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Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

A comparative study of subtenon's anaesthesia with peribulbar anaesthesia for manual small incision cataract surgery in patients with age related cataracts

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ARTICLE INFO

Article history:
Received 16-07-2022
Accepted 05-08-2022
Available online 06-10-2022

Keywords:
Keywords: Subtenon's
Peribulbar
MSICS

ABSTRACT

Aim: To compare the safety, efficacy and ease of administration of subtenon's anaesthesia with peribulbar anaesthesia in manual small incision cataract surgery(MSICS) and assess the surgeon and patient comfort.
Settings and Design: A prospective longitudinal study was conducted among 200 patients undergoing MSICS at a rural tertiary care hospital wherein patients were randomly divided into the two groups of peribulbar (P) and subtenon's (ST) block.
Materials and Methods: After randomization, 200 patients were assessed for various factors including pain at the time of administration of anaesthetic, time to attain akinesia, patient's comfort and satisfaction score.
Results: 200 eyes of 200 patients who underwent MSCIS were divided into Peribulbar and Subtenon's group by random number table; of which 122 were women (61%) and 78 were men (39%). There was a significant difference in the amount of anaesthetic used, with the group P (8.37+1.19 ml) usage being more than the group ST(4.02+0.91 ml) ($p<0.001$). Group P took significantly lesser time to attain akinesia compared to group ST. Group P achieved significantly higher degree of akinesia than group ST. ($p<0.001$) Significantly greater number of eyes in the group ST required additional anaesthetic injection compared to the group P ($p<0.001$). A significantly more number of patients experienced pain in the group P. ($p=0.008$). Significantly greater number of eyes in group ST had mild and moderate chemosis and subconjunctival haemorrhage compared to group P($p<0.001$).
Conclusion: We found that subtenon's anaesthesia was an equally effective technique for achieving analgesia and akinesia when compared to peribulbar anaesthesia in patients undergoing MSICS.

1. Introduction

Cataract surgery is the one of the most common surgical procedures with a good safety profile. As cataract surgery has evolved over the years, so has the anaesthesia used in an attempt to reduce the risks and complications. Shorter acting, less invasive methods of anaesthesia are being used nowadays for small incision cataract surgery (SICS), which is possible due to the development of better surgical techniques like a self-sealing and smaller wound, availability of better intraocular lens designs and less tissue manipulation with modern instrumentation.[1]

Historically, retrobulbar anaesthesia was used for a long time for cataract surgery but lost popularity due to its associated multiple potentially sight-threatening complications. Peribulbar anaesthesia has become the most popular technique over the last decade. However, it is also not completely free from risks like perforation.[1]

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https://doi.org/10.18231/j.ijceo.2022.083

Ophthalmologists are now looking at subtenon's anaesthesia, in which the local anaesthetic agent is directly injected into the subtenon's space. After instilling topical anaesthetic drops in the conjunctival fornix, a small opening is made in the conjunctiva and tenon's capsule. Through this opening a blunt cannula is inserted to deliver the anaesthetic agent into the subtenon's space. It is becoming popular because of its simplicity and decrease in the risk of needle related injuries and complications as the procedure of injecting into a blind space is prevented.

The Subtenon's anaesthesia is being used in developed countries for phacoemulsification surgeries along with topical anaesthesia,[2] however, there are limited studies on the topic in our country. Therefore, this study was conducted to compare the safety, efficacy and ease of administration of subtenon's anaesthesia with peribulbar anaesthesia in MSICS and assess the surgeon and patient comfort.

2. Materials and Methods

A prospective longitudinal study was conducted among 200 patients who attended Ophthalmology OPD at a rural tertiary care hospital for cataract surgery. After obtaining ethical approval from our institutional review board and informed consent from the patients, patients of both sexes opting for SICS were enrolled in our study. Patients undergoing MSICS for age related cataracts were included in this study. Our exclusion criteria included patients who had sensitivity to the drugs used (lignocaine), > 85 years of age, history of previous ocular surgery, injury or inflammation of the eye, history of previous scleritis/episcleritis, traumatic cataract/congenital cataract/ complicated cataract, patients on aspirin and clopidogrel, unable to follow or having difficulty understanding the scale for pain assessment, patient requesting for a phacoemulsification surgery, anxious patient, chronic alcohol and tobacco users and patient not willing to participate. Patients undergoing MSICS were divided into the two groups of peribulbar (P) and subtenon's (ST) block by using a random number table. Intraoperatively oxygen saturation and pulse rate were monitored continuously till the end of surgery. The ophthalmic blocks were performed under strict asepsis by one of two consultant ophthalmologists with minimum of three years of experience in SICS and in administering peribulbar blocks and subtenons blocks. Both consultants had limited 50 cases each experience of giving subtenon's blocks.

