Brazilian Journal of Anesthesiology xxxx;xxx(xx):xxx–xxx

Sociedade Brasileira de Anestesiologia

Brazilian Journal of ANESTHESIOLOGY

ORIGINAL INVESTIGATION

Effect of adding clonidine to lidocaine on ocular hemodynamics during sub-Tenon's anesthesia: randomized double-blind study

Sigmar Aurea Cabral [a], **Antonio Roberto Carraretto** [a], **Angela Maria Sousa** [b], **Renato Santiago Gomez** [c,*]

[a] *Universidade Federal do Espírito Santo, Departamento de Cirurgia, Vitória, ES, Brazil*
[b] *Universidade de São Paulo, Faculdade de Medicina, Departamento de Anestesia São Paulo, SP, Brazil*
[c] *Universidade Federal de Minas Gerais, Departamento de Cirurgia, Belo Horizonte, MG, Brazil*

Received 11 May 2020; accepted 28 August 2021

KEYWORDS
Sub-Tenon's anesthesia;
Clonidine;
Intraocular pressure;
Ocular pulse amplitude;
Ocular perfusion pressure;
Cataract surgery

Abstract
Introduction and objectives: Different regional anesthesia techniques for ophthalmology can have hemodynamic effects on the eye. We assessed the effects of adding clonidine to lidocaine on Intraocular Pressure (IOP), Ocular Pulse Amplitude (OPA), and Ocular Perfusion Pressure (OPP) after the sub-Tenon's technique for cataract surgery.
Methods: The study included 40 patients randomly allocated into two groups: sub-Tenon's blockade with Lidocaine plus Saline Solution (LS) or Lidocaine plus Clonidine (LC). IOP, OPA and OPP were measured before anesthesia, and 1, 5 and 10 minutes after the injection of anesthetic solution.
Results: There was no difference between the groups in IOP, OPA, and OPP baseline values. After the injection of the anesthetic solution, the IOP increased in both groups at minute one, with a mean difference of +4.67 mmHg (p = 0.001) and +2.15 mmHg (p = 0.013) at 5 minutes. The increase was lower in the LC group when compared to LS (p = 0.027). OPA decreased in both groups, with a baseline difference, after 1 minute, of -0.85 mmHg (p = -0.85 mmHg (p = 0.001), and at 5 and 10 minutes with differences of -1.17 (p = 0.001) and -0.89 mmHg (p = 0.001), respectively. The highest decrease was observed in group LC in relation to group LS (p = 0.03). There was no difference in OPP in relation to baseline measurements.
Conclusions: Adding clonidine to lidocaine for sub-Tenon's anesthesia reduced IOP and OPA without significant changes in OPP.

* Corresponding author.
E-mail: renatogomez2000@yahoo.com.br (R.S. Gomez).

https://doi.org/10.1016/j.bjane.2021.08.004

Please cite this article as: S.A. Cabral, A.R. Carraretto, A.M. Sousa et al., Effect of adding clonidine to lidocaine on ocular hemodynamics during sub-Tenon's anesthesia: randomized double-blind study, Brazilian Journal of Anesthesiology, https://doi.org/10.1016/j.bjane.2021.08.004

Introduction

Cataract surgery is the most frequently performed surgical procedure in ophthalmology and it is usually performed under regional anesthesia, such as retrobulbar, peribulbar and sub-Tenon's anesthesia.[1] The sub-Tenon's technique provides effective anesthesia and a lower incidence of complications compared to techniques that introduce needles into the orbit.[2–4]

Anesthetic management in ophthalmology requires maintenance of Intraocular Pressure (IOP) during the perioperative period, as changes in IOP can dramatically affect clinical outcomes after cataract surgery. IOP is defined as the pressure exerted by the contents of the eye against the wall that contains it. An increase in IOP linearly reduces the perfusion of ocular structures and, at high levels, is more important than blood pressure in determining retinal function. At pressures that exceed Ocular Perfusion Pressure (OPP), increased IOP causes compression of the vasculature, resulting in retinal ischemia and blindness in animal models.[5]

Several studies have pointed out the effects of regional anesthesia on IOP and ocular hemodynamics. Soon after a retrobulbar,[6,7] peribulbar[7–10] or sub-Tenon's.[11,12] anesthetic injection, there is a significant increase in IOP and a reduction in ocular blood flow. Acute increases in IOP in an ''open'' eye globe potentially result in expulsive hemorrhage or extrusion of orbital contents.[13] Such hemodynamic changes can impair retinal blood flow and exacerbate damage to eyes with previously abnormal perfusion pressure, as in patients with glaucoma and increased intravitreal pressure, for example.[13,14] Moreover, regional blocks may reduce Ocular Pulse Amplitude (OPA) due to the pharmacological effects of local anesthetics.[7,9,15]

Clonidine is a central and peripheral $\alpha 2$ adrenergic receptor agonist. It has been used as an adjuvant during regional ophthalmic anesthesia due to its analgesic properties[16] with potentiation of motor and sensory blocks,[17–22] as well as IOP reduction.[17,21] Studies, however, were performed to assess the quality of anesthesia and did not assess the effects of clonidine on ocular hemodynamics in ophthalmic blocks.

