

Original research article

## Effects of Intrathecal Isobaric Ropivacaine with Fentanyl Versus, Hyperbaric Bupivacaine with Fentanyl in Elective Inguinal Hernia Surgeries

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### Abstract

**Introduction:** Regional Anaesthesia is the most common and preferred technique for elective inguinal hernia surgeries. The most commonly used anaesthetic agent for spinal anaesthesia are Lidocaine and Bupivacaine. Ropivacaine is an alternative to Bupivacaine due to its lesser degree and duration of motor blockade, good hemodynamical stability and lesser systemic toxicity. Hence this study was conducted to find out the efficacy and side effect profile of the Ropivacaine against the bupivacaine for elective inguinal surgery as part of day care surgery.

**Material and Methods:** This present study was a prospective study conducted at tertiary health care hospital on 80 patients undergoing elective inguinal hernia surgery divided into two groups, **Group R** – receives 3 ml of isobaric ropivacaine 0.5% with 0.5 ml of Fentanyl which contains 25 micrograms and **Group B** – receives 3 ml of hyperbaric bupivacaine 0.5% with 0.5 ml of fentanyl which contains 25 micrograms. Sensory and motor blockade were assessed along with duration and the analgesia.

**Results:** Onset of sensory blockade was delayed in ropivacaine group. Maximum height of sensory blockade was found to be same in both groups. The time taken to achieve maximum height of sensory blockade was significantly increased in ropivacaine group. Onset of motor blockade was delayed in ropivacaine as compared to bupivacaine and it was statistically significant. The two-segment regression time was less in case of ropivacaine as compared to bupivacaine which was statistically significant. Duration of sensory blockade was more with bupivacaine as compared to ropivacaine. The duration of motor blockade was less in ropivacaine as compared to bupivacaine.

**Conclusion:** Ropivacaine along with fentanyl is a good alternative for bupivacaine and fentanyl as it has shorter duration of action with lesser motor block resulting in early ambulation for elective inguinal hernia surgeries.

**Keywords:** Bupivacaine, Ropivacaine, Fentanyl, Inguinal hernia, Local Anesthesia

### Introduction

Regional Anaesthesia is the most common and preferred technique of anaesthesia for elective inguinal hernia surgeries. It is better alternative to general anaesthesia and is beneficial to day care surgeries. August Bier, Performed the first spinal anaesthesia in 1898 by injecting 0.5%

Cocaine solution intrathecally. The most commonly used anaesthetic agent for spinal anaesthesia are Lidocaine and Bupivacaine. Lidocaine has faster onset but short duration of anaesthesia. Bupivacaine has slightly slower onset but provides intermediate duration. It is more popular than lidocaine but its prolonged duration of motor blockade makes it undesirable for day care surgeries. Ropivacaine is an alternative to Bupivacaine due to its lesser degree and duration of motor blockade. It also has good hemodynamical stability and lesser systemic toxicity. Hence this study was conducted to find out the efficacy and side effect profile of the Ropivacaine against the bupivacaine for elective inguinal surgery as part of day care surgery.<sup>[1], [2], [3]</sup>

### **Aim and Objectives:**

The present study was conducted to find out the effectiveness of isobaric ropivacaine over hyperbaric bupivacaine with fentanyl. To Study the highest sensory block, time to reach peak sensory and motor block, two dermatome regression time of sensory block, duration of motor and sensory block.

### **Material and Methods:**

This present study was a prospective study conducted at tertiary health care hospital attached to government medical college. After obtaining approval from internal Ethics committee 80 patients undergoing elective inguinal hernia surgery were included in the study with informed consent. Group R – 40 patients and Group B – 40 patients.

Inclusion criteria was: Patient must be having inguinal hernia (direct or indirect or congenital) being posted for inguinal hernia surgery under spinal anesthesia. Patients must be able to understand the study and also able to give informed consent to it. Their age should be between 18 to 60 years of age and should belong to either ASA grade 1 or ASA grade 2 in pre anesthetic evaluation.

Exclusion criteria was: Patients having allergy to drugs used in the study, Pregnant and lactating women, Coagulopathy, Neurological disorders, Septicaemia, Morbid obesity, Deformities of spine, Systemic disorders such as uncontrolled diabetes and hypertension and Patients belonging to ASA grade 3 and above in pre anesthetic evaluation.

