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Cool phaco in combined phacoemulsification and vitrectomy surgery

Zimna fakoemulsyfikacja w operacjach łączonych fakoemulsyfikacji oraz witrektomii

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Summary: Purpose: The aim of this paper is to present the use of bimanual phacoemulsification technique in combined phacoemulsification and vitrectomy surgery.
Material and methods: Combined phacoemulsification and vitrectomy procedure was performed in 20 eyes. Phacoemulsification was performed through two paracenteses. Soft acrylic intraocular lenses were implanted into the capsular bag through a paracentesis 1.8 mm wide. Standard three-port pars plana vitrectomy followed. Indications for vitrectomy were diabetic retinopathy, retina detachment, uveitis, macula hole. All surgeries were performed as one-day surgeries. Follow-up lasted six months.
Results: Visual acuity improved in 19/20 eyes (95%). The achieved functional results were similar to that achieved in standard phacoemulsification combined with vitreoretinal surgery. Surgery time did not differ significantly from time needed to perform a standard procedure. The bimanual technique allowed the stablization of the anterior chamber during vitreoretinal surgery. No serious postoperative complications occurred.
Conclusions: The presented method improves the quality of combined surgery, ensures stability of the anterior chamber, reduces postoperative astigmatism, lowers the risk of inflammation.

Słowa kluczowe: zimna fakoemulsyfikacja, operacje łączone fakoemulsyfikacji i witrektomii fakoemulsyfikacja przez małe nacięcie.
Key words: small incision phacoemulsification, combined phaco and vitrectomy surgery, cool phaco.

Purpose

Modern cataract surgery is developing towards minimizing the incision length and thus minimizing intraoperative trauma and reducing postoperative complications. The first method that enabled cataract extraction through an incision of less than 2.00 mm was Erbium: YAG laser or Nd: YAG phacoemulsification. Until recently the method was not widely adopted. The majority of surgeons use ultrasound phacoemulsification. Ultrasound technology has also undergone many modifications. Ultrasound applied in pulses allows cooling of the tip of the phacoemulsificator. This modification enabled removal of the infusion sleeve and thus the performance of ultrasound phacoemulsification through an incision smaller than 2.00 mm without causing wound burn. Another complication connected with bimanual phacoemulsification was destabilization of the anterior chamber, but this can be resolved with increased pressure in the infusion line or thin walled tubing in the irrigating chopper.

This method was completed with the introduction of foldable intraocular lenses, which fit into a 2.00 mm incision.

Simultaneous phacoemulsification and vitreoretinal surgery became a popularly used method in the last decade (2,7,12). It has become the method of choice, not only because one surgery, rather than two separate surgeries, is always less invasive for the patient and cheaper for the insurance company, but also because combined phacoemulsification and vitrectomy surgery enables more precise surgery performance than any other peripheral (vitreous base) vitrectomy. As it is proven that cataract develops more often in patients after vitreoretinal surgery, lens extraction even without advanced cataracteous changes protects the patient against future cataract surgery. It is also important because cataracteous lens extraction after vitrectomy can be technically difficult and the complication rate of such a surgery is increased.

The purpose of this paper is to present our preliminary results of cool phacoemulsification in combined cataract and vitreoretinal surgery. To our knowledge this is the first paper describing sleeveless phacoemulsification in combined surgery.

Patients and Methods

20 patients (12 women, 8 men) with coexisting cataract and vitreoretinal pathology were consecutively recruited into the study.

Inclusion criteria were the need for surgical intervention in the presence of complicated proliferative diabetic retinopathy in 14 eyes, retinal detachment complicated through proliferative retinopathy in 3 eyes, uveitis in 2 eyes and macular hole in 1 eye. All cases were combined with clinically significant cataract.

At the preoperative visit the best corrected visual acuity was measured, tonometry, slitlamp examination, and opththalmoscopy were performed.

The surgical method consisted of bimanual phacoemulsification through two paracentheses of 1,7 mm (19 gauge) each

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followed by vitreoretinal surgery performed by the same surgeon in all 20 eyes. The surgical technique was similar to that described by Tsuneoka et al. (14). Local anesthesia was used in all cases. At the beginning of the surgery two paracentheses were made with a 17,1 mm (19 gauge) microvitreoretinal keratome. The anterior chamber was then filled with viscolastic substance and continuous curvilinear capsulorhexis was created with a bent needle through one of the paracentheses. This was followed by hydrodissection and hydrodelineation. Then bimanual cataract phacoemulsification was performed. A sleeveless phacoemulsification probe was inserted though one paracenthesis, and an irrigation chopper with infusion was inserted through the second one. All surgeries were performed with the OS 3 machine produced by Oertli. The parameters used: ultrasound power: 40%. Maximum aspiration pressure: 250 mmHg. Flow rate: 18–24 ml/min. Length of ultrasound pulse: 12 ms (Pulse rate 8/sek, US-pulse–ratio 10%).

