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Comparison of Fentanyl and Dexmedetomidine added to low dose Bupivacaine Heavy for Spinal Anaesthesia in Lower Abdominal Surgeries

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Introduction

Spinal anaesthesia is the most commonly used technique for below umbilical surgeries. It is economical, easy to administer and relatively safer. It is important to limit the block level for minimizing hemodynamic changes during the spinal anesthesia in elderly and those with cardiopulmonary, endocrine and other comorbidities.

Low-dose local anesthetics can limit the block level and induce rapid recovery from anesthesia, but sometimes these low-dose local anesthetics may not provide an adequate anesthetic level for surgery. Intrathecal opioids or clonidine are frequently co-administered with local anesthetics to improve the anesthetic quality and postoperative analgesia.

The side effects of bupivacaine are dose dependent. This can be reduced by lowering it's dose and use of adjuvants like fentanyl, clonidine, dexmedetomidine. Opioids used as adjuvants with local anaesthetics improve the quality and duration of post operative analgesia. It has beneficial effect of early ambulation because of minimal motor block. Use of lipophilic opiates have a favourable pharmacokinetic and pharmacodynamic profile. Morphine was the first opioid to be used intrathecally but side effects like delayed respiratory depression limited its utility.

Fentanyl being highly lipid soluble diffuses rapidly into spinal cord and binds to opioid receptors in dorsal horn when administered intrathecally. This produces rapid onset of analgesia with minimal cephalic spread. Hence the risk of delayed respiratory depression is less.

Dexmedetomidine is an S enantiomer of medetomidine. It has high selectivity for alpha 2 adrenoreceptors (alpha 2 / alpha 1 : 1620 / 1) compared to clonidine (alpha 2 / alpha 1 : 220 / 1). It has anxiolytic, analgesic and sympatholytic properties. Neuraxial route is appropriate for administration as adjuvant because of it's high lipophilicity

This study will compare the effect of intrathecal fentanyl and intrathecal dexmedetomidine with low dose bupivacaine heavy in spinal anaesthesia for lower abdominal surgeries based on duration of analgesia, time of onset of analgesia , time to reach peak sensory level, degree of motor blockade, hemodynamic profile and side effects.

Objectives

To compare fentanyl and dexmedetomidine when added to low dose bupivacaine heavy for spinal anaesthesia in lower abdominal surgeries based on the onset of sensory blockade, the onset of motor blockade, peak sensory block level, duration of analgesia and side effects if any

Materials and Methods

Study Design: Observational study

Study Period and Duration: For a period of 18 months after getting clearance from ethical committee.

Study Setting: Adult patients undergoing elective lower abdominal surgeries at Govt. T.D Medical college Hospital Alappuzha

Sample Size: A sample size of 120 was arrived after obtaining mean and standard deviation from a study on "A prospective randomised double blind study of intrathecal fentanyl and dexmedetomidine added to low dose bupivacaine for spinal anesthesia in lower abdominal surgeries" done by Hem Anand Nayagam et.al and substituting the values in the formula :

(Z α + Z1-β) 2 X (S12 + S22) (M1 – M2) 2 Zα = 1.96 Z 1- β = 0.84 1.

On substituting values with TPSBL (Time to reach peak sensory block level => 4.312 X (2.782 + 2.322) / (8.20- 6.64)2 => 23.27 2.

On substituting values with TFAR (Time for first analgesic requirement) => 4.312 X (3.132 + 2.1562) / (12.92 – 11.88)2 =>57.59 rounding to 60 Therefore a sample size of 120 was arrived

Sampling Method

Patients were given either fentanyl or dexmedetomidine as adjuvant added to low dose bupivacaine heavy .Time to reach peak sensory block level and duration of analgesia was observed.

Study Population: Adult patients posted for elective lower abdominal surgeries.

Inclusion Criteria

1. Patients undergoing elective lower abdominal surgeries under spinal anaesthesia receiving either intrathecal fentanyl or dexmedetomidine, who give consent to take part in this study.
2. Age between 18 and 60 years, of both sexes
3. ASA physical status Grade I and II
4. Weight : 50kg to 70 kg
5. Height between 155 cm to 170cm

Exclusion Criteria

1. With a history of spine surgery, spinal deformities
2. Infection at the injection site
3. Coagulopathy
4. Hypovolemia
5. Increased intracranial pressure
6. Indeterminate neurologic disease
7. Known hypersensitivity to local anaesthetics, opioids or dexmedetomidine.

Study Variables

In dependant variables: Heart rate ,Systolic blood pressure , Diastolic blood pressure , Mean arterial blood pressure, oxygen saturation, respiratory ratewere monitored and recorded every 5 minutes for half an hour ,then every 15 minutes until patient requested for break through analgesics.