**Sample size** was calculated using the formula

$$N = 2S^2(Z_1+Z_2)^2/(m_1-m_2)^2 = 80$$

Where,  $m_1=3.17$  ,  $m_2=2.52$  ,  $S_1=0.72$  ,  $S_2=0.69$  ,  $S=0.70$

**Group R** – receives 3 ml of isobaric ropivacaine 0.5% with 0.5 ml of Fentanyl which contains 25 micrograms.

**Group B** – receives 3 ml of hyperbaric bupivacaine 0.5% with 0.5 ml of fentanyl which contains 25 micrograms.

Patient was given injection ondansetron 4 mg IV and RL was used for maintenance infusion. Lumbar puncture is done with Quinke's needle 25 G in L3 – L4 in sitting position. After obtaining free flow of CSF, local anaesthetic along with fentanyl according to their group was given.

Hemodynamic Parameter recorded: Pulse, non-invasive blood pressure and oxygen saturations were recorded at every 3 minutes for first 10 minutes followed by every 5 minutes till the end of surgery followed by hourly for 24 hours. Any drop in mean arterial more than 20 % of baseline was given a dose of injection mephentermine 6mg IV. Any decrease in pulse rate less than 60/minute was given glycopyrrolate 0.2mg IV.

Sensory blockade: It was assessed by pin prick method along the mid axillary line. The time onset of sensory blockade is established by blockade of L1 dermatomes. The maximum

dermatomal blockade was also determined. The offset is determined by return of sensation in S5 dermatomes.

Motor blockade: It was assessed by modified Bromage Score.

Bromage 3 was considered onset of motor blockade and Bromage 0 was considered offset.

The time taken for highest sensory blockade was also noted. The two dermatomal regression time with respect to sensory blockade was noted. Total duration of motor and sensory blockade was also noted. In case of any patient requiring general anaesthesia for surgical reason or inadequate analgesia were excluded from the study. Duration of surgery was noted.

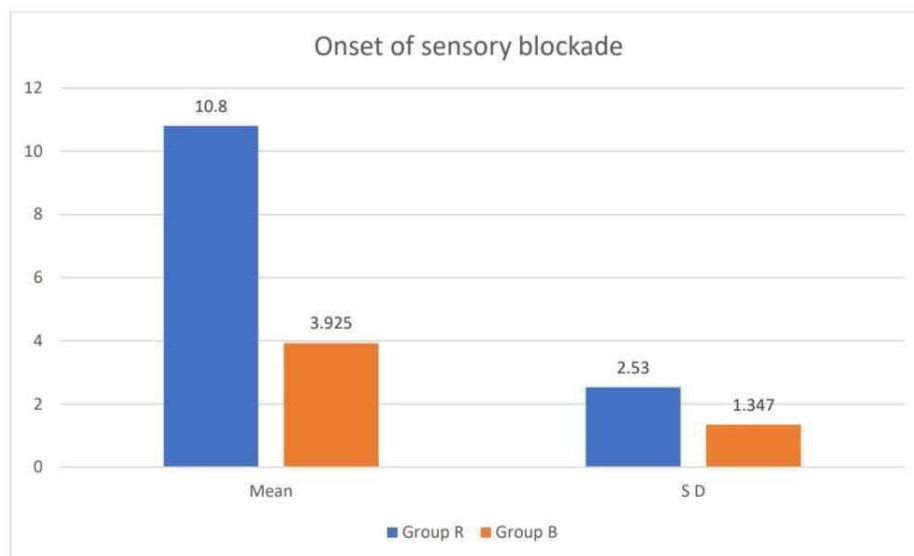
**Data analysis:** Data analysis was done using Epidemiological Information Package (EPI 2010) developed by centre for disease control (CDC), Atlanta. Using this software, range, frequencies, percentages, means, standard deviations, chi square and P values were calculated. Kruskal Wallis Chi square test was used for quantitative variables and Yate’s Chi square test was used for qualitative variable. A “P value” less than 0.05 is taken to be significant statistically.

**Results:**

**Table no.1: Onset of Sensory Blockade.**

Group	Onset of Sensory Blockade (In minutes)		
	Range	Mean	SD
Group R	5 – 15	10.8	2.53
Group B	2 – 7	3.925	1.347
P – value	< 0.0001		

Onset of sensory blockade was delayed in ropivacaine group and statistically found to be significant.