2.1. Technique of peribulbar block (Figure 1)

The cleaning and draping of the eye to be operated and the surrounding area was done with povidone iodine solution (5%) and then asked to look straight up so as to put the eye into the primary position. After palpating the inferior orbital rim, at the junction of the medial two-third and lateral one-third of the rim, a 10 ml syringe with a 24 gauge(G) needle (bevel facing towards the globe) is used to inject the anaesthetic solution (4 ml of 2% ligocaine with 1:1,000 adrenaline, 4% bupivacaine and 75 IU/ml hyaluronidase) through the eyelid skin. The needle was advanced along the floor of the orbit (i.e. parallel to it) and kept tangential to the globe until the hub of the needle touched the eyelid skin. After ensuring there was no aspiration of blood in the syringe, 4-5ml of the anaesthetic solution was injected. This was followed by a digital massage for 2 minutes to increase the spread of the anaesthetic solution. Another 3-4 ml of the anaesthetic solution was injected through the lid at the medial $1/3^{rd}$ and lateral $2/3^{rd}$ junction of the superior orbital rim followed by a digital massage for another 2 minutes and then 2 minutes later akinesia was assessed.

The assessment of akinesia was done with the help of a scale(transparent). Keeping the limbus as a landmark for each quadrant, movement from the primary position was assessed. No movement in three or more quadrants was considered "excellent akinesia", less than two millimetres movement in three or more quadrants was considered as "good akinesia" and movement of the eye to an amount greater than two millimetres in two or more quadrants was considered as "fair akinesia" for which additional anaesthetic was required to be injected.

2.2. Technique for sub-tenon space block (Figure 2)

To be operated eye and surrounding area was cleaned with povidone iodine (5%), two drops of topical anaesthetic (0.5%proparacaine) followed by insertion of a universal wire speculum. The patient was asked to look supero-temporally in order to expose the inferonasal quadrant. The conjunctiva along with the tenon's capsule was grasped with a Lim's forceps and a nick was made with a blunt Westcott scissor approximately 5-6 mm from the limbus, making sure to avoid direct injury to blood vessels. Blunt dissection of the tenon capsule was done using the Westcott scissors, making a narrow channel so as to avoid leakage of the anaesthetic outside through it. After withdrawing the Westcott's, a curved, blunt tipped steel subtenon's cannula (21G, 2.54-cm) was inserted through the channel created, keeping the cannula along the curvature of the globe. It was inserted till the hub of the cannula touched the external conjunctival opening. This position ensured that the cannula tip was placed posterior enough to help attain an effective block.

The anaesthetic solution comprising of 6ml of lignocaine along with adrenaline, bupivacaine and 75 IU/ml hyaluronidase was injected slowly. Initially 3ml was injected as subtenon's Minimal digital compression was performed followed, 2 minutes later by assessment of akinesia. If akinesia was inadequate, additional 2ml was administered.

2.3. Pain assessment

Pain assessment was carried at multiple intervals i.e. during the procedure and postoperatively at 0, 1, 4 and 24 hours. It was assessed using a ten point numeric rating scale by asking the patient to score the pain in a range of zero to ten. Only the complaint of most severe pain on more than one occasion was considered as significant. According to the rating scale, absence of pain was taken as zero, scores less than five were considered as mild pain and moderate to severe pain was scored as >5. Oral paracetamol was used to alleviate the moderate-to-severe postoperative pain and oral diclofenac was administered if the pain was still persistant.

The other factors assessed included the time to attain akinesia, patient's comfort and satisfaction score with regards to the administration of anaesthesia. Patient comfort score was assessed as: 0- complete absence of sensation in the operated eye, 1- presence of sensation of the eye (slight pressure) but with no discomfort, 2- mild discomfort, but with the patient declining further analgesia or with no obvious clinical need for such further intervention, 3- patient expresses wish for additional analgesia or exhibits an obvious clinical need for such intervention such as a state of distress related to pain on further questioning or requested for pain relief.

