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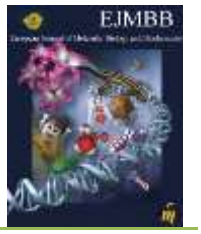

COMPARATIVE EVALUATION OF ANALGESIC EFFECTS OF HYPERBARIC BUPIVACAINE WITH DEXMEDETOMIDE AND FENTANYL FOR FEMUR FRACTURE SURGERIES

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ABSTRACT
Dexmedetomidine is a new addition to the class of α2 adrenergic agonists and Fentanyl, a synthetic opioid, has got numerous beneficial effects when used as adjuvants in spinal anaesthesia to prolong intraoperative and postoperative analgesia Aims and objectives: To evaluate dexmedetomidine and fentanyl as an adjuvant to hyperbaric bupivacaine in femur fracture surgeries surgeries, administered intrathecally and to compare the early onset of analgesia, duration of sensory and motor block, postoperative analgesia and changes in hemodynamic, of fentanyl and dexmedetomidine. Materials and methods: The study was carried out at the Department of Anesthesia of the Swamy Vivekanandha Medical College Hospital and Research Institute, Elayampalayam, Tiruchengode. This Prospective Randomized Observational study was carried out for one year and in patients aged between 20 and 75 years of either gender, undergoing elective femur fracture surgeries, classified in American Society of Anaesthesiologist (ASA) grade I and II were recruited. One hundred and twenty patients were randomly allocated to three groups of 40 patients. Results: The three groups were statistically similar to each other in age, gender, ASA (American Society of Anaesthesiologists) status, type of surgery, and duration of surgery. No significant differences was found between HBD with HBF and HBN groups in regression to Bromage 0 ($p < 0.05$). The mean duration of surgery in group HBD was 156.06± 42.7 minutes and 151.9± 40.0 minutes in group HBF. There were statistically significant differences between groups HBD, HBF and HBN in the time of onset of sensory block ($p < 0.05$), time for two segmental regression from the highest sensory level ($p < 0.05$), sensory regression to S1 from highest sensory level ($p < 0.001$), time to rescue analgesia ($p < 0.001$) and Numeric Rating Scale (NRS). The highest sensory block occurred in T6 dermatome in all the three groups. Conclusion: Dexmedetomidine as an adjuvant to hyperbaric bupivacaine has prolonged the duration of analgesia and decreased the consumption of analgesics than bupivacaine with fentanyl. It is effective in pain control, reduced post-anaesthesia care unit stay, decreased duration of ventilation, good haemodynamic stability, decreased complications and reduced agitation are other advantages observed in patients undergoing traumatized lower limb orthopaedic surgery.

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INTRODUCTION

The International Association for the Study of Pain (IA SP) defines, pain as “an unpleasant sensory and emotional experience associated with actual or potential

tissue damage, or described in terms of such damage".[1] An inappropriate management of post-operative patients could give rise to a range of medical problems as physiological, psychological and metabolic disturbances in patients, these conditions require special considerations for anaesthesiologist, which has led to the evaluation of various anaesthetic techniques.[2]

Femur neck fractures FNFs demonstrate, a two modes of distribution pattern, among elderly patients occurring secondary due to low energy falls and in younger patients occurring as higher energy traumatic mechanisms.[3] All the fractures related to femur, need an internal fixation surgically, from another perspective, the intensity of pain is significantly more among these patients, eventually the pain related complications are also high.Hence, these post-operative surgeries are associated with high demand for analgesics, including opioids.[1]

Several drugs have been used as adjuvants when coupled with local anaesthetic agents, either epidurally or intrathecally, in order to extend the duration of a denser neuraxial block and achieve adequate peri-operative conditions.[4] Many adjuvants such as opioids, sodium bicarbonate, adrenaline, α-2 adrenoreceptor agonists and Gamma-aminobutyric acid (GABA) receptor agonists are employed to upgrade and prolong analgesia.[1] Even though opioids like fentanyl and morphine are often used in treating pain, still pain isn't invariably relieved completely, often patients develop tolerance to these drugs.[5] Sedation, stable haemodynamics and an ability to provide smooth and prolonged post-operative analgesia are the main desirable qualities of an ideal adjuvant.[4]

