VOLUME - 10, ISSUE - 07, JULY- 2021 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Anaesthesiology

COMPARATIVE STUDY OF FENTANYL VS DEXMEDETOMIDINE AS ADJUVANTS TO INTRATHECAL BUPIVACAINE IN LOWER LIMB SURGERIES

Dr. Seema* Senior Resident, Department Of Anaesthesia, PGIMS, Rohtak-124001, Haryana, India. *Corresponding Author

Dr. Sumit Garg Junior Resident, Department Of Anaesthesia, Pgims, Rohtak-124001, Haryana, India.

ABSTRACT

INTRODUCTION: Spinal block is a common procedure for lower limbs surgery. Fentanyl, a synthetic opioid and dexmedetomidine, a selective 2 agonist have been used as adjuvants in spinal anesthesia to prolong intraoperative and postoperative analgesia. The aim of current study is to compare the efficacy of dexmedetomidine and fentanyl added to intrathecal bupivacaine in orthopedic procedures in lower limbs.

METHODS: In this randomized clinical trial, 80 patients undergoing elective lower limb surgeries were randomly allocated to two groups. Via intrathecal approach, the patients received 2.5 ml hyperbaric bupivacaine 0.5% with 5 micrograms dexmedetomidine (D group) and 25 micrograms fentanyl (F group) respectively. Time to reach the complete motor block, the highest sensory level, regression from block, analgesic request and duration of the drug effect and side effects were compared between the groups.

RESULTS: There was significant difference between group D and F in regression to Bromage 0 ($p < 0.001$), two segmental regression ($p < 0.001$), sensory regression to S1 ($p < 0.001$), time to rescue analgesia ($p < 0.001$) and NRS 6 hours after surgery ($p < 0.001$), but there was no significant difference between groups in time from injection to highest sensory level and onset of Bromage III ($p > 0.05$). Incidence of side effects such as bradycardia in Group D was significantly more than that of Group F ($P < 0.05$), although hypotension occurred in both the groups was statistically not significant ($P > 0.05$).

CONCLUSIONS: Using dexmedetomidine as an adjuvant to bupivacaine for spinal anesthesia in lower limb surgeries has longer duration of sensory and motor block and longer postoperative analgesia.

KEYWORDS : Lower limb surgery, Dexmedetomidine, Fentanyl, Intrathecal

INTRODUCTION

There are various modalities of anaesthesia to perform lower limb surgeries, but neuroaxial block is the preferred method due to its deep sensory block as well as fewer side effects.[1] Despite many benefits of this method, it has a short duration and cannot provide sufficient postoperative analgesia; so the postoperative analgesic administration is necessary.[2,3] Various other classes of drugs including opioids, α2 agonists, neostigmine and vasoconstrictors etc has been used with local anesthetics to increase the duration and to provide long lasting analgesia.[4]

Fentanyl is the most common short-acting opioid that is used intrathecally in combination with local anesthetics. It has been reported that intrathecal administration of fentanyl at the dose of 10–25 microgram can prolong the duration of postoperative analgesia for approximately 180–240 min.[5] However, intrathecal opioids can cause some side effects such as itching, urinary retention, nausea and vomiting as well as respiratory depression.[6,7]

Dexmedetomidine is a potent and highly selective α-2-adrenoceptor agonist.[8] It has a relatively high ratio of α-2/α-1 activity (1620:1). The increased specificity of dexmedetomidine for the α-2 receptor causes it to be with much more effective sedative, anxiolytic, analgesic, antihypertensive and sympatholytic properties with much less unwanted cardiovascular effects from α-1 receptor activation.[9] The aim of the present study was to compare the effect of dexmedetomidine and fentanyl as an adjuvant to bupivacaine during spinal anaesthesia in lower limb surgeries.

MATERIAL AND METHOD

After approval from institutional ethical committee, this prospective randomized controlled study was carried out in 80 patients, aged between 18 to 65 years of ASA grade I and II, posted for lower limb orthopedic surgeries over a period of one year. Participants were equally divided into Fentanyl group (Group F) and Dexmedetomidine group (Group D). The patients of group F received 2.5 ml intrathecal hyperbaric bupivacaine with 25 micrograms fentanyl and group D with 5 micrograms dexmedetomidine. All medications were prepared in 3 ml syringes. The patients and physician evaluating the outcome of the treatments were blinded to the group allocation.

