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Peribulbar vs. incisionless sub-Tenon's blocks: a retrospective cohort study

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Abstract

Background Ophthalmic procedures are increasingly being performed under regional anesthesia techniques such as peribulbar and incisionless sub-Tenon's blocks. The aim is to compare peribulbar block with incisionless sub-Tenon's block in terms of perioperative complications in patients who underwent cataract and vitreoretinal surgeries.

Methods The patients who underwent cataract or vitroretinal surgery under peribulbar block or incisionless sub-Tenon's block were included in the study. Two groups were compared each other in terms of anesthesia-related complications.

Results A total of 125 patients [peribulbar block ($N=48$) and incisionless sub-Tenon's block ($N=77$)] were included in the study. All basic characteristics and perioperative hemodynamic parameters were similar between the groups. One (0.8%) patient in the peribulbar block developed retrobulbar hemorrhage, whereas there was no major complication in the incisionless sub-Tenon's group ($P=0.389$). At 15th minutes after block and at the end of the operation, minor complications including chemosis and subconjunctival hemorrhage were observed significantly lower in the peribulbar block group in comparison to the incisionless sub-Tenon's block group ($P<0.05$).

Conclusions Minor complications including subconjunctival haemorrhage and chemosis were more common in the incisionless sub-Tenon's block; however, this difference was statistically balanced on the first postoperative day. One patient in the peribulbar block developed retrobulbar hemorrhage, whereas there was no major complication in the incisionless sub-Tenon's block. According to those results, incisionless sub-Tenon's block seems to be a safe and reliable alternative for ophthalmic procedures.

Keywords Complication, Incisionless sub-Tenon's block, Ophthalmic regional anesthesia, Peribulbar block

Introduction

The use of regional anesthesia techniques in ophthalmic surgery has gradually increased in recent years. The most important factor of this trend is the significant rise in the number of geriatric population whose the risk of general anesthesia is often high. In addition, efforts to increase operating room efficiency to meet both increasing patient volumes and financial challenges are other factors contributing to this situation.

Cataract and vitreoretinal surgeries are the most common ophthalmic procedures, and are increasingly being performed under regional anesthesia techniques. Peribulbar block is one of the most frequently used anesthesia methods for ocular procedures, and is performed by injecting the anesthetic drug in the orbit around the equator of the globe. Easily applicability and low complication profile are the leading advantages of this technique [1]. On the other hand, sub-Tenon's block is a newer technique via injecting local anesthetic into the sub-Tenon's space [2]. This method has gained more popularity in

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recent years by providing better akinesia and less damage to the vasculature and optic nerve [3].

Sub-Tenon's anesthesia has also reported to allow less pain and anxiety related to the use of needles in the peribulbar anesthesia [4]. Traditionally, sub-Tenon's block is performed through a conjunctival incision followed by insertion of a rigid metal cannula into the sub-Tenon's space. This standard approach is associated with the higher incidence of chemosis and subconjuctival haemorrhage, compared with peribulbar anesthesia [5–8]. To reduce such complications, flexible short intravenous cannula technique described by Palte was recommended [2]. Recently, several minimal invasive approaches of sub-Tenon's block, such incisionless technique, have been described [9–12]. In the literature, there is only one study compared standard and incisionless sub-Tenon's blocks. In that study, the authors found that incisionless lacrimal dilator-facilitated sub-Tenon's block decreased intraoperative chemosis and postoperative conjunctival haemorrhage in comparison to the standard technique [13]. However, no comparative data between peribulbar block and incisionless sub-Tenon's block have been reported to date.

In this study, we aimed to compare peribulbar block with incisionless sub-Tenon's block in terms of perioperative minor and major complications in patients who underwent cataract and vitreoretinal surgeries.

