RELATIVE POTENCIES OF MOTOR BLOCKADE AFTER INTRATHECAL ROPIVACAINE, LEVOBUPIVACAINE AND BUPIVACAINE

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ABSTRACT

AIM

Ever since the times spinal anaesthesia has been introduced by August Bier, multiple drugs at different dosages, concentrations and differing baricities have been studied. This study was conducted to compare the anaesthetic efficacy of intrathecal isobaric 0.5% ropivacaine, isobaric 0.5% bupivacaine and isobaric levobupivacaine in lower abdominal and lower limb surgeries, in 150 ASA grade I and II patients of both sexes in the age group of 19-65 years undergoing elective surgery under spinal anaesthesia.

MATERIALS & METHODS

After getting ethical committee approval and informed written consent from the patients, 150 patients were allocated into three groups of 50 patients each. The baseline pulse rate and mean arterial pressure were recorded. The first group A received 3ml of isobaric 0.5% ropivacaine (5mg/ml), the second group received 3ml of isobaric 0.5% bupivacaine and the third group C received 3ml of isobaric levobupivacaine intrathecally. The onset of sensory and motor blocks, duration of sensory and motor blocks was recorded in three groups.

RESULTS

The results were analyzed statistically using epidemiologically information package. On comparison of data we have found that the intrathecal isobaric 0.5% ropivacaine produces delayed onset of both sensory and motor block but of shorter duration which is statistically significant when compared with that of isobaric 0.5% bupivacaine and levobupivacaine. There is no significant inter-group difference between bupivacaine and levobupivacaine except for the mean duration of sensory block, which is more in levobupivacaine group. The quality of motor block which was assessed by Bromage scale, shows relatively lesser degree of motor block for ropivacaine group, when compared with that of bupivacaine and levobupivacaine groups. The haemodynamics were also recorded. The incidence of hypotension and Bradycardia is more in bupivacaine group. The height of block (peak sensory level) is higher for bupivacaine group followed by levobupivacaine and then ropivacaine. T4+T6% of Groups A, B& C are 5%, 48% and 44% respectively.

KEYWORDS

Intrathecal, Isobaric, Ropivacaine, Bupivacaine, Levobupivacaine, Sensory Blockade, Motor Blockade.

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INTRODUCTION: August Bier was the first person to introduce spinal anaesthesia on 16-08-1898[1] using 0.5% cocaine which is the first known local anaesthetic. Spinal anaesthesia defined[1] as 'the regional anaesthesia obtained by blocking nerves in the subarachnoid space'. Spinal anaesthesia blocks autonomic, sensory and motor nerve fibres. The choice of local anaesthetics is determined by the duration of surgery and by the intensity of motor blockade that is required. Lignocaine was an extensively used local anaesthetic for spinal anaesthesia, but now the use has fallen dramatically due to concerns regarding transient neurological symptoms. Bupivacaine is long acting amide local anaesthetic, compared to lignocaine, due to increased lipid solubility and protein binding. But it has lower therapeutic index with respect to cardiovascular toxicity. The increase in day care surgery has generated a need for a local anaesthetic with a faster onset and shorter duration of action, allowing early ambulation, this led to the development of ropivacaine, a new long acting amide with a reasonably stable hemodynamic profile. The S(-) enantiomer, 'Levobupivacaine' has been developed for clinical use as a long acting local anaesthetic.[2] It has less of negative inotropism and decreased affinity for cardiac sodium channels than bupivacaine. Thus it has an improved safety profile over bupivacaine. The major clinical advantage of isobaric solution is that the patient's position during and after injection have no effect on the spread of local anaesthetic in cerebrospinal fluid. Thus isobaric solution does not tend to distribute as far from the site of injection. It is useful when lower thoracic dermatomal sensory block is desired and when degree of

