**Comparison the efficacy of 0.5% levobupivacaine, 0.5% ropivacaine and 0.25%levobupivacaine plus 0.25% ropivacaine for peribulbar anesthesia in cataract surgery**

**Abstract**

**Purpose:**

To compare efficacy of levobupivacaine 0.5%, ropivacaine 0.5% and 0.25% levobupivacaine plus 0.25% ropivacaine for peribulbar block in patients undergoing cataract surgery.

**Patients and Methods:**

Double-blinded clinical trial on 90 patients undergoing phacoemulsification equally and randomly divided into three groups; Group I received peribulbar anesthesia (PBA) using levobupivacaine 0.5%, Group II received PBA using ropivacaine 0.5% and Group III received PBA using combination of half of volume used for both other groups. Akinesia was assessed using ocular and eye lid movement scores, while a verbal pain score (VPS) used to assess pain.

**Results:**

VPS for injection pain showed non-significant (p=0.763) difference between the three groups. 82 patients (91.1%) felt no pain (score=0). 5 patients (8.9%); 3 from group II and 2 from group III felt mild discomfort (score= 1-2) with non-significant (p=0.542) difference, despite of being in favor of group III. Ocular movement scores showed no significant differences between study groups. Duration of anesthesia was non-significantly (p=0.693) shorter in group I compared to group II. While it was significantly (p=0.015) shorter in group I compared to group III and significantly (p=0.0055) shorter in group II compared to group III.

**Conclusion:**

Ropivacaine 0.5% is as effective as levobupivacaine 0.5% in terms of pain scores, akinesia and duration of anesthesia. Combination of 0.25% of both types add the benefit of low systemic complication profile of ropivacaine to the rapid onset of levobupivacaine.

**Introduction**

Ophthalmic surgery is almost exclusively performed in local anesthesia. Elderly patients and the presence of chronic medical diseases exclude, except particular situations (emergencies, pediatric and psychiatric patients), recurrence to general anesthesia. **(1)**

The choice of local anaesthetic in ocular surgery depends on the procedure, the patient and, to a lesser extent, the surgeon's preferences. **(2)**

Choice of local anesthetic varies, but lidocaine 2% and bupivacaine 0.5% are most common. **(3)**

Bupivacaine has increased potency and a much longer duration. This provides a relative guarantee of sufficient duration for more complicated surgery, when a procedure takes an unexpectedly long time or if there is unavoidable delay in starting the surgery. **(4)**

The well-known toxic effects of bupivacaine on the central nervous system and the cardiovascular system were a base for the development of new long-acting local anesthetics (LAs), such as ropivacaine and levobupivacaine, to present a safer alternative to bupivacaine. **(5)**

Ropivacaine is a pure enantiomer (S-enantiomer) amide local anesthetic drug. It was less cardiotoxic than bupivacaine in experimental models **(6)** and preclinical studies in healthy volunteers **(7).**

The S-isomer Levobupivacaine has been extensively studied in the search for a safer form of bupivacaine, and in peribulbar blocks shows a similar pharmacodynamic profile to the racemic mixture**. (8)**

Pharmacological research suggests that new anesthetics, such as ropivacaine and levobupivacaine, to reduce cardiotoxicity and neurotoxicity. **(9)**

Local anaesthetic mixtures are widely used in eye blocks. There are an endless number of mixtures that can be made. One of the most popular mixtures is the Bupivacaine / Lidocaine mixture. This is to take advantage of the perceived more rapid onset of lidocaine and the longer duration and postoperative analgesia of bupivacaine. **(10)**

So many other mixtures tested and used. They differ in either the substances used or in concentrations used or in both. Some examples are: Bupivacaine / Lidocaine mixture, L-Bupivacaine / Lidocaine mixture **(8)**, and as in this study Ropivacaine / Levobupivacaine mixture.

In this study, we evaluated and compared the efficacy of levobupivacaine 0.5% alone, equal volume of ropivacaine 0.5% alone or combination of half of volume used for both other groups, so as to give patients of all groups the same volume and concentration, in patients undergoing cataract surgery with phacoemulsification.