Methods

Data source and study populatian

The study was approved by the XXX Clinical Research Ethics Committee (28.11.2023/9), and was carried out at the Department of Anesthesiology and Reanimation in XXX University between March 2023 and August 2023, in accordance with Good Clinical Practice guidelines and the principles of the Declaration of Helsinki. The patients who underwent cataract or vitroretinal surgery under two regional anesthesia techniques, peribulbar block or incisionless sub-Tenon's block, were included in the study. All patients were informed in detail about the stages of the study and written informed consent was obtained from all. The patients' age, gender, American Society of Anesthesiologists (ASA) status, body mass index (BMI), surgical procedures, regional block types, and complications were recorded. Patients under 18 years, who had any previous ocular operation were excluded from the study.

Anesthesia management

The patients were taken to the regional block room, and monitored via electrocardiogram (ECG), pulse oximetry, and non-invasive blood pressure. Intravenous (IV) access was provided using a 20 G pink cannula over the hand, and saline infusion was started to keep the vascular access open. Premedications included deksmetodimidine (5–10 mcg), midazolam (0.5–2 mg), and fentanyl (25–50 mcg). Subsequently, proparacaine (1 drop) and 1% povidone–iodine (1 drop) were instilled into the eye. All regional blocks were performed by a single anesthesiologist. Thereafter, the patients were transferred to the operating room. Before surgery, IV parasetamol (1 g) was given to all patients. During the intraoperative period, additional sedoanalgesic medication (dexmedetomidine, fentanyl, or midazolam) was administered to the patient when needed (in case of restlessness or pain). Hemodynamic parameters, including heart rate (HR), mean arterial pressure (MAP), and peripheral oxygen saturation (SpO_2), were recorded five times (before sedation/baseline, 15 min after the regional block, at the end of the surgery, 3 h after surgery, and 1 day after surgery).

Peribulbar block

After the skin cleaning with alcohol, the technique was applied by entering through the skin with the help of a needle (25 gauge, 25 mm) at the junction of the medial 2/3 and lateral 1/3 of the orbital rim. With the patient's eye in a neutral position, local anesthetic (a mixture of 0.5% marcaine and 2% lidocaine at an appropriate volume of 4–7 mL according to the axial length of the eyeball) was applied to the extraconal area, passing through the main inferior temporal quadrant.

Incisionless sub-Tenon's block

The conjunctiva and Tenon were grasped and lifted together with a forceps 5–8 mm away from the limbus in the inferonasal quadrant, while the patient was looking upward and outward. A lacrimal dilatator was placed tangential to the globe creating a round and small hole. A plastic cannula (22 gauge) was placed along the curvature of the eyeball, and local anesthetic (a mixture of 0.5% marcaine and 2% lidocaine at suitable volume of 4–7 mL) was injected to the sub-Tenon space through the cannula.

Evaluation of complications

Minor complications included chemosis and subconjunctival hemorrhage, and were recorded four times (before sedation, 15 min after regional block, at the end of the surgery, and 1 day after surgery). These complications were assessed in four quadrants of the eye (superior nasal, superior temporal, inferior nasal, and inferior temporal) using a 2-point scale from 0 (absent) to 1 (in any quadrant). Major complications included brainstem anesthesia, acute seizure activity, and cranial nerve block, retro/peribulbar hemorrhage, ocular penetration/perforation, retinal vascular spasm, optic nerve injury, and ocular myotoxicity.

Table 1 Comparison of basic patient and surgical characteristics between the anesthesia groups

