e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15 (12); 1578-1584

Original Research Article

Effectiveness of 0.125% Bupivacaine Versus 0.125% Ropivacaine in Epidural Labour Analgesia

Rahul Rajan[1], Bashishth Narayan[2*]

[1]Assistant professor, Department of Anesthesia Gouri Devi Institute of Medical Sciences and Hospital
[2]Assistant professor, Department of Anesthesia Laxmi Chandravansi Medical College and Hospital

Received: 25-08-2023 / Revised: 28-09-2023 / Accepted: 30-10-2023
Corresponding author: Dr. Bashishth Narayan
Conflict of interest: Nil

Abstract:

Introduction: Epidural labour analgesia is the most effective and admired method of pain relief. Bupivacaine and ropivacaine are the most extensively used local analgesics (LA). All current labour epidurals are administered with low strength LA as these minimal doses confines motor blockade with negligible adverse-effects. So to uncover better option, the current study was planned to compare the effectiveness of '0.125% bupivacaine' and '0.125% ropivacaine' for epidural labour analgesia.

Material and Methods: The present study was a cross-sectional, double blinded hospital based study. The subjects were randomly divided into two groups each having 41 subjects i.e. group A received ropivacaine and group B received bupivacaine. Preanaesthesia evaluation was done. Anesthesia and delivery was conducted considering all standard protocols of the hospital. Vitals, mode of delivery, onset duration and total amount of analgesia, APGAR score, VAS score, bromage scale grade, maternal satisfaction score was noted and statistically analyzed. A 'p-value <0.05 was considered significant'.

Result: The mean age, duration of labour and mean gestational age was almost similar between both the groups with no statistical significance. The total duration of analgesia was significantly higher and volume of LA used was lower in group B than group A. APGAR score, distribution of subjects based on cervical dilation and mode of delivery among both the groups was also almost comparable although spontaneous vaginal delivery was prominent. In both the groups, maximum of the subjects had no motor blockade and excellent pain satisfaction score. VAS score at 30 minutes and 240 minutes was significantly higher in group A than group B with no statistical significance difference observed at other time intervals.

Conclusion: Our study finds both bupivacaine and ropivacaine epidurally to be comparable & clinically indistinguishable in 0.125% concentrations without any adjuvants as degree of motor blockade, maternal satisfaction and VAS score were comparable in both the groups.

Keywords: Analgesia, labour, epidural, bupivacaine, ropivacaine etc.

Introduction

Labour is a tremendously painful physiological process and the pain during labour can have negative effects on fetal and maternal physiology. The inability to tolerate labour pain can increase the chances for elective caesarean sections. The pain experienced by pregnant female is the chief contributor to stress and anxiety [1] and this stress response affects both mother and foetus as it activates maternal sympathetic nervous system affecting cardiovascular (CV) system, respiratory system, endocrine system and uteroplacental circulation causing uncoordinated uterine activity.[2,3] Therefore, pain relief is vital to avoid chances of caesarean section and to reduce perinatal and maternal morbidity. [4] Neuroaxial techniques during labor and delivery have reported significantly lesser pain scores with higher maternal satisfaction. Additionaly these techniques have very few side effects on fetal physiology and maternal pulmonary and CV functions. [5] Epidural labour analgesia is the most effective and admired neuroaxial method of pain relief. [6] Epidural blockade allows conscious participation of mother in delivery and prevents gastric aspiration along with avoidance of GA (general anaesthetic) drugs. During labour, to avoid these adverse effects, maintenance of analgesic adequacy is critical. So, the care providers adjust requirement and dose of the analgesic based on many factors like foetal condition, pain tolerability, predicted labour duration etc. Ideal analgesic drugs used during labour should have lesser motor blockade along with extended period of action, less perinatal transfer and no side effects on the fetus and mother. Many local analgesics (LA) meet few of the criteria of ideal analgesic drugs and out of all, bupivacaine

is the most extensively LA used. These days less potent ropivacaine is rising as preferred LA during labour as it is less toxic to CV and nervous system along with improved differential motor and sensory blockade than bupivacaine [7] due of its physicochemical and structural properties. [8]