**Patients & Methods**

The is a double-blinded clinical trial which was approved by the Local Ethical Committee. We recruited 90 patients undergoing phacoemulsification surgery in the Ophthalmology department, Benha University Hospital. This trial included patients older than 60-year-old with physical status I-III according to the American society of Anesthesiologists (ASA). Patients refusing consent, obese (Body Mass Index BM ≥30 kg/m2), on sedatives or analgesics prior to procedure, have uncompensated cardiac, renal or hepatic diseases, having hemorrhagic tendency or blood diseases, with high intraocular pressure, having allergy to any of the drugs to be studied, refuse local anesthesia (LA), single-eyed, with glaucoma, history of sleep apnea, inability to lie flat, having communication barrier e.g. language, deafness, with impaired mental status, drug abusers and high myopes (Axial length > 26 mm) were excluded from the study.

Patients were randomly divided into three groups, each group including 20 patients;

a) Group I received peribulbar anesthesia (PBA) using levobupivacaine 0.5% (Chirocaine®) solution alone

b) Group II received PBA using ropivacaine 0.5% (Naropin®) solution alone

c) Group III received PBA using combination of half of volume used for both other groups so-as-to give patients of all groups the same volume and concentration.

The prepared solution was diffusely mixed with 1-ml hyaluronidase in concentration of 15 IU/ml.

Pre-procedure evaluation included; general Examination for determination of age, gender, body weight (kg), height (cm) and calculation of body mass index (BMI). - Patients were graded according to the international classification of BMI into: underweight (BMI<18.5 kg/m2); normal weight range (BMI=18.5-24.99 kg/m2); overweight (BMI=25-29.99 kg/m2); Obese (BMI>30 kg/m2) **(WHO, 1995)**. Determination of baseline pulse rate (beats/min), systolic arterial pressure (SAP), diastolic arterial pressure (DAP) and calculation of mean arterial pressure (MAP) were carried out.

On the preoperative day, all patients were interviewed for development of any factor to postpone surgery and to be trained to respond to the verbal numerical pain rating scale (VNPRS) which is 11-point scale with 0 indicates no pain and 10 indicates the terrible intolerable pain sensation. VNPRS for injection pain was evaluated at time of injection and 1 and 2 hours postoperatively (PO). Anxious patients were pre-medicated by intramuscular midazolam 2 mg.

A peripheral 22G IV catheter was inserted. Non-invasive monitoring for heart rate, MAP and oxygen saturation were carried out. A nasal cannula was applied and supplemental oxygen was given throughout the procedure.

Topical Benoxinate 0.4% eye drops were used to anaesthetize the conjunctival sac. Two peri-bulbar injections using 25-gauge needle were applied, infero-temporal and nasal. Gentle intermittent pressure on the eye with the fingers of one hand was done.

Akinesia was assessed using ocular and eye lid movement scores every 2 minutes for 10 minutes. Ocular movement was assessed using 4-point score with 0: indicates no movement, 1: indicates flickering, 2: indicates moderate movement for 1-2 mm and 3: indicates full movement for >2mm. Score of ≤2 is considered adequate for surgery. Lid movement was assessed using 3-point score with 0: indicates no movement, 1: indicates flickering and 2: indicates full movement for >2mm.

Before PBA, a verbal pain score (VPS); an 11-point scale with 0 indicates no pain and 10 indicates the terrible intolerable pain sensation was explained to the patients. Each patient’s subjective level of pain sensation was determined at incision, during surgery, at the end of surgery, and at 1, 2, 4 and 24-hrs after surgery was quantified as a VPS.

Intraocular pressure was measured in the operated eye using tonopen, 2- hours before PBA, just before PBA and 1, 5 & 10-min after PBA. - 10-min after PBA, if block is inadequate a supplementary injection of 2-5 ml of the anesthetic mixture was given. If PBA was still inadequate, GA instituted immediately or planned later and this was considered as failure of PBA.

**Results**

Baseline data of patients enrolled in the study groups are depicted in table (1). Pre-operative clinical evaluation of ASA grading results in 32.2%, 41.1% and 26.7% of patients are ASA grade I, II and III respectively. 64.4% were free of additional morbidities while 35.6% had controlled additional morbidities, table (2).

According to VNPRS (Fig. 1) there were 18 patients (20%) felt no pain on injection (VNPRS = 0), 19 patients (21.1%) felt injection pain of (VNPRS = 1), 31 patients (34.5%) felt injection pain of (VNPRS = 2), 21 patients (23.3%) felt injection pain of (VNPRS = 3) and only one patient felt injection pain of (VNPRS = 4).