Characteristics	Peribulbar group ($n=48$)	İncisionless sub-Tenon's group ($n=77$)	*P*
Age (mean, y)	64.6 ± 12.3 (42–91)	61.6 ± 12.4 (30–90)	0.221
Gender (F/M)	27 (56.3%)/21 (43.8%)	32 (41.6%)/45 (58.4%)	0.141
ASA status			0.179
ASA 1	16 (33.3%)	26 (33.8%)	
ASA 2	24 (50%)	46 (59.7%)	
ASA 3	8 (16.7%)	5 (6.5%)	
BMI (kg/m^2)			0.134
Under 30	42 (87.5%)	56 (72.7%)	
Above 30	6 (12.5%)	21 (27.3%)	
Operation side			0.711
Right eye	22 (45.8%)	40 (51.9%)	
Left eye	24 (50%)	37 (48.1%)	
Missing	2 (4.2%)	0	
Anticoagulant use	10 (20.8%)	7 (9.1%)	0.081
LA volume (mL)	5 ± 0.9 (4–7)	5.3 ± 1 (4–7)	**0.028**
Operation type			0.086
Cataract surgery	36 (75%)	46 (59.7%)	
Vitroretinal surgery	12 (25%)	31 (40.3%)	
Operation time (min)	43.9 ± 27.1 (20–150)	48.5 ± 25.4 (15–110)	0.157

Age, LA volume, and operation time are presented as mean ± SD (range); other variables are presented as *n* (%)

y: Year, F: Female, M: Male, ASA: American Society of Anesthesiologists, BMI: Body Mass Index, LA: Local anesthetic, mL: Mililiter, min: Minute

Bold indicates a p value less than 0.05

Statistical analysis

The SPSS 20.0 statistical software for Windows (IBM Corp., Armonk, NY, USA) was used for the data analyzes. Descriptive statistics are given as the mean and standard deviation (continuous variables) or frequency and percentage (categorical variables). The data distribution was evaluated with the Kolmogorov–Smirnov test. The Mann–Whitney *U* test was used for nonparametric continuous variable differences between groups, and chi-square test was used for categorical group differences. A *P* value less than 0.05 was considered as the statistical significance level.

Results

Baseline characteristics of participants

A total of 125 patients with a mean age of 64.6 (30–91) years were included in the study. There were 66 (52.8%) males and 59 (47.2%) females. All patients were operated due to the elective cataract surgery ($N=82$, 65.6%) or vitroretinal surgery ($N=43$, 34.4%) by the same surgical team. The patients were classified into two groups according to the regional anesthesia technique used: peribulbar block ($N=48$, 38.4%) and incisionless sub-Tenon's block ($N=77$, 61.6%). The two groups had similar basic patient and surgical characteristics (Table 1).

All (before sedation, 15 min after block, at the end of the surgery, and postoperative first day) HRs, MAPs,

Table 2 Comparison of hemodynamic parameters between the anesthesia groups

Parameters	peribulbar group ($n=48$)	İncisionless sub-Tenon's group ($n=77$)	*P*
Before sedation (baseline)			
HR	79.8 ± 16.9 (49–119)	78.3 ± 18.6 (48–149)	0.436
MAP	105.6 ± 12 (75–140)	104.1 ± 16.8 (60–159)	0.532
SpO_2	97.1 ± 2.4 (86–100)	97.2 ± 2.2 (83–100)	0.942
15th min after block			
HR	72.7 ± 15.7 (43–123)	72.9 ± 16.1 (50–136)	0.889
MAP	91.8 ± 12.4 (67–123)	92.8 ± 14 (57–141)	0.546
SpO_2	98 ± 2 (91–100)	98.1 ± 1.8 (92–100)	0.983
At the end of the surgery			
HR	71.4 ± 14.8 (46–122)	68.5 ± 11.5 (47–99)	0.331
MAP	94.2 ± 14.7 (67–131)	90.5 ± 12.3 (63–127)	0.202
SpO_2	98.7 ± 1.3 (94–100)	98.5 ± 3.1 (74–100)	0.979
Postoperative first day			
HR	73.1 ± 12.1 (45–100)	71.8 ± 12.4 (49–118)	0.453
MAP	91.8 ± 11.7 (68–128)	88.1 ± 10.2 (65–117)	0.087
SpO_2	98.7 ± 1.5 (98–100)	98.6 ± 1.6 (92–100)	0.471

All variables are presented as mean ± SD (range)

HR: heart rate, MAP: mean arterial pressure, SpO2: peripheral oxygen saturation

SpO_2 were statistically similar between peribulbar and incisionless sub-Tenon's groups (Table 2).

