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COMPARISON OF EFFECT OF HEIGHT ADJUSTED DOSE VERSUS HEIGHT AND WEIGHT ADJUSTED DOSE OF 0.5% BUPIVACAINE HYDROCHLORIDE (HEAVY) ON SPINAL ANAESTHESIA FOR ELECTIVE CAESAREAN SECTION

Anaesthesiology

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ABSTRACT

INTRODUCTION:

Bupivacaine is commonly used in spinal anaesthesia for caesarean sometimes in combination with opioids. Most common adverse effect is significant incidence of hypotension. Maternal hypotension causes decreased placental perfusion which leads to adverse foetal outcome and may present with maternal vomiting, nausea and dizziness. Many spinal anaesthesia dosing regimen have been studied for caesarean section. While a fixed dose is preferred by some anaesthesiologists, others adjust the dose based on patient characteristics. Previous studies have confirmed that the final level of the block can be predicted by patient height and weight and would allow adequate segmental spinal spread with a decreased incidence of maternal hypotension. In some studies, local anaesthetic dose has been adjusted with height alone. However, whether level of the block is related to patient height and weight or height only is controversial. The purpose of this study was to determine the best dosing regimen with adequate anaesthesia and minimal side effects.

MATERIALS AND METHODS:

This was a randomized controlled study which was performed over a period of 18 months from September 2016 to march 2018 in Department of Anesthesiology, Krishna Institute of Medical Sciences University, Karad after approval of ethical committee of the institution.100 parturients posted for elective caesarean section after considering inclusion and exclusion criteria were divided into two groups (group I and II) of 50 each. Group I was given 0.5% hyperbaric bupivacaine, dose adjusted to height and weight and group II was given 0.5% hyperbaric bupivacaine, dose adjusted to height only. Time required to achieve adequate sensory block (T5), maximum level of sensory block and time required to attain maximum sensory block, total duration of sensory block, time required to attain complete motor block, total duration of motor block, and haemodynamic parameters including incidence of hypotension were noted. Other adverse effects like bradycardia, nausea and vomiting and neurological sequelae were recorded.

RESULTS:

The incidence of hypotension was more in height adjusted dose group (48% vs. 30%) but was not statistically significant. There was no significant difference in heart rate, SBP, DBP and MAP between two groups. The onset time for adequate sensory and motor block was longer in height adjusted dose group (4.44±0.99 minutes in group II vs. 4.18±1.7 minutes in group I and 2.21±0.45 in group II vs.2.10±0.5 in group I respectively) but was not statistically significant. In group I, 2% achieved maximum sensory block of T3, 32% attained T4 and 66% attained T5, while in group II, 2% attained maximum sensory block of T3, 38% attained T4 and 60% attained T5 .Time to attain maximum sensory block was more in height adjusted dose group (5.16±1.22 minutes vs. 4.86±1.49 minutes in group I) but was not statistically significant. The duration of sensory block at T5 and total duration of sensory block was more in weight and height adjusted dose group (64.39±17.65minutes in group I vs. 55.31±10.04 minutes in group II and 156.33±20.57 minutes in group I vs. 148.88±15.45 minutes in group II respectively) which was statistically significant. The total duration of motor block was more in weight and height adjusted dose group (127.96±19.69 minutes vs. 125.20±17.56 minutes in group II) but was not statistically significant. Incidence of bradycardia was more in height adjusted dose group (6% vs.2% in group I) and shivering was more in weight and height adjusted dose group (10% vs, 2% in group II) but was not statistically significant.

CONCLUSION:

Bupivacaine dose for spinal anaesthesia can be calculated based on height and weight or height alone. The study reveals that height and weight based dose can be superior.

KEYWORDS

0.5% Hyperbaric Bupivacaine hydrochloride,Elective caesarean section,Height and weight adjused dose,Height adjusted dose,Spinal anaesthesia

INTRODUCTION

The delivery of a baby to a conscious and pain free mother is one of the most exciting and rewarding moments in medicine. In the recent decades, there has been a worldwide shift in obstetric anaesthesia practice in favour of regional anaesthesia with spinal anaesthesia being the most popular among them [1].

Spinal anaesthesia was introduced into clinical practice by German Surgeon, Karl August Bier in 1898. More than a century has passed and today it is one of the most popular techniques for lower limb and lower abdominal procedures including caesarean section. Popularity is due to its advantages like simplicity, speed, reliability, minimal foetal exposure to depressant drugs, awake parturient and reduced hazards of aspiration [2].

