



Original Research Article

To Compare the Motor and Sensory Blockade and The Recovery with Intrathecal 0.5% Hyperbaric Bupivacaine, Intrathecal Buprenorphine And Dexmedetomidine as Additives To 0.5 % Hyperbaric Bupivacaine for Spinal Anaesthesia

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ABSTRACT

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Background: The supplementation of local anaesthetics with adjuvants to improve the efficacy of subarachnoid block has been recognised since long. The most preferred drug has been opioids, but newer drugs like dexmedetomidine has also been introduced and investigated as an effective adjuvant.

Objective: To study the duration of analgesia, motor and sensory blockade and post operative analgesic effects of the drugs under study.

Methods: In a Prospective interventional study on 90 patients undergoing elective Infraumbilical surgeries were randomly divided into three groups of 30 each.

Group A, Group B & Group C (each group 30) with ASA - I/II aged between 18 to 60 years, Group A: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine.

Group B: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine+5mcg Dexmedetomidine Group C: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine +60mcg of buprenorphine as adjuvant.

Onset & duration of sensory block, onset & duration of motor block noted

Result: There was no significant difference between groups regarding demographic characteristics. The motor, sensory blockade and time of rescue analgesia were significantly prolonged in Group B, compared to Group C and Group A. The sedation level was higher in Group B, compared to Group C and Group A.

Conclusion: Intrathecal dexmedetomidine causes prolonged anaesthesia, analgesia with better degree of sedation when compared to intrathecal Bupivacaine with Buprenorphine and Bupivacaine.

Keywords: Buprenorphine; Lower abdominal surgery; Dexmedetomidine.

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INTRODUCTION

The International Association for pain (IASP) defined as “an unpleasant sensory or emotional experience associated with actual or potential tissue damage or described in terms of such damage”^[1].

Spinal anaesthesia was first performed by August Bier on 16th August 1898. It is a simple technique widely followed for both elective and emergency surgical procedures.

Spinal anaesthesia has many advantages over general anaesthesia making it the anaesthesia of choice in current surgical practice. Several clinical studies support the fact that Postoperative morbidity and mortality may be reduced when neuraxial blockade. Early return of gastro intestinal function following surgery can be considered as an added advantage. However Spinal anaesthesia has its own risks and complications. Few of them being bradycardia, hypotension, prolonged motor block and high spinal^[2].

Though most of the patients are comfortable under Plain spinal anaesthesia, nearly fifty percent patients report pain or discomfort & at times it needs to supplement with either iv analgesics or general anaesthesia or by increasing dose of bupivacaine

It is found that addition of adjuvants like Buprenorphine, Dexmedetomidine, Fentanyl, Clonidine, Tramadol etc to 0.5% Hyperbaric Bupivacaine potentiates Anesthesia.

By adding the adjuvants, the dose of local anesthetics like bupivacaine can be reduced, thereby reducing its side effects like hypotension, bradycardia, myocardial depression, heart block and ventricular arrhythmias^[3]

MATERIAL AND METHODS

This Prospective Interventional study was conducted on the patients in Department of Anesthesiology, Basaveshwar teaching and general hospital, Mahadevappa Rampure Medical College, Kalaburagi. Period of study was 01-08-2022 to 31-01-2024 (18 months)

Data will be collected in prescribed proforma meeting the objectives of the study. Patients are grouped randomly by simple Random technique into 3 groups (n=30): Group A: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine.

Group B: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine+5mcg Dexmedetomidine

Group C: will receive 3ml (15mg) of 0.5% hyperbaric bupivacaine +60mcg of buprenorphine.

Sampling procedure

Study subjects will be selected after applying inclusion and exclusion criteria. Information will be collected through prepared proforma from each case.

