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Effect of Height Adjusted Dose of Intrathecal Hyperbaric Bupivacine for Elective Cesarean Section: A Study of 2 Different Concentrations

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Abstract

Introduction: Study compare spinal anesthesia using hyperbaric bupivacine (0.5% - 0.75%) between fixed dose and height adjusted dose during elective cesarean section. **Methods:** Hundred parturients who had given their consent and were scheduled for elective cesarean section under spinal anesthesia, were divided into four groups—first group received 0.5% hyperbaric bupivacine fixed dose, the second group received 0.5% hyperbaric bupivacine in a dose adjusted to the height, the third received 0.75% hyperbaric bupivacine fixed dose, the fourth group received 0.75% hyperbaric bupivacine in a dose adjusted to height. The anesthesia onset time, haemodynamic changes, side effects and fetal outcome observed. **Results:** spinal block provide excellent surgical anesthesia in all patients. Anesthesia onset time is longer in adjusted than fixed groups, in 0.5% (5 ± 0.816 vs. 3.84 ± 0.746) ($P < 0.001$) and in 0.75% (3.76 ± 0.778 vs. 3.28 ± 0.741) (P 0.03), the motor block was less dense and of short duration in adjusted groups with decrease in the length of post-anesthetic care unit stay. There is decrease in incidence and severity of hypotention with decrease in total dose of vasopressors used in adjusted than fixed dose groups in 0.5% ephedrine (10 ± 6.123 vs. 19.6 ± 12) mg (p 0.008) and in 0.75% phenylephrine (0.268 ± 0.07 vs. 0.596 ± 0.2) mg ($P < 0.004$), Nausea and vomiting were more frequent in fixed dose groups. **Conclusion:** Adjusting dose of hyperbaric bupivacine (0.5% - 0.75%) to patient's height, decreases the dose of bupivacine in use, it also provide adequate anesthesia for elective cesarean section with decrease the use of vasopressors, the incidence and severity of maternal hypotention also markedly reduced.

Keywords

Cesarean Section, Height, Spinal Anesthesia, Local Anesthesia

1. Introduction

Spinal anesthesia with hyperbaric bupivacine in combination with opioids for cesarean section has become increasingly popular and preferred technique for majority of anesthesiologists. Which led to decrease in maternal mortality and morbidity related to complications in airway management [1]. Many anesthesiologists prefer it to epidural block as it takes less time to perform, rapid onset and provides more consistent and reliable block [2]. However, spinal anesthesia is often associated with significant maternal hypotention which has been reported in 55% to 100% of cases which can cause maternal morbidity (nausea, vomiting, aspiration) and directly affect the neonate by reducing uteroplacental perfusion [3]. Traditional approaches used to prevent or treat hypotention as avoidance of aortocaval compression and fluid preloading with back-up vasopressors have proven not to be adequate [4].

Spinal anesthesia hypotention is primarily due to decrease efferent sympathetic outflow. The relation between extent of sympathetic block and incidence of hypotention has led to many trials to reduce the dose of local anesthetics for cesarean section [5]. Many dosing regimens have been described for cesarean section; while some anesthesiologists prefer fixed dose, others adjust the dose according to patient characteristics as height, weight and body mass index [6] , aiming to obtain best balance between the need for adequate analgesia and the need to decrease anesthetic dosage to avoid maternal and fetal morbidity [7].

Addition of opioids to hyperbaric bupivacine in spinal block have synergistic effect, hasten onset, prolong duration and improve quality of analgesia with favourable effect on haemodynamic stability when compared to isolated bupivacine [8].

This study aim to compare spinal block characteristics, maternal adverse effects and neonatal outcome, between height adjusted dose versus fixed dose regimen in women undergoing elective cesarean section using two different hyperbaric bupivacine concentrations.

