Topical anesthesia versus topical anesthesia plus sedation in cataract surgery

Anestesia tópica versus anestesia tópica más sedación en cirugía de catarata

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Abstract

Introduction: The use of topical anesthesia in cataract surgery is increasingly frequent due to the advantages it represents compared to other types of anesthesia. In this study, we aimed to evaluate the usage of topical anesthesia alone and topical anesthesia plus sedation in patients undergoing cataract surgery in an objective manner with the assessment of vital signs during the surgical procedure. **Methods:** Retrospective, cross-sectional and observational study. We evaluated a total of 214 patients undergoing cataract surgery in which the type of anesthesia was determined (topical and topical plus sedation), correlating with the vital signs (blood pressure, heart rate, respiratory rate) obtained during the surgical procedure. The behavior of vital signs between groups was evaluated with the Mann Whitney U-test. **Results:** Average age of 69.59 years ($\pm$ 12.010). Of the total patients, 79 were men (36.9%) and 135 women (63.1%); 51 (23.8%) were operated with topical anesthesia and 163 (76.2%) with topical anesthesia plus sedation. No differences were found in the behavior of vital signs between both groups ($p > 0.05$). **Conclusion:** Topical anesthesia and topical anesthesia plus sedation are considered safe in phacoemulsification surgery.

Keywords: Cataract surgery. Phacoemulsification. Topical anesthesia. Sedation. Vital signs. Advantages.

Resumen

Introducción: El uso de anestesia tópica en cirugía de catarata es cada vez más frecuente debido a las ventajas que representa con respecto a otros tipos de anestesia. En este estudio decidimos evaluar el uso de anestesia tópica sola y anestesia tópica más sedación en pacientes sometidos a cirugía de catarata de manera objetiva con la valoración de los signos vitales durante el procedimiento quirúrgico. **Métodos:** Estudio retrospectivo, transversal y observacional. Evaluamos un total de 214 pacientes sometidos a cirugía de catarata en los que se determinó el tipo de anestesia, (tópica y tópica más sedación), correlacionándose con los signos vitales (tensión arterial, frecuencia cardíaca, frecuencia respiratoria) obtenidos durante el procedimiento quirúrgico. Se evaluó el comportamiento de los signos vitales entre grupos con la prueba de U de Mann Whitney. **Resultados:** Edad promedio de 69.59 años ($\pm$ 12.010). Del total de pacientes, 79 eran hombres (36.9%) y 135 mujeres (63.1%); 51 (23.8%) fueron operados con anestesia tópica y 163 (76.2%) con anestesia tópica más sedación. No se encontraron diferencias en el comportamiento de los signos vitales entre ambos grupos ($p > 0.05$). **Conclusión:** La

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Date of reception: 04-01-2017

Date of acceptance: 22-11-2017

DOI: 10.24875/RMOE.M18000003

Available online: 07-05-2018

Rev Mex Oftalmol (Eng). 2018;92(2):56-61

www.rmo.com.mx

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anestesia tópica y la anestesia tópica más sedación se consideran seguras en la cirugía de catarata por medio de facoemulsificación.

Palabras clave: Ambliopía. Estrabismo. Discapacidad visual. Salud pública. Ceguera.

Introduction

The application of topical anesthesia dates back to 1884, when Knapp used 5% cocaine in cataract extraction¹. It was proposed for the first time by Fichman as an alternative to local anesthesia with injections². In 1993, Kershner introduced topical anesthesia in small incision phacoemulsification¹. In 2000, 49% of the members of the American Society of Cataract and Refractive Surgery in the USA preferred topical anesthesia, and of these, 82% preferred topical anesthesia plus injection of intracameral lidocaine³. From 1998 to 2003, there was a significant decline in procedures using retrobulbar anesthesia and an increase in procedures with topical anesthesia in the USA and in the UK⁴.

The advantages of topical anesthesia include rapid onset of action, avoidance of postoperative complications related to peri or retrobulbar anesthesia such as diplopia, ptosis, periocular ecchymosis, subconjunctival hemorrhage, optic nerve injury, ocular perforation, retrobulbar hemorrhage, intravascular injection of the anesthetic, retinal detachment and postoperative akinesia. Even one case of visual loss and incomplete paralysis of the third cranial nerve has been reported after peribulbar anesthesia.⁵ Topical anesthesia does not produce pressure in the vitreous and does not affect the blood flow of the optic nerve. Postoperative recovery is faster and less painful. Improvement in visual function and contrast sensitivity was achieved 4 hours after surgery using topical anesthesia, which has also been associated with greater color perception in the early postoperative stages^{2,6,7}. Due to advances in phacoemulsification techniques, it is not essential to have total akinesia of the eye, which has caused topical anesthesia to become popular³.

