



### Original Research Article

## Comparative evaluation of Ropivacaine hydrochloride with varying doses of fentanyl citrate as an adjuvant for epidural anaesthesia in below umbilical surgeries

Authors

**Dr Avadhesh Sukhla<sup>1</sup>, Dr Suman Gupta<sup>2</sup>, Dr Avadesh Sharma<sup>3</sup>**

<sup>1</sup>(Mch. Neurosurgery) Associate Professor, Department of Neurosurgery, GRMC, Gwalior (MP)

<sup>2</sup>Associate Professor, Department of Anaesthesiology, GRMC, Gwalior (MP)

<sup>3</sup>Senior Consultant, Kalyan Hospital, Gwalior (MP)

Corresponding Author

**Dr Suman Gupta**

11-Helipad Colony, Lashkar Gwalior (MP) 474009, India

### Abstract

**Background:** Ropivacaine hydrochloride is increasingly being used for the epidural anesthesia for below umbilical surgeries. To increase its efficacy, opioids like fentanyl has been added to ropivacaine in different dose combinations. The present study was conducted at a tertiary care centre in north India. Total of 90 patients in age group 20-60 were enrolled and were equally divided to receive one of the three group medications (Group R (n=30): 18.5 ml of 0.75% Ropivacaine hydrochloride with 1.5 ml of normal saline, Group RF1 (n=30): 18.5 ml of 0.75% Ropivacaine hydrochloride with 50µg of Fentanyl Citrate (1 ml) and 0.5 ml of normal saline and Group RF2 (n=30): 18.5 ml 0.75% Ropivacaine hydrochloride with 75 µg of Fentanyl Citrate (1.5 ml)).

**Results:** Addition of fentanyl to ropivacaine improved the onset of sensory block, decreased the time taken to reach highest level of sensory block, onset of motor block, and increased duration of analgesia which was statistically significant. The Visual Analog Score (VAS) at the time of rescue analgesia was not statistically significant among the three groups.

**Conclusion:** Fentanyl accelerates onset of sensory and motor block as an adjuvant to ropivacaine hydrochloride in epidural block. It prolongs the duration of sensory block and duration of analgesia in dose dependent manner.

**Keywords:** Ropivacaine, fentanyl, epidural, anaesthesia.

### Introduction

Ropivacaine hydrochloride is unique in being the first local anesthetic marketed as a pure levorotatory stereoisomer, this characteristic gives it motor block-sparing properties<sup>(1)</sup>, less cardiotoxicity and neurotoxicity as compared to

bupivacaine<sup>(2,3)</sup>, become preferred long-acting local anesthetic drug. Ropivacaine hydrochloride is considered the safest long-acting local anesthetic currently available.

In an attempt to lower the dosages, combination of the local anesthetic and opioids is used. Such drug

combinations may produce analgesia by additive or even synergistic ('supra-additive') mechanisms and permit smaller doses of each drug with correspondingly fewer dose-related side-effects, to make epidural anesthesia last longer<sup>(1,4)</sup>, to improve the quality of blockade, or to accelerate the onset of blockade.

With this objective we planned to evaluate the efficacy and duration of analgesia of epidural ropivacaine hydrochloride alone and in combination with different doses of fentanyl citrate i.e., 50µg and 75µg for post-operative pain relief in patients undergoing below umbilical surgeries.

### Material and Methods

The present study was carried out after approval of study protocol by the institute Ethics committee. Total of 90 patients of ASA grade I & II, between 20-60 years of age of either sex, for elective below umbilical surgeries were involved in the study. Anaesthetic procedure was well explained to all the patients and well informed written consent was obtained.

Unwilling or non-cooperative patients, hypersensitive to fentanyl citrate or ropivacaine hydrochloride, having spinal deformity or infection at the site of epidural puncture, having chronic backache, cardiovascular diseases, hepatic disease, bleeding diathesis, renal impairment, and neurological disorders were excluded from the study.

All the patients were kept nil orally for at least 6 hours before procedure. Intradermal sensitivity test with 0.75% ropivacaine hydrochloride was done in every patient. Inj. Glycopyrrolate 0.2 mg IM was given 30 minutes prior to operative procedures. 500ml of lactated Ringer's solution was infused before induction of epidural anesthesia for preloading.

Total of 90 patients undergoing below umbilical surgeries were randomized in a double blind manner using random number table, into three groups, to receive one of the three solution epidurally, while total volume will remain constant i.e., 20 ml.

