Comparison Between single injection Technique for Percutaneous Inferomedial and Medial Canthus episcleral anesthesia Using a Short Fine Needle (27G-12.5mm)In Cataract Surgery

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Abstract: Objective: Comparing the efficacy and safety of single injection technique for both percutaneous inferomedial peribulbar and medial canthus episcleral anesthesia using a short fine needle (27G-12.5mm) to optimize operating conditions for both patient and surgeon in cataract surgery. **Methods:** This comparative study included 108 patients allocated into two groups (54 patients each). Single injection was performed using a short fine needle (27G -12.5mm) in the percutaneous inferomedial peribulbar site in the first group(Group A) and in the in the medial canthus episcleral site in the second group (Group B). The mean age was 67.5 ± 3.54years in Group A and 58.06 ± 11.64 years in Group B, and the mean axial length was 19.03 ± 3.13mm in Group A and 24.39 ± 2.39mm in Group B. Surgical akinesia was assessed as a primary end point, while analgesia, incidence of complications as well as patient and surgeon satisfaction were assessed as secondary end points. **Results:** The volume of the local anesthetic injected had a mean value of 7.50 ± 0.71ml in group A, and 7.91 ± 0.92 ml in group B with ***statistically significant difference,*** (p = 0.024 i.e;***<0.05***). Regarding the efficacy of anesthesia(successful block), 40 cases (74.07%) did not need supplementation and 14 cases (25.93%) needed supplementation in group A, while 45 cases (83.3%) did not need supplementation and 9 cases (16.7%)needed supplementation in group B with non significant difference, (p = 0.239 i.e; >0.05). Complications (Chemosis and subconjunctival haemorrhage) occurred in 5 cases (9.26%) in group A and in 6 cases (11.11%) in group B with a non significant difference, (p = 0.75 i.e;>0.05) .15 cases (27.7%) in group A and 20 cases (37.04%) in group B experienced grade 0 (i.e;no pain) during local anesthesia injection, 31 cases (57.41%) in group A and also in group B experienced grade 1 (Mild pain), 8 cases (14.81%)in group A and 3 cases (5.56%) in group B experienced grade 2 (Moderate pain).No cases in either group experienced grade 3 (Severe pain) or grade 4 (Maximum imaginable pain) with a ***statistically significant difference*** with higher grades of pain during injection in group A (p=0.038 i.e;<0.05). All cases 54 (100%) did not experience any grade of pain during surgery in either group .51cases (94.44%) in group A and 50 cases (92.59%) in group B in which surgeons were satisfied during surgery while, 3 cases (5.56%) in group A and 4 cases (7.41%) in group B in which surgeons were dissatisfied during surgery) denoting an non significant difference between both groups (p=0.696 i.e:> 0.05). All patients (100%) were satisfied during in either group. There was no serious complications in either group. **Conclusion:** Single injection technique for both percutaneous inferomedial peribulbar and medial canthus episcleral anesthesia using a short fine needle (27G -12.5mm) proved to be safe and efficient technique that offer excellent comparable anesthesia i:e; akinesia and analgesia between both injection techniques (with slightly lower injection volume and more pain on injection in the percutaneous inferomedial technique) and with negligible complications for cataract surgery patients.

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1. Introduction:

Ophthalmic procedures such as cataract extraction is commonly performed nowadays with using a variety of local anesthetic techniques [(1)]. Peribulbar anesthesia for intraocular surgery has gained popularity over the last few years. It is relatively safe, easy to perform and provides effective ocular anesthesia. Peribulbar anesthesia is therefore considered an almost ideal anesthetic technique for ophthalmic surgery[(2)]. However, the main drawback of peribulbar block is the use of long needles (1-1.25) inches, which may have the potential risk of optic nerve injury, retro-bulbar hemorrhage and globe perforation[(3,4)].This consequently led to the proposal of a single rather than a double injection technique in order to decrease the risks related to multiple orbital punctures[(5)]. The use of 25 mm needle is the standard practice for extra-conal injections[(6)].The single injection technique for percutaneous inferomedial peribulbar anesthesia with short needle appear to be simple, easy to perform with less pain, requires less anesthetic agent, a single rather than multiple

punctures and provides adequate analgesia and akinesia[7]. Similarly Ripart and his colleagues in 2005 had shown that medial canthus single-injection episcleral anesthesia is a suitable alternative to peribulbar anesthesia, simple to learn and use ,with acceptable safety. It provides better akinesia, with a quicker onset and more constancy in effectiveness [6].

