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Original Research Article

Comparative Study of Analgesic Effect of Intrathecal Administration of Dexmedetomidine and Fentanyl as Adjuvants to Bupivacaine in Lower Limb Ilizarov Surgeries

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Conflict of interest: Nil

Abstract:

Background: In present day anesthesia practice various drugs has been used for a better somatic and visceral analgesia as adjuvants along with local anesthetic drug given in spinal anesthesia.

Aim: The main aim of the study was to compare efficacy, safety, hemodynamic stability and analgesic effect of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric 0.5% bupivacaine in lower limb Ilizarov surgeries.

Materials and Methods: Study was done taking 60 no. of patients who were classified under American society of Anesthesiologists classes I, II & III posted for lower limb ilizarov surgeries. Patients were randomly allocated using sealed envelopes into two groups. Group I-Given 15mg hyperbaric bupivacaine +5µg dexmedetomidine, group II-15mg hyperbaric bupivacaine +25µg fentanyl intrathecally.

Results: In patients who have received dexmedetomidine observed to have significantly longer analgesic effect than the other group who received fentanyl as adjuvant. Meantime taken for sensory regression to S1 were 160 ±22.7 in group I and 110±20.5 in group II. Time taken for regression of motor block to Bromage scale 0 was 350±22.3 in group I and 277±17.9 in group II.

Conclusion: Intrathecal administration of dexmedetomidine as adjuvant is associated with prolonged analgesic effect, hemodynamic stability and minimal requirement of rescue analgesia as compared to fentanyl.

Keywords: Bupivacaine, Dexmedetomidine, Fentanyl, Spinal Anesthesia, lower limb ilizarov surgeries.

Introduction

Spinal anesthesia/sub arachnoid block is most common mode of anesthesia for infraumbilical surgeries, as it has effective motor and sensory block with rapid onset, cost effective, less chances of infections etc. But as it give with local anesthetic agent's duration of block wears off.

A number of adjuvants, such as clonidine and midazolam, and others have been studied to prolong the effect of spinal anesthesia. [1,2] The addition of fentanyl to hyperbaric bupivacaine improves the quality of intraoperative and early postoperative subarachnoid block. [3]The addition of opioids to local anesthetic solution has disadvantages, such as pruritus and respiratory depression. Dexmedetomidine has been approved by Food and Drug Administration (FDA) as a short-term sedative for mechanically ventilated intensive care unit (ICU) patients. Based on earlier human studies, it is hypothesized that intrathecal 5 μg dexmedetomidine would produce more postoperative analgesic effect with hyperbaric bupivacaine in spinal anaesthesia with minimal side effects. [4-6]

It is under evaluation as a neuraxial adjuvant as it provides stable hemodynamic conditions, good quality of intraoperative and prolonged postoperative analgesia with minimal side effects. Dexmedetomidine highly selective alpha 2 agonist

provides intraoperative and post-operative hemodynamic stability, prolonged postoperative analgesia with minimal side effects unlike fentanyl.

Based on couple of previous studies we decided to inspect and explore wide uses and effects of dexmedetomidine along with fentanyl. So we have conducted a randomized double blinded comparative study between two groups who were posted for lower limb ilizarov surgery and evaluated them in terms of quality of block and post-operative span of effective analgesia.

Material and Methods

We have conducted this randomized double blinded comparative study on 60 no. patients after getting approval from ethical committee of our institute GMERS Medical college Junagadh. Duration of surgery was 1year. Written informed consent was taken from patients. Our inclusion criteria was patients who were posted for lower limb ilizarov surgery of femur and tibia deformity corrections, nonunion, malunion, in open fractures as primary treatment with ASA grade I, II & III either sex, age between 20-60yrs.Under exclusion criteria we have patients with poor GCS, liver and renal diseases, bleeding tendency and coagulopathy, local anesthetic allergy or local site infection, patients undergoing general anesthesia and known case of neuropathy.

Parameters observed in study are heart rate, mean arterial pressure, time to achieve sensory block, time to achieve motor block, time taken to reach maximum sensory block, post-operative analgesic effect.