2. Patients and Methods

This prospective observational study was carried out at Benha University Hospital. The procedure was explained to each subject and informed consent was obtained. The Human Research Ethics Committee in hospital approved the study from July 2022 to July 2023. We enrolled 100 ASA physical status I and II patients, aged between 18 to 40 years old with full term uncomplicated pregnancies who presented for elective cesarean delivery under spinal anesthesia. We excluded parturients who refuse to participate, those with hypersensitivity to amide local anesthetics or opioids, contraindications to central neuroaxial block, parturients in labor, those have obstetric complications such as pre-eclampsia, placenta previa, multiple pregnancies, neurological or cardiovascular comorbidities and other organ system disease. Parturients who were at extremes of height and weight (BMI < 20 or >35 kg/m^2), height < 140 cm or >185 cm were also ex-

cluded.

Before administration of neuroaxial anesthesia, an 18 gauge intravenous Cannula Inserted. Each patient received 4 mg ondansterone intravenously and rapid intravenous infusion of saline 10 ml/kg over 15 minutes. In addition to loading dose patients received further saline solutions during the reminder of the operation. Standard monitoring applied to the patients including continous electrocardiogram, pulse oximeter and non invasive blood pressure. Baseline blood pressure and maternal heart rate were recorded before lumbar puncture, recording continue at 1- minute intervals for the first 20 – minutes after spinal injection and then every 5 minutes till end of surgery.

After aseptic measures, skin infiltration with 2% Lidocaine, a 25G pencil point spinal needle inserted in the midline at L3-4 or L4-5 vertebral interspace with the patient in sitting position, after confirming a free flow of cerebrospinal fluid, the following anesthetic solutions were injected over 30 seconds:

Group A: Patients in 0.5% fixed dose group were given 2.5 ml 0.5 hyperbaric bupivacine (12.5 mg) plus 0.2 ml fentanyl (20 ug).

Group B: Patients in 0.5% Height adjusted dose group were given 0.5 hyperbaric bupivacine according to dosage regimen detailed in **Table 1** plus 0.2 ml fentanyl (20 ug).

Group C: Patients in 0.75% fixed dose group were given 1.6 ml 0.75 hyperbaric bupivacine (12 mg) plus 0.2 ml fentanyl (20 ug) plus 0.2 ml diamorphine (100 ug).

Group D: Patients in 0.75% height adjusted dose group were given 0.75 hyperbaric bupivacine according to dosage regimen detailed in **Table 1** plus 0.2 ml fentanyl (20 ug) plus 0.2 ml diamorphine (100 ug).

Volume in all groups adjusted to 3 ml by adding normal saline.

Patients were immediately turned supine and wedge position maintained to minimize aortocaval compression. We did not supplement oxygen unless SPO_2 decreased to <92%.

Patient's haemodynamics and block profile assessed at 1 – min intervals for the first 20 minutes thereafter the anesthesia onset time which is time from end of injection of local anesthesia in subarachnoid to bilateral loss of pin-prick sensation to surgical incision level at T6 which assessed in mid clavicular line using a 24 gauge sterile needle. During this period the followings recorded: blood pressure, heart rate, oxygen saturation, respiratory rate, maximum sensory block level, time needed for maximum level to be reached, degree of motor block assessed by modified Bromage score (0 = no impairment, 1 = unable to raise extended legs but able to move knees and ankles; 2 = unable to extend legs or flex knees but able to move feet; 3 = unable to flex ankles, knees or hips), and time taken to reach maximum Bromage score. Also the following data were recorded: duration of surgery, fetal extraction time (time between start of surgery till delivery of fetus), total dose of oxytocin administrated post delivery, apgar score at 1 and 5 minutes, frequency of hypotention episodes, total amount of ephedrine and phenylephrine used, other complications also recorded as nausea, vomiting,

Table 1. Adjusted dose regimen for hyperbaric bupivacine 0.75% - 0.5% for cesarean section under spinal anesthesia (Values in milliliters) [9]:

Ht in feet	≤5	5"1'	5"2'	5"3'	5"4'	5"5'	5"6'	5"7'	5"8'	5"9'
Dose in mg	8.25	9	9.75	10	10.5	11.25	12	12.75	13.5	14.25
Dose in ml 0.5%	1.65	1.8	1.95	2	2.1	2.25	2.4	2.55	2.7	2.85
Dose in ml 0.75	1.1	1.2	1.3	1.35	1.4	1.5	1.6	1.7	1.8	1.9

pruritis, respiratory depression ($SPO_2 \leq 92\%$ and respiratory rate < 10 bpm), total volume of saline infused and blood loss (estimated in graded suction bottle and observation of soaked materials).

