ORIGINAL PAPER DOI: 10.5603/oj.94021

Medial canthal peribulbar block — a safe, efficacious alternative to conventional peribulbar block

Ditsha Datta, Perwez Khan

Department of Ophthalmology, GSVM Medical College, Kanpur, India

ABSTRACT

BACKGROUND: Peribulbar block (PBB), under which the majority of ocular surgeries are performed, is associated with several complications like conjunctival chemosis, hemorrhage, lid edema, retrobulbar hemorrhage, myotoxicity, and optic nerve injury. The volume of drug injected is 6–10 mL. Thus, a new innovative technique of peribulbar block through the medial canthus (MCB) with a lesser volume of 5 mL was developed as an alternative to conventional peribulbar block. The aim of the study was to assess effectiveness, safety profile, complications, and severity of pain in MCB for intraocular surgeries and to compare the same with conventional PBB.

MATERIAL AND METHODS: A total of 54 patients and 108 eyes planned for cataract surgery — phacoemulsification and small incision cataract surgery (SICS) — were enrolled for the study. One eye of each patient was operated on under PBB anaesthesia, and the other eye under MCB. Anaesthesia, akinesia, complications, and pain associated with both block techniques were assessed and compared.

RESULT: MCB allowed to achieve higher akinesia (overall akinesia score was low), better block-induced anaesthesia(no sensation), lesser pain sensation during the block (numerical pain scale), and fewer complications than conventional PBB.

CONCLUSION: MCB is superior to conventional PBB in terms of efficacy, safety profile, complications, and associated pain. A smaller quantity of drugs required is an added advantage.

KEY WORDS: medial canthal block; peribulbar block; akinesia

Ophthalmol J 2023; Vol. 8, 131–137

INTRODUCTION

Surgical procedures are undertaken under different modes of anaesthesia, including local, regional and general anaesthesia. Surgical anaesthesia may be loosely defined as complete or partial loss of sensation, with or without loss of consciousness, due to administration of an anaesthetic agent, usually by injection or inhalation [1].

Ophthalmic surgeries are one of the most common surgical procedures that require anaesthesia. Several options are available, including local anaesthetic options such as topical, sub-Tenon's, peribulbar and retrobulbar techniques, and general anaesthesia. Local anaesthesia is usually preferred over general anaesthesia in ophthalmology owing to short duration of procedures and complications

CORRESPONDING AUTHOR:
Ditsha Datta, Department of Ophthalmology, GSVM Medical College, Kanpur, India; e-mail: medicoditsha@rediffmail.com

associated with general anaesthesia. The subset of surgeries that can be undertaken under local anaesthesia includes cataract removal, corneal transplantation, glaucoma surgeries, vitreoretinal surgeries, strabismus repair, and evisceration [2, 3].

The aim of anaesthesia during ophthalmic surgery is to provide the patient with analgesia to ensure patient cooperation and provide akinesia for the surgeon's ease to create optimal surgical conditions and facilitate the procedure. Anaesthesia is vital to reduce the risk of intraoperative complications [4].

A comprehensive knowledge of ocular anatomy and physiology is vital for the administration of anaesthesia to achieve adequate levels of anaesthesia and akinesia and to identify the complications that may occur during anaesthesia delivery.

The orbit consists of the globe anteriorly, adipose tissue, extraocular muscles, connective tissue sheaths, nerves, and vessels. The ophthalmic division of the trigeminal nerve V1 is responsible for the sensory innervation of the globe. Motor innervation to extraocular muscles is by the oculomotor, trochlear, and abducens nerves [5]. Local anaesthesia will cause anaesthesia, analgesia, and akinesia of both the globe and extraocular muscles [5]. The ciliary ganglion, a parasympathetic ganglion lying inside the conal space, is blocked, too. Because the optic nerve also passes through the intraconal space in close proximity to these nerves, there is a risk of inadvertent puncture of the optic nerve.

Normal intraocular pressure (IOP) is approximately 10 mm Hg to 21 mm Hg. Increases in IOP frequently occur during the retrobulbar and peribulbar block (PBB). This has detrimental effects, causing impairment of perfusion, reduced blood flow, and ischaemic insult to ocular structures, including the retina, choroid, and optic nerve, resulting in visual impairment following surgery [6].

Anaesthetic requirements vary depending on the procedure and level of cooperation from the patient. Peribulbar and topical anaesthetic techniques are the most frequently used anaesthesia methods in the United States for cataract procedures [7].

