in the optic nerve. It appears that impairment of the haemodynamic parameters is conditioned not only by the size of the ODD, but also by the locality (distance from lamina cribriformis) and also the intrapapillary relationship to the vascular system.

Key words: drusen optic nerve, glaucoma; visual field, haemodynamics, flow parameters, Doppler ultrasonography

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INTRODUCTION

With the development of imaging techniques, the diagnostics (dg) of many pathologies of the optic nerve is also improving. These include optic disc drusen (ODD).

It has been clinically demonstrated that the occurrence and progression of changes in the visual field in the case of ODD is closely related to the haemodynamics of vascular supply to the eye – the optic nerve (7, 9). The problem of ODD has been described in detail in several publications and observations. However, less attention has been devoted to real haemodynamic changes in the optic nerve in ODD. In ODD it has been both experimentally and clinically demonstrated that the haemodynamic parame-

ters are impaired. However, a more serious issue is that progression of changes in the visual field has likewise been demonstrated. ODD may visually overlap excavation of the disc of the optic nerve, on the basis of which it is more difficult to evaluate changes (scotomas) in the visual field in the case of glaucoma.

METHOD

A prospective evaluation was conducted on 54 patients with bilateral or unilateral optic disc drusens. The patients had stabilised blood pressure and pulse, intraocular pressure was 11-19 torr. Diabetics and patients with glaucoma and untreated or uncompensated hypertension were excluded. The presence of drusens in the head of the optic nerve was demonstrated by means of a fundus examination (Fig. 1) and B-scan ultrasonography (USG). For more precise measurement and to minimise the "halo" effect in USG imaging, the value of acoustic imaging ("Gain") was minimised to 5 dB (Fig. 2).

Drusens were divided into 3 groups according to summary size. Area size of the drusens according to USG imaging was taken into consideration. In the case of occurrence of multiple drusens within the framework of a single optic nerve (drusen complex), the total surface area was determined by the sum of the individual drusens. Group I: ophthalmoscopically invisible + visualisation only with the aid of ultrasonography, area size up to 1.9 mm. Group II: area size: 1.9-3.9 mm (Fig. 3). Group III: area size > 4.0 mm.

Haemodynamic parameters (HP) were recorded in the central retinal artery (CRA) (Fig. 4), in the central retinal vein (CRV), in the temporal and nasal ciliares posteriores arteries breves (CPAb) and in the ophthalmic artery (OA). The evaluated parameters were maximum systolic velocity (MSV), minimum diastolic velocity (MDV) and resistivity index (RI) and pulsatility index (PI), indicating the state of peripheral resistance from the place of detection.

The values were divided into 1. Physiological: CRA: 8.7 ± 0.9 / 2.9 ± 0.6 cm/s, or RI: 0.70 ± 0.05, 2. Slightly impaired: CRA: 6.6 ± 0.8 / 2.0 ± 0.5 cm/s, or RI: 0.75 ± 0.04. 3. Significantly impaired: CRA: 5.2 ± 1.2 / 1.9 ± 0.7 cm/s, or RI: 0.79 ± 0.03. The relationship between the individual variables was evaluated with the aid of a Pearson correlation coefficient.

RESULTS

No linear relationship was demonstrated between the size of the drusens and flow (haemodynamic) parameters. Slightly impaired or significantly impaired HP in ODD was typified by an equal reduction of flow parameters in the CRA and CRV for example in comparison with glaucoma and other clinical findings. Significant impairment of HP in the CRA was present in 28.6% of group I drusens, 48.3% in group II and 62.4% in group III.

HP in the CPAb and OA were not of significant importance with regard to the presence and size of the drusens. The relationship between the individual variables was evaluated with the aid of a Pearson correlation coefficient: 0.213, group I P: 0.354, group II P: 0.073, group III P: 0.287.

DISCUSSION

From a histological perspective ODDs are calcified hyaline deposits accumulated on the inner side of the lamina cribriformis (from the vitreous body), and occur in approximately 3.5-5% of people (6, 13), 0.3-0.5% (2, 9, 15, 16). They appear at a young age, and change in size only rarely in adulthood. They are mostly diagnosed by chance. Subjectively ODDs are mostly asymptomatic. Sometimes various subjective changes of the visual field are manifested (constriction of visual field, transitory scotomas).

It is very important to differentiate ODD from other pseudo-edema, edema of the disc of the optic nerve, as well as oncological pathology, either primary or following preceding irradiation of an ocular tumour (6). Diagnosis is based on imaging of ODD with the aid of ophthalmoscopy, OCT examination, autofluorescence, computer tomography and USG. The most conclusive dg so far is ultrasonography in B-mode (1, 4, 5, 10, 13, 21).

