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Original research article

The effect of intravenous dexmedetomidine on central neuraxial blockade

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Abstract

Introduction: Spinal anesthesia is the gold standard for lower abdominal surgeries. Bupivacaine has proved to be an excellent local anaesthetic for spinal anaesthesia. Hyperbaric bupivacaine is suitable for operations of medium duration, and when early mobilization is desirable. Dexmedetomidine is a selective a2-receptor agonist is used to increase the quality and duration of sensory-motor block. The aim of the present study was to compare the duration of postoperative analgesia, the extent of motor and sensory block, adverse effects along with the haemodynamic changes between bupivacaine with dexmedetomidine.

Material and Methods: A prospective comparative study was conducted in the Department of Anesthesiology and Critical Care, INHS Asv**i**ni, Mumbai from May 2017 to May 2019 for a period of 2 years. 120 patients of ASA I and ASA II of either sex were divided into two groups. Group D received IV dexmedetomidine 0.5-1microgram/kg over 10 minutes before central neuraxial blockade and Group C received normal saline as a placebo before central neuraxial blockade. Postoperative pain was assessed using the visual analogue scale, Modified Bromage Scale was used to assess motor blockade, Ramsay Sedation Scale was used to assess the level of sedation. IBM SPSS version 22 was used for statistical analysis.

Results: 53 (88.33%) were male, and 7 (11.67%) were female in both the groups. There was no statistically significant difference between two groups in heart rate, SBP, DBP, MAP. The mean VAS score at 4, 8, 12, 24 hours in both the groups was statistically significant (P value <0.001). The extent of sensory block assessed by two-segment regression (in minutes), in DEXMEDETOMIDINE group was 158.75 ± 36.59, and it was 81.55 ± 14.43 in Non-dexmedetomidine group. The mean Time for complete sensory loss (in minutes), was 229.58 ± 30.2 in Dexmedetomidine group and 180.08 ± 14.34 in Non-dexmedetomidine. It was statistically significant (P value <0.001) in both the groups.

Conclusion: Dexmedetomidine can be safely administered tp prolong the duration of central neuraxial blockade using bupivacaine.

Keywords: Dexmedetomidine, neuraxial blockade, bupivacaine

Introduction

Spinal neuraxial blocks result in the sympathetic blockade, sensory analgesia, or anesthesia and motor blockade, depending on the dose, concentration or volume of local anesthetic, after insertion of a needle in subarachnoid space. Spinal anesthesia is the gold standard for lower abdominal surgeries. Spinal anesthesia has several advantages of cost-effective, easy administration technique, rapid onset of action, spared spontaneous respiration, low cost, reduced risk for pulmonary aspiration secondary to vomiting in patients whose stomach is full, facilitation of surgery by relaxing the intestines and abdominal wall, elimination of intubation, minimal disruption of blood chemistry, reduced blood loss during surgery, and earlier return of intestinal motility and most importantly patient remaining aroused throughout the procedure.

However, spinal anesthesia also has complications and contraindications, including the refusal by the patient, the inability to estimate the duration of surgery, postdural puncture headache (PDPH), urinary retention, waist and back pain, paresthesia, allergic reactions, total spinal anesthesia, shivering, and vomiting [2].

Therefore, in order to extend the intraoperative analgesia into the postoperative period, following spinal anaesthesia, various spinal adjuvants like morphine, buprenorphine and fentanyl, clonidine, ketamine are being used in anaesthetic practice. Such adjuvants have been helpful in the induction of early ambulation along with prolongation of analgesia but at the cost of their associated adverse effects. Therefore, search for an effective adjuvant is still going on.

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Aims and Objectives

To study and compare the effect of IV Dexmedetomidine on prolonging the duration of central neuraxial blockade using bupivacaine by

1. Noting two-segment regression of sensory level.
2. Noting VAS score.
3. 24-hour rescue analgesia required.

Materials and Methods

Study site

This study was conducted in the Department of Anesthesiology and Critical Care, tertiary center, Mumbai.

Study population

Patients of ASA I and ASA II of either gender attended to the department of Anesthesiology and Critical Care at INHS Asvini, Mumbai were considered as the study population. The study participants were randomly divided into two groups by draw of lots.

Group D: Patient was received, IV Dexmedetomidine 0.5-1µg/kg over 10 minutes before central neuraxial blockade and maintenance infusion of Dexmedetomidine at the rate of 0.5 microgram/kg/h after the central neuraxial blockade.

Group C: Patient was received, normal saline as a placebo before central neuraxial blockade and the same rate of infusion of normal saline would be administered after the central neuraxial blockade.