- Group R (n=30): 18.5 ml of 0.75% Ropivacaine hydrochloride with 1.5 ml of normal saline.
- Group RF1 (n=30): 18.5 ml of 0.75% Ropivacaine hydrochloride with 50 µg of Fentanyl Citrate (1 ml) and 0.5 ml of normal saline.
- Group RF2 (n=30): 18.5 ml 0.75% Ropivacaine hydrochloride with 75 µg of Fentanyl Citrate (1.5 ml).

On arrival into operation theatre, patients were placed in sitting position. Under all aseptic precautions, the L<sub>3</sub>-L<sub>4</sub> interspace was infiltrated with 0.75% ropivacaine hydrochloride using 24G hypodermic needle. Toughy 17-gauge needle was advanced, through which epidural catheter 19G was guided in the epidural space which was identified by the loss of resistance technique using a midline approach. Finally catheter was fixed & patient made supine.

Each patient received a test dose of 3 ml of 0.75% ropivacaine hydrochloride solution to detect an unintentional intrathecal or intravascular placement of catheter. Intrathecal injection will manifest by signs of spinal block within few minutes (like decreased sensation in the buttock's, paresis of legs and absence of knee jerk).

A double-blind randomized trial design was applied and the patient was allocated randomly (by using a random number table) into three groups (sealed opaque envelopes). All envelopes containing study solution were prepared by an anaesthesiologist not involved in data collection to avoid biasing.

Five minutes after the test dose, sealed opaque envelope was opened and patient enrolled in one of the three groups described above. After the procedure patients were evaluated for onset of sensory blockade, onset of motor blockade, highest level of sensory blockade achieved, duration of analgesia, pain assessment at the time of rescue analgesia and level of sedation was observed.

Onset of sensory blockade is defined as the time duration of onset of sensory loss from end of epidural injection till the failure of perception of pin prick sensation by the patient above T<sub>10</sub> dermatome. It was assessed every 2 minutes till failure of pin prick perception by the patient at T<sub>10</sub> dermatome and final time was recorded. Onset of motor blockade is defined as the time required for achieving the modified Bromage's grade<sup>(5)</sup> 03 block from end of epidural injection. Motor blockade was assessed every 2 minutes until desirable grade 03 was achieved and final time was recorded.

Duration of analgesia was the time duration from onset of sensory block to request for rescue analgesia and recorded. Assessment of pain was done via Visual Analog Score (VAS). Patients were asked to mark on the VAS scale when they request for rescue analgesia to evaluate the intensity of pain. Each patient was presented with a line 100 mm long and explained that the left end represents no pain and right end the worst pain imaginable. They were asked to represent severity of pain on VAS Scale. Score of 0, 1-25, 26-50, 51-75 and 76-100 was considered as no Pain,, mild pain, moderate pain, severe pain and very severe pain. respectively.

Intergroup comparison for continuous variables were performed, using ANNOVA, to assess significant differences among groups. Quantitative data's were expressed as mean and standard deviation ( $\pm$ SD). P value- 0.05 was considered to be significant.

## Results

Total of 90 patients were enrolled in the study. The mean  $\pm$  SD of age (yr) were 47 $\pm$ 9.69, 50 $\pm$ 8.32, and 47 $\pm$ 10.75 in groups R, RF1 and RF2 respectively. The mean  $\pm$  SD of duration of surgery (min) were 93.87  $\pm$ 25.08, 88.83 $\pm$ 14.72, and 90.17 $\pm$ 20.02 in groups R, RF1 and RF2 respectively. These variables were statistically analyzed, and found to be comparable (Table 1).

Onset time (mean  $\pm$ SD) of sensory blockade was found to be 17.87 $\pm$ 2.32 minutes, 14.63 $\pm$ 1.54 minutes and 12.45 $\pm$ 1.76 in Group R, Group RF1 and Group RF2 respectively. On intergroup statistical analysis, the difference was found to be significant (p value <0.05) between the groups (Table 2).

The (mean  $\pm$  SD) time taken to reach highest level of sensory blockade were 22.3 $\pm$ 2.42 minutes, 18.57 $\pm$ 1.89 minutes and 16.17 $\pm$ 1.64 in Group R, Group RF1 and Group RF2 respectively. On intergroup statistical analysis, the difference was found to be significant (p value <0.05) in all groups (Table 2).