The most common drug combination is a 1:1 mixture of 2% lignocaine with 0.5% or 0.75% bupivacaine with hyaluronidase 25 IU/mL [8].

A brief description of the conventional techniques like retrobulbar and peribulbar is as follows.

In the retrobulbar block, the eye is first topically anaesthetized with proparacaine 0.5%. Under all aseptic precautions, a 32 mm 23 to 25 G needle is inserted through the lower eyelid just above the orbital margin between the lateral and middle third of the lower eyelid. Nearly 5 mL of the drug infiltrates behind the globe into the intracellular space. This used to be the gold standard in the past, but now it is infrequently used due to the risk of severe adverse effects [9, 10].

The PBB requires the same preparation as the retrobulbar, but a shorter needle, 24 mm in length, is used. Owing to the shorter length of the needle, the drug is infiltrated into the extraconal space. A total of 6–10 mL medicine is used [9], globe perforation in posterior staphyloma is a potential complication [10].

Sub-Tenon's block is applied under Tenon's capsule [11], and topical anaesthesia supplemented with intracameral lidocaine is also an emerging option, preferred for its non-invasive nature, but it does not provide akinesia. Eye movements are possible. Therefore, only cooperative patients and short-duration surgeries like cataracts can be suitable [9].

All the anaesthetic techniques described above are associated with complications, like transient decrease in visual acuity due to conduction blockade of the optic nerve or ischemia to the optic nerve [12].

More severe complications, including retrobulbar haemorrhage, oculocardiac reflexes, globe penetration, optic nerve damage, and brainstem anaesthesia are possible when the drug is injected in the cerebrospinal fluid [12, 13]. Diplopia can also occur due to the injection of anaesthetic into a muscle sheath.

Minor and more frequent complications include: pain during the procedure, lid oedema, and conjuctival chemosis with subconjuctival haemorrhage. Also, the inadequate effect of block with partial akinesia and anaesthesia is frequent, requiring supplementation of the block, which is a challenging task once the surgery has started. Thus, the need arises for a superior anaesthetic technique that overcomes the downsides of the conventional PBB while ensuring a higher safety profile with limited risks for severe complications, as mentioned above.

In this study, we compared the medial canthal block (MCB) with the conventional PBB in terms of akinesia score, anaesthesia, and analgesia induced by the block. Also, the need for supplementation of the block due to inadequate effect was taken into consideration. Interestingly, in a study conducted by Ripart et al. it has been demonstrat-

ed that anaesthetic drug injected via the medial canthus may result in either PBB (by Hustead technique, which inserts the needle at the medial most corner of the medial canthus) or subtenons block (by Ripart technique which inserts the needle at the lateral convexity of plica semilunaris) depending on the puncture site. In our study, we used the first site of injection demonstrated by Hustead, ensuring peribulbar infiltration of anaesthetic drug [14].

Aim of the study

The aim of this study was to compare MCB and conventional PBB in patients planned for various intra-ocular surgeries like cataracts, trabeculectomy, secondary intraocular lens (IOL) implantation with regards to anaesthesia, akinesia, pain during the block administration and complications of the block. The need for supplementation is due to each technique's inadequate effect and safety profile.

MATERIAL AND METHODS

The study was a hospital-based randomized, prospective, comparative, interventional study, which included 54 patients of both sexes and 108 eyes planned for cataract surgery — phacoemulsification and small incision cataract surgery (SICS), who were admitted to the Department of Ophthalmology, at a tertiary care centre in India, from January 2022 to February 2023. Both patients' eyes were included in the study. One eye was operated under peribulbar anaesthesia, and the other under medial canthal peribulbar anaesthesia. The same surgeon administered all the blocks and surgeries to reduce the inter-observer variability. The study was conducted after approval from the institution's ethical approval committee and after obtaining written informed consent from patients in accordance with the Declaration of Helsinki.

Exclusion criteria

The exclusion criteria were as follows:

- refusal to give consent and participate in the study;
- patients under the age of 18 years;
- psychiatric and uncooperative patients;
- concurrent ocular infection or infection at the site of injection;
- axial length more than 30 mm;
- anaphylactic reaction to anaesthetic drugs;
- uniocular patients.

Computer-generated randomization was used to randomise patients into group A and group B:

- group A (54 patients) — MCB technique;
- group B (54 patients) — PBB technique.

