Section: Anaesthesiology

Original Research Article

COMPARATIVE EVALUATION OF A VARYING DOSES OF DEXMEDETOMIDINE AS A ADJUVANT TO LEVO-BUPIVACAINE IN ULTRASOUND GUIDED UNILATERAL ILIO-HYPOGASTRIC AND ILIO-INGUINAL NERVE BLOCK FOR POSTOPERATIVE ANALGESIA IN INGUINAL HERNIOPLASTY.

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ABSTRACT

Background: Ultrasound-guided procedures have been increasingly utilized in patients for perioperative analgesia, one such method is ilioinguinal/iliohypogastric (II/IH) nerve block for surgical procedures like hernioplasty.

Material and Methods: Forty-five adults aged 18 to 60 years with the American Society of Anesthesiologists grade I or II were included in the study. After spinal anaesthesia, patients of Group A received USG-guided IIN/IHN block using 22ml of 0.25% levo-bupivacaine with Dexmeditomedine 0.75ug/kg, and those in Group B received IIN/IHN block using 22 mL of 0.25% levobupivacaine with 1ug/kg Dexmeditomedine. VAS score between the two groups, time to first rescue analgesia were the primary objectives; total analgesic consumption, hemodynamic effects, and other side effects were also evaluated.

Results: The mean VAS score of Group B is less than that of Group A, with a significant P-value (<0.05). The time for the first rescue analgesia of Group B (1050±98min) is more than that of Group A (789 ± 66min) with a significant p-value (<0.05). The mean values of sedation scores between the two groups did not show any significant difference, p values(p>0.05). The mean value of the mean arterial pressure heart rate of group B is less than that of group A in the post-operative period, with a significant p-value (<0.05).

Conclusion: Post-op analgesia with 0.25% Bupivacaine with Dexmeditomedine 1mcg/kg given via ilioinguinal/iliohypogastric nerve block has a longer duration of action, less total analgesic consumption than 0.25% Bupivacaine with 0.75 mcg/kg Dexmeditomedine but with significant, bradycardia as a side effect.

Keywords: Ultrasound, Ilioinguinal/iliohypogastric nerve, Inguinal surgery, levo- Bupivacaine, Dexmeditomedine.

INTRODUCTION

Open inguinal hernia surgery is a commonly performed operation that is associated with acute post-operative pain and distress. Traditionally enteral and parenteral NSAIDs and weak opioids such as tramadol were used for post-operative analgesia after hernia repair. Recently, ilioinguinal/iliohypogastric (II/IH) nerve block and transversus abdominis plane (TAP) block are gaining more attention as viable alternatives to provide effective perioperative analgesia in inguinal hernia surgery.[1,2]

Both TAP and II/IH blocks block the ilioinguinal and hypogastric nerves. The only difference is that the TAP is a compartment block, while the ilioinguinal/iliohypogastric (II/IH) nerve block is truncal. Ultrasound-guided (USG) TAP block is observed to be inferior to USG ilioinguinal/iliohypogastric (II/IH) nerve block in open inguinal hernia repair in various studies that evaluated the analgesic effect of TAP block in various abdominal procedures.[3]

Many studies have shown that II/IH block provides better pain control than TAP block after inguinal hernia repair in children and adults.[4,5]

Levobupivacaine is the S(-)-enantiomer of racemic Bupivacaine. The cardiotoxicity of levobupivacaine is lower than that of racemic Bupivacaine due to the lower affinity of the S(-) isomer than the R(+) isomer for the inactivated state of cardiac sodium channel(3). Given this potential reduction in cardiotoxicity and early motor recovery, levobupivacaine appears to be an attractive alternative to racemic Bupivacaine.[6,7]

The duration of analgesia depends on the duration of action of local anaesthetics. Several adjuvants such as steroids, opioids, and alpha-2 agonists such as clonidine and Dexmedetomidine are used to prolong analgesia.

Dexmedetomidine is a selective alpha2 agonist that improves pain control and exerts axonal neuroprotection.[8]

Dexmedetomidine significantly shortens the onset time for sensory and motor block and prolongs the duration of analgesia. The optimal dose of Dexmedetomidine as an adjuvant to levobupivacaine for II/ IH block is controversial.