Intraoperative Positive Pressure(PP) was graded as: 0 – No PP 1 – Mild – not requiring intervention, 2 – Moderate – settled with intraoperative manoeuvres and 3 – Severe – requiring intravenous mannitol.

Amount of Subconjunctival Haemorrhage (SCH) was graded as 0 – no haemorrhage, 1 – mild(<90 degrees/ 1 quadrant), 2 – moderate (> 90 degrees/ 2 quadrants) and 3 – severe (> 180 degrees/ > 2 quadrants).

Amount of Chemosis was graded as 0 – no chemosis, 1 – mild (<90 degrees/ 1 quadrant), 2 – moderate (> 90 degrees/ 2 quadrants) and 3 – severe (> 180 degrees/ > 2 quadrants) – causing obstruction in vision.

The presence of pain intraoperatively and postoperatively and its severity were the primary outcome measures. The secondary outcome measures included anaesthesia related complications, amount of anaesthesia used and the patient satisfaction after the MSICS.

2.4. Statistical analysis

Continuous variables were expressed as mean with standard deviation or median with interquartile range (IQR) and group differences between continuous variables were analyzed using the student t test or the Wilcoxon's ranksum test in cases with nonparametric distribution. The Shapiro Wilk test was used to understand the normalcy of distribution of continuous variables. Categorical variables were expressed as proportions (n, %) and group differences between categorical variables were analyzed using the chi square test or the Fischer's exact test for proportions below 5%. Correlations between some of the continuous variables were assessed using the Pearson's correlation coefficient and expressed graphically using the Locally Weighted Scatterplot Smoothing (LOWESS) curve.

The data analysis was done using STATA 12.1 I/c (STATA Corp, Fort Worth, Texas, USA) after entering the data into Microsoft Excel. A p value was considered statistically significant when it was less than 0.05.

3. Results

We included 200 eyes of 200 patients in this study who underwent MSCIS during the study period. Of these, they were divided into a group of 100 who underwent surgery under peribulbar anaesthesia (Group P) and the remaining 100 patients underwent surgery using the sub-tenon's anaesthesia(Group ST) by random number table. The mean age of patients was 62.37 + 8.9 years (median= 64.5 years, IQR=57-69 years, range=38-85 years).

There were 122 women (61%) and 78 men (39%) in the study cohort.(Figure 3) There were no differences in age between men (62.46+8.2 years) and women (62.41+9.5 years) participants.

Comparison of various study parameters between two groups; Group P vs Group ST.

3.1. Amount of anaesthetic injected

There was a significant difference in the amount of anaesthetic used, with the group P (8.37+1.19 ml) usage being more than the group ST(4.02+0.91 ml) (p<0.001) (Figure 4)

3.2. Time to akinesia

Group P took significantly lesser time to attain akinesia 3.11+0.82 minutes (95% CI=2.94-3.27 minutes, median= 3minutes, IQR=2.5-4 minutes) compared to group ST i.e. 3.69+0.0 minutes (median=3.5 minutes, IQR=3-4 minutes)(Figure 5).

3.3. Degree of akinesia

In group P, 88 eyes achieved excellent akinesia, 11 eyes achieved good akinesia and 1 eye achieved fair akinesia while in group ST, 66 eyes achieved excellent akinesia, 20 eyes achieved good akinesia and 14 eyes achieved fair akinesia. Group P achieved significantly higher degree of akinesia than group ST. (p<0.001)

3.4. Association between amount of anaesthetic injected and time to akinesia

There was a negative correlation between amount of anesthetic injected and time taken to achieve akinesia i.e. greater volume of anaesthetic lead to faster akinesia i.e. took

lesser time to attain akinesia. This was true irrespective of type of technique used for anesthesia. (Figure 6)

3.5. Additional anaesthetic injection

Significantly greater number of eyes in the group ST (n=17, 16.5%) required additional anaesthetic injection compared to the group P(n=1, 1%) (p<0.001). The amount of additional anesthetic required in the group ST varied from 1-4 ml with a mean of 2.16+0.78ml and median of 2ml with IQR=1-3ml.