**Figure no.1: Onset of Sensory blockade.**

**Table no.2: Maximum height of sensory blockade:**

Maximum height of sensory blockade	Group B		Group R	
	No.	%	No.	%
T6	40	100	40	100
T7	0	0	0	0

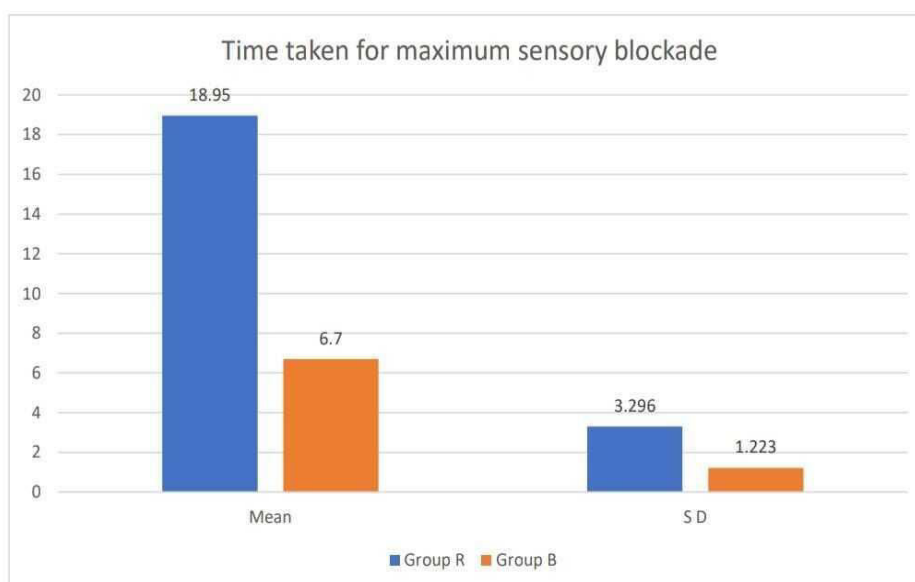
T8	0	0	0	0
P Value	1			

Maximum height of sensory blockade was found to same in both group and was statistically insignificant.

**Table no.3: Time taken for maximum height of sensory blockade:**

Group	Time taken for maximum height of sensory blockade (In minutes)		
	Range	Mean	SD
Group R	14 – 25	18.95	3.296
Group B	4 – 9	6.7	1.223
P – value	< 0.0001		

The time taken to achieve maximum height of sensory blockade was significantly increased in ropivacaine group and was statistically significant.

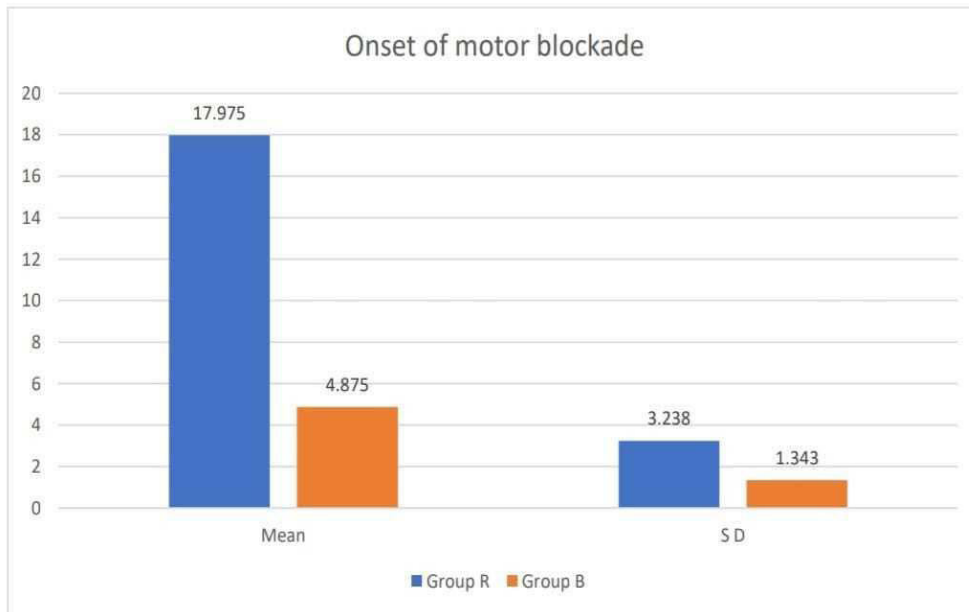


**Figure no.2: Time taken for maximum sensory blockade.**

**Table no.4: onset of motor blockade:**

Group	onset of motor blockade (In minutes)		
	Range	Mean	SD
Group R	13 – 24	17.975	3.238
Group B	3 – 8	4.875	1.343
P – value	< 0.0001		

Onset of motor blockade was delayed in ropivacaine as compared to bupivacaine and it was statistically significant.