Dexmedetomidine has certain advantages over other adjuvants. Dexmedetomidine is a highly selective drug α2-adrenergic receptor agonist with characteristics including sedation, analgesia, anti-anxiety, inhibition of sympathetic activity, mild respiratory inhibition, and stable hemodynamics.[9] Numerous studies have discovered that applying Dexmedetomidine in peripheral nerve blocks can shorten the onset time of anaesthesia, prolong the time of sensory and motor nerve block, and achieve a satisfactory sedative effect. However, Dexmedetomidine can lead to adverse reactions, such as bradycardia, hypotension, and excessive sedation.[10,11]

Our aim was to compare the duration of post-op analgesia using ilio inguinal and ilio hypogastric nerve blocks with levo Bupivacaine and varying doses of dexmeditomedine. The primary objective was to compare VAS scores between the two groups and the time to first rescue analgesia. The Secondary objective was to compare total analgesic consumption, hemodynamic effects, and side effects.

MATERIAL AND METHODS

A prospective randomized double-blind controlled trial study was conducted in a tertiary care hospital. 90 Male patients of 18–60 years, belonging to ASA grade I & II, undergoing unilateral inguinal hernia repair under subarachnoid block, were included in the study. Refusal for study, patients with a history of cardiorespiratory disease, hypersensitivity to study drugs, coagulopathy and patients on adrenergic agonists/antagonists were excluded from the study. To detect a 25% difference in the duration of analgesia, with 90% power of the study and a 5% level of significance, we need 30 patients in each group. To compensate for the loss to follow-up and failure of the block, we included 45 patients in each group. All patients were subjected to pre-anesthetic check-ups.

Written and informed consent was obtained for surgery and participation in the study, and the participants were explained briefly in the pre-operative period, about the anaesthetic technique, including the ilio-inguinal and ilio-hypogastric nerve block and visual analogue score (VAS). Overnight fasting for 8 hours. inj. Alprazolam 0.5mg was given the day before surgery. Inj pantoprazole 40mg IV given one hour before surgery. Using block randomization and a sealed envelope system, 45 patients each were allotted into two groups. Once the patient gave consent to enter the trial, an envelope was opened, and they were allocated to a group. Neither the patient nor the investigator recording the readings was aware of the label which represented the group, making the study double-blinded. In the operating room, standard monitors, including electrocardiogram (ECG),non-invasive blood pressure(NIBP), heart rate (HR) and blood oxygen saturation (SpO2), were connected; preoperative vitals were recorded; IV line was secured; and co-loading was done with intravenous ringer lactate solution. The Sub-Arachnoid block was given using a 25G Quincke spinal needle with 3 ml 0.5% heavy bupivacaine in the L3–L4 inter-vertebral space. The surgery was started after the patient had attained a block up to the T6 level. Vitals were monitored continuously during the procedure. After the completion of the surgery, when the level of Sub-Arachnoid block receded up to the T10 level, ilioinguinal /iliohypogastric block was done using ultrasonographic guidance. Group A received 0.25% levobupivacaine 20 ml and dexmedetomidine 0.75 mcg/kg diluted to 2 ml with Normal saline (total volume 22 ml), and Group B received 0.25% levobupivacaine 20 ml and dexmedetomidine one mcg/kg diluted to 2 ml with Normal saline (total volume 22 ml). Under aseptic precautions, a linear high-frequency probe was placed medial to the anterior superior iliac spine oriented towards the umbilicus. In this location, the ilio-inguinal and ilio-hypogastric nerves appear hypoechoic between the transverses abdominis and internal oblique muscle.[12]

After visualization, a 22G 1.5-inch needle was used in a plane approach to reach the nerves. After aspiration, 0.25% levobupivacaine with varying

doses of Dexmedetomidine was injected till the nerves were surrounded by the drug (kayak sign).

Figure 1: Ilioinguinal Nerve Block

After administering the block, Patients were monitored in the postanesthesia care unit for 24h for the following parameters, which were recorded at 0,1, 2, 4, 6,12, and 24 hr. VAS, time to the first request of analgesia, Total analgesic consumption, Ramsay sedation score (RSS), heart rate, mean arterial pressure, Respiratory rate (RR), and SpO2 were monitored when the patient complained of pain inj. Diclofenac 75 mg I.M was administered. Duration of analgesia was calculated from the time of administration of the Ilioinguinal /Iliohypogastric nerve block to the time of first rescue analgesia. Any clinically associated side effects such as bradycardia (heart rate <60/min), hypotension (Mean arterial pressure <20% of baseline), nausea, and vomiting were also observed. The total analgesic consumption was noted in the first 24 hours after the block. All the observations were made by an anesthesiologist unaware of Group allocation and blind to the study drug.

