ORIGINAL ARTICLE

Buprenorphine Significantly Prolongs Postoperative Analgesia in Intravenous Regional Anesthesia

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Abstract

The current study was conducted to assess the efficacy of buprenorphine as an adjuvant in IVRA with 0.5 % lidocaine on 50 patients aged between 18-65 years, of either sex, scheduled for hand or forearm surgery, who were divided randomly into two groups of 25 each. Group BL- Patients in the group received 10 ml of the preservative free lidocaine 2% diluted with saline, to a total volume of 40ml. Group BB- Patients in the group received 10 ml of the preservative free lidocaine 2% mixed with 1ml of buprenorphine 0.3mg diluted with saline to a total volume of 40ml. Various parameters like onset and duration of sensory and motor blockade, degree of intra and postoperative analgesia, and requirement of the postoperative analgesia and occurrence of any complications was noted. The time of onset for sensory block was shorter in group BB (4.0 + 0.35min) as compared to group BL (6.0 + 0.6 min) (p=0.001). The onset of motor block did not differ between the groups (p=0.05). In all patients in group BL analgesic duration did not last for more than 2/3 hours (0.33 + 0.2 hours). In group BB, mean analgesic duration was 6.7 + 1.2 hours. Consumption of Diclofenac was also markedly lower in group BB (80.0 + 9.0mg vs. 214 + 33mg). Addition of buprenorphine as an adjuvant in 0.5% preservative free lidocaine(40 ml volume) significantly improves the postoperative analgesia and it also improved the onset of sensory block. Consumption of Diclofenac was also markedly lower in group BB (80.0 + 9.0 mg vs. 214 + 33 mg).

Key Words

Intravenous Regional Anesthesia, Buprenorphine, Lidocaine, Limb Surgery

Introduction

Intravenous regional anesthesia (IVRA) was first described by August Gustav Bier in 1908 for anesthesia of hand and forearm. The principle applied in this technique is of isolating the vascular supply to the distal extremity by the proximally placed tourniquet and the isolated vascular segment is injected with a weak local anesthetic solution that produces rapid onset of analgesia. This method is ideal for short operative procedures of extremities performed on an ambulatory basis, lasting less than an hour because of increasing discomfort from the tourniquet (1).

IVRA is easy to administer, reliable and cost-effective. Major nerve blocks such as brachial plexus block and femoral sciatic block requires technical expertise. Conversely, the administration of IVRA requires only the skill necessary to perform a veni-puncture (2).

The ideal IVRA solution should have rapid onset, reduced tourniquet pain and prolonged post-deflation analgesia. Lidocaine is considered to be one of the least toxic local anesthetic agent used in IVRA. However, toxic reactions like cardio-respiratory depression, convulsions, coma and even cardiac-arrest have been reported which may be due to leakage past the tourniquet.

IVRA is a safe, simple procedure to administer anesthesia for hand and upper arm surgeries but lack of postoperative analgesia has been its major disadvantage. A variety of opioids have been tried so far including fentanyl, sulfentanil, morphine, mepridine, buprenorphine

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and tramadol to improve perioperative analgesia. In contrast to other μ-opioid receptor agonists, buprenorphine potentially blocked multiple isolated voltage gated allpha-subunits of sodium channels via the local anesthetic binding sites. This property is likely to be relevant when buprenorphine is used for pain treatment and for local anesthesia (3). However, very few studies have been done to establish the use of buprenorphine as adjunct to lidocaine in IVRA. So this study was conducted to assess the efficacy of buprenorphine as an adjuvant in IVRA with 0.5% lidocaine.

Aims and Objectives- This study was conducted with the following aims and objectives:

- To evaluate the anesthetic and postoperative analgesic efficacy of buprenorphine when administered as an adjunct to lidocaine in IVRA.
- To find out sensory and motor block onset times.
- To record time of onset of tourniquet pain.
- To find out sensory and motor block recovery times.
- To assess duration of postoperative analgesia.
- To look for complications, if any.

Material and Methods

After obtaining approval from the hospital's ethical committee, the study was conducted in the Department of Anesthesiology and Intensive Care, Government Medical College Jammu on ASA physical status I and II patients aged between 18-65 years , of either sex, scheduled for hand or forearm surgery.