The most common agents used for topical anesthesia are proparacaine, tetracaine, lidocaine, bupivacaine and ropivacaine⁸. Proparacaine can be used safely in patients allergic to other ester-type anesthetic agents⁴. Ropivacaine has an efficacy similar to lidocaine, although it requires a longer time to be effective and provides longer duration in terms of the postoperative analgesic effect⁹. Another agent, benoxinate, although rapidly inactivated in corneal tissue and anterior chamber, provides good

superficial anesthesia¹⁰. Lidocaine gel is well tolerated by the cornea and very effective when applied to mucous membranes, and provides an effect similar to 0.5% tetracaine for topical anesthesia in cataract surgery¹¹. A comparative clinical study suggests that lidocaine gel is a better agent than bupivacaine or benoxinate drops. Studies have indicated that preservative-free intracameral 1% lidocaine is well tolerated by the corneal endothelium; however, high concentrations are toxic. Levobupivacaine, articaine and 2-chloroprocaine have recently been developed⁴.

In 2002, Álvarez-Marín et al. successfully reported pain control during phacoemulsification using an intraocular solution at 4 °C (cryoanalgesia). Torres-Moreno reported that the use of topical anesthesia combined with intraocular irrigation with a cold solution during phacoemulsification was associated with better patient comfort compared to topical anesthesia and solutions at room temperature¹².

In North America, intravenous sedation is widely used, unlike in northern Europe, where it is increasingly used less. The Royal College of Anesthesiologists of London does not recommend the use of sedation and suggests that it should only be used in certain cases, not in inappropriate blocks⁴. Andrew, et al. found that the main reason for anesthesiologist's intervention due to the need of sedation were patients with systemic arterial hypertension, followed by bradycardia and hypotension during the intraoperative period¹³. The low frequency of anesthesiologist's intervention when topical anesthesia is used during cataract surgery is important, because it is significantly lower compared to peribulbar or retrobulbar anesthesia plus intravenous sedation¹³. However, there are contraindications regarding the use of topical anesthesia without sedation, such as language barriers, dementia, deafness and nystagmus. There are also reasons to use general anesthesia, such as extreme nervousness, Down syndrome, neurological disease with severe head movements and back pain with difficulty lying down^{13,15}.

Propofol could be a suitable sedative for ophthalmic surgeries because it decreases intraocular pressure; however, inadvertent movements of the patient's head or respiratory depression could occur, and patients

could fall asleep and wake up without being aware of what is happening around them¹⁶. The pharmacological group that has been found to be most useful for sedation in ophthalmic surgeries are benzodiazepines. Midazolam is widely used for its amnesic effect, short duration of action and decreased anxiety in elderly patients. Fentanyl is used for its analgesic properties at low doses¹⁷.

In topical anesthesia, the fibers of the iris or the ciliary body are not blocked, so it is expected that manipulation of the iris may induce pain, being the main cause of discomfort referred by the patient¹⁸. Peribulbar anesthesia is the choice in complex cases of cataract surgery that require total akinesia or manipulation of the iris⁴. It is necessary to consider that the sensitivity of the cornea is greater in the central 5 mm and lower in the upper part due to the disposition of the nerves, and that at 65 years of age, corneal sensitivity declines by half, which would explain the better results in the elderly³.

Methods

A cross-sectional, observational and analytical study was conducted, in which the records of patients operated by phacoemulsification were evaluated in the period between November 2013 and November 2015. Phacoemulsification was carried out under standardized conditions and was performed by the same surgeon, who has extensive experience in cataract surgery.