The objective of the present study was to assess the effects of adding clonidine to lidocaine on IOP, OPA and OPP for patients submitted to cataract surgery under sub-Tenon's anesthesia.

Methods

The Ethics in Research Committee of the Universidade Federal de Minas Gerais – COEP/UFMG, according to project – CAAE: 03409512.2.0000.5149, and of the Universidade Federal do Espírito Santo – CEP/UFES, according to protocol #298/2011, where the study was carried out, approved the present prospective, randomized double-blind clinical study, and it was also registered on Clinicaltrials.gov, number NCT 02733757. The study complied with CONSORT statement recommendations. Patients were selected during the preanesthetic consultation on the day of the surgery. Patients who accepted to participate received instructions about the study and signed the Consent Form.

Patient inclusion criteria were patients between 30 and 86 years of age, both genders, ASA (American Society of Anesthesiologists) physical status I and II, selected for phacoemulsification cataract surgery. Exclusion criteria were inability to communicate, allergy to any study drug, chronic treatment with clonidine, hypertension, diabetes, glaucoma, previous surgery on the same eye, clotting disorders, patient refusal.

Patients were divided into two groups of 20 using computer-generated random number tables. In the LS group, 5 mL of 2% lidocaine plus saline solution (1 mL) were used. In the LC group, 5 mL of 2% lidocaine plus 1 $\mu g.kg^{-1}$ of clonidine diluted in saline solution (1 mL) were used. 25 $IU.mL^{-1}$hyaluronidase was added to both solutions. The final anesthetic solution volume was 6 mL, and the doses of lidocaine and clonidine used were based on previous studies.[11,18,22] Patients were monitored with electrocardiogram, Mean Arterial Pressure (MAP), Heart Rate (HR), and Oxygen Saturation (SpO_2), preoperatively. A 22G intravenous catheter in the upper limb was used for peripheral venous access of infusion of 0.9% sodium chloride solution. Syringes were prepared by one of the researchers not involved in the execution of blocks. The same anesthesiologist performed all blocks and the same ophthalmologist performed ocular monitoring measurements.

For IOP and OPA measurements, a dynamic contour digital tonometer – DCT (Pascal Tonometer, Zimer Ophthalmic Systems, Switzerland) was used. DCT measures the physiological fluctuations in IOP that occur with heartbeat, and the difference between systolic and diastolic IOP is referred to as OPA, an indirect indicator of choroidal perfusion, reflecting the conditions of the arterial vascular system and heart function.[23] The scale for IOP and OPA measurements is descendent, ranging from 5 to 1, depending on the quality of the signal obtained by the device software. Values ranging from 1 to 3 are satisfactory and were taken into account.

Patients received two drops of 0.5% proxymetacaine hydrochloride topical anesthetic on the eye to be anesthetized. Then, they were accommodated in a reclining chair with an attached slit lamp, and for IOP, OPA, PAM, HR and SpO_2 control measurements. They were placed in the supine position and received 0.07 $mg.kg^{-1}$ diazepam intravenously, insertion of a nasal catheter with 2 $L.min^{-1}$ oxygen, and the sub-Tenon's block was performed. IOP, OPA, PAM, HR and SpO_2 were measured at one, five and ten minutes after the injection of the anesthetic solution. At the end of assessments, patients were sent to the operating room. OPP was calculated using the following formula: OPP = 2/3 MAP – IOP.[8] A decrease in MAP greater than 20% of preanesthetic values during the procedure was treated with ephedrine bolus (5 mg), and HR below 50 beats per minute was treated with increasing doses of 0.25 mg atropine. We used the classic surgical technique of sub-Tenon's anesthesia described by Stevens,[24] as well as the Stevens cannula. No additional intervention was performed after anesthetic injection so as to not interfere with subsequent assessments. Patients were evaluated up to 10 minutes after the sub-Tenon's blockade, during surgery, and after completion of the surgical procedure in the postanesthetic recovery unit. Adverse events related to the anesthetic technique were registered.