3.6. Pain at various time points in the two groups

3.6.1. At time of administration

In group P, 40 eyes experienced no pain, 56 eyes experienced mild pain and discomfort and 4 eyes experienced moderate and bearable pain while in group ST, 63 eyes experienced no pain, 33 eyes experienced mild pain and discomfort and 4 eyes experienced moderate and bearable pain. A significantly more number of patients experienced pain in the group P. (p=0.008) (Figure 7)

3.6.2. Immediately after surgery

In group P, 80 eyes experienced no pain and 20 eyes experienced mild pain and discomfort while in group ST, 89 eyes experienced no pain and 11 eyes experienced mild pain and discomfort. There was no difference in pain in the two groups immediately after surgery. (p=0.17)

3.6.3. 1 hour post-op

In group P, 93 eyes experienced no pain and 7 eyes experienced mild pain and discomfort while in group ST, 96 eyes experienced no pain and 4 eyes experienced mild pain and discomfort. There was no difference in pain in the two groups 1 hour after surgery. (p=0.34)

3.7. Comfort score

3.7.1. Patient comfort

In group P, 97 eyes experienced no pain and 3 eyes experienced slight pain. In group ST, 98 eyes experienced no pain and 2 eyes experienced slight pain. There was no significant difference in patient comfort scores in the two groups.(p=0.47)

3.7.2. Surgeon comfort

Surgeons reported no discomfort at all in any of the cases operated across both groups.

3.8. Complications

3.9. PP during surgery

In group P, 94 eyes experienced no PP, 4 eyes experienced mild PP and 2 eyes experienced moderate PP. In group ST, 84 eyes experienced no PP, 10 eyes experienced mild PP, 3 eyes experienced moderate PP and 3 eyes experienced severe PP. Slightly higher number of eyes in the group ST experienced PP during surgery compared to group P. (p=0.05)

3.10. Globe perforation

There were no globe perforations in either group.

3.11. Chemosis

In group P, 83 eyes showed no chemosis, 15 eyes showed mild chemosis, 1 eye showed moderate chemosis and 1 eye showed severe chemosis. In group ST, 50 eyes showed no chemosis, 30 eyes showed mild chemosis, 19 eyes showed moderate chemosis and 1 eye showed severe chemosis. Significantly greater number of eyes in group ST had mild and moderate chemosis compared to group P(p<0.001). (Figure 8)

3.12. SCH

In group P, 98 eyes showed no SCH and 2 eyes showed mild SCH. In group ST, 58 eyes showed no SCH, 35 eyes showed mild SCH and 6 eyes showed SCH. Significantly greater number of eyes in the group ST had mild and moderate SCH compared to group P(p<0.001).(Figure 8)

4. Discussion

Cataract surgery using phacoemulsification with a clear corneal incision is much different from MSICS wherein conjunctival peritomy, dissection and a scleral incision is required. Usually, a superior rectus bridle suture is employed in MSICS. The bridle suture placement is painful since the muscle belly is grabbed with tooth forceps and this particular step, in addition to more globe handling, in MSICS makes it a slightly more painful procedure for the patient. This warrants use of preoperative anaesthesia that provides significantly deeper analgesia when performing MSICS compared to clear corneal phacoemulsification. Hence, even though topical anaesthesia has become the standard of care while performing clear corneal phacoemulsification, more invasive forms of anaesthesia are necessary for MSICS.

The anaesthesia for MSICS can range from general anaesthesia to retrobulbar anaesthesia, peribulbar anaesthesia, subtenon's anaesthesia and topical anaesthesia.[3] General anaesthesia is rarely performed for cataract surgery these days and is generally restricted to pediatric age group and for very uncooperative patients such as those with Down's syndrome and very rarely in eyes where cataract is being combined with trauma repair.[4,5] Retrobulbar anaesthesia involves injecting small amount of anaesthetic in the intraconal space and is considered