With the promising idea of nominal LA volumes & doses, all current labour epidurals are administered with walking epidurals i.e. negligible strength LA doses of 0.125% - 0.0625% [9] as these minimal doses confine motor blockade with negligible adverse-effects and do not interfere with the labour progress. For 'labour analgesia, programmed intermittent bolus injections into the epidural space' are more effective than other techniques, as second stage of labour is significantly short so total anesthetic used is considerably less with higher maternal satisfaction. [10,11]

Hence, the current study was planned to compare the effectiveness of low concentrations of '0.125% bupivacaine' and '0.125% ropivacaine' with programmed intermittent bolus injections of top-up doses of low volumes of 5 ml for epidural labour analgesia. Till date very few studies are documented comparing efficacy of 'bupivacaine' and 'ropivacaine' alone as epidural analgesia for labour, so this study was planned without any adjuvants.

Material and Methods

Our study was a double blinded, cross-sectional hospital based study conducted at Gouri Devi Institute of Medical Sciences and Hospital for a period of around one year from August 2022 to July 2023 after attaining ethical clearance from institutional ethics committee. A total of 82 primigravida females requiring epidural analgesia during active labour were enrolled in the study after obtaining informed consent. Pregnant females with vertex presentation in labour and no complications with dilatation of cervix of around 3 to 6 cm having 'ASA (American Society of Anesthesiologists)' physical status I or II with singleton were taken as subjects or participants of the study.

Females who were overweight (>115kg), not willing to participate, had allergy to study drugs, infection at epidural catheter insertion site or had impaired coagulation profile were excluded from the study. The subjects were randomly divided into two groups i.e. group A or group B, each having 41 subjects. Computer-generated random allocation of the participants to any of the 2 groups was done using blinded opaque envelopes. Group A was comprised of subjects who received 10ml of '0.125% ropivacaine' as bolus. Group B had subjects who received 10ml of '0.125% bupivacaine' as bolus. The study was a double blinded to the participants, anaesthesiologist and the care providers. Preanaesthesia evaluation was conducted for both the groups in detail i.e. condition of the membrane, gestational age and demographic data was noted. Procedure was explained to the subjects and then in sitting position, standard monitors were applied to note the baseline vitals. Epidural space between L3-L4 or L4-L5 was spotted using a 18G Tuohy's needle and then a secured 18G intravenous (IV) cannula already loaded with 300ml ringer's lactate was inserted approximately 3cms into the epidural space.

After fixing the position, a test dose was given. Participants of group A and group B received 10ml of '0.125% ropivacaine' and 'bupivacaine' respectively as bolus. Intermittent bolus injections of 5ml of respective LA were administered every 60minutes to maintain the analgesia. During the labour, subjects who experienced insufficient analgesia, were administered additional 5 ml of anesthesia after 20minutes of previous dose until comfort of the patient was attained to maximum limit of 10ml/h uptil the delivery.

The pain score before epidural and after epidural was assessed from 0-10 using VAS (Visual Analog Scale) score. Degree of motor block was seen by bromage scale and maternal pain satisfaction was seen on a '4-point scale as excellent, good, fair, or poor'. In addition vitals, mode of delivery, duration, onset and total amount of analgesia used among mothers was also observed along with 'APGAR (appearance, pulse, grimace, activity and respiration)' score of neonates at 1 and 5minutes. All the observations were noted on a prestructured proforma and statistical analysis was done using SPSS 20 and 'p-value <0.05 was considered significant'.

Result

The study was done on pregnant females visiting 'Gouri Devi Institute of Medical Sciences and Hospital'. The cases were aligned into 2 groups based on the epidural LA administered during labour i.e. group A received ropivacaine and group B received bupivacaine as epidural LA. The mean age in group A was 26±2.74years and in group B it was 25±3.62years with no statistical difference among them. Table 1 shows the demographic and other variables of the two groups.

Duration of labour was non-significantly higher in group A i.e. 5.49±3.39hours than group B with 4.59 ±2.39hours. Mean gestational age of both the groups was almost similar with no statistical difference among them i.e. 38.34±0.63 and 38.41±0.85weeks in group A and B respectively. Table 1 depicts the onset of analgesia was significantly late in group A i.e. at 8.23±0.88minutes than group B at 7.08±0.92minutes. The total duration of analgesia was significantly higher in group B

(47.80±4.15minutes) compared to group A (43.20±2.29minutes) although total volume of LA administered was significantly low in group B i.e. 35.60±4.01ml than group A i.e. 38.40±3.09ml.