This study aimed to compare the efficacy and safety of percutaneous peribulbar single injection technique described by Rizzo *et al.,* [8]with medial canthus episcleral single injection technique described by Ripart *et al.,* [6] but with using a shorter finer needle (27 G-12.5mm) for cataract extraction,looking for ability to provide akinesia ,analgesia, block-related complication as well as patient and surgeon satisfaction aiming to reduce incidence of complications by this short fine needle.

2. Methods:

This study was conducted in Research Institute of Ophthalmology between June 2012 and July 2013.After obtaining approval of the institutional ethical committee and written informed consent from all patients,108 adult patients (ASA physical status I,II and III) scheduled for elective cataract surgery were included in this study. Single eyed patients, patients below 25 years of age, patients refusing local anesthesia, patients with coagulation abnormalities ,drug abusers, and patients with history of convulsions or epilepsy ,mental instability or sensitivity to local anesthetic drugs and patients with previous intraocular injury or surgery were excluded from the study. Patients were randomly allocated to one of the two groups: the first group (group A) included 54 patients and received single injection inferomedial percutaneous peribulbar anesthesia, whereas the second group (group B) included 54 patients and received single injection medial canthus episcleral anesthesia. Patients were admitted to the operating room and a peripheral IV cannula was inserted in which the patients were premedicated with midazolam IV (0.05 mg/kg) 5 minutes before the block. Standard monitoring included noninvasive arterial blood pressure (NABP), electrocardiogram (5 lead) heart rate (HR) and peripheral oxygen saturation (SPO2) was used and recorded. Patients were connected to nasal catheter for oxygen at flow rate of 3L/min. The local anesthetic solution used was 0.5% bupivacaine and 2% lidocaine in equal amounts plus hyaluronidase 15 IU/ml. Benoxite hydrochloride (0.4%) eye drops was instilled into conjunctival sac. The needle used in the study was 27G-12.5mm .The patient lies in a supine position and is asked to look directly ahead focusing on fixed point on the ceiling so that the eyes are in neutral position.

In the first group (group A) the injection site was as described by Rizzo *et al.* [8] percutaneous limited superiorly by the inferior lacrimal canaliculus, medially by the lateral margin of the nose, laterally by imaginary perpendicular line joining inferior lacrimal papilla to the inferior margin of the orbit and inferiorly by the inferior margin of the orbit. The needle was advanced in the anteroposterior direction obliquely in the direction of the optical foramen , digital pressure was applied by the thumb and index fingers around the needle hub during injection. After negative aspiration, 5-7 ml of local anesthetic solution was slowly injected.

In the second group (group B),the procedure was similar to that described by Ripart *et al.* [6]but with a shorter needle inserted to contact the conjunctiva between the eyeball and the semilunaris fold at a depth of less than 1mm,with the bevel directed toward the globe ,the needle was advanced in anteroposterior direction to its maximum depth, digital pressure was applied by the thumb and index fingers around the needle hub during injection. After negative aspiration 5-7 ml local anesthetic solution was slowly injected. After injection, mechanical orbital compression was then applied for 10 min in both groups using honan balloon set at 30 mmHg. All punctures were performed by the senior anesthesiologist in charge of the patient, who is experienced in both techniques and all measures were assessed by an observer who was blinded to the technique. Akinesia was evaluated in the 4 quadrants using a 3- point scoring system:0=akinesia, 1= partial akinesia and 2= normal movement, giving a maximal score of 8 for the 4 muscles .An akinesia score of 3 or less was defined as successful block[9]If inadequate motor block i.e; akinesia score more than 3 was observed 10 minutes after block ,then supplementary anesthetic solution (3ml) was injected into the involved site using the same needle length and additional assessment was performed 5 minutes later. Any complication was recorded. The patients were asked to assess degree of pain experienced during injection and surgery using a linear scale of 0-4 (no pain=grade 0, mild pain=grade 1, moderate pain = grade 2,severe pain= grade 3, maximum pain imaginable = grade 4).The surgeon, immediately after end of surgery, and the patient 24 hours after the end of surgery in the first postoperative visit were asked to answer the question (How would you rate your satisfaction with regional block?) using a 7-point likert -like verbal rating scale[10].