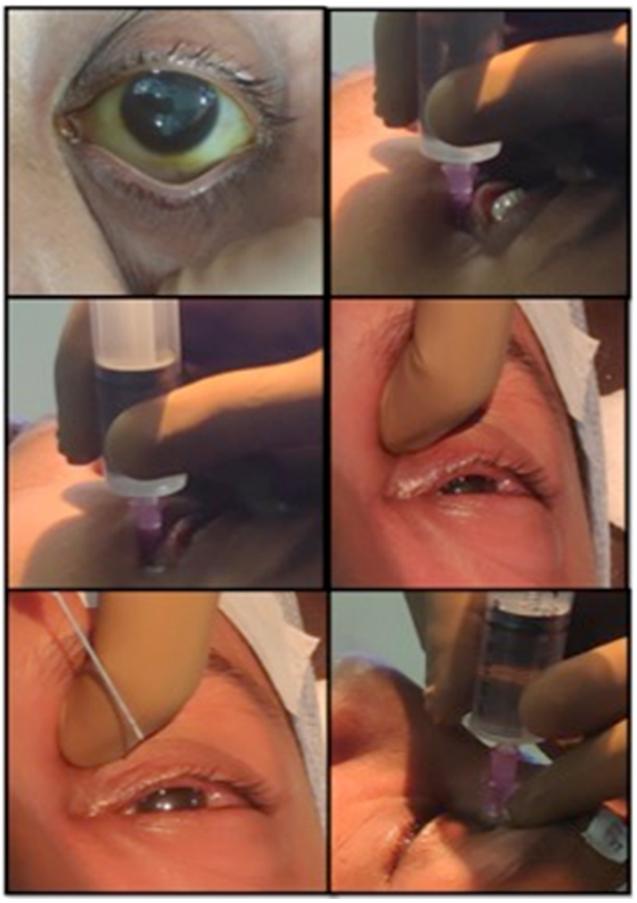

Fig. 1: Technique of giving a peribulbar block

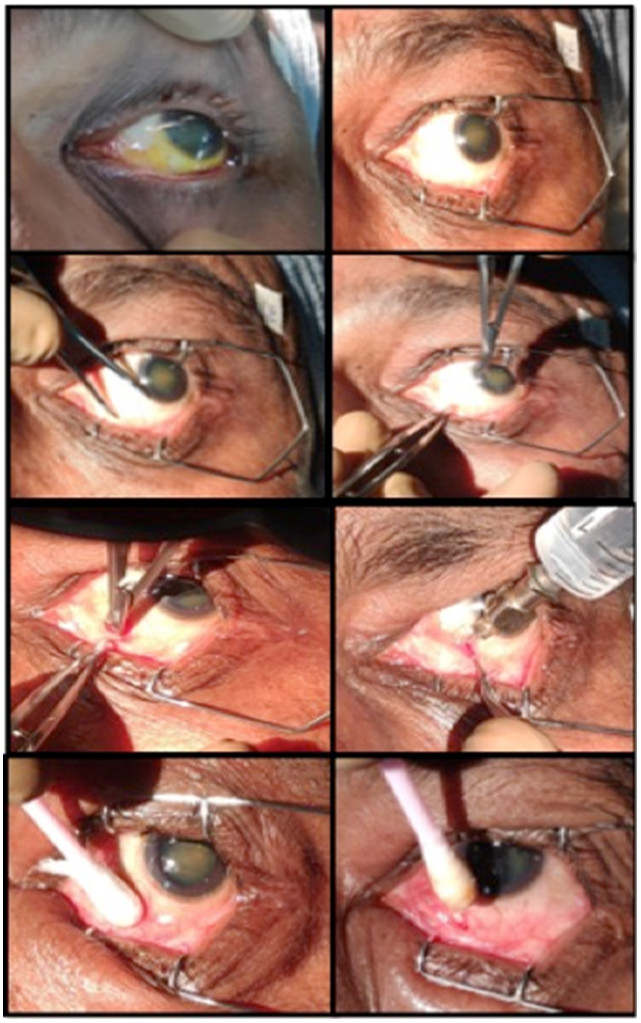

Fig. 2: Technique of giving a subtenon's block

more dangerous due to risk of injury to delicate structures as well as much higher risk of globe perforation and life threatening complications such as brainstem anaesthesia.[6,7] Peribulbar anaesthesia is the most preferred route of anaesthesia for MSICS since injecting into the extraconal space is much easier and the risk of complications is much lower compared to retrobulbar anaesthesia.[8,9] However, the peribulbar injection is still more painful during administration. To alleviate pain, surgeons have attempted using subtenon's anaesthesia for MSICS with mixed success.[1,10–14]

In our study, we found a higher proportion of complete akinesia in the group P (89%) as compared to group ST(66%). However, Parkar et al. observed that 64.8% of the patients in their group P had absolute akinesia and none of the subjects in group ST attained absolute akinesia.[1] This difference between the studies, especially the greater akinesia using sub-tenons's achieved by us, may be due to the amount of anaesthetic i.e. Parkar et al. injected only 1ml of 2% lignocaine combined with 1:10 000 adrenaline in the subtenon's space where as we injected 3-4ml in our patients. Our analysis showed a clear positive correlation between amount of anaesthetic injected and the time to akinesia.

