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Phacoemulsification with Malyugin ring in an eye with persistent pupillary membrane – case report

Fakoemulsyfikacja z użyciem pierścienia Malyugina w oku z przetrwałą błoną źreniczną – opis przypadku

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Summary: During fetal development the lens receives nourishment through a vascular net called "tunica vasculosa lentis" which forms the pupillary membrane on its anterior surface and may cause iris deformation.
Nowadays, even more attention is paid to the safety of surgical procedures. Phacoemulsification in eyes with a narrow pupil, which doesn't respond to standard mydriatic agents applied preoperatively, is a challenge for any ophthalmic surgeon. Recently, a new device for intraoperative pupillary stretching has been described – the Malyugin ring. We describe a patient with persistent pupillary membrane succesfully operated for hard cataract using standard phacoemulsification with Malyugin ring. The purpose of using Malyugin ring in this case was to avoid intraoperative bleeding caused by cutting blood vessels that might have been present within the pupillary membrane, to secure a wide and stable pupil, to avoid accidental aspiration of the membrane, to postpone the moment of cutting the membrane until the end of the procedure and in this way to increase overall safety of the procedure.
The case indicates that Malyugin ring is a good tool which used intraoperatively may assist the surgeon in cataract extraction in eyes with persistent pupillary membrane of unknown blood vessel content.

Key words: iris retractors, narrow pupil, phacoemulsification, Malyugin ring, persistent pupillary membrane.

Streszczenie: Podczas życia płodowego soczewka odżywiana jest przez sieć naczyniową, zwaną błoną naczyniową soczewki (łac. *tunica vasculosa lentis*), która tworzy błonę źreniczną na jej przedniej powierzchni, ona z kolei może prowadzić do deformacji tęczówki.
Obecnie coraz większą uwagę zwraca się na bezpieczeństwo zabiegów chirurgicznych. Fakoemulsyfikacja stała się standardową, powszechnie stosowaną metodą usuwania zaćmy, zabieg ten jest jednak wyzwaniem i utrudnieniem dla chirurga okulisty, który ma do czynienia z oczami, w których źrenica jest wąska – wówczas nie reaguje ona na środki farmakologiczne służące do uzyskania przedoperacyjnej mydriazy. W ostatnim czasie wprowadzono nowe narzędzie chirurgiczne służące do rozszerzenia źrenicy – pierścień Malyugina. Przedstawiamy przypadek oka z przetrwałą błoną źreniczną, w którym skutecznie przeprowadzono fakoemulsyfikację zaćmy z zastosowaniem pierścienia Malyugina.
Cele zastosowania pierścienia Malyugina w opisywanym przypadku to: uniknięcie śródoperacyjnego krwawienia z przeciętych naczyń krwionośnych mogących występować w obrębie przetrwałej błony źrenicznej, stabilizacja źrenicy, zmniejszenie ryzyka przypadkowej aspiracji błony źrenicznej oraz odłożenie w czasie momentu przecięcia błony –na koniec zabiegu, miało to na celu zwiększenie bezpieczeństwa operacji.
Przypadek ten pokazuje, że pierścień Malyugina jest dobrym narzędziem śródoperacyjnym, które może wspomóc chirurga okulistę w przeprowadzeniu fakoemulsyfikacji w oku z przetrwałą błoną źreniczną wobec braku pewności co do istnienia unaczynienia błony źrenicznej.

Słowa kluczowe: retraktory tęczówkowe, wąska źrenica, fakoemulsyfikacja, pierścień Malyugina, przetrwała błona źreniczna.

Introduction

The persistent pupillary membrane is thought to be one of the most common congenital ocular anomalies in ophthalmic practice (1).

During fetal development the lens receives nourishment through a vascular net called "tunica vasculosa lentis" which forms the pupillary membrane on its anterior surface and may cause the deformation of the iris (2).

Phacoemulsification in eyes with a narrow pupil, which doesn't respond to standard mydriatic agents applied preoperatively, is a challenge for any ophthalmic surgeon.

Recently, a new device for intraoperative pupillary stretching has been described – the Malyugin ring (3). The ring is a flexible polypropylene expansion device designed to secure a wide and stable pupil throughout the surgery.

We describe a patient with persistent pupillary membrane succesfully operated for hard cataract using standard phacoemulsification with Malyugin ring.

Case report

An 82-year old man was admitted to the Department of Ophthalmology for a routine cataract surgery.

The initial preoperative examination revealed best corrected distance visual acuity (BCDVA) of 0.3 in the right eye. The degree of nuclear and cortical opacification was NC/NO 5 according to LOCS III scale, and there was a white plaque on the anterior surface of the lens present with attached strands of the persistent pupillary membrane spreading at 90 degrees in the nasal quadrant (Fig. 1, Fig. 2a).