Dependant variables: Peak sensory dermatome level, Onset of analgesia, motor level, onset of motor blockade, post operative analgesia.

Definitions and Measurements of Variables

- Peak sensory level was tested by pinprick along midclavicular line, bilaterally, every minute, using a blunt 25-guage needle, until the level was stabilised for two consecutive tests .
- Onset of analgesia– Time interval from completion of spinal injection to loss of pinprick sensation at T 10 was noted.
- The motor level was assessed using modified Bromage scale 0 – No motor block

1) Inability to raise extended leg, able to move knees and feet

2) Inability to raise extended leg and move knee, able to move feet.
3) Inability to flex ankle (complete motor block).

- Onset of Motor blockade: Time interval from completion of spinal injection to inability to move both ankles was noted.
- Occurrence of side effects such as nausea, vomiting, pruritis and respiratory depression were noted.
- Incidence of hypotension [decrease in systolic blood pressure < 90 mm of Hg] , bradycardia [heart rate < 50 beats /min] , respiratory depression [respiratory rate < 8/min or spO2 < 95 %] were noted.

  Post operatively heart rate , blood pressure ,O2 saturation were recorded during 1st hour at 15 ,30 ,45 and 60 minutes and thereafter every hour during the study period .When VAS was > 40, Inj. Tramadol 100mg was given intra-muscularly.
- Assessment of post operative analgesia – VAS
- VAS– (Visual Analogue Score) Commonly used pain assessment score
- It is usually presented as a 100 mm horizontal line on which patient's pain intensity is represented by a point between the extremes of " no pain at all" to "worst pain imaginable"

Study Procedure

After getting clearance from Institutional ethical committee, subjects were included based on inclusion and exclusion criteria. Age, gender and weight of participating patients were recorded. Detailed preanaesthetic checkup was done.

- Before surgery, patients were taught how to use Visual Analogue Scale (VAS) ,with 0 indicating no pain and 100 indicating the worst imaginable pain.
- They were given T.Alprazolam 0.25 mg , T. Omeprazole 20mg, T. Ondansetron 4 mg on preoperative day at 10.00pm and on the day of surgery at 6 am.
- Ringer lactate was started using an 18G IV cannula.
- Patients were placed in right lateral position and lumbar puncture was performed at L3-L4 interspace through a mid-line approach using a 23-guage Quincke babcock needle under strict asepsis.
- Included patients were given either injection bupivacaine 0.5% (2 ml) + Fentanyl(0.5ml) or dexmedetomidine (0.5 ml) Injection bupivacaine 0.5%(2ml) + injection Fentanyl 0.5ml (25ug) with the total volume of 2.5 ml was administrered intrathecally.
- Injection dexmedetomidine was first diluted in normal saline (0.05ml ie: 5 ug of dexmedetomidine diluted in 0.45ml of NS)to obtain a dose of 5 ug in 0.5 ml .Then injection bupivacaine 0.5% (2ml) + dexmedetomidine 0.5ml (was administered intrathecally for total volume 2.5 ml).
- Systolic blood pressure, diastolic blood pressure, heart rate, respiratory rate were recorded every 5 minutes . Time to reach peak sensory block level (PSBL), degree of motor blockade and time of VAS >40 was noted.
- The primary outcome of the study was to assess duration of analgesia.

The secondary outcome was to assess time of onset of analgesia, time to reach peak sensory level, degree of motor blockade, hemodynamic profile and side effects.

Data Analysis

Baseline data was entered into Microsoft excel .Data was analysed using SPSS.

Qualitative variables were summarized using proportions with 95% confidence interval (CI). Quantitative variables was summarized using mean with standard deviation.

Test of significance such as t test for quantitative variables and chi square for qualitative variables were done. For all statistical evaluation, a two tailed probability of valve < 0.05 was considered significant.

Results

In my study, the demographic profile of the patients in terms of age, male:female ratio, ASA status, height, weight were comparable (p value >0.05). The mean time of onset of analgesia in the study patients receiving intrathecal dexmedetomidine and injection fentanyl as adjuvant was observed to be 1.12 and 1.37minutes respectively. The time of onset of analgesia was faster in dexmedetomidine group but not statistically significant. (p value >0.05). The mean time to reach peak sensory blockade in the study patients receiving intrathecal dexmedetomidine and injection fentanyl as adjuvant was observed to be 2.23 and 4.12minutes respectively .The mean time to reach peak sensory blockade was significantly lower in dexmedetomidine group(p value(p value<0.05)

The mean time to reach motor blockade (modified bromage scale 3) in the study patients receiving intrathecal dexmedetomidine and injection fentanyl as adjuvant was observed to be 3.22 and 4.51 minutes respectively .The mean time to reach motor blockade (modified bromage scale 3) was significantly lower in dexmedetomidine group (p value<0.05)