The sample size was calculated based on the study by Pianka et al.,[11] which detected a 24% reduction in OPA right after sub-Tenon's anesthesia. Considering this value and a 5% significance level, and test power of 80%, 20 patients were required for each group. Student's *t*-test was used to check whether baseline values between both groups were similar for symmetrical continuous variables such as age, MAP, HR, SpO_2, IOP, OPA and OPP. For continuous asymmetric or ordinal variables such as weight, ASA, volume of injected local anesthetic and surgical time, the nonparametric Mann-Whitney test was adopted. To analyze the effect of clonidine on systemic and ocular hemodynamic values, the repeated measurement test, called the mixed linear model, was used and allowed comparing the general effect between the LS and LC groups (regardless of time); compare the difference in effect over time (baseline, 1 min, 5 min, and 10 min) within each group; and whether the effect over time on one group was more effective than the effect over time on the other group (time x group interaction). Differences were presented with their respective 95% Confidence Intervals (95% CI). Significance was set at 0.05. All analyses were performed using SPSS version 17.0 (IBM Corporation, Armonk, USA).

Results

The CONSORT flow diagram of the study is presented in Figure 1. Of the 53 eligible patients, 40 were randomized and all of them concluded the study. There was no significant difference between groups regarding demographics, ASA, and total volume of local anesthetic injected. There was also no significant difference in baseline MAP, HR, SpO_2, IOP, OPA, and OPP (Table 1). After blockade, MAP was significantly reduced in the group that received clonidine, 10 minutes after blockade (-4.20 mmHg; 95% CI -12.40 – -4.0) (p = 0.01), and clinical intervention with ephedrine was not required. No significant differences were observed in HR between groups over time, and atropine was not required. SpO_2 showed only a significant difference between baseline and the 5th minute for both groups (difference of -0.75; 95% CI -1.40 – -0.08) (p = 0.02), with no clinical significance.

Table 2 presents mean, standard deviation, and 95% confidence interval of the ocular IOP, OPA and OPP variables throughout the 10 minutes; it also shows the general results of the mixed linear model for group interaction, time, and group versus time. There was a significant difference for IOP over time between groups, between groups and interaction between groups versus time. For OPA, there was only difference over time, and interaction between group and time. No significant differences were observed for OPP.

Table 3 describes detailed results, with an estimate of the effect of clonidine on ocular variables over time, when compared to baseline. Baseline IOP interception status was 18.79 mmHg, not different between the groups. The difference between the LC and LS groups was -1.075 mmHg (95% CI -2.81 – 0.66) (p = 0.22). Mean IOP values increased significantly from baseline to minute one after blockade in both groups (difference of 4.67 mmHg, 95% CI 2.67–6.66) (p = 0.001). After 5 minutes, the difference was smaller (2.15 mmHg, 95% CI 0.46–3.83) (p = 0.013) and there was no difference from baseline at 10 minutes (1.09 mmHg, 95% CI -0.47–2.65) (p = 0.17) (Table 3).

When we analyzed group interaction versus time, we observed a significant increase in IOP for both groups when compared to baseline, one minute after blockade. However, the increase in IOP was lower than in the LC group, a difference of -3.18 mmHg (95% CI -5.99 – -0.37) (p = 0.027) when compared to the LS group. After 5 minutes of observation, the difference in IOP was -2.44 mmHg (95% CI -4.82 – -0.062) (p = 0.044) and, after 10 minutes, the difference was -2.66 mmHg (95% CI 4.87 – -0.44) (p = 0.019).

The OPA intercept under baseline conditions was 2.95 mmHg and was not different between the two groups. There was a significant reduction in OPA after anesthesia for both groups. The difference from baseline at 1 minute was -0.85 mmHg (95% CI -1.36 – -0.33) (p = 0.00), and at 5 and 10 minutes the difference was -1.17 (95% CI -1.65 – -0.69) (p = 0.00) and -0.89 mmHg (95% CI -1.37–0.41) (p = 0.001), respectively (Table 3). The analysis of the trajectory of each group over time, shows that the LC group presented a significantly larger reduction in OPA than the LS group. The difference between baseline and 1 minute was -0.78 mmHg (95% CI -1.51 – -0.51) (p = 0.03). After 5 and 10 minutes, the difference was -0.28 mmHg (95% CI -0.96–0.39) (p = 0.40) and -0.81 mmHg (95% CI -1.48 – -0 .13) (p = 0.02).