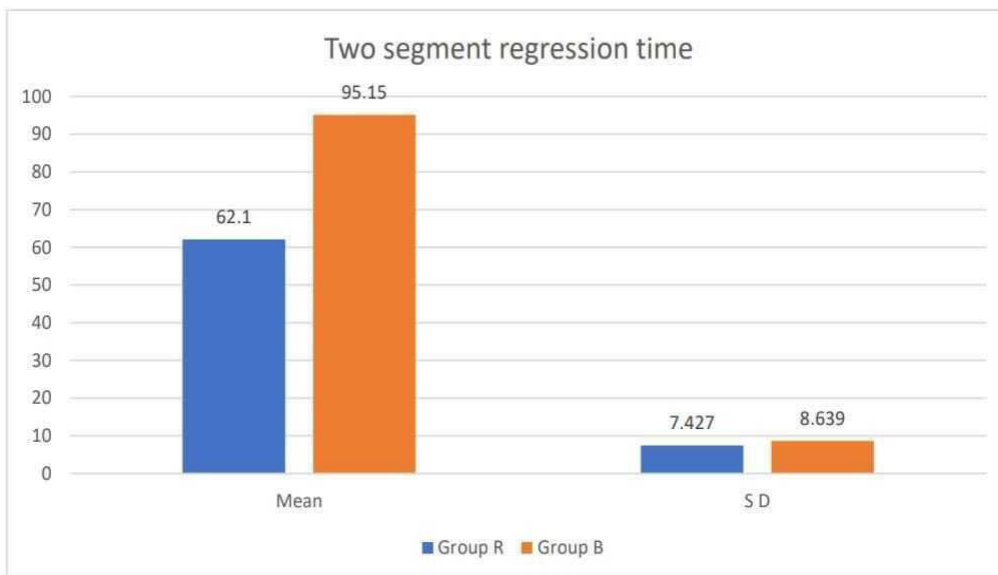


**Figure no.3: Onset of motor blockade**

**Table no.5: Two segment regression time:**

Group	onset of motor blockade (In minutes)		
	Range	Mean	SD
Group R	48 – 76	62.1	7.427
Group B	74 – 108	95.15	8.639
P – value	< 0.0001		

The two-segment regression time was less in case of ropivacaine as compared to bupivacaine which was statistically significant.

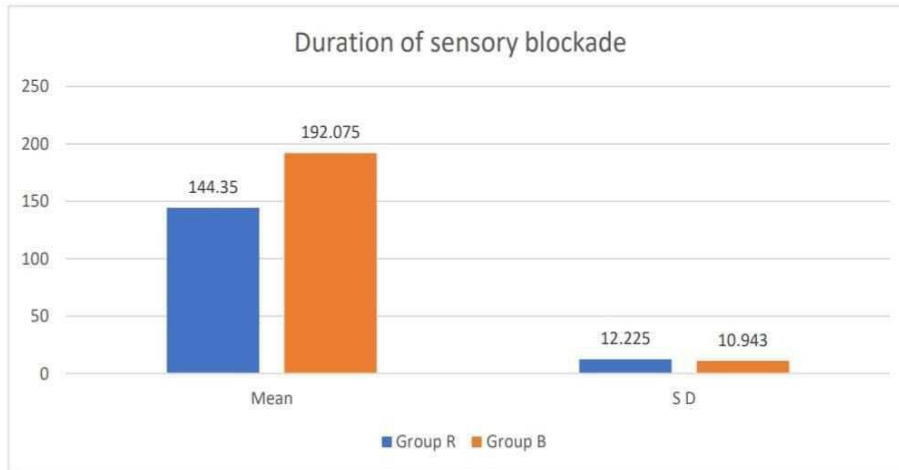


**Figure no.4: Two segment regression time**

**Table no.6: Duration of sensory blockade:**

Group	onset of motor blockade (In minutes)		
	Range	Mean	SD
Group R	124 – 180	144.35	12.225
Group B	168 – 212	192.075	10.943
P – value	< 0.0001		

Duration of sensory blockade was more with bupivacaine as compared to ropivacaine which was statistically significant.