After successful phacoemulsification of the nucleus, bimanual aspiration of residual cortex was performed. Subsequently the anterior chamber was filled with viscoelastic substance and a foldable soft acrylic lens ("Acri-Smart" by Acritec) with an optic diameter of 5.50 mm was injected. The injector was pressed against the incision, but was not introduced into the anterior chamber. Just before loading of the soft acrylic lens, the microincision was enlarged to 1.80 mm. The anterior chamber was finally hydrated.

The next step was three-port pars plana vitrectomy. Either flat contact lenses or BIOM were used as the visualization system. Sclerotomies were placed 3.00 mm posterior to the limbus. Peripheric vitrectomy was performed in all cases except the patient with macular hole. In this case peripheric vitreous body was removed with the aim of producing enough space for gas bubble but vitreous base was not removed in this case.

In a 9 year old patient with a giant retinal tear/retinal detachment, additional circumferential scleral buckling was performed. In $^{2}/_{3}$ eyes with retinal detachment circular 360° retinotomy with retinectomy was performed. Silicone oil was applied to 14 eyes, gas in 1 eye and no internal tamponade in 5 eyes. In one case of severe diabetic retinopaty, in a patient with end stage renal disease treated with hemodialysis, iris retractors were used because his pupil was 2 mm wide and did not respond to midriatica. This eye was treated with miotica for glaucoma.

The mean duration of the surgeries was compared with those of conventional phacoemulsification combined with vitreoretinal surgery. The total time of ultrasound use was counted for each patient.

All surgeries were performed as one-day surgeries. Follow-up lasted 6 months. All patients were monitored one day after surgery, then after one week, one month, three, and six months after surgery.

Results

The mean age was 56 years (range 9 to 71 years). Preoperative visual acuity was light perception in 6 eyes, hand movement in 13 eyes, and 0.1 in one eye. Mean grade of nuclear sclerosis 3. The mean duration of the surgery was 50-75 min., which does not seem to be different from combined conventional phacoemulsification and vitreoretinal surgery. Mean time of ultrasound use was 3.6 sec (0.5-9.3 sec). No serious complications appeared while the surgery was performed. In all cases the lens was implanted into the capsular bag. No lens dislocation and no iris capture syndrome was observed, the anterior chamber was deep through the whole time of the surgery. No leakage of silicone oil to anterior chamber was observed. Wound burn did not occur.

Visual acuity improvement was observed in 19/20 eyes (95%). Useful visual acuity 0.02-0.3 was achieved in 14/20 eyes (70%). The visual acuity ranged from hand-movements to counting fingers in 5/20 eyes (25%). One patient with proliferative diabetic retinopathy complicated with complete retinal detachment had 360° retinotomy and retinectomy performed, visual acuity remained at light perception although retinal reattachement was succesful.

Intraocular pressure increased during the first 24 hours after surgery in 5 eyes, but was normalised after topical medication application. In one patient, on whom phacoemulsification with intraocular lens implantation, vitrectomy and circumferential scleral buckling were performed, exudation to the anterior chamber was observed in the first postoperative days, which disappeared after topical antibiotics, steroids and midriatica were applied. Final visual acuity was in this case 0.3.

Hypotony (IOP$<$10mmHg) was observed in 2 eyes.

Discussion

In our material final visual acuity better than 0.02 was achieved in 70% of eyes. The results seem to be similar to our earlier results and to the results achieved by other authors describing the combined surgery of standard phacoemulsification and vitrectomy (7, 9,10,12).

Combined surgery has changed over recent years as have trends in modern cataract surgery. Combined cataract and vitrectomy surgery was described for the first time by Kokame et al. and Blankenship et al. in 1989 (6). They extracted the lens through pars plana and without anterior capsule removal and thereby enabled intraocular lens implantation to the sulcus ciliaris. This method ensured a stable anterior chamber and it was able to be performed even without red reflex from the posterior pole. This method was not performed by other surgeons possibly because of nonphisiologic lens location and the possibility of iris irritation and sulcus ciliaris injury. The majority of papers no longer describe this method although MacCumber et al. did recently report the results of this method in 15 eyes with rhegmatogenous retinal detachment and proliferative vitreoretinopathy. The next step was the combining of extracapsular cataract extraction with vitreoretinal surgery (3). Neither surgical technique was performed often and only a small number of patients were presented.