Mean verbal rating score for injection pain of studied patients showed non-significant (p=0.763) difference between the three groups (Fig. 2).

Ocular movement scores showed no significant differences between study groups. (Table 3) Eyelid movement scores showed no significant differences between study groups. (Table 4) IOP changes 2-hr before PBA, at time of PBA, and till 10-min after PBA showed non-significant change between patients of studied groups. (Table 5)

Regarding pain at time of incision; 82 patients (91.1%) felt no pain (score=0) while 8 patients (8.9%) felt mild discomfort (score= 1-2). The differences between the frequency of patients felt no pain showed non-significant between patients of studied groups. (Table 6) During surgery (Fig 3); three patients (3.3%); one from group III and two from group II, required general anesthesia and were excluded from the study. The difference between the frequency of need for GA between groups II and III was non-significant (p=0.707), despite of being in favor of group III. The difference between the frequency of need for GA between groups I and III was non-significant (p=0.072), while was significant between groups I and II (p=0.041).

Seven patients (7.8%) required supplemental doses of LA. The difference between the frequency of need of supplemental doses of LA between groups II and III was non-significant (p=0.542), despite of being in favor of group III. The difference between the frequency of need of supplemental doses of LA between groups I and III was non-significant (p=0.129), despite of being in favor of group I. The difference between the frequency of need of supplemental doses of LA between groups I and II was significant (p=0.038). The remaining 74 patients (82.3%) required no additional anesthesia till end of surgery.

Eighty-two patients (91.1%) felt no pain (score=0). Five patients (8.9%); three from group II and two from group III felt mild discomfort (score= 1-2) with non-significant (p=0.542) difference, despite of being in favor of group III. The frequency of patients felt mild discomfort was non-significantly high (p=0.365) higher in group III versus group I, while the difference was significant between groups I and II (p=0.045). (Table 6)

Time till adequate surgical anesthesia was significantly (p=0.042) shorter in group I compared to group II. Time till adequate surgical anesthesia was non-significantly (p=0.489) shorter in group I compared to group III. Time till adequate surgical anesthesia was non-significantly (p=0.243) shorter in group III compared to group II. (Table 7) (Fig. 4)

Duration of anesthesia was non-significantly (p=0.693) shorter in group I compared to group II. Duration of anesthesia was significantly (p=0.015) shorter in group I compared to group III. Duration of anesthesia was significantly (p=0.0055) shorter in group II compared to group III. (Table 8)

One patient (3.3%) in group I required GA and represents the failure rate for PBA using levobupivacaine. Two patients (6.7%) in group II required GA and represents the failure rate for PBA using ropivacaine. No failure rate was detected for the use of the combination of both drugs. The use of ropivacaine showed non-significantly (p=0.707) higher failure rate than levobupivacaine. The use of levobupivacaine showed non-significantly (p=0.072) higher failure rate than the combination of both drugs. The use of ropivacaine showed significantly (p=0.041) higher failure rate than the combination of both drugs. (Fig. 5)

No patient was excluded from the study because of development of major complications. Four patients (4.4%) developed cough during the procedure; one in each of groups I and III and two in group II. No difference in the frequency of coughing between patients of groups I and III. The frequency of coughing between patients of groups I and II was non-significant (p=0.532). The frequency of coughing between patients of groups I and III was non-significant (p=0.534). (Fig. 6)

Seven patients (7.8%) developed ecchymosis; two in each of groups I and III and three in group II. No difference in the frequency of development of ecchymosis between patients of groups I and III. The frequency of development of ecchymosis between patients of groups I and II was (p=0.639). The frequency of development of ecchymosis between patients of groups I and III (p=0.612). (Fig. 7)

Eight patients (8.9%) developed subconjunctival hemorrhage; four in group I, 3 in group II and one in group III. The frequency of development of subconjunctival hemorrhage between patients of groups I and III was non-significantly (p=0.149) higher in favor of group II. The frequency of development of subconjunctival hemorrhage between patients of groups II and III was non-significantly (p=0.268) higher in favor of group II. The frequency of development of subconjunctival hemorrhage between patients of groups I and II was non-significantly (p=0.723) higher in favor of group I. (Fig. 8)

 No patient developed proptosis or retro-bulbar hematoma.

