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Viscostaining in Cataract Surgery

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ABSTRACT

Purpose: *To evaluate the effectiveness of a new combined ophthalmic viscosurgical device (OVD) in patients undergoing phacoemulsification.*

Design: *Consecutive case series study.*

Material and Methods: *This is a case series study of five eyes of five patients who underwent cataract surgery with a new combined OVD (2% hydroxypropyl methylcellulose - HPMC - mixed with 0.012% trypan blue). Data regarding clinical history, age, gender and best-corrected visual acuity (BCVA) were analyzed. All patients underwent a complete ophthalmologic examination. During the phacoemulsification the effectiveness of the viscostaining was analyzed at the time of the capsulorhexis. Postoperatively, parameters such as corneal edema and intraocular inflammatory reaction were evaluated.*

Results: *Three women and two men were included. The mean age of the patients was 69.6 ± 1.6 years (68 to 72 years). The mean preoperative LogMAR BCVA was 0.5 ± 0.14 (0.7 to 0.3). During the phacoemulsification there were no cases of "lost" capsulorhexis. Postoperatively, there were no patients with persistent corneal edema or with abnormal intraocular inflammatory reaction. The mean postoperative BCVA was 0.0 LogMAR units (Snellen equivalent - 20/20) in all cases.*

Conclusions: *Effectiveness of the viscostaining with this new OVD was satisfactory at the time of the capsulorhexis. HPMC mixed with trypan blue gives the impression of being safe during and after the phacoemulsification.*

Keywords

Hydroxypropyl methylcellulose, Ophthalmic viscosurgical device, Trypan blue, Viscoelastic substance.

Introduction

Ophthalmic viscosurgical devices (OVDs) formerly called viscoelastic substances or viscoelastic agents have been used in a wide spectrum of ocular surgical procedures and have played an essential role in cataract surgery. They have many functions in phacoemulsification, among them, protect corneal endothelium, deepen the anterior chamber, push away the ocular tissues, facilitate surgical maneuvers, perform ocular mydriasis and create space for intraocular lens implantation.

Depending on the physical and rheological properties, the OVDs can be didactically classified into dispersive and cohesive. This subdivision has undergone changes over the years and the rheologic properties of OVDs have a direct impact on the clinical characteristics of a substance and they are essential for choosing a particular material in cataract surgery [1-3]. There are three categories of substances that are normally used during the phacoemulsification: hydroxypropyl methylcellulose (HPMC), sodium hyaluronate and chondroitin sulfate. In Brazil, the most commonly OVD used in cataract surgery is the HPMC, at least in hospitals where there are medical residency programs.

Before starting the capsulorhexis, many surgeons fill the anterior chamber with a dye that allows a better visualization of the anterior

capsule of crystalline lens. Staining of ocular tissues by using ophthalmic dyes makes visual distinction and surgical maneuvers easier. There are several dyes that can be used in cataract surgery and the most common in Brazil is the trypan blue. In a general way, it is necessary to use a dye prior to filling the anterior chamber with OVDs and because they are separate substances, it is mandatory to perform two different surgical steps during the phacoemulsification. Alternatively, a technique developed in 2001 proposed the mixture of trypan blue (0.4%) with sodium hyaluronate (1%) in order to decrease the toxic potential of this dye with the corneal endothelium [4]. This technique was called "viscostaining of the anterior lens capsule". There are very few articles published in the literature and none in Brazil about viscostaining.

The purpose of this study is to evaluate the effectiveness of a new combined OVD (2% HPMC with 0.012% trypan blue) in patients undergoing phacoemulsification.

Methods

Subjects

This consecutive case series study was conducted at Hilton Rocha Foundation (FHR), Brazil, in March, 2018. The participants were informed about the nature of the study and signed informed consent forms, based on the Declaration of Helsinki, with the aim of obtaining permission to collect data.

Five eyes of five patients were evaluated at Cornea and Cataract Surgery Section in FHR. Data regarding clinical history, age, gender, affected eye and symptoms were analyzed. All patients underwent a complete ophthalmologic examination, including measurement of the best-corrected visual acuity (BCVA), applanation tonometry, biomicroscopy and indirect ophthalmoscopy. Preoperatively, the power of the intraocular lens (IOL) was calculated by Lenstar® LS 900 (Haag-Streit AG, Koeniz, Switzerland) and nucleus density was graded as follows: 1+/4+ (soft), 2+/4+ (medium), 3+/4+ (hard) and 4+/4+ (very hard). Postoperative follow-up was performed on the first, seventh and thirtieth days.

Surgical Procedure

After peribulbar anesthetic block, standard phacoemulsification was performed by the same surgeon (J.R.H). A 2.4 mm clear corneal incision was created with a keratome. After this step the anterior chamber was filled with a mixture of 0.012% trypan blue and 2% HPMC. This "combined OVD" (figure 1. A) was developed, purified and sterilized by one of the authors [(A.P.M.) - Leedsay Medical Products, São Paulo, Brazil)]. This solution was left in the anterior chamber for approximately 10-15 seconds and the quality of anterior lens capsule staining was analyzed at the time of the continuous curvilinear capsulorhexis. After phacoemulsification and aspiration of the residual cortical matter, posterior foldable IOL was implanted. Postoperatively, all patients were instructed to start a combination of steroid and antibiotic eye drops (Vigadexa®, Alcon, Fort Worth, E.U.A.) for 2 weeks. Some parameters were analyzed during the postoperative period, including corneal edema and intraocular inflammatory reaction.