It wasn't until the end of the 1990's that combined phacoemulsification – vitrectomy surgery became a widely used technique. It became so, due to improvements in cataract and vitreoretinal surgery which had reduced the surgical trauma. Despite this, inflammation is a commonly occuring complication following these surgeries (13). In our earlier material we have shown that the occurrence rate of this complication depends both on the severity of the posterior segment eye disease and on the type of intraocular lens (11). Different amounts of fibrin formation were observed in 24.2% of eyes with PMMA intraocular lens implan-

tation compared to 8.7% in eyes with acrylic foldable intraocular lens implantation. Similar observations were presented by Heiligenhaus et al. (4), who showed that eyes with smaller clear corneal incisions and foldable acrylic IOL's had less postoperative inflammation and posterior capsule opacification. It should also be emphasised not only that incision size may play a role but also that the diminished overall ultrasound use time may be also a factor in reducing the inflammation rate in these cases. In our group of patients, fibrin formation appeared only in one eye (5%). In this case, additionally to phacoemulsifiction and vitrectomy, scleral buckling was performed, and the surgical trauma was much greater than in the rest of the group. Results presented in this paper allow us to suggest that minimizing surgical trauma during sleeveless phacoemulsification may be a factor in reducing the postoperative inflammation. Weindler et al. (15) observed a similar rate of fibrin formation in eyes with hydrophilic Acrylic and hydrophobic Acrylic foldable intraocular lenses. This information is important for our paper because the "Acri-Smart" lenses that we used are produced from a material which is a combination of hydrophobic and hydrophyllic acrylic material.

Mueller et al. also presents different factors which can play a role in postoperative inflammation reaction (8). They found that different surgeons had different amounts of postoperative inflammation. Also the severity of eye diseases and the amount of laser or Cryo–coagulation had an influence on the inflammation rate after combined surgery. This is similar to our earlier observations which showed more frequent fibrin formation in cases with more severe posterior segment eye disease (11). Our material contains similarities to our earlier study and to data from literature on the majority of severe cases of proliferative diabetic retinopathy, proliferative vitreoretinopathy and uveitis. Even where these difficulties were present a low amount of inflammation was observed. This can be another argument for ultrasmall phacoemulsification vitrectomy surgery.

Other authors propose performing separate cataract extraction and vitreoretinal surgery in diseases that are predisposed to postoperative inflammation and fibrin formation such as f.ex. diabetes (13). But 13/20 (65%) of our patients had severe diabetic retinopathy and none of them developed inflammation during the postoperative control period, which is, once again, a proof for the thesis that combined bimanual phacoemulsification and vitreoretinal surgery reduces the inflammation risk in comparison to standard phacoemulsification and vitreoretinal surgery.

Different authors dissuade us from using silicone IOL's because of firm adhesion of silicone oil (1) and the condensation effect on silicone oil (5), they propose using acrylic and PMMA lenses. However a recently published paper states that, contrary to this belief, the use of PMMA lenses is associated with lower inflammatory complication rates (8). This subject requires future discussion.

Another complication described after combined phacoemulsification and vitreoretinal surgery is silicone oil leakage into the anterior chamber while vitrectomy is being performed. This complication did not appear in any of our cases due to the good stability of anterior chamber. Also, in 2003 Demetriades and co. (2) presented that iris capture by intraocular lens optic was observed in 5.3% of eyes. This observation was not supported in our group of patients, possibly because of the different shape of the "Acri-Smart" lenses, however we believe the main factor is the small incision size in the anterior chamber that results in a stable and deep anterior chamber during the whole surgery. This can reduce oil leakage to the anterior chamber.

It should be discussed whether lens implantation before or after performing vitrectomy should be preffered. We agree with Heiligenhaus that implantation of the intraocular lens before vitrectomy prevents posterior capsule bulging and enables posterior capsule visualization (4). On the other hand this type of surgery is much easier to perform and allows physiologic into the bag implantation of the IOL. However, both techniques can be aplied in combined surgery. Intraocular lens implantation after vitrectomy may be used more frequently with bimanual vitreoretinal surgery with OFFISS. This new illumination/ observation system allows the best visualization of the posterior eye segment in an aphakic eye.

There is no significant difference in surgery time when compared to standard phacoemulsification and vitreoretinal surgery.

In conclusion we would like to state that bimanual phacoemmulsification through a 1.8 mm paracenthesis can be succesfully combined with vitreoretinal surgery. It can be an important developmental factor in the evolution of ophthalmic surgical techniques in the treatment of vitreoretinal diseases complicated through cataract formation whilst helping towards the prevention of cataract formation after vitrectomy especially in younger patients.

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