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SUBSTANTIATION OF THE TACTICS OF TREATMENT OF GLAUCOMA ON THE EQUIPMENT OF UBM

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ABSTRACT

The scientific article shows the role and significance of the UBM examination in the diagnosis and treatment of proletarian eye diseases, problems in the development and diagnosis of diseases, the results of the examination. Basically, the diagnosis of glaucoma using UBM has a great value in the Prevention of wilting, anicizing the angle of the front camera and disease.

With all the advantages of numerous variants of non-perforating type operations performed in primary open-angle glaucoma, the facts of a short-term hypotensive effect of the operation are noted. In these situations, the possibility of normalization of ophthalmotonus after laser puncture of the trabecular-descemet membrane has been proven, which has received due recognition and is performed, according to the literature, from 10 to 80% of cases in the first two years after the main operation.

At the same time, in a number of cases, insufficient effectiveness of laser operations and the need to connect additional drug therapy or repeat them to achieve the proper hypotensive effect were noted.

Ultrasound biomicroscopy makes it possible to evaluate with micron accuracy the morphological structure of the operation area after NGSE with a detailed characteristic of the drainage system in cases of compensation and lack of compensation for ophthalmotonus. However, the small number of works devoted to studies of the drainage zone by the UBM method after laser descemetogoniopuncture (DGP) does not allow us to fully assess the effectiveness of laser intervention, taking into account the initial state of the drainage system, the time elapsed after the main operation, and the stage of the glaucoma process. **The purpose of this section of the work** is to assess with the help of UBM the state of the drainage system after laser descemetogoniopuncture, taking into account the timing of its implementation and the initial state of the zone after the main operation. **Materials and methods of clinical research** The studies were performed in 80 patients (150 eyes), in whom laser BPH was performed at various times after NGSE due to an increase in ophthalmotonus. In 17 eyes (11.2%) there was an initial glaucoma (stage I), in 54 eyes (35.5%) — developed (stage II) and in 81 eyes (53.3%) — far advanced (stage III). The age of the patients ranged from 40 to 82 years, averaging 69 ± 7 years. The increase in

ophthalmotonus was noted at various times: from 2 weeks to 10 years. Intraocular pressure ranged from 25 to 48 mmHg, averaging 32.35 ± 0.30 mmHg.

The scope of research included visometry, field of vision examination, tonometry, tonography, gonioscopy. UBM was performed before laser DGP, during the first 3 days after it, after 1 month and then every 3-6 months for 2 years.

UBM was performed on a HUMPHREY UBM-840 device (USA) with a sensor frequency of 50 MHz, a penetration capacity of 5 mm, and a resolution of 40-50 microns. The study was performed using both radial and frontal sections of the operation area. The results of UBM were compared with the data obtained during the study of the characteristics of the drainage system in 88 patients (100 eyes) with compensated ophthalmotonus who underwent NGSE for primary open-angle glaucoma, detailed information about which is described in the preceding sections.

Comparison of the results of UBM obtained before laser BPH in patients with hypertension turned out to be identical in basic parameters with the results previously obtained with UBM in 83 patients (121 eyes) with decompensated ophthalmotonus after NGSE. When assessing the drainage system by the UBM method, the zones of surgically formed drainage paths were examined and the acoustic characteristics of the structures forming them were determined. Laser DGP was performed on a Visulos YAG II plus Zeiss device with a wavelength of 1,064 microns, a power of 2.4-5.7 MJ.

The effectiveness was assessed by the appearance of a vapor-gas bubble and humidification of the impact zone. The acoustic density of the structures was determined as a percentage of the density of the sclera of the examined eye. The studies do not include situations where laser BPH was preceded or accompanied by laser (iridectomy, iridoplasty) or surgical interventions (revision of drainage system structures).

Statistical processing of the results of the study was carried out using the SPSS 11.0 mathematical statistics application software package.