The modern orthopaedics is about early postoperative mobilisation and rehabilitation along with minimal pain and discomfort for better results.[1] Seeking for appropriate adjuvants for regional nerve blocking is still under research, with medication that increases the time of analgesia but with lesser side effects.[7] Dexmedetomidine is an α2 -adrenergic receptor agonist having sedative, anxiolytic, analgesic, hypnotic and antihypertensive, neuroprotective and sympatholytic properties. These effects were produced by inhibiting the central sympathetic outflow by blocking the α-receptors in the brainstem, leads to inhibition of norepinephrine release.[8,9]

MATERIALS AND METHODS

The study was carried out at the Department of Anesthesia of the Swamy Vivekanandha Medical College Hospital and Research Institute, Elayampalayam, Tiruchengode.This randomized double-blinded study was carried out for one year and the patients aged between 20 and 75 years of either gender, classified in American Society of Anesthesiologist (ASA) grade I and II were recruited. 120 patients undergoing elective femur fracture surgeries, were randomly allocated to three groups. Institutional ethics committee approval was taken. A written informed consent was taken from the patients included in this study.

Inclusion criteria:

Informed consent was taken from patients explaining the intrathecal procedure, patients aged 20–75 years, Patients classified in American Society of Anesthesiologists (ASA) Class I and II, Lack of anaphylaxis, no substance misuse, no contraindication for epidural analogy, duration of surgery between 210 and 90 minutes.

Exclusion criteria:

Patients refusing to participate, Patients with age range below 20 and 85 above years, Patients with grade III and IV ASA, patients with substance abuse, patients undergoing general anaesthesia, patients with known neurologic and psychiatric illness, anatomical deformities of the spine, hepatic, renal or cardiopulmonary abnormality, alcoholism, rheumatoid arthritis (RA), any contraindication to spinal anaesthesia or allergic to local anaesthetic and to the study drugs were excluded.

Patients were randomly divided into three groups: Group HBD - receiving 2.5 mL volume of 0.5% hyperbaric bupivacaine and 5 μg dexmedetomidine in 0.5 mL, (dexmedetomidine (100 μg/mL) was diluted in preservative-free normal saline) and Group HBF - to receiving 2.5 mL volume of 0.5% hyperbaric bupivacaine with 25 μg fentanyl and Group – HBN received 2.5 ml intrathecal hyperbaric bupivacaine with 0.5 ml normal saline via intrathecal approach, at the level of L4-L5 interspace in sitting position using a midline or paramedian approach by a 25G Quincke spinal needle. Soon after completion of the injection patients were made to lie supine. Time required to reach the complete motor block, time to reach highest sensory level, time of regression from block, analgesic request and duration of the drug effect, hemodynamic changes and side effects were compared between the groups.

Prior to surgery all the patients were kept in fasting for eight hours. The patients were preloaded with lactated ringer's solution 5 mL/kg. They were monitored for non-invasive blood pressure (NIBD), ECG, heart rate and pulse oximetry. Systolic and diastolic blood pressure and the heart rate were recorded before regional anaesthesia and after 5, 10, 15, 30, 45 and 60 min of anaesthesia. As we need to evaluate anaesthetic effects, both the sensory and motor status were assessed before the spinal injection, then for every 2 min after injection until reaching the highest sensory level and Bromage scale reaches.

- Bromage 0 (none): Free movement of legs and feet,
- Bromage I (Partial): Just able to flex knees with free movement of feet,

- Bromage II (Almost complete): Unable to flex knees, but with free movement of feet,
- Bromage III (Complete): Unable to move legs or feet) to Bromage 3.

After surgery, assessment performed for every 10 min until the time to regression of 2 sensory levels, then for every 20 min until the regression time to the dermatome S1 and motor scale to Bromage 0. Severity of pain 6h after surgery was measured by Numeric Rating Scale (NRS). The patients were asked to rate their pain from a scale of 0 = no pain to 10 = the worst possible pain. In case of any side effects, it was recorded thoroughly.

