SURGICAL TREATMENT OF THE IDIOPATHIC MACULAR HOLE BY MEANS OF 25-GAUGE PARS PLANA VITRECTOMY WITH THE PEELING OF THE INTERNAL LIMITING MEMBRANE ASSISTED BY BRILLIANT BLUE AND GAS TAMPONADE

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SUMMARY

SURGICAL TREATMENT OF THE IDIOPATHIC MACULAR HOLE BY MEANS OF 25-GAUGE PARS PLANA VITRECTOMY WITH THE PEELING OF THE INTERNAL LIMITING MEMBRANE ASSISTED BY BRILLIANT BLUE AND GAS TAMPONADE

25-gauge pars plana vitrectomy with briliant blue assisted internal limiting membrane peeling and gas tamponade for idiopatic macular hole

Purpose: The evaluation of anatomic and visual outcomes in idiopatic macular holes treated with 25-gauge pars plana vitrectomy, briliant blue (BB) assisted internal limiting membrane (ILM) peeling and gas tamponade.

Materials and methods: Retrospective analysis. 53 eyes of 52 patients (39 women, 13 men) of mean age 68,8 years (58-83) with the diagnosis of stage 2, 3, or 4 macular holes according to Gass Classification from 6/2012 to 7/2014 were included. All patient undergone 25-gauge pars plana vitrectomy with brillinat blue assisted ILM peeling, gas tamponade (35 cases 15 % C3F8, 18 cases 20 % SF6). 50 cases (94,3 %) were performed in retrobulbar anesthesia, 3 cases in general anesthesia. Face-down positioning should have been maintained for three days. Best corrected visual acuity (BCVA), optical coherence tomography findings and complications were evaluated.

Results: The mean follow-up time was 6 months (1–22). Macular hole closure was achieved in 49 eyes (92,5 %). The mean BCVA improved from 0,16 (0,5–0,05) to 0,5 (1,0–0,1). BCVA was improved by 3 and more ETDRS lines in 42 eyes (79,2 %).

Conclusion: 25-gauge pars plana vitrectomy with briliant blue assisted internal limiting membrane peeling and gas tamponade is safe and effective method of macular hole therapy with high anatomic and functional effect.

Key words: macular hole, 25-gauge, ILM peeling, brilliant blue, gas tamponade

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INTRODUCTION

Idiopathic macular hole (IMH) represents a defect of the centre of the fovea in its full thickness from the internal limiting membrane (ILM) to the outer segments of the photoreceptors, leading to loss of central vision (fig. 1, 2). This represents an age-related disease, which is most frequently diagnosed between the ages of 60 and 70 years. Women are afflicted twice as often as men. In 10-20% of cases both eyes are afflicted, but rarely simultaneously. The risk of development of IMH in the second eye is around 15% over the course of 5 years in eyes with a non-separated vitreous body. The prevalence of idiopathic macular hole is approximately 3 cases per 1000 of the population (19, 24, 25, 26, 30, 40).

According to Gass's theory from 1988, idiopathic macular hole is generated through the action of vitreoretinal tractional forces, both tangential and front-to-back. According to Gass's classification, we clinically differentiate between four stages in the development of IMH (13). The method of optical coherence tomography (OCT) is entirely sovereign in determining the diagnosis, the stage of the disease and also for monitoring the development of macular hole and the success of therapy.

The disease was considered untreatable until 1991, when Kelly and Wendell were the first to publish a report on the successful solution of macular hole by means of pars plana vitrectomy (PPV) with gas tamponade (27). Thanks to this report, interest in this pathology and its treatment was revived.

The operation is performed most frequently by standard 3-port pars plana vitrectomy, either 20-gauge or with the use of one of the non-suture techniques with 23-gauge, 25 gauge or the thus far least widely used 27-gauge. The results of IMH operations are excellent, closure is usually achieved within the range of 85 to 100% of cases (4, 40, 41). Visual acuity of 6/12 and better is achieved in 25-40% of operated patients (16, 23, 37, 43). The high rate of anatomical and

functional success of surgical solution of idiopathic macular hole is due to the fact that this does not represent a defect of loss, but that centrifugal traction has led to a tearing of the retina with the photoreceptors from the centre of the macula. The edges of the hole can be reattached through a relaxation of these forces (2).

A new option for treatment of IMH with a diameter of < 400 µm is enzymatic vitreolysis intravitreally with applied ocriplasmin preparation (Jetrea, ThromboGenics). Closure of the macular hole in patients treated with this preparation was achieved in 40.6% of patients, as against 10.6% of patients who were given a simulated injection (45).