Research results

Terms up to 1 month after NGSE

During the first month after NGSE, laser BPH was performed on 29 eyes with anь increase in intraocular pressure from 25 to 48 mmHg, which averaged 36 ± 4.2 mmHg. Stage I glaucoma occurred in 7 eyes (24.3%), stage II occurred in 10 eyes (34.5%) and in 12 eyes (41.4%) — stage III. In the UBM study, the greatest changes (75.9%) were detected from the TDM side.

Laser DGP was performed with the following changes:

-in 17.2% of cases, a thin (no more than 0.09 mm), with a linear TDM profile, but with a high acoustic density of the structure reaching up to 70% was observed, which, apparently, negatively affected its filtering function (Fig. 5.18 a). This symptomatology was considered by us as an independent sign of the failure of the NHS and was diagnosed, as a rule, in patients with advanced stages of glaucoma (II, III stages);

-in 24.1% of cases, there was a prominence of acoustically dense (up to 70%) and thin (0.06-0.08 mm) TDM in the area of surgery with flattening and even disappearance of AF and ISP in half of these cases (Fig. 5.19a);

-in 34.5% of cases, there was a "thick" TDM, which in its parameters (thickness 0.12–0.15 mm) significantly ($p \leq 0.01$) differed from the parameters of the eyes when compensating for ophthalmotonus (0.06-0.08 mm).

In the remaining cases (24.1%), there was a combination of several unfavorable factors, where an acoustically dense, thin or thickened TDM was combined with the presence of a "thick" SL, which in its parameters significantly ($p \leq 0.05$) differed from the thickness of the SL in the group with ophthalmotonus compensation, amounting to 0.31 mm versus 0.27 mm. Concomitant changes in other departments of the drainage system included a decrease in the volume and height of the AF, a decrease or disappearance of the height and volume of the ICP, the appearance of inclusions of different acoustic densities in it, narrowing or disappearance of hypoechoic tunnels, a decrease in the height and volume of the AF. Changes in the structures of the drainage system were most pronounced with the full prominence of TDM in the area of operation, where in half of the cases there were no AF and ICP. During gonioscopy, the area of the operation was viewed in the form of a translucent rectangle, practically devoid of pigmentation, with characteristic reflexes during TDM prominence.Laser operations in almost all patients were not complicated. Intraocular pressure decreased by an average of 10.8±4.8 mm with fluctuations from 8 to 18 mm Hg. In only one case, it was not possible to eliminate the complete blockade of the ISP by the penetrating trabeculodescamete membrane tightly soldered to the scleral flap, where surgical revision of the operation zone was recommended. In two cases of the presence of a "thick" TDM, success was achieved after repeated laser DGP. In one of these cases, there was a prominence of a thin, acoustically dense TDM into the operation area, without signs of its soldering with the SL, in another case there was a "thick", acoustically dense TDM.

The scans revealed significant changes after laser DGP, reflecting the restoration of the filtering function of TDM, which were manifested by an increase in ICP, the appearance of hypoechogenicity of the scleral flap, expansion and better visualization of tunnels running from under the SL into the subconjunctival space, an increase in the height and volume of the AF, a decrease in the acoustic density of conjunctival tissue and even the appearance of micro cavities in the AF (37.9%), corresponding to accumulations of intraocular moisture, as well as the complete restoration of the linear profile of TDM in cases of its prominence. The perforation hole in the TDM in the laser puncture zone was clearly visualized. The parameters of all structures of the drainage system studied by UBM were significantly ($p \leq 0.05$-0.001) better than the initial ones, and by a number of values better than the ophthalmotonus compensation group in the early stages after NGSE (see Table 5.7). Positive changes in the studied parameters of the drainage system indicated an improvement in the filtration of intraocular moisture.

Terms 3-6 months after NGSE

UBM studies were conducted within 3-6 months after NGSE in 25 eyes with an increase in IOP in the range of 25-46 mm Hg, which averaged 36 ± 4.2 mm Hg. Attention was drawn to the high frequency of ophthalmotonus disorders in patients with advanced stages of glaucoma: stage I was detected only in 3 eyes (12%), Stage II — on 7 eyes (28%), stage III — on 15 eyes (60%).