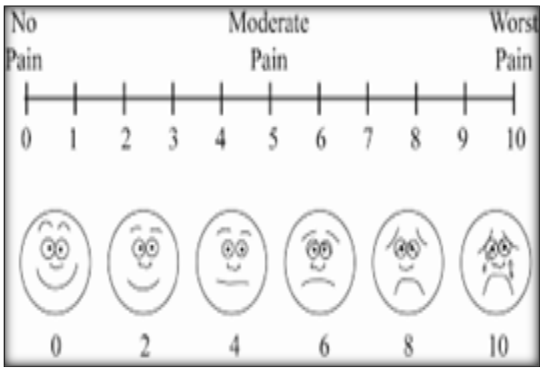

Figure 2: VAS Score

Ramsay score	Level of sedation
1	Anxious, agitated, restless
2	Oriented, tranquil
3	Responds to commands
4	Brisk response to light glabellar tap
5	Sluggish response to light glabellar tap
6 (deep sedation)	No response

Figure 3: Ramsay Sedation Score

Statistical analysis

The data was compiled, tabulated, and statistically analyzed using SPSS version 21. A paired or unpaired student t-test was done for continuous variables, and for categorical data, a Chi-square test or Fisher test (whichever was applicable) was done. Results were presented as mean ± standard deviation. $P < 0.05$ has been considered statistically significant

RESULTS

The demographics with respect to age, weight, height, duration of surgery were comparable with statistically non-significant, p value. (p>0.05). [Table 1]

The mean heart rate value of Group B was less than Group A at 1, 2, 3, 4, 6, 12, 24 hours with significant p value (<0.05). [Table 2]

The mean value of mean arterial pressure of Group-B is less than group A at 1, 2, 3, 4, 6, 12, 24 hrs in the post-operative period with significant P value (<0.05). [Table 3]

VAS scores of group A are 0 at 0, 2, 4 hrs, where as VAS scores of Group-B are 0 at 0,2,4,6 hrs. At 12, 24 hrs the mean VAS score of Group-B is less than Group-A with significant P value. (<0.05). [Table 4]

The mean values of sedation scores between two groups did not show any significant difference, P values(p>0.05). [Table 5]

The time for first rescue analgesia of Group-B (1050±98min) is more than Group-A(789±66min) with significant p value (<0.05). [Table 6]

Side effects

One patient in Group-A, two patients in Group-B complained of nausea and vomiting.

Table 1: DEMOGRAPHICS

	GROUP A	GROUP B	P VALUES
AGE	38 ± 1.02	39 ± 1.04	0.89
WEIGHT	79 ± 1.12	76± 1.01	0.49
HEIGHT	162± 2.4	165±3.0	0.14
DURATION OF SURGERY in min	66 ± 1.2	70 ±1.4	0.31

Table 2: Heart Rate

HOURS	GROUP A	GROUP B	P VALUES
1	56.66 ±2.21	52.21± 1.63	0.04
2	63.06± 1.00	60.12± 1.4	0.02
3	71.63± 2.01	68.27±1.5	0.059

4	72.11± 2.6	69.44± 1.84	0.023
6	71.88 ±2.44	68.96±1.36	0.0001
12	72.16±1.5	69.55±2.01	0.055
24	71.77±3.25	69.76±1.21	0.027

Table 3: Mean Arterial Pressure

HOURS	GROUP A	GROUP B	P VALUES
1	85.02 ± 1.6	80.00±1.1	0.01
2	88.03±2.01	84.06±1.3	0.004
3	88.58±3.5	88.11±2.5	0.027
4	89.21±3.3	87.31±2.1	0.003
6	89.01 ±4.1	87.22±3.0	0.040
12	89.56±3.6	87.67±2.7	0.059
24	89.11±4.2	87.55±3	0.027

Table 4: VAS Score

HOURS	GROUP A	GROUP B	P VALUES
0	0	0	
2	0	0	
4	0	0	
6	2.78 ± 0.02	0	
12	2.88 ± 0.08	2.22±0.06	0.059
24	2.5±0.06	2.1±0.04	0.008

Table 5: Ramsay Sedation Scores

HOURES	GROUP A	GROUP B	P VALUES
0	2±0.77	2±0.88	0.4
2	2±0.65	2±0.66	0.9
4	2±0.11	2±0.13	0.27
6	2±0.21	2±0.20	0.7
12	1±0.23	2±0.29	0.1
24	1±0.24	2±0.23	0.7