The aim of our study is a retrospective evaluation of the anatomical and functional results of idiopathic macular hole operations using non-suture 25-gauge pars plana vitrectomy with peeling of the internal limiting membrane assisted with brilliant blue and expansive gas tamponade.

METHOD AND STUDY COHORT

We examined the best corrected visual acuity (BCVA) of each patient on ETDRS optotypes before surgery. On a slit lamp we examined the anterior segment, we biomicroscopically evaluated the finding on the posterior segment of the eye. A standard component of the examination of each patient was also performance of OCT and measurement of intraocular tension (IOT). The same spectrum of examination as before the operation was also performed at all postoperative checks. If there was a development or progression of cataract in the postoperative period, this was operated on by standard phacoemulsification with implantation of a posterior chamber intraocular lens.

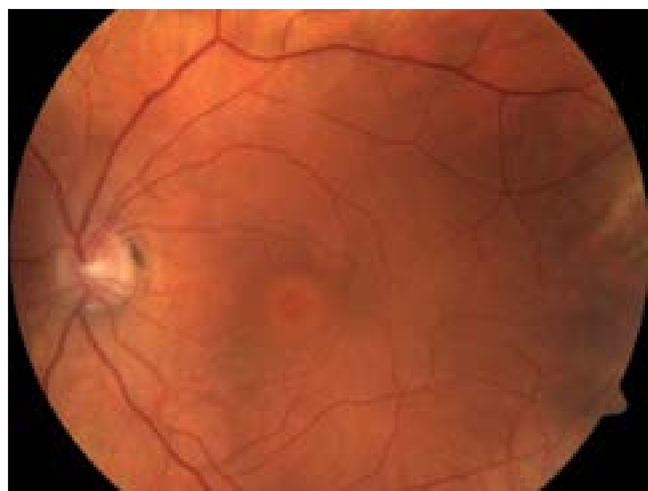

Fig. 1 Colour photograph of macular hole before PPV

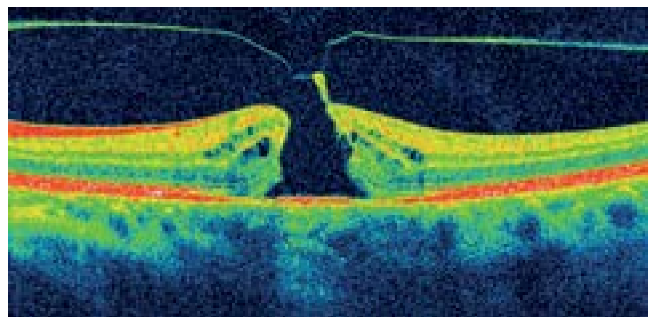

Fig. 2 OCT finding before PPV

Surgical technique: All patients were operated on by a single surgeon (MV) using 25-gauge pars plana vitrectomy on a Constellation (Alcon) instrument. After the application of trocars transconjunctivally via pars plana 3.5-4 mm from the limbus, core vitrectomy was performed. In the case of fixation of the posterior vitreous membrane to the posterior pole of the eye, after staining by crystalline corticosteroid (betamethazone) suction of vitrectomy, it was released approximately to the region of the equator. ILM peeling (if applicable also peeling of the present epiretinal membrane) was performed using Eckardt's micro-forceps and a macular lens. For easy identification of the membranes and their safe and complete removal, brilliant blue was used (Ocublue Plus, Aurolab), which was applied to the vitreous cavity filled with sterile solution, thus without its replacement with air. We apply brilliant blue in a closed infusion, subsequently the infusion is practically immediately opened and the colouring is drained. The extent of ILM peeling was 2-3 PD (papilla diameter) on average. Before concluding the procedure, the periphery of the retina was checked for the purpose of detecting cracks, using scleral indentation. There followed incomplete, approximately 90% replacement of fluid by air and instillation of expansive gas – 20% SF6 or 13% C3F8. After extraction of the trocars, the watertightness of the sclerotomies was tested. After the operation it was recommended that patients keep the head in a prone position for 3 days, with the greatest emphasis on maintaining this position for the first 24 hours after the operation (each patient also obtained an instruction diagram after surgery).