Patients were accessed and investigated day before surgery, also familiarized with the VAS score prior to surgery. Patients were fasted for 6hrs and all patients are given tablet alprazolam 0.25mg orally night before surgery. Patients were randomly divided into two groups using sealed envelopes. Preloading was done with ringer lactate solution at 15ml/kg. Vitals like pulse, noninvasive blood pressure, and electrocardiogram were connected and monitored throughout the intraoperative period. Following strict aseptic precautions, patient in sitting position receives spinal anesthesia with 25G quince's needle at L3-L4 interspace level after giving local anesthesia at spinal site.

Group-I given bupivacaine heavy 15mg (3ml)+dexmedetomidine 5µg(0.05ml),

Group II-bupivacaine heavy 15mg (3ml)+fentanyl 25µg(0.5ml).

Anesthesiologist performing spinal was blinded to the nature of drug given to patients, as the drug was prepared by another anesthesiologist. Patients were brought to supine position immediately after spinal anesthesia. Drugs like ephedrine and atropine were kept ready for adverse effects of spinal anesthesia i.e, hypotension and bradycardia respectively. O2 support given with the help of mask ventilation if saturation drop below 90%.Other adverse effects like nausea, vomiting, pruritis, sedation were noted. Sensory loss assessed every 5min for first 20min with 23G hypodermal needle, there after every 15min and surgery was allowed after achieving T8.Onset of sensory block, motor block, time to reach highest sensory block, duration of sensory and motor block, duration of spinal anesthesia were recorded. Duration of spinal anesthesia defined as time between spinal injection and first time pain complaint by patient in post-operative period. Vitals were recorded every 5,10,15,20 and every 15 min thereafter.

Motor block was assessed by bromage scale.

Bromage 0, the patient is able to move the hip, knee, and ankle; Bromage 1, the patient is unable to move the hip, but is able to move the knee and ankle; Bromage 2, the patient is unable to move hip and knee, but is able to move the ankle; and Bromage 3, the patient is unable to move the hip, knee, and ankle.

Pain was assessed with VAS score firstly before spinal injection and 2, 4, 6,8,10,14,18,24 hourly postoperatively and managed accordingly. POST OPERATIVE-Sensory block regression was assessed and patients with VAS score >4 were given IV paracetamol as rescue analgesia.

Statistical analysis

The recorded data was compiled and entered in a spread sheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA).

Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively. Independent Student's t-test was carried out to compare VAS score.

Results

Demographic features like age, gender, ASA physical status were compared between two groups. Duration of surgery has not shown any significant difference between groups.

Table 1: Demographic Distribution of Patients

Features	Group I	Group II	P value
Age (mean/standard deviation)	39.93+14.6	39.7+_12.08	0.95
Gender(male/female)	24:6	11:9	>0.05
ASA physical status	20:9:1	18:11:1	>0.05
Duration of Surgery	148.13+_22.6	146.+_26.3	0.786

Duration of surgery was shown to be unaffected. P value was nil significant.

Table 2: Characteristics of spinal block

Variable	Group I	Group II	P value
Time of onset of sensory block	5.86+ 1.6	5.6+ 1.4	0.624
Time of onset of motor block	7.7+ 1.53	7.4+ 1.27	0.395
Time to reach max. sensory level	12.2+ 1.52	11.8+ 1.3	0.274
Duration of sensory block	179+ 11.7	122.7+ 15.9	0.0001
Duration of motor block	300+ 12.8	202+ 15.96	0.0001
Duration of spinal anesthesia	356+ 22.3	277+ 17.9	0.0001

There was no significant difference between two groups in achieving highest/peak level of block. Reversion of block with intrathecal dexmedetomidine was observed to be much slower than with fentanyl. Achieving Bromage scale 3 has not shown any significant difference between two groups, but reversal of motor block to Bromage scale 0 was slower with dexmedetomidine. Intervention with rescue analgesia was needed after a longer time in group with dexmedetomidine than in group with fentanyl. Vitally patients of two groups had shown hemodynamic stability. Two patients in group I required ephedrine for control of hypotension,1 patient required atropine for bradycardia.

Table 3: VAS score post-operative period at rest

VAS Score	Group I		Group II		Requirement of rescue Analgesia	P value
Pre intervention	1.4	0.50	1.5	0.5	-	0.4
2nd hour	0.733	0.63	0.96	0.76	-	0.17
4th hour	1.4	0.6	2.8	0.9	-	0.0001
6th hour	2.6	0.96	2.6	1.06	+	0.89
8th hour	2.7	1.02	4	1.25	+	0.0001
10th hour	4.06	1.04	5.7	1.0	+	0.0001
14th hour	5.5	1.10	5.56	1.13	+	0.836
18th hour	5.9	0.8	6	0.83	+	0.6
24th hour	6.4	1.22	6.4	1.19	+	0.83

None of the patients required rescue analgesia during intra operative period. Two patients in group II required inj. ondansetron due to vomiting. VAS score and requirement of rescue analgesia was expressed in table no.3.

