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Comparison of clinical efficacy of intrathecal ropivacaine versus ropivacaine with dexmedetomidine in patient posted for infraumbilical surgeries under spinal anesthesia

Isha Yadav[1], Ankita Aggarwal[2], Mahima Lakhanpal[3], Himanshu Nirvan[4]

[1,2]Associate Professor, [3]Assistant Professor, Department of Anaesthesia, Santosh Medical College, Ghaziabad, [4]Assistant Professor, Department of Psychiatry, Noida International Institute of Medical Sciences, Greater Noida, Uttar Pradesh, India

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ABSTRACT

Background: Data related to clinical efficacy of intrathecal dexmedetomidine as an adjuvant to isobaric ropivacaine in spinal anesthesia were found to be inadequate, but the efficacy of newer molecules as an adjuvant is investigated constantly. Considering the favorable profile of dexmedetomidine, it could have a potential role as an adjuvant to ropivacaine. **Aims and Objectives:** The aim of the study was to evaluate the benefits of adding intrathecal dexmedetomidine as an adjunctive along with ropivacaine. The aim of the study was to assess and compare the safety and efficacy, post-operative analgesia, complications, duration of analgesia, and time of rescue analgesia for intrathecal ropivacaine versus a combination of intrathecal ropivacaine with dexmedetomidine. **Materials and Methods:** An observational study was carried out in 80 patients of either sex between 25 and 60 years of age, ASA Grade 1 and 2, undergoing elective abdominal, and lower limb surgeries. Subjects selected as per set inclusion/exclusion criteria and divided into two groups for spinal anesthesia. Group A: 3 ml of intrathecal 0.75% isobaric ropivacaine with 0.5 ml of normal saline. Group B: 3 ml of intrathecal 0.75% isobaric ropivacaine with 5 mcg preservative free dexmedetomidine in 0.5 ml of normal saline. Vital parameters were noted at 0 min, 1 min, 2 min, 5 min, 10 min, and thereafter every 15 min, till the surgery continued. Onset and the time for maximum sensory blockade were assessed and VAS scoring was done every 10 min till 30 min and thereafter every 15 min. The duration of effective analgesia was recorded along with the duration of sensory regression to S1, and time for administration of rescue analgesia was noted. **Results:** The combination of ropivacaine with dexmedetomidine was statistically found to be efficacious when compared to ropivacaine alone, as evidenced by statistically significant differences ($P<0.05$) in VAS scores at 80, 180, and 360 min and duration of regression to S1 level. The differences in time for rescue analgesia were also statistically significant ($P<0.05$), further proving the advantage for longer lasting analgesia without any additional adverse effects. **Conclusion:** 5 mcg dexmedetomidine is an attractive alternative as an adjuvant to spinal ropivacaine in surgical procedures, as opposed to ropivacaine alone, without any additional adverse effects.

Key words: Abdominal surgeries; Dexmedetomidine; Lower limb surgeries; Ropivacaine; Spinal anaesthesia

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INTRODUCTION

Post-operative pain management is an important practice in the field of anesthesia and critical care and has become absolutely essential for patient comfort and care. The degree of post-operative pain varies with the site of incision.[1,2]

For a long time, morphine and other opioids such as Fentanyl and Sulfentanyl have been commonly used, but

Address for Correspondence:
Dr. Himanshu Nirvan, Assistant Professor, Department of Psychiatry, Noida International Institute of Medical Sciences, Greater Noida - 201 312, Uttar Pradesh, India. **Mobile:** +91-9599116620. **E-mail:** himanshu.nirvan@gmail.com

these are prone to causing side effects such as pruritus,[3] nausea, and vomiting.

Ropivacaine is the first enantiomer specific compound with better recovery of motor function and a reduced risk of cardiotoxicity and neurotoxicity,[4] but post-operative pain relief is an important issue with ropivacaine. This necessitates using an adjuvant drug with ropivacaine for better intraoperative hemodynamic conditions along with optimal post-operative analgesia, while having minimal side effects.