Hypotention defined as SBP < 100 mmHg or MBP decrease > 20% from baseline, treated with intravenous ephdedrine 5 - 10 mg or phenylephrine 50 - 100 ug boluses at discretion of anesthesiologist, bradycardia defined as heart rate < 50 bpm and treated with intravenous atropine 0.6 mg.

Surgery via transverse lower abdominal incision was allowed to start once sensory block reach or exceed bilateral T6 sensory dermatomes. If this was not achieved after 10 minutes, the patient was positioned in the 10^0 head down tilt to reach desirable block level T6. After delivery, patients were given 30 unit oxytocin in 500 ml saline at rate 10 unit/h. If patients reported pain or discomfort during surgery as assessed by VAS ≥ 40, bolus of intravenous fentanyl 1.5 ug/kg given (repeated once), if discomfort continue protocol allow for general anesthesia conversion.

Postoperative, in PACU, haemodynamics and block profile monitoring were continued till sensory level regressed below L1 and patients can freely move lower limb.

Data were analyzed by using SPSS version 16 (SPSS, Chicago, IL, USA). Quantitative data were presented as mean and standard deviation and were analyzed by unpaired student t-test qualitative parametric data were presented as numbers and percentages and were analyzed by Chi-square test. Qualitative non –parametric data were presented as median and IQR and were analyzed by man –Whitney U-test, P value < 0.05 was considered statistically significant, and P-value ≤ 0.01 was considered statistically highly significant.

3. Results

Fifty women received 0.5% hyperbaric bupivacine, 25 received fixed dose (group A), the other 25 received dose adjusted to height (group B). Another fifty women received 0.75% hyperbaric bupivacine, the first 25 received fixed dose (group C), and the remaining 25 received dose adjusted to height (group D). The patients of each two study groups were similar regarding (Age, weight, height, BMI, ASA) **Table 2**.

On a dose adjustment for height, significantly (P < 0.001) smaller amount of hyperbaric bupivacine, median IQR; 1.95 (1.8 - 1.95), 1.3 (1.2 - 1.6 ml) were given intrathecally in group B, D respectively than given to fixed dose group patients A and C; 2.5 (2.5 - 2.5), 1.6 (1.6 - 1.6 ml).

Table 2. Demographic data.

	Group A	Group B	Test	P- value	Group C	Group D	Test	P- value
Age	27.76 ± 5.08	28.2 ± 4.1	t = 0.33	0.73	32.76 ± 4.21	29.56 ± 5.09	t = 2.4	0.019
Weight	79.88 ± 11.14	74.32 ± 11.5	t = 1.7	0.08	77.37 ± 11.37	80.53 ± 12.42	t = 0.93	0.35
Height	63.48 ± 2.2	62.36 ± 2.6	t = 1.6	0.1	64.04 ± 2.49	63.72 ± 3.95	t = 0.34	0.73
BMI	30.52 ± 3.05	29.7 ± 3.4	t = 0.83	0.4	29.6 ± 3.59	30.5 ± 3.14	t = 0.89	0.37
ASA I	5 (20%)	8 (68%)	$X^2 = 0.93$	3 (12%)	4 (16%)	$X^2 = 0.16$	0.68	0.33
ASA II	20 (80%)	17 (32%)		22 (88%)	21 (84%)			

Data presented as mean ± SD. ASA presented as number and percentage.

Spinal anesthetic was placed at L3-4 interspace in 68% of patients in group A, 80% of group B with the reminder of patients received spinal anesthesia at L4-5 (P = 0.33), in group C 76% of patients received spinal at L3-4 interspace while 80% in group D (P = 0.73). The anesthesia onset time for desired spinal block of T6 was significantly (P < 0.001) prolonged in group B than in group A (5 ± 0.816 vs. 3.84 ± 0.746 min) and the same in group D than in group C (3.76 ± 0.778 vs. 3.28 ± 0.791 min), (P = 0.03), in group A the maximum block level extended above T3 in 4 patients (16%), in group B no patient develop this level, with a predominance of T4 (40%) in group A and T5 (56%) in group B, without statistically significant difference between two groups **Table 3**, **Table 4** in group C the maximum block level extended above T3 in 6 patients (24%), in group D only one patient (4%) develop this level, with predominance of T4 (44%) in group C and T5 (48%) in group D but with statistically significant difference (P = 0.002).