The VAS scores at 2nd hr,3rd hr,4th hr and 5th hr after instituition of spinal anaesthesia was significantly lower in dexmedetomidine group compared to fentanyl group.(p value<0.05)

The mean systolic blood pressure in the study patients receiving intrathecal dexmedetomidine and injection fentanyl as adjuvant was observed to be 114 mm of Hg and 121 mm of Hg respectively. The mean systolic blood pressure was significantly lower in dexmedetomidine group (p value<0.05)

Table 1 :Comparison of age based on group

Age (Years)	Group-I (Dexmedetomidine)		Group-II (Fentanyl)	
	Count	Percent (%)	Count	Percent (%)
18-30 years	5	8.11	4	6.76
31-40 years	16	27.03	16	27.03
41-50 years	22	35.14	21	36.49
51-60 years	17	29.73	17	29.73
(MEAN±SD)	45.95±1.89		4 .78±1.12	

(t=1.89, p =0.45)

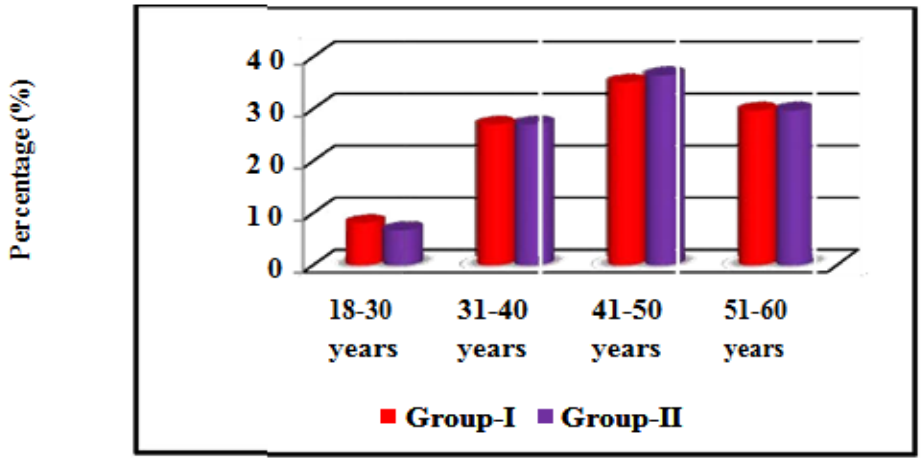

Figure 1 :Comparison of age based on group

Age distribution of the 2 study groups are given table 1.Majority of study population was in 41 -50 yrs. Statistical analysis revealed a p value > 0.05, which is not significant. Hence both groups are comparable with respect to age distribution.

Table 2: Comparison of gender between the groups

Groups	Gender				P value
	Male		Female		
	Count	Percentage (%)	Count	Percentage (%)	
Group-I	60	100 00	0	0.00	0.09
Group-II	56	94.59	4	5.41	

(t=1.89, p =0.09)

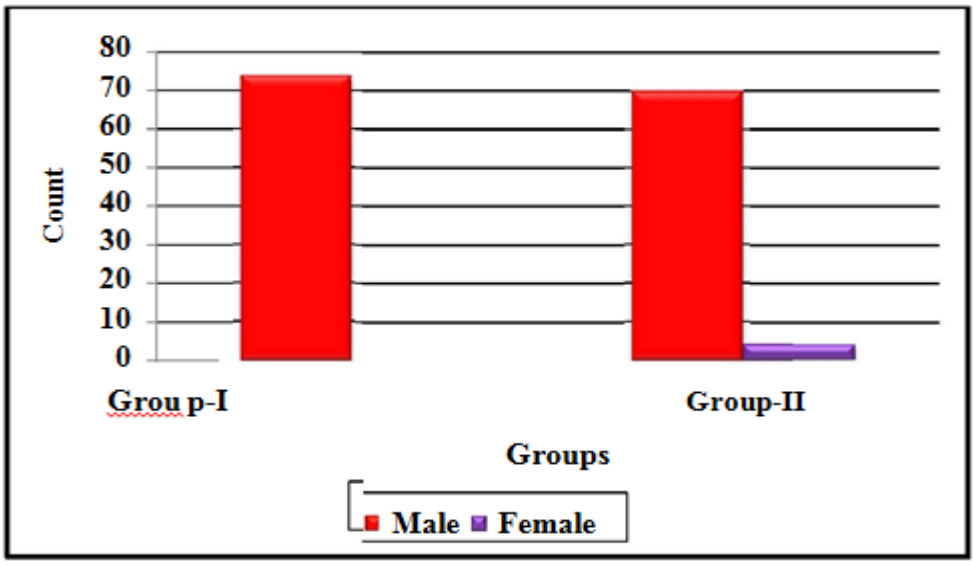

Figure 2: Comparison of gender between the groups

Gender distribution between the groups aredepicted above. There is no statistical significant difference between the groups. So both groups are comparable.