Pre-anesthetic check-up was done a day before surgery and included a detailed history, complete physical and systemic examination and relevant investigations.

Following patients were excluded from the study:

- History of allergy to the drugs used in the study
- Patients with sickle cell anemia
- Patients with bleeding and coagulation disorders
- Patients with Raynaud's disease, Scleroderma, myasthenia gravis, liver or renal insufficiency, diabetes mellitus, thrombocytopenia, history of convulsions, asthma or cardiac disease.
- Pregnancy and lactation.

Informed written consent was taken for each patient and patient was kept 8 hours fasting overnight before surgery. Patient was premedicated with 50 mg tramadol i/m and 0.2mg glycopyrrolate i/m 45 minutes before the surgery. Intradermal test for lidocaine sensitivity was done in all patients.The study was approved by IEC GMC Jammu.The patients were divided randomly into two groups of 25 each.

Group BL- Patients in this group received 10 ml of preservative free lidocaine 2% diluted with saline, to a total volume of 40 ml.

Group BB- Patients in this group received 10 ml of preservative free lidocaine 2% mixed with 1 ml of buprenorphine 0.3 mg diluted with Saline, to a total volume of 40 ml.

1.*Sensory blockade* was assessed by blunt bevel pin-prick at six areas, representing smaller branches of four peripheral nerves i.e. lateral aspect of forearm for musculocutaneous nerve, dorsal 1st web space for radial nerve, index fingertip and thenar eminence for median nerve and little fingertip and hypothenar eminence for ulnar nerve.

Sensory block onset time was noted as the time elapsed from injection of drug to sensory block achieved in all dermatomes. The sensory block was assessed by the response to pinprick using a score scale of 0-2

- 0-Sharp
- 1-Touch only (cannot appreciate pin prick)
- 2-Cannot feel touch

Score2 was taken as onset of complete sensory block.

2. *Onset of motor block* was assessed on score scale 0-3

- 0-able to move arm against resistance.
- 1-Inabilility to move wrist against resistance.
- 2- Inabilility to move wrist and elbow against resistance.
- 3-Inability to move arm.

Score 3 was taken as onset of complete motor block.

3.*Intraoperative degree of analgesia* was evaluated by visual analogue scale (VAS) of 0-10 every minutes. (0-No pain, 10-Worst pain)

4. Assessment of the postoperative pain was done on linear VAS from 0 (no pain) to 100 (unbearable pain)

5.Time of onset of tourniquet pain was recorded.

6. Sensory block recovery time was noted as the time elapsed from release of tourniquet to perception of pain in all dermatomes determined by pin-prick test.

7. Motor block recovery time was noted as the time elapsed from release of tourniquet to ability to move arm against resistance.

Table1. Demographic Distribution of the Study Groups

Variable	Group BL(N=25)	Group BB(N=25)
Age(yrs)	40 (18-25)	38(19-52)
Weight(Kg)	55.6±4.6	58.1± 4
Gender (M/F)	17/8	16/9
Operative time (min)	42±16	43± 20
Tourniquet time(min)	50± 9	53±6

Table 2. Sensory and Motor Block Onset and Recovery Times in the Study Groups

Variable	Group BL(N=25)	Group BB(N=25)
Sensory block onset time (min)	6±0.6	4±0.35
Sensory block recovery time (min)	6±0.8	10±0.9
Motor block onset time (min)	10±1.8	11±1.6
Motor block recovery time(min)	6±0.9	7±0.54

Table 3. Analgesia and Consumption of Analgesics in the Study Group

Variable	Group BL (N=25)	Group BB (N=25)	P value
Duration of analgesia (Hrs)	0.33±0.2	6.7±1.2	0.001
Supplemental analgesia consumption (Diclofenac	214±33	80±9	0.001

8. Post operatively, the duration of analgesia was assessed by the time elapsed from the release of tourniquet to first demand of analgesics. The surgery started 10 minutes after the distal tourniquet inflation in all patients. Mean arterial pressure, heart rate, SpO2 and VAS were monitored before and after tourniquet application every 10 minutes.