Onset time of motor block (Grade III motor block) was 39.13 $\pm$ 4.24 min, 29.83 $\pm$ 3.03 min & 24.23 $\pm$ 2.84 min in groups R, RF1 & RF2 respectively. On intergroup statistical analysis, the difference was found to be significant (p value <0.05) between all the three groups (Table 2).

The (mean $\pm$ SD), duration of analgesia was found to be 277.17 $\pm$ 13.37 min, 347.5 $\pm$ 20.5 min, and 359.47 $\pm$ 31.31 in Groups R, RF1 and RF2 respectively. On intergroup statistical analysis, the difference was found to be significant (p value <0.5) between all the three groups (Table 2).

**Table No. 1** Demographic data of the study population

Variable	Group R		Group RF1		Group RF2	
	Mean	$\pm$ SD	Mean	$\pm$ SD	Mean	$\pm$ SD
Age(yrs)	47	9.69	50	8.32	47	10.75
Sex Ratio (M:F)	14:16		14:16		12:18	
Duration of surgery (min)	93.87	25.08	88.83	14.72	90.7	20.2

**Table No. 2** Sensory, motor blockade, duration of Analgesia, Visual Analog Score (VAS) at the time of rescue analgesia in the three groups

S. No.	Parameters	Group R		Group RF1		Group RF2		P value
		Mean	± SD	Mean	± SD	Mean	± SD	
	Onset of sensory block (min)	17.87	2.32	14.63	1.54	12.43	1.76	<0.01
	Time taken to reach highest level of sensory block (min)	22.3	2.42	18.57	1.89	16.17	1.64	<0.01
	Onset of motor block (min)	39.13	4.24	29.83	3.03	24.23	2.84	<,0.01
4.	Duration of Analgesia(min)	277.17	13.37	347.5	20.5	359.47	31.31	<0.01
5.	Visual Analog Score (VAS) at the time of rescue analgesia	25.7	3.37	24.47	3.12	24.97	3.63	0.59

## Discussion

When local anaesthetics or opioids used in epidural techniques, the provision of effective analgesia may be limited because of possible undesired effects associated with use of high dose of either drug. Therefore, in an attempt to lower the adverse effect, combination of the local anesthetic and opioids is used; more over addition of opioids prolongs the duration of anaesthesia as well as analgesia, so that it provides satisfactory anaesthesia for long surgical procedures and post operative analgesia.

On intergroup comparison of onset of sensory block and time taken to achieve highest level of sensory block the difference was found to be statistically significant between all three group (p value<0.05). Thus we found epidural fentanyl citrate (either 50 µg or 75 µg) when added to epidural ropivacaine hydrochloride resulted in early onset of sensory block; this finding coincides with Cherng C H et al<sup>(6)</sup> who reported that the addition of fentanyl citrate to ropivacaine hydrochloride solution shortened the onset time of sensory and motor block during epidural anesthesia without increasing side effects. Bachmann-Mennenga B et al<sup>(7)</sup> observed that time to reach the sensory block was significantly reduced ( $P < 0.001$ ) in each group by addition of 10 or 20 µg of sufentanil in the plain ropivacaine hydrochloride.

Grade III motor block was found in 11(36.67%), 12(40%), and 13(43.33%) patients in Group R, Group RF1, and Group RF2 respectively and there were no significant difference among three groups in incidence of motor block. Similarly Morton C P

J et al<sup>(8)</sup> observed grade III motor block in 35% patients for LSCS with 0.75% ropivacaine hydrochloride of extradural anaesthesia. Topcu I et al<sup>(9)</sup>, observed that there were no difference in incidence of motor block when 80µg fentanyl citrate was added to epidural ropivacaine hydrochloride.

In the present study, onset time of motor block (min) were found to be for group R 39.13±39.13, for group RF1 29.83±3.03 and for group RF2 24.23±2.84. On intergroup comparison, the difference was founds statistically significant in all three groups (p value <0.05). Similarly Cherng C H et al<sup>(6)</sup> demonstrated in his study that the addition of 100µg fentanyl citrate to 1% ropivacaine hydrochloride solution for epidural anesthesia accelerates the onset of sensory and motor blocks. The mechanisms by which fentanyl citrate speeds the onset of motor blocks are not clear. Possible mechanisms of the earlier onset of motor blocks produced by fentanyl citrate are same as explained earlier regarding early onset of sensory block.