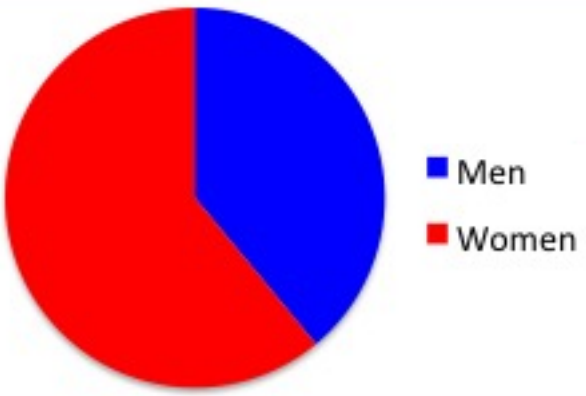

Fig. 3: Pie chart showing gender distribution

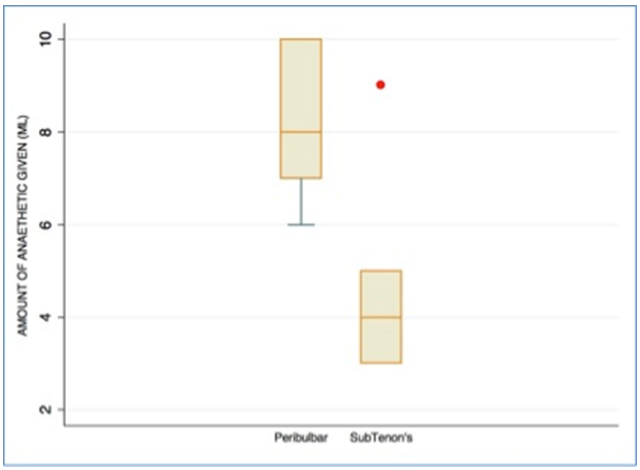

Fig. 4: Box and whisker plot showing difference in the amount of anesthetic used in the two groups

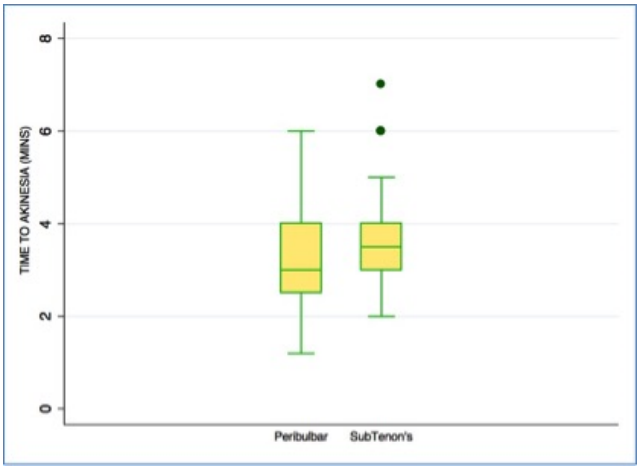

Fig. 5: Box and whisker plot showing difference in time taken to achieve akinesia

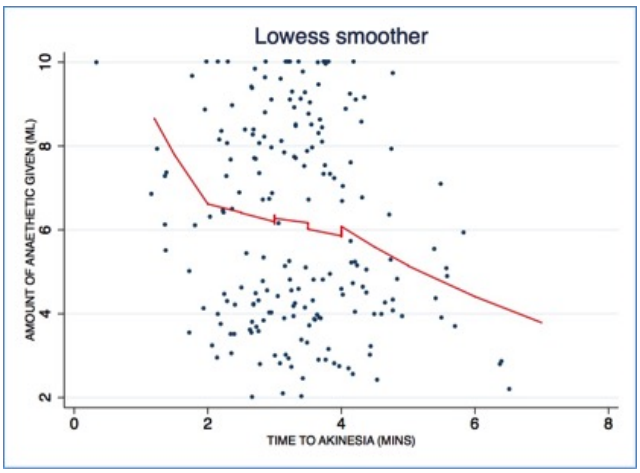

Fig. 6: LOWESS curve showing the relationship between time to akniesia and amount of anesthetic injected