SELECTION CRITERIA FOR PATIENTS

Inclusion criteria

1. Patients belonging to ASA category 1 and 2
2. Male and Female gender
3. Age 18- 60 years
4. Posted for Elective spinal anaesthetic surgeries

Exclusion criteria

1. Patients with known contraindication for spinal anaesthesia.
2. Patients with coagulation disorders or on anticoagulation therapy.
3. Patients with cardiac disease, heart blocks and dysarrhythmias
4. Patients with betablockers & alpha antagonists.

Sample size: 90

90 patients (30 patients in each group). Sample size was calculated using the formula:

$$N = (Z_{1-\alpha})^2 \times pq / d^2$$

Considering the motor blockage (p): 30 q: 100-p: 70

Standard Normal variate ($Z_{1-\alpha}$): 1.96 Tolerable error (d): 10%

$$\text{Sample required } n = (1.96)^2 \times \frac{30 \times 70}{10^2} = 80.67 = 81$$

Adding 10% attrition rate= 90

METHODOLOGY

1. **Materials required:** Standard anaesthesia work station.
2. Intravenous cannula 20 G.
3. Intravenous fluids – crystalloids
4. Monitoring equipments such as Pulse Oximeter, ECG monitor, noninvasive blood pressure apparatus.
5. 25 G Quincke's spinal needle .
6. Disposable syringe.
7. Drugs for spinal anaesthesia : 0.5% Hyperbaric Bupivacaine, Dexmedetomidine and Buprenorphine
8. Drugs and equipments necessary for resuscitation.

Onset of sensory block will be assessed by loss of pin prick sensation every 30 seconds till maximum level is achieved.

- Time taken for 2 segment regression will be noted down.
- Motor blockade will be assessed by modified Bromage scale

Modified Bromage scale :

- Bromage 0-subject is able to move the hip, knee and ankle and is able to lift his leg against gravity.
- Bromage 1-subject is unable to lift his leg against gravity but is able to flex his knee and ankle.
- Bromage 2-subject is unable to flex his hip and knee, but is able to flex his ankle.

- Bromage 3-subject is unable to flex his hip, knee and ankle, but is able to move his toes.
- Bromage 4-Complete paralysis.

During the postoperative period, patients were given Inj. Tramadol 100mg i.v. in 100ml Normal saline (0.9%) on demand for rescue analgesia for pain based on Visual Analog Scale.

VAS Score is a 10 cm long slide ruler with “no pain” written at one end and “Maximum Pain” at the other. VAS more than 4 was considered as cut off for analgesic dose to be given and duration of analgesia was noted, Subsequent rescue analgesics will be given if the patient has a pain score of 5 or more than 5. Time of administration of the rescue analgesic was noted.

VAS SCORE ^[4]

1. 0 = No pain
2. 0-3 = Mild pain
3. 3-7 = Moderate pain
4. >7 = Maximum pain

All subjects will be monitored during the surgery and perioperative period till complete sensory and motor recovery,.

Sedation score:- Sedation was assessed by **Ramsay sedation scale** on arrival in OR or, 10 minutes post spinal anesthesia and post operatively.

The following parameters were noted.

1. Time of injection of subarachnoid block.
2. Time of onset of sensory block at T8 level.
3. Time of onset of motor block.
4. Duration of sensory block.
5. Duration of motor block.
6. Degree of sedation.
7. Time for sensory regression to S1 dermatome.
8. Duration of surgical procedure.

SENSORY BLOCK

The **onset** of sensory block was defined as the time between the injection of anaesthetic solution and the absence of pain at the T8 dermatome. Sensory block was assessed by loss of sensation to pin prick using 25G sterile needle bilaterally along the midclavicular line. This assessment started immediately after turning the patient to supine position and continued every minute till loss of sensation to pinprick at T8 level was noted.

The **duration** of sensory block was defined as the time between the intrathecal administration of anaesthetic solution and the first supplementation of rescue analgesic when patient complained of pain.

MOTOR BLOCK

Motor block was assessed bilaterally using Modified Bromage scale.

