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Original Research Article

EFFECT OF HEIGHT AND WEIGHT ADJUSTED DOSE OF BUPIVACAINE ON THE INCIDENCE OF COMPLICATIONS FOLLOWING SPINAL ANAESTHESIA FOR CAESAREAN SECTION

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ABSTRACT

Background: Spinal anaesthesia is widely used for caesarean section; however, maternal hypotension and other complications remain common following intrathecal administration of local anaesthetics [(1,2)]. A fixed dose of hyperbaric bupivacaine may result in variable spread of spinal block among parturient with different anthropometric characteristics. Height- and weight-adjusted dosing may provide an appropriate level of anaesthesia while reducing haemodynamic complications[(3,13,14)]. The present study was undertaken to evaluate and compare the effect of height and weight adjusted dose versus fix dose of hyperbaric Bupivacaine 0.5% on maternal blood pressure, characteristics of sensory block and neonatal outcome during spinal anaesthesia for elective caesarean section. Additionally, the study aimed to compare the incidence of hypotension and requirement of vasopressor between the two groups.

Materials and Methods: This prospective comparative study included 120 parturient scheduled for elective caesarean section under spinal anaesthesia. Participants were allocated into two groups: a fixed-dose (FD) group receiving a predetermined dose of hyperbaric bupivacaine 0.5% and an adjusted-dose (AD) group receiving a dose calculated according to height and weight (Harten's chart)[(9)]. Maternal haemodynamic parameters, including blood pressure and heart rate, were recorded at predetermined intervals. Total required dose of bupivacaine, time to achieve required sensory block, incidence of hypotension and requirement of vasopressors, neonatal outcome and other spinal anaesthesia-related complications were also evaluated.

Results: A total of 120 patients underwent randomization and divided into two groups. 16(26%) patients in group FD & 4(6.6%) patients in group AD reported hypotension, among which 12 patients in group FD and 2 patients in group AD require vasopressor, the difference was statistically highly significant. Average total required dose of Bupivacaine in group AD was 1.65±0.13 ml versus 2 ml in group FD, and time to adequate block to T6 in group FD was 5.33 ± 1.35 min and in group AD it was 7.43 ± 2.56 min, both differences were also statistically highly significant. (p value-0.00001). APGAR score at 1 minute (p value- 0.16) and at 5 minutes (p value- 0.3) was comparable between both groups.

Conclusion: Height- and weight-adjusted dosing of hyperbaric bupivacaine may provide a better hemodynamic stability with an adequate sensory block. Further studies with larger sample sizes may help establish the optimal dosing strategy.

Keywords: caesarean section, maternal hypotension, hyperbaric bupivacaine

INTRODUCTION

The use of neuraxial anaesthesia has gained popularity over general anaesthesia for cesarean section due to its high quality anesthesia and no adverse effect on the fetus. It also facilitates post-operative pain relief. If parturient is not nil by mouth then spinal anaesthesia also prevent maternal aspiration pneumonitis. Unfortunately, pregnancy related physiological adaptations and sympathetic blockade significantly increase the likelihood of maternal hypotension, which causes dizziness, nausea & vomiting in mother. Severe hypotension may lead to utero placental hypoperfusion and severe drop in intervillous blood flow with possibility of fetal acidemia.[1,2]

Fixed dosing regimen is preferred by some anaesthesiologists. Majority of time anaesthesiologist adjust the dose of local anaesthetic drug in spinal anaesthesia randomly according to patient's characteristics like height of patient, size of uterus, weight of patient etc. Height of block level is difficult to predict and depends upon position of patient, site and speed of injection and properties of anaesthetic agent such as baricity, volume and dose.[3] Pregnant women have increased weight and smaller amount of CSF so they require lesser dose compared to non-pregnant females. The administration of excessively low dose of Bupivacaine may decrease the incidence of low blood pressure episodes but also exposes to an increased risk of inadequate muscle relaxation and pain due to inadequate achievement of block level. [4-6]

The rational for adjusted dosing is supported by hemodynamic data, which demonstrates that the time to achieve an adequate sensory level for surgery is positively correlated with patient's height and inversely correlated with body weight.[7] Clinical observation confirms that weight and height are significant variables in predicting the final level of the block.[8] So the present study was undertaken to evaluate and compare the effect of height and weight adjusted dose versus fix dose of hyperbaric Bupivacaine 0.5% on maternal blood pressure, characteristics of sensory block and neonatal outcome during spinal anaesthesia for elective caesarean section. Additionally, the study aimed to compare the incidence of hypotension and requirement of vasopressor between the two groups.