There was no significant difference in OPP between groups or over time (Table 3). Regarding adverse events related to the anesthetic technique, in the LS group, 1 (5%) patient had Subconjunctival Hemorrhage (SC) in the Inferior Nasal Quadrant (INQ), 1 (5%) patient had SC hemorrhage in 2 quadrants, INQ and Superior Nasal Quadrant (SNQ), 1 (5%) patient presented chemosis in 2 quadrants, INQ and Inferior Lateral Quadrant (ILQ) and visual sensation in 3 (15%) patients. In the LC group, 2 (10%) patients had SC hemorrhage in IQN, and 1 (5%) patient had SC hemorrhage in 2 quadrants, INQ and SNQ. The adverse events did not interfere with the surgical technique. There were no clinically important hemodynamic changes at the post-anesthetic care unit. All patients were discharged from the hospital within six hours after the end of surgery, without any event preventing discharge.

Discussion

There are substantial fluctuations in IOP during intraocular surgery, ranging between 13 and 96 mmHg for cataract procedures.[25] These intraoperative IOP fluctuations can result in abnormal blood flow to the optic nerve and retina, because OPP becomes sharply decreased.[26] The acute increase in IOP (20 mmHg for 5 min) reduces blood flow to the retina, choroid and optical nerve in healthy volunteers.[27] Therefore, the challenge to anesthesia is to optimize surgical conditions, minimize risk of complications to vision and other adverse effects, and preserve retina perfusion.

In our study, we demonstrated a 4.67 mmHg increase in IOP in the first minute after blockade. This is in agreement with previous studies comparing retrobulbar, peribulbar and sub-Tenon's blockade, which demonstrated an initial increase, ranging from 5 to 10 mmHg in IOP.[28] This initial increase in IOP seems to be related to the volume of

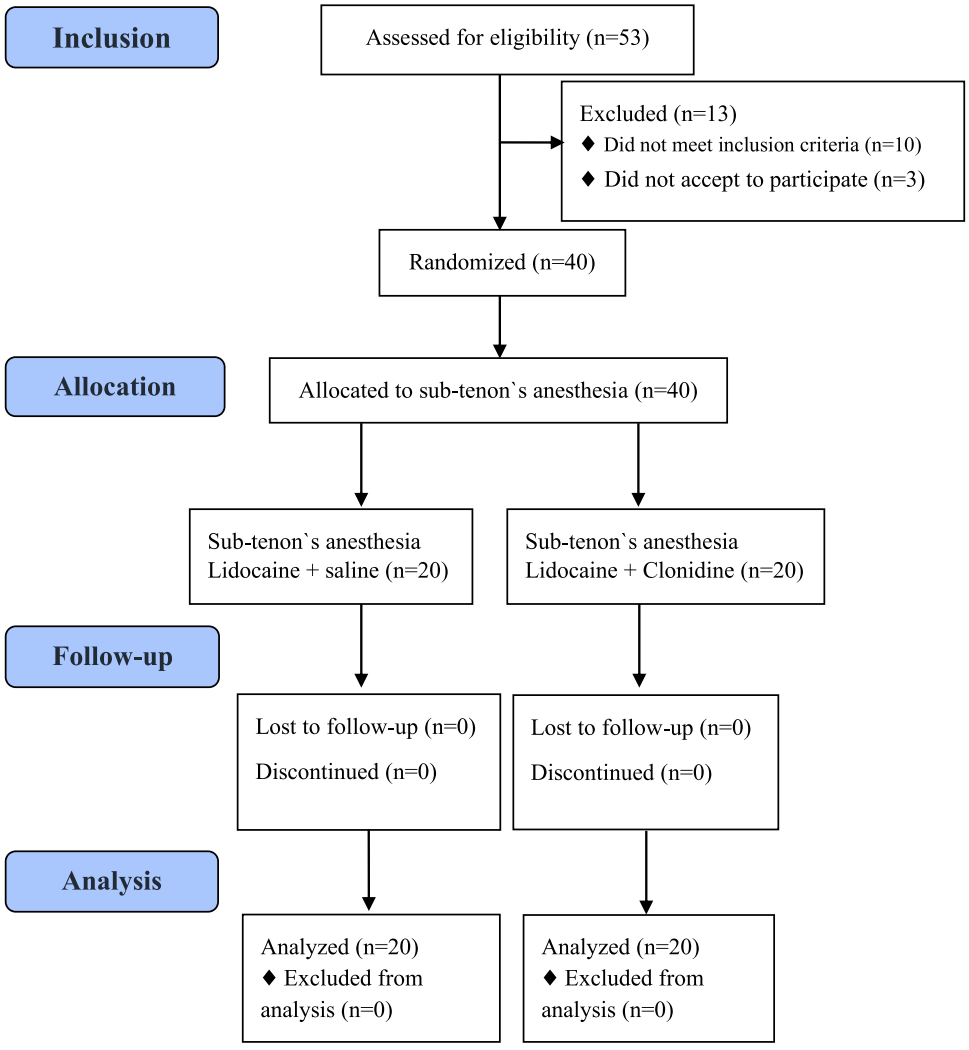

Figure 1 CONSORT flow diagram for inclusion.

