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THE EFFECT OF HEIGHT AND WEIGHT ADJUSTED DOSE OF INTRATHECAL HYPERBARICBUPIVACAINE FOR ELECTIVE CAESAREAN SECTION

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ABSTRACT

Background: The commonly observed hypotension during spinal block, if uncorrected, causes adverse effects on the mother and the neonate. The means to reliably prevent maternal hypotension under spinal anesthesia continues to elude the practicing anesthesiologist. Thus, one of the important methods to reduce hemodynamic changes would be to limit wide spread sympathetic block during spinal anesthesia. This can be achieved by restricting the spinal segment block desired for a caesarean section. While some studies have identified the patient's height and the sensory block level as risk factors for the hypotensive episodes in the mother during caesarean section others have been inconclusive. Nevertheless, the use of a dose of hyperbaric bupivacaine adjusted to patient's weight and height has shown to limit the spinal segment block spread. The dose adjustment study has been based on a Caucasian population and Nepalese women. No such study has been based on Iraqi women, where height is generally shorter than that of Caucasian women. **Aim of the study:** The study compared spinal anesthesia using intrathecal hyperbaric bupivacaine between height and weight adjusted dose and fixed dose during caesarean section. **Methods:** eighty parturient, who were scheduled for elective caesarean section under spinal anesthesia, were randomly assigned into two groups. We adjusted the intrathecal dose of heavybupivacaine (0.5 %) according to the height and weight of patients (Group AD) from Harten's dose chart developed from the Caucasian parturient and the fixed dose (2.5 ml) was used in Group FD patients. Keeping the observer blinded to the study groups, the sensory block up to T10, were observed. **Results:** we found that statistical differences in visual analogue scores, shivering, Ephedrine use,nausea and vomiting were significant in all readings. While, differences in Diastolic blood pressure were significant at 3min., 6 min., 9 min., 12 min., and 15 min. readings, and were insignificant at 25 min., 35 min., and 45 min. readings. No significant statistical differences in systolic blood pressure were found in all reading. **Conclusions**: the heavy bupivacaine dose adjusted on the basis of the chart of Harten significantly decreased the bupivacaine dose requirement compared with the usual dose use, with lesser incidence of hypotension, nausea and vomiting, and shivering during cesarean delivery

KEYWORDS: Caesarean section, low-dose hyperbaric bupivacaine, spinal anesthesia.

INTRODUCTION

Spinal, epidural, and caudal neuraxial blocks result in sympathetic blockade, sensory analgesia, or anesthesia and motor blockade, depending on the dose, concentration, or volume of local anesthetic, after insertion of a needle in the plane of the neuraxis. Despite these similarities, there are significant physiologic and pharmacologic differences. Spinal anesthesia requires a small mass (i.e., volume) of drug, virtually devoid of systemic pharmacologic effect, to produce profound, reproducible sensory analgesia.[1]

More than 20 factors have been postulated to alter spinal anesthetic block height.[2,3]:

- Patient characteristics:
  - ❖ Age
  - ❖ Height
  - ❖ Weight
  - ❖ Gender

- ❖ Intra-abdominal pressure
- ❖ Anatomic configuration of the spinal column
- ❖ Position.
- Technique of injection:
- ❖ Site of injection
- ❖ Direction of injection (needle)
- ❖ Direction of bevel
- ❖ Use of barbotage
- ❖ Rate of injection
- Characteristics of spinal fluid:
- ❖ Volume
- ❖ Pressure (cough, strain, Valsalva maneuver)
- ❖ Density
- Characteristics of the anesthetic solution:
- ❖ Density
- ❖ Amount (mass)
- ❖ Concentration
- ❖ Temperature
- ❖ Volume
- ❖ Vasoconstrictors the most important documented factors known to influence block height:
- Controllable Factors:
- ❖ Dose (volume × concentration).
- ❖ Site of injection along the neuraxis.
- ❖ Baricity of the local anesthetic solution.
- ❖ Posture of the patient.
- Factors Not Controllable:
- ❖ Volume of cerebrospinal fluid.
- ❖ Density of cerebrospinal fluid.