In the period from 6/2012-7/2014 we conducted surgery for idiopathic macular hole on 53 eyes of 52 patients (39 women, 13 men) with an average age of 68.8 years (58-83) at the Department of Ophthalmology of the Královské Vinohrady University Hospital. We indicated patients with idiopathic macular hole stage 2-4 according to the Gass classification for surgery. The average initial BCVA was 0.16 (0.5-0.05). A cataract had already been operated on in the preoperative period in 13 eyes, 40 eyes were phakic.

In 35 cases 15% C3F8 was used as a tamponade, in 18 cases 20% SF6 (according to current availability). In 46 eyes (86.8%) ZSM was attached and it was therefore necessary to release it. In 23 eyes (43.4%) an epiretinal membrane was also present. In three cases we indicated general anaesthesia, the other procedures were performed under retrobulbar anaesthesia.

We evaluated a condition in which flattening and closure of the edges of the macular hole as anatomically successful.

RESULTS

The average observation period is 6 months (1-22). Anatomical success, i.e. full closure of macular hole was achieved in 49 eyes (92.5%) (fig. 3 and 4). Average BCVA improved to 0.5 (1.0-0.1). Visual acuity remained the same in 3 eyes (5.7%), in all other cases there was an improvement (94.3%). In 42 eyes (79.2%) visual acuity improved by 3 or

more rows of ETDRS optotypes (improvement by more than 3 rows was recorded also in 2 out of 4 eyes in which macular hole was not closed). At the end of the operation all sclerotomies were sufficiently watertight and suturing was therefore not necessary. In the postoperative period we did not record hypotonia. Cataract surgery was performed in 12 out of 40 of the phakic eyes (30%) due to progression in the observation period.

The frequency of complications was relatively low. In 7 cases (13.2%) we detected minor retinal cracks at the end of the procedure upon a check of the peripheral retina, in two cases in areas due to lattice degeneration. We treated the cracks with laser photocoagulation or cryopexy. In the postoperative period higher IOT was measured in 4 eyes (7.5%), which was quickly and successfully treated with local anti-glaucoma therapy. We did not record any other perioperative or postoperative complications in this cohort.

DISCUSSION

Gass's theory concerning the pathogenesis of the origin of IMH through the action of vitreo-macular tractional forces remains valid. The disruption of these forces brings about spontaneous closure in 5-12% of macular holes in stages 2-4. Patients with macular hole stage 1 have a 50-60% change of its spontaneous closure (7). Therefore, unless they are symptomatic, we do not refer macular holes in stage 1 for

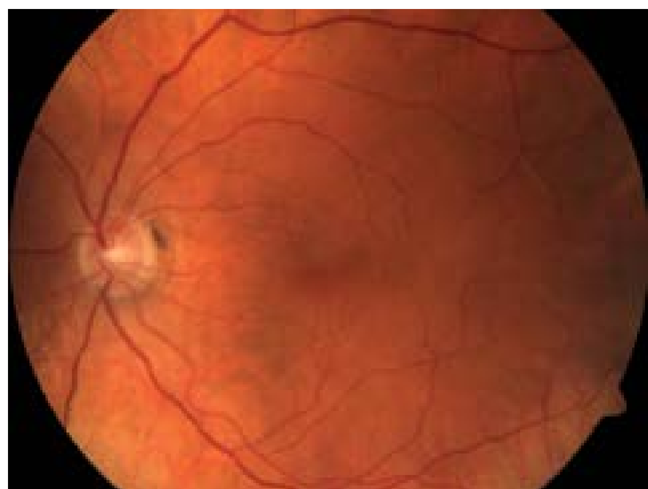

Fig. 3 Colour photograph of ocular fundus after macular hole surgery

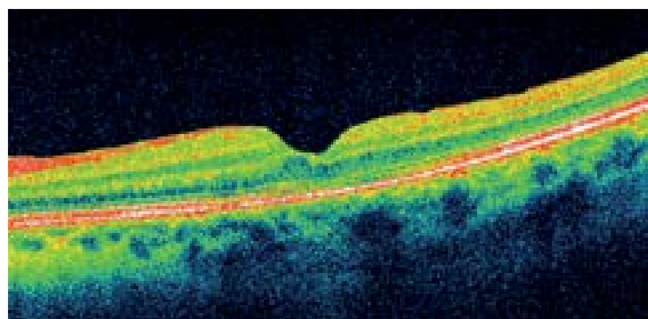

Fig. 4 OCT finding after PPV

surgery, furthermore here there is a risk of postoperative development of a full defect. In an extensive multicentric study observing the results of pars plana vitrectomy on macular holes "The Vitrectomy for Prevention of Macular Hole Study", full macular hole was generated in 37% of eyes following PPV in comparison with 4% of eyes which were randomised into a group for observation (7).