Thus, arises the need to test dexmedetomidine, which is a highly selective alpha-2 adrenergic agonist. The impetus for its use resulted from observations made in patients receiving clonidine therapy during anesthesia.[5] As an intrathecal adjuvant drug,[6] it has longer duration of sensory and motor blockade, thus reducing the requirement for opioids. Dexmedetomidine being alpha-2 agonists produces its sedative-hypnotic effect by an action on alpha-2 receptors in the locus ceruleus and an analgesic action at alpha-2 receptors within the locus ceruleus and within the spinal cord.[7]

While many foreign researchers have conducted similar studies in the past, data are scarce in this regard in an Indian context. Furthermore, the most of the past studies had a much smaller sample size than this present undertaking. With this study, we aim to fill that void of data in an Indian demographic context and perspective.

Our study is designed to compare intrathecal isobaric ropivacaine with the combination of ropivacaine and dexmedetomidine (5 mcg), in lower abdominal and lower limb surgeries.

Aims and objectives

The objectives of the study are as follows:

1. To assess safety and efficacy of intrathecal ropivacaine versus a combination of intrathecal ropivacaine and dexmedetomidine.
2. To compare post-operative analgesia and complications of intrathecal ropivacaine versus a combination of intrathecal ropivacaine and dexmedetomidine.
3. To assess the duration of analgesia and time of rescue analgesia for intrathecal ropivacaine versus a combination of intrathecal ropivacaine and dexmedetomidine.

MATERIALS AND THETHODS

The observational study was conducted at the Department of Anaesthesiology and Critical Care, Santosh Medical College and Hospital, Ghaziabad. Institutional Ethics Committee approval was taken and 80 subjects were included in the study as per the inclusion/exclusion criteria, after taking an informed/written consent and performing a thorough pre-anesthetic check-up. Forty patients were included in each group with a total of 80 patients.

Inclusion criteria

The following criteria were included in the study:

1. Age 25–60 years.
2. ASA physical status 1 and 2.
3. Patients undergoing elective lower abdominal and lower limb surgeries.
4. Written Informed Consent.

Exclusion criteria

The following criteria were excluded from the study:

1. Consent not given.
2. Patients with contraindication to spinal anesthesia.
3. Patients with significant hepatic, renal, cardiovascular disease, or history of bleeding abnormalities.
4. Allergy to either drug used in the study.
5. History of substance use.
6. Non-cooperative patients.

The 80 patients were divided into two groups after explaining the nature and purpose of the study.

Group R: 3 ml of intrathecal 0.75% isobaric ropivacaine with 0.5 ml of normal saline.

Group D: 3 ml of intrathecal 0.75% isobaric ropivacaine with 5 mcg preservative free dexmedetomidine in 0.5 ml of normal saline.

For statistical analysis, SSPS 21.0 software was used. Variables between studied groups were compared using proportions, Fischer's exact probability test, and Chi-square tests for significance of associations. $P<0.05$ was taken as statistically significant.

Patients were kept NPO for 6 h before surgery. Routine pre-medication (injection Ondansetron 4 mg) was given. In the operation theatre, routine multipara monitors were attached, I.V. line was secured, and preloading was done using ringer lactate (10 ml/kg). Two anesthetists were involved: One prepared the anesthetic solution and performed the spinal block, while the other evaluated the study variables. Under aseptic precautions, lumbar puncture was performed in the left lateral position in L-3–L-4/L-4–L-5 interspace through midline approach with 26G Quincke lumbar puncture needle. In group R, 3 ml of 0.75% isobaric ropivacaine with 0.5 ml of normal saline and in Group D, 3 ml of 0.75% isobaric ropivacaine with

5 mcg preservative free dexmedetomidine in 0.5 ml of normal saline was administered.

After injecting the drug, sensory blockade was assessed and vital parameters noted. Pulse and non-invasive blood pressure were noted at 0 min (at the time of injecting the drug), 1 min, 2 min, 5 min, 10 min, and thereafter every 15 min till the surgery continued.