We included the records of 214 patients diagnosed with cataract, older than 18 years old and of both sexes. Exclusion criteria included patients operated with retrobulbar block or sub Tenon's anesthesia due to history of uveitis, posterior synechiae, uncooperative patients during slit lamp examination, disability that did not allow for collaboration during the surgical procedure, deafness and dementia. In addition, cases in which the patients were under treatment for systemic hypertension were excluded. We determined the type of anesthesia received (only topical or topical plus sedation) and the vital signs obtained intraoperatively during cataract surgery. Topical anesthesia consisted in the application of tetracaine hydrochloride three times with 10 minutes between each application prior to the surgical procedure; in those cases in which intravenous sedation was also administered, midazolam, fentanyl or ketamine was administered according to the criterion or experience of the anesthesiologist. Briefly, after aseptic preparation, the surgical technique used consisted in a clear corneal incision, anterior

continuous curvilinear capsulorhexis, bimanual endocapsular phacoemulsification and cortical aspiration; finally, a foldable intraocular lens was inserted into the capsular bag.

The main objective of the study was to evaluate the behavior of vital signs in patients operated by phacoemulsification. The patients were divided into two groups: the first received only topical anesthesia and the second topical anesthesia plus sedation. Heart and respiratory rates were monitored, as well as systolic and diastolic pressure.

It was verified in the records that before surgery, informed consent of all the patients had been obtained after the explanation about the procedure to be performed, the type of anesthesia and the possible risks and complications. To carry out this study, the ethical principles postulated in the Declaration of Helsinki were followed, and it was evaluated and approved by the Research Ethics Committee of the Unidad Clínica de Bioequivalencia de S. de R.L de C.V. with protocol number 000751.

Statistical analysis

The differences in vital signs were evaluated in a comparative manner between the group operated under topical anesthesia versus the group operated under topical anesthesia plus sedation, and the presence of complications was recorded. The statistical program SPSS for Windows, version 22 was used to analyze the data. The normality of the data was determined with the Kolmogorov-Smirnov test and the behavior of the vital signs between groups was evaluated with the Mann Whitney U test. A p-value less than 0.05 was considered statistically significant.

Results

The study included 214 records of patients undergoing cataract surgery with intraocular lens implantation, with an average age of 69.65 years (± 12.010). Of the total patients, 79 (36.9%) were men and 135 (63.1%) women; 51 (23.8%) were operated only with topical anesthesia and 163 (76.2%) under topical anesthesia plus sedation.

The results of both groups are summarized in [table 1](#). Of the 214 patients, 208 underwent cataract surgery alone and 6 underwent a combined procedure with trabeculectomy.

For the patients who received sedation, the drugs employed were midazolam in 74.3%, fentanyl in 62.1%

Table 1. Characteristics by group

	Local	Local + sedation	Total	p-value
Number of patients	51	163	214	
Age				—
Average	72.65 ± 11.98	68.71 ± 11.90	69.65 ± 12.010	
Range	28-96	26-94	26-96	
Respiratory rate				0.013
Average	18.86 ± 2.79	17.43 ± 3.60	17.77 ± 3.476	
Range	12-24	10-26	10-26	
Heart rate				0.257
Average	72.20 ± 8.76	70.71 ± 11.37	71.07 ± 10.808	
Range	55-93	45-110	45-110	
Systolic pressure				0.414
Average	132.53 ± 21.29	136.11 ± 22.88	135.26 ± 22.519	
Range	94-187	83-215	83-215	
Diastolic pressure				0.923
Average	76.73 ± 11.79	77.30 ± 12.79	77.16 ± 12.538	
Range	49-98	50-147	49-147	
Mean arterial pressure				0.724
Average	95.32 ± 12.84	97 ± 14.47	96.610 ± 4.0888	
Range	65.3-125.7	66.7-169.7	65.3-169.7	

and ketamine in 54.2%. There were no complications in either group. According to the Mann Whitney U Test, no significant difference was found ($p > 0.05$) regarding the behavior of heart rate, respiratory rate, systolic pressure, diastolic pressure and mean arterial pressure between both groups.

According to the classification of arterial hypertension in the European guidelines, 50.3% of the patients were found with normal or normal-high figures and 49.7% presented some degree of hypertension (Table 2). There were no statistically significant differences in patients with intraoperative hypertension between the group operated with topical anesthesia and the group of topical anesthesia plus sedation.

Discussion

Our results show that there is no statistically significant difference in the behavior of heart rate, respiratory rate, systolic, diastolic and mean arterial pressure among patients operated with topical anesthesia alone or topical anesthesia plus sedation. Neither group presented complications related to the type of anesthesia used.