Table 1 Demographic variables, ASA, total volume of Local Anesthetic (LA) injected, duration of surgery, baseline hemodynamic and ocular variables of groups LS (Lidocaine + Saline) and LC (Lidocaine + Clonidine).

Variables	Group LS (n = 20)	Group LC (n = 20)	*p*-value
Age (years)	66.40 ± 11.89	63.30 ± 14.09	0.457[a]
Weight (Kg)	60.90 ± 11.36	68.65 ± 15.15	0.056[b]
Gender (female)	13 (65%)	11 (55%)	0.340[c]
ASA I/II	17 (85%)/3 (15%)	16 (80%)/4 (20%)	1.00[b]
Volume of LA injected (mL)	5.17 ± 0.54	5.48 ± 0.55	0.105[b]
Surgical time (min)	28.25 ± 11.84	27.50 ± 9.80	0.924[b]
MAP (mmHg)	100.96 ± 10.46	96.76 ± 14.79	0.30[a]
HR	65.55 ± 8.77	68.25 ± 7.33	0.29[a]
SpO_2 (%)	98.75 ± 0.85	98.5 ± 0.83	0.35[a]
IOP (mmHg)	18.79 ± 3.01	17.72 ± 2.37	0.22[a]
AOP (mmHg)	2.95 ± 0.70	3.22 ± 1.28	0.42[a]
OPP (mmHg)	48.51 ± 8.32	46.79 ± 9.99	0.55[a]

Data shown as ± SD for age, weight, volume injected, surgical time.
MAP, Mean Arterial Pressure; HR, Heart Rate; SpO_2, Oxygen Saturation; IOP, Intraocular Pressure; OPA, Ocular Pulse Amplitude; OPP, Ocular Perfusion Pressure. Values expressed as absolute numbers and percentages for gender, ASA (American Society of Anesthesiologists).
[a] Independent Student's *t*-test.
[b] Mann-Whitney test.
[c] Chi-square test; $p < 0.05$.

Table 2 IOP, OPA and OPP up to 10 minutes.

Variables	Time				Mixed model	
	Baseline	1 min	5 min	10 min	Effects	*p*-value
IOP						
Group LS	18.79 ± 3.01 (17.54-20.04)	23.47 ± 3.55 (22.21-24.71)	20.94 ± 2.40 (19.69-22.19)	19.88 ± 2.33 (18.63-21.13)	Time	0.001
Group LC	17.72 ± 2.37 (16.47-18.97)	19.21 ± 3.53 (17.95-20.45)	17.42 ± 2.84 (16.17-18.67)	16.15 ± 2.09 (14.90-17.40)	Group	0 .001
					Time x Group	0 .002
OPA						
Group LS	2.95 ± 0.70 (2.48-3.42)	2.10 ± 0.86 (1.76-2.44)	1.78 ± 0.74 (1.42-2.14)	2.06 ± 0.79 (1.75-2.37)	Time	0 .001
Group LC	3.22 ± 1.28 (2.61-3.82)	1.58 ± 0.60 (1.24-1.92)	1.76 ± 0.84 (1.40-2.12)	1.51 ± 0.54 (1.20-1.82)	Group	0 .261
					Time x Group	0 .04
OPP						
Group LS	48.51 ± 8.32 (44.62-52.41)	43.99 ± 8.96 (39.69-48.28)	46.36 ± 9.48 (42.51-50.22)	48.24 ± 7.84 (44.69-51.80)	Time	0.68
Group LC	46.79 ± 9.99 (42.62-50.95)	43.33 ± 9.99 (39.04-47.63)	44.11 ± 7.42 (40.26-47.97)	45.43 ± 7.88 (41.88-48.99)	Group	0 .43
					Time x Group	0.84

Data shown as mean ± SD and 95% CI for IOP (intraocular pressure), OPA (ocular pulse amplitude), and OPP (ocular perfusion pressure); Groups LS (lidocaine + saline) and LC (lidocaine + clonidine);

Table 3 Results of mixed linear model to identify which baseline ocular values were influenced by clonidine throughout 10-minutes.