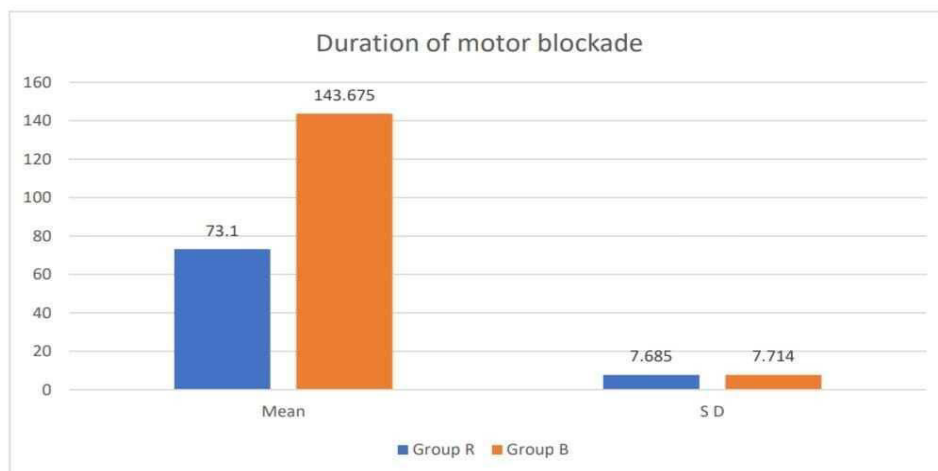


**Figure no.5: Duration of Sensory blockade**

**Table no.7: Duration of motor blockade:**

Group	onset of motor blockade (In minutes)		
	Range	Mean	SD
Group R	58 – 98	73.1	7.685
Group B	129 – 162	143.675	7.714
P – value	< 0.0001		

The duration of motor blockade was less in ropivacaine as compared to bupivacaine and it was statistically significant.



**Figure no.6: Duration of motor blockade**

**DISCUSSION:**

Ropivacaine was introduced as an alternative to bupivacaine especially for the day care surgeries. Its motor blockade action is having lesser intensity and duration as compared to bupivacaine. It is of most beneficial in case of labour analgesia and post operative pain. Ropivacaine's differential blockade makes it ideal for early immobilisation thereby preventing many complications related to it.

Inguinal hernia surgery was selected as it's a common surgery conducted nowadays as a day care surgery.

**Onset of sensory blockade:**

According to study, mean onset of sensory blockade in case of ropivacaine was found to be 10.8 minutes whereas the mean onset of sensory blockade was found to be 3.925 minutes. In a similar study conducted by **Ertuk et al** <sup>[4]</sup> on Sixty ASA- II-III patients scheduled for hip arthroplasty were randomly assigned to receive an intrathecal injection of either 12 mg ropivacaine with 20 microg fentanyl (group R, aged 70 +/- 7 years, range 67-89) or 8 mg hyperbaric bupivacaine with 20 microg fentanyl (group B, aged 69 +/- 6 years, range 66-92). Motor and sensory block, hemodynamics and side effects were recorded. Mean levels of sensory block were similar, but the onset time of sensory block in group B (2.52 +/- 0.69 min) was shorter than that in group R (3.17-0.72 min); the difference was statistically significant ( $p < 0.01$ ). The lower lipid solubility of ropivacaine as compared to bupivacaine is responsible for delay in onset. This result is consistent with other studies as well as literature. Study conducted by Upadya M, Neeta S, Manissery JJ, Kuriakose N, Singh RR in 2016 on hundred patients concluded that Isobaric bupivacaine fentanyl mixture was found to provide adequate anaesthesia with minimal incidence of haemodynamic instability.<sup>[5]</sup>

**Maximum height of sensory blockade:**

According to our study the height of sensory blockade was found that both ropivacaine as well as bupivacaine is found to be having similar effects.