The presence of "thick" TDM in these terms was the leading symptom (28%). The thickness of the TDM averaged 0.13 mm, significantly ($p \leq 0.001$) differing from the group with ophthalmotonus compensation (0.07 mm), the acoustic density of the membrane varied from 50 to 80%. TDM changes were accompanied by disturbances in all structures of the drainage system, manifested not only by a decrease in the studied parameters, but also by the appearance of different density of inclusions in the extrascleral zone, in the lumen of the tunnels connecting the ISP with the AF, along the periphery and inside the ISP with its preservation.Attention was drawn to the presence of a "thick" SL (0.39-0.41 mm) against the background of a pronounced compaction of its structure. "Thick" SL in these terms becomes more important among the postoperative factors of hypertension due to a gradual increase in the density of its structure and an indirect increase in the deterioration of the filtration of intraocular moisture from under the SL. With the predominant localization of changes at the intrascleral level (12%), the thickness of the SL reached 0.43 mm and, as a rule, was combined with a decrease in volume to one third of the AF or its disappearance. With the predominant localization of changes in the extrascleral parts (19%), AF was absent (32%) or was sharply reduced, the acoustic density of the outer cover increased sharply, amounting to 70-80%, areas of dense adhesion appeared between the conjunctival cover and SL.In many cases (44%), a combination of negative signs at various levels of the surgically formed drainage pathway was characteristic. The changes visualized in UBM were interpreted by us as an active proliferative process with the prevalence of changes at one or more levels of the drainage system. Gonioscopy revealed the area of the performed NGSE for mild or moderate pigmentation, different from the adjacent sections. Laser BPH led to a decrease in ophthalmotonus in all eyes to 13-21 mmHg, which averaged 16 mmHg.

During the UBM study, microperforations in the TDM were clearly visualized. Activation of the filtering function of the membrane led to the restoration of the acoustic morphology of the overlying sections of the drainage system, which was manifested by an increase in the volume and height of the AF, in 20% of cases there were acoustically negative spaces corresponding to the accumulation of intraocular moisture. The height and volume of the ICP increased, the hypoechoic tunnels expanded, and the number of inclusions in their lumen decreased. The thickness of the layer has not changed, but its acoustic density has decreased. The studied parameters in all cases were better than the initial ones and reached values in the group of compensated ophthalmotonus in these terms.

However, in two eyes with predominant localization of changes at the extrascleral and intrascleral levels, the hypotensive effect of laser BPH was short-lived. In these cases, there was a combination of a "thick" acoustically dense TDM with a "thick" SL against the background of a high acoustically dense conjunctiva. The failure of drug therapy determined two months later indications for surgical revision of the operation area, which normalized ophthalmotonus. In general, the effectiveness of laser BPH during these periods was high (92%) with a persistent hypotensive effect observed in the overwhelming number of patients.

Terms 6 months-1 year after NGSE

In the period from 6 months to 1 year after NGSE, UBM studies were conducted on 29 eyes of 20 patients who underwent laser DGP. These terms were also characterized by cases with advanced stages of glaucoma: stage I occurred in 3 eyes (10.4%), stage II — in 7 eyes

(24.1%), stage III — in 19 eyes (65.5%). Intraocular pressure was in the range of 27-33 mm Hg, averaging 30± 4.8 mm Hg . The gonioscopic picture was poor: the operation area was determined by moderate pigmentation of the operation area.