Diagnosis of ODD is significant not only from the perspective of description (differential diagnosis of papilloedema), but also for timely identification of potential accompanying complications: disorders of the visual field, haemorrhages, increased risk of occlusive pathologies – non-arterial anterior ischemic neuropathy, branch central retinal vein occlusion, central retinal artery occlusion, choroidal neovascular membrane, changes in the retinal capillaries or differentiation of concurrent glaucoma damage (8, 15, 18, 23). Didactically it is possible to divide ODD according to various criteria. For example, according to Gripp (6) in terms of the number of displayed drusens in the head of the optic nerve, according to topography with regard to the lamina cribriformis. We selected division according to area size, which can be verified on various USG instruments.

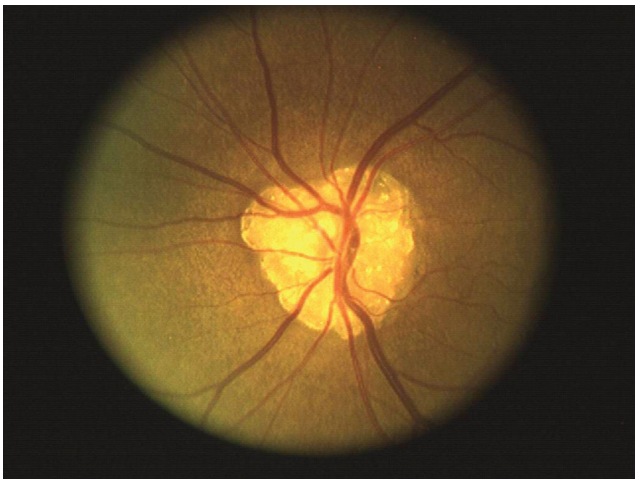

Fig. 1. Photograph of a large complex of optic disc drusens

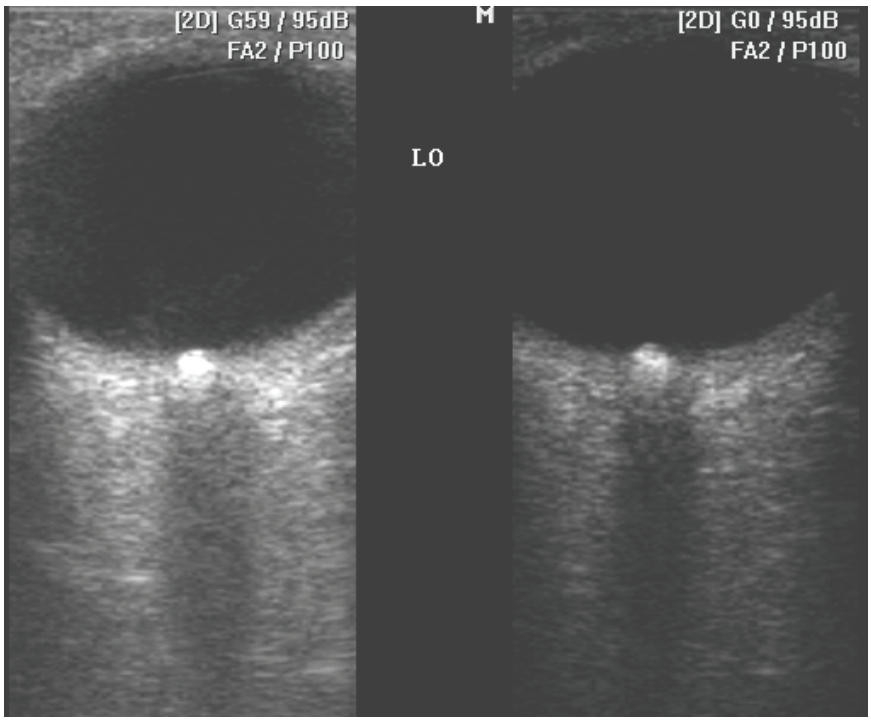

Fig. 2. Left: Optic disc drusens B-scan ultrasonography in standard mode – gain 59 dB. Right: "halo" effect of optic disc drusens is minimised (drusens display in actual size) when gain is reduced to 0 dB.