The time for block to regress below L_1 was significantly (P < 0.001) shorter in group B than group A (116.68 ± 6.8 vs. 130.2 ± 8.71 min) and the same in group D than in group C (109.56 ± 17.76 vs. 133.36 ± 17.38 min) (P < 0.001). The time for motor block to reach maximum Bromage score was significantly (P = 0.001) shorter in group A than in B (3.6 ± 0.577 vs. 4.16 ± 0.533 min), this duration also shorter in group C than D but without significant difference (P = 0.11) (3.12 ± 7.25 vs 3.4 ± 0.5 min). The depth of motor block and the time required for complete recovery of block were significantly less in group B than A and in group D than C. The length of PACU stay was significantly shorter in group B than A and in group D than C **Table 3**, **Table 4**

Mean heart rate did not differ between groups either A and B or C and D but SBP was significantly different between group A and B and also between group C and D (**Figure 1(a)**, **Figure 1(b)** and **Figure 2(a)**, **Figure 2(b)**).

The hypotention occurred in 96% of patients in group A, 76% in group B, 100% in group C and 84% in group D.

The incidence of hypotention, number of hypotensive episodes, total dose of vasopressors and total volume of fluid infused were all significantly less in group B and D than group A and C respectively (**Table 4**).

Nausea and/or vomiting occurred in 8 patients in group A, 3 in group B, 9 in group C and 3 in group D, **Table 5** pruritis also noted in all groups with predo-

minance in groups C and D. Only 2 patients in group B developed bradycardia. One patient in group B and another one in group D developed discomport late in surgery which relieved with single dose of intravenous fentanyl in group D and after second fentanyl dose in group B, no patient in any group required conversion to general anesthesia. The respiratory rate of all patients remains above 10 breaths per minute and oxygen saturation above 92% in all patients.

Table 3. Characterise of spinal anaesthesia and surgery 0.5% heavy marcaine (EBL, duration of surgery).

Level of injection		Group A	Group B	Test	P-value
		L3-4	17 (68%)	20 (80%)	$X^2 = 0.93$
Level of injection	L4-5	8 (32%)	5 (20%)	$X^2 = 0.93$	0.33
Time to reach T6	3.84 ± 0.746	5 ± 0.816	t = 5.24	<0.001**	
Peak sensory level		T6	0 (0%)	2 (8%)	$X^2 = 9.5$
	T5	7 (28%)	14 (56%)		
	T4	10 (40%)	7 (28%)		
Peak sensory level	T3	4 (16%)	2 (8%)	$X^2 = 9.5$	0.04*
Maximum Bromage scale	<T3	4 (16%)	0 (0%)	$X^2 = 3.9$	
	3	22 (88%)	16 (64%)		
Maximum Bromage scale	2	3 (12%)	9 (36%)	$X^2 = 3.9$	0.04*
Time to max. Bromage scale	3.6 ± 0.577	4.16 ± 0.553	t = 3.5	0.001**	
Time to regression blow L1.		130.2 ± 8.71	116.68 ± 8.6	t = 5.52	<0.001**
Duration of motor block		135.2 ± 11.13	123.8 ± 8.32	t = 4.1	<0.001**
PACU stay time		137.4 ± 10.9	127.8 ± 6.93	t = 3.7	<0.001**
Total fluid volume		2188 ± 435	1844 ± 345.3	t = 3.09	0.003**
Estimated blood loss		690 ± 79.057	726 ± 73.76	t = 1.6	0.1
Urine output		137.6 ± 65.53	138.8 ± 47.9	t = 0.07	0.9
Duration of surgery		49.48 ± 10.51	48.4 ± 7.32	t = 0.42	*0.67*
Dose of ephedrine		19.6 ± 12	10 ± 6.123	t = 3.5	0.0008**
Dose of phenylephrine		50 ± 35.64	35 ± 20.82	t = 1.8	0.07