Table 6: Time for Rescue Analgesia

	GROUP A	GROUP B	P VALUES
FIRST RESCUE ANALGESIA TIME IN MIN	789 ± 66	1050±98	0.01
TOTAL ANALGESIC CONSUMPTION IM DICLOFENAC	162 ± 10.22	80 ± 7.5	0.04

DISCUSSION

The primary goal in the management of post-operative pain is minimizing the dose of medications to lessen side effects, while still providing adequate analgesia. Currently, available perioperative pain management options include oral or intravenous analgesics, surgical wound infiltration, and single-shot caudal blocks. However, these treatments may yield suboptimal pain control or may be limited by the significant risk of side effects.[13]

Regional nerve block techniques offer a great degree of post-operative pain relief, thus facilitating early ambulation and discharge. Recently, ilioinguinal/iliohypogastric (II/IH) nerve or transversus abdominis plane (TAP) blocks have attracted interest as viable alternatives,[14] to provide effective perioperative analgesia for open inguinal surgery.

Ilioinguinal and iliohypogastric (IIN/IHN) nerve blocks are among the most frequently used regional blocks performed for analgesia following inguinal surgery and have been shown to reduce pain associated with herniorrhaphy significantly.[15,16,17]

An ilioinguinal and iliohypogastric nerve block is truncal, whereas a TAP block is a field block [18]. II/IH, nerve block injectate, is delivered directly near nerves. In contrast, in the TAP block, the drug is delivered in a plane where ilioinguinal and iliohypogastric nerves are found, requiring large volumes of injectate to reach the site of action and surrounding nerves. Studies proved that guided ilioinguinal /iliohypogastric nerve block was better than TAP block in post-operative analgesia.[19]

This improved efficacy is due to proximity of needle placement and deposition of local anaesthetic agent close to II/IH nerves. Ultrasound-guided II/IH nerve block could target the II/IH nerve with more accuracy because of the high-resolution imaging of the soft tissue. The abdominal wall layers, in addition to the II/IH nerves themselves, can often be detected on real-time ultrasound. The real-time visualization of the injectant flow assists with the final adjustment of the needle position for optimal distribution of the local anaesthetic solution to the nerves lying under the fascia of the transversus abdominis muscle. This includes the II/IH nerves.

Time to first rescue analgesia:

The time to first rescue analgesia was approximately 17.5 hours in our study. This also corelates to the finding of study done by Vishnu Priya et al.,[20]In their study, patients of Group B on whom dexmedetomidine 50 mcg was added to 0.25% Bupivacaine given via ilio inguinal/iliohypogastric

nerve block had a duration of analgesia of 1295.33±103 min compared to Group-A(543.33±475 min) patients on whom Dexmedetomidine was not added to 0.25% Bupivacaine, with a significant p-value.

In a study done by Daisy Karen et al.,[21] which was a randomized, double-blind trial, Group RD (dexmedetomidine one mcg/kg was added as an adjuvant to Ropivacaine 0.2%) had the duration of analgesia as 970.23 ±46.71 min when compared to group R(419.56 ± 46.71) with a significant p-value.

Dexmedetomidine is an α-2 agonist when added as an adjuvant to local anesthetic in neuraxial blocks, peripheral nerve blocks, or intravenous regional anesthesia. The action of α2 agonists may be due to spinal, supraspinal, or peripheral mechanisms. At the spinal level, the α2 agonists inhibit the release of substance P in the nociceptive pathway at the level of the dorsal root neurons, inhibiting pain.[22,23]

The local vasoconstriction effects of Dexmedetomidine may prolong the duration of analgesia by reducing the systemic absorption of the LA from the effect site.[24]

VAS score

In our study VAS scores were compared between two groups at 12 and 24 hours as there is no VAS score up to 12 hours in Group B . This might be attributed to longer duration of action of adjuvant Dexmeditomidine (1 mcg/kg)

In a study by Vishnu Priya et al,[20] the VAS score between the two groups, B and BD, at regular intervals from 60 mins to 24 hours was statistically significant, with a p-value less than 0.05.

Daisy Karan et al,[21] in their study, thirty patients were randomized to Group (Ropivacaine 0.2%) and 30 patients to Group RD (Ropivacaine 0.2% with dexmeditomedine1mcg/kg), the median pain scores were significantly lower in Group RD compared to Group R at 6 to 8 h At 24 th hour, pain scores were higher in Group R than in Group RD.