**Discussion**

Cataract is the second leading cause of visual impairment and the first of blindness globally. **(11)** Cataract surgery is the most common ophthalmic surgery and may be performed simultaneously with glaucoma or vitreous surgery in many cases. **(12)** The gold standard of cataract surgery, phacoemulsification and intraocular lens implantation is the most commonly performed surgical procedure. **(13)**

The current prospective study included 90 ARC patients; 62 females (68.9%) and 28 males (31.1%) with non-significantly (p=0.093) higher frequency of females among study population and male-to-female ratio of 1:2.2. Mean age of enrolled patients was 68.3; range: 58-80 years, similarly mean age of study population evaluated by **Kurawa & Abdu** was 62.8 and ranging between 40 and 99 years. Also, **Benzekri et al.** studied a group of cataract patients with age range of 39-95 and mean age of 74.1 years. (14) (15)

All patients received peribulbar anesthesia (PBA) using the local anesthetic (LA), assigned for each group, mixed with 1-ml hyaluronidase in concentration of 15 IU/ml for its tissue spreading effect which allowed rapid initiation of action of the injected LA. In line with this rational, **Buhren et al.** documented that when applied as an adjuvant, hyaluronidase enhances the diffusion capacity and bioavailability of injected drugs. (16)

All patients had two peribulbar injections including infero-temporal and nasal injection to achieve full ocular anesthesia and aknesia. Such procedure of double injections allowed reduction of the need for general anesthesia down to 3.3% and for supplemental LA injection down to 7.8%.

Levobupivacaine, LA used for patients of group I, showed higher efficacy for PBA than ropivacaine, LA used for patients of group II, as it provided significantly (p=0.042) shorter time till adequate surgical anesthesia and significantly (p=0.015) longer duration of anesthesia. Moreover, levobupivacaine PBA significantly (p=0.045) minimized the frequency of patients felt mild discomfort, required supplemental doses of LA (p=0.038) and abolished the need for GA (p=0.041) with 0% failure rate.

These results go in hand with **Di Donato et al.** who documented that with respect to ropivacaine, levobupivacaine showed a significant reduction in the average motor and sensory onset with significantly higher both the akinesia score and mean motor and sensory offset times. (17)

**Ghali** who evaluated the anesthetic efficacy and postoperative (PO) analgesic effects of 0.75% levobupivacaine versus 0.75% ropivacaine for PBA in patients undergoing primary vitreoretinal surgery and found levobupivacaine provided significantly longer motor and sensory block duration, provided more successful akinesia at 10 min after block, fewer supplementary injections, and less volume was used with significantly lower PO pain scores and lower consumption of PO analgesia than with ropivacaine. (5)

However, the results of the current study surpassed that obtained by **Ghali** by the use of both anesthetics at lower concentrations (0.5%) and approved a similar outcome to that of **Ghali**. (5)

Moreover, the obtained results are superior to that obtained by **Ahmed et al.** who evaluate the quality and efficacy of PBB for superficial extraconal anesthesia with levobupivacaine 0.5% versus bupivacaine 0.5%, both combined with lidocaine 2% and reported no significant differences between groups with respect to the akinesia score, the number of supplementary injections and initial and total required volume of local anesthetics, and concluded that PBB using levobupivicaine or bupivicaine provides similar block quality and efficacy. (18)

The obtained results of levobupivacaine PBA assured previous studies compared it versus ropivacaine during various peripheral nerve blocks; where **Li et al.** conducted a review for controlled comparative trials using levobupivacaine or ropivacaine for peripheral nerve block and detected no statistically significant difference between the two drugs with respect to onset time of surgical anesthesia, sensory block and motor block, duration of motor block, and patients overall satisfaction, but levobupivacaine provided greater duration of sensory block, more long-term anesthesia and significantly lower incidence of PO rescue analgesia. (19)

Recently, **Malav et al.** levobupivacaine provides significantly longer duration of sensory and motor block with prolonged PO analgesia in sciatic nerve block and reduction of PO analgesic consumption. (20)

Ropivacaine PBA also did well as patients of group II had acceptable outcome as regards duration of sensory and motor blocks, number of patients required supplemental LA injection and frequency of complications, despite the significant difference versus levobupivacaine.