There was no significant difference between two groups during preintervention and 2nd hour(post-operative). At 4th hour post operatively p value observed to be significant.7 patients in group II required rescue analgesia with inj. paracetamol. During 6th hour p value was insignificant .6 patients in group I,8 patients in group II required rescue analgesia . During 8th&10th hour of postoperative period p value is significant. Severity of pain was high in group II. During 14th, 18th and 24th hour requirement of rescue analgesia in both groups is almost same hence the p value was insignificant.

Discussion

The mechanism by which intrathecal α 2 -adrenoceptor agonists prolong the motor and sensory block of local anesthetics is not well known. They act by binding to presynaptic C-fibers and postsynaptic dorsal horn neurons. Their analgesic action is a result of depression of the release of C-fiber transmitters and hyperpolarisation of postsynaptic dorsal horn neurons.[7] Local anesthetic agents act by blocking sodium channels. The prolongation of effect may result from synergism between local anesthetic and α 2 -adrenoceptor agonist, while the prolongation of the motor block of spinal anesthetics may result from the binding of α 2 -adrenoceptor agonists to motor neurons in the dorsal horn. [8] Intrathecal α2 -receptor agonists have been found to have antinociceptive action for both somatic and visceral pain. [5] Fentanyl is a lipophilic μ-receptor agonist opioid. Intrathecally, fentanyl exerts its effect by combining with opioid receptors in the dorsal horn off spinal cord and may have a supraspinal spread and action. [9]

In our study we compared intrathecal efficacy and post-operative analgesia provided by two drugs

dexmedetomidine and fentanyl. Analgesic mechanism of α2 adrenoreceptor agonists (i.e dexmedetomidine) is by depression of release of C-fiber transmitters and hyperpolarization of postsynaptic dorsal horn neurons. On the other hand, fentanyl lipophilic μ receptor agonist opioid shows its effect by combining with opioid receptors in dorsal horn of spinal cord after intrathecal injection.

Previously studies have been done using intrathecal clonidine; fentanyl etc. but comparative studies about intrathecal dexmedetomidine and fentanyl for analgesic effect are very few in no. Fukushima et al administered 2 μg/kg epidural dexmedetomidine for post-operative analgesia and there was no neurological deficit seen.In our study we administered 5 μg dexmedetomidine with hyperbaric bupivacaine and observed significant prolongation in sensory and motor block. Quality of block was good in both the drugs dexmedetomidine and fentanyl but duration of analgesia was observed to be longest in group I (dexmedetomidine) than in group II (fentanyl). Al Ghanem [7] et al study also showed significant prolongation in sensory and motor blockade in patients with dexmedetomidine than with fentanyl. Al-Mustafa [8] et al also made studies regarding dose dependent effect of dexmedetomidine. 5μg, 10μg doses have shown difference in prolongation of sensory and motor blockade (dose dependent prolongation).

Local anesthetic agents such as bupivacaine act by blocking sodium channels while alpha-2 adrenoceptor agonist such as dexmedetomidine act by binding to presynaptic C-fibers and postsynaptic dorsal horn neurons. The prolongation of effect may result from synergism between local anesthetic and alpha-2-adrenoceptor agonist while the prolongation of the motor block of spinal anesthetics may result from the binding of alpha-2-adrenoceptor agonists to motor neurons in the dorsal horn. [6] Intrathecal alpha-2-receptor agonists have been found to have antinociceptive action for both somatic and visceral pain. [10] Fentanyl is a lipophilic μ-receptor agonist opioid. Intrathecally, fentanyl exerts its effect by combining with opioid receptors in the dorsal horn of spinal cord and may have a supraspinal spread and action. [5]

Thus the present study showed that the intrathecal adjuvant administration of dexmedetomidine as compared to fentanyl provided a longer duration of sensory and motor blockade apart from providing a longer postoperative analgesic effect.

Conclusion

Intrathecal dexmedetomidine has shown prolonged sensory &motor block, hemodynamic stability, less side effects, good postoperative analgesia.

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