Total analgesic consumption

In our study the total analgesic consumption (inj. Diclofenac 75 mg I.M) in patients of Group B (80 mg) was less than the patients of Group A, more over the patients were satisfied with inj Diclofenac and none of them required any further analgesics like Tramadol . This shows that Dexmeditomidine is a better adjuvant to 0.25% levo bupivacaine given via Ilioinguinal/Iliohypogastric nerve block. This correlates well with the findings of study done by Sakalli et al,[25] who reported a reduced pain score and amount of PCA and tramadol consumption in a patient given an Ilioinguinal/Iliohypogastric nerve block group during the 24 hours following caesarean delivery when performed after wound closure.

LVamsee Kiran et al,[26] conducted a study in which 60 patients who underwent LSCS were randomly allocated into two groups to receive either US-guided TAP block or Ilioinguinal/Iliohypogastric nerve block. All patients in both study groups required one dose of rescue analgesics in the form of an injection of diclofenac sodium 50 mg intravenously. Still, 57% of patients in the TAP block group did not require any further analgesics till 24 hrs. In contrast, in the Ilioinguinal Ilioihypogastric nerve group, only 13% did not require further analgesics. Correspondingly, the cumulative tramadol dose was significantly higher at all the time intervals in the Ilioinguinal Iliohypogastric group than in the TAP group. The quality of post-operative analgesia provided by the TAP block was superior to that of the ilioinguinal iliohypogastric block following LSCS. This findings doesn't correlates with our study.

Sedation

In our study sedation score of Group B was higher than group A all the time, however the difference was not significant. This correlates well with the findings of study done by Vishnu Priya etal,[20] who observed that throughout the study, the sedation score was 2 among the participants. Highly selective activation of the dexmedetomidine α2A receptor is sedative and hypnotic by acting on the locus coeruleus nucleus.[27]

Hemodynamics

The mean values of heart rate and mean arterial blood pressure of group B patients was less than group A at all the time in the postoperative period in our study with a significant P value. Similar results were observed in the study done by Vishnu Priya et al,[20] who observed that heart rate variation between the groups group B and group BD, at regular intervals from 0 mins to 24 hours, is not statistically significant ($p > 0.05$). Systolic Blood Pressure variation between groups B and BD at regular intervals from 12 to 24 hours is statistically significant ($p<0.05$). Diastolic Blood Pressure variation between the groups, group B and group BD, at regular intervals from 0 to 24 hours, is not statistically significant ($p > 0.05$) except at 8 hours and 16 hours, which is statistically significant ($p <0.05$).

Dexmedetomidine might be associated with some side effects, such as hypotension, bradycardia and sedation, particularly at higher doses.[28] The decrease in pulse rate might be related to the post-synaptic activation of central α2 adrenoceptors, leading to decreased sympathetic activity and slower HR.[29,30]

Other side effects like nausea and vomiting are insignificant in both the groups.

Strength of the study

The strength of our study lies in the study design. it's a double-blinded, randomized study. We have taken a good number of subjects for the study. Hernioplasty is also a commonly done procedure, and hence, the results of the study are more useful to them.

Limitations

The disadvantages of an ultrasound-guided procedure include the required special equipment, training, and increased cost. The cost-benefit justification requires assessing the efficacy of ultrasound guidance in comparison with the landmark-based approach.

We are unable to predict whether the action of dexmeditomidine was due to a local effect or systemic effects as we cannot estimate its plasma concentration.

Moreover, the visual analogue scale rating of pain is not an objective method; there could be some variability in the patient's ability to use this scale. Only male patients participated.

An additional study limitation was that the nerve blocks were performed in the post-operative period after the initial physical injury, and, theoretically, central sensitization and "wind up" of the pain stimulus had already occurred.

CONCLUSION

In Our study, we observed that Dexmeditomidine1 mcg/kg added to 0.25% of Levo-bupivacaine is associated with prolonged duration of analgesia compared to Dexmeditomidine 0.75 mcg/kg, decreasing the total analgesic requirement in the postoperative period with better VAS. 1 mcg/kg of Dexmeditomidine is associated with significant bradycardia and hypotension when compared to 0.75 mcg/kg of Dexmeditomidine as a adjuvant to 0.25 % levo bupivacaine, which requires close monitoring, however the sedation scores between the two groups is not significant.

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