Variables	IOP Estimated (95% CI)	*p*-value	OPA Estimated (95% CI)	*p*-value	OPP Estimated (95% CI)	*p*-value
Group Intercepted	18.79		2.95		48.51	
Clonidine	-1.075 (-2.81; 0.66)	0.22	0.26 (-0.38-0.91)	0.41	-1.72 (-7.47; 4.02)	0.54
Time						
Baseline						
1 minute	4.67 (2.67; 6.66)	0.001	-0.85 (-1.36; -0.33)	0.001	-4.52 (-12.19; 3.14)	0.25
5 minutes	2.15 (0.46; 3.83)	0.013	-1.17 (-1.65; -0.69)	0.001	-2.15 (-9.68; 5.38)	0.57
10 minutes	1.09 (-0.47; 2.65)	0.17	-0.89 (-1.37; -0.41)	0.001	-0.26 (-7.67; 7.13)	0.94
Group x Time						
Baseline						
Clonidine						
1 minute	-3.18 (-5.99; -0.37)	0.027	-0.78 (-1.51; -0.51)	0.03	1.07 (-5.25; 7.40)	0.72
Clonidine						
5 minutes	-2.44 (-4.82; -0.062)	0.044	-0.28 (-0.96; 0.39)	0.40	-0.52 (-6.44; 5.40)	0.86
Clonidine						
10 minutes	-2.66 (-4.87; -0.44)	0.019	-0.81 (-1.48; -0.13)	0.02	-1.08 (-6.67; 4.50)	0.69
Clonidine						

Data shown as mean ± SD and 95% CI for IOP (intraocular pressure), OPA (ocular pulse amplitude), and OPP (ocular perfusion pressure).

local anesthetic injected into the orbital cavity.[10] Excessive volume may cause an increase in IOP at the beginning of surgery, which may be associated with positive vitreous pressure and risk of intraoperative complications. Posterior capsule rupture, vitreous prolapse and suprachoroidal hemorrhage have been some of the complications reported.[13] In our study, we injected, on average, 5.5 mL of anesthetic solution which could have created an initial compression effect on structures of the globe, but it was reversed after 10 minutes.

In the present study, we observed a small reduction of roughly 2.5 mmHg in IOP after 5 and 10 minutes, when we compared the blockade in the presence or absence of clonidine. However, the effect, even if small, could be clinically relevant if we consider that small increases in IOP in patients can impair blood flow to the retina and exacerbate damage

to eyes with an already abnormal perfusion pressure, as is the case of patients with glaucoma.[13]

The initial increase in IOP right after the administration of the anesthetic solution with clonidine was of a lower magnitude when compared to the more pronounced effect of the local anesthetic with saline solution. Lidocaine is known to induce vasoconstriction on the orbit and decrease the volume effect on IOP. Local anesthetics are also known to prevent endothelial formation of Nitric Oxide (NO) in isolated ciliary arteries,[29] impairing the endothelial relaxation mechanism and reducing blood flow after regional anesthesia on the orbit. The intensity of those effects on Ocular Blood Supply (OBS) depends on the kind of local anesthetic,[15] kind of anesthesia,[9] volume of local anesthetic solution,[10] and the adjuvants added to the anesthetic solution. On the other hand, in peribulbar blocks with lidocaine associated with adrenaline, a reduction in the resistive index of the ophthalmic artery was observed ten minutes after blockade, suggesting that an induced vasoconstriction due to adrenaline can trigger self-regulation mechanisms to maintain OBS.[30]

Previous studies have shown a predominance of α2 adrenergic receptors in richly vascularized ocular tissues, such as the choroid, ciliary body[31] and ciliary arteries, whose activation mediate powerful vasoconstriction.[32] Clonidine activates the α2a adrenergic receptors of vascular smooth muscle cells and of the vascular endothelium, changing the endothelial production of NO which results in ocular vasoconstriction.[33] Its association to local anesthetic exacerbates it's vasoconstrictor effect. The mechanism for decreasing IOP may be due to vasoconstriction in the ciliary body and episclera by α receptor stimulation and increased uveoscleral aqueous drainage.[19] Our results show that clonidine is capable of minimizing increase in IOP after sub-Tenon's blockade, without changes in OPP. The peribulbar and sub-Tenon's technique reduced OPA in a previous study,[11] without changing IOP. The authors, however, used 2 mL of lidocaine without adrenaline, a lower volume than the one used in the present study.