Pre-operative settings

History, clinical examination, and routine investigations, including complete blood count (CBC), random blood sugar (RBS), electrocardiogram (ECG), prothrombin time (PT), and activated partial thromboplastin time (aPTT), and routine ophthalmological investigations like biometry, ultrasound (USG) B-scan were performed in all patients. Pre-operative sensitivity to anaesthetic drugs was performed.

Anesthetic technique

The procedure was performed in the operating theatre under all aseptic precautions. The patient was placed in the supine position. The periorbital skin was cleaned with 10% povidone-iodine for sterilization. The conjunctival sac was cleaned with 5% povidone-iodine eye drops and a drop of 5% moxifloxacin. Topical anaesthesia was provided with 0.5% proparacaine before the performance of the block.

The anaesthetic block injection consisted of 1:1 mixture of 2% lignocaine hydrochloride, equivalent to 20 mg/mL, and 0.5% bupivacaine hydrochloride, equivalent to 5 mg/mL with 1500 IU hyaluronidase dissolved in the vial (30 IU/mL). A mixture of 2.5 mL of lignocaine and 2.5 mL bupivacaine-hyaluronidase was prepared in the syringes (5 mL total volume).

Group A: MCB

The 24 G, 25-mm long syringe was inserted through the conjunctiva at the medialmost corner of the medial canthus. The needle was advanced vertically downwards and slightly medially following the contour of the orbital medial wall with the bevel directed toward the globe. Once the needle was inserted into the hub without any resistance, the patient was asked to move his eyes horizontally to prevent trauma to the medial rectus muscle. 5 mL of the block was injected after ensuring that the needle tip hadn't punctured any vessel.

Group B: PBB

The 24 G, 25-mm needle was inserted transcutaneously just above the inferior orbital rim at the junction between the medial two-third

and the lateral third of the lower lid with a bevel towards the globe and the tip toward the floor of the orbit until the needle passed through the orbital septum it was directed then posteriorly tangential to the floor of the orbit for 25-mm length at which the 2.5-ml local anesthetic mixture was injected. Another 2.5 mL of the anaesthetic solution is injected transcutaneously through the upper lid just below the superior orbital margin at the junction of the medial third and lateral two-third similarly. Ocular compression was applied for 5 minutes by Honan's IOP reducer, adjusted at 20 mm Hg.

Data collection

We assessed and compared the two groups on the following parameters:

- akinesia score based on motor blockade, assessed using a 1–3 score: grade 1 — complete restriction of movement, grade 2 — eye movement < 15º, grade 3 – eye movement > 15º. This score was compared between the groups 1, 5, and 10 min after injection and at the end of the surgical procedure. All the four recti muscle, levator palpebrae superioris and orbicularis oculi were assessed for akinesia. Thus, a total score of 18 was obtained. An inadequate block was defined as a score > 12 after 10 min from the local anaesthetic injection. The need for supplemental injection in the two groups was also recorded. Supplemental block, if required, was administered in both groups using the same solution, and 5 mL was used (2.5 ml of 5% lignocaine and 2.5 ml of 0.5% bupivacaine combined with hyalonuridase) as peribulbar technique is considered the classic well-tested technique;
- pain sensation produced during injection of the block was graded using a Likert numeric 10-point scale; 0 indicates no pain, while 10 represents the worst possible pain;
- anaesthesia induced by the block was recorded as no sensation, touch sensation, or pain sensation at 10 min after block administration. All the scores were recorded by the investigator in a blinded manner, unaware of the technique of block used;
- various complications associated with the block, such as lid edema, conjunctival chemosis, subjunctival haemorrhage, or any severe complications such as retrobulbar haemorrhage, and raised IOP, were also recorded by the investigator in a blinded manner;
- duration of surgery in minutes for every patient in each group was recorded;

Primary outcomes

Akinesia score, quality of anaesthesia produced, and Likert numerical pain scale grading of pain during the procedure were the main parameters for assessing and comparing the two groups. The time of onset of the accepted akinesia score needed for supplementation in each group was recorded, too.

Secondary outcomes

Secondary outcome was assessed by comparing the incidence of complication and safety profile between the two groups (MCB and PBB).

Data management and analysis

Using the STATA program, the alpha error was set at 5%, power was set at 90%, and the significant level was set at 95%. The confidence limit was kept at 0.05.