In line with efficacy and safety of ropivacaine PBA, **Palte et al.** found that the 50:50 mixture of 2% lidocaine with 0.4% ropivacaine as compared to 2% lidocaine in PBA for adjustable-suture strabismus surgery did not impair return of full ocular motility at 6 hours, which is advantageous in adjustable-suture strabismus surgery. (21)

Recently, **Kashyap et al.** compared ropivacaine and bupivacaine for phacoemulsification under deep topical fornix nerve block and reported no statistical significance between mean pain scores, surgical satisfaction scores and the need for supplemental anesthesia, so concluded that ropivacaine is a good alternative to bupivacaine for its efficacy and better safety margin and lesser toxic effect. (22)

The current study tried to get the benefits of both levobupivacaine and ropivacaine using combination of half concentration of both drugs to achieve a total volume similar to that used by either drug alone, the obtained results as regards time till achieve motor and sensory block, duration of analgesia, need for supplemental LA and GA, were non-significantly better than with ropivacaine alone, but levobupivacaine alone provided non-significantly better results than the combination.

In support of the use of combined drug therapy to improve anesthetic and surgical outcome of cataract surgery under PBA, **Sinha et al.** detected decreased onset of akinesia without any obvious side effect on addition of magnesium sulfate (50 mg) to the lidocaine-bupivacaine mixture for PBA. **(23)**

The obtained results with the used mixture were superior to that reported by **Jaichandran et al.** who documented that in PBA 0.5% bupivacaine solution provides better quality of anesthesia than does combination 2% lidocaine and 0.5% bupivacaine in patients undergoing vitreoretinal surgery. (24)

The reported minimal systemic complication rate especially with levobupivacaine could be attributed to its pharmacokinetics of levobupivacaine as evidenced by **Butterworth JF** who analyzed plasma levels of levobupivacaine associated with continuous wound infiltration via a catheter following neonatal surgical procedures and its unbound plasma concentration remained relatively stable and below levels associated with toxicity throughout 72 hours with low pain scores and morphine consumption and concluded that studied infusion regimen was associated with plasma levels of levobupivacaine well. (25)

In support of the efficacy and safety of PBA, **Calenda et al.** checked the safety of continuation of oral anticoagulants in ophthalmic procedures requiring PBA and found oral anticoagulants were not associated with a significant increase in potentially sight-threatening LA complications. (26)

Finally, we conclude that ropivacaine 0.5% is as effective as levobupivacaine 0.5% in terms of pain scores, akinesia and duration of anesthesia. Combination of 0.25% levobupivacaine plus 0.25% ropivacaine add the benefit of low systemic complication profile of ropivacaine to the rapid onset of levobupivacaine.

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Table (1): Baseline data of patients enrolled in the study groups

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Data | Group I | Group II | Group III | P value |
| Age (years) | 66.9±5.8 (60-76) | 67.7±6.5(58-77) | 70.5±7.2 (61-80) | 0.074 |
| Gender  | Males | 10 (33.3%) | 11 (36.7%) | 7 (23.3%) | 0.093 |
| Females  | 20 (56.7%) | 19 (63.3%) | 23 (76.7%) |
| Body weight (kg) | 81.8±9.8 (70-98) | 83.9±8.6 (156-195) | 85.3±10.4 (70-99) | 0.418 |
| Body height (cm) | 168.7±1.6 (166-172) | 170±3.3 (167-178) | 170.5±8.3 (159-176) | 0.522 |
| Mean BMI (±SD) | 28.8±3.6 (23.7-34.7) | 28.7±3.7 (20.8-33.8) | 29.6±4.5 (18.7-34.8) | 0.681 |
| HR (beats/min) | 79.2±4.1(69-89) | 78.2±4.7(72-86) | 78.5±4.5(70-88) | 0.671 |
| MAP (mmHg) | 90.1±5.1 (76.3-97) | 89.9±4.6 (75.7-97.3) | 88.4±7 (75.7-101.3) | 0.455 |

Table (2): Patients' distribution according to ASA grading and frequency of additional morbidities