MATERIALS AND METHODS

This prospective randomized observational study was conducted in 120 patients of ASA grade I & II undergoing elective caesarean section. Patients selected were singleton pregnant, weight between 50-110 Kg & height between 140 – 180cm. Patients with pregnancy induced hypertension, any cardiovascular co-morbidities, known central nervous system disease, coagulation disorder, allergy to local anaesthetic drug or patient not willing to take spinal anaesthesia were excluded.

All the patients underwent pre anaesthetic check-up, which include history taking, height and weight of parturient, and general and physical examinations with all routine investigations as per protocol. The detailed of anaesthesia technique and study protocol was explained to the patient and written informed consent was taken from patient and her relatives. All the patients were advised nil by mouth as per fasting guideline. Patients were randomly divided into two groups, using computer generated random number chart. Each group contains 60 patients.

Group FD (fixed dose): Patients were given intrathecal injection of 2 ml of 0.5% hyperbaric Bupivacaine (10mg). **Group AD (adjusted dose):** Patients were given height and weight-based dose (according to Harten's chart) of intrathecal injection of 0.5% hyperbaric Bupivacaine.

Harten's Chart[9]

Patient wt(kg)		Height(cm)								
		140	145	150	155	160	165	170	175	180
50		1.5	1.7	1.8	1.9					
55		1.5	1.6	1.8	1.9	2.0				
60		1.4	1.6	1.7	1.8	2.0	2.1			
65		1.4	1.5	1.7	1.8	1.9	2.1	2.2		
70		1.3	1.5	1.6	1.8	1.9	2.0	2.2	2.3	
75			1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4
80			1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.4
85				1.5	1.6	1.8	1.9	2.1	2.2	2.3
90				1.4	1.6	1.7	1.9	2.0	2.2	2.3
95					1.5	1.7	1.8	2.0	2.1	2.3
100					1.5	1.7	1.8	1.9	2.1	2.2
105						1.6	1.7	1.9	2.0	2.2
110							1.7	1.8	2.0	2.2

On arrival at the operation theatre, an intravenous line was secured with intravenous cannula no 18 and patients were pre-loaded with Ringer's lactate 10ml/kg. Pulse oximeter, non-invasive blood pressure cuff and ECG electrodes were applied. Baseline vitals were recorded. Inj. ondansetron 4mg was given to all patients before surgery. Lumber puncture was performed in sitting position with 23 G Quinke's spinal needle, under all aseptic precaution. After confirming free flow of CSF, selected drug was

injected in the subarachnoid space with bevel facing cephalad at a rate of 0.2 ml/sec. Patients were then immediately turned into the supine position with a 150 lateral tilt with a folded towel under the right buttock to prevent aortocaval compression. Oxygen administered at a flow of 4 L/min through venti mask. Sensory and motor block were assessed every 2 minutes interval up to 20 minutes and at the end of surgery. Motor block was assessed by modified Bromage scale (10) and time to reach grade 3 of Bromage scale was noted as onset of motor blockage. Surgical incision was allowed when loss of pin prick sensation reached the T6 dermatome. Intra operative vitals were noted. Heart rate < 60/ min was treated with 0.6mg i.v. atropine. Blood pressure > 20% decrease in baseline MAP or SBP< 100 mmHg was treated with 6mg i.v mephentermine. Incidence of hypotension and need of vasopressor were also noted If sensory blockade was inadequate 8 min after giving spinal anesthesia, 10^0 head down tilt was given. If discomfort was there during the operation, inj, fentanyl 50µg i. v. and nitrous oxide and oxygen 50%:50% were given via face mask. If discomfort continue, general anesthesia was given. After delivery of baby, oxytocin 20 U was given in 500 ml DNS. APGAR score of fetus was noted at 1min & 5 min after birth of baby.

At the time of shifting, post op vitals, level of sensory and motor blockade, analgesia if needed were noted. Post operative analgesia was provided with Diclofenac suppository 100 mg and 1 gm PCM iv when required.

Statistical Analysis: The data obtained was statistically analyzed using SPSS software. Data was expressed as mean and standard deviation or number and percentages. Data was compared using unpaired t test and chi square test. P value <0.05 was considered statistically significant (S) and P value <0.001 was considered highly significant (HS).

RESULTS

120 patients were divided into 2 groups of 60 each. Both groups were comparable with respect to age, height, weight, ASA grading and duration of surgery. There was no statistically significant difference in baseline hemodynamic parameters in both groups. There was highly significant difference (p value <0.001) between doses of bupivacaine between two groups to reach required level of sensory block. (table 1). Group FD was given 2 ml 0.5% bupivacaine while in group AD, mean required dose of bupivacaine was 1.65 ± 0.13 ml. Mean time from insertion of spinal anesthesia to incision (Time to loss pinprick sensation to T6) was 5.33 ± 1.35 min in group FD, while it was 7.43 ± 2.56 min in group AD, which was also highly significant. 6 patients in group AD required head down tilt after 8 min, while none of the patient in group FD required it. 2 patients in group FD and 4 patients in group AD needed supplementary analgesia, the difference was not significant. None of the patient required conversion to general anesthesia.