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sympathetic blockade needs to be minimized. Hence the present study has been undertaken to compare the efficacy of isobaric ropivacaine, isobaric bupivacaine and isobaric levobupivacaine for lower abdominal and lower limb surgeries. Cerebrospinal fluid was discovered by Domenico Cotugno in 1764 and its circulation was described by F. Magendie in 1825 who also named it.37 Alexander Wood introduced hollow needle and glass syringe in 1853. Cocaine was isolated from Erythroxylon coca in 1860 by Neimann and Lossen. Its analgesic properties were described by Schroff in 1862. It was introduced in medicine as local analgesic for ophthalmology by Carl Koller in 1884, encouraged by Sigmund Freud. The first spinal anaesthesia was performed in the year 1885, J. Leonard Corning, a New York Neurologist. He injected cocaine into the subarachnoid space by accidentally piercing the dura while experimenting on a dog. Later he deliberately repeated the intradural injection of 60 minutes of 3% cocaine and suggested it might be used in surgery. "Be the destiny of this observation, what it may, it had seemed to me, on the whole worth recording", were his words. Heinrich Iraneus Quinke of Keil in Germany standardized the lumbar puncture as a simple procedure in 1891. In the same year, Essex Wynter described lumbar puncture in England. On 16th of August, 1898, in Keil, August Bier performed the first planned spinal anaesthesia in man. He injected 3ml of 0.5% cocaine into the subarachnoid space of a 34 years old labourer for the operation on the lower limb. After using it on 6 patients, he and his assistant injected cocaine into each other's theca.[1] In 1986, Rosenberg PH, Kytta J, Alila A, in a study: Absorption of bupivacaine, etidocaine, lignocaine and ropivacaine into N-heptane, rat sciatic nerve and human extradural and subcutaneous fat showed that onset of sensory block is slower in ropivacaine group probably due to lesser lipid solubility of ropivacaine41 causes the drug to penetrate the large myelinated A fibres less than more lipid soluble bupivacaine[3] In 1999, Delfino J., Pontes S., Gondim D., Do Vale N., compared Isobaric 0.5% bupivacaine and 0.5% ropivacaine in spinal anaesthesia for orthopaedic surgery: found the time of onset of non-stimulated pain at the surgical site and duration of motor block was significantly shorter in ropivacaine group.[4] In 2000, Malinovsky J. M., Charles F., Kick O., Lepage J. Y., Malinge M., Cozian A., Bouchot O., Pinaud M., in a study-Intrathecal anesthesia: ropivacaine versus bupivacaine, in patients undergoing transurethral resection of prostate or bladder comparing 5ml of each 0.2% of isobaric bupivacaine and 0.5% of isobaric ropivacaine found that cephalad spread of sensory level is more with bupivacaine and the intensity of motor block is less in ropivacaine group.[2] In 2001, Delfino J., Bezerra do Vale N., in a study-Spinal anaesthesia with 0.5% isobaric ropivacaine or levobupivacaine for lower limb surgeries, found that the time of onset of non-stimulated pain at surgical site and duration of motor block were significantly longer in levobupivacaine group.[5] In 2002, Christian Glaser, Peter Marhofer, Gabriela Zimpfer, Marie T. Heinz, et al., in a study- Levobupivacaine versus Racemic Bupivacaine for Spinal Anesthesia, found that there is no significant inter-group difference between levobupivacaine and bupivacaine.[6] In 2002, DA Mc Namee, Mc Clelland AM et al., in their study-Spinal Anaesthesia comparison of plain Ropivacaine 5mg /ml with bupivacaine 5mg/ml for major orthopaedic surgery compared the efficacy and safety of l7.5mg of plain ropivacaine with 17.5mg of plain bupivacaine for spinal anaesthesia in patients undergoing total hip arthroplasty stated that there was a trend for patients in42 bupivacaine to achieve higher upper dermatomal level of sensory block but this difference was not significant. There was no significant difference in the median time of onset of sensory block at T10 dermatome which was 2 minutes with ropivacaine and bupivacaine. Duration of sensory block is longer in bupivacaine (3.5 hours) compared to ropivacaine (3 hours). There is a shorter duration of motor block in ropivacaine 2.1 hours versus 3.9 hours in bupivacaine.[7] In 2003, P. Gautier, De Kock, L. Huberty, T. Demir, in a study- "Comparison of effects of intrathecal ropivacaine, levobupivacaine, and bupivacaine for caesarean section" compared the effects of intrathecal isobaric ropivacaine, levobupivacaine and bupivacaine for caesarean section in 90 parturients. Combined spinal epidural technique was used with bupivacaine (8mg), levobupivacaine (8mg), ropivacaine (12mg) all combined with sufentanil 2.5 microgram. In the study, the onset and duration of motor block in ropivacaine 14 and 116 minutes, bupivacaine was 9 and 142 minutes and with levobupivacaine was 10 minutes and 120 minutes, respectively, showing shorter duration of motor block with ropivacaine. The duration of sensory block with ropivacaine was 135 minutes, bupivacaine was 145 minutes and levobupivacaine was 140 minutes showing shorter duration with ropivacaine group.[8] In 2003, Whiteside JB, Burke D, Wildsmith JAW, in study- "Comparison of ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia for elective surgery" compared ropivacaine 0.5% (in glucose 5%) with bupivacaine 0.5% (in glucose 8%) for spinal anaesthesia, elective surgery and found that ropivacaine 15mg in glucose 50mg ml-1 provides reliable spinal anaesthesia of shorter duration and with less hypotension than bupivacaine. The recovery profile for ropivacaine may be of interest given that more surgery is being performed in the day care setting.[9] In 2004, Andrea Casati, Elena Moizo, Chiara Marcheti et al, in a study-"Prospective randomized double blind comparison of unilateral spinal anaesthesia with hyperbaric bupivacaine, ropivacaine & levobupivacaine for inguinal herniorraphy"-showed no significant difference in the onsets of sensory block between the three groups.[10] In 2004, Helena Kallio, EVT Snail et al-A comparison of intrathecal plain ropivacaine 20 or 15mg versus bupivacaine 10mg anaesthesia-in a prospective randomized double blinded study in 90 ambulatory lower extremity surgery patients who received 2ml of isobaric ropivacaine 1%, 0.75% and isobaric 0.5% bupivacaine. It showed adequate block level with hemodynamic stability and faster motor recovery of about 137.2 minutes in ropivacaine when compared to bupivacaine (204.4 minutes).[11] In 2006, Coppejans H.C., Vercauteren M.P., in their study- "Low dose combined spinal and epidural anaesthesia for caesarean delivery. A comparison of three plain anaesthetics" confirmed

the slower onset of motor block in the ropivacaine group than bupivacaine and levobupivacaine group in a low dose combined spinal epidural anaesthesia for caesarean delivery.[12] In 2006, F Fattorini, Z Ricci et al; "Levobupivacaine versus racemic bupivacaine for spinal anaesthesia in major orthopaedic surgery; compared levobupivacaine versus racemic bupivacaine in 60 patients, using 3ml of 0.5% isobaric solutions of each anaesthetic and found that the onset and duration of sensory block in bupivacaine and levobupivacaine are 9±5min, 381±105 minutes and 12±6, 391±96 minutes showing that they have almost similar effects.[13]