The exclusion criteria included patient's refusal, ASA grade III, IV and V, inadequate fasting status, weight > 100 kg, history of diabetes mellitus, renal or hepatic failure, dysrythmia, coagulopathies, neurologic disorders and any contraindication to spinal anaesthesia. Preoperatively all routine investigations including blood group, haemoglobin, serum urea and serum creatinine of the patients were checked. Written informed consent and fasting status of the patient was confirmed and IV line was secured with 18G cannula in preoperative room. In the operation theatre, standard monitors were attached (five lead ECG, Non-invasive blood pressure, pulse oximeter) and baseline recordings were noted in supine position. Under proper aseptic conditions, spinal anesthesia was given at the level of L3-L4 interspace in sitting position using a midline or paramedian approach by a 23G Quincke spinal needle and all patients were made to lie in supine position. Blood pressure, heart rate and pulse oximetry were performed every minute in the first 10 min and then every five minutes for one hour. We recorded systolic and diastolic blood pressure and heart rate before regional anesthesia and in the 5, 10, 15, 30, 45 and 60 min after anesthesia. All data were recorded in a data sheet specified to each patient. Both sensory and motor status were assessed prior to the spinal injection, then every 2 min after injection until reaching the highest sensory level and Bromage scale reaching to Bromage III. After surgery, assessment performed every 10 min until the time to regression of 2 sensory levels, then every 20 min until the regression time to the dermatome S1 and motor scale to Bromage 0. The motor dermatome level was assessed according to the Bromage scale:

- 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.

Severity of pain was measured by Numeric Rating Scale (NRS) after 6 hour of surgery. 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. Hypotension was defined as decrease in systolic blood pressure (SBP) more than 30% of baseline or SBP < 90 mmHg. If hypotension occurred, 6 mg mephentremine would be administered. Bradycardia was defined as heart rate below 50 pulses per minute and if occurred, 0.6 mg atropine would be administered.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS v22 software. Student t-test, Chi-square test and repeated ANOVA test were applied according to the requirement. The level of significance was fixed at 95%. P < 0.05 was considered statistically significant.

RESULTS

The demographic profile of all the patients in group F and group D were comparable. ***(Table 1)***

Table 1: Demographic data

Parameters	Group F	Group D	P value
Age (years)	42.37 ± 11.52	44.2 ± 9.28	0.34
Sex (M/F)	22/18	21/19	0.09
Weight (kg)	67.40 ± 7.95	68.73 ± 5.56	0.38
Height (cm)	154.14 ± 7.05	156.18 ± 7.08	0.24
Duration of surgery (min)	130.67 ± 14.11	128.23 ± 16.02	0.28

Characteristics of block between the groups are demonstrated in ***Table 2***. There was significant difference between group D and F in regression to Bromage 0 (p < 0.001), two segmental regression (p < 0.001), sensory regression to S1 (p < 0.001), time to rescue analgesia (p < 0.001) and NRS 6 hours after surgery (p < 0.001), but there was no significant difference between groups in time from injection to highest sensory level and onset of Bromage III (p > 0.05).

Table 2: Characteristics of block between groups

Characteristic of block (min)	Group F	Group D	P value
Time from injection to highest sensory level	7.18 ± 1.55	6.28 ± 1.75	0.07
Time of 2 segment regression from the highest sensory level	89.80 ± 13.85	148.00 ± 24.17	< 0.001
Time for sensory regression to S1 from highest sensory level	328.84 ± 45.10	550.53 ± 81.76	< 0.001
Onset to Bromage III	5.04 ± 1.82	4.90 ± 1.76	0.34
Regression to Bromage 0	186.56 ± 38.86	330.50 ± 74.96	< 0.001
Time to rescue analgesia	298.33 ± 45.83	495.63 ± 70.29	< 0.001
NRS six hours after surgery	6.36 ± 1.44	1.80 ± 0.94	< 0.001

In both groups, the highest sensory block occurred in T6 dermatome ***(Table 3)***,whereas T5 dermatome was the second highest.

Table 3: Highest dermatome level of sensory block

Dermatome level	Group F		Group D	
	n	%	n	%
T4	3	7.5	5	12.5
T5	9	22.5	10	25
T6	18	45	14	35
T7	5	12.5	6	15
T8	5	12.5	5	12.5

Incidence of side effects such as bradycardia in Group D was significantly more than that of Group F (P < 0.05), although hypotension occurred in both the groups was statistically not significant (P > 0.05) ***(Table 4)***.