Table 3: Comparison of weight based on group (kg)

Groups	Mean	S D	N	t value	P value
Group-I	52.55	8. 0	60	**0 06**	**0.07**
Group-II	57.79	7. 1	60		

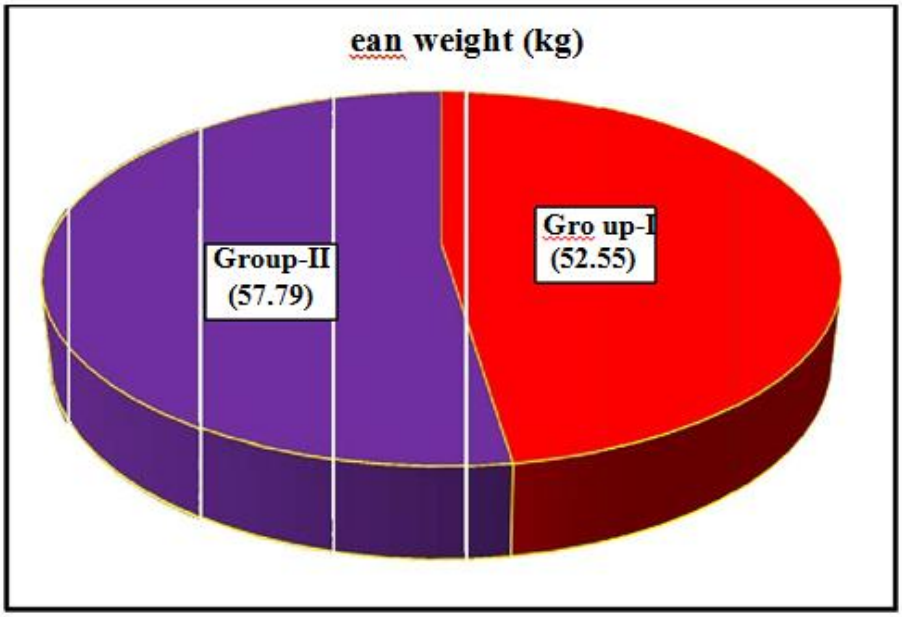

Figure 3: Comparison of weight based on group (kg)

Weight distribution of both groups is given above. Both groups are comparable.

Table 4: Comparison of height based on group (cm)

Groups	Mean	S D	N	t value	P value
Group-I	165.05	3. 35	60	**1.89**	**0.84**
Group-II	162.77	5. 17	60		

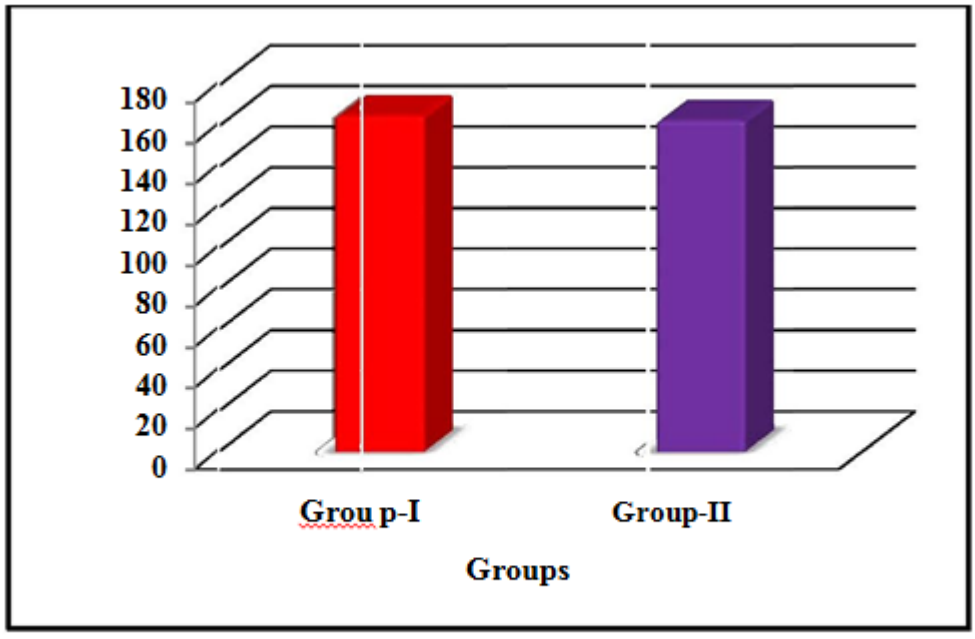

Figure 4: Comparison of height based on group (cm)

Height distribution of both groups is given above.Both groups are comparable.