Age has a statistically significant effect on block height, but when examined, the difference in block height with isobaric bupivacaine in patients in the third to ninth decades is small (i.e., T9 for those 20 to 28 years old and T6 for those older than 80 years).[4]

Unlike epidural dose requirements, weight is not related to block height during spinal anesthesia. Patient height is related, although the contribution is minor when compared with more importantfactors.[5]

Similarly, the injection rate and barbotage of isobaric and hyperbaric solutions have not been shown to affect block height, although injection rates in these studies have been greater than 0.1to 0.2 mL/sec.[6]

It is becoming clear that the direction of the laterally facing openings of spinal needles affects block height levels, even with isobaric spinal solutions.[7]

Other maneuvers that do not appear to affect block height are coughing and straining after local anesthetic injection. This is related to the physics of injecting drugs into a closed column of CSF, which instantaneously transmits pressure changes throughout the CSF column, such as those that occur with coughing or straining.[8]

Factors Probably Unrelated to Height of the Spinal Anesthetic Block.[2]

- Added vasoconstrictor
- Coughing, straining, or bearing down (labor)
- Barbotage
- Rate of injection (except hypobaric)
- Needle bevel (except Whitacre needles)
- Gender
- Weight

PATIENT AND METHODS

This prospective, randomized, double-blinded, clinical study was conducted at medical city complex, Baghdad teaching hospital, department of anesthesia and intensive care medicine, from1st of November 2012 to the end of February 2013. After approval of the study by the Board Committee and agreement of the department of anesthesiology and gynecology in Baghdad teaching hospital, 80 patients in the criterion of the American Society of Anesthesiology Physical Status I and II With term and full term uncomplicated single gestation scheduled for elective caesarean delivery under spinal anesthesia were enrolled in the study.

Patients with pre-existing or pregnancy-induced hypertension, cardio¬ respiratory problem and any contraindication to spinal block were excluded from the study. Since the Harten et al table of bupivacaine dose adjustment is limited between 50 to 110 kg body weight and 140 to 180 cm of height; patients out of this range were also excluded from the study.[9]

Patient Weight (kg)	Patient 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				
60	1.4	1.6	1.7	1.8	2	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	2.2	2.3	
75		1.4	1.6	1.7	1.9	2	2.1	2.3	2.4
80		1.4	1.5	1.7	1.8	2	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	2.2	2.3
95				1.5	1.7	1.8	2	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	2.2
110						1.7	1.8	2	2.2

Adjusted dose regimen for hyperbaric bupivacaine 0.5 % for caesarean section under spinal anesthesia, (values are in milliliters)

The patients were divided randomly into two equal groups of (40 adjusted-dose) and (40 fixed- dose), The patients were not aware of the group that they were in and the observer was also kept blinded for the bupivacaine dose injected by the anesthesiologist giving the spinal block. Group AD (adjusted dose) received intrathecal heavy bupivacaine (0.5 %) according to the height and weight of patient calculated from the Harten's dose chart developed from Caucasian parturient (above), and a fixed dose (2.5ml, 12.5 mg) was used in Group FD (fixed dose) patients.

All patients were premedicated with intravenous metoclopramide (10 mg) and ranitidine (50 mg)injections intravenously, 20 minutes before surgery. In the theatre, pulse oximetry, ECG (lead II) and non-invasive blood pressure (NIBP) were monitored. After recording the baseline hemodynamic values, a preloading infusion of Ringer's lactate (10 ml/kg) was given over 15 minutes through a peripheral 18-gauge intravenous cannula. Under full aseptic technique, a 22- gauge Quinke spinal needle was inserted into the LR3R -LR4R intervertebral space with the patient in the sitting position. After confirming a free flow of cerebrospinal fluid (CSF), hyperbaric bupivacaine (0.5%) was injected at a rate of approximately 0.2 ml/sec intrathecally.

The patients were then turned to the supine position with a left lateral uterine tilt with a folded towel beneath the right pelvic region.

The sensory block (loss of sensation to cold ice) was assessed along the mid-clavicular line every minute. The skin incision was allowed when the spinal block reached up to the thoracic (TR10R) level. If the desired level of block failed at the end of 4 minutes, the patients were positioned in the 10° head down tilt to attain the desired block level of TR10R. After the intrathecal injection, heart rate, arterial blood pressure and oxygen saturation were recorded at intervals 3 minutes for 15 min and then at 10-minute intervals till the end of surgery. Intraoperative pain was assessed with a 10 cm linear visual analogue scale (VAS), where 0 represented 'no pain' and 10 represented 'most severe pain'. Patients reporting intraoperative pain of VAS 3 - 7 were treated with a 0.25 mg/kg intravenous bolus dose of ketamine and 0.02mg/kg midazolam. If the pain still persisted, (VAS > 7), conversion to general anesthesia with a tracheal intubation was done and the patient was dropped from the study. Lactated Ringer's solution was used as the maintenance fluid during operation. After delivery of the baby and cord clamping, a slow bolus of 10U of oxytocin was administered followed by an infusion of 30 U. Hypotension was defined as a fall in systolic arterial pressure (SAP) by more than 20 % from the baseline value and was treated with an intravenous fluid and if not corrected ephedrine (5mg) is given. The incidence of other adverse effects was also noted.