An investigator assessed the upper and lower limit of sensory analgesia to pinprick using short bevel end of 27G needle. The onset time of sensory block was assessed referring to the interval between spinal puncture and the maximal pinprick score. Sensory block was tested using loss of sensation to pin-prick in the present study. All parameters were noted by taking the time of intrathecal administration of drug as time 0. Surgery was allowed to start when sensory block to T10 dermatome was achieved. The time taken for achieving maximum sensory blockade was noted. VAS scoring was done every 10 min till 30 min and thereafter every 15 min.

The duration of effective analgesia was recorded along with the duration of sensory regression to S1, and time for administration of rescue analgesia was noted. The number of doses of rescue analgesia required in the post-operative period was also noted. Any side effects or complications such as dry mouth, nausea, vomiting, hypotension, bradycardia, sedation, urinary retention, headache, and neurological changes were monitored for 24 h.

RESULTS

In the present study, both the study groups were comparable with respect to their demographic characteristics and baseline hemodynamic parameters. The two groups in the present study were comparable in terms of age distribution. Maximum number of patients in both groups had body weight between 51 and 60 kg (Table 1). Maximum number of patients in both groups underwent orthopedic, gynecological, and lower abdominal surgeries (Table 2).

Cardiovascular changes were unremarkable, with no statistically significant differences between the groups in heart rate, % fall in diastolic blood pressure, and % fall in mean arterial pressure.

Mean fall in heart rate in ropivacaine group was 11.835±8.490 min compared to 14.960±9.109 min in the dexmedetomidine group, which was insignificant statistically ($p>0.05$). Only two patients in Group R had a fall >30% as compared to none in D group (Table 3 and Figure 1).

For systolic BP, 15 patients (40%) in dexmedetomidine group had a fall >30% as compared to 1 in ropivacaine group. 50% of patients had a fall of 11–20% in R group, as compared to 25% in D group, while 20% patients had a fall between 21% and 30% as compared to 10% patient in group D. Mean % fall in systolic blood pressure in ropivacaine group was 14.620±7.171 as compared to 19.910±14.228 in dexmedetomidine group, which was statistically significant. (Table 3 and Figure 1)

Mean % fall in diastolic blood pressure in ropivacaine group was 20.280±8.005 min as compared to 22.310±12.788 min in dexmedetomidine group, which was statistically insignificant (Table 3 and Figure 1).

Mean % fall in mean arterial pressure in ropivacaine group was 20.670±12.867 as compared to 18.475±6.509 in dexmedetomidine group. This was not significant statistically (Table 3 and Figure 1).

Maximum number of patients (65%) had onset time of sensory block within 3 min in dexmedetomidine group as compared to 75% of patients in the ropivacaine group which was comparable and statistically not significant (Table 4).

Time taken to achieve maximum level of sensory block was within 10 min for 55% of the patients in the R group as compared to 45% patients in D group. About 35% patients in Group R took between 11 and 15 min as compared to 45% patients in Group D. All the data were comparable and statistically not significant (Table 5 and Figure 2).

Mean VAS score in the ropivacaine group remained zero for 45 min after administration of the drug as compared

Table 1: Demographic data

Parameter	Group R	Group D
Mean age of patients (mean±SD)	35.1±12.1	41.1±15.1
Males	17	22
Females	20	11
Average weight (kg) (mean±SD)	56.2±6.5	59.5±8.3

Table 2: Type of surgeries

Type of surgery	Group R	Group D
Gynecological	17	13
Appendicectomy	5	9
Hernia	4	8
Anal	7	5
Orthopedic	3	3
Hydrocele/scrotal	3	3
Urethral	1	1