Table 1: Comparison of demographic and other variables among group A and B

Parameter	GroupA (Mean ± SD)	GroupB (Mean ± SD)	p-value
Age (years)	26.00±2.74	25.00±3.62	0.1623
Duration of labour (hours)	5.49±3.39	4.59 ±2.39	0.1686
Gestational age (weeks)	38.34±0.63	38.41±0.85	0.6730
Onset of analgesia (min)	8.23±0.88	7.08±0.92	**0.0001**
Duration of analgesia (min)	43.20±2.29	47.80±4.15	**0.0001**
Total volume of LA consumed (ml)	38.40±3.09	35.60±4.01	**0.0007**

Figure 1 shows the subjects distributed into 3 groups based on the mode of delivery i.e. 'spontaneous vaginal, instrumental vaginal and caesarean section' delivery with 77%, 11% and 12% subjects in group A and 75%, 12% and 13% subjects in group B respectively.

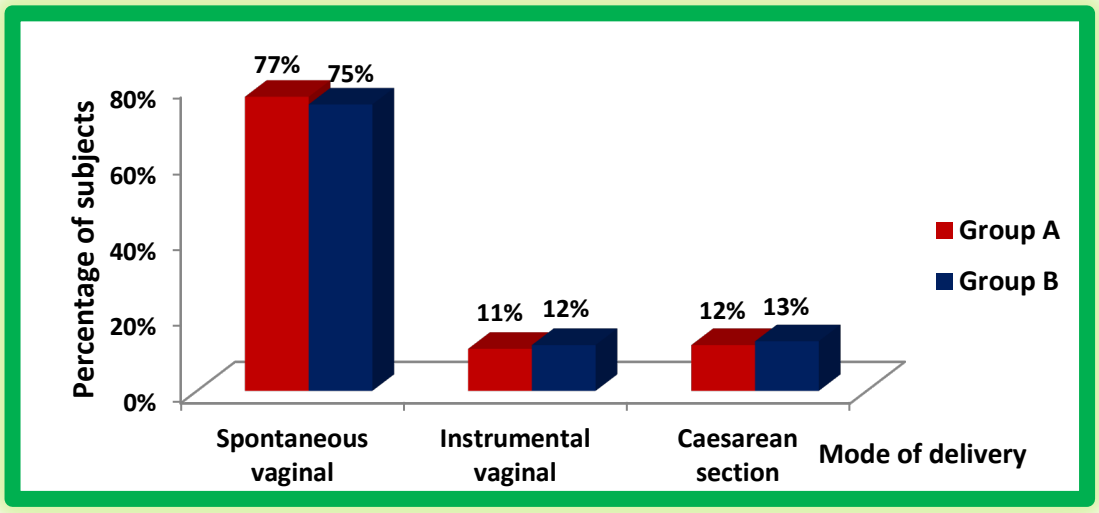

Figure 1: Distribution of patients based on mode of delivery

Figure 2 clearly depicts that distribution of subjects based on cervical dilation among both the groups was almost similar. Group A had 49% subjects with cervical dilation of 3cm and 51% with cervical dilation of 4cm in comparison to group B with 41% and 59% subjects having cervical dilation of 3 and 4cm consecutively.