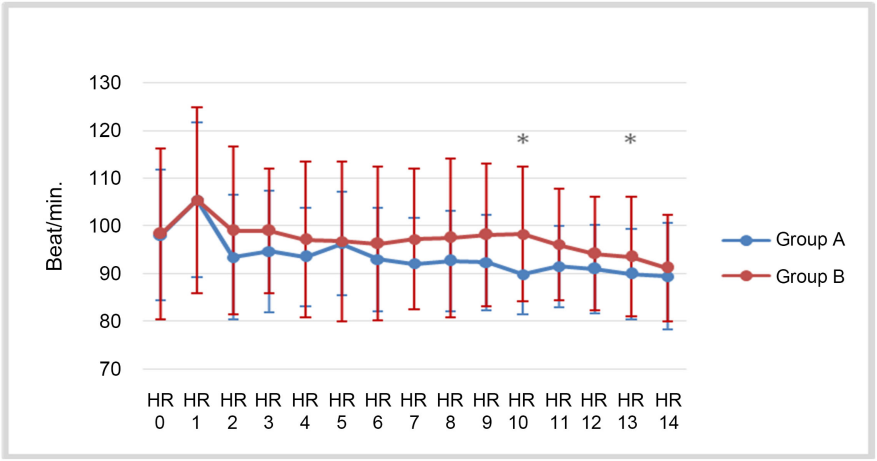
Table 4. Characterise of spinal anaesthesia and surgery 0.75% heavy marcaine (EBL, duration of surgery).

Level of injection		Group C	Group D	Test	P-value
		L3-4	19 (76%)	20 (80%)	$X^2 = 0.11$
Level of injection	L4-5	6 (24%)	5 (20%)	$X^2 = 0.11$	0.73
Time to reach T6	3.28 ± 0.791	3.76 ± 0.778	t = 2.16	0.035*	
Peak sensory level		T6	0	1 (4%)	$X^2 = 16.8$
	T5	1 (4%)	12 (48%)		
	T4	11 (44%)	9 (36%)		
Peak sensory level	T3	7 (28%)	2 (8%)	$X^2 = 16.8$	0.0001**
Maximum Bromage scale	<T3	6 (24%)	1 (4%)	$X^2 = 4.5$	
	3	23 (92%)	17 (68%)		
Maximum Bromage scale	2	2 (8%)	8 (32%)	$X^2 = 4.5$	0.03*
Time to max. Bromage scale	3.12 ± 0.725	3.4 ± 0.5	t = 1.5	0.11	

