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The Importance of Ultrabiomicroscopy in the Diagnosis of Open-Angle Glaucoma in the Early Stages

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Abstarct: Open-angle glaucoma is a syndrome of optic nerve damage associated with an open angle of the anterior chamber and increased or, sometimes, average intraocular pressure (IOP). Open–angle glaucoma is in second place among eye pathologies leading to irreversible vision loss, therefore, the study of the causes, identification of early symptoms, treatment and prevention of this disease is a priority in scientific and practical ophthalmology.

Purpose: The purpose of our study is to study and determine the indicators of the patency of the angle anterior chamber obtained by ultrasound biomicroscopy (UBM) in primary open–angle glaucoma (POAG).

Materials and methods: 30 people (60 eyes) participated in the study: in the observation group there were 15 patients with OAG (30 eyes), in the control group there were healthy individuals (15 people – 30 eyes) without ocular pathology and with normal values of intraocular pressure (IOP). The study did not include patients who had undergone surgery, trauma, uveitis, PES with dislocation of the lens, as well as with clinically diagnosed swelling cataract, which obviously can become the leading the reason for the change in anatomical and topographic parameters.

Keywords: Ultrasound biomicroscopy, OAG, intraocular pressure.

Relevance. Glaucoma is one of the most severe eye diseases characterized by rapid progression and leading to irreversible blindness. Primary open-angle glaucoma is a syndrome of optic nerve damage associated with an open angle of the anterior chamber and increased or, sometimes, average intraocular pressure (IOP). Open–angle glaucoma is in second place among eye pathologies leading to irreversible vision loss, therefore, the study of the causes, identification of early symptoms, treatment and prevention of this disease is a priority the direction in scientific and practical ophthalmology. For a long time, open-angle glaucoma is asymptomatic, and the first signs appear only when at least 40% of the optic nerve fibers are destroyed, which cannot be restored. Currently ultrabiomicroscopy is the most informative method of diagnosing open-angle glaucoma (OAG) and allows the identification of preclinical signs of activation of the proliferative process in structures drainage system, the presence of a retention zone. The state of the anterior and posterior chambers of the eye by the UBM method allows pathogenetically substantiating and developing differentiated approaches to the diagnosis and treatment of various forms of glaucoma.

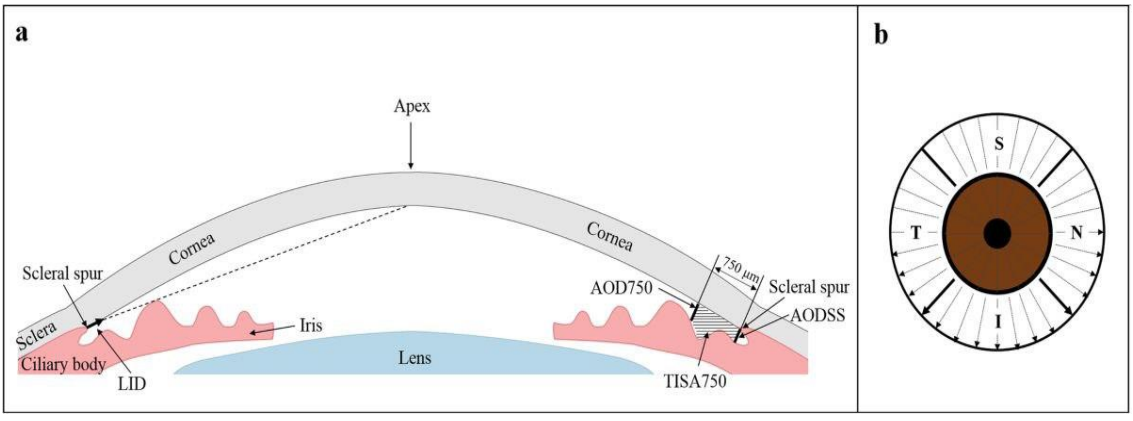
Purpose: The purpose of our study is to study and determine the patency parameters of the anterior chamber angle obtained by ultrasound biomicroscopy (UBM) in primary open–angle glaucoma (POAG).