Hypotension was defined as decrease in Systolic Blood Pressure (SBP) more than 30% of baseline or Systolic Blood Pressure (SBP) < 90 mmHg. If hypotension occurred, 10 mg ephedrine would be administered. Bradycardia was defined as heart rate (HR) below 50 pulses per minute and if occurred, 0.6 mg atropine would be administered.

RESULTS

One hundred and twenty patients were randomly allocated to three groups of 40 patients. No patients were excluded after recruitment and data from all the patients included, were analysed. The three groups were statistically similar to each other in age, gender, ASA (American Society of Anaesthesiologists) status, type of surgery, and duration of surgery. There was no significant difference between the groups in baseline findings (Table-1). Characteristics of sensory and motor block between the three groups are demonstrated in (Table 2). There was significant differences was observed between HBD with HBF and HBN groups in regression to Bromage 0 ($p < 0.05$). The mean duration of surgery in group HBD was 156.06± 42.7 minutes and 151.9± 40.0 minutes in group HBF. There were statistically significant differences between groups HBD, HBF and HBN in the time of onset of sensory block ($p < 0.05$). Time for two segmental regression from the highest sensory level ($p < 0.05$), sensory regression to S1 from highest sensory level ($p < 0.001$), time to rescue analgesia ($p < 0.001$) and Numeric Rating Scale (NRS) ($p < 0.001$). The highest sensory block occurred in T6 dermatome in all the three groups (Table: 3). Nausea and vomiting were higher in HBN group and bradycardia and hypotension and were significantly higher in HBF group (Table:4)

Table 1: Demographic characters

Parameter	Group HBD(n=40)	Group HBF(n=40)	Group HBN(n=40)	*p* Value
Age	38.8	42.15	38.85	**<0.05**
Sex Male Female	 36 (90%) 4 (10%)	 34 (85%) 6 (15%)	 32 (80%) 8 (20%)	-
ASA I	18 (45%)	17 (42.5%)	15 (37.5%)	-
ASA II	22 (55%)	23 (57.5%)	25 (62.5%)	-
Mean duration of the surgery	156.06 ± 42.7	151.9 ± 40.0	155.5±39.9	**>0.05**
Weight	73.5 ± 9.8	67.6 ± 9.74	69.25 ± 8.50	**<0.05**
Height	162.1 ±19.4	159.8 ± 17.6	161.2±16.4	**>0.05**
Body mass index (kg/m^2)	22.4 ± 5.4	21.9±4.4	21.49 ±3.6	**>0.05**

Table 2: Characteristics of block between three groups

	Group HBD(n=40)	Group HBF(n=40)	Group HBN(n=40)	P value
Time from injection to highest sensory level	6.10±1.23	7.0 ± 1.19	6.5 ± 1.2	**<0.05**
Time of two segment regression from the highest sensory level (min)	146.3±16.4	90.2 ±11.39	63.1 ± 7.36	**<0.05**
Time for sensory regression to S1 from highest sensory level (min)	558.9±58.6	326.07±38.8	239.3± 18.6	**<0.05**
Onset to Bromage 3 (min)	4.78±1.00	5.02 ±1.11	5.41±1.15	**<0.05**
Regression to Bromage 0 (min)	338.1±46.0	189.75±36.6	148.5 ± 21.9	**<0.05**
Time to rescue analgesia (min)	233.4±2079	290.35±32.8	496.6±36.5	**<0.05**
NRS six hours after surgery	1.84±0.5	6.14±1.02	6.44±0.74	**<0.05**

Table 3: Highest dermatome level of sensory block

	Group HBD	Group HBF	Group HBN
T4	1 (2.5%)	2 (5%)	3 (7.5%)
T5	4 (10%)	10 (25%)	12 (30%)
T6	16 (40%)	19 (47.5%)	14 (35%)
T7	14 (35%)	5 (12.5%)	7 (17.5%)
T8	5 (12.5%)	4 (10%)	4 (10%)