Table 1: Characteristics Of Sensory Block

	Group (FD)	Group (AD)	P value	Inference
Dose of Bupivacaine 0.5%; (ml) (Mean ± SD)	2	1.65 ± 0.13	0.0000001	HS
Time from insertion of spinal anaesthesia to incision (Time to loss pinprick sensation to T6) (min). (Mean ± SD)	5.33 ± 1.35	7.43 ± 2.56	0.00001	HS
Head down tilt used	0	6	0.0274	S
Supplementary analgesia	2	4	0.6749	NS
Conversion to general anaesthesia	0	0	1.0	NS

Figure 1: shows that in both groups mean HR decreases up to 18 to 20 min, then gradually increases and returns to near baseline value by the end of surgery. However the reduction was more pronounced in group FD

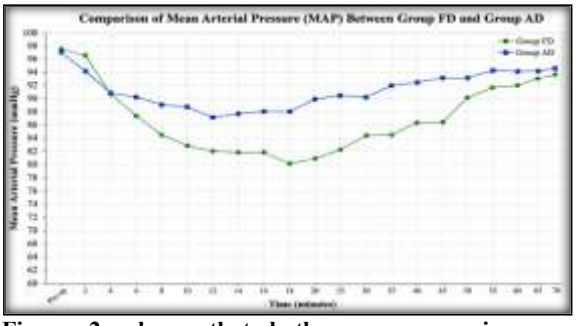

Figure 2: shows that both groups experience a downward trend in MAP. Group FD shows deeper downward slope than group AD. After 20 min, there is an increasing trend, which returns to near baseline value by the end of surgery.

Table 2: Need For Vasopressor

	Group (FD) (no. of patients)	Group (AD) (no. of patients)	P value
Inj. Mephentermine	12	2	0.0084

Hypotension was observed in 16 patients in group FD compared with 4 patients in group AD. Among which 12 patients in group FD and 2 patients in group AD required vasopressor support [Table 2]. Thus significant difference was found between two groups regarding incidence of hypotension (p value 0.006) and need of vasopressor (p value 0.0084).

Table 3: Neonatal Apgar Score

APGAR score	Group (FD)	Group(AD)	P value	Inference
1 min (Mean ± SD)	8.21 ± 0.51	8.28 ± 0.45	0.16	NS
5 min (Mean ± SD)	9.35 ± 0.47	9.35 ± 0.47	0.3	NS

Difference between APGAR score [Table 3] of both groups at 1 min and 5 min interval was not significant (p value >0.05)

Table 4: Complications

		Group (FD)		Group (AD)	
	No. of cases	%	No. of cases	%	P value
Nausea/Vomiting	14	23.33	3	5	0.004
Hypotension	16	26.67	4	6.67	0.006
Bradycardia	4	6.67	1	1.67	0.3644
Shivering	8	13.33	5	8.3	0.3782

[Table 4] shows that there was significant difference regarding complications like nausea/vomiting (p value 0.004) and hypotension (0.006) between both groups. Inj atropine for bradycardia was required in 4 patients in group FD, compared with only 1 patient in group AD, which is not significant.

In post-operative period, vitals between group FD and group AD remain same.

DISCUSSION

According to Stout's principle of spread of solutions [11] several factors influence the level of sensory block achieved following subarachnoid block. The extent of block is directly proportional to concentration, speed of injection, volume of drug, specific gravity of the solution and position of the patient. [4,5] The block level is also related to vertebral column length. It is known fact that spinal anaesthesia required is inversely proportional to weight and it is suggested that higher BMI might increase the risk of spinal hypotension.[9-11] Therefore, obese parturient requires lesser volume of a local anaesthetic to achieve the desired level of blockade as compared to lean or non-pregnant counterpart.[12] So this study was undertaken to compare the height and weight adjusted dose vs fixed dose of bupivacaine on incidence of complications following spinal anaesthesia for caesarean section.

Characteristics Of Sensory Block: Total dose of bupivacaine and Time to adequate block (T6): In our study, average total dose of Bupivacaine in group AD was 1.65±0.13 ml versus 2.0 ml in group FD, the difference is highly significant(P=0.0000001).

Thoracic block up to T6 (loss of pinprick sensation) has been accepted for cesarean section. J. M. Harten et al[9] studied that there was significant statistical difference (p value-0.02) in adequate block to T6 between fixed dose and adjusted dose groups. He found that the onset of sensory block was faster in FD group than with the AD group. Kiran Kumar KC et al[13] & A Subedi et al[14] 2011 also stated that there was significant statistical difference in time to insertion of spinal anesthesia to incision. Our study supports their study in a way that, in group FD it was 5.33 ± 1.35 min and in group AD it was 7.43 ± 2.56 min, which shows highly significant statistical difference (p value-0.00001). Perhaps the lesser spinal doses of heavy Bupivacaine in the adjusted group delayed the onset of the block. Our observation of a delayed onset time for adjusted dose Bupivacaine was similar to the study by above authors.