In 2007, Ying Y Lee, Ngan Kee, K Chang, in a study "Spinal ropivacaine for lower limb Surgery: A dose response study"-randomized, double blinded study of 60 patients scheduled for lower limb surgery received 2, 4, 7, 10, or 14mg of ropivacaine diluted to 2.8ml with normal saline. Anesthesia was successful in 0, 0, 42, 83, and 100% of the 2, 4, 7, 10, 14mg groups, respectively. The derived value for ED50 was 7.6 mg and for ED95 was 11.4mg for spinal ropivacaine in lower limb surgeries.[14] In 2007, A Mehta, V Gupta, R Wakhloo, N Gupta, A Gupta, R Bakshi, B Kapoor, S Gupta, in study- "Comparative evaluation of intrathecal administration of newer local anaesthetic agents Ropivacaine and Levobupivacaine with Bupivacaine in patients undergoing lower limb surgery." concluded that the newer local anaesthetic agent Levobupivacaine has very similar pharmacokinetic properties to those of racemic bupivacaine. Thus it can be used with equal efficacy and better safety as bupivacaine in similar doses in subarachnoid block. The results of this study show that ropivacaine produces adequate spinal blockade of shorter duration with early ambulation and faster home discharge as compared with levobupivacaine and bupivacaine. Thus it can be used intrathecally with equal efficacy and better safety as bupivacaine in similar doses for short surgical procedures.[15]

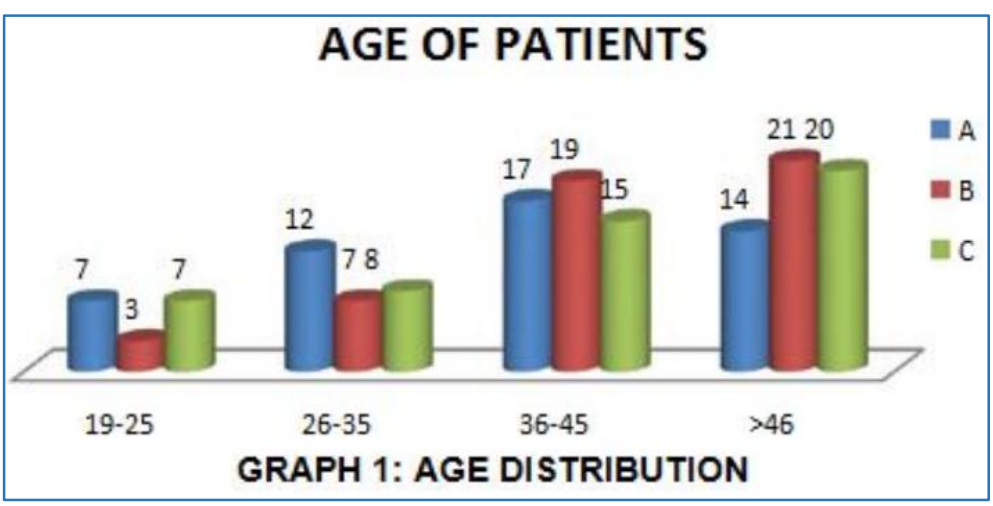
In 2008, M Mantouvalou, S Ralli, H Arnaoutoglou, G Tziris and G Papadopoulos, in "Spinal anaesthesia: Comparison of plain Ropivacaine, bupivacaine and levobupivacaine for lower abdominal surgery." compared the anaesthetic efficacy and safety of 3 local anaesthetic agents namely 15mg of racemic bupivacaine, ropivacaine and levobupivacaine in patients undergoing lower abdominal surgeries. It stated that cephalic spread of sensory block was similar in all groups with onset of motor block in ropivacaine 12+5 minutes, bupivacaine is 8+5 45 minutes and levobupivacaine 11±7 minutes. Thus it showed faster onset with bupivacaine and levobupivacaine, and shorter duration of motor block in ropivacaine of 100+ 34 minutes when compared to bupivacaine of 150+40 minutes and 145±37 in levobupivacaine group.[16] In 2008, Luck JF, Fettes PD, Wildsmith JA; in "Spinal anaesthesia for elective surgery: a comparison of hyperbaric solutions of racemic bupivacaine, levobupivacaine and ropivacaine" concluded that hyperbaric ropivacaine produces reliable spinal anaesthesia of shorter duration than bupivacaine and levobupivacaine both of which are clinically indistinguishable.[17] In 2011, Sathitkarnmanee T1, Thongrong C, Tribuddharat S, Bn MT, Bn KP, Bn RK., in "A comparison of spinal isobaric levobupivacaine and racemic bupivacaine for lower abdominal and lower extremity surgery" concluded that both the drugs showed equal efficacy in the onsets and duration of both sensory and motor block.[18]