Statistical analysis

Results were expressed as means±standard deviation (SD) or numbers (%).Comparison between the mean values of different parameters of the two studied groups was performed using student t-test. Comparison between categorical data was performed

using Chi-square test.The data were considered significant if p values was ≤ 0.05 and highly significant if *p*< 0.01. Statistical analysis was performed with the aid of the SPSS computer program (version 12 windows).

3. Results :

Regarding the demographic data in this study (Table 1); the ages of the patients ranged from 40-76 years with a mean value of 67.5 ± 3.54years in group A, and from 30-81years with a mean value of 58.06 ±11.64years in Group B with t-test showing a *p* value of 0.455 (>0.05) denoting non significant difference. The female/male ratio was 28/26 (51.85%/48.15%) in group A, and 30/24 (55.6%/44.4%) in Group B with Chi-square test showing a *p* value of 0.699 (>0.05) denoting non significant difference .The number of patients with ASA classes (I/II/III) were 15/26/13 (27.78%/48.15%/24.07%) in group A, and 18/20/16 (33.3%/37.04%,29.63%) in Group B with Chi-square test showing a *p* value of 0.505(>0.05) denoting non significant difference (Table 1).

Table 1: Demographic features of the two studied groups.

Characteristics	**Group A Percutaneous inferomedial short needle (n= 54)**	**Group B Medial canthus episcleral short needle (n= 54)**	***P* value**
Age (yrs)			
Range	40-76	30-81	
Mean ± SD	67.5 ± 3.54	58.06 ± 11.64	0.455 NS
Sex (female/male)	28/26 (51.85%/48.15%)	30/24 (55.6%/44.4%)	0.699 NS
ASA (I/II/III)	15/26/13 (27.78%/48.15%/24.07%)	18/20/16 (33.3%/37.04%,29.63%)	0.505 NS

Data are expressed as mean ± standard deviation or number (%). *p*> 0.05= NS= not significant. *p*<0.05=Significant(*).

Other criteria included in this study (Table 2) were: the axial length had a mean value of 19.03 ± 31.3mm in group A, and a mean value of 24.39 ± 2.39mm in group B with t-test showing a *P* value of 0.558(>0.05) denoting non significant difference (Chart1).

Table 2: Comparison between various criteria of the two studied groups.

Criteria	**Group A Percutaneous inferomedial short needle (n= 54)**	**Group B Medial canthus episcleral short needle (n= 54)**	***P* value**
Axial length	19.03 ± 3.13	24.39 ± 2.39	0.558 NS
Volume injected	7.50 ± 0.71	7.91 ± 0.92	0.024 *
Efficiency(successful block)			
Do not need supplementation	40 (74.07%)	45 (83.3%)	0.239 NS
Need supplementation	14 (25.93%)	9 (16.7%)	
Complication (yes)	5(0%)	6 (0%)	0.75 NS

Data are expressed as mean ± standard deviation or number (%). *P*> 0.05= NS= not significant. *P*<0.05=Significant(*).