For sample size calculation for the study, the following formula was used:

$$Number\ of\ patients\ \{n\} = \frac{2x\left(Z\left(1-\frac{\alpha}{2}\right)\leftarrow Z\beta\right)^2 x\sigma^2}{\Delta^2}$$

Where α = significance level; β = power, probability of detecting a significant result; δ = standard deviation (SD) of data; Δ = size of the difference. p-value of < 0.05 was considered significant at a 95% confidence interval. The sample size was calculated as 54 eyes in each group, a total of 108 eyes in 54 patients:

- group A (54 eyes). Medial canthal block (MCB) technique;
- group B (54 patients). Peribulbar block (PBB) technique.

The collected data was analysed by Statistical Package for Social Science (IBM Corp. released 2011, IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). Data was compiled, and suitable statistical tests for analysis were done according to the type of data obtained for each parameter. Data were tested for normality with the Shapiro-Wilk test and expressed as mean (standard deviation) for parametric numerical data or median (interquartile range) for non-parametric numerical data. The p-value was considered significant as the following: p > 0.05 — non-significant (NS), p < 0.05 — significant (S), p e < 0.01 — highly significant (HS).

RESULTS

Demographic data

The two groups were compared regarding patients' age, sex, and duration of surgery, with non-significant statistical differences noted. Table 1 presents patients' demographics and duration of surgery.

Akinesia score

Comparison between group A and group B showed a highly significant statistical difference in the akinesia score at 1, 5, and 10 minutes and at the end of surgery. Akinesia's score was much better in group A. Table 2 presents the comparison between groups A and B regarding the Akinesia score.

Likert Numerical Pain Scale (LNPS)

Comparison between group A and group B showed highly significant statistical difference in the Likert numerical pain scale. The results in the Likert numerical pain scale were much better in group A. Table 3 presents the comparison between groups A and B regarding the Likert numerical pain scale. Scoring was performed out of 10.

Anaesthesia induced by the block technique

Comparison between group A and group B showed a significant statistical difference in the anaesthesia induced by the two different block techniques after 10 mins.

Table 4 compares groups A and B regarding anaesthesia induced by two block techniques at 10 mins.

Complications

No major complications were recorded in group A, 2 patients (3.07%) in group B had extraocular muscle injury, and 3 patients (5.56%) had raised IOP post-block administration. In group A (MCB), 7 cases (12.96%) developed conjunctival chemosis, and 2 cases developed subconjunctival haemorrhage (3.70%). In group B (PBB), 31 cases (57.41%) developed conjunctival chemosis, and 9 cases (16.67%) developed subconjunctival haemorrhage.

Table 1. Patients' demographics and duration of surgery

		Group A (n = 54)		Group B (n = 54)		P-value	Significance
		Mean	SD	Mean	SD		
Age		50.34	6.53	52.43	6.05	> 0.05	NS
Durationofsurgery (min)		21.67	6.77	22.38	6.71	> 0.05	NS
Sex	Male	30	55.56%	26	48.15%	> 0.05	NS
	Female	24	44.44%	28	51.85%		

Group A — medial canthal block; Group B — peribulbar block; n — number of cases; SD — standard deviation

Table 2. Comparison between groups A and B regarding the Akinesia score

Time	Group A (n = 54)	Group B (n = 54)	P-value	Significance
Akinesia at 1 min	18	18	> 0.05	NS
Akinesia at 5 min	9	15	< 0.05	S
Akinesia at 10 min	6	14	< 0.01	HS
Akinesia at the end of surgery	6	10	< 0.01	HS
Need for supplement	8 (14.81%)	28 (51.85%)	< 0.01	HS

Group A — medial canthal block; Group B — peribulbar block; n — number of cases; Data are presented as median (IQR) or number of patients

Table 3. Ccomparison between groups A and B regarding the Likert numerical pain scale

Variable	Group A (n = 54)	Group B (n = 54)	P value
Numerical pain score	4.5	9	< 0.01

Group A — medial canthal block; Group B — peribulbar block; n — number of cases; Data are presented as median (IQR) or number of patients

Table 4. Comparison between groups A and B regarding anaesthesia produced by two different block techniques at 10 mins

	Group A (n = 54)	Group B (n = 54)	P-value	Significance
No sensation	45 (83.33%)	11 (20.37%)	< 0.05	S
Touch sensation	7 (12.96%)	33 (61.11%)		
Pains ensation	2 (3.70%)	10 (18.52%)		

Group A — medial canthal block; Group B — peribulbar block, n number of cases; Data are presented as median (IQR)

DISCUSSION

In this study, the MCB allowed to achieve better akinesia (lower akinesia score) than PBB at 1, 5, 10 min and after completion of surgery with a significant statistical difference (p-value < 0.01).