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Data  | Parameter  | Group I | Group II | Group III | P value |
| ASA-grade | I | 8 (26.7%) | 11 (36.7%) | 10 (33.3%) | 0.838 |
| II | 14 (46.6%) | 10 (33.3%) | 13 (43.3%) |
| III | 8 (26.7%) | 9 (30%) | 7 (23.4%) |
| Additional morbidity | No | 19 (63.4%) | 18 (60%) | 21 (70%) | 0.712 |
| Yes | DM | 4 (13.3%) | 6 (20%) | 3 (10%) | 0.533 |
| HPT | 4 (13.3%) | 3 (10%) | 2 (6.7%) | 0.691 |
| COPD | 1 (3.3% | 2 (6.7%) | 1 (3.3%) | 0.769 |
| CD  | 2 (6.7%) | 1 (3.3%) | 3 (10%) | 0.585 |

Table (3): Ocular movement scores

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time  | Score  | Group I | Group II | Group III | P value |
| 2-min | 0 | 0 | 0 | 0 | 0.791 |
| 1 | 6 (20%) | 5 (16.7%) | 7 (23.3%) |
| 2 | 10 (33.3%) | 8 (26.7%) | 11 (36.7%) |
| 3 | 14 (46.7%) | 17 (56.6%) | 12 (40%) |
| 4-min | 0 | 4 (13.4%) | 5 (16.7%) | 8 (26.7%) | 0.659 |
| 1 | 7 (23.3%) | 7 (23.3%) | 10 (33.3%) |
| 2 | 9 (30%) | 10 (33.3%) | 7 (23.3%) |
| 3 | 10 (33.3%) | 8 (26.7%) | 5 (16.7%) |
| 6-min | 0 | 9 (30%) | 7 (23.3%) | 12 (40%) | 0.599 |
| 1 | 11 (36.7%) | 9 (30%) | 10 (33.3%) |
| 2 | 7 (23.3%) | 9 (30%) | 7 (23.3%) |
| 3 | 3 (10%) | 5 (16.7%) | 1 (3.4%) |
| 8-min | 0 | 15 (50%) | 12 (40%) | 19 (63.4%) | 0.788 |
| 1 | 10 (33.3%) | 10 (33.3%) | 7 (23.3%) |
| 2 | 5 (16.7%) | 6 (20%) | 4 (13.3%) |
| 3 | 0 | 2 (6.7%) | 0 |
| 10-min | 0 | 27 (90%) | 21 (70%) | 26 (86.7%) | 0.744 |
| 1 | 3 (10%) | 7 (23.3%) | 4 (13.3%) |
| 2 | 0 | 2 (6.7%) | 0 |
| 3 | 0 | 0 | 0 |

Table (4): Eyelid movement scores

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time  | Score  | Group I | Group II | Group III | P value |
| 2-min | 0 | 0 | 0 | 0 | 0.585 |
| 1 | 2 (6.7%) | 1 (3.4%) | 3 (10%) |
| 2 | 28 (93.3%) | 29 (96.6%) | 27 (90%) |
| 4-min | 0 | 0 | 0 | 0 | 0.656 |
| 1 | 6 (20%) | 7 (23.3%) | 9 (30%) |
| 2 | 24 (80%) | 23 (76.7%) | 21 (70%) |
| 6-min | 0 | 6 (20%) | 3 (10%) | 4 (13.3%) | 0.351 |
| 1 | 13 (43.3%) | 8 (26.7%) | 10 (33.3%) |
| 2 | 11 (36.7%) | 19 (63.3%) | 16 (53.4%) |
| 8-min | 0 | 13 (43.3%) | 8 (26.7%) | 15 (50%) | 0.345 |
| 1 | 10 (33.3%) | 13 (43.3%) | 11 (36.7%) |
| 2 | 7 (23.4%) | 9 (30%) | 4 (13.3%) |
| 10-min | 0 | 22 (73.3%) | 13 (43.3%) | 20 (66.6%) | 0.176 |
| 1 | 8 (26.7%) | 14 (46.7%) | 9 (30%) |
| 2 | 0 (3.4%) | 3 (10%) | 1 (3.4%) |