Table 5: Comparison of groups based on ASA

ASA PS	Group-I		Group-II		P v alue
	Count	Percent	Count	Perce t	
1	4	7.41	8	13.32	> 0.05
2	56	93.33	52	86.68	

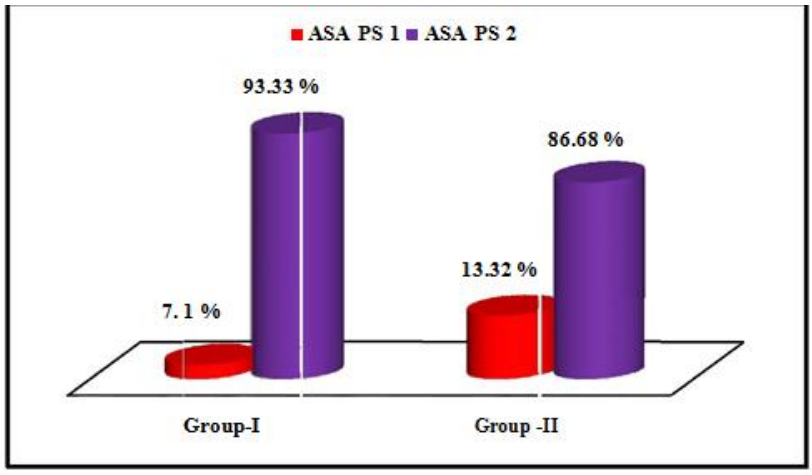

Figure 5: Comparison of groups based on ASA

ASA distribution of both the groups are shown above.ASA PS 2 patients are more in both the groups. Both groups are comparable.

Table 6: Comparison of groups based on time of onset of analgesia

Groups	Mean	S D		t value	P value
Group-I	1.12	0. 4	60	0 89	>0.05
Group-II	1.37	0. 5	60		

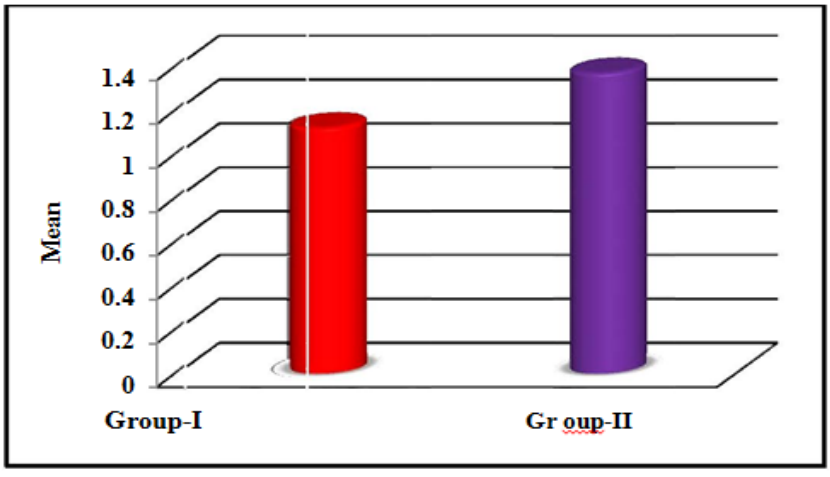

Figure 6: Comparison of groups based on time of onset of analgesia

The mean time of onset of analgesia between the groups is depicted above.Group I shows faster onset of analgesia which is statistically not significant.

Table 7: Comparison of groups based on time to attain peak sensory block level

Groups	Mean	S D	N	t value	P value
Group-I	2.23	1. 4	60	0 78	0.04
Group-II	4.12	1. 5	60		

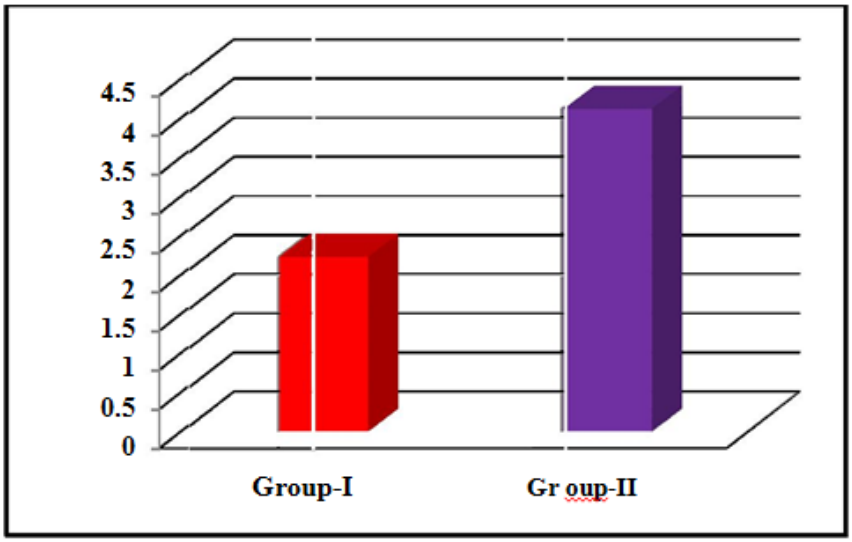

Figure 7: Comparison of groups based on time to attain peak sensory block level

The mean time to attain peak sensory blockade level of both the groups is depicted above. Group I shows faster attainment of peak sensory blockade which is statistically significant.