All data were entered in a database of the statistical program SPSS-20/IBM for Windows for analysis. The data are presented as mean, standard deviation or frequencies as appropriate.

Categorical data were analyzed with T test as appropriate. A p value of < 0.05 was considered significant.

RESULTS

The mean age of adjusted -dose group was 26 years, while the mean age of the fixed-dose group was 25 years, statistically there is no significant difference between the two group, (p value >0.05).

Group	No.	Mean of height	Standard Deviation	P-Value
A.D	40	159.897	14.588	0.493
F.D	40	161.941	12.987	

Height

The mean height of the adjusted- dose group was 159 cm, while the mean height of the fixed- dose group was 161 cm, statistically there is no significant difference between the two group, (pvalue >0.05).

The mean weight of the adjusted –dose group was 79 Kg, while the mean weight of the fixed- dose group was 74 Kg, statistically there is no significant difference between the two group, (pvalue >0.05).

Group	No.	Mean of weight	Standard Deviation	P-Value
A.D	40	79.115	4.677	0.635
F.D	40	74.785	6.738	

Weight

	Group	No.	Mean	STD Deviation	P-Value
PR 3Min	A.D	40	91.7193	17.29962	.368
	F.D	40	100.7826	17.20454	
PR 6min	A.D	40	101.8947	22.51879	.882
	F.D	40	95.4348	21.32610	
PR 9min	A.D	40	102.5614	20.40747	.499
	F.D	40	99.3043	19.02256	
PR 12Min	A.D	40	104.9123	20.03593	.037
	F.D	40	100.1304	13.74873	
PR 15Min	A.D	40	105.0526	21.24804	.053
	F.D	40	99.9565	14.78783	
PR 25Min	A.D	40	101.7193	16.76386	.652
	F.D	40	102.5217	17.77606	
PR 35Min	A.D	40	104.5965	14.99745	.858
	F.D	40	103.2174	15.84285	
PR 45Min	A.D	40	106.1754	14.37026	.646
	F.D	40	101.1739	16.68601	

Statistical differences in Pulse Rate between adjusted-dose group and fixed-dose group wereinsignificant in all readings (p value >0.05) except for the 12-minute readings that were significant (p value <0.05).

Pulse rate

Statistical differences in systolic blood pressure between adjusted- dose group and fixed-dose group were insignificant in all reading (p value >0.05).

	Group	No.	Mean	STD Deviation	P-Value
Sys 3Min	A.D	40	110.2632	24.03385	.386
	F.D	40	100.8696	20.02114	
Sys 6min	A.D	40	104.5439	18.95584	.639
	F.D	40	92.0000	20.38939	
Sys 9min	A.D	40	108.2632	21.19006	.973
	F.D	40	99.4348	26.77826	
Sys 12Min	A.D	40	112.7368	14.10740	.916
	F.D	40	100.1739	17.64975	
Sys 15Min	A.D	40	114.4211	15.18334	.548
	F.D	40	103.4348	19.29632	
Sys 25Min	A.D	40	116.6140	12.34729	.505
	F.D	40	107.5217	15.48862	
Sys 35Min	A.D	40	116.4912	10.67896	.556
	F.D	40	105.6087	13.99266	
Sys 45Min	A.D	40	117.0351	11.37504	.219
	F.D	40	110.2174	10.56132	

Systolic pressure

Statistical differences in Diastolic blood pressure between adjusted- dose group and fixed-dosegroup were significant at 3min., 6 min., 9 min., 12 min., and 15 min. readings (p value<0.05). And were insignificant at 25 min., 35 min., and 45 min. readings (p value>0.05). This could beattributed to aggressive treatment of hypotension by vasopressor and intravenous fluid.

	Group	No.	Mean	STD Deviation	P-Value
Dia 3Min	A.D	40	59.4912	19.76118	.004
	F.D	40	54.0000	20.35592	
Dia 6min	A.D	40	60.1228	19.73672	.0045
	F.D	40	45.2174	12.06406	
Dia 9min	A.D	40	63.0877	14.57037	.003
	F.D	40	47.9130	14.11612	
Dia 12Min	A.D	40	59.7018	15.17160	.003
	F.D	40	46.4783	11.43308	
Dia 15Min	A.D	40	59.5439	15.10921	.001
	F.D	40	50.2174	9.89011	
Dia 25Min	A.D	40	65.1053	12.53664	.112
	F.D	40	54.0870	11.76634	
Dia 35Min	A.D	40	67.3333	10.10186	.792
	F.D	40	50.9130	13.31750	
Dia 45Min	A.D	40	68.1053	11.19101	.835
	F.D	40	55.3913	5.75041	