Head down tilt used: A Subedi et al,[14] studied that 12% patients in AD group required head down tilt after 10 minutes of intrathecal injection to attain T5 block height as compared to 2% in the FD group (p value-0.12). J. M. Harten et al [9] 2005 studied that 11.1% patients in AD group required head down tilt after 8 minutes of intrathecal injection compared to 0% in FD group(p=0.034). There was significant statistical difference between both groups in above studies regarding head down tilt. In our study, 10% patients in AD group required head down tilt after 8 minutes, while none of the patient required head down tilt in FD group (p value 0.02, significant difference), which supports their study.

Supplementary analgesia: Waqas Alam et al[3] studied that only 5% patients in group FD & 7.5% patients in group AD required supplementary analgesia, while none of the patient in any group required general anaesthesia. Our results are almost same. Supplementary analgesia (50% N2O+ 50% O2) required in group FD & group AD were 3.3 % & 6.3% respectively. So, there was also no statistical difference between two groups and none of the patient required general anaesthesia due to inadequate block in any group.

Hemodynamic parametres: [Figure 1] shows mean HR comparison and both groups experienced a progressive decrease in HR immediately following spinal anaesthesia, lasting up to 18 to 20 min., which gradual increases toward near baseline value by the end of surgery. Group FD exhibited a steeper decline during this initial window compared to group AD.

[Figure 2] shows that in both groups MAP progressive decreases up to 18 min, followed by an increasing trend, which returns to near baseline value by the end of surgery. J. M. Harten et al,[9] noted hypotension in 71.7% vs 50% of patients in the fixed dose and adjusted dose groups respectively (p=0.035). Etsuro Nagata et al,[15] studied that incidence of hypotension was significantly lower in 8 mg group (8 mg) (37%) than in 10 mg group (71%). A Nagraj, P Gupta et al,[16] found that 43% in fixed dose group had hypotension as compared to 20% in height and weight adjusted dose group. A Subedi et al,[14] studied that 32(64%) patients in FD group had hypotension than in 15(30%) patients in AD group. So there was significant statistical difference between two groups.

In our study, In group AD, there is low incidence of hypotension & decrease requirement of the vasopressors. P value of MAP in group AD, from baseline to 20 min & baseline to 40 min were 0.19 & 0.18 respectively and the difference was not statistical significant. But there was statistical significant difference in p value of MAP in group FD from baseline to 20 min(0.000064) & from baseline to 40 min (0.000024). Thus the reduction was less pronounced in group AD than group FD. 16(26%) patients in group FD & 4(6.6%) patients in group AD reported hypotension, among which 12 patients in group FD and 3 patients in group AD require vasopressor. Thus, there was significant statistical difference regarding hypotension between two groups. In postoperative period, there was no difference between mean HR and MAP between both groups.

Neonatal Outcome: A Subedi et al, E Nagata et al, A Nagrag et al,[14-16] found that there was no statistical significant difference in neonatal outcome based on APGAR score in both groups. Our study supports their study in a way that there was also no statistical significance difference regarding to APGAR score at 1 min and at 5 min interval between both groups.

Complications: Nausea/vomiting which was not much distressing, reported in 14(23.3%) patients in FD group, while 3 (5%) patients in AD group, the difference is significant with p value < 0.05. Patients were given inj pantaprazole for the same. There was significant statistical difference between two groups regarding hypotension, which was well explained previously. In group FD 4(6.6%) patients & in group AD 1(1. 67%) patient had bradycardia and required atropine. Shivering, though not disturbing, was reported in 8(13%) patients in FD group & 5 (8.3%) patients in AD group. Our results support the study of A Subedi et al,[14] who also noted that there was statistical significant difference in hypotension, nausea and vomiting, while there was no statistical significant difference in bradycardia and shivering among both of the groups.

CONCLUSION

The dose of intrathecal bupivacaine for spinal anaesthesia is influenced by both patient's height and weight. The height and weight-based algorithm of bupivacaine provided sufficient anaesthesia with a lower incidence of hypotension and lower need of vasopressor.

Limitation of our study: Parturients with height ≥ 180 cm or ≤ 140 cm, and weight > 110 kg or < 50 kg are not assessed in our study. Various height adjusted charts for calculating intrathecal bupivacaine have been described in the literature, but we have chosen the chart that was most appropriate for our study, which can achieve desired level of sensory block and prevent maternal discomfort.

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