MATERIALS & METHODS: After approval by the Institutional Ethical Committee, the study was conducted on 150 ASA physical status I-II patients, undergoing elective lower limb and abdominal surgeries under spinal anesthesia. The age of the patients ranged between 19-68 yrs weighing 35-65kgs and height ranging between 150-168 cms. All patients were thoroughly examined preoperatively. Informed written consent was obtained and the procedure was explained. All patients' weight and height were recorded. In the assessment room, vital parameters-heart rate, blood pressure and respiratory rate were recorded. Investigations-Haemoglobin, blood grouping and typing, complete urine examination, blood urea, serum creatinine, random blood sugar, liver function tests and ECG were checked. Thorough systemic examination and airway assessment were done. Exclusion criteria: a) Local infection b) Coagulopathy and bleeding disorders c) ASA grade >3 The patients were randomly allocated into three groups of 50 each. Group A patients received 3m1 of 0.5% isobaric ropivacaine (15mg) 5mg/ml. Group B patients received 3m1 of 0.5% isobaric bupivacaine (15mg) 5mg/ml. Group C patients received 3ml of 0.5% isobaric levobupivacaine (15mg) 5mg/ml. The total volume of the injected solution was 3ml in all the three groups. In the operating room, equipment for emergency airway management and emergency drugs were kept ready. Patients were shifted to the operating room. The horizontal position of the operating table was checked. Standard monitoring was used (NIBP, Pulse oximetry and ECG). Preoperative baseline mean arterial pressure, pulse rate and SP02 were recorded. Patients were secured with 18G intravenous cannula and preloaded with 10ml/kg of ringer lactate (Hartman's solution). The patients were placed in right lateral position. The skin over the back was prepared with antiseptic solution (5% povidone-iodine) and draped with sterile towel. Lumbar puncture was performed with a 25G Quincke Babcock spinal needle at L2-L3 or L3-L4 intervertebral space through midline approach. After confirming free flow of CSF, the drug was administered. The patients were placed in supine position immediately after injection and the time at which the drug administered was noted. The following parameters were observed:

1. **Sensory block:** The Onset of Sensory Block was defined as the time between the injection of anesthetic solution and the absence of pain to pinprick at the T10 dermatome. Sensory block was assessed by loss of sensation (pin prick sensation using 21 G sterile needles) bilaterally along the mid-clavicular line. Assessment started immediately after turning the patient to supine position and continued every minute till the peak block height was reached and the time was noted. The Duration of Sensory Block was defined as the time from the onset of sensory block to the time when the patient required first dose of rescue analgesia (for post-operative pain).

2. **Motor block:** Motor block was assessed bilaterally using Modified Bromage scale. Modified Bromage Scale: 0-No block, able to raise extended legs against gravity. 1-Unable to raise extended legs, but just able to flex knees. 2-Unable to flex knees, but able to flex ankle. 3- Total block-inability to flex ankle. Assessment of motor block was started immediately after placing the patient in supine position and continued every minute till Bromage score of 3 was reached. The Onset of Motor Block was defined as the time to achieve Bromage score of 2 or 3 from the time of injection whichever is achieved. The Duration of Motor Block was taken as the time from subarachnoid injection to return of Bromage score to zero.
3. **Vital signs & Side effects:** Mean arterial pressure, pulse rate were recorded every two minutes for the first 10 mins and thereafter at every 5 mins interval until the end of surgery. SPO2 was monitored continuously. Hypotension was defined as a decrease in mean blood pressure more than 20% from baseline or systolic blood pressure less than 90mm Hg. Hypotension was managed by incremental doses of 6mg intravenous ephedrine. Bradycardia was defined as heart rate less than 50/min and managed by incremental doses of 0.5mg intravenous atropine. Respiratory depression was said to be present if respiratory rate was less than 8/min and SPO2 less than 90%. Vomiting was managed with ondansetron 4mg intravenously. Urinary retention was monitored postoperatively and catheterization was planned in patients with urinary retention for more than 6 hours. Patients were shifted to recovery room after completion of surgery. Methodology: The statistical analysis was done using Microsoft Excel 2010 and Analysis Tool Pak in excel 2010. The results were expressed as mean and standard deviation for quantitative variables like Age, PR, and onsets of sensory and motor block, duration of sensory and motor block. The comparison between the means of the three groups was done using one way analysis of variance (ANOVA). The intra-group and inter-group analysis of variance is expressed as Mean Squares (MS). F test statistic is calculated at $\alpha=0.05$. A p value <0.05 is considered statistically significant suggesting that there is significant difference of means in at least two groups. Then, Bonferroni Post-HOC test is used to perform multiple comparisons and identify the groups among which there is a significant difference, when the F test statistic is significant.

RESULTS & DISCUSSION: This study includes 150 patients posted for lower limb and lower abdominal surgeries, divided into three groups of 50 each. Group A-50 patients received ropivacaine; Group B-50 patients received Bupivacaine and Group C-50 patients Levobupivacaine. The anaesthetic efficacy of the above three drugs were and contrasted, and the results are tabulated as follows.