Table 3: Comparison of vital parameters

	<10%	11–20%	21–30%	>30%	Mean±SD	P - Value
%Fall in HR						
D	13	14	13	0	14.960±9.109	P>0.05 (NS)
R	21	12	5	2	11.835±8.490	
% Fall in SBP						
D	12	9	4	15	19.910±14.228	P<0.05 (S)
R	11	19	9	1	14.620±7.171	
% Fall in DBP						
D	11	7	7	15	22.310±12.788	P>0.05 (NS)
R	5	14	17	4	20.280±8.005	
% Fall in MAP						
D	13	7	3	17	18.475±6.509	P>0.05 (NS)
R	8	16	13	3	20.670±12.867	

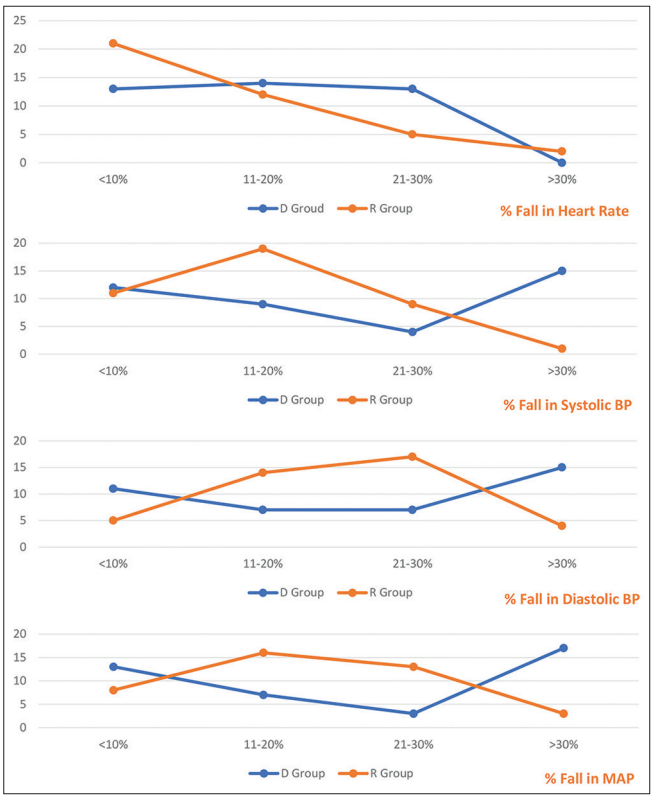

Figure 1: Comparison of vital parameters

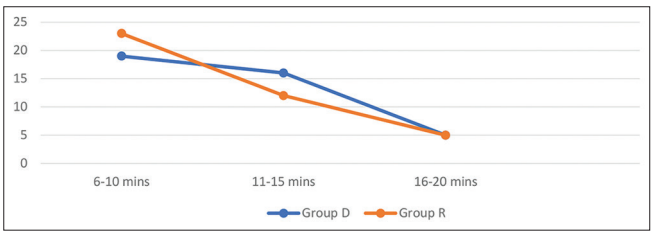

Figure 2: Time taken to achieve maximum sensory block level

to 90 min in the dexmedetomidine group (P value – 0.330). Mean VAS score at 180 min was 0.99±1.170 for the ropivacaine group as compared to 0.49±0.597 for dexmedetomidine group. P value was significant statistically (<0.05). The mean VAS score reached >4 (moderate severity when rescue analgesia was administered) at 223 min in ropivacaine group as compared to 462 min in dexmedetomidine group which was significant statistically (Table 6 and Figure 3).

Duration of sensory regression to S1 level was 221.79±41.29 in R group as compared to 376.3290±31.22 in D group. This was significant statistically (Table 7 and Figure 4).

Administration time of rescue analgesia was 224.81±43.401 in the R group while it was 458.64±37.194 in the D group which was statistically significant (Table 8 and Figure 5).

DISCUSSION

The present study "Comparison of Clinical Efficacy of Intrathecal Ropivacaine Versus Ropivacaine with Dexmedetomidine in Patient Posted for Infraumbilical Surgeries Under Spinal Anesthesia" has been undertaken at Santosh Hospital, Ghaziabad, in 80 patients of age group between 25 and 60 years, and weight 40 and 100 kg, of both sexes belonging to ASA Grade I and II, undergoing lower abdominal and lower limb surgeries. The study was conducted to assess the safety and efficacy of intrathecal ropivacaine with dexmedetomidine, to compare their post-operative analgesia, and to assess the time of rescue analgesia.