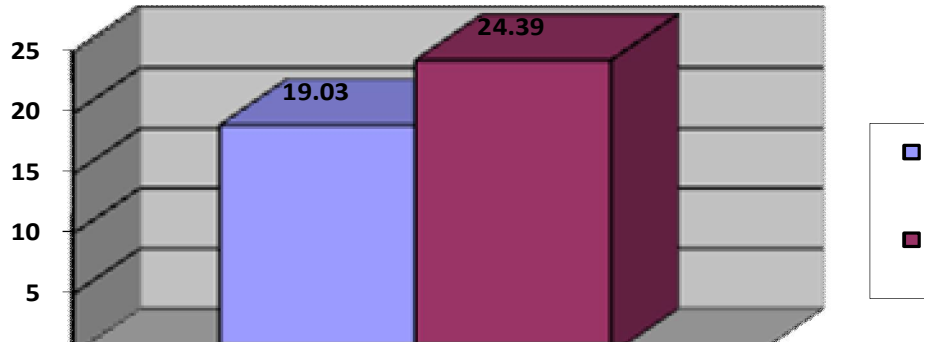

Chart1: Mean value for the axial length in the two groups.

The volume of the local anesthetic injected had a mean value of 7.50 ± 0.71ml in group A, and a mean value of 7.91 ± 0.92ml in group B with t-test showing a *p* value of 0.024(i.e<0.05) denoting a statistically significant difference (Chart 2).

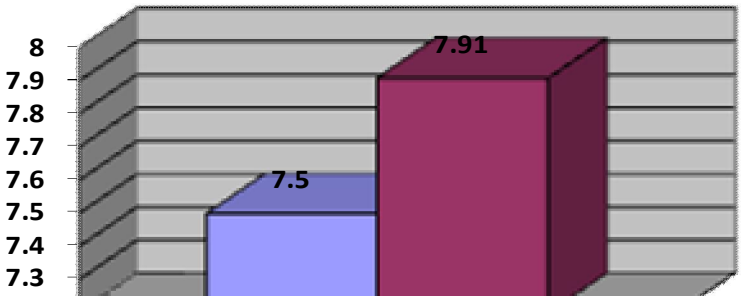

Chart 2: Mean value of the volume of local anesthetic injected in both groups.

Regarding the efficacy of anesthesia(successful block), 40 cases (74.07%) did not need supplementation and 14 cases (25.93%) needed supplementation in group A, while 45 cases (83.3%) did not need supplementation and 9 cases (16.7%)needed supplementation in group B with Chi-square test showing a *P* value of 0.239 (>0.05) denoting non significant difference (Chart3).

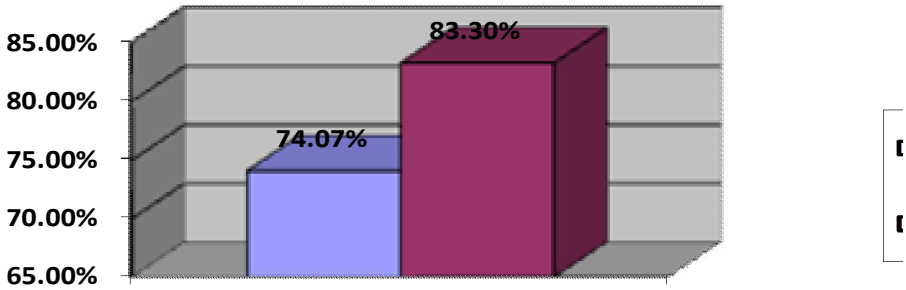

Chart3: Percentage of cases that did not need anesthetic supplementation in the two groups.

Complications (Chemosisand subconjunctival haemorrhage) occurred in 5 cases (9.26%) in group A and in 6 cases (11.11%) in group B with Chi-square test showing a *p* value of 0.75 (>0.05) denoting non significant difference (Chart 4).

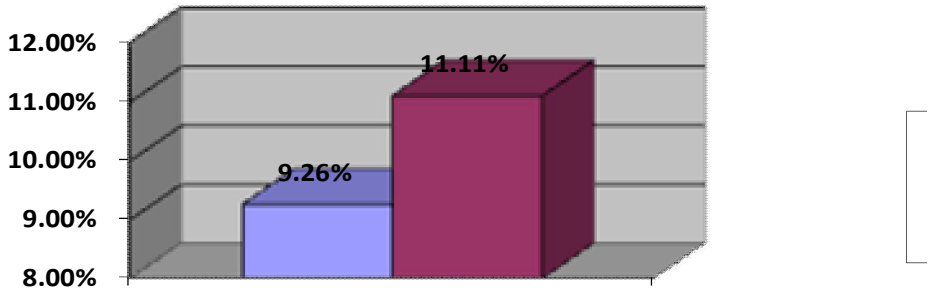

Chart4: Percentage of cases that developed complications (namely, chemosis and subconjunctival haemorrhage) in the two groups.