Table 4: Side effects between groups

Side effect	Group F	Group D	P value
Bradycardia	5	14	0.02
Hypotension	9	11	0.9

DISCUSSION

There are various anaesthetic techniques used for postoperative pain, including systemic (opioid and non opioid) analgesics and regional (neuraxial and peripheral) analgesic procedures. Neuraxial blockade plays an integral role in the management of lower limb orthopaedic surgeries as these are not only used to provide surgical analgesia but can be used in the postoperative period to provide effective pain relief which decreases the requirement of other systemic analgesics.

Opioid analgesics are most frequently used for the treatment of postoperative pain but their use is associated with side effects like nausea, respiratory depression, pruritis and urinary retention etc. Routine use of opioids as an adjuant in neuraxial analgesia has recently been challenged.[10]

In an effort to avoid the side effects seen with opioids and to find a good alternative to it, we decided to compare the effect of dexmedetomidine (α-2 adrenoreceptor agonist) with fentanyl (a synthetic opioid) as adjuvant to bupivacaine in our study.

We found that although there was no significant difference between groups in time to onset of Bromage III and complete motor block, D group had lower time to reach the highest sensory level than F group. Similar to our study *Mahendru et al*[11] found no significant difference in onset of motor block between dexmedetomidine and fentanyl groups. While *Yektas et al*[12] and *Ravipati et al*[13] reported faster onset of motor block for dexmedetomidine compared to fentanyl. Other studies have also mentioned lower time to reach the highest sensory level in dexmedetomidine compared to fentanyl.[14] The mechanism of how dexmedetomidine prolongs sensory and motor blockade is not known. In our study, the highest sensory level in D and F group were T6 and T5. One study reported the highest sensory level at T5 dermatome[13] and *Mahendru et al*[11] reported in T6 dermatome. Other study reported the highest sensory level at T5 dermatome in dexmedetomidine and T6 in fentanyl group.[15]

None of the patients requested analgesic during the surgery. Bromage III occurred in all patients before operation. Complete regression of motor block (Bromage 0) was reached in all patients and with the highest duration in D group. Moreover, time to regression to S1 sensory level and regression of two sensory levels in D group was significantly longer than the other groups. These patients also experienced lower pain intensity six hours after surgery indicative of the highest postoperative analgesia duration in D group. Reduced need for analgesics in the post-operation period, more stable hemodynamics, longer duration of sensory and motor block for dexmedetomidine have been reported in previous studies comparing this drug with other drugs such as clonidine, fentanyl and sufentanil.[14,16] In orthopedic surgeries of lower limb, better results have also been reported for dexmedetomidine compared to fentanyl.[11]

We observed that bradycardia was more in group D as compared to group F while incidence of hypotension was

comparable between the groups. Previous studies have reported different rate of side effects. There is also only one study reporting increase in hemodynamic side effects, bradycardia and hypotension, in dexmedetomidine. [17] Another important side effect of anesthesia medications is respiratory system suppression. However, we observed no respiratory suppression. First, fentanyl compared to other opioids is less likely to cause respiratory suppression. Second, this complication is not common in dexmedetomidine.

In order to reach better efficacy, we can increase the dose of the used dexmedetomidine. *Gupta et al*[14] reported that increasing the dose of dexmedetomidine from 2.5 g to 10 g would show better and longer sensory and motor block, with longer duration of anesthesia and comparable hemodynamic and side effects profile.

CONCLUSION

In conclusion, using dexmedetomidine as an adjuvant to bupivacaine for intrathecal analgesia in lower limb surgeries has longer duration of sensory and motor block, longer postoperative analgesia with low side effects.