Table-4: Side effects between groups

	Group HBD (n=40)	Group HBF (n=40)	Group HBN (n=40)
Nausea	**1 (2.5%)**	**2 (5%)**	**3 (7.5%)**
Vomiting	**0**	**1(2.5%)**	**2 (5%)**
Chilling	**0**	**2 (5%)**	**1(2.5%)**
Pruritis	**0**	**1(2.5%)**	**0**
Hypotension	**1 (2.5%)**	**4 (10%)**	**1(2.5%)**
Bradycardia	**0**	**3 (7.5%)**	**2 (5%)**

DISCUSSION

In this study, we assessed the efficacy of three spinal anaesthesia methods, bupivacaine alone or bupivacaine with dexmedetomidine or with fentanyl in femur fracture surgeries. No significant difference was observed between groups in time to onset of Bromage 3 and complete motor block, bupivacaine with dexmedetomidine group had lesser time to reach the highest sensory level than bupivacaine with fentanyl group, with no difference with bupivacaine alone group but it was not statistically significant (P= >0.05).Similar findings were reported in other studies with no significant difference observed in the onset of motor block between dexmedetomidine and fentanyl groups.[10,11] In contrast other studies reported faster onset of motor block for dexmedetomidine compared to fentanyl.[10,12,13,14]

In this study, we observed highest sensory level in HBD and HBF group were T6 and T5 dermatomes, similar finding was observed by Poupak Rahemjadehz *et al.,*[11] Whereas Ravipati *et al.,*[10]reported a highest level of block reached in both groups was T5 dermatome and Mahendru *et al.,*[13] at T6 dermatome. In contrast Gupta R *et al.,*[15] reported the highest sensory level at T5 and T6 dermatome with dexmedetomine and fentanyl group respectively.

None of our patients required analgesic during the surgery. Bromage 3 reached in all patients before surgery. Bromage 0 (Complete regression of motor block) was occurred in all patients with the highest duration among HBD group. Moreover, time to regression to S1 sensory level and regression of two sensory levels, in dexmedetomidine group was significantly longer compared to other groups. HBD patients experienced highest postoperative analgesia with low pain intensity six hours after operation indicative of long duration of analgesia. Similar findings were observed by other studies.[11,16]

In this study we observed changes in Systolic Blood Pressure, Diastolic Blood Pressure and Heart rate in HBF was higher than BD and group, similar to studies other studies, no significant difference was observed between dexmedetomidine and fentanyl regarding hemodynamic status by other studies.[10,12,13] Side effects are common in any anaesthesia medications, we found no significant difference in the rate of bradycardia, hypotension, nausea, vomiting and chilling between groups. Whereas, a study by Ravipati *et al.,*[13] observed nausea, vomiting common in dexmedetomidine group. Ibrahim FA. *et al.,*[17] observed an increased hemodynamic affect. Based on the results of the current study, it is stated that intrathecal administration of bupivacaine with dexmedetomidine is found superior to intrathecal administration of bupivacaine with fentanyl.

CONCLUSION

We conclude that using dexmedetomidine as an adjuvant to hyperbaric bupivacaine has prolonged the duration of analgesia and decreased the consumption of analgesics than hyperbaric bupivacaine with fentanyl on intrathecal administration. Although, both the drugs adequately reduced the postoperative requirements of rescue analgesics and offered a greater patient satisfaction. Comparatively dexmedetomidine with hyperbaric bupivacaine is a promising technique has longer duration of sensory and motor block and longer postoperative analgesia in femur fracture surgeries. Effective in pain control, reduced post-anaesthesia care unit stay, decreased duration of ventilation, good haemodynamic stability, decreased complications and reduced agitation are other advantages observed in patients undergoing traumatized lower limb orthopaedic surgery. It is associated with early-onset postoperative mobilization and rehabilitation with minimal associated pain and discomfort, which is the most desirable feature in modern surgery.

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