GRAPH 1: AGE DISTRIBUTION

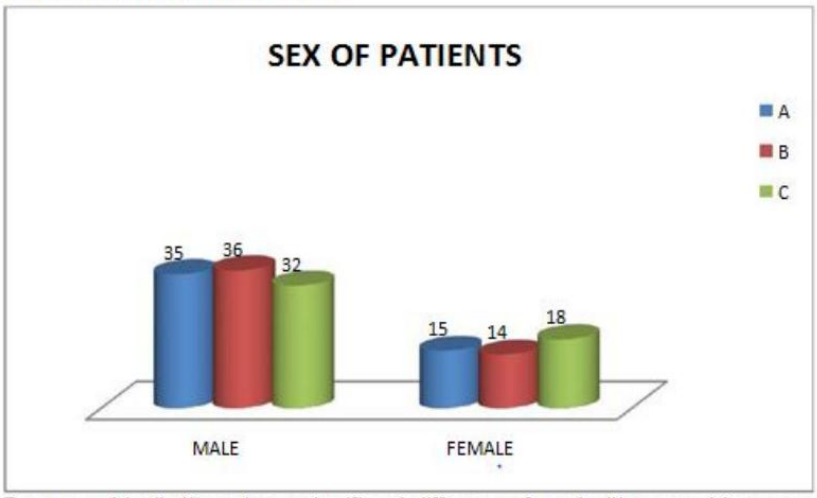
DEMOGRAPHIC PROFILE

Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
MEAN	S.D	MEAN	S.D	MEAN	S.D	MS Between groups (df=2)	MS Within groups (df=147)	F	A B	A C	B C
39.8	12.56	43.9	11.56	43.16	13.31	238.73	156.1	1.52			

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (0.22) – not significant
Difference significant between groups by Post hoc Bonferroni 't' test :-
Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;
Bupivacaine and Levobupivacaine = **BC**;

Table 1: Age distribution in three groups

GRAPH 2: SEX DISTRIBUTION



Demographically there is no significant difference found with respect to age and sex factors.

Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
Male	Female	Male	Female	Male	Female	MS Between groups (df=2) 0	MSF Within groups (df=3)		A A B C	B C	
35 (70%)	15 (30%)	36 (72%)	14 (28%)	32 (64%)	18 (36%)		180	0			

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (1) – not significant
Difference significant between groups by Post hoc Bonferroni 't' test :-
Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;
Bupivacaine and Levobupivacaine = **BC**;

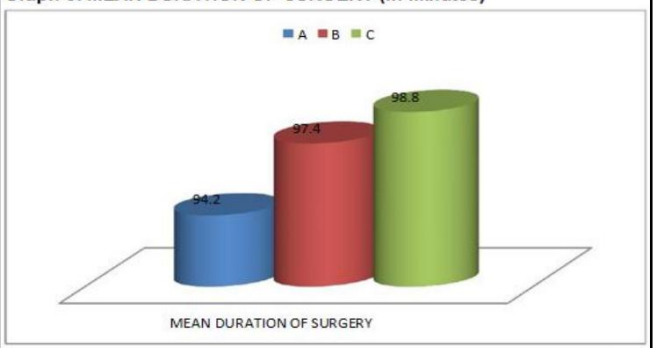
Table 2: Sex Distribution in three groups

Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
MEAN	S.D	MEAN	S.D	MEAN	S.D	MS Between groups (df=2) 278	MS Within groups (df=147) 442.91	F	A AB B CC		
94.2	20.85	97.4	12.95	98.8	26.95			0.63			

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (0.535)- not significant
Difference significant between groups by Post hoc Bonferroni 't' test :-
Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;
Bupivacaine and Levobupivacaine = **BC**;

Table 3: Duration of Surgery (In Minutes)

Graph 3: MEAN DURATION OF SURGERY (In Minutes)



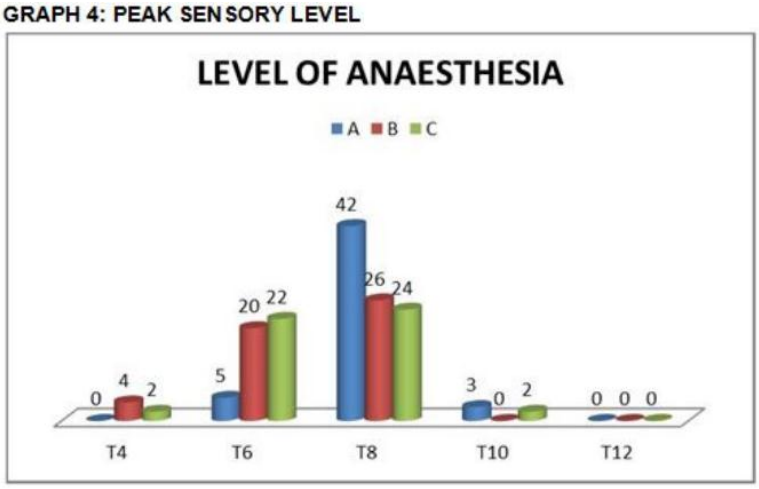
The average duration of surgery, in all the three groups is not statistically significant. The 'p' value is 0.535.