The two groups in our study were statistically comparable with respect to age, sex, weight, and type of surgeries. The maximum number of patients in our study belonged to age group of 26–35 years.

Through our study, we also aim to assess if there are any additional adverse effects with adding dexmedetomidine. In our study, there had been no significant change in heart rate from base line values in R group as well as in comparison to D group. Mean % fall in pulse rate in ropivacaine group was 11.835±8.490 as compared

to 14.960±9.109 in dexmedetomidine group which was statistically insignificant.

The mean % fall in mean arterial pressure in ropivacaine group was 18.475±6.5096 as compared to 20.670±12.8677 in dexmedetomidine group, which is statistically not significant. In this regard, our study is comparable to studies conducted by Ashraf Amin Mohammed *et al*., (2011)[8] McNamee *et al*., (2001)[9] who obtained similar results. This also stresses that dexmedetomidine does not contribute to any additional adverse effects.[10]

Our study found that there was no statistically significant difference between the two study groups on parameters of sensory block onset and time taken to achieve maximum sensory block. Our results are comparable with the results of Salgado *et al.,*[11] (2008). Al-Ghanem *et al*., (2009)[12] who studied synergistic effect of dexmedetomidine with ropivacaine, bupivacaine, and fentanyl, found that dexmedetomidine did not affect onset time of sensory block and time taken to achieve maximum sensory block level, reflecting a similar, if not better efficacy on these parameters.

Our study also aims to assess the quality and duration of analgesia and the time of rescue analgesia. In our study, the mean VAS score at 180 min was 0.99±1.170 for the ropivacaine group as compared to 0.49±0.597 for the dexmedetomidine group, which was statistically significant. At 360 min, mean VAS score for the ropivacaine group was 4.91±0.79 and was 3.81±1.11 for the dexmedetomidine group which was again statistically significant, clearly emphasizing the benefits of adding dexmedetomidine, resulting in reduced pain perception and better analgesia. These results are comparable with the study of Lin *et al*., (2009)[13] Bajwa *et al.,* (2011)[14] where addition of dexmedetomidine increases the analgesic effects or provides a better post-operative analgesia.

The duration of analgesia with respect to the sensory regression to S1 level and the time required for administering rescue analgesia are also important factors in establishing superiority of a drug in providing better anesthesia. In our study, we found that duration of sensory regression in R group was 221.79±41.30 min and in D group it was 376.3290±31.22 min. These results are statistically significant, proving the efficacy of adding dexmedetomidine, specially for surgeries requiring longer operating times.

The time requires to administer rescue analgesia is also a strong indicator of the quality of analgesia offered by the medications

Table 4: Time of onset of sensory block

Group	Time (min)			P - value
	0-3	4-7	8-10	
D	30	10	0	P>0.05 (NS)
R	26	14	0	

Table 5: Time taken to achieve maximum sensory block level

Group	Time (min)			Mean±SD	P - value
	6–10	11–15	16–20		
D	19	16	5	11.770±2.42	P>0.05 (NS)
R	23	12	5	11.50±2.74	

Table 6: VAS Scores

Group	VAS 15 min	VAS 30 min	VAS 45 min	VAS 90 min	VAS 180 min	VAS 360 min
D	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.000	0.49±0.597	3.81±1.11
R	0.00±0.00	0.00±0.00	0.00±0.00	0.06±0.211	0.99±1.170	4.91±0.79
P value	>0.05 (NS)	>0.05 (NS)	>0.05 (NS)	<0.05 (S)	<0.05 (S)	<0.05 (S)

Table 7: Duration of sensory regression to S1

Group	Time (min)						Mean±SD	P - value
	90-139	140-189	190-239	240-289	290-339	340-420		
D	0	0	0	0	5	35	376.3290±31.22	P<0.05 (S)
R	0	9	19	12	0	0	221.79±41.29	