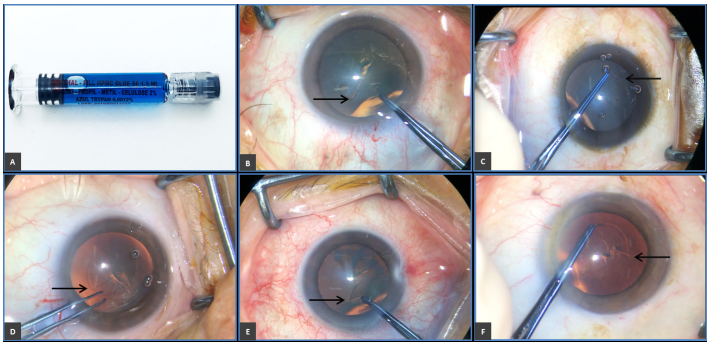

Figure 1: (A) Ophthalmic viscosurgical device with 2% hydroxypropyl methylcellulose (HPMC) and 0.012% trypan blue. (B – F) Intraoperative photos at the time of the capsulorhexis. Black arrows show the edge of the anterior capsule flap.

Results

A total of five eyes of five patients (3 females and 2 males) were studied. The mean age of the patients was 69.6 ± 1.6 years (range from 68 to 72 years). Regarding classification of the cataracts, three eyes were diagnosed with a cataract grade 2+/4+ (medium cataracts) and two eyes had a grade 3+/4+ (hard cataracts). The mean preoperative LogMAR BCVA was 0.5 ± 0.14 (range from 0.7 to 0.3). All surgeries were performed successfully completed without any complications, ie, no case of posterior capsule rupture and no radial tear of the capsulorhexis. The quality of the intraoperative visualization of the anterior lens capsule was good enough to allow an ideal capsulotomy. Intraoperative photographs were taken at the time of the capsulorhexis under the combination of 2% HPMC with 0.012% trypan blue (figure 1. B - F). After phacoemulsification all IOLs were implanted in the capsular bag. Postoperatively, there were no cases of corneal edema or non-normal intraocular inflammatory reaction. The mean postoperative BCVA was 0.0 logMAR units (Snellen equivalent, 20/20) in all cases.

Discussion

Effectiveness of anterior lens capsule staining depends on a number of factors, among which can be included the type of cataract, dye concentration and the time that dye remains in the anterior chamber. Capsule staining aims to assist novice surgeons in the accomplishment of the capsulorhexis, ensure a better visualization of the edges of the anterior lens capsule and allow safer intraoperative maneuvers, among others.

Conventionally for the performance of the capsulorhexis, at least three surgical steps are necessary: fill the anterior chamber with some dye, remove the dye and refill the anterior chamber with some OVD. It is important to note that there are several variations of the surgical steps preceding the performance of the capsulorhexis, mainly due to the endothelial toxicity caused by dyes in cataract surgery. These variations may include use of air bubble under the corneal endothelium [5] or a dye under the ophthalmic viscosurgical device as described in sotf-shell [6] and visco-shell [7] staining techniques, painting technique [8] and others. These techniques had significant relevance, however, they require several steps prior

to the accomplishment of the capsulorhexis and none of them used a combined substance made by mixing the OVD with a dye in a single solution. As stated above, only a limited number of reports have been published regarding the viscostaining (combined or mixed OVDs with dyes) in cataract surgery [4]. To our knowledge, this is the first study of Brazil related to this issue.

The current study evaluated the effectiveness of the HPMC mixed with trypan blue in a single solution in patients undergoing phacoemulsification. Unlike the study by Kayikiçioglu and colleagues [4], the OVD used in this case series study was HPMC in contrast to the aforementioned study in which sodium hyaluronate was utilized as viscoelastic substance. Moreover, in the present study, it was not necessary to fill the anterior chamber with air bubble. According to some authors [9], the use of trypan blue may be toxic to the corneal endothelium, depending on its concentration. In the present study, the combination of HPMC and trypan blue (at a concentration of 0.012%) did not cause any apparent deleterious effect on the corneal endothelium during the surgical procedure or in the postoperative period. Even without specular microscopy to prove the action of these mixed substances, we believe the combined solution (OVD with trypan blue) must be less aggressive to the corneal endothelium than pure trypan blue in the same concentrations. Particularly, in the perioperative and postoperative periods there were no cases of decreased transparency or corneal edema.

In our experience, the advantages obtained from the use of mixed substances during phacoemulsification are the simultaneous filling and staining in a single surgical step prior to the completion of capsulorhexis, making the cataract surgery faster. Another benefit is that both trypan blue and HPMC are low-cost substances. On the other hand, the bluish coloration of this mixture reduced the red reflex of the retina and, consequently, decreased the contrast of the ocular tissues. However, it is important to emphasize that there were no cases of "lost" capsulorhexis and the capsular staining was suitable in all patients. Concerning the safety of the combined substances there was no case of abnormal inflammatory reaction and TASS up to the 30th postoperative day. The limitations of the current study include absence of a control group, small sample size, non-randomized design and short follow-up. Randomized and controlled studies with larger sample size are needed to confirm our results.

Conclusion

Viscostaining of the anterior lens capsule with the association of 2% HPMC and 0.012% trypan blue was satisfactory and the association of these substances ensures filling of the anterior chamber and capsular staining simultaneously in a single surgical step. HPMC mixed with trypan blue gives the impression of being safe during and after the phacoemulsification.

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