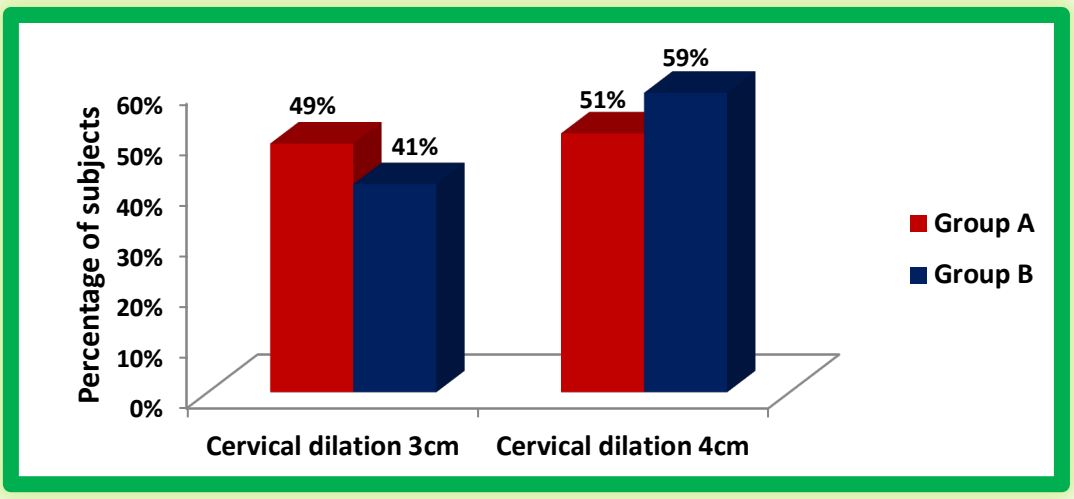

Figure 2: Distribution of patients based on cervical dilation

Table 2 compares the APGAR score, Patient satisfaction and Bromage scale score of both the groups.

The condition of newborn was assessed by APGAR score immediately after birth at 1minute and at 5minute and the score was comparable among both the groups. APGAR score at 1 and 5minute in group A was 7.56±0.75 and 8.91±0.25 compared to group B with 7.66±0.63 and 8.90±0.26 respectively. To assess the pain depending on the type of LA administered, patient satisfaction score was analyzed. In both the groups, experience of maximum of the subjects was excellent with 30 (73.17%) and 28 (68.29%) in group A and group B consecutively. Experience of rest of the subjects i.e. 11 (26.82%) in group A & 13 (31.71%) in group B was analyzed to be good. None of the subject had fair or poor pain experience in either of the groups. Further, to measure the degree of motor blockade, bromage scale was used in both the groups. Maximum of the subjects in both the groups were of grade 0 with no motor blockade i.e. 36 (87.80%) followed by grade 1, 2 and 3 with partial, almost complete and complete blockade.

Group A had 4 (9.75%) and 1 (2.44%) subjects falling into grade 1 and 2 respectively. Group B had 5 (12.19%) and 0 (0.00%) subjects with grade 1 and 2. Both groups had no subject with grade 3.

Table 2: Comparison of Bromage scale grade, APGAR and Patient satisfaction score among groupA and group B

Variable		GroupA	GroupB	p-value
APGAR score	1min	7.56±0.75	7.66±0.63	0.5152
	5min	8.91±0.25	8.90±0.26	0.8595
Patients satisfaction score n (%)	Excellent	30 (73.17%)	28 (68.29%)	
	Good	11 (26.82%)	13 (31.71%)	
	Fair	0	0	
	Poor	0	0	
Bromage scale grade n (%)	0	36 (87.80%)	36 (87.80%)	
	1	4 (9.75%)	5 (12.19%)	
	2	1 (2.44%)	0 (0.00%)	
	3	0 (0.00%)	0 (0.00%)	

Table 3 illustrates the comparison of 'VAS score' among groupA and groupB. In both the groups VAS score was almost comparable.

Mean VAS score at 0, 5, 15, 30, 60, 90, 120, 150, 180, 210 and 240minutes in group A was found to be 8.59±0.75, 4.44±0.70, 0.39±0.76, 0.76±0.27, 0.66±0.78, 0.39±0.60, 0.51±0.58, 0.61±0.62, 0.72±0.60, 1.08±0.68 and 1.74±0.49 respectively whereas group B had VAS score of 8.39±0.75, 4.69±0.71, 0.41±0.66, 0.26±0.50, 0.45±0.60, 0.59±0.80, 0.76±0.69, 0.74±0.67, 0.71±0.59, 1.07±0.60 and 1.24±0.47 respectively on the same time interval.

VAS score of groupA was significantly greater than groupB at 30minutes and 240minutes. The difference in 'VAS score' among both groups at 0, 5, 15, 60, 90, 120, 150, 180 and 210minutes was found to be statistically non-significant.