Regarding pain during injection of local anesthesia,15 cases (27.7%) in group A and 20 cases (37.04%) in group B experienced grade 0(no pain), 31 cases (57.41%) in group A and also in group B experienced grade 1 (Mild pain), 8 cases (14.81%)in group A and 3 cases (5.56%) in group B experienced grade 2 (Moderate pain).No cases in either group experienced grade 3 (Severe pain) or grade 4 (Maximum imaginable pain).Comparing the results by Chi-Square test reveals a Chi^2=6.53(p=0.038 i.e:<0.05) denoting a statistically significant difference with higher grades of pain during injection in group A(Table 3).

Table 3: Grades of pain and number of cases that experienced pain during injection of local anesthesia in both groups.

Grade and degree of pain during injection of local anesthesia	Number of patients in Group A Percutaneous inferomedial short needle) total 54 patients	Number of patients in Group B(medial canthus episcleral short needle) total 54 patients	Chi-Square test	*P*-Value	Significance
0 (No pain)	15(27.7%)	20(37.04%)			
1 (Mild pain)	31(57.41%)	31(57.41%)			
2 (Moderate pain)	8(14.81%)	3(5.56%)			
3 (Severe pain)	0(0%)	0(0%)			
4 (Maximum imaginable pain)	0(0%)	0(0%)	6.53	0.038	Significant

Data are expressed as mean ± standard deviation or number (%). *P*> 0.05= NS= not significant. *P*<0.05=Significant(*).

Regarding pain during surgery, all cases 54 (100%) did not experience any grade of pain in either group (Table 4).

Table 4: Grades of pain and number of cases that experienced pain during surgery in both groups.

Grade and degree of pain during surgery	Number of patients in Group A(Percutaneous inferomedial short needle) total 54 patients	Number of patients in Group B(medial canthus episcleral short needle) total 54 patients
0 (No pain)	54(100%)	54(100%)
1 (Mild pain)	0(0%)	0(0%)
2 (Moderate pain)	0(0%)	0(0%)
3 (Severe pain)	0(0%)	0(0%)
4 (Maximum imaginable pain)	0(0%)	0(0%)

Regarding the number of cases in which the surgeons were satisfied or dissatisfied during surgery, 51cases (94.44%)in group A and 50 cases (92.59%)in group B in which surgeons were satisfied during surgery while, 3 cases (5.56%)in group A and 4 cases (7.41%)in group B in which surgeons were dissatisfied during surgery. Comparing the results by Chi-Square test reveals a Chi^2=0.153(*p*=0.696 i.e:> 0.05) denoting an non significant difference between both groups (Table 5).

Table 5: Number of cases in which the surgeons were satisfied or dissatisfied during surgery in both groups.

Surgeon satisfaction during surgery	Number of patients in Group A (Percutaneous inferomedial short needle) total 54 patients	Number of patients in Group B (medial canthus episcleral short needle) total 54 patients	Chi-Square test	*P*-Value	Significance
No of cases with surgeon Satisfied	51(94.44%)	50(92.59%)			
No of cases with surgeon Dissatisfied	3(5.56%)	4(7.41%)	0.153	0.696	non significant

Regarding the number of cases in which the patients were satisfied or dissatisfied during surgery, all cases 5 (100%) were satisfied in either group (Table 6).

Table 6: Number of cases in which the patients were satisfied or unsatisfied during surgery in both groups.