In a similar study conducted by Sheetal Jagatap et al. <sup>[6]</sup> Intrathecal bupivacaine results in complete anaesthetic block of longer duration than ropivacaine. Fentanyl as an adjuvant may improve the quality of spinal block of ropivacaine while maintaining its advantage of early motor recovery. Sixty patients were randomly allocated to receive either intrathecal 15 mg 0.5% ropivacaine with 25 mcg fentanyl (Group RF) or 15 mg 0.5% bupivacaine with 25 mcg fentanyl (Group BF). The onset, duration, spread of sensory and motor block, haemodynamic parameters and side effects were recorded. Highest sensory level and complete motor block were comparable. There is no difference between the drug with respect to height of sensory blockade.

**Time taken for maximum height of sensory blockade:**

The mean time taken for achieving maximum height of sensory blockade was 18.9 minutes for ropivacaine as compared 6.7 minutes in case of bupivacaine. Ropivacaine requires considerably more time than bupivacaine for achieving maximum height of sensory blockade. Study conducted by **Somjit Chatterjee** <sup>[7]</sup>, a total of 100 patients aged ranges between 18 and 60 years of either sex, ASAPS 1 and 2, undergoing elective lower limb orthopaedic surgeries were divided into two groups, RP group and BP group receiving intrathecal 0.75% RP 3 ml and glucose 50%, 0.5 ml and 0.5% hyperbaric BP 3 ml and 0.9% normal saline 0.5 ml, respectively. The two study groups were comparable in terms of demography and duration of surgery. Patients in group RP experienced significantly late onset and shorter duration of sensory and motor block in comparison to patients in group BP. Hence, it was observed in

this study that equipotent dose of hyperbaric RP had shorter duration of analgesia and anaesthesia than with equipotent dose of hyperbaric BP.

#### **Onset of motor blockade:**

Mean onset of motor blockade was 17.975 min. in case of ropivacaine whereas it was 4.875 min. for bupivacaine. Ropivacaine was having delayed onset considerably than bupivacaine. Also, the quality of block was very much low as compared to bupivacaine.

In a similar study conducted by **Lee YY et al** <sup>[8]</sup>, Early studies have suggested that ropivacaine causes less motor block than bupivacaine, which might be advantageous in spinal anaesthesia for short procedures. This was a prospective randomized double-blind study. 34 ASA I-III patients scheduled for urological surgery were randomly assigned to receive intrathecal injection of either plain ropivacaine 10 mg with fentanyl 15 microg (ropivacaine group) or plain bupivacaine 10 mg with fentanyl 15 microg (bupivacaine group) using a combined spinal-epidural technique. All patients achieved sensory block to the T10 dermatome or higher at 15 min after intrathecal injection. The primary outcome, the duration of motor block, was shorter in the ropivacaine group (median, 126 min; interquartile range, 93-162 min) compared with the bupivacaine group (median, 189 min; interquartile range, 157-234 min; difference between medians, 71 min; 95% confidence interval, 28-109 min; P = 0.003). The onset of motor blockade was significantly longer in ropivacaine as compared to bupivacaine. The duration of complete motor block was also shorter in the ropivacaine group compared with the bupivacaine group. Again, the result was consistent with previous studies and literature.

#### **Two segment regression time:**

Mean two segment regression time for ropivacaine was found to be 62.1 minutes as compared with 95.15 minutes for bupivacaine. Ropivacaine was having considerably less time as compared bupivacaine which roughly co relates to faster offset of action in case of ropivacaine.

In a similar study conducted by **Koltka K et al** <sup>[9]</sup>, in a double-blinded study amongst 52 ASA I to II male patients scheduled for lower abdominal surgery were randomly received intrathecal plain ropivacaine 19.5 mg with fentanyl 20 microg (group R, n =26) or plain bupivacaine 13 mg with fentanyl 20 microg (group B, n =26) in 3 ml. All patients achieved sensory block to T10 or higher The level of sensory block was significantly higher in group B (T4 [T3 to T7] vs T7 [T4 to T9], P <0.05). The duration and intensity of complete motor block (Bromage score=3) were also shorter in group R (90+/-25 minutes vs 130+/-40 minutes, P <0.05). Two dermatomal regression was also considerably shorter in group R as compared to group B, conclude that plain ropivacaine 19.5 mg plus fentanyl 20 microg is associated with a lower level of sensory block and a shorter duration of motor block when compared to bupivacaine 13 mg plus fentanyl 20 microg for spinal anaesthesia in lower abdominal surgery.