MODIFIED BROMAGE SCALE

- 0- No block. Able to raise extended legs against gravity.
- 1- Unable to raise extended legs, but just able to flex knees.
- 2- Unable to flex knees but able to flex ankles.
- 3- Total block. Inability to flex ankle/ move leg.

Assessment of motor block was started immediately after turning the patient to supine position and continued every minute till Bromage score of 3 was reached. The **onset** of motor block was defined as the time to achieve Bromage score of 3 from the time of intrathecal injection. **Duration** of motor block was taken as the time from intrathecal injection to return of Bromage score of 0 (complete recovery).

SEDATION

RAMSAY SEDATION SCORE was used to assess the degree of sedation.

1. Anxious and Agitated.
2. Cooperative, oriented, tranquil
3. Responds only to verbal commands
4. Asleep with brisk response to light stimulation
5. Asleep with sluggish response to light stimulation
6. Asleep without response to light stimulation

DURATION OF ANALGESIA

The duration of effective analgesia was defined as the period from spinal injection to the first occasion when the patient complains of pain in the postoperative period.

Statistical data analysis

All cases will be completed within the stipulated time. Data will be collected, compiled and tabulated. The statistical analysis will be done by using parametric test and final interpretation by using Software SPSS 20.0. Quantitative data will be analysed by paired and unpaired, ANOVA test and qualitative data by Chi square test or T test.

RESULTS

Table 1 - Comparison of Mean Age between Study Groups

Parameters	GROUP A		GROUP B		Group C		p value
	Mean	± SD	Mean	± SD	Mean	± SD	
Age (yrs)	40.73	± 11.8	40.2	±2.8	41.2	± 12.3	0.953

The age distribution was in the range of 19-60 in Group A, 18-60 in Group B and 18-60 in Group C. The 'p' value for mean age was not statistically significant (p value = 0.953).

Table -2 Gender distribution among patients in three groups

Parameters		GROUP A (n =30)	GROUP B (n= 30)	Group C (n=30)	Total
Gender	Male	11 (36.6%)	18 (60%)	25 (83.3%)	54 (60%)
	Female	19 (63.4%)	12 (40%)	5 (16.7%)	36 (40%)
Total		30 (100%)	30 (100%)	30(100%)	90 (100.0%)

The Gender distribution between the Three groups, A had 11 males, 19 females. B had 18 males 12 females, C had 25 males and shows no significant difference, as indicated by a p-value of 0.773.

Table 3 – Distribution based on ASA Grading among three groups

Parameters		GROUP A (n =30) Mean ± SD	GROUP B (n= 30) Mean ± SD	Group C (n=30) Mean ± SD	Total	P – value
ASA	I	17 (56.7%)	20 (66.6%)	20 (66.6%)	57 (63.4%)	
	II	13 (43.3%)	10 (33.4%)	10 (33.4%)	33 (36.6%)	
Total		30 (100%)	30 (100%)	30(100%)	90 (100.0%)	

Table 4 – Association of parameters between the groups

Parameters	GROUP A (n =30) Mean ± SD	GROUP B (n= 30) Mean ± SD	Group C (n=30) Mean ± SD	P – value
Time of onset of sensory block (Min)	4.23 ± 0.773	4.13 ± 0.776	4.13 ± 0.776	0.801
Time of onset of motor block (Min)	5 ± 0.78	2.56 ± 0.504	3.83 ± 0.79	<0.001
Duration of sensory blockade (min)	245.76 ± 6.83	398.1 ± 6.503	332 ± 18.80	<0.001
Duration of motor blockade (Min)	199.86 ± 30.25	502.133 ± 12.2	298.63 ± 35.78	<0.001
Duration of analgesia (Min)	266.06 ± 6.5	432.23 ± 12.7	356.3 ± 8.11	<0.001

Time of Sensory Regression to S1 (min)	161.7 ± 9.42	495.2 ± 13.17	272.26 ± 15.3	<0.001
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The time of onset of sensory block was slower in Group A (4.23 ± 0.773) when compared with Group B and Group C (4.13 ± 0.776) and the p value was statistically not significant (P value 0.801).