Peak Sensory Level	Group A		Group B		Group C	
No.		%	No.	%	No.	%
T2	-	-	-	-	-	-
T4	0	0%	4	8%	2	4%
T6	5	10%	18	36%	22	44%
T8	42	84%	28	56%	24	48%
T10	3	6%	0	0%	2	4%
T12	0	0%	0	0%	0	0%
Total	50	100	50	100	50	100

In this table, the maximum distribution of upper extent of sensory block in group A is at T8 (84%). In Group B, it is 56% at T8 and 36% at T6 and in group C, levels are distributed almost equally between T8 (48%) and T6 (44%).

Table 4: Peak sensory level

GRAPH 4: PEAK SENSORY LEVEL



Changes in onset of sensory block between three groups

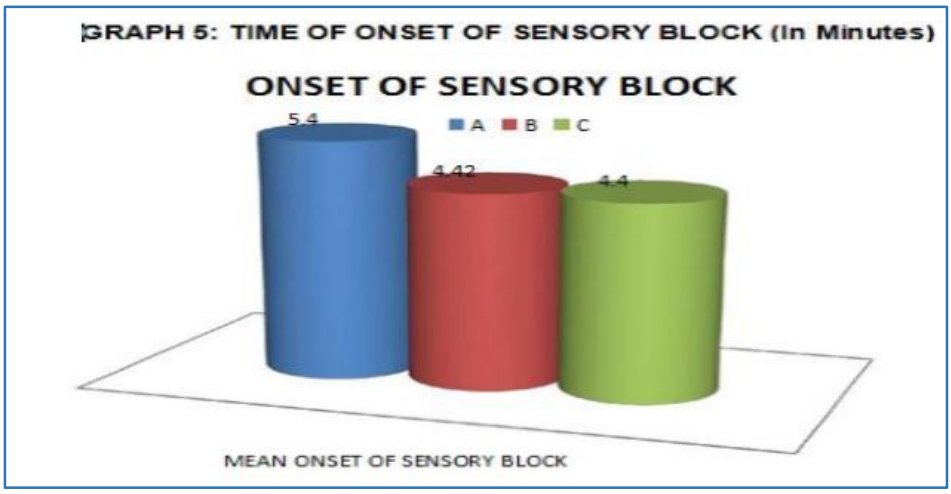
Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
MEAN	S.D	MEAN	S.D	MEAN	S.D	MS Between groups (df=2)	MS Within groups (df=72)	F	A A B B C C		
5.4	1.05	4.42	1.80	4.4		1.51	16.34	2.22	7.36		*

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (0.000895617)- significant Difference significant between groups by Post hoc Bonferroni 't' test :-
Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;
Bupivacaine and Levobupivacaine = **BC**;

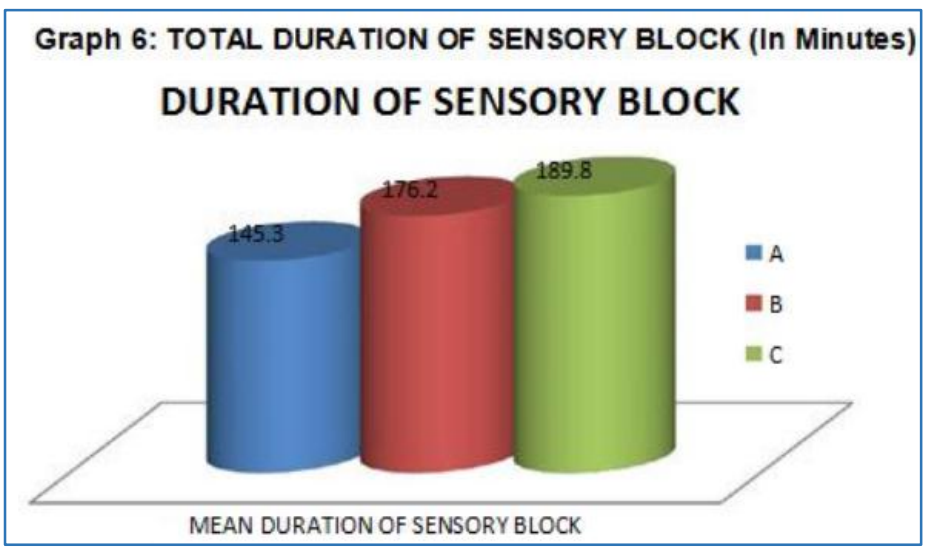
't' test	0.001287636	0.000216883	0.952274124
	A:BA:CB:C		

Table 5: Mean onset time of sensory block (in minutes)

This graph shows, the mean onset time of sensory block in all the three groups, with the highest mean onset time in ropivacaine group, and almost similar onsets of sensory block in bupivacaine and levobupivacaine groups.



This graph shows, the mean onset time of sensory block in all the three groups, with the highest mean onset time in ropivacaine group, and almost similar onsets of sensory block in bupivacaine and levobupivacaine groups.