UBM-symptoms on the part of the drainage system had certain similarities with the previous period, differing in the qualitatively greater severity of changes. Characteristic was the presence of a "thick", acoustically dense TDM, which penetrated into the operation zone with the appearance of accretions with adjacent sections of the sclera, which affected a significant ($p \leq 0.02$) decrease in its length to 0.6 mm. Changes in TDM were combined with pronounced symptoms on the part of all departments of the drainage system. AF was absent in 52.6% of cases. There was an increase in thickness up to 0.38 mm and an increase in the acoustic density of the SL, the appearance of a characteristic "bumpiness" of its outer contour, the fusion of zones of high acoustic density of the conjunctiva and underlying tissues. There was a tendency to decrease the ICP parameters. Laser DGP led to normalization of ophthalmotonus with a decrease of 10-12 mmHg, averaging 18 ± 3.8 mmHg. Restoration of the filtering function of TDM contributed to normalization of the acoustic picture during the UBM study. The average ICP values increased due to a decrease in the acoustic density of inclusions, the visualization of tunnels improved, the height and volume of the AF increased, the acoustic density of its structure decreased (Fig. 5-21a, b). The studied parameters for UBM were significantly ($p \leq 0.05$-0.001) higher than the initial ones, and in a number of values exceeded the group with compensated ophthalmotonus after NGSE, however, in 6 eyes (20.7%), the hypotensive effect of laser BPH was short-lived (up to 2 months). The analysis of the scans in these cases showed a thickening of the SL to 0.46 mm, which was combined with the formation of sclero-conjunctival and sclero-scleral accretions. As a rule, in these cases, there was also a thickening of the TDM to 0.16 mm against the background of an increase in its acoustic density to 85%.

In 2 out of 6 cases, vascular detachment occurred after laser DGP, which was clinically accompanied by a decrease in the depth of the anterior chamber, the appearance of descemet folds, and the UBM study revealed an expansion of the supraciliary and suprachoroidal spaces to 0.3-0.5 mm, as well as an increase in the thickness of the ciliary body to 1.5 mm, which exceeded 0.7-0.8 mm its maximum thickness in the opposite segment. Against the background of drug relief of these complications, IOP returned to the initial level, but during the UBM study, a further deterioration in the parameters of the drainage system and their acoustic density was observed.

In terms from 1 to 10 years, UBM studies were conducted on 39 eyes of 32 patients with increased ophthalmotonus. As in previous periods, advanced stages of glaucoma prevailed: stage I — in 10.3%, stage II — in 25.6%, stage III — in 64.1% of cases. Intraocular pressure was at the level of 27-35 mmHg, averaging 31 ± 5.2 mmHg. UBM-studies reflected generalized proliferative changes with a transition to scarring at all levels of the drainage system created by the NGSE, and manifested by a decrease in the parameters of the studied structures, loss of their hypoechogenicity with an increase in acoustic density, often reaching up to sclera densities

The presence of a "thick" TDM was characteristic, which in some cases reached 0.16 mm, averaging 0.14 mm against the background of a high acoustic density reaching up to 90%. A

distinctive feature of these terms was a significant decrease in the width of the TDM to 0.5 mm due to the appearance and progression of fusion of the distal parts of the membrane with adjacent structures.

The ICP was absent in 13.2% of cases, its height and volume were reduced with a wide range of fluctuations: from 0.21 to 0.31 mm. The thickness of the SL increased significantly to 0.46 mm, its boundaries were poorly differentiated. Visualization of tunnels was possible in 68.4% of cases due to their narrowing and a large number of inclusions of predominantly high acoustic density in their lumen. AF was absent in 85.5% of cases. Special attention should be paid to situations in which laser DGP performed within the specified time frame was not effective (12 operations). In these cases, extreme values of the acoustic parameters of the drainage system structures took place, namely: thickening of the TDM to 0.16 mm, a decrease in its width to 0.3 mm, a decrease in the size of the ICP to a gap or its absence, the inability to visualize tunnels and differentiate the boundaries of the SL, an increase in the area of propagation of the acoustic density of the extrascleral zone in the distal part from the operation zone, the presence of dense sclero-conjunctival and sclero-scleral accretions, the absence of AF.

These changes in the drainage system are designated as the final stage of the proliferative process with cicatricial changes in the structures of the drainage system, which determine the futility of laser DGP. At the same time, with less pronounced changes in the drainage zone, laser DGP performed on 27 eyes led to normalization of ophthalmotonus in 22 eyes (Fig. 22b, 23b). Intraocular pressure decreased to 17-21 mmHg, and remained at this level throughout the entire follow-up period (up to 2 years). UBM symptoms reflected activation of intraocular moisture filtration.