Study design

The current study was a prospective comparative study

Sample size

Sample size was calculated assuming the mean time to 2 regression of sensory block in group D as 145 minutes with a standard deviation of 90 and in group C as 97 with a standard deviations of 40 As per the study by Kaya FN *et al*. The other parameters considered for sample size calculation were 95% power of study and 5% alpha error. The following formula was used for sample size calculation.[48]

$$N = \frac{(u + v)^2(\sigma_1^2 + \sigma_0^2)}{(\mu_1 - \mu_0)^2}$$

N= Sample size

$\mu_1 - \mu_0$ = Difference between the means (145 and 97)

σ_1, σ_0 = Standard deviations (90 and 40)

U = one-sided percentage point of the normal distribution corresponding to 100%: The power If the power is = 95% u =1.34

V = Percentage point of the normal distribution corresponding to the (two-sided) significance level for significance level = 5%, v = 1.96

As per the above-mentioned calculation, the required sample size was 55 in each group. To account for non-participation rate of about 10%, another 5 subjects will be added to the sample. Hence the final required sample size is 60 subjects in each group

Sampling method

All the eligible subjects were recruited into the study consecutively by convenient sampling till the sample size is reached.

Study duration

The data collection for the study was done between May 2017 to May 2019 for a period of 2 years.

Inclusion criteria

1. Age 18-65 years
2. Both Genders
3. ASA I and II
4. Patients are undergoing Infra umbilical surgeries under central neuraxial blockade.

Exclusion criteria

1. Patient refusal
2. Emergency surgeries

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3. Use of any opioid or sedative medications in the week prior to surgery, known allergy to any of the test drugs
4. Contraindication to spinal anesthesia (as infection at the puncture site, pre-existing neurological deficits in the lower extremities, coagulation defects)
5. Cardiovascular, respiratory, neurological, psychological, hepatic, or renal disease.
6. Hypotension, Bradycardia, Hypovolemia, Hemorrhagic shock.

Results

A total of 120 subjects were included in the final analysis.

Table 1: Descriptive analysis of drugs in the study population (N=120)

Drugs	Frequency	Percentages
Dexmedetomidine (Group D)	60	50.00%
No Dexmedetomidine (Group C)	60	50.00%

Among the study population 60 (50%) patients were received Dexmedetomidine and remaining 60 (50%) people were not under Dexmedetomidine drug. (Table1).

Table 2: Comparison of gender between drugs (N=120)

Gender	Drugs		Chi square	P-value
	Dexmedetomidine (N=60) (Group D)	No Dexmedetomidine (N=60) (Group C)		
Male	53 (88.33%)	53 (88.33%)	0	1.000
Female	7 (11.67%)	7 (11.67%)		

In Dexmedetomidine group, 53 (88.33%) participants were male, and 7 (11.67%) participants were female. In No Dexmedetomidine group, 53 (88.33%) participants were male, and 7 (11.67%) participants were female. The difference in the proportion of gender between study groups was statistically not significant (P value 1.000). (Table 2 & Figure 1).

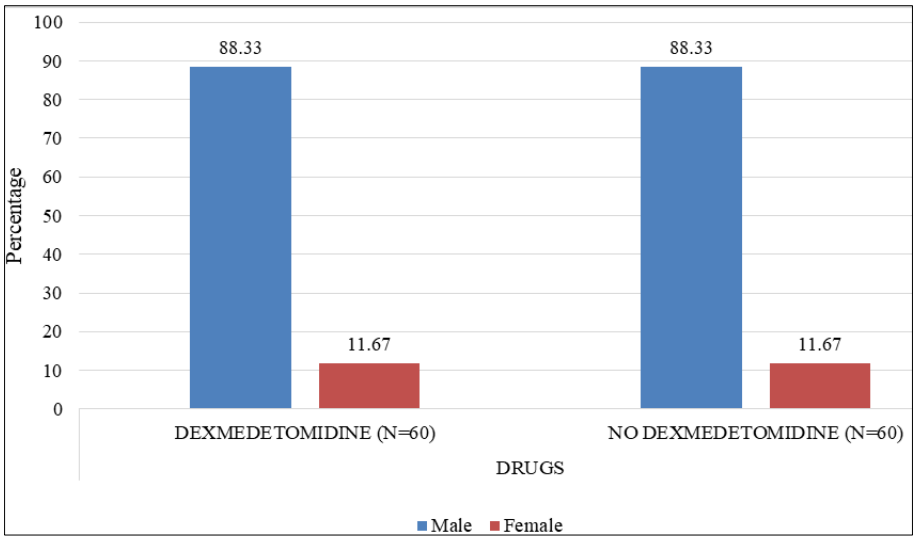

Fig 1: Cluster bar chart of comparison of gender between drugs (N=120)

Table 3: Comparison of mean of weight between the drugs (N=120)

Parameter	DRUGS (Mean± SD)		P value
	Dexmedetomidine (N=60) (Group D)	No Dexmedetomidine (N=60) (Group C)	
Weight (in kgs)	68.92 ± 5.69	68.92 ± 5.69	1.000