The average time taken for the onset of motor block was 5 ± 0.78 minutes in Group A, 2.56 ± 0.504 minutes in Group B and 3.83 ± 0.79 minutes in Group C. It was statistically significant (p value <0.001).

The mean duration of sensory block was shorter in Group A (245.76 ± 6.83) when compared with Group B (398.1 ± 6.503) and Group C (332 ± 18.80).

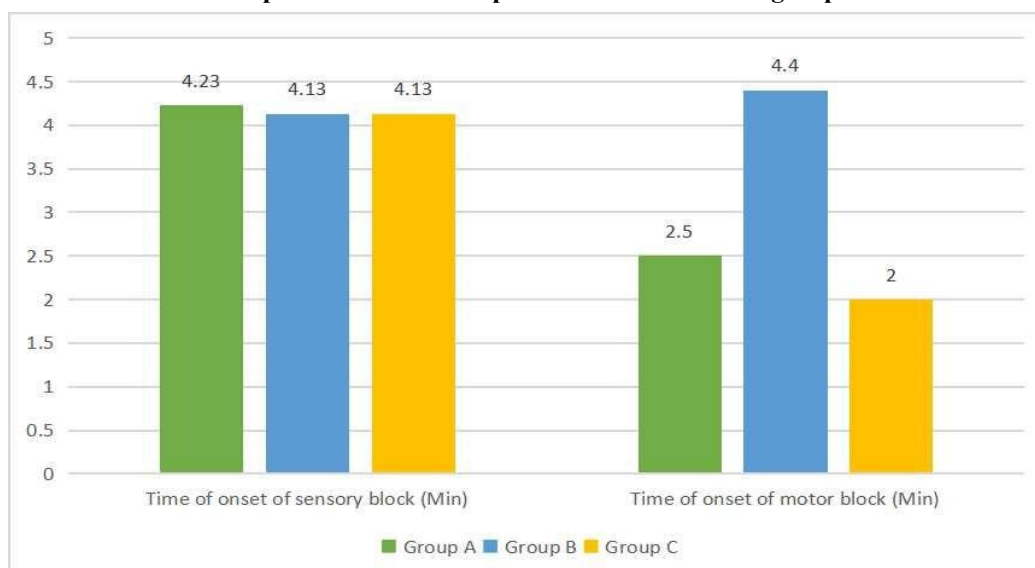
It was statistically significant (p value <0.001). The mean duration of sensory block in Group B is *longer* than Group A and C.

The mean duration of motor block was shorter in Group A (199.86 ± 30.25) when compared with Group B (502.133 ± 12.2) and Group C (298.63 ± 35.78). It was statistically significant (p value <0.001).

The time of sensory regression to S1 was shorter in Group A (161.7 ± 9.42) when compared with Group B (495.2 ± 13.17) and Group C (272.26 ± 15.3). It was statistically significant (p value <0.001).

The mean duration of Analgesia was shorter in Group A (266.06 ± 6.5) compared with Group B (432.23 ± 12.7) and Group C (356.3 ± 8.11). It was statistically significant (p value <0.001).