Patient satisfaction during surgery	Number of patients in Group A(Percutaneous inferomedial short needle) total 54 patients	Number of patients in Group B(medial canthus episcleral short needle) total 54 patients
No of cases with patient Satisfied	54(100%)	54(100%)
No of cases with patient dissatisfied	0(0%)	0(0%)

4. Discussion:

The delivery of single injection percutaneous peribulbar technique is effective and reliable in providing both analgesia and akinesia [5]It appears to get closer to the characteristics of an ideal block than the classic peribulbar technique as it uses smaller injectate volume and had speed of onset with less complications comparable to the classic supplemental injection[11,12] . Many studies have compared Single injection peribulbar with double injection techniques ([7,13]) and had shown comparable results regarding anesthesia (i.e; akinesia and analgesia) and injection pain scores. In this study we used two techniques of a single perbulbar injection; namely percutaneous inferomedial and medial canthus episcleral injections. The percutaneous inferomedial injection with short needle as described by Rizzo *et al.,* 2005 [8] had been shown to provide adequate akinesia and analgesia for cataract surgery as the sensitivity of the eyeball is provided by the ciliary nerves, which cross the episcleral space after they emerge from the globe. The fascial sheath of the eyeball (tenon's capsule) extends to rectus muscle sheath. This explains why the anesthetic is preferentially guided to this muscle sheath to produce good akinesia; also, the fascial sheath of the eyeball guides the injected solution to the lids, especially to the orbicularis muscle preventing blinking during surgery without performing any facial nerve block. This explains why single percutaneous technique is more effective than the classic peribulbar technique[8].Ripart *et al.,*[14], proved that medial canthus episcleral single injection is a convenient technique for periocular anesthesia as the needle path is less subjected to misdirection with an anatomical(click) that guide the depth of needle insertion at 15-20 mm, the easily felt click gives a limit to the depth of needle insertion ; this is the only periocular anesthesia technique that provides such a marker[14]. As the medial wall of the orbit has a strictly anteroposterior orientation, the needle must be directed in such away as to avoid a change in the needle direction during insertion and simplify the angle of insertion, possibly decreasing the risk of globe perforation especially for large myopic globes and although some authors recommended general anesthesia for eyes with an axial length greater than 26mm[15,16],we used this technique without globe perforation with axial length up to 29.73 mm.It is known that hazardous areas of the orbit are posterior and limitation of the depth of needle my limit puncture hazards as most of the orbital vessels ,the optic nerve and the muscular cone are posteriorly located in the orbit.Katsev *et al.,*and Hamilton, demonstrated that higher needle length associated with increased risk of complication[15,16] .In our study we didn't record the (click) as described by Ripart *et al.,*[14] as the needle length was 12.5 mm however effective block with minimal complication was achieved.

In previous studies regarding percutaneous inferomedial injection ,:

Singh, *et al., in a study involving 102 eyes of patients who were candidates for cataract with IOL implantation* showed that globe akinesia was achieved in (86.2% of patients), lid akinesia in (76.4% of patients), and globe anaesthesia in (88% of patients) and supplemental injection was only required in 13.7% of patients with satisfactory painless operating conditions[17].

Ghali *et al.,*studying 100 eyes who were candidates for phacoemulsification found that the percentage of patients who developed an akinesia score of 3 or less (successful block) 10 minutes after the injection of local anesthetic was (87%). The degree of pain experienced during the operation, was 1.3±0.6,chemosis developed in 16% of patients and subconjunctival hemorrhage developed in 2% of patients. Patient satisfaction 6.9±0.7 and surgeon satisfaction was 6.2±0.8[1].

Also in previous studies regarding medial canthus injection:

Ripart , *et al.,* studying 66 eyes (divided into two groups) who were candidates for cataract surgery comparing medial canthus episcleral anesthesia with peribulbar anesthesia found that: episcleral anesthesia with the same average injectable volume (10ml) provided a quicker onset of anesthesia, a better akinesia score than peribulbar anesthesia and a lower rate of incomplete blockade necessitating reinjection [18] .