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Materials and methods: The study involved 30 people (60 eyes): in the observation group there were 15 patients with OAG (30 eyes), in the control group there were healthy individuals (15 people – 30 eyes) without ocular pathology and with normal values of intraocular pressure (IOP). The study did not include patients who had undergone surgery, trauma, uveitis, PES with dislocation of the lens, as well as with clinically diagnosed swelling cataract, which obviously can become the leading cause of changes in anatomical and topographic parameters. Average

The age of patients with POAG was 65 years, in the control group – 68 years and did not significantly differ ($p>0.05$). The diagnosis of glaucoma in the group of patients with POAG was confirmed using standard techniques. The oscillation of the sensor is 50 MHz. Scanning was performed in four meridians 12, 6, 3 and 9 h with the sensor positioned perpendicular to the studied structures: cornea, anterior chamber angle, iris, iris root, corneocleral spur and sclera. According to the methodology of Pavlin S. et al. [9] measurements were made (in mm) of the thickness of the sclera from the spur furrow perpendicular to the surface scleral membrane, iris thickness: in the basal zone, as well as 500, 1000 and 1500 microns from the basal zone. Conventional research methods (tonometry, perimetry, goniocopy) were supplemented by ultrasound biomicroscopy on the Sonomed escalon Vumax device.

Results and discussion The thickness of the iris and sclera is normal and in case of OAG according to UBM data. The study established a reliable ($p<0.05$) reduction of sclera thickness in patients with glaucoma compared to a group of healthy individuals. Thus, in the absence of ophthalmopathology in persons of appropriate age, the thickness of the sclera according to UBM data averaged 1,38 (1,28–1,38; 1,28; 1,37) mm with fluctuations from 1.32 to 1.52 mm, and with AUG, the average was 1,04 (0,98–1,24; 0,98; 1,24) mm with a span from 0.80 to 1.44 mm. The change in the thickness of the sclera that we found reflects involvement of the scleral membrane in the pathological glaucoma process and in primary glaucoma may indicate a change in its structural properties. From this point of view, assuming the involvement of others in the glaucoma process connective tissue structures of the anterior segment of the eye, namely the iris tissue, it seems to us important to assess its condition in case of AUG. Therefore, our study included determining the thickness of the iris at different measurement points. Thus, the UBM examination of the iris at different measurement points revealed a decrease in its thickness from the basal zone to the pupillary edge in both groups, which is due to structural and functional features. However, when comparing the thickness of the iris in patients in both groups for different measurement zones, it was found that its thickness in primary glaucoma is significantly less than the norm (Table 1)