Our result was similar to that of a studies performed by Ripart et al. [14] and Elsayed et al. [15]. They compared MCB and conventional PBB. They concluded that MCB had better akinesia score when measured at different intervals of time than PBB, and hence, the need for supplementation was lower in the MCB group.

Moreover, in our study, although the same volume (5 mL) of anaesthetic drug injection was injected in both groups at the start, the number of patients who required supplementation was higher in the PBB group. Thus, we can safely conclude that a higher volume of the drug, 6–10 mL, is required to produce adequate anaesthesia in the PBB. This finding is similar to a study conducted by Fahmi et al. [16], who used 7–10 mL of anaesthetic solution to apply the PBB.

In contrast to our study, Ashok et al. found no statistically significant difference between the two groups with regard to akinesia score. However, a drawback of the study was that the volume injected for PBB was 10 mL which was divided into 7 mL injected through the lower lid at the inferotemporal orbital border and 3 mL injected through the upper lid at the superonasal orbital border, whereas for subtenons anaesthesia via MCB they injected 3 mL of anaesthetic drug [17].

In the PBB group in our study, 28 patients (51.85%) required supplementation, with a total volume of 10 mL of anaesthetic drug injected, whereas in the MCB group, only 8 patients (14.81%) required supplemental block. It is worth mentioning that orbit is a closed space with limited volume; higher drug volumes, when injected, always carry the risk of raised IOP, which may cause optic nerve compression and alter vascular haemodynamics, resulting in ischaemic insult to the retina, choroid, or optic nerve. 5.56% of the PPB group had raised IOP in our study post-block administration.

In our study, four cases (7.41%) in the PBB group had a worsened akinesia score at the end of surgery, as the duration of surgery exceeded 30 mins. The MCB group, on the other hand, had no wearing-off effect of anaesthesia even if the surgical procedure extended beyond 30 mins, thus, akinesia score was maintained. This was also recorded by the Elsayed et al. [15] study, as they also had two cases with regressed motor score at the end of surgery.

Regarding the onset of action of the block, the MCB was superior to PBB, and the difference was statistically significant at 5 min and 10 min after block injection, i.e., faster action was recorded for the MCB group. This result was similar to the results of the studies of Ripart et al. [14], Ashok et al. [17], and Elsayed et al. [15].

Regarding pain sensation at the time of block administration of the block in the Likert numerical pain scale, the MCB group in our study achieved better results in the numeric pain scale than the PPB group, and the result was statistically highly significant (p-value < 0.01). This result was supported by Ashok et al. and Elsayed et al. studies, where authors found similar results.

In our study, there were no significant complications (optic nerve injury, retrobulbar hemorrhage, globe perforation, raised IOP, extraocular muscle injury) in the MCB group. However, the PPB group had 5 significant complications: 2 had muscle injury, and 3 had raised IOP. Both groups had conjunctival chemosis and subconjunctival haemorrhage, but the incidence was higher in the PBB group. This is similar to the study conducted by Nouvellon et al., in which only a small number of patients had similar complications [18]. Nouvellon et al. concluded that MCB was theoretically safer than PBB. They also observed the correlation between a higher incidence of complications and experience of person administering the block.

CONCLUSION

We conclude that MCB is superior to PBB in terms of motor akinesia score, quicker onset of action, and infrequent need for supplementation with high statistically significant value. Anaesthesia induced by MCB was better than PBB. Pain experienced by patients during MCB administration was much less than during PBB, which is very important as this reduces patients' apprehension during the surgery, ensuring better cooperation. Complications were also less often in the MCB group than in the PBB group, ensuring a safety profile. In conclusion, our study proved that MCB was the better choice than PBB.

Conflict of interest

No conflict of interest.

Funding

No financial support.