Currently, the trend shows a marked increase in the use of topical anesthesia in cataract surgery, followed by sub-Tenon anesthesia and with a tendency to perform it without sedation¹⁹. Pain during anesthesia administration, during the intraoperative period or after cataract

surgery are the main causes of poor patient satisfaction. Topical anesthesia, different from the techniques that include anesthetic injection, is associated with minimal discomfort⁴.

Comparative studies according to the type of local anesthesia have reported serious adverse events with all the techniques except in the topical, intracameral and subconjunctival methods. Severe complications that threaten vision include globe perforations, cilioretinal artery occlusion, and severe corneal edema. Serious life-threatening complications include deep vasovagal episode, silent myocardial infarction, anaphylactic reaction and supraventricular tachycardia²⁰ and, although these complications occur infrequently, they may be under-reported and justify the use of topical anesthesia.

The application of intravenous sedation (fentanyl or midazolam) in combination with topical anesthesia in cataract surgery has been evaluated in order to reduce patient's pain and achieve better postoperative results, but the preservation of eye mobility and obtaining conscious support of the patient help to improve the surgical conditions, optimizing the red reflex and the corneal access².

It is also important to mention that each patient should be evaluated and choose the appropriate type of anesthesia in an individual basis, since there are certain contraindications for topical anesthesia or sedation. There are even cases that require general

Table 2. Classification of systemic arterial hypertension

Blood pressure	Frequency	Percentage
Normal	89	41.6
Normal-high	28	13.1
Mild arterial hypertension	58	27.1
Moderate arterial hypertension	28	13.1
Severe arterial hypertension	11	5.1
Total	214	100

anesthesia, such as extreme nervousness, Down syndrome, neurological disease with severe head movement and back pain with difficulty reclining, and others in which it could be a relative indication, such as language barriers, dementia, deafness and nystagmus¹⁵. In addition, topical or general anesthesia are also indicated in patients who receive dual platelet inhibition²¹.

Regarding arterial pressure, it should be noted that half of the patients included in the study had a baseline pressure above the ranges considered normal, which was probably secondary to history of undiagnosed or untreated systemic arterial hypertension; however, despite this, no differences were observed between the groups.

In addition, there was no difference observed in the vital signs between the young patients and the older patients. In addition, six patients also underwent trabeculectomy, without finding any alteration in the vital signs figures compared to those who only underwent cataract surgery.

It should be noted that all surgeries were performed by the same surgeon, who has extensive experience in performing this surgery; in the hands of beginners or inexperienced surgeons the results could be different, either with topical anesthesia or in combination with intravenous sedation. Randleman, et al. found that intraoperative complications in cataract surgery decreased significantly after the first 80 cases²².

Patients who have a cataract extraction in the second eye with topical anesthesia often report an increase in pain and greater awareness compared to the first surgery despite having been in similar conditions. A physiological explanation is that the surgery of the first eye causes a sympathetic irritation that sensitizes the second eye to the painful stimulus. The pharmacological explanation is that prior exposure to analgesic and sedative medications during the first surgery leads to pharmacological tolerance with a lower response during the second surgery.²³

Different studies have reported the disadvantages of sedation, such as inadvertent movements of the patient's head or respiratory depression; likewise, patients could fall asleep and wake up without being aware of what is happening around them, making it difficult for surgery or even leading to a complication. That is why topical anesthesia alone is considered a good alternative in cataract surgery¹⁴.

One point to consider is whether the surgery is performed on the dominant side of the patient. There are studies in which topical anesthesia has been used in cataract surgery and a lower degree of pain and greater cooperation have been found in the eyes operated on the non-dominant side of the patient despite a longer surgery time²⁴.

Although it is possible to use topical anesthesia without sedation in a high percentage of patients undergoing cataract surgery with a minimum of complications, the technique should be chosen based on patient safety, comfort and achieving the necessary safety conditions for surgery. The younger the age, the greater the need for sedation aids, so elderly patients would require it in a minimum percentage and should be better supervised if required.

Conclusion

The use of topical anesthesia and topical anesthesia plus sedation show no differences in the behavior of vital signs and can be considered equally effective for cataract surgery by phacoemulsification. The decision of using one over another should be individualized, considering the particular characteristics of each patient and, in the same way, the surgical skills of the surgeon.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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