Graph 1- Association of parameters between the groups



Graph 2 - Association of parameters between the group

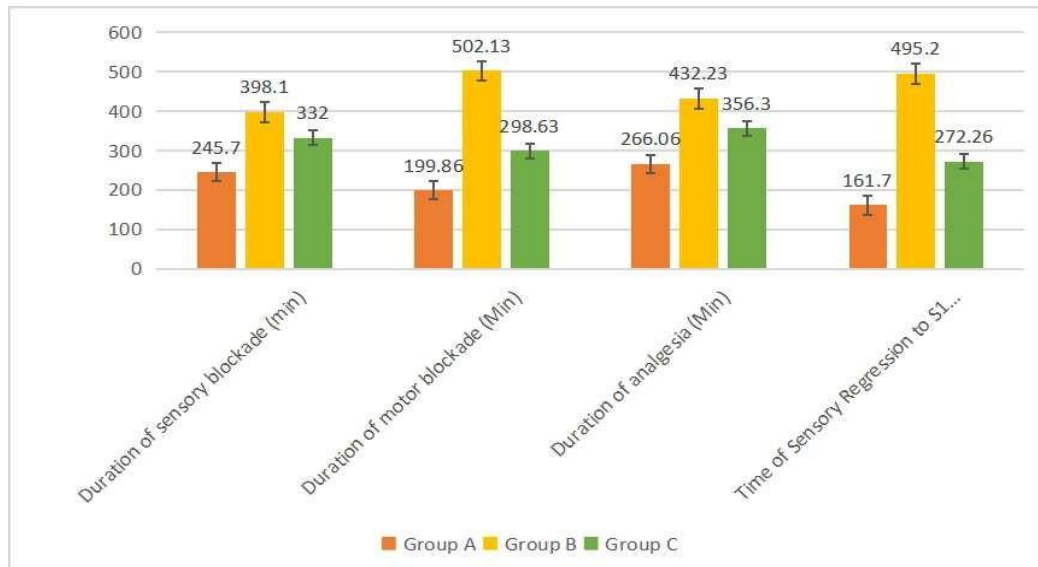


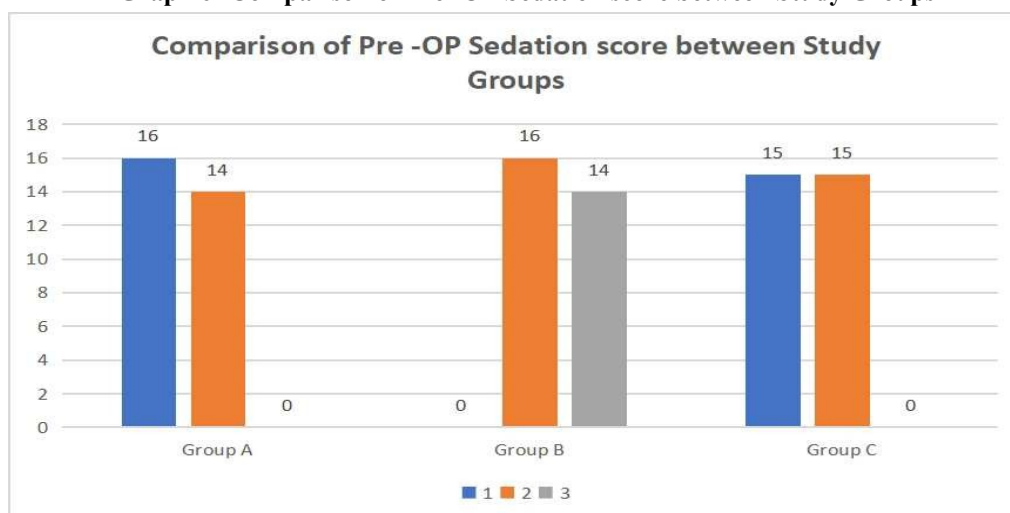
Table 5 - Comparison of Sedation score between Study Groups