REFERENCES

1. Khosravi F, Alishahi M, Khanchemehr Y, Jarineshin H. A comparison between the effects of preloading with Ringer's solution and effect on hemodynamic changes in patients undergoing elective cesarean section under spinal anesthesia. Med Arch. 2019;73(1):44. doi:10.5455/medarh.2019.73.44-8
2. Elia N, Culebras X, Mazza C, Schiffer E, Tramèr MR. Clonidine as an adjuvant to intrathecal local anesthetics for surgery: systematic review of randomized trials. Reg Anesth Pain Med. 2008;33(2):159–67.
3. Boussofara M, Carlès M, Raucoules-Aimé M, Sellam MR, Horn JL. Effects of intrathecal midazolam on postoperative analgesia when added to a bupivacaine-clonidine mixture. Reg Anesth Pain Med. 2006;31(6):501–5.
4. Faiz SH, Rahimzadeh P, Sakhaei M, Imani F, Derakhshan P. Anesthetic effects of adding intrathecal neostigmine or magnesium sulphate to bupivacaine in patients under lower extremities surgeries. J Res Med Sci. 2012;17(10):918–22.
5. Dahl JB, Jeppesen IS, Jorgensen H, Wetterslev J, Moiniche S. Intraoperative and postoperative analgesic efficacy and adverse effects of intrathecal opioids in patients undergoing cesarean section with spinal anesthesia: a qualitative and quantitative systematic review of randomized controlled trials. Anesthesiol J Am Soc Anesthesiol. 1999;91(6):1919–27.
6. Jarineshin H, Fekrat F, Kermanshah AK. Treatment of postoperative pain in pediatric operations: comparing the efficiency of bupivacaine, bupivacaine-dexmedetomidine and bupivacaine-fentanyl for caudal block. Anesthesiol Pain Med. 2016;6(5). doi:10.5812/aapm.39495
7. Belzarena SD. Clinical effects of intrathecally administered fentanyl in patients undergoing cesarean section. Anesth Analg. 1992;74 (5):653–657. doi:10.1213/00000539-199205000-000068.
8. Dyck JB, Maze M, Haack C, Vuorilehto L, Shafer SL. The pharmacokinetics and hemodynamic effects of intravenous and intramuscular dexmedetomidine hydrochloride in adult human volunteers. Anesthesiology 1993;78:813-20.
9. Elhakim M, Abdelhamid D, Abdelfattach H, Magdy H, Elsayed A, Elshafei M, et al. Effect of epidural dexmedetomidine on intraoperative awareness and post-operative pain after one-lung ventilation. Acta Anaesthesiol Scand 2010;54:703-9.
10. Ivani G, De Negri P, Lonnqvist PA, L'Erario M, Mossetti V, Difilippo A, et al. Caudal anesthesia for minor pediatric surgery: A prospective randomized comparison of ropivacaine 0.2% vs levobupivacaine 0.2%. Paediatr Anaesth 2005;15:491-4.
11. Mahendru V, Tewari A, Katyal S, Grewal A, Singh MR, Katyal R. A comparison of intrathecal dexmedetomidine, clonidine, and fentanyl as adjuvants to hyperbaric bupivacaine for lower limb surgery: a double blind controlled study. J Anaesthesiol Clin Pharmacol. 2013;29(4):496–502.
12. Yektas A, Belli E. The effects of 2 g and 4 g doses of dexmedetomidine in combination with intrathecal hyperbaric bupivacaine on spinal anesthesia and its postoperative analgesic characteristics. Pain Res Manag. 2014;19(2):75–81.
13. Ravipati P, Isaac GA, Reddy PN, Krishna L, Supritha T. A comparative study between intrathecal isobaric Ropivacaine 0.75% plus Dexmedetomidine and isobaric Ropivacaine 0.75% plus fentanyl for lower limb surgeries. Anesth Essays Res. 2017;11(3):621–6.
14. Gupta M, Gupta P, Singh DK. Effect of 3 different doses of intrathecal Dexmedetomidine (2.5 g, 5 g, and 10 g) on subarachnoid block characteristics: a prospective randomized double blind dose-response trial. Pain Physician. 2016;19(3):E411–20.
15. Gupta R, Verma R, Bogra R, Kohli M, Raman R, Kushwaha JK. A comparative study of intrathecal dexmedetomidine and fentanyl as adjuvant to bupivacaine. J Anaesthesiol Clin Pharmacol. 2011;27(3):339–43.
16. Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, Bulbul M, Baraka AS. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand. 2006;50(2):222–7.
17. Ibrahim FA. A comparative study of adding intrathecal dexmedetomidine versus sufentanil to heavy bupivacaine for postoperative analgesia in patients undergoing inguinal hernia repair. Benha M J. 2009;26(3):207–17.