Table 8: Comparison of groups based on time to attain motor blockade (MODIFI ED BROMAGE 3)

Groups	Mean	S D	N	t value	P value
Group-I	3.22	0. 8	60	0 83	0.04
Group-II	4.51	0. 7	60		

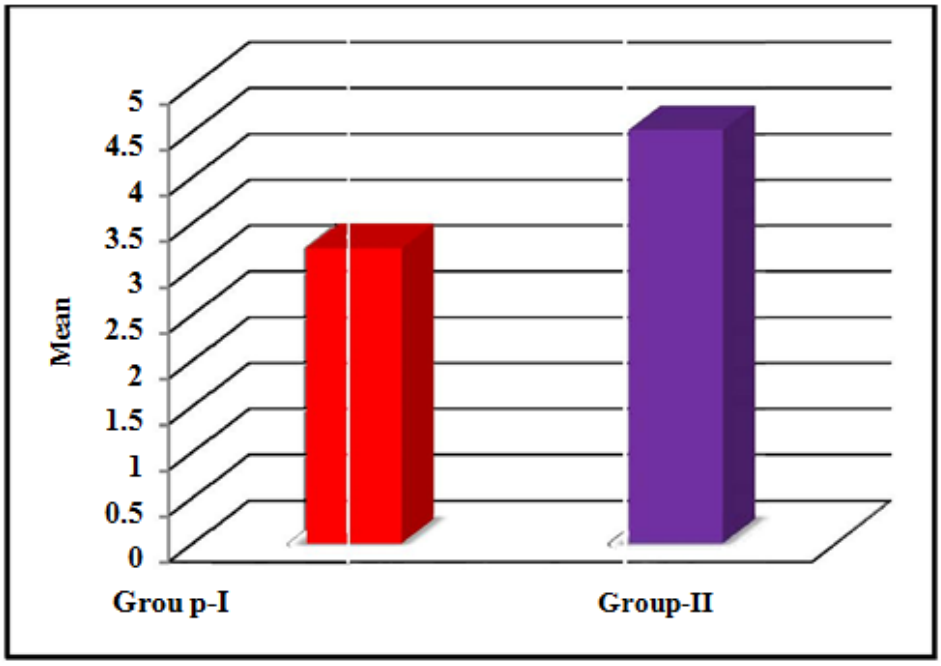

Figure 8: Comparison of groups based on time to attain motor blockade

(Modified BROMAGE 3)

The mean time to attain motor blockade of the groups is depicted above .Group I shows faster attainment of motor blockade which is statistically significant.

Table 9: Comparison of pain score between groups at different time intervals .

Time	roup-I			Group-II			t value	p value
	Mean	SD	N	Mean	S D	N		
1st hour	0.00	0.00	60	0.00	0.0 0	60	-	-
2nd hour	9.86	2.56	60	10 .86	2.8 6	60	8.98**	0.04
3rd hour	20.86	2.83	60	28 .10	3.9 5	60	11.34**	0.001
4th hour	30.68	2.55	60	41 .20	3.2 8	60	13.45**	0.001
5th hour	41.37	3.47	60	47 .24	4.5 0	60	9.45**	0.01

**: Significant at 0.0 1 level

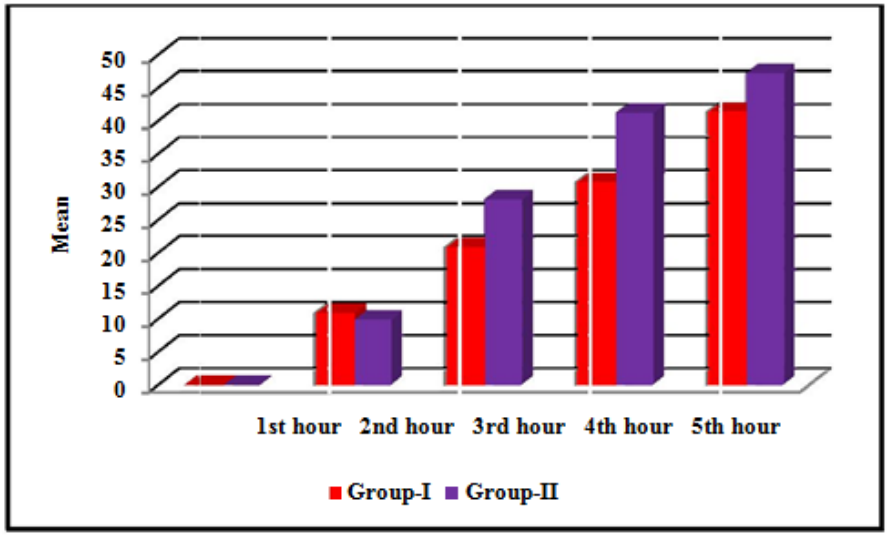

Figure 9: Comparison of pain score between groups at different time intervals.