		GROUP A (n =30)	GROUP B (n= 30)	Group C (n=30)	Total
Pre-OP	1	16 (53.3%)	0 (0%)	15 (50%)	31 (34.4%)
	2	14 (46.7%)	16 (53.3%)	15 (50%)	45 (50%)
	3	0 (0%)	14 (46.7%)	0 (0%)	14 (15.6%)
Total		30 (100%)	30 (100%)	30(100%)	90 (100.0%)
10 min after Spinal Anesthesia	1	14 (46.7%)	0 (0%)	0 (0%)	14 (15.6%)
	2	14 (46.7%)	12 (40%)	15 (50%)	41 (45.6%)
	3	02 (6.6%)	18 (60%)	15 (50%)	35 (38,8%)
Total		30 (100%)	30 (100%)	30(100%)	90 (100.0%)
Post OP	1	14 (46.7%)	0 (0%)	0 (0%)	14 (15.6%)
	2	13 (43.4%)	17 (56.7%)	17 (56.7%)	46 (51.1%)
	3	03 (9.9%)	13 (43.3%)	13 (43.3%)	29 (33.3%)
Total		30 (100%)	30 (100%)	30(100%)	90 (100.0%)

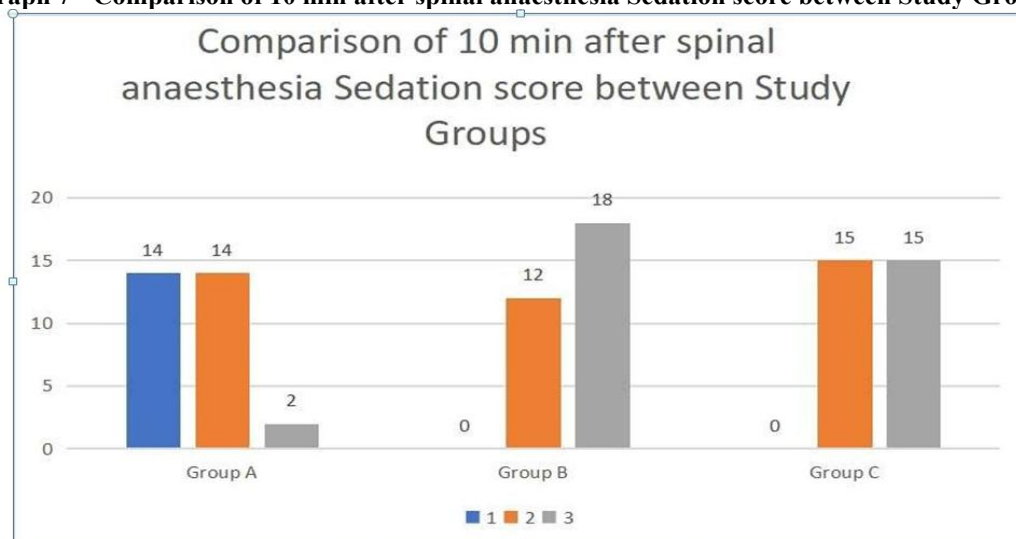
Degree of Sedation in the three groups was depicted.

Degree of Sedation was better in Group B when compared with Group A and Group C.

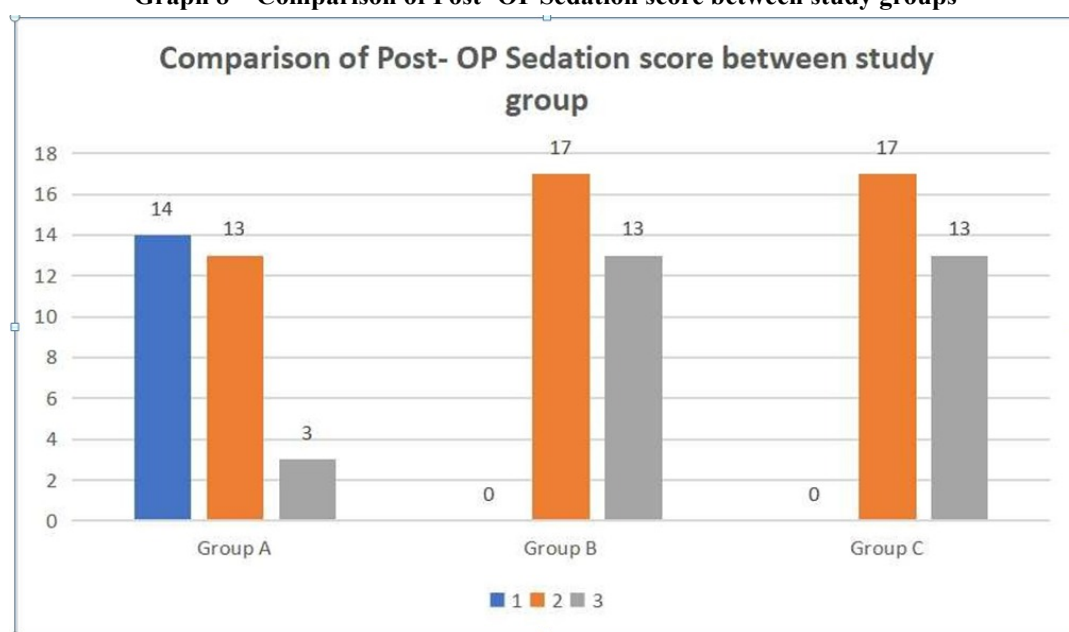
Graph 6- Comparison of Pre -OP Sedation score between Study Groups