The evaluation of complications

There was no chemosis or subconjunctival hemorrhage in the study population before surgery. One (0.8%) patient in the peribulbar block developed retrobulbar hemorrhage, whereas there was no major complication in the incisionless sub-Tenon's group ($P=0.389$). At 15th minutes after block and at the end of the operation, minor complications including chemosis and subconjunctival hemorrhage were observed significantly lower in the peribulbar block group in comparison to the incisionless sub-Tenon's block group ($P<0.05$) (Table 3).

Transient visual lose was observed in two patients (both were in the peribulbar group) ($P=0.146$). They had preoperative visual acuity scores of 6/18 measured on Snellen chart. After the blocks, no light perception was observed in their visual acuity assessments.

Discussion

In recent decades, there is a rising trend in the use of regional anesthesia techniques in ophthalmic surgery; however, no optimal technique has been described to date. The aim of all advances in this area is to provide appropriate globe immobilization, good analgesia, and low complication rate. In this context, the primary endpoint of the present study was planned to compare peribulbar block, one of the most commonly used regional anesthesia techniques, with incisionless sub-Tenon's block, a newer technique, in terms of perioperative minor and major complications. In our study, one major complication including retrobulbar haemorrhage was observed in the peribulbar block group, whereas no patient in the incisionless sub-Tenon's block group developed any major complication. On the other hand, minor complications including subconjunctival haemorrhage and chemosis were slightly more common in the incisionless sub-Tenon's block, compared with the peribulbar block.

Chemosis (orbital swelling) and subconjunctival hemorrhage are accepted as minor complications related to regional ophthalmic blocks, while major complications include orbital and retrobulbar hemorrhages, scleral perforation, optic neuropathy, accommodation defects, retinal vascular occlusion, brainstem anaesthesia, seizures, ventricular fibrillation and death [2, 5, 14, 15]. Palte classified the major complications as life (brainstem anesthesia, acute seizure activity, and cranial nerve block) and sight (retro/peribulbar hemorrhage, ocular penetration/perforation, retinal vascular spasm, optic nerve injury, and ocular myotoxicity) threatening [2]. Life threatening complications are extremely rare, and have been mainly reported as case reports or small case series [16, 17]. On the other hand, retro/peribulbar hemorrhage and ocular penetration/perforation are slightly more common than other major complications. It is very important for the regional ophthalmic anesthesiologists to avoid such sight-threatening misadventures.

In fact, peribulbar block is known as a safe anestesia procedure, with reported low complication rates [18]. However, the incidences of retro/peribulbar hemorrhage and ocular penetration/perforation were 1–3% and 0.1%, respectively [19, 20]. Edge demonstrated that patients with acquired vascular disease were at a significantly greater risk of ocular hemorrhage [21]. In parallel, one patient in our study who developed retrobulbar hemorrhage had a history of acetyl salicylic acid use as an anticoagulant. It was discontinued 3 days before surgery. Treatment of this complication depends on the severity of bleeding, and varies from conventional approaches such as external ocular pressure to urgent surgical interventions such as lateral canthotomy and anterior chamber paracentesis [2]. Our patient had a mild ecchymosis around the eye, was conservatively treated with external ocular compression, bed elevation, and ice packs, closely monitored for 24 h, and healed within few days. In the present study, two patients in the peribulbar block group experienced transient visual loss, in other words amaurosis. Actually, peribulbar block is not expected to induce amaurosis as the injection of anesthetic agent occurs in the extraconal space, in contrast to the retrobulbar block. Thus, potential risks associated with the presence of the needle close to the optic nerve and ophthalmic