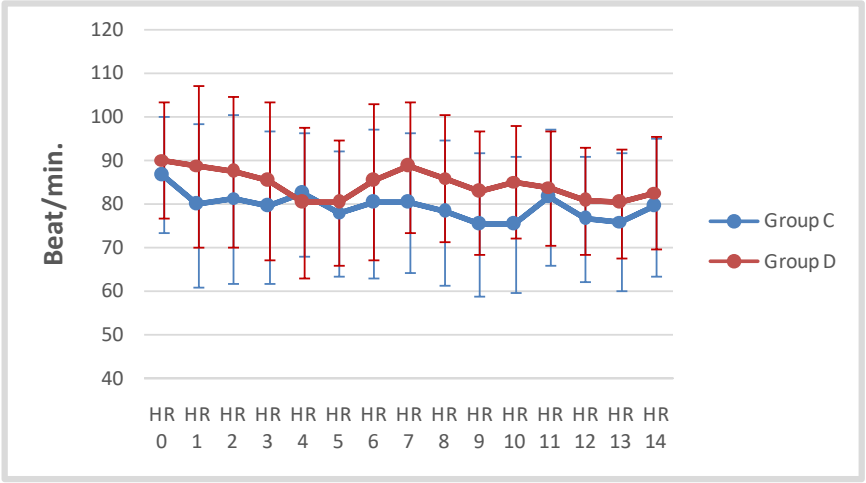
Continued

Time to regression blow L1.	133.36 ± 17.38	109.56 ± 17.76	t = 4.7	<0.001**
Duration of motor block	142.8 ± 16.52	118 ± 11.9	t = 6	<0.001**
PACU stay time	147 ± 15	121 ± 11.08	t = 6.9	<0.001**
Total fluid volume	2946 ± 675.76	2384 ± 739.61	t = 2.8	0.007**
Estimated blood loss	680 ± 102.8	710 ± 127.37	t = 0.916	0.36
Urine output	133 ± 70.75	173.2 ± 176.53	t = 1.05	0.29
Duration of surgery	59.88 ± 14.73	53.52 ± 13.87	t = 1.57	*0.12*
Dose of ephedrine	14.04 ± 6.58	12.08 ± 7.75	t = 0.96	0.33
Dose of phenylephrine	596 ± 200.01	268 ± 70.48	t = 5.8	<0.0004**

- Data presented as mean ± SD. - Peak sensory level, level of injection and bromage score were presented as number and precentage. - Total volume of injectate was presented as median and IQ range.

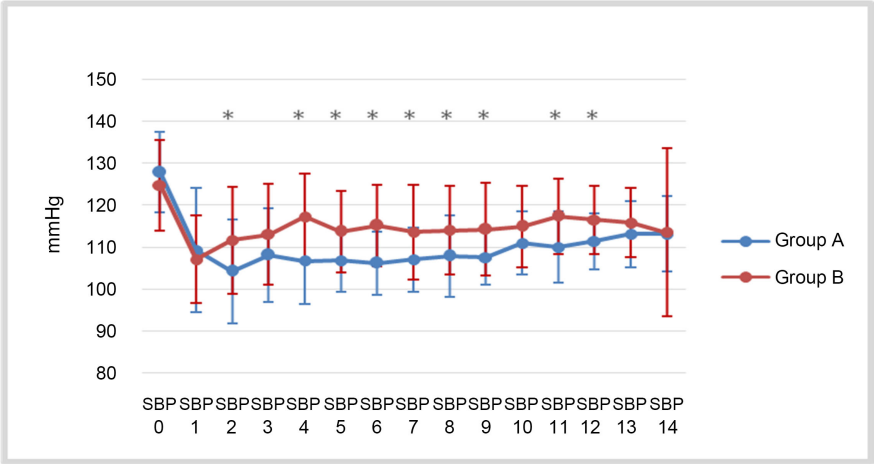


(a)

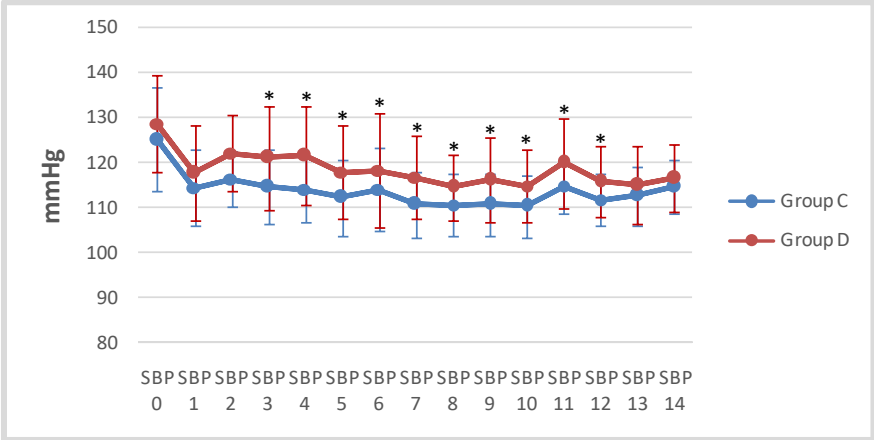


(b)

Figure 1. (a, b): Comparison of mean HR between patients received fixed dose of hyperbaric bupivacine (no. = 25, blue line) and those received dose adjusted to height (no = 25, red line), No significant difference was observed between groups.



(a)



(b)

Figure 2. (a, b): Comparison of SBP between patients received fixed dose of hyperbaric bupivacine (no. = 25, blue line) and those received dose adjusted to height (no = 25, red line), significant differences were observed between groups.

Apgar scores of newborns were not significantly different between groups at 1 and 5 minutes interval, **Table 5**.