Table 8: Time of Administration of rescue analgesia

Groups	Time (Min)								Mean±SD	P - value
	101–150	151–200	201–250	251–300	301–350	351–400	401–450	451–550		
D	0	0	0	0	0	6	8	26	458.64±37.194	P<0.05 (S)
R	0	12	17	8	4	2	0	0	224.81±43.401	

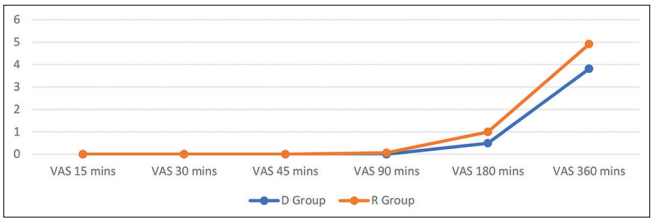

Figure 3: VAS Scores

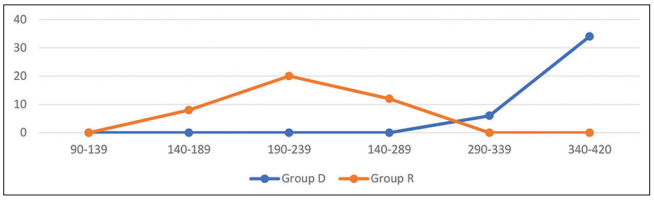

Figure 4: Duration of sensory regression to S1

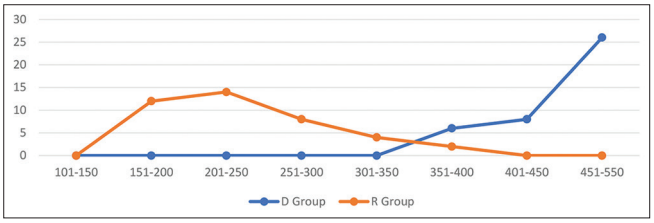

Figure 5: Time of administration of rescue analgesia

used. In our study, administration time of rescue analgesia was 224.81±43.401 in Group R while it was 458.64±37.194 in Group D, which was higher in comparison. This was significant statistically, proving that dexmedetomidine helps increase the duration of effective analgesia. Results of our study are comparable with the study of Fyneface–Ogan *et al.*, (2012).[15] In their study duration of spinal block increased from 98.7+1.70 min in the bupivacaine group, 103.2±3.33 min in the bupivacaine plus fentanyl group to 221.12±1.37 min in the bupivacaine plus dexmedetomidine group.

Many authors have observed and concluded that addition of intrathecal dexmedetomidine to ropivacaine helps improve the duration of anesthesia and provides better analgesia for longer time duration without causing any additional adverse effects. These findings have been replicated in our study as well.

Limitations of the study

Sample size was small.

CONCLUSION

5 mcg dexmedetomidine seems to be an attractive alternative as an adjuvant to spinal ropivacaine in surgical procedures, as opposed to ropivacaine alone. It has excellent quality of post-operative analgesia with minimal side effects. However, clinical studies to prove its efficacy and safety and varying dosages for supplementation of spinal local anesthetics are recommended.

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Authors Contribution:
IY- Concept and design of study, data collection and prepared first draft of manuscript; **AA-** Review of literature and interpretation of results; **ML-** Statistical analysis and preparation of manuscript. **HN-** Interpretation of results, manuscript preparation and review of manuscript

Work attributed to:
Santosh Medical College and Hospital, Ghaziabad - 201 001, Uttar Pradesh, India

Orcid ID:
Dr. Isha Yadav - https://orcid.org/0000-0001-7650-1248
Dr. Ankita Aggarwal - https://orcid.org/0000-0003-0459-593x
Dr. Mahima Lakhanpal - https://orcid.org/0000-0003-4612-6576
Dr. Himanshu Nirvan - https://orcid.org/0000-0002-3135-4544

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