Graph 7 - Comparison of 10 min after spinal anaesthesia Sedation score between Study Groups



Graph 8 – Comparison of Post- OP Sedation score between study groups



DISCUSSION

Even though there are lot of adjuvants, the above mentioned two adjuvants were considered for this study because there were only very few studies in the literature comparing the benefits and side effects of buprenorphine and dexmedetomidine as an adjuvants to bupivacaine for lower abdominal surgeries [4].

The results of the clinical study are discussed under the following headings. Onset of sensory and motor block Duration of sensory block Duration of motor block

ONSET OF SENSORY AND MOTOR BLOCK

The mean onset of sensory block in Bupivacaine group was 4.23 ± 0.773 , buprenorphine group was 4.13 ± 0.776 minutes where as in dexmedetomidine group it was 4.13 ± 0.776 minutes. It was not statistically significant.

The mean onset of motor block in Bupivacaine group was 5 ± 0.78 minutes, buprenorphine group was 3.83 ± 0.79 minutes where as in dexmedetomidine group it was 2.56 ± 0.504 minutes. It was not statistically significant.

Though the values of onset of motor blockade is similar to *Mahima gupta et al* [5] and others, the onset of sensory blockade of dexmedetomidine group was clinically faster than buprenorphine group in our study which could not be explained.

DURATION OF ANALGESIA

Duration of analgesia was taken from the time of intrathecal injection of drugs to the first supplementation of rescue analgesic when patient complained of pain. In our study, the mean duration of analgesia was 266.06 ± 6.5 minutes in Bupivacaine group 356.3 ± 8.11 minutes in buprenorphine group and 432.23 ± 12.7 minutes in dexmedetomidine group.

The mean duration of analgesia in the studies conducted by *Shaikh and Kiran et al* [6] and *Capogna et al* [7] was 475 minutes and 430 minutes respectively which is very high than our study. This gross difference might be explained by the geriatric group of patients in Capogna et al and lower limb surgeries as noted by Mahima gupta et al.

The duration of analgesia in the **dexmedetomidine** group in the study conducted by *Mahima gupta et al* [5] was 493 minutes and the study conducted by *Shah et al* [8] was 474 minutes. The duration of analgesia was significantly prolonged in the study done by *Rajni Gupta et al* [7] (478 minutes). In our study, the mean duration of analgesia was 432.23 ± 12.7 minutes in dexmedetomidine group which was similar to above mentioned studies.

In this study, Dexmedetomidine group had prolonged duration of analgesia compared to Buprenorphine group which was 51% higher than the latter. *Mahima Gupta et al* [5] have shown similar results. The prolonged analgesic action of intrathecal α_2 agonist is by decreasing the fibres neurotransmitters and by causing hyperpolarisation of neurons in the post synaptic dorsal horn [9].