Table 3: Comparison of VAS score between groupA and groupB

VAS score at	GroupA (Mean ± SD)	GroupB (Mean ± SD)	p-value
0min	8.59±0.75	8.39±0.75	0.2308
5min	4.44±0.70	4.69±0.71	0.1123
15min	0.39±0.76	0.41±0.66	0.8991
30min	0.76±0.27	0.26±0.50	**0.0001**
60min	0.66±0.78	0.45±0.60	0.1756
90min	0.39±0.60	0.59±0.80	0.2040
120min	0.51±0.58	0.76±0.69	0.0796
150min	0.61±0.62	0.74±0.67	0.3646
180min	0.72±0.60	0.71±0.59	0.9395
210min	1.08±0.68	1.07±0.60	0.9439
240min	1.74±0.49	1.24±0.47	**0.0001**

Discussion: The current study was a cross-sectional hospital based study conducted at 'Gouri Devi Institute of Medical Sciences and Hospital' on 82 primigravida females in labour from August 2022 to July 2023. Labour pain intensity fluctuates with different labour stages and is experienced to be the most severe form of pain. [12] For pain relief in labour, the most common and accepted technique called as the "Gold standard" is epidural analgesia. [13] Through epidural route, the nerves

can be blocked to produce sufficient analgesia. The most commonly administered drugs for epidural analgesia in different concentrations are bupivacaine and ropivacaine. So the study was done to compare effectiveness of '0.125% bupivacaine' and '0.125% ropivacaine' for epidural labour analgesia. Subjects were randomly assigned into 2 groups each having 41 participants. The age of participant and gestational age in both the groups was comparable. The outcome is in concordance with the study by Meister et.al. [14] as they found nearly similar mean age in both the groups. Another study by Kalpana Kulkarni et.al. [13] Found similar outcome regarding gestational age in both the groups. Duration of labour in current study was non-significantly more in groupA than groupB. The finding is strongly supported by a study of Medge D. Owen et.al. [15] The analgesia in group A of our study was started at 8.23±0.88min which was significantly late than group B. The findings are in harmony with the study by K Udaya Bhaskar et.al. [16], Finegold H et.al. [17] And Shenvi SS and Jaiswal AV [18] as they also found significant early onset of analgeaia in bupivacaine group. The reason behind late onset of analegesia in group A could be the lower lipid solubility of ropivacaine which increases entry time of the drug to block nerve transmission. In our research, duration of analgesia in groupB was significantly more than ropivacaine group. This outcome is also supported by K Udaya Bhaskar et.al [16] along with other studies done by Greg C. Meister et.al, [14] 'Kumar GS' et.al., [19] and 'Kulkarni K' [13] Further in current study the total volume of LA consumed was significantly higher in group A compared to group B which is in disagreement with the study by 'Meister GC' et.al., [14] as they found comparatively lesser values in group A.

As far as cervical dilation is concerned, subjects in current study were presented with cervical dilation of 3-4cms which could be due to less mediators liable for uterine activity.(20) The result is in concordance with the study by Chora and Hussain [21] and Kulkarni K [13] as they also observed similar findings and concluded that subjects in early labour administered with the drugs is linked with fast cervical dilation.

Further present study observed that maximum cases had spontaneous vaginal delivery followed by other modes of delivery and distribution of subjects in both the groups was similar depicting that mode of delivery does not get influenced by the type of LA used. The findings are strongly in harmony with the study by Chethananand et.al.,[22] Halpern et.al,[23] and Chetty et.al.[24] although few studies believe that vaginal delivery can get influenced by the type of LA used for epidural analgesia.[25] Maximum subjects in our study had bromage scale grade of 0 either administered with bupivacaine or ropivacaine followed by grade 1 and grade 2 with none of the subject falling into grade 3 possibly due to low concentration of LA used, as motor blockade chiefly relys on concentration, volume & strength of LA administered.[25] The findings is in concordance with the study by Gündüz et.al.[25) and K Udaya Bhaskar et.al.[16] Although our study is in contrast to study by Halpern et.al.[23] and Fernández-Guisasola J et.al.,[26] as they found bupivacaine and Kumar GS et.al.,[19] who found ropivacaine to be related with higher grade of bromage scale. Thus severance of sensory to motor blockade depending on type of LA used may be clinically evident only at higher concentrations. In present study, in neonates APGAR score was analyzed at 1min and 5min and it was assessed to be alike in both the groups with no statistical significance.