The mean weight of subjects in Dexmedetomidine group was 68.92 ± 5.69 Kgs, and the mean Weight of subjects in No Dexmedetomidine group was 68.92 ± 5.69 kgs the difference in the age between the two groups was statistically not significant (P Value 1.000). (Table 3 & Figure 2)

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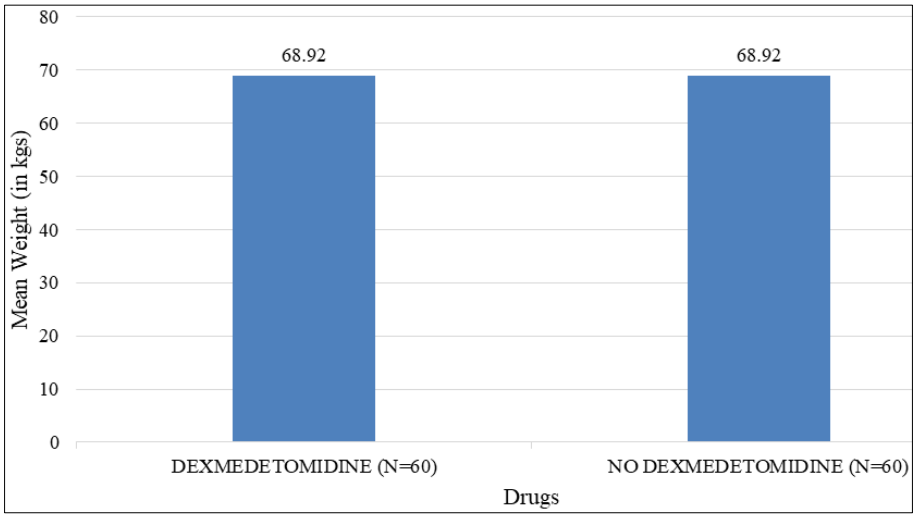

Fig 2: Bar chart of comparison of Weight between drugs (N=120)

Table 4: Comparison of co-morbidities between drugs (N=120)

Co-morbidities	Drugs		Chi square	P-value
	Dexmedetomidine (Group D) (N=60)	No Dexmedetomidine (Group C) (N=60)		
DM II	5 (8.33%)	6 (10%)	0.273	0.872
HTN	3 (5%)	4 (6.67%)		
NIL	52 (86.67%)	50 (83.33%)		

In Dexmedetomidine group, 5 (8.33%) participants were DM II, and 3 (5%) participants were HTN, and 52 (86.67%) participants were NIL. In No Dexmedetomidine group, 6 (10%) participants were DM II and 4 (6.67%) participants were HTN and 50 (83.33%) participants were NIL The difference in the comorbidities between the two groups was statistically not significant (P Value 0.872). (Table 4 & Figure 3).

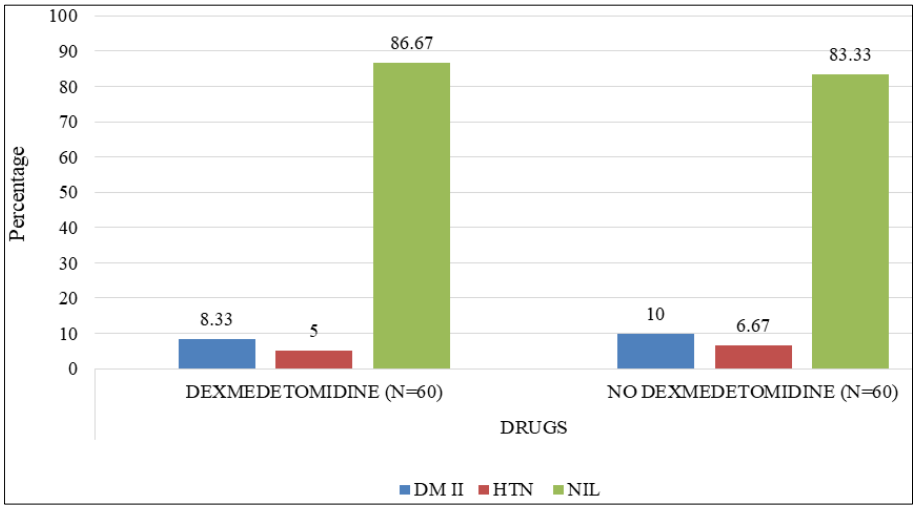

Fig 3: Cluster bar chart of comparison of CO-MORBIDITIES between drugs (N=120)