REFERENCES

1. Armstrong RA, Mouton R. Definitions of anaesthetic technique and the implications for clinical research. Anaesthesia. 2018; 73(8): 935–940, doi: 10.1111/anae.14200, indexed in Pubmed: 29280142.
2. Mavrakanas NA, Stathopoulos C, Schutz JS. Are ocular injection anesthetic blocks obsolete? Indications and guidelines. Curr Opin Ophthalmol. 2011; 22(1): 58–63, doi: 10.1097/ICU.0b013e328341426f, indexed in Pubmed: 21088581.
3. Wong DH. Regional anaesthesia for intraocular surgery. Can J Anaesth. 1993; 40(7): 635–657, doi: 10.1007/BF03009701, indexed in Pubmed: 8403138.
4. Kelly DJ, Farrell SM. Physiology and Role of Intraocular Pressure in Contemporary Anesthesia. Anesth Analg. 2018; 126(5): 1551–1562, doi: 10.1213/ANE.0000000000002544, indexed in Pubmed: 29049074.
5. Ripart J, Nouvellon E, Chaumeron A. Regional Anesthesia for Eye Surgery. Reg Anesth Pain Med. 2005; 30(1): 72–82, doi: 10.1097/00115550-200501000-00009, indexed in Pubmed: 15690272 .
6. Wang YaX, Xu L, Wei WB, et al. Intraocular pressure and its normal range adjusted for ocular and systemic parameters. The Beijing Eye Study 2011. PLoS One. 2018; 13(5): e0196926, doi: 10.1371/journal.pone.0196926, indexed in Pubmed: 29771944.
7. Leaming DV. Practice styles and preferences of ASCRS members--2002 survey. J Cataract Refract Surg. 2003; 29(7): 1412–1420, doi: 10.1016/s0886-3350(03)00405-x, indexed in Pubmed: 12900253.
8. Bina B, Hersh EV, Hilario M, et al. True Allergy to Amide Local Anesthetics: A Review and Case Presentation. Anesth Prog. 2018; 65(2): 119–123, doi: 10.2344/anpr-65-03-06, indexed in Pubmed: 29952645.
9. Nanji KC, Roberto SA, Morley MG, et al. Preventing Adverse Events in Cataract Surgery: Recommendations From a Massachusetts Expert Panel. Anesth Analg. 2018; 126(5): 1537–1547, doi: 10.1213/ANE.0000000000002529, indexed in Pubmed: 28991115.
10. Davis DB, Mandel MR. Efficacy and complication rate of 16,224 consecutive peribulbar blocks. A prospective multicenter study. J Cataract Refract Surg. 1994; 20(3): 327–337, doi: 10.1016/s0886-3350(13)80586-x, indexed in Pubmed: 8064611.
11. Crandall AS. Anesthesia modalities for cataract surgery. Curr Opin Ophthalmol. 2001; 12(1): 9–11, doi: 10.1097/00055735-200102000-00003, indexed in Pubmed: 11150075.
12. Mavrakanas NA, Stathopoulos C, Schutz JS. Are ocular injection anesthetic blocks obsolete? Indications and guidelines. Curr Opin Ophthalmol. 2011; 22(1): 58–63, doi: 10.1097/ICU.0b013e328341426f, indexed in Pubmed: 21088581.
13. Kumar CM. Needle-based blocks for the 21st century ophthalmology. Acta Ophthalmol. 2011; 89(1): 5–9, doi: 10.1111/j.1755-3768.2009.01837.x, indexed in Pubmed: 20163372.
14. Ripart J, Lefrant JY, Vivien B, et al. Ophthalmic regional anesthesia: medial canthus episcleral (sub-tenon) anesthesia is more efficient than peribulbar anesthesia: A double-blind randomized study. Anesthesiology. 2000; 92(5): 1278–1285, doi: 10.1097/00000542-200005000-00015, indexed in Pubmed: 10781272.
15. Elsayed AA, Zaghlol M, Allah S, et al. Comparative study between medial canthus episcleral block versus peribulbar block in intracapsular cataract surgery. Ain-Shams J Anesthesiol. 2021; 13(1), doi: 10.1186/s42077-021-00138-6.
16. Fahmi A, Bowman R. Administering an eye anaesthetic: principles, techniques, and complications. Community Eye Health. 2008; 21(65): 14–17, indexed in Pubmed: 18504471 .
17. Ashok A, Krishnagopal S, Jha K. Comparison of peribulbar anesthesia with sub-tenon's in manual small incision cataract surgery. TNOA J Ophthal Sci Res. 2018; 56(2): 67, doi: 10.4103/tjosr.tjosr_12_18.
18. Nouvellon E, L'Hermite J, Chaumeron A, et al. Ophthalmic Regional Anesthesia. Anesthesiology. 2004; 100(2): 370–374, doi: 10.1097/00000542-200402000-00028.