DURATION OF MOTOR BLOCK

The duration of motor block was taken from time of intrathecal drug administration to the time taken to attain modified bromage 3. The mean duration of motor block in Bupivacaine group was 199.86 minutes, Buprenorphine group was 298.63 minutes and in dexmedetomidine group was 432.33 minutes (p value 0.00).

This was similar with the study conducted by *Mahima gupta et al* [5], where the duration of motor block in *dexmedetomidine group* was 413.4 minutes and the study conducted by *Rajni Gupta et al* [10], where the duration of motor block was 421 minutes.

The mean duration of motor block in *buprenorphine group* is 298.6 minutes, whereas the duration of motor block in *Mahima gupta et al* [5] study was 205.17 minutes which is significantly lower than our study.

In our study itself, motor blockade in dexmedetomidine group was about **45%** prolonged than Buprenorphine group. Such a prolongation of motor blockade may not be liked by many patients who have undergone surgeries that would end by one hour.

In this perspective, Buprenorphine would be a better adjuvant. Also, the duration of 'pure' sensory blockade (after the wear of motor blockade effect) in dexmedetomidine group was twice that of buprenorphine group (70 Vs 34 minutes). Still, Dexmedetomidine is a better drug as it would spare the rescue analgesic requirements.

TIME FOR SENSORY REGRESSION TO S1

The mean duration for sensory regression to S1 in Bupivacaine group was 161.7 minutes, buprenorphine group was 272.26 minutes and in dexmedetomidine group 495.21 minutes.

In a study conducted by *Mahima gupta et al* [5], the mean duration for sensory regression to S1 in buprenorphine group was 225.9 min which was lower than the same group in our study. But in dexmedetomidine group it was 451.4 min that was higher than the same group in our study.

Subhi M Al-ghanem et al [11] showed that the mean duration for sensory regression to S1 dermatome was 274.8 minutes in dexmedetomidine group which was lower than our study.

This may be because of the higher volume (3ml) of a hyperbaric solution probably prolonged the regression time comparing to the lower volume (2ml) of isobaric solution in their study.

Rajni gupta et al ^[10] have shown that the mean time for sensory regression to S1 was 476 minutes in dexmedetomidine group which is higher than our study. This may be because either the usage of higher concentration (0.75%) of isobaric ropivacaine or due to the potentiation of intrathecal ropivacaine by intrathecal dexmedetomidine ^[12].

S1 dermatome is used as the sensory regression point in most of the studies ^[10,5]. S1 dermatome is well below the dermatomes those are involved in the surgery (T8 – L1) in our study. But patients in both groups *never complaint of pain* at the time of sensory regression to S1.

More than that, analgesia was extended to the time for first analgesic requirement. This is the classical effect of adding an adjuvant to the local anesthetics i.e improving patient's comfortness and reducing both the postoperative analgesic requirement and side effects.

In this purview, in our study dexmedetomidine is superior to buprenorphine in having prolonged duration of sensory block, duration of motor block and sensory regression to S1.

DEGREE OF SEDATION

There were significant differences between the three groups with respect to the degree of sedation as evidenced by the significance value obtained from the chi square test that was less than 0.05. The need for further intraoperative sedation was nil in dexmedetomidine group.

Mahima gupta et al ^[5] in their study noted that the sedation score was higher in patients belonging to dexmedetomidine group as compared to buprenorphine group which is similar to our study. This was due to the action of dexmedetomidine on α_2 receptors on locus ceruleus.

CONCLUSION

The present study concludes that the onsets of sensory and motor blockades were not statistically significance between the groups. The **duration** of both sensory and motor blockades were prolonged in **dexmedetomidine** group compared to buprenorphine group and Bupivacaine group with the best statistical significance. The degree of sedation was better in the dexmedetomidine group when compared to buprenorphine and Bupivacaine groups

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