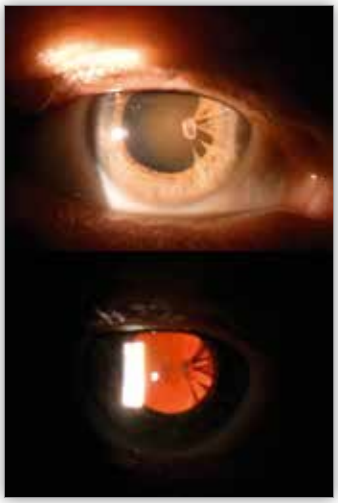

Fig. 1. Preoperative view of the right eye with persistent pupillary membrane.
Ryc. 1. Prawe oko z przetrwałą błoną źreniczną przed operacją.

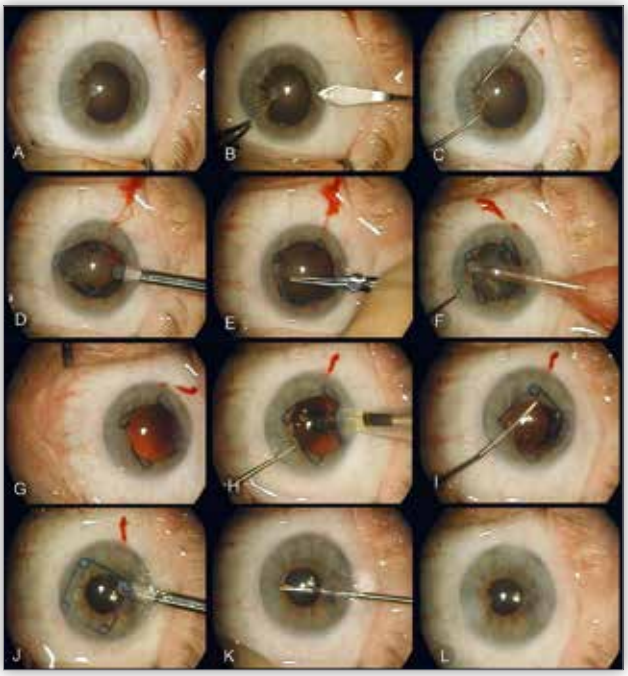

Fig. 2. Intraoperative photographs of phacoemulsification with Malyugin Ring in an eye with persistent pupillary membrane.
Ryc. 2. Fotografie śródoperacyjne fakoemulsyfikacji w oku z przetrwałą błoną źreniczną z zastosowaniem pierścienia Malyugina.

The surgery was performed under local, topical proxymetacaine hydrochloride (Alcaine) drops, Lidocaine gel 2% and intracameral (Lidocaine 1% solution) anaesthesia.

Before the surgery, the pupilwas dilated using a solution of Tropicamide and phenylephrine (NeoSynephrine), however, the pupil did not dilate well.

Two ophthalmic viscosurgical devices (OVDs) were used: Hydroxypropyl methylcellulose 2% (Celoftal, Alcon) and a mixture of chondroitine sulfate and sodium hyaluronate (DiscoVisc, Alcon). The balanced salt solution (BSS) was used as the infusion fluid.

The surgery was performed using the burst mode of phacoemulsification and "divide and conquer" technique of dividing the nucleus. The following surgical settings were used: aspiration flow was set at 25 cm^3/min and vacuum at 400 mmHg. A standard coaxial phacoemulsification was performed. First, a self-sealing 2.75 mm wide clear corneal incision was created temporally with a 2.75 mm ClearCut™ Dual Bevel (Alcon) metal slit knife (Fig. 2b). After injecting intracamerally 1% Lidocaine solution and adrenaline solution, the above-mentioned two OVDs were used in a "soft-shell" technique. Next, a hook was used in order to manually shift the strands of the persistent pupillary membrane and the plaque on the surface of the lens capsule and to separate the synechiae of the membrane from the capsule (Fig. 2c).

In the next step, the Malyugin ring was introduced to the anterior chamber with an injector and it was placed on the pupillary margin with the assistance of a single hook, thus stabilizing the pupil as well as the strands of the persistent pupillary membrane (Fig. 2d).

Continuous curvilinear capsulorrhexis was done with Utrata forceps under protection of an OVD (Fig. 2e). Two side-ports were created with a 20-gauge MVR blade in the clear cornea, about 90 degrees away from the main incision, for bimanual aspiration and irrigation tips. Phacoemulsification and aspiration were then performed (Fig. 2f) and a single-piece acrylic foldable lens (Acrysof IQ, Alcon) was implanted in the bag through the main incision using an injector (Alcon) (Fig. 2g, and 2h). The pupillary expansion device maintained a constant pupil diameter of 6.0 mm during the entire procedure.

After moving the Malyugin ring from the pupil (Fig. 2i), it was removed with the injector (Fig. 2j). In the next step, a vitreoretinal mircoscissors were used to cut off the persistent pupillary membrane with the attached plaque from the iris (Fig. 2k). After making sure that no bleeding occurred, OVD swere removed by irrigation-aspiration, the side ports were sealed with saline and Cefuroxime was injected to the anterior chamber (Fig. 2l).