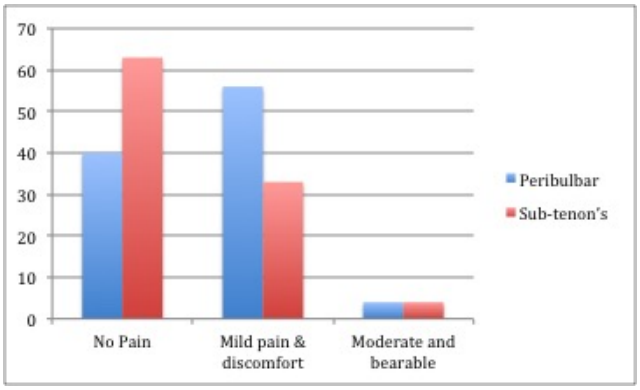

Fig. 7: Bar diagram showing difference in pain during drug administration in group P and group ST

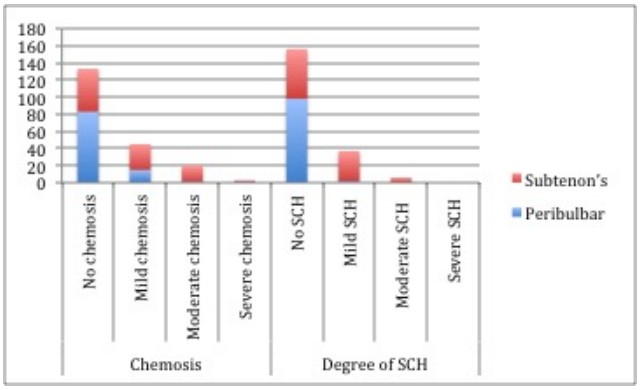

Fig. 8: Bar diagram showing Chemosis and SCH in the two groups

It is possible that greater amount of anaesthetic injected into the subtenon's space percolates into the surrounding extraconal space and acts on the extraocular muscles leading to significant akinesia. Additonally, time to akinesia in group P was significantly less than group ST in our study. Hence, we believe that the amount of anaesthetic is an important factor in achieving akinesia and greater volume of anaesthetic causes faster akinesia. However, the downside of injecting more volume is more pain as seen in our series (39% in group ST) compared to Parkar (22% in group ST) as well as more chemosis. Chemosis did not hamper the surgeon technically or cause any intraoperative difficulty and settled, in most cases by post op day 1 in our study. In our opinion, akinesia and analgesia are equally important factors of anaesthesia for MSICS and a subtenon's block can achieve both.

A significantly higher number of patients in the group P (n=65/88, 57%) reported pain during anesthesia administration compared to group ST (n=18/80, 18%). The pain during and 4 h after surgery was similar in both groups. These results are similar to the results of the study done by Parkar et al [1] where 59% in the group P and 39% in the group ST reported some pain.

Presence of SCH was significantly more in the group ST than the group P. This could be because of comparatively less experience of the surgeons in giving the subtenon's anaesthesia as apposed to giving peribulbar anaesthesia, with which they are more comfortable. We reckon that the occurrence of SCH will reduce as the surgeon experience with the technique of subtenon's increases.

Adekola et al.[10] conducted a study to compare peribulbar and subtenon's anaesthesia for MSICS among 462 patients. They reported significantly less pain score in the group ST than the group P, significantly higher chemosis in the group ST (3.2%) than in the group P (0%) and a very small proportion of patients with complete akinesia (only 10 eyes in group P and 1 eye in group ST). After comparing all the above parameters, Adekola et al reported a higher overall patient satisfaction with the subtenon's technique. There was no significant difference in patient comfort scores in the two groups(p=0.47) in our study.

Ashok et al.[15] conducted a similar randomized controlled trial(RCT) study with113 patients. They reported that average time to akinesia with subtenon's technique was significantly shorter (2.78 ± 0.9 minutes) compared to peribulbar technique (9.96 ± 2.2 minutes). Higher pain score with peribulbar technique (5.12 ± 1.255) as compared to subtenon's anaesthesia (3.77 ± 1.716) at the time of injection. Similar to our study, minor complications like SCH and chemosis were observed to be more frequently present with the subtenon's technique.