EL Matri *et al.,*studied seventy(70) patients undergoing posterior segment surgery and they found that medial canthus episcleral anesthesia provided a quick onset of anesthesia, good akinesia and high rate of complete blockade. Only fifteen patients (21.42%) received additional anesthesia[19].

In our study which was different from previous studies**,** we compared percutaneous inferomedial with medial canthus episcleral injections using a short fine needle (27G -12.5mm) to try to decrease incidence of complications and pain related to injection and we found that:

The volume of the local anesthetic injected was statistically lower in percutaneous inferomedial group (mean value 7.50 ± 0.71ml) than in medial canthus episcleral group (mean value of 7.91 ± 0.92ml).We considered that akinesia score of 3 or less after 10 minutes as successful block and does need supplementation .If inadequate motor block i.e; akinesia score more than 3 was observed 10 minutes

after block ,then supplementary anesthetic solution (3ml) was injected into the involved site using the same needle length and additional assessment was performed 5 minutes later.Regarding the efficacy of anesthesia(successful block), 40 cases (74.07%) did not need supplementation and 14 cases (25.93%) needed supplementation in percutaneous inferomedial group (the percentage of supplementary injection was higher than study done by Singh *et al., and* Ghali *et al.,* with wider longer needle), while 45 cases (83.3%) did not need supplementation and 9 cases (16.7%)needed supplementation in medial canthus episcleral group with non significant difference .Complications (Chemosis and subconjunctival haemorrhage) occurred in 5 cases (9.26%) in percutaneous inferomedial group and in 6 cases (11.11%) in medial canthus episcleral group with non significant difference and with much lower incidence than in ***Ghali** et al.,* owing to the finer shorter needle that we used for injection. Regarding pain during injection,15 cases (27.7%) in percutaneous inferomedial group and 20 cases (37.04%) in medial canthus episcleral group experienced grade 0 (no pain), 31 cases (57.41%) in percutaneous inferomedial group and also in medial canthus episcleral group experienced grade 1 (Mild pain), 8 cases (14.81%)in percutaneous inferomedial group and 3 cases (5.56%) in medial canthus episcleral group experienced grade 2 (Moderate pain).No cases in either group experienced grade 3 (Severe pain) or grade 4 (Maximum imaginable pain).There was a statistically significant difference with relatively higher grades of pain during injection in group percutaneous inferomedial group. All cases 54 (100%) did not experience any grade of pain during surgery in either group and this result was better than that obtained by ***Ghali et al.,*** showing effective analgesia despite the shorter finer needle used .Surgeons were satisfied during surgery, in 51 cases (94.44%)in percutaneous inferomedial group and 50 cases (92.59%)in medial canthus group, while, in 3 cases (5.56%) in percutaneous inferomedial group and 4 cases (7.41%) in medial canthus episcleral group, surgeons were dissatisfied during surgery revealing a non significant difference between both groups . All patients 54 (100%) were satisfied in either group and this result was better than that found by ***Ghali et al.,***owing to the efficient anesthesia despite the finer needle causing less discomfort Both sites i.e; percutaneous inferomedial and medial canthus episcleral peribulbar injections showed infrequent complications as they are relatively avascular sites which may decrease the risk of hematoma ,indeed so;we noted no orbital hematoma in this series ,and also because the insertion of the needle is limited to the anterior orbit,so ophthalmic artery,optic nerve or retinal injury was unlikely as the needle length is an important consideration in needle related complication particularly with the ultrashort needle used in both groups 27G-12.5 mm(compared with short needles used in previous studies) and so ,we reported a very low incidence of complications; namely hematoma and globe perforation .Another advantage of the single injection technique is that it is usually associated with only minor discomfort which may explain the excellent degree of patient acceptability[8].

Conclusion:

Single injection technique for both percutaneous inferomedial peribulbar and medial canthus episcleral anesthesia using a short fine needle (27G -12.5mm) proved to be safe and efficient technique that offer excellent comparable anesthesia i:e; akinesia and analgesia between both injection techniques(with slightly lower injection volume and more pain on injection in the percutaneous inferomedial technique) and with negligible complications for cataract surgery patients.

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