4. Discussion

Adjusting dose of local anesthetic of spinal anesthesia for cesarean section remain one of issues that pay attention of anesthetist in clinical practice using high dose (15 mg or more of bupivacine) can complicated by severe hypotention and total spinal anesthesia. Desimone *et al.* [10] reported high dose of 0.75% hyperbaric bupivacine may exceed capacity of thoracic curvature producing high level of anesthesia. While excessively small doses may cause anesthesia failure and both conditions result in conversion to general anesthesia.

Our study is first one to adjust dose of intrathecal local anesthetic for cesarean section according to height regarding two different concentrations commonly used in clinical practice all over the world. The aim of the study to get best balance

Table 5. Side effects and apgar score.

Adverse effects	Group A	Group B	Test	P-value	Group C	Group D	Test	P-value
Hypotension episodes	5 [2 - 6]	2 [2 - 3]	164.5	0.004**	9 [5 - 10]	3 [2 - 6]	129.5	<0.001**
Nausea	6 (24%)	2 (8%)	$X^2 = 2.3$	0.12	8 (32%)	3 (12%)	$X^2 = 2.9$	0.08
Vomiting	2 (8%)	1 (4%)	$X^2 = 0.35$	0.55	1 (4%)	0 (0%)	$X^2 = 1.08$	0.29
Pruritis	4 (16%)	3 (12%)	$X^2 = 0.16$	0.68	15 (60%)	14 (56%)	$X^2 = 0.08$	0.77
No. of cases with no vasopressors	1 (4%)	6 (24%)	$X^2 = 4.4$	0.03*	0 (0%)	4 (16%)	$X^2 = 4.3$	0.04*
Incidence of hypotension	96%	76%			100%	84%		
APGAR score								
1 min.	7.16 ± 0.624	7.36 ± 0.64	1.12	0.26	7.24 ± 0.72	7.4 ± 0.70	0.79	0.43
5 min.	9.36 ± 0.49	9.44 ± 0.5	0.56	0.57	9.4 ± 0.5	9.52 ± 0.51	0.84	0.4

-Data presented as number and percentage. -Hypotenstion episodes were presented as median IQR. -Apgar score was presented as mean ± SD.

between adequate analgesia and the need to decrease dosage to avoid maternal and fetal adverse effects. Our findings the dose adjustment of intrathecal bupivacine (0.5% - 0.75%) (according to **Table 1** modified from local anesthetics commonly used for cesarean section with subarachnoid block table of Paul G. Barach) significantly reduce the dose of bupivacine, limit sensory anesthesia to lower segments but delay anesthesia onset time. However, baby outcome and adequacy of anesthesia were same in both groups. The incidence, severity of hypotention and total required dose of fluid and vasopressors were much less in height adjusted dose than fixed dose group in both concentrations.

This study shows that satisfactory anesthesia with hyperbaric bupivacine (0.5% - 0.75%) for elective cesarean section can be conducted with lower doses than usually used in clinical practice. Patients in adjusted group received median dose of 9.75 mg (1.3 ml of 0.75% - 1.95 ml of 0.5%) and lowest administrated dose 8.25 mg (1.1 ml of 0.75% - 1.65 ml of 0.5%). Our results comparable with that of J.M. Harten [11] who found median dose of bupivacine 9.5 mg (1.9 ml of 0.5%) and lowest dose of 8 mg (1.6 ml of 0.5%) was satisfactory for cesarean delivery. Asish Subedi *et al.* [12] found the use of median dose of 9 mg (1.8 ml, 0.75%) in adjusted dose group was at lower normal recommended dose of bupivacine for spinal anesthesia in cesarean section but this study conducted on Nepalean women who are shorter than women in united sates and Egypt, also in agree to our study Negata *et al.* [13] of Japan and Chung *et al.* [14] of Korea shown that the required dose of local anesthetics is less in pregnant than non pregnant women and maternal hypotention decreased by adjusting the dose according to height.

Factors documented to affect height of spinal anesthesia block, including but not limited to age, height, baricity, local anesthetic dosage and patient positioning must be considered, as they may affect final outcome in cesarean section.