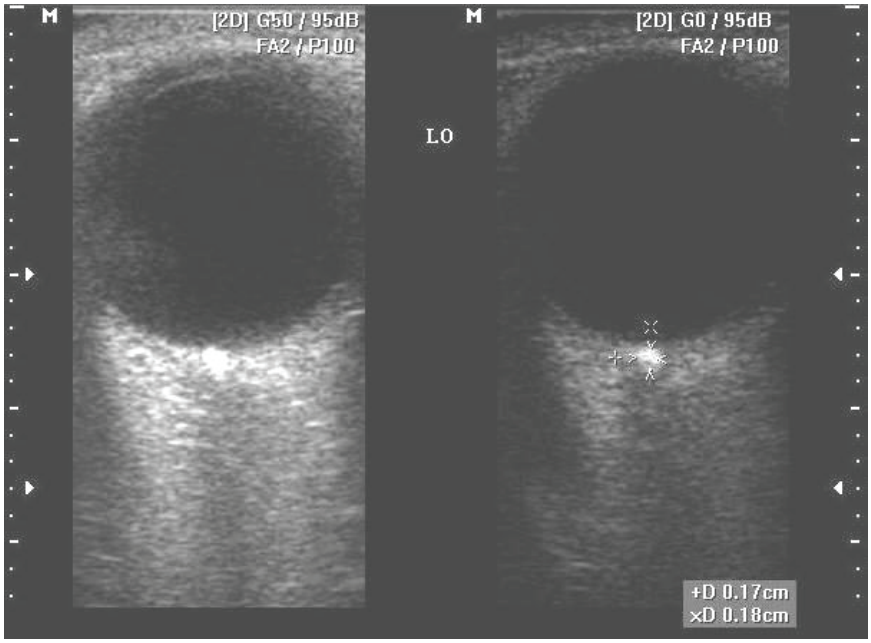

Fig. 3. USG imaging B-scan of optic disc drusens – Group III (according to size)

It is very important and at the same time difficult to differentiate changes in the visual field in ODD and in the case of glaucoma (20). If diagnosis of ODD with the aid of B-scan ultrasonography is sufficiently processed, the real flow parameter in ODD requires relatively little work (3, 9, 12, 19). In the past the prevailing opinion was that examination with the aid of colour Doppler ultrasonography was not possible in the case of ODD (22). The study conducted by Pinto et al., as well as our experience, indicates that in the majority of cases this is possible without problems upon an appropriate inclination of the USG probe and setting of reading pa-

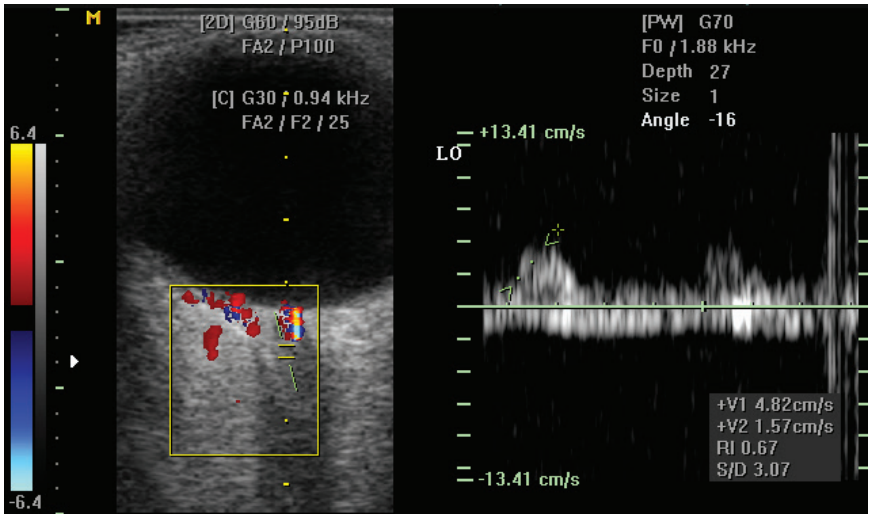

Fig. 4. Colour Doppler ultrasonography – pronouncedly low flow parameters in central retinal artery

rameters in Color Doppler.

It is suitable to take the flow parameters as a part of the haemodynamics of the optic nerve, because they represent only a part of the complicated complex of blood supply of the optic nerve. Impairment of the flow parameters is illustrated not only by an increase in peripheral resistance (increase of resistivity index), but also by slowing of the current flow speed to beneath the physiological norm.

An interesting finding was that although significant and thus also risk impairment of HP was mostly in the largest drusen complexes, this was not an absolute rule. For this reason it would be suitable to evaluate also HP of the optic nerve in patients with ODD and progressive changes of the visual field.

CONCLUSION

Haemodynamic parameters are generally more often impaired in the case of "large" optic disc drusens (group III), and less frequently in group I ODDs – though this is not an absolute rule.

It appears that impairment of the haemodynamic parameters is conditioned not only by the size of the ODD, but also by the locality (distance from lamina cribriformis) and also the intrapapillary relationship to the vascular system. It is not possible to predict haemodynamic parameters according to the size of the drusen formation in the optic nerve. Evaluation of the real flow parameters should be a component of the examination of each patient with ODD who has progressive changes in the visual field.

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