Table 3 Comparison of minor complications between the two anesthesia groups

Parameters	peribulbar group (*n* = 48)	İncisionless sub-Tenon's group (*n* = 77)	*P*
15th min after block			
Chemosis	2 (4.2%)	25 (32.5%)	**0.003**
Subconjunctival hemorrhage	2 (4.2%)	25 (32.5%)	**0.003**
At the end of the surgery			
Chemosis	2 (4.2%)	19 (24.7%)	**0.012**
Subconjunctival hemorrhage	4 (8.4%)	22 (28.6%)	**0.045**
Postoperative first day			
Chemosis	4 (8.4%)	12 (15.6%)	0.482
Subconjunctival hemorrhage	5 (10.4%)	15 (19.5%)	0.462

All variables are presented as *n* (%)

Bold indicates a p value less than 0.05

artery are supposed to avoid in the peribulbar technique. Amaurosis following peribulbar block might be explained by the fact that some anesthetic solution may have penetrated the retrobulbar space, and affected the optic nerve [22]. Needle size and handling, the injection sites, the number of injections, and LA volume were all demonstrated as the risk factors for amaurosis. In cases where only the optic nerve is affected, transient visual loss is usually resolved spontaneously. However, a few cases of brainstem intoxication, characterized with the involvement of 2.–4. cranial nerves and the meninges/subarachnoid space surrounding the optic nerve, resulting in sympathetic hyperactivity, confusion and respiratory depression have been reported in the literature [16, 17, 22]. The two patients with amaurosis recovered vision fully spontaneously.

The incidence of minor complications including chemosis and subconjunctival hemorrhage varies in the previous studies [1, 3, 6, 23, 24]. Chemosis is defined as swelling of the conjunctiva due to the inappropriate forward spread of the local anesthetic agent. In the majority of previous studies, it has been reported that chemosis is more common after sub-Tenon's block compared to peribulbar block [6, 7]. Contrary, Budd et al. [25], and Antony et al. [3] found no significant difference in terms of chemosis between these methods. In a study compared standard and incisionless lacrimal dilator-facilitated sub-Tenon's blocks, the authors showed that the incidence of intraoperative chemosis and postoperative conjunctival hemorrhage was decreased by the use of incisionless technique [13]. In one of the first studies on sub-Tenon's block, it was stated that such minor complications were common in this technique, but did not cause serious intraoperative complications [26]. In our study, chemosis and conjunctival hemorrhage were observed more commonly in the incisionless sub-Tenon's group at 15th min of block and at the end of surgery. However, those complications resolved within few days after surgery, and no serious clinical problem developed in any patient.

The study had several limitations. First, it was conducted in a single center, which may limit the generalizability of the results. Second, the relatively small sample of subgroups may be considered another limitation of this work, particularly for major complications including retro/peribulbar hemorrhage and ocular penetration/perforation. However, the fact that the present study is the first to compare incisionless sub-Tenon's block and peribulbar block in terms of perioperative complications makes it scientifically valuable.

Conclusion

Incisionless sub-Tenon's and peribulbar blocks were similar in hemodynamic parameters. Minor complications including subconjunctival haemorrhage and chemosis were more common in the incisionless sub-Tenon's block; however, this difference was statistically balanced on the first postoperative day. Three patients in the peribulbar block developed major complications including one retrobulbar hemorrhage and two transient visual loses, whereas there was no major complication in the incisionless sub-Tenon's block. According to those results, incisionless sub-Tenon's block seems to be a safe and reliable alternative for ophthalmic procedures.

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Author contributions
Y.K. wrote the main manuscript text. All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Y.K. All authors reviewed the final manuscript.

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Availibility of data and materials
The data sets supporting the findings of the current study are openly available in Zenodo at athttps://doi.org/10.5281/zenodo.14108338. The data sets used and/or analysed during the current study available from the corresponding author on reasonable request. No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
The original study followed guidelines outlined by the Helsinki Declaration and was approved by the Eskisehir Osmangazi University Clinical Research Ethics Committee (28.11.2023/9). All methods were performed under the relevant Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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