Table (5): IOP changes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time  | Score | Group I | Group II | Group III | P value |
| 2-hr before PBA | Mean (±SD) | 14.9±2.2 | 14.6±2.1 | 15±2.3 | 0.767 |
| Range | 11-18 | 11-18 | 12-18 |  |
| At time of PBA | Mean (±SD) | 14.9±2.4 | 14.6±2.6 | 14.8±2.3 | 0.735 |
| Range | 11-19 | 11-18 | 11-18 |  |
| 1-min after PBA | Mean (±SD) | 15.1±2.2 | 14.8±2.2 | 14.9±2.4 | 0.763 |
| Range | 11-18 | 11-18 | 11-18 |  |
| 5-min after PBA | Mean (±SD) | 15±2.1 | 14.7±2.5 | 14.8±2.3 | 0.875 |
| Range | 11-18 | 11-18 | 11-18 |  |
| 10-min after PBA | Mean (±SD) | 14.9±2.2 | 14.9±2 | 15.2±2.1 | 0.783 |
| Range | 11-18 | 11-18 | 12-18 |  |

Table (6): Pain scores

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time  | Score  | Group I | Group II | Group III | P value |
| At time of incision | No pain (0) | 29 (96.6%) | 26 (86.7%) | 27 (90%) | P1=0.688P2=0.161P3=0.301 |
| Mild discomfort (1-2) | 1 (3.4%) | 4 (13.3%) | 3 (10%) |
| During surgery | No pain (0) | 30 (100%) | 26 (89.7%) | 26 (92.9%) | P1=0.688P2=0.045P3=0.161 |
| Mild discomfort (1-2) | 0 | 3 (10.3%) | 2 (7.1%) |
| At end of surgery | No pain (0) | 30 (100%) | 29 (100%) | 28 (100%) | P=1 |
| 1-hr after surgery | No pain (0) | 29 (96.6%) | 26 (89.7%) | 26 (92.9%) | P1=0.669P2=0.284P3=0.513 |
| Mild discomfort (1-2) | 1 (3.4%) | 3 (10.3%) | 2 (7.1%) |
| 2-hr after surgery | No pain (0) | 27 (89.9%) | 23 (79.3%) | 22 (78.6%) | P1=0.841P2=0.521P3=0.439 |
| Mild discomfort (1-2) | 2 (6.7%) | 4 (13.8%) | 3 (10.7%) |
| Mild pain (3-4) | 1 (3.4%) | 2 (6.9%) | 3 (10.7%) |
| 4-hr after surgery | No pain (0) | 18 (60%) | 12 (41.4%) | 9 (31%) | P1=0.767P2=0.404P3=0.125 |
| Mild discomfort (1-2) | 8 (26.6%) | 9 (31.1%) | 10 (39.3%) |
| Mild pain (3-4) | 3 (10%) | 5 (17.2%) | 7 (22.6%) |
| Moderate pain (5-6) | 1 (3.4%) |  3 (10.3%) | 2 (7.1%) |
| 24-hr after surgery | No pain (0) | 22 (73.3%) | 13 (44.8%) | 17 (60.7%) | P1=0.561P2=0.0408P3=0.068 |
| Mild discomfort (1-2) | 7 (23.3%) | 10 (34.5%) | 8 (28.6%) |
| Mild pain (3-4) | 1 (3.4%) | 6 (20.7%) | 3 (10.7%) |

Table (7): Time till adequate surgical anesthesia (min) for patients of studied groups

|  |  |  |  |
| --- | --- | --- | --- |
| Times  | Group I | Group II | Group III |
| Mean (±SD) | 17.1±1.9 | 18.3±2.7 | 17.5±2.5 |
| Range | 14-20 | 15-22 | 14-22 |
| P value | P1 |  | 0.042 | 0.489 |
| P2 |  |  | 0.243 |

Table (8): Duration of anesthesia (hours) for patients of studied groups

|  |  |  |  |
| --- | --- | --- | --- |
| Times  | Group I | Group II | Group III |
| Mean (±SD) | 5.1±1.2 | 5.2±0.7 | 5.8±0.9 |
| Range | 3-7 | 4-7 | 5-8 |
| P value | P1 |  | 0.693 | 0.015 |
| P2 |  |  | 0.0055 |

(Figure 1): Patients’ distribution according to VNPRS for injection pain

(Figure 2): Mean VNPRS for injection of patients of studied groups 

(Figure 3): Patients, distribution according to requirement for shift to general anesthesia

(Figure 4): Mean time till adequate surgical anesthesia



(Figure 5): Procedural failure rate of studied groups



(Figure 6): Patients’ distribution according to development of coughing during surgery



(Figure 7): Patients’ distribution according to development of ecchymosis during surgery



(Figure 8): Patients’ distribution according to frequency of development of sub-conjunctival hemorrhage