1-scheme for measuring the "iris-lens" distance

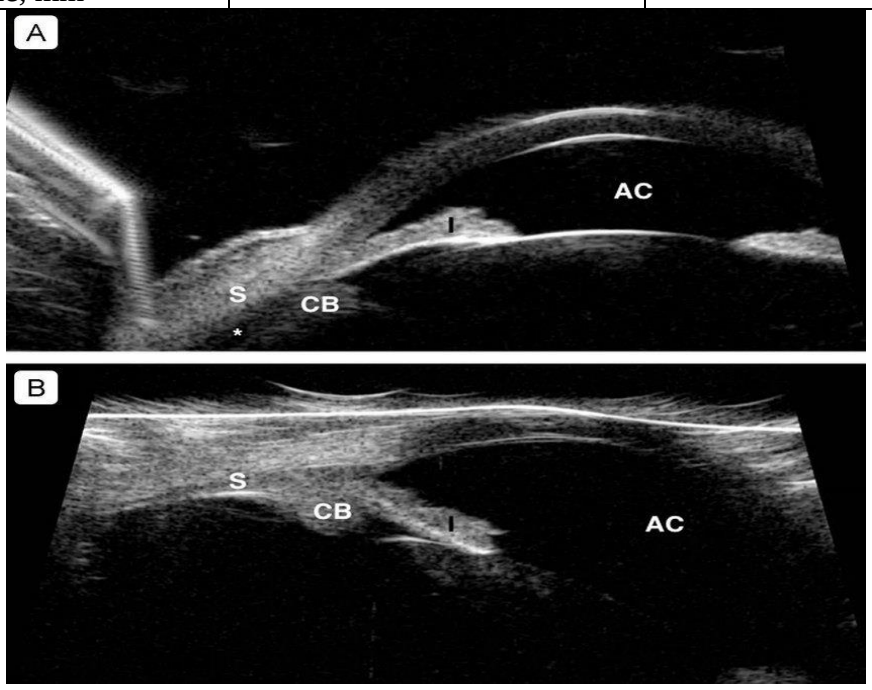
Thus, the thickness of the iris directly in the root zone in healthy individuals averaged 0,41 (0,38–0,4; 0,39; 0,39) mm with a range from 0.33 to 0.48; in patients with acute respiratory failure, the average value was equal to 0,31 (0,28–0,39; 0,35; 0,34) mm, while the maximum value reached 0.48 mm, and the minimum value is 0.18 mm (with a confidence difference of $p<0.05$). When comparing the

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thickness of the iris 500 microns from the basal zone in the glaucoma group there was a statistically significant ($p<0.05$) decrease in its average 0,34 (0,31– 0,40; 0,40; 0,37) mm, and the thickness of the iris in this zone ranged from 0.22 to 0.46 mm compared to the norm, where the average value was 0,44 (0,42–0,46; 0,44; 0,44) mm with a span of 0.37 to 0.56 mm. Then, analyzing the data of measuring the thickness of the iris in other zones, we also revealed a significant decrease in its thickness in the AUG group. At 1000 microns from the basal zone, the thickness of the iris in glaucoma ranged from 0.38 to 0.49 mm and averaged 0,42(0,34–0,40; 0,40; 0,39) mm, and in the norm group – on average 0,48 (0,40–0,44; 0,44; 0,40) mm with a fluctuation in its thickness from 0.40 to 0.54 (at $p<0.05$) mm. At 1500 microns from the root zone, the range of iris thickness values ranged from 0.29 to 0.49 mm and averaged 0,39 (0,34–0,41; 0,38; 0,38) mm in patients with OAG and 0,46 (0,44 – 0,48; 0,45; 0,3) mm in healthy subjects with a span in this group from 0.39 to 0.59 mm. At the same time, the differences they were statistically significant ($p<0.05$).

2- Scheme. Biometric parameters of the sclera and iris are normal and with AUG (M, min -max)

Indicators/groups	Standard	OAG
Thickness of the sclera, mm	1,38(1,32–1,52)	1,04(0,80-1,44)
The thickness of the iris in the basal zone, mm	0,41 (0,33-0,48)	0,31 (0,18-0,48)
The thickness of the iris is 500 microns of the basal zone, mm	0,48(0,40 -0,54)	0,34 (0,22-0,46)
The thickness of the iris is 1000 microns of the basal zone, mm	0,48(0,40 -0,54)	0,42(0,38-0,49)
The thickness of the iris is 1500 microns of the basal zone, mm	0,46(0,39-0,59)	0,39(0,29-0,49)



3-scheme. UBM images of a patient without glaucoma with a clear lens

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Thus, **the results** of the performed studies demonstrate the influence of the pathological glaucoma process on the condition of the iris, namely on its thickness. The negative consequences of this process for the biomechanical properties of the iris may manifest themselves in the loss of its elasticity, i.e. in increased rigidity due to dystrophy of its tissue. However, the wide range of values of the thickness of the scleral and iris membranes in both observation groups does not allow us to determine the clinical significance of this feature for each individual.

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