This finding indicates that type of LA used has no direct effect on the fetus and is nearly in harmony with the study by Kalpana Kulkarni et.al.[13] and K Udaya Bhaskar et.al.[16] Maternal satisfaction score in our study was observed to be similar in both the groups i.e. excellent and good. This shows that ropivacaine and bupivacacine, both showed appreciable control over pain. This is in accordance with the study by K Udaya Bhaskar et.al.[16] and Steinstra R et.al.,[27] The present study showed insignificant and comparable mean VAS scores between the two groups at different time intervals. At 30min and 240mins the values were significantly raised in 'ropivacaine' group. This outcome is strongly supported by the study of Kumar GS et.al.,[19] K Udaya Bhaskar et.al.[16] and 'Kulkarni K and Patil R'[13] The results of our study showed both LAs to be clinically equipotent and indistinguishable at low concentrations as depicted by different variables, bromage scale grade, maternal satisfaction and VAS scores.

The possible reason could be that the myelinated small nerve fibres have comparatively more sensitivity than non-myelinated and large fibres, thus even at low concentration, analgesia is produced by blockage of Aγ and Aδ fibres. Three recent researches have proposed bupivacaine as more potent LA than ropivacaine [28-30] but clinical use of the findings is unknown. Few other studies have reported benefits of ropivacaine which can be more visible with higher concentrations of LAs used.

Conclusion

The current research was done to see the efficiency of 0.125% bupivacaine & 0.125% ropivacaine as epidural labour analgesia. Our study finds both bupivacaine and ropivacaine to be comparable and clinically indistinguishable when given epidurally in 0.125% concentrations without any adjuvants in small volumes as intermittent bolus doses. Either of

the drugs showed no effect on mode of delivery and foetal outcome although onset of rovacaine was late and more volume was consumed in the study.

As far as quality of analgesia is concerned, both bupivacaine and ropivacaine were found to have similar quality as degree of motor blockade, maternal satisfaction score and VAS score were comparable in both the groups. Ropivacaine being safer can be considered over bupivacaine and these benefits can be apparent with higher doses of the drug.

Acknowledgement:

We appreciative the participation and cooperation of all the patients.

References

1. Beigi NM, Broumandfar K, Bahadoran P, Abedi HA. Women's experience of pain during childbirth. Iran J Nurs Midwifery Res 2010; 15(2): 77-82.
2. Chestnut's Obstetric Anesthesia: Principles and Practice; 6th edition. 2019:296-98.
3. Hawkins JL. Epidural analgesia for labour and delivery. N Engl J Med. 2010; 362:1503-10.
4. Rao ZA, Choudhri A, Naqvi S, Ehsan-Ul-Haq. Walking epidural with low dose bupivacaine plus tramadol on normal labour in primipara. J Coll Physicians Surg Pak 2010; 20(5): 295-8.
5. Cambic CR, Wong CA. Labour analgesia and obstetric outcomes. Br J Anaesth 2010; 105(Suppl. 1): i50-60.
6. Zhao Q, Yan C, Fang B, et al. Efficacy and side effects comparison of bupivacaine and ropivacaine with fentanyl for labor analgesia under combined spinal and epidural analgesia. Int J Clin Exp Med 2018; 11(8): 8003-10
7. Delgado C, Ciliberto C, Bollag L, Sedensky M, Landau R. Continuous epidural infusion versus programmed intermittent epidural bolus for labour analgesia: Optimal configuration of parameters to reduce physician-administered top-ups. Curr Med Res Opin. 2018;34(4):649-56
8. Beilin Y, Halpern S. Focused review: Ropivacaine versus bupivacaine for epidural labor analgesia. Anesth Analg 2010; 111(2): 482-7.
9. Atienzar MC, Palanca JM, Torres F, Borras R, Gil S, EsteveI. A randamized comparison of levoBupivacaine, Bupivacaine and ropivacaine with fentanyl, for labour analgesia. IntJ Obstet Anesth. 2008;17:106-11
10. Lim Y, Sia ATH, Ocampo C. Automated regular epidural analgesia: A comparision with continuous infusion. Int J Obstet Anesth. 2005; 14(4):305-09.
11. Wong CA, Ratliff JT, Sullivan JT, Scavone BM, Toledo P, McCarthy RJ, et al. A randomised comparison of programmed intermittent epidural bolus with continuous epidural infusion for labour analgesia. Anesthesia & Analgesia. 2006;102(3):904-09
12. Chestnut's Obstetric Anesthesia: Principles and Practice; 6th edition. 2019:425-26.
13. Kulkarni K, Patil R. Comparison of ropivacaine-fentanyl with bupivacainefentanyl for labour epidural analgesia. The Open Anesthesiology Journal. 2020; 14(1):108-14.
14. Meister GC, D'Angelo R, Owen M, Nelson KE, Gaver RA. Comparison of epidural analgesia with 0.125% ropivacaine with fentanyl versus 0.125% bupivacaine with fentanyl during labour. Anesthesia and Analgesia. 2000;90(3):632-37
15. Medge D. Owen et.al., 0.125% Ropivacaine Is Similar to 0.125% Bupivacaine for Labor Analgesia Using Patient-Controlled Epidural Infusion, Anesth Analg 1998;86:527-31
16. K Udaya Bhaskar et.al. , Effectiveness of 0.125% Bupivacaine versus 0.125% Ropivacaine in Epidural Labour Analgesia-A Randomised Clinical Stud, Journal of Clinical and Diagnostic Research. 2022 Dec, Vol-16(12): UC01-UC05.
17. Finegold H, Mandell G, Ramanathan S. Comparrison of ropivacaine 0.1%- Fentanyl and bupivacaine 0.125%-Fentanyl infusions for labour epidural analgesia. Can J Anesth. 2000; 47:740-45.
18. Shenvi SS, Jaiswal AV. A comparative study on the effects of 0.1% bupivacaine and 0.15% ropivacaine for epidural analgesia during labour. International Journal of Contemporary Medical Research. 2018;5(12):L1-L6
19. Kumar GS, Rao BS, Kumar UM. A comparative study of equi-concentration of Bupivacaine-Fentanyl and Ropivacaine-Fentanyl for epidural labour analgesia. Int J Sci Stud. 2018;6(5):112-20.
20. Rahm VA. Hallgren A, Hogberg H, HurtigI, Odlind V. Plasmaoxytocin levels in women during labor with or without epidural analgesia: A prospective study. Acta Obstet Gynecol Scand 2002; 81: 1033-9.
21. Chora I, Hussain A. Comparison of 0.1% Ropivacaine-Fentanyl with 0.1% Bupivacaine-Fentanyl Epidurally for Labour Analgesia. In: Advances in Anesthesiology. 2014.
22. Chethanananda TN, Shashank MR, Madhu N, Achyutha J, Siva Kumar KV. Comparative efficacy of minimal concentration of racemic bupivacaine (0.0625%) with fentanyl and ropivacaine (0.1%) with fentanyl for epidural labor analgesia. Anesth Essays Res 2017; 11(3): 583-8.
23. Halpern SH, Breen TW, Campbell DC, et al. A multicenter, randomized, controlled trial comparing bupivacaine with ropivacaine for