In 1991, Kelly and Wendel were the first to publish a report on the successful macular hole surgery by means of PPV with gas tamponade (27). They succeeded in closing macular hole in 58% of patients, 73% of whom also recorded improvement of BCVA by 2 or more rows of Snellen's optotypes. Since this time, this surgical approach has become the standard solution for IMH from stage 2 onwards, when the patient has a 90% chance of anatomical success of the procedure (4, 41). With the further development of vitreretinal surgery, the anatomical and functional success of this operation continued to increase (3, 35, 40). The surgical procedure differs slightly in individual workplaces according to the experiences of the surgeon, customs and possibilities of the workplace.

At our clinic we use exclusively 25-gauge or 23-gauge nonsuturing techniques for macular hole operations. In comparison with standard 20-gauge pars plana vitrectomy they are at minimum equally as safe, and do not bring patients a greater risk of complications (21, 34, 38). On the contrary, they shorten the time of convalescence, increase postoperative comfort for patients (49) and another considerable advantage is shortening of the operating time, which is an advantage also with regard to the use of local anaesthesia.

ILM peeling has become a standard component of macular hole surgery. The majority of authors confirm the significance of ILM peeling for closure of macular hole (3, 6, 12, 28, 29, 44). Kwok et al. (32) recorded anatomical success of the operation in 89% of patients with macular hole stage 3 and 4, on whom ILM peeling was performed, as against 59% of patients without the performance of peeling. Removal of the ILM increases not only the chance of an anatomical effect of the procedure, but also improves the resulting functional effect (1, 19, 32). In our cohort ILM peeling was performed on all patients, with anatomical success in 92.5% of cases.

Because the ILM is thin and transparent, for safe, quick and complete removal it is suitable to use special colourings to ensure its visualisations. Amongst the most widely used colouring are indocyanine green (ICG), trypan blue (TB) and brilliant blue (BB). The longest used is ICG, which however has been linked with numerous toxic effects such as blind spots in the visual field, damage to cells of the retinal pigment epithelium or ganglion cells (10, 14, 46, 47, 50). Trypan blue has a high affinity primarily to the epiretinal membrane (39). Toxic effects on the cells of the retinal pigment epithelium have been recorded also upon its use, although less often than in the case of ICG (33, 37). However, if it is used in lower concentrations, no toxic effects have been observed (5, 15). At our workplace we use brilliant blue, which selectively stains the ILM (9, 20, 40). No side effects or toxicity have been recorded with this colouring, in high concentrati-

ons on animal models only formation of vacuoles in the cells of the inner layers of the retina, but not their apoptosis was recorded (8, 20). Furthermore, brilliant blue is used easily, before its application it is not necessary to perform replacement of the sterile solution with air.

Intraocular tamponade and postoperative positioning are of fundamental significance for closure of macular hole. The most frequently selected tamponade is expansive gas (3, 4, 11, 19, 27, 28, 29). Works also appear which demonstrate a sufficient effect only of air tamponade (17, 48). An advantage of air tamponade is a lower cataractogenic effect and shorter time of tamponade, which increases patients' postoperative comfort. The need for duration of the tamponade and therefore positioning, which is usually very demanding and unpleasant for the patient, remains unclear. We most often encounter a recommendation for a prone position of the head, for a period of 3-14 days (3, 11, 28, 29, 40). Studies have also been published in which patients were instructed to hold the head only in a reading position postoperatively for 3-5 days, with similar surgical successes (11, 22, 36). Before the actual instillation of gas, complete drainage of the fluid and dehydration of the vitreous cavity is usually recommended. On the other hand, some authors state that one of the possible causes of surgical failure is the obstruction of macular hole by residues of vitreous fibres which float on the surface of the infusion solution. After its drainage the fibres then become caught in the macular hole and become an obstacle to the migration of the glial cells necessary for its closure (42). As a result, in agreement with these authors, we leave a small amount of fluid in the eye and upon change of head position into a prone position, the fluid with residues of vitreous fibres drains into the area of the anterior segment of the eye.

CONCLUSION

Pars plana vitrectomy with ILM peeling stained by brilliant blue and gas tamponade is an effective and safe method of treating idiopathic macular hole with a high probability of anatomical and functional success. Non-suturing techniques then bring a further benefit in the form of shortening the surgical procedure, faster convalescence and greater postoperative comfort.

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