Highest incidence of hypotention observed under spinal anesthesia. Many

factors affecting that, some factors are non modifiable as sex, age > 50 years, BMI > 35 kg/m^2 and surgery nature. Others are modifiable as high dose of local anesthetic and block level exceed or equal to T_5, in our study, all variables were comparable between each two groups [15].

Low dose of bupivacine used in height adjusted dose of both concentrations limit spinal block segments and decrease extent of sympathetic block. Incidence of sensory block above T_3 was higher in fixed dose groups of both concentrations than in adjusted groups. 10 patients in fixed groups (20%) had sensory level above T3 and only one patient in adjusted groups (2%) exceeded this level. Generally sympathetic block extended fewer segments higher than sensory block with increasing risk of arterial hypotention, if peak level extended to T_2 due to cardiac sympathetic block [16]. This restriction of extent of sympathetic block in dose adjusted group of both concentrations maintain better haemodynamic parameters with decrease incidence and severity of hypotention and significant decrease in total dose of administrated fluid and vasopressors in adjusted groups than fixed dose groups. However, the anesthesia onset time is significantly longer in adjusted groups than fixed groups, in patients undergoing elective cesarean section this difference is insignificant but may be of significance in emergency cases. In agree with our study J.M. Harten *et al.* [11] who also advised not using adjusting dose regimen in emergency cesarean section. This point need further assessment in future studies with large sample of parturients.

In our study, degree of motor block and block regression time were significantly higher in fixed groups than dose adjusted groups, this allowed earlier mobilization and decrease in the length of PACU study. In agree with our study, Gregorly *et al.* [17] also found that low dose spinal anesthesia result in less dense motor block and of short duration but he did not find any improvement in haemodynamics with reduction of local anesthetic dose and this is in contrast to our findings.

Addition of opioids to local anesthetics intrathecally potentiate surgical anesthesia, making the patients more satisfied with their anesthetic. Opioids have selective site of action in spinal cord, synergistically it enhances L.A effect on efferent pathway without effect on sympathetic pathway so enhance pain relief without haemodynamic changes [18]. In our study 2 patients (4%) one in each adjusted dose group developed slight pain (VAS < 40) late in surery, and pain relieved with intravenous fentanyl these results matched with metanalysis that showed addition of opioids to local anesthetic intrathecally, 4% of patients require supplementary analgesia during their cesarean section [19].

Regarding other side effects, pruritis is more common in 0.75% groups due to addition of diamorphine to local anesthetic intrathecally. Improvement of maternal haemodynamics reflected by marked decrease in incidence of nausea and vomiting in adjusted than fixed dose groups. But, interestingly, despite higher incidence of nausea in 0.75% groups than 0.5% groups, the incidence of vomiting is higher in 0.5% groups, this may be due to phenylephrine which is vasopressor commonly used in 0.75% groups. Cooper and Colleges [20] suggested

that possible explanation due to decreased preload by spinal block which stimulate vagal tone and this heighten by beta stimulation but phenylephrine is pure alpha agonist causing venoconstriction, minimizing the decrease in preload and decrease the vagal tone.

Mature placenta is highly capacitance organ with no autoregulation and so uteroplacental flow is dependent on systemic blood pressure although the incidence and severity of maternal hypotention were decreased in adjusted groups, we cannot prove any difference in fetal outcome using Apgar score at 1 and 5 minutes which is specific but not highly sensitive test. Future studies measuring umbilical cord blood gases and uteroplacental blood flow may prove that.

In developing countries, there is lack of anesthesiologists. Anesthesia doctor can induce spinal anesthesia for two or more cesarean sections together, with the use of fixed or unadjusted doses of bupivacine, this mostly increase hazardous effects of spinal anesthesia during cesarean delivery, using adjusted dose increase patient safety. In advanced countries, using adjusted doses which maintain haemodynamics and decrease the incidence of nausea and vomiting, this increase patient safety and satisfaction with this type of anesthesia.

5. Conclusion

We have shown that adjusting the dose of hyperbaric bupivacine (0.5% - 0.75%) to patient's height is used in combination with opioids provide adequate anesthesia for elective cesarean section. This regimen associated with decrease in cephalic spread of anesthesia, decrease incidence, severity of maternal hypotention and decrease in dosage of vasopressors used.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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