Datti et al.[11] conducted a prospective and RCT to compare the two techniques among 500 patients who underwent MSICS with rigid polymethyl Methacrylate (PMMA) IOL implantation. Similar to our study, they reported that there was a significant difference in the pain scores at the time of administration of anaesthetic between the two techniques, being more for the group P. Contrary to our finding of more number of patients having better degree of akinesia in the group P, Datti et al. reported that group ST attained good or even slightly better akinesia compared to group P though they have not mentioned a particular reason for the same. SCH (58.4%) and chemosis (28%) were commonly noted in group ST while ptosis (5 cases) was noted in group P. They concluded that subtenon's anaesthesia was a better alternative to peribulbar in MSICS.

A few other studies by Hiremath et al.[14] Iganga et al.,[16] Matcha et al.[12] Ngwu et al.[13] Nithisha et al.[17] and Padmavathi et al.[18] have all lead to similar conclusions of greater pain during administration of anaesthetic in the group P, though it has greater akinesia and lower incidence of chemosis and SCH. A lot of disparity between the volume of anaesthetic injected, quadrant used for subtenon's anaesthesia, anterior vs. posterior subtenon's administration and different methods of pain assessment makes it difficult to compare across these studies.

In our study, we found that peribulbar anaesthesia required greater volume of anaesthetic to be injected, had faster akinesia and also had significantly greater number of eyes with complete akinesia compared to subtenon's anaesthesia. However, peribulbar anaesthesia was significantly more painful at administration with over half the patients complaining of pain and discomfort compared to only a third of those receiving subtenon's anaesthesia. There were no difference in the postoperative pain perception between groups except for a mild tingling sensation or discomfort around the eye in those patients given a peribulbar block as the anaesthesia wore out. Additional top up anaesthetic injection was required less frequently in the group P. Eyes with peribulbar anaesthesia had significantly lower incidence of chemosis, SCH and slightly lower percentage of surgeons experienced PP during surgery, though this difference was only marginally significant. There were no differences in patient comfort score between the two groups and surgeons were equally comfortable while operating regardless of the anaesthetic technique used.

Given the pros and cons of subtenon's anaesthesia for MSICS, we believe that is a good option in most cases.

It is much better in terms of patient comfort, amount of pain and most importantly in terms of safety. Though in our study the group P did not have any sight threatening complication e.g a perforation, though a few such have been reported in literature. Subtenon's technique, however has none such reported to our knowledge and logically a blunt cannula is far safer than a sharp needle even in the most experienced hands.

We have not included complicated cataracts in our study thereby would advise caution in using subtenon's for the same. Also, our surgeons are experienced in performing MSICS, having performed over 500 such cases, thereby they were quick and efficient. However, using subtenon's anaesthesia by inexperienced cataract surgeon may not be advisable, as time taken for surgery and intraoperative manipulation may be more. Subtenon's anaesthesia and the technique of administration are a required skill for residents in training, not only for the purpose of giving a block but also for steroid injections in cases of intermediate uveitis etc. therefore it would be a useful skill for residents in training. Our surgeons had limited experience with administering subtenon's anaesthesia in MSICS as compared to peribulbar. It is thus possible that we had more side effects like chemosis and SCH due to this inexperience.

5. Conclusion

We conclude that subtenon's anaesthesia is as effective a technique for achieving analgesia and akinesia as peribulbar anaesthesia in MSICS with no technical difficulty to the surgeon. Of note is that it offers an alternative type of safe anaesthesia with significantly less pain to the

patient as compared to peribulbar block. Since we did not include complicated cataracts, efficacy of the subtenon block remains to be studied in those cases. We believe that given the technique and instrumentation used it is relatively safe and residents in training must be taught this technique. Also, it has applications in other surgeries and is a good skill to acquire.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Cite this article: Bhonsale G, Mehta I, Gandhi PH, Ramakrishnan R, Hussain SF. A comparative study of subtenon's anaesthesia with peribulbar anaesthesia for manual small incision cataract surgery in patients with age related cataracts. *Indian J Clin Exp Ophthalmol* 2022;8(3):409-416.