VAS scores at 3rd hr,4th hr,5th hr after instituition of spinal anaesthesia is significantly lower in group I when compared to group II.

Table 10: Comparison of groups based on systolic blood pressure (mmHg)

Groups	Mean	S D	N	t value	P value
Group-	114.07	8. 67	60	**0.67**	**0.03**
Group-II	121.30	6. 86	60		

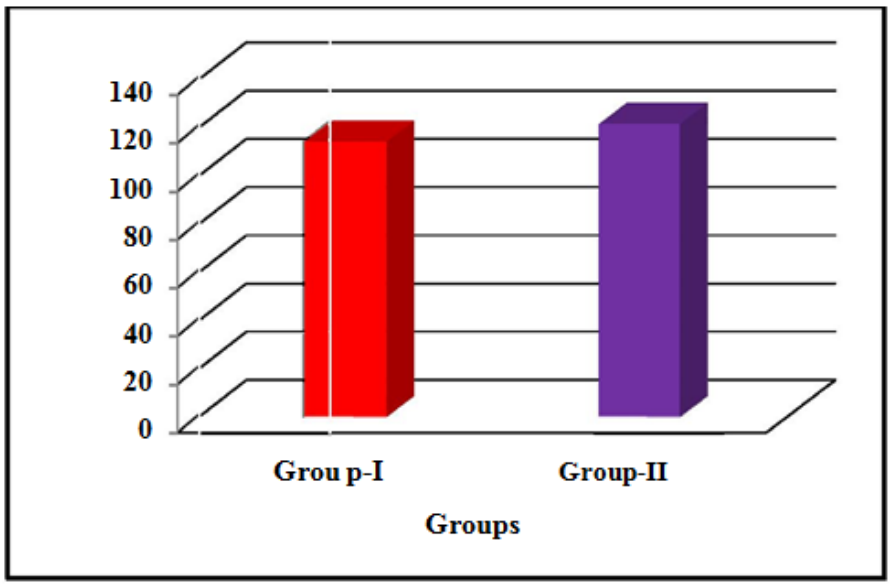

Figure 10: Comparison of groups based on systolic blood pressure (mmH g)

Mean systolic blood pressure of both groups is given above. Systolic blood pressure is significantly lower in group I.

Table 11: Comparison of groups based on heart rate (min)

Groups	Mean	S D	N	t value	P value
Group-	68.70	8. 6	60	0 23	0.04
Group-II	80.51	4. 4	60		

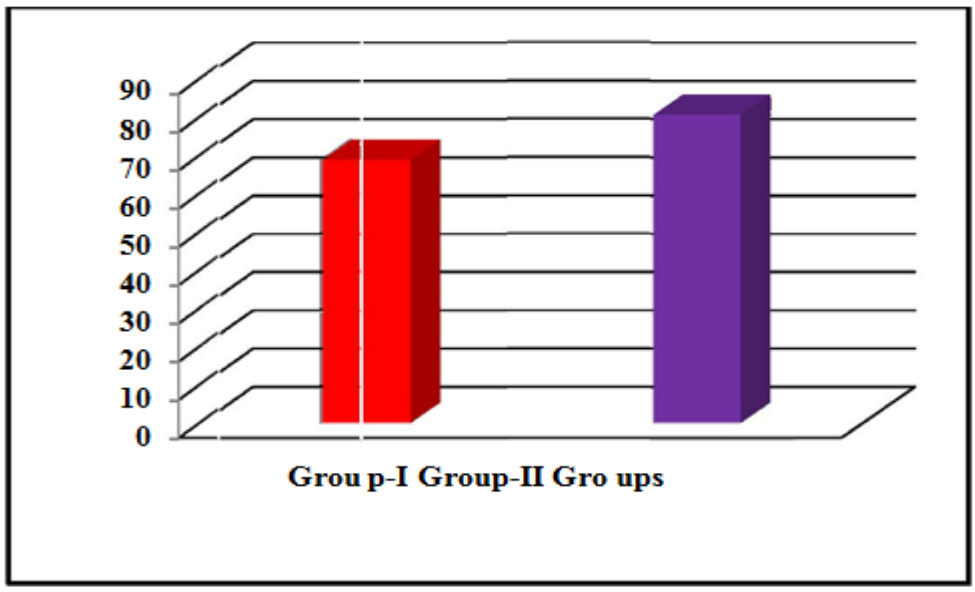

Figure 11: Comparison of groups based on heart rate (min)

Mean heart rate of both groups is given above. Mean Heart rate is significantly lower in group I.