Discussion

Spinal anaesthesia is the most preferred anaesthetic technique used for lower abdominal surgeries because of its advantage of producing a high degree of sensory denervation and muscle relaxation associated with a very low degree of physiological trespass. But the main limitation of this technique is the duration. Only short duration action is obtained with spinal anaesthetics.[50] Bupivacaine is one of the widely used spinal anaesthetic agents, which also has the same disadvantages as seen in other spinal anaesthetic agents, the short-duration analgesic effect produced when it is used alone. Addition of adjuvants like morphine, pethidine, phenylephrine, neostigmine, ketamine, and alpha 2 (α2) agonists has found to prolong the duration of anaesthesia. Among these adjuvants, α2-agonist adjuvants like Dexmedetomidine have been found to cause less side effects when compared with opioid, which causes adverse side effects. The α2 agonists bind to presynaptic c-fibres and postsynaptic dorsal horn neurons,

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causing a reduction in the release of c-fibre transmitters and hyperpolarisation of postsynaptic dorsal horn neurons. This results in antinociceptive action for somatic and visceral pain. Intravenous Dexmedetomidine is being increasingly used as an adjuvant to spinal anaesthetic to increase the duration of analgesic effect without any respiratory distress. Considering the above-mentioned points and the fact that very few Indian studies are available which compare extent of motor and sensory block, adverse effects along with the haemodynamic changes between use of isolated bupivacaine and use of bupivacaine with Dexmedetomidine, this study was conducted to compare duration of postoperative analgesia extent of sensory block, adverse effects along with the haemodynamic changes obtained by using bupivacaine with Dexmedetomidine and bupivacaine alone.

This study is a prospective comparative study conducted in the Department of Anesthesiology and Critical Care, INHS Asvini, Mumbai. The study population comprised of Patients of ASA I and ASA II of either sex attended to the department of Anesthesiology and Critical Care at a tertiary center, Mumbai. The study was done between May 2017 to May 2019 for a period of 2 years. ASA, Weight, Co-Morbidities, Heart Rate BPM, SBP, DBP, MAP, SPO2, VAS were considered as primary outcome variables and study group (DRUGS) was considered as the primary explanatory variable. A total of 120 subjects divided into two equal groups of 60 each were included in the final analysis. One group was administered Dexmedetomidine along with Bupivacaine, and another group was given bupivacaine alone without any added adjuvant. There was no statistically significant difference between two study groups with respect to gender distribution, age and weight. The comorbidities of DM II and HTN found in two groups were statistically not significant.

In Dexmedetomidine group, 76.67% of participants were ASA I and 23.33% of participants were ASA II. In No Dexmedetomidine group, 76.67% of participants were ASA I and 23.33% of participants were ASA II. Vital signs (heart rate, systolic, and mean blood pressure and SpO_2 were recorded at 5 minutes, 15 minutes, 45 minutes, 75 minutes, 120 minutes and 180 minutes time periods. No statistically significant difference between the two groups was found in the above-mentioned vital signs.

Conclusion

- A total of 120 subjects were included in the final analysis, with 60 subjects each in Dexmeditomedine (Group D) and No Dexmeditomedine (Group C).
- In the Dexmeditomedine (Group D) the mean VAS at 4 hours, 8 hours,12 hours and 24 hours was 2.83 ± 1.86, 3.53 ± 1.38, 3.15 ± 1.15 and 2.35 ± 0.97 and in No Dexmedetomidine (Group C), the difference of VAS score at 4 hours, 8 hours,12 hours and 24 hours was 5.55 ± 1.03, 5.42 ± 0.67, 4.8 ± 0.73 and 4.22 ± 1.15 respectively, the difference of VAS score between two groups was statistically significant (P value <0.001).
- Comparison of mean of (level of sensory loss) time to two-segment regression in minutes. In Dexmedetomidine (Group D) it was 158.75 ± 36.59, and in No Dexmedetomidine (Group C) it was 81.55 ± 14.43 respectively, the difference of time to two-segment regression (in minutes) between two groups was statistically significant (P value <0.001).
- The mean Time for complete (in minutes), Dexmedetomidine (Group D) was 229.58 ± 30.2, and it was 180.08 ± 14.34 in No Dexmedetomidine (Group C), the difference of Time for complete (in minutes) between two groups was statistically significant (P value <0.001).
- On the basis of the results of our study, we conclude that IV supplementation of loading dose of dexmedetomidine 1 μg/kg followed by infusion at 0.5 μg/kg/h prolongs the duration of sensory block, motor block and duration of analgesia. There was also significant prolongation of the time for the two segment dermatome regression in the Dexmedetomidine (Group D) compared to the No Dexmedetomidine (Group C) control group.
- There was no significant difference between two study groups with respect to gender distribution, age and weight. The comorbidities of DM II and HTN found in two groups were statistically not significant. Considering no statistically significant difference between two groups in vital signs like heart rate, systolic and mean blood pressure, and SpO_2, it can be concluded that Dexmedetomidine provides sufficient sedation and prolongs duration of surgery with transient bradycardia and hypotension.
- However it is envisaged larger multicentric trials are needed to unequvivocally establish the findings of this study

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