Diastolic pressure

Group	Level of block	No. of patient	Percent
Adjusted dose	T3	0	0%
	T4	4	10%
	T5	8	20%
	T6	16	40%
	T7	8	20%
	T8	4	10%
Fixed dose	T3	4	10%
	T4	12	30%
	T5	16	40%
	T6	6	15%
	T7	2	5%
	T8	0	0%

Sensory level of block in each group

DISCUSSION

The main finding of this study was that the dose adjustment of intrathecal heavy bupivacaine on the basis of the Harten chart significantly reduced bupivacaine requirement for caesarean section. The quality of anesthesia was similar in both the dose-adjusted and fixed-dose groups. The incidence of hypotension and the need for the use of a vasoconstrictor was more in the fixed dose group patients than in the dose- adjusted group. Thoracic block up to TR10R for loss of sensation to cold has been accepted for caesarean section. So, the dermatome TR10R block was targeted before allowing surgery.

The spinal anesthesia was adequate in the majority of our patients. Only few patients in the dose-adjusted group (4 patient) complained of pain and required intravenous ketamine and midazolam supplementation, and 12 patients in fixed-dose group need intravenous ketamine and midazolam sedation because anxiety and restlessness that develop after nausea and vomiting which occur more frequently in that group.

3 patients in the dose- adjusted group and 2 patients in fixed-dose group develop sever pain (VAS>7) and considered as failed spinal and converted to general anesthesia and excluded fromour study.

We noticed that there is higher incidence of hypotension in the fixed-dose group patients with the greater incidence of higher spinal block level reaffirmed that the high level of spinal block is the potential risk factor for the intraoperative hypotension. Other intraoperative side effects like nausea and vomiting during spinal anesthesia in caesarean section is multifactorial. The high incidence of nausea and vomiting in the fixed- dose group of our study could be attributed to the greater reduction in arterial blood pressure in the fixed-dose intrathecal block. A reduction in incidence of nausea and vomiting with controlled arterial blood pressure. Further explains a reduction in the incidence of nausea and vomiting in patients where the bupivacaine dose was adjusted for the height and weight, with better hemodynamics.

Our study has the limitation of the small group of patients studied and a multi-center trial is needed before making any recommendations for the general practitioners practicing spinal anesthesia in Iraq.

Subedi A **et al found that** the bupivacaine dose was significantly reduced on its dose adjustment for the body weight and height of patients for cesarean section. This adjusted-dose use suitably restricted spinal block level for cesarean section with a distinct advantage of less hypotension and with a similar neonatal outcome as fixed compared with the dose use.[10]

Mhamed S. Mebazaa **et al found that** a dose of 7.5 mg of isobaric bupivacaine for caesarian section reduced incidence of hypotension, nausea and vomiting and improved patient satisfaction.[11]

IHEB LABBENE **et al** suggest that the use of a low dose of bupivacaine (5 mg) added to fentanyl (25 µg) for endoscopic urological surgery, resulted in short-acting sensory block, without motor block and a lower incidence of cardiovascular side effects, as compared to eitherof 7.5 or 10 mg bupivacaine with 25 µg fentanyl.[12]

Yehuda Ginosar **et al. found that** The ED95 of intrathecal bupivacaine under the conditions of this study is considerably in excess of the low doses proposed for cesarean delivery in some recent publications. When

doses of intrathecal bupivacaine less than the ED95, particularly nearthe ED50, are used, the doses should be administered as part of a catheter- based technique.

Although no clear advantage for low doses could be demonstrated (hypotension, nausea, vomiting, pruritus, or maternal satisfaction), this study was underpowered to detect significancein these variables.[13]

Turhanoglu S, Kaya S, Erdogan H. Found that the development of hypotension after spinal blockin subjects undergoing cesarean section was not prevented despite low-dose (4 mg) bupivacaine plus 25 microgram fentanyl, but the severity of maternal hypotension, and the number of ephedrine treatments and the total dose of ephedrine were decreased.[14]

Ben David et al. found that with low-dose bupivacaine plus fentanyl, 8 out of 16 patients notedtransient pain or pressure with stretching of the incision and/or with uterine fundal pressure at delivery.[15]

CONCLUSION

Our study has highlighted that the heavy bupivacaine dose adjusted on the basis of the Harten's Chart significantly decreased the bupivacaine dose requirement though the chart was developed upon Studies of Caucasian women. Yet, it was more effective in our patients for its selective segmental spinal spread of the block than the uniform dose used, a lesser incidence of hypotension, nausea and vomiting and shivering during cesarean delivery.

Recommendation

We wish to recommend use of a modified dose of heavy bupivacaine, according to the weight and height chart, for its distinct advantages of a lesser incidence of hypotension and nausea and vomiting during cesarean delivery.

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