OPP can be reduced by increase in IOP, decrease in venous drainage, and change in the diameter of blood vessels induced by local anesthetic.[7,9,15] In our study, OPP decreased along with increasing IOP and decreasing OPA soon after administration of anesthetic solutions. OPP tended toward normal after 10-minutes, despite the decrease in OPA. These findings are similar to previous reports using different anesthetic solutions,[7,8,15] and are probably due to the vasoconstrictor effects of the local anesthetic. In the present study, the magnitude of the increase in IOP was lower in patients who received clonidine, while the reduction in OPA was more pronounced than what occurred in the LS group.

Subconjunctival hemorrhage ranged from 5% to 10% and is in agreement with other reports in the literature. Chemosis was also observed due to the volume of local anesthetic injected passing to the anterior region of the conjunctiva. Visual sensation was also observed, and it seems that its incidence does not significantly differ among regional orbital block techniques.[2]

One of the limitations of the present study is that OPA measurements are considered indirect measurements of FSO, that is, pulsatile blood flow, without quantifying diastolic non-pulsatile flow. Another limitation is the clinical nature of the study that did not allow assessment beyond 10 minutes. We do not know if OPP was maintained after this period, given the vasoconstricting effects of lidocaine were accentuated by clonidine.

The findings of the present clinical study may benefit patients with some degree of ocular hemodynamic changes or who have glaucoma before performing regional blockades on the orbit. As OPA is an easy to perform, practical and low-cost test, it can reveal OBS status beforehand, and help as to the best anesthesia care, type of regional blockade, choice of less vasoconstrictor anesthetic, and type of adjuvant that may interfere in ocular hemodynamics. On the other hand, sub-Tenon's anesthesia becomes an excellent choice for phacoemulsification cataract surgery due to its efficacy and the safety inherent to the technique.[2–4]

Concluding, sub-Tenon's anesthesia, associating clonidine to lidocaine was capable of decreasing IOP and OPA without significant changes to OPP. Clonidine in the anesthesia technique can be considered beneficial, especially by reducing IOP, providing excellent surgical conditions. However, special care should be taken, mainly for patients with glaucomatous dysfunction, diabetes, hypertension, or other endothelial dysfunctions because of the drug's vasoconstrictor capacity on the orbit. Changes to the self-regulatory system of the orbit vasculature, due to the vasoconstrictor effect on the orbit, should not be excluded.

Ethics approval

All procedures involving human participants were performed according to the ethical standards of institutional and/or national research committees, and of the 1964 Declaration of Helsinki and its posterior changes or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants enrolled in the study.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Nanji KC, Roberto SA, Morley MG, et al. Preventing adverse events in cataract surgery: recommendations from a Massachusetts Expert Panel. Anesth Analg. 2018;126:1537–47.
2. Chua MJ, Lersch F, Chua AWY, et al. Sub-Tenon's anaesthesia for modern eye surgery-clinicians' perspective, 30 years after re-introduction. Eye. 2021;35:1295–304.
3. Eke T, Kumar CM. Preventing Adverse Events in Cataract Surgery: Sub-Tenon's Block. Anesth Analg. 2018;127:68–9.
4. Ribeiro JAS, Ribeiro DS, Scot IU, et al. Pain during pars plana vitrectomy following sub-Tenon versus peribulbar anesthesia: A randomized trial. PLoS One. 2020;15:e0236624.
5. Hartsock MJ, Cho H, Wu L, et al. A mouse model of retinal ischemia-reperfusion injury through elevation of intraocular pressure. J Vis Exp. 2016;113:54065.