Upon a detailed analysis of the initial acoustic symptoms, it was found that the following acoustic signs were characteristic of the group with a positive effect after laser DGP: the preservation of the linear profile of the TDM, the absence of dense adhesions of the membrane with surrounding tissues, the preservation or reduction of the height of the ICP of at least 0.15 mm, the ability to visualize tunnels, differentiate the boundaries of the SL and the presence of relatively low acoustic the density of the extrascleral zone, not exceeding 75-80%. However, in 5 eyes (18.5%), the effect of laser BPH was not stable, and within 2-3 months after laser surgery, IOP returned to its original values (27-30 mmHg). The perforation of the TDM did not lead to significant changes in the overlying sections of the drainage system. Analysis of the initial state of the drainage paths showed that acoustic changes in the parameters of the drainage system structures were almost similar to the cases of lack of efficiency of laser DGP, but less pronounced. Drug therapy also did not give a stable hypotensive result. After 5-7 months, a second surgical intervention was performed. It is possible that with timely preventive measures taken and the identification of a risk group of patients at a late date after the main operation, such situations could have been prevented.

Discussion of the results

The TDM formed during non-perforating operations is the main filtration zone of intraocular moisture, the viability of which is controlled by the surgeon already on the operating table according to the degree of its permeability to HCV. The authors associate the main reasons for retention of the outflow of intraocular moisture with the compaction and

thickening of the TDM, without stopping their attention on changes in the acoustic density of the membrane.

The assessment of the state of TDM was also in the focus of our attention when characterizing the structures of the drainage system before the laser goniopuncture. At the same time, we attached importance not only to changes in the membrane thickness and profile, but certainly took into account the width, acoustic density of the membrane, as well as concomitant violations of other structures of the drainage system.

The UBM-signs of TDM changes reflected in the work: thin, acoustically dense with prominence in the area of surgery; thin, acoustically dense with a linear profile; "thick", acoustically dense TDM — should be regarded as risk factors in the development of postoperative hypertension already at the stage of compensated ophthalmotonus and can serve as an indication for laser BPH even in the absence of pronounced clinical symptoms with impaired ophthalmotonus.

It draws attention to the fact that in terms of 1-3 months, the specific weight of "thick", acoustically dense TDM increases in the structure of the causes of increased ophthalmotonus. Observation of patients in such situations revealed a tendency to rapid fibrosis of the initially "thick" TDM and a pattern of more transient concomitant changes in the drainage system. As the research results have shown, it is not possible to gonioscopically and clinically diagnose micron thickening of TDM, the presence of a thin, transparent, but initially acoustically dense membrane, which can negatively affect its drainage function.

It is difficult to overestimate the possibilities of UBM as a non-invasive, non-contact technique that allows not only to identify the cause of retention in the early stages of the postoperative period after NGSE, but also to objectively determine the indications for laser BPH even in the absence of severe hypertension. It has been proved that in the early stages after NGSE (up to 3 months), laser BPH has a high efficiency (96.8%) and a stable hypotensive effect, virtually independent of the cause of the increase in ophthalmotonus.

The presented UBM symptoms after laser DGP in the early stages after NGSE reflect the activation of the filtering function of TDM, which is manifested by an increase in the parameters of the structures of the drainage system studied by UBM, including ICP, AF, a decrease in their acoustic density, and improved visualization of tunnels. When performing laser DGP in the early stages, the parameters of the drainage system exceed the initial ones, and for a number of values — the parameters after the NGSE with stable compensation of ophthalmotonus.

Within 3-6 months after the laser DGP, the intervention remains highly effective — 92%. During these periods, an increase in the thickness of the TDM against the background of an increased acoustic density of the drainage system structures is the leading cause of a violation of its drainage activity. However, in 68% of cases with UBM, combined causes of retention are observed, where, first of all, a progressive increase in the thickness of the SL draws attention. In our opinion, thick SL in these terms becomes more important among the postoperative factors of hypertension, preventing the flow of intraocular moisture. It is not by chance that its changes are often combined with flattening or disappearance of AF, compaction of extrascleral structures.