The postoperative treatment included topical combination of neomycin-polymyxin B-dexamethasone (Maxitrol) eyedrops 4 times daily for 3 weeks after the surgery. The postoperative course was uneventful, and postoperative uncorrected distance visual acuity (UCDVA) was 1.0. In the postoperative examination, the pupil was round with minimally visible strands of persistent pupillary membrane nasally.

Fig. 3. Postoperative view of the right eye.
Ryc. 3. Prawe oko po operacji.

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Discussion

During the early development of the eye, the crystalline lens is nourished by the vascular net called the *tunica vasculosa lentis*, the posterior part of which originates from branches of the hyaloid artery (1, 4).

During the 4th and 5th gestational months, the *tunica vasculosa lentis* and the pupillary membrane start shrinking (involution) and breaking down (atrophy) gradually. By the 8th gestational month, the pupillary membrane will have been atrophic with the minor circle of the iris being the derivative from the vessels of the pupillary membrane (1, 2). If the reabsorption of the anterior part of the *tunica vasculosa lentis* during fetal development fails, the condition known as persistent pupillary membrane develops, which may cause the deformation of the iris (1, 2).

The reabsorption failure of the *tunica vasculosa lentis* may be complete or incomplete. The persistent pupillary membrane may extend from the minor circle of the iris to either the anterior surface of the lens or to the posterior surface of the cornea. Such persistent tissue may manifest as delicate white strands or threads traversing across the pupil. In some cases more prominent residua are present, which may even occlude the pupil and lead to amblyopia (5). Persistent pupillary membrane may be associated with other ocular conditions, such as: high myopia, lens coloboma, anterior polar cataract, goniodysgenesis and corneal anomalies: microcornea, cornea plana, and posterior keratoconus (6–8). Nevertheless, this condition is usually asymptomatic and is noticed incidentally at the slit-lamp examination (1).

Such lesions have been successfully photodisrupted with the YAG laser or excised surgically (9–12). Nevertheless, it should be remembered that sometimes shunt vessels originating from the pupillary membrane may communicate with remnants of the posterior tunica vasculosa lentis (4). It has even been reported that persistent strand of vascularised pupillary membrane may be a source of a spontaneous hyphaema (13, 14).

The development of surgical techniques in modern cataract surgery has reduced surgical trauma. During phacoemulsification it is necessary to have an adequate intraoperative transpupillary access to the lens. In patients who do not respond to pharmacological mydriatic agents, mechanical techniques of stretching the pupil are used.

The intraoperative pupillary expansion may be achieved in many ways, such as: manual stretching the pupil with two hooks, using iris retractors or specially designed devices, like Malyugin ring (3, 15). Some of these methods require additional corneal incisions and pose the additional risk (16).

Recently, a new device for intraoperative pupillary stretching has been described – the Malyugin ring (MicroSurgical Technology, USA) (3). The ring is a flexible 5–0 polypropylene expansion device designed to be a surgical tool for intraoperative use in order to maintain a wide and stable pupil during the surgery. The device does not require creating additional incisions, its application is easy, as it is shipped in an injector. The ring delicately wraps around the pupillary margin and stretches the pupil to the diameter of 6.0 mm, thus ensuring adequate space for phacoemulsification. The fact that the ring is a single-piece device, helps to balance the forces exerted to the pupillary margin.

It was reported to have been used in eyes with a narrow pupil which doesn't respond to mydriatic agents, as well as in cases of intraoperative floppy iris syndrome (IFIS) in order to stabilize the pupil (17). In the presented case, the ring was used for both indications and it helped avoid aspirating strands of the persistent pupillary membrane by the phaco tip.

It was also possible to cut the strands of the pupillary membrane at the beginning of the surgery; however, cutting a persistent strand of vascularised pupillary membrane might cause a hyphaema.

If the hyphaema happened repeatedly during the surgery, it could make the procedure difficult to perform and would increase the risk of other complications. Moreover, loose strands of the membrane could be easily aspirated by the phaco tip.

In contrast, stabilizing the pupillary membrane with the Malyugin ring and cutting it off at the end of the procedure helped maintain a clean anterior chamber and decreased the risk of aspirating the iris.

In summary, the purpose of using Malyugin ring in this case was to avoid intraoperative bleeding from cutting blood vessels that may be present within the pupillary membrane, to secure a wide and stable pupil, to avoid accidental aspiration of the membrane, to postpone the moment of cutting the membrane until the end of the procedure and, as a result, to increase the overall safety of the surgery. If the procedure had been performed without the Malyugin ring; the risk of intraoperative complications (especially bleeding) would have been higher, yet the procedure would have been possible.

The presented case indicates that Malyugin ring may be a good tool which used intraoperatively may assist the surgeon in cataract extraction in eyes with persistent pupillary membrane.

To the best of our knowledge, this is the first reported case of using the Malyugin ring during phacoemulsification in an eye with persistent pupillary membrane.

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