Table 12: Comparison of groups based on respiratory rate

Groups	Mean	S D	N	t value	P value
Group-	12.48	1. 9	60	0 71	0.16
Group-II	13.66	1. 6	60		

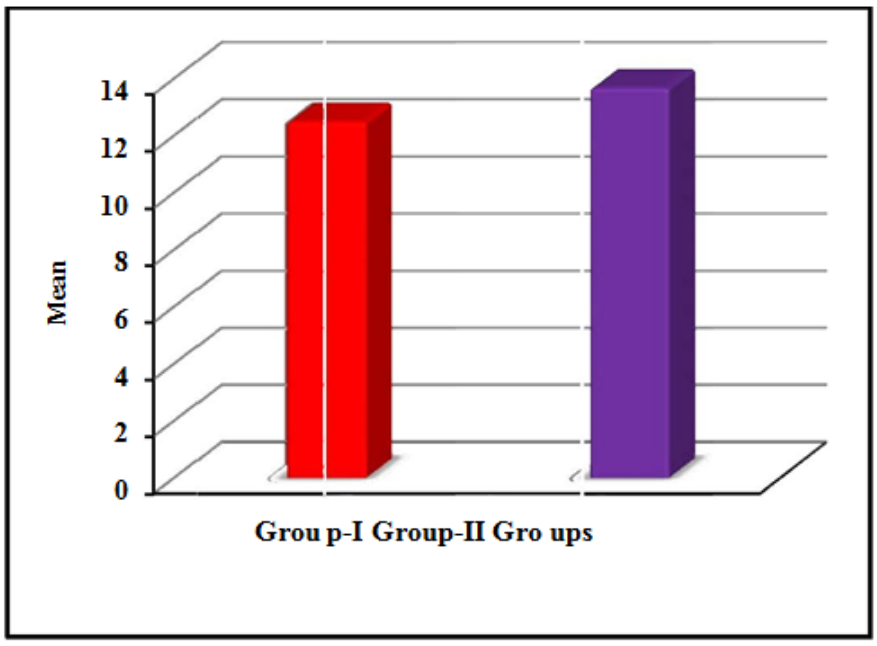

Figure 12: Comparison of groups based on respiratory rate

Mean respiratory rate of both groups is given above. Mean respiratory rate is comparable between the groups.

Discussion

Spinal anaesthesia is the most commonly used technique for below umbilical surgeries. It is important to limit the block level to minimize hemodynamic changes during the spinal anaesthesia in elderly and those with cardiopulmonary, endocrine and other comorbidities. Low-dose local anaesthetics may not provide an adequate anaesthetic level for surgery. Henceintrathecal opioids or clonidine are frequently co-administered with local anaesthetics to improve the anaesthetic quality and postoperative analgesia.

A study done by Hem Anand Nayagam, on intrathecal fentanyl and dexmedetomidine added to low dose bupivacaine for spinal anaesthesia for lower abdominal surgeries revealed that fentanyl and dexmedetomidine along with low dose bupivacaine provided adequate anaesthesia in lower abdominal surgeries with a hemodynamic stability.

Dexmedetomidine facilitates the spread of block and offers prolonged postoperative analgesia compared to Fentanyl. A study by Ji Eun Kim on Effects of intrathecal dexmedetomidine on low dose bupivacaine spinal anaesthesia in elderly patients undergoing Transurethral prostatectomy revealed that time to reach peak block level was shortened in dexmedetomidine group.

In this study, intrathecal fentanyl 25µg and dexmedetomidine 5µg was added to injection bupivacaine 0.5% Heavy for spinal anaesthesia for lower abdominal surgeries .Only normotensive patients in the age group 18-60 years belonging to ASA 1 and 2 class were included in the study. The effects of drugs were compared with regard to time of onset of analgesia, time to reach peak sensory level, time to reach complete motor blockade, duration of analgesia and hemodynamic parametres (Heart rate and systolic BP).

Conclusion

It is concluded that adding injection Dexmedetomidine 5µg (diluted to 0.5 ml) as adjuvant to intrathecal Bupivacaine 0.5%Heavy (2ml) for lower abdominal surgeries is superior to injection Fentanyl 25µg as intrathecal adjuvant with regard to time of onset of analgesia, time to reach peak sensory level, time to reach motor blockade (modified bromage 3), VAS scores with hemodynamic stability.

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