These changes in the drainage system are possible for diagnosis only by the UBM method and can give reasonable indications for performing combined pathogenetically oriented interventions, including not only laser, but also surgical operations to revise the structures of the drainage system. In the period from 6 months to 1 year after NGSE, laser DGP was performed against the background of combined changes in the drainage system detected during UBM. In cases of predominant changes in TDM, the efficiency of laser surgery remained high and stable (79.3%). The short-term effect in 6 cases was due to the predominant lesion of the extra- and intrascleral zones of the drainage pathway.At a later date (1 year-10 years) after NGSE, proliferative changes in the drainage system were more intense than in previous terms, covered all areas of the surgically formed pathway of the outflow of HCV and were more widespread. Such a progression of the proliferative process in the late follow-up period led to the appearance of dense accretions of TDM with SL, which was accompanied by a gradual prominence of TDM into the area of surgery, followed by a decrease and disappearance of ICP. Therefore, the decrease in the effectiveness of laser surgery during this period indicates the need to perform combined interventions, including laser and surgical components, especially in cases of combined changes in the extra- and intrascleral zones of the operation.

A clear dependence of the results of laser DGP on the UBM symptoms of the drainage system structures was found. Laser DGP proved to be effective with a combination of such features as the preservation of the linear profile of the TDM, the absence of dense adhesions of the membrane with surrounding tissues, the presence of ICP with a height of 0.15 mm and higher, the possibility of visualizing tunnels with an acoustic density of inclusions in their lumen not exceeding 70%, the ability to differentiate the boundaries of the SL and limited compaction of extrascleral tissues with acoustic with a density of no more than 75%, regardless of the presence of AF. In the absence of these signs, the hypotensive effect of laser BPH is short-term or absent.

There are signs of activation of the proliferative process in the late stages after NGSE, namely:

• the appearance of fresh inclusions of low acoustic density;

• progressive increase in the acoustic density of drainage system structures reaching the density of the sclera;

• poor visualization or disappearance of SL boundaries;

• reduction of ISP parameters;

• the disappearance of tunnels or their poor visualization due to a large number of acoustically dense (≥70%) inclusions in their lumen;

• prominence of TDM, its reduction in width, increase in thickness and acoustic density.

The research results can be summarized by the following provisions:

1. The symptoms of the drainage system of the eye presented by UBM after laser DGP reflect the activation of the filtering function of the trabeculo-descemet membrane, which is manifested by an improvement in the parameters of the drainage system structures studied by UBM, an increase in their hypoechogenicity, improved visualization of tunnels, an increase in cavities, including the intrascleral cavity and filtration cushion.

2. The greatest efficiency of laser DGP is noted in the first three months after the NGSE. The parameters of the drainage system studied by UBM in these terms exceed the initial parameters and in a number of values exceed the parameters after NGSE with stable compensation of ophthalmotonus.

3. A comparison by UBM of the morphological state of the surgically formed drainage system of the eye with compensation, decompensation of ophthalmotonus, as well as after laser BPH revealed the increasing development of the proliferative process after the main operation. At the same time, the effectiveness of laser DGP depended on the degree of changes in TDM: the smaller the changes in TDM, the better the hypotensive effect was.

4. The symptoms of the proliferative process detected by UBM after NGSE make it possible to diagnose the main level of intraocular moisture retention, predict the hypotensive effect of laser BPH and justify pathogenetically oriented tactics of normalization of ophthalmotonus to achieve a persistent hypotensive effect

5. The set of negative symptoms presented in the work, detected by the UBM method in the late stages after NGSE, reflects the final stage of proliferative processes with the transition to fibrous changes that cause the short-term hypotensive effect of laser BPH or its absence.

6. The morphological changes detected by the UBM method in the drainage system after NGSE, correlating with the decompensation of the glaucoma process, indicate the expediency of including UBM as an objective and highly informative diagnostic method in the complex of dispensary examination of patients after glaucoma operations for timely preventive measures and pathogenetically oriented treatment in violation of ophthalmotonus.

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