Changes in onset of motor block between three groups

Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
MEAN	S.D	MEAN	S.D	MEAN	S.D	MS Between groups (df=2)	MS Within groups (df=72)	F	A B	A C	B C
6.48	1.15	5.76	1.93	5.48	1.7	13.31	2.65	5.02		*	

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (0.007821)- significant

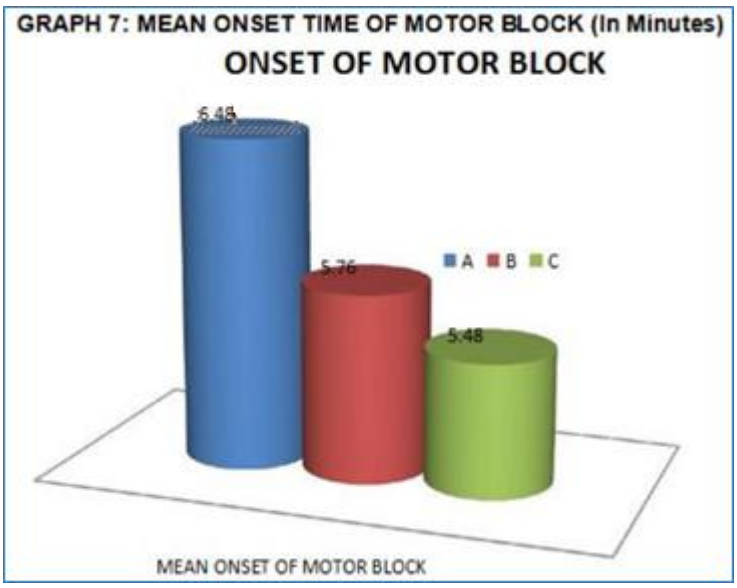
Difference significant between groups by Post hoc Bonferroni 't' test :-

Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;

Bupivacaine and Levobupivacaine = **BC**;

't' test	0.025723797	0.000854234	0.444294432
	A:B	A:C	B:C

Table 6: Mean onset time of motor block (in minutes)



Changes in duration of motor block between three groups

Group A		Group B		Group C		ANOVA			Post Hoc 't' test		
MEAN	S.D	MEAN	S.D	MEAN	S.D	MS Between groups (df=2)	MS Within groups (df=147)	F	A B	A C	B C
130.2	30.64	168.6	46.11	172.6	39.06	27402.67	1530.35	17.9		*	

MS = Mean Squares; **df** = degrees of freedom; * = P<0.05 (1.1E-07)- significant

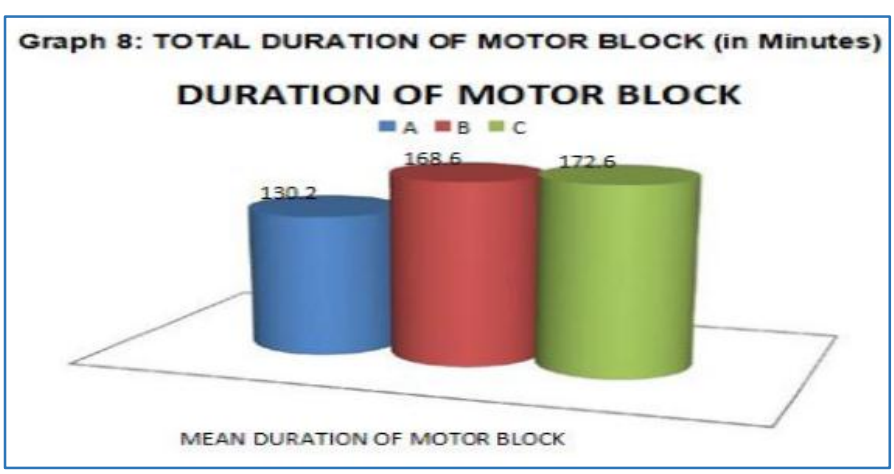
Difference significant between groups by Post hoc Bonferroni 't' test :-

Ropivacaine and Bupivacaine = **AB**; Ropivacaine and Levobupivacaine = **AC**;

Bupivacaine and Levobupivacaine = **BC**;

't' test	3.72405E-06	2.78278E-08	0.640812728
	A:B	A:C	B:C

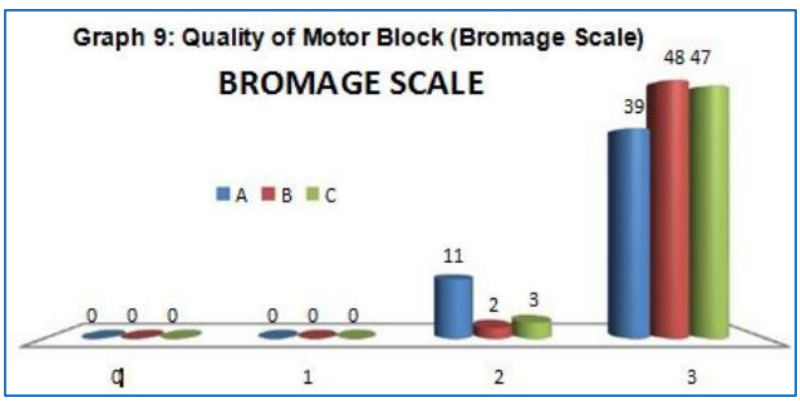
Table 7: Total duration of motor block (in minutes)



Bromage scale	Group A	Group B	Group C
0	0	0	0
1	0	0	0
2	11(22%)	2(4%)	3(6%)
3	39(78%)	48(96%)	47(94%)

The table 17, shows that the percentage of cases not achieving bromage scale 3, which is higher in group A (22%) i.e., ropivacaine group than the other two groups which is 4% and 6% in bupivacaine and levobupivacaine groups respectively.