Mean ±SD of duration of analgesia (min) in the present study were 277 ±13.37 for group R, 347.5±20.5 for group RF1 and 359.47±31.31 for group RF2, and found to be statistically significant between all the three groups (p value <0.05). Both fentanyl citrate increases duration of analgesia when added to ropivacaine hydrochloride.

Similarly King M J et al<sup>(10)</sup> reported longer duration of postoperative analgesia who received epidural fentanyl citrate. Debon R et al<sup>(11)</sup> also found that when sufentanil was added to

ropivacaine hydrochloride duration of analgesia produced by ropivacaine hydrochloride increased by approximately 40 min. Sinatra R S et al(12) reported longest duration of pain relief in epidural bupivacaine fentanyl citrate than bupivacaine alone or bupivacaine lidocaine combination.

Exact mechanism of prolonged analgesia in epidural fentanyl citrate group not known but may be due to lipophilic property of fentanyl citrate so the drug gets absorbed into the epidural vasculature and epidural pad of fat and slowly gets released and provides prolonged duration.

### Conclusion

Fentanyl citrate accelerates onset of sensory and motor block as an adjuvant to local anaesthetic ropivacaine hydrochloride in epidural block. Addition of fentanyl citrate prolongs duration of sensory block and duration of analgesia in dose dependent manner.

### References

1. Bader A M, Datta S, Flanagan H, Covino BG. Comparison of bupivacaine and ropivacaine induced conduction blockade in the isolated rabbit vagus nerve. *Anesth Analg* 1989; 68: 724-7.
2. Knudsen K, Beckman S M, Bloomberg S, Sjøvall J, Edvardsson N et al. Central nervous and cardiovascular effects of i.v. infusions of ropivacaine, bupivacaine and placebo in volunteers. *Br J Anaesth* 1997 May; 78 (5): 507-14.
3. Scott D B, Lee A, Fagan D et al. Acute toxicity of ropivacaine compared with that of bupivacaine. *Anesth Analg* 1989; 69: 563-9.
4. Cousins M J & Veering B T. Epidural neural blockade. In: Cousins MJ, Bridenbaugh P O eds. *Neural blockade in clinical anesthesia and management of pain*. Philadelphia: Lippincott-Raven, 1998:243-320.
5. Graham AC<sup>1</sup>, McClure JH. Quantitative assessment of motor block in labouring women receiving epidural analgesia. *Anaesthesia*. 2001 May;56(5):470-6.
6. Cherg C H, Yang C P, and Wong C S. Epidural fentanyl speeds the onset of sensory and motor blocks during epidural ropivacaine anesthesia. *Anesth Analg* 2005; 101:1834-7.
7. Bachmann-Mennenga B, Veit G, Steinicke B, Biscopig J, Heesen M. Efficacy of sufentanil addition to ropivacaine epidural anaesthesia for Caesarean section. *Acta Anaesthesiologica Scandinavica* April 2005; 49, 4, 532-537.
8. Morton C P J, Bloomfield S, Magnussion A, Jozwiak H and McClure H. Ropivacaine 0.75% for extradural anaesthesia in elective caesarean section: an open clinical and pharmacokinetic study in mother and neonate. *British Journal of Anaesthesia* 1997; 79:3-8.
9. Topcu I, Luleci N, Tekin S, Kefi A, Erincler T.: Effectiveness of clonidine and fentanyl addition to bupivacaine in postoperative patient controlled epidural analgesia: *Anesthesiol. Intensive med. Notfallmed Schmerzther*. 2005 Sep;40(9): 521-5.
10. King M J, Bowden M I and Cooper G M. Epidural fentanyl and 0.5% bupivacaine for elective caesarean section: *Anaesthesia*, 1990,( 45); 285-288.
11. Debon R, Allaouchiche B, Duflo F, Boselli E and Chassard D. the analgesic effect of sufentanil combined with ropivacaine 0.2% for labor analgesia: A comparison of three sufentanil doses. *Anesth Analg* 2001; 92:180-3.
12. Sinatra RS, Goldstein R, Sevarino FB. The clinical effectiveness of epidural bupivacaine, bupivacaine with lidocaine, and bupivacaine with fentanyl for labor analgesia: *J Clin Anesth*. 1991 May-Jun; 3(3):219-24.