labor analgesia. Anesthesiology 2003; 98(6): 1431-5.
24. Chhetty YK, Naithani U, Gupta S, Bedi V, Agrawal I, Swain L. Epidural labor analgesia: A comparison of ropivacaine 0.125% versus 0.2% with fentanyl. J Obstet Anaesth Crit Care 2013; 3: 16-22.
25. Gündüz Ş, Yalçın SE, Karakoç G, Akkurt MÖ, Yalçın Y. Comparison of bupivacaine and ropivacaine in combination with fentanyl used for walking epidural anesthesia in labor. Turk J Obstet Gynecol 2017; 14(3): 170
26. Fernández-Guisasola J, Serrano ML, Cobo B, Munoz L, Plaza A, Trigo C, et al. A comparison of 0.0625% bupivacaine with fentanyland 0.1% ropivacaine with fentanyl for continuous epidural labour analgesia. Anesth Analg. 2001;92:1261-65
27. Stienstra R, Jonker TA, Bourdrez P, Kuijpers JC, van Kleef JW, Lundberg U, et al. Ropivacaine 0.25% versus bupivacaine 0.25% for continuous epidural analgesia in labour: A double blind comparison. Anesth Analg. 1995;80:285-89
28. Polley LS, Columb MO, Naughton NN, et al. Relative analgesic potencies of ropivacaine and bupivacaine for epidural analgesia in labor. Anesthesiology 1999; 90:944–50.
29. Capogna G, Celleno D, Fusco P, et al. Relative potencies of bupivacaine and ropivacaine for analgesia in labour. Br J Anaesth 1999; 82:371–3.
30. McDonald SB, Liu SS, Kopacz DJ, Stephenson CA. Hyperbaric spinal ropivacaine: a comparison to bupivacaine in volunteers. Anesthesiology 1999; 90:971–7.