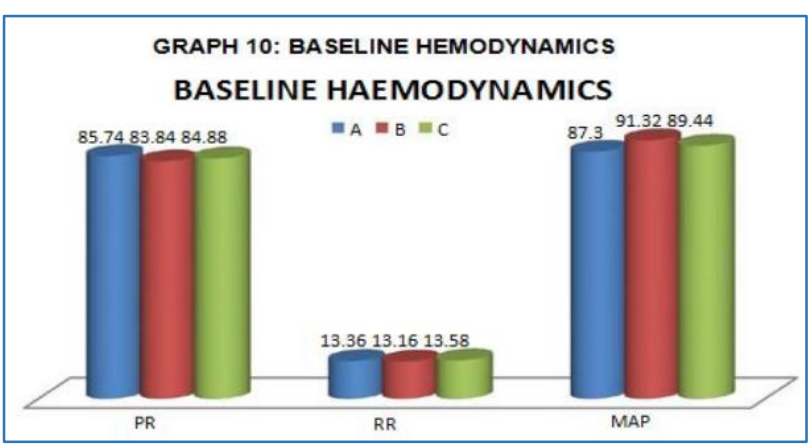
Table 8: Quality of motor block (Bromage Scale)

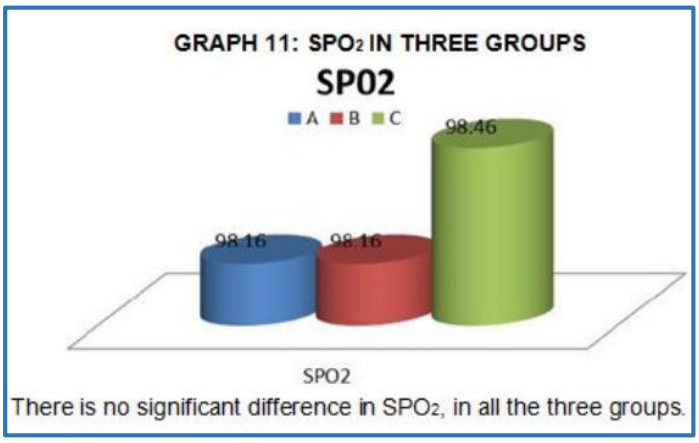


Parameter	Group A		Group B		Group C		'p'(ANOVA)
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Pulse rate	85.74	17.03	83.84	14.13	84.88	16.19	0.8349 Not significant
Respiratory rate	13.36	1.68	13.16	1.29	13.58	1.13	0.322Not significant
Mean Arterial Pressure	87.3	17.5	91.32	18.13	89.44	18.08	0.534Not significant

The study showed stable hemodynamic status with decreased incidence of hypotension and insignificant 'p' value.

Table 9: Baseline Hemodynamics



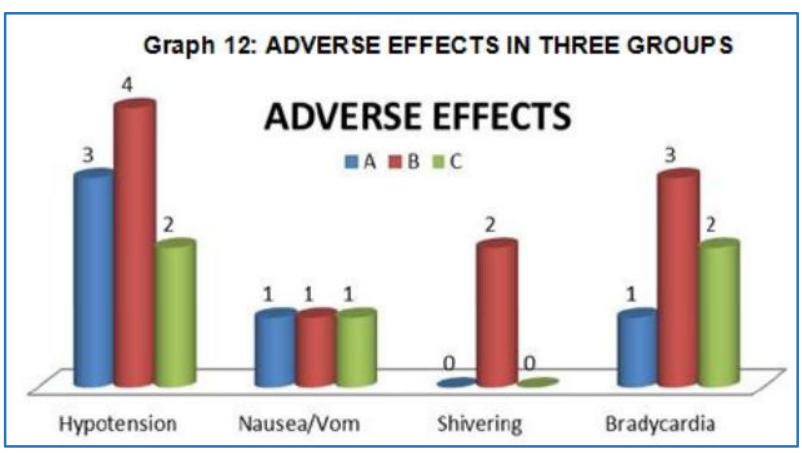


There is no significant difference in SPO_2, in all the three groups.

ADVERSE EFFECTS	A	B	C
Hypotension	3(6%)	4(8%)	2(4%)
Nausea/ Vomiting	1(2%)	1(2%)	1(2%)
Shivering	0	2(4%)	0
Bradycardia	1(2%)	3(6%)	2(4%)

The incidence of hypotension, Shivering and Bradycardia is 8%, 4% and 6% in Group B.

Table 10: Adverse Effects in three groups



CONCLUSION: We conclude from this study, that the intrathecal administration of 3ml of 0.5% isobaric ropivacaine when compared to 3ml of 0.5% isobaric bupivacaine and 3ml of 0.5% isobaric levobupivacaine produces delayed onsets of both sensory and motor block and early recovery from both sensory and motor block. Though the onset of sensory and motor block is delayed, because of the favorable early recovery effects, we consider ropivacaine to be a better choice for ambulatory anaesthesia, when compared to bupivacaine and levobupivacaine.

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