9. Intra and post operatively, the following complication were looked for allergic reactions, sedation, convulsions, nausea and vomiting.

Results

In our study, the demographic data of the groups were similar for mean age, sex ratio and weight. There was no significant difference in duration of surgery and tourniquet time. There was also no difference between the groups when compared for mean arterial pressure, heart rate and oxygen saturation (SpO2) during intra and postoperative period (p>0.05). (*Table-1*)

The time of onset for sensory block was shorter in group BB (4.0 + 0.35 min)as compared to group BL (6.0+0.6min) (p=0.001). The onset of motor block did not differ between the groups p=0.05. The quality of sensory and motor block did not differ between groups when compared (p=0.078 and 0.088 respectively). *Table-2*) In all patients in group BL analgesic duration did not last for more than 2/3 hours (0.33+ 0.2 hours). In group BB, mean analgesic duration was 6.7 + 1.2 hours. Consumption of Diclofenac was also markedly lower in group BB (80 + 9.0 mg vs. 214 + 33 mg). (*Table-3*)

VAS scores were significantly lower in group BB as compared to BL (p<0.001). All the patients were monitored for 30 minutes postoperatively and then 2 hourly for 12 hours and 4 hourly thereafter for complications, if any. None of the patients in BL group experience any complications postoperatively, while complications rates were significantly higher in group BB (p=0.002), with 5 patients having nausea and vomiting and 2 having sedation.

Discussion

IVRA is a simple and reliable technique with a success rate between 94-98%, but has been limited by tourniquet pain and inability to provide postoperative analgesia. Numerous attempts to reduce the severity of tourniquet

discomfort, improve the quality of block and to prolong postoperative analgesia have been made by adding a wide range of agents to the local anesthetic for the Bier's block. The present study was undertaken in Government Medical College, Jammu and comprised of 2 groups with 25 patients each, with one group receiving only 0.5% lidocaine while the other group received Buprenorphine 0.3 mg as an adjuvant with lidocaine. The patients of group BB had markedly prolonged period of postoperative analgesia, better VAS scores and had lower requirements of analgesia in postoperative period. No serious side effects were observed in BB group. This finding is supported by other studies by numerous researchers, who also observed that addition of Buprenorphine to IVRA led to prolonged period of post operative analgesia, better VAS scores and had lower requirements of analgesia in postoperative period, but they observed that addition of opioids reduced the sensory onset time (4-7). Swarnkar *et al* (8) concluded that addition of 0.3 mg buprenorphine to lidocaine for IVRA significantly prolonged analgesia without causing systemic side effects. In our study too, the addition of Buprenorphine caused slight shortening of sensory block but did not affect the onset of motor block. This shortening has been attributed to the action of opioids on the peripheral opioid receptors causing the analgesic effect, thereby augmenting the sensory block onset.

Buprenorphine is a synthetic partial μ-receptors agonist derived from thebain, one of the opioid alkaloid. It has a rapid onset and prolonged duration of action. It is 25-40 times more potent than morphine on parenteral administration. It is potentially safe in conditions of over dosage due to its bell shaped dose response curve and has a low abuse potential. Researchers have reported analgesic synergy between Buprenorphine and lidocaine (9). The duration of response from the lidocaine/ Buprenorphine combination exceeded that seen with any of the other opioid tested as an adjuvant.

Addition of Buprenorphine to Lidocaine in IVRA resulted in significant prolongation of analgesia and was associated with a threefold decrease in analgesic consumption in the postoperative period. Candido *et al* (7) used Buprenorphine in brachial plexus block and reported marked prolongation of analgesia extending upto 30 hours, further endorsing the enhanced peripheral opioid antinociception. YaDeau *et al* (10) used dexamethasone and buprenorphine to bupivacaine in sciatic nerve block and they concluded that perinueral buprenorphine and dexamethasone prolonged the duration of block, reduced the worst pain experienced and reduced the opioids used. Similar findings were also noted when Buprenorphine was added to central neuraxial blocks.

Conclusion

The Current study demonstrates that addition of Buprenorphine to Lidocaine for IVRA significantly prolongs the duration of postoperative analgesia possibly through peripheral mechanism while causing minimal side effects.

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