6. Coupland SG, Deschênes MC, Hamilton RC. Impairment of ocular blood flow during regional orbital anesthesia. Can J Ophthalmol. 2001;36:140–4.
7. Watkins R, Beigi B, Yates M, et al. Intraocular pressure and pulsatile ocular blood flow after retrobulbar and peribulbar anaesthesia. Br J Ophthalmol. 2001;85:796–8.
8. Findl O, Dallinger S, Menapace R, et al. Effects of peribulbar anesthesia on ocular blood flow in patients undergoing cataract surgery. Am J Ophthalmol. 1999;127:645–9.
9. Chang BY, Hee WC, Ling R, et al. Local anaesthetic techniques and pulsatile ocular blood flow. Br J Ophthalmol. 2000;84:1260–3.
10. Lung S, Luksch A, Weigert G, et al. Influence of infusion volume on the ocular hemodynamic effects of peribulbar anesthesia. J Cataract Refract Surg. 2006;32:1509–12.
11. Pianka P, Weintraub-Padova H, Lazar M, et al. Effect of sub-Tenon's and peribulbar anesthesia on intraocular pressure and ocular pulse amplitude. J Cataract Refract Surg. 2001;27:1221–6.
12. Coşkun M, Kağlioğlu MC, Davran R, et al. Effects of sub-Tenon's anaesthesia on ocular hemodynamics. Can J Ophthalmol. 2014;49:141–4.
13. Savastano A, Rizzo S, Savastano MC, et al. Choroidal effusion and suprachoroidal hemorrhage during phacoemulsification: intraoperative management to prevent expulsive hemorrhage. Eur J Ophthalmol. 2016;26:338–41.
14. Alwitry A, Koshy Z, Browning AC, et al. The effect of sub-Tenon's anaesthesia on intraocular pressure. Eye (Lond). 2001;15:733–5.
15. Govêia CS, Magalhães E. Ropivacaine in peribulbar anesthesia – vasoconstrictive properties. Rev Bras Anestesiol. 2010;60:495–512.
16. Nehra P, Oza V, Parmar V, et al. Effect of addition of fentanyl and clonidine to local anesthetic solution in peribulbar block. J Pharmacol Pharmacother. 2017;8:3–7.
17. Barioni MF, Lauretti GR, Lauretti-Fo A, et al. Clonidine as coadjuvant in eye surgery: comparison of peribulbar versus oral administration. J Clin Anesth. 2002;14:140–5.
18. Madan R, Bharti N, Shende D, et al. A dose response study of clonidine with local anesthetic mixture for peribulbar block: a comparison of three doses. Anesth Analg. 2001;93:1593–7.
19. Eldeen HM, Faheem MR, Sameer D, et al. Use of clonidine in peribulbar block in patients undergoing cataract Surgery. Aust J Basic Appl Sci. 2011;5:247–50.
20. Yazbeck-Karam VG, Siddik-Sayyid SM, Abi Nader EL, et al. Supplementation of retrobulbar block with clonidine in vitreoretinal surgery: effect on postoperative pain. J Clin Anesth. 2011;23:393–7.
21. Khan B, Bajwa SJ, Vohra R, et al. Comparative evaluation of ropivacaine and lignocaine with ropivacaine, lignocaine and clonidine combination during peribulbar anaesthesia for phacoemulsification cataract surgery. Indian J Anaesth. 2012;56:21–6.
22. Cabral SA, Carraretto AR, Brocco MC, et al. Effect of clonidine added to lidocaine for sub-Tenon's (episcleral) anesthesia in cataract surgery. J Anesth. 2014;28:70–5.
23. Bertelmann T, Langanke S, Potstawa M, et al. Can dynamic contour tonometry and ocular pulse amplitude help to detect severe cardiovascular pathologies? Clin Ophthalmol. 2014;8:1317–21.
24. Stevens JD. A new local anesthesia technique for cataract extraction by one quadrant sub-Tenon's infiltration. Br J Ophthalmol. 1992;76:670–4.
25. Zhao Y, Li X, Tao A, et al. Intraocular pressure and calculated diastolic ocular perfusion pressure during three simulated steps of phacoemulsification in vivo. Invest Ophthalmol Vis Sci. 2009;50:2927–31.
26. Iwase T, Akahori T, Yamamoto K, et al. Evaluation of optic nerve head blood flow in response to increase of intraocular pressure. Sci Rep. 2018;8:17235.
27. Findl O, Strenn K, Wolzt M, et al. Effects of changes in intraocular pressure on human ocular haemodynamics. Curr Eye Res. 1997;16:1024–9.
28. Kelly DJ, Farrell SM. Physiology and role of intraocular pressure in contemporary anesthesia. Anesth Analg. 2018;126:1551–62.
29. Meyer P, Flammer J, Lüscher TF. Local anesthetic drugs reduce endothelium-dependent relaxations of porcine ciliary arteries. Invest Ophthalmol Vis Sci. 1993;34:2730–6.
30. Machado IP, Vasconcelos GC, Lopes RS, Gomez RS. Ophthalmic artery resistance index after peribulbar block in the presence of epinephrine. Int Ophthalmol. 2021;41:203–10.
31. Bylund DB, Chacko DM. Characterization of alpha2 adrenergic receptor subtypes in human ocular tissue homogenates. Invest Ophthalmol Vis Sci. 1999;40:2299–306.
32. Wikberg-Matsson A, Simonsen U. Potent alpha(2A)-adrenoceptor-mediated vasoconstriction by brimonidine in porcine ciliary arteries. Invest Ophthalmol Vis Sci. 2001;42:2049–55.
33. Figueroa XF, Poblete MI, Boric MP, et al. Clonidine-induced nitric oxide-dependent vasorelaxation mediated by endothelial alpha(2)-adrenoceptor activation. Br J Pharmacol. 2001;134:957–68.