#### **Duration of sensory Blockade:**

The mean duration of anaesthesia was found to be 144.35 minutes for ropivacaine as compared to 192.075 minutes for bupivacaine. This means that ropivacaine has shorter duration of sensory blockade as compared with bupivacaine.

In a similar study conducted by **S Suresh Kumar et al** <sup>[10]</sup>, in a randomized controlled study to compare the efficacy of intrathecal isobaric ropivacaine with bupivacaine and to assess their postoperative recovery profile in patients undergoing arthroscopic knee surgery. A total



of 90 adults ASA- 1 and 2 patients were randomized into two groups to receive 2 ml plain solution of either 0.5% bupivacaine (Group B) or 0.75% ropivacaine (Group R). The mean onset time of sensory block at L1 was significantly less ( $P = 0.025$ ) and duration of sensory and motor block was significantly more ( $P = 0.001$ ) with bupivacaine as compared to ropivacaine. The postoperative recovery profile and discharge times were similar between the groups. Isobaric ropivacaine was associated with a longer onset and shorter duration of sensory and motor block.

Study conducted by Kaushik Rao, Seetharam and Gayathri Bhat <sup>[11]</sup> conducted in 2015 on 100 patients concluded that addition of Fentanyl to Ropivacaine can significantly prolong the duration of post operative analgesia with clinically insignificant influence on hemodynamics and motor blockade with minimal side effects.

#### **Duration of motor blockade:**

Mean duration of motor blockade for ropivacaine was found to be 73.1 minutes as compared to 143.675 minutes for bupivacaine. This proves that ropivacaine has shorter duration of blockade as compared to bupivacaine.

Study conducted by **Amitava Layek et al** <sup>[12]</sup> aimed to evaluate and compare the block characteristics and duration of analgesia of intrathecal isobaric ropivacaine-fentanyl and bupivacaine-fentanyl combination in adult patients undergoing lower limb orthopaedic surgery. Seventy-four ASA grade- I and II adult patients undergoing lower limb orthopaedic surgery under subarachnoid block were randomized to receive either 3 ml 0.5% isobaric ropivacaine and 25 mcg fentanyl (Group R) or 3 ml 0.5% isobaric bupivacaine and 25 mcg fentanyl (Group B). The median (range) peak sensory block height was T7 (T4-T9) in Group R and T7 (T4-T10) in Group B. Time to reach peak block height ( $13.2 \pm 2.3$  min in Group R vs.  $13.7 \pm 2.2$  min in Group B;  $P = 0.385$ ) was similar between the groups.

Two dermatome regression time in sensory block (median 120 min vs. 85 min;  $P < 0.001$ ) and duration of motor block (median 245 min vs. 150 min;  $P < 0.001$ ) was significantly higher in Group B. The duration of analgesia (median 360 min vs. 245 min;  $P < 0.001$ ) was significantly higher in the bupivacaine group. Intrathecal isobaric bupivacaine-fentanyl combination produces a significantly longer duration of analgesia, sensory block and motor block than isobaric ropivacaine-fentanyl combination. As ropivacaine has a shorter duration of sensory and motor block, it may be preferred in day care surgery.

The hemodynamics and side effect profile of the both drugs were comparable and there was no significant difference among them. But study conducted by **Amitava et al** <sup>[12]</sup> noticed increased incidence of side effects like urinary retention in case of ropivacaine. Intrathecal isobaric bupivacaine-fentanyl combination produces a significantly longer duration of analgesia, sensory block and motor block than isobaric ropivacaine-fentanyl combination. As ropivacaine has a shorter duration of sensory and motor block, it may be preferred in day care surgery.

The result was in consistent with previous studies as well as literature. The hemodynamics and side effect profile of the both drugs were comparable and there was no significant difference among them. But study conducted by **Amitava et al** <sup>[12]</sup> noticed increased incidence of side effects like urinary retention in case of ropivacaine.

#### **CONCLUSION:**

Ropivacaine along with fentanyl is a good alternative for bupivacaine and fentanyl as it has shorter duration of action with lesser motor block resulting in early ambulation for elective inguinal hernia surgeries.

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