Bupivacaine is commonly used in spinal anaesthesia for caesarean sometimes in combination with opioids. Most common adverse effect is significant incidence of hypotension which occurs due to sympathetic blockade. Maternal hypotension causes decreased placental perfusion which leads to adverse foetal outcome and presents as maternal vomiting, nausea and dizziness [3][4]. Many studies on spinal anaesthesia dosing have been done for caesarean section, while a fixed dosing regimen is preferred by some anaesthetists, others adjust the dose based on patient characteristics

[5]. Adjusted dosage is supported by haemodynamic data and also shows that the time to attain a suitable sensory block level for surgery correlates directly with height and inversely with weight [6].

Previous studies have confirmed that final level of the block can be predicted by patient height and weight and would allow adequate segmental spinal spread with a decreased incidence of maternal hypotension [7]. In some studies, local anaesthetic dose has been adjusted with height alone [8]. However, whether level of the block is related to patient height and weight or height only is controversial. The purpose of this study was to determine whether height adjusted dose or height and weight adjusted dose of bupivacaine is better for caesarean section.

MATERIALS AND METHODS

This was a randomized controlled study which was performed over a period of 18 months from September 2016 to march 2018 in Department of Anesthesiology, Krishna Institute of Medical Sciences, Karad after approval of ethical committee of the institution. Sample size was calculated to detect 30% difference in the incidence of hypotension between two groups for alpha value 0.05 and power of

80% (and based on previous study [11]) was total of 84 patients. We included a total of 100 patients for the study. 100 parturients posted for elective caesarean section after considering inclusion and exclusion criteria were divided into two groups (group I and II) of 50 each on basis of random sampling done with Microsoft Excel software. Group I was given 0.5% hyperbaric bupivacaine, dose adjusted to height and weight and group II was given 0.5% hyperbaric bupivacaine, dose adjusted to height only. All the patients were evaluated prior to surgery. The procedure and possible complications associated with the procedure were explained to patient. Written informed consent was obtained. Patients were asked to maintain nil per oral status for 8 hours preoperatively. Time required to achieve adequate sensory block (T5), maximum level of sensory block and time required to attain maximum sensory block, total duration of sensory block, time required to attain complete motor block, total duration of motor block, and haemodynamic parameters including incidence of hypotension were noted. Other adverse effects like bradycardia, nausea and vomiting and neurological sequelae were recorded. Statistical analysis was done by descriptive statistics as mean, SD.Onset and duration of sensory and motor block were analysed by students unpaired t-test For haemodynamic parameters, general linear model for repeated measures in SPSS version 22 was used (IBM Inc, Chicago, Illinois)and for maximum sensory blockade attained and adverse effects Fischer exact test was used

In Group 1 the local anaesthetic dose was adjusted according to height and weight in accordance with Harten's dose chart (Table 1)[12].
Harten's dose chart

Table 1.Weight- and height-adjusted 0.5% bupivacaine dosing regimen in ml for spinal anaesthesia in women undergoing caesarean Section.

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
	(Values are in milli liters)								

In Group 2 pregnant ladies were given local anaesthetic dose adjusted according to height only (table 2).

Table 2.Bupivacaine dose adjusted according to height only [8].

Patient height in (cm)	Bupivacaine Dose in (mg) with Respect to Patient Height	Bupivacaine Dose in (ml) with Respect to Patient Height
140	7.0	1.4
145	7.2	1.4
150	7.5	1.5
155	7.7	1.5
160	8.0	1.6
165	8.2	1.6
170	8.5	1.7
175	8.7	1.7
180	9.0	1.8

Inclusion criteria:
- Singleton pregnancies with maternal age 20-35 yrs
- ASA physical status I and II
- Elective caesarean section
- Those giving written and informed consent
- Weight between 50kg to 110 kg
- Height between 140 cm to 180cm

Exclusion criteria:
- Hypertensive disorders in pregnancy
- Cardiovascular co-morbidities
- Contraindications to neuraxial block
- Allergy to local anaesthetic drug

DEFINITION OF VARIABLES USED AS PARAMETERS
- Time of onset of sensory block at T5: Is the time from intrathecal injection of drug to loss of pin prick sensation at T5 dermatomal level.
- Maximal sensory level: Maximum sensory dermatomal level achieved following intrathecal injection of drug measured when dermatomal level of sensory block remains same at successive two points of time.
- Time to achieve maximal sensory block: Is the time taken from intrathecal injection of drug to loss of pin prick sensation at highest dermatomal level.
- Duration of sensory block at T5: Is the time from onset of sensory block till time of complete return of sensations at T5 level.
- Total duration of sensory block: Is the time from onset of action of drug to complete return of sensations.
- Onset of motor block: Is the onset of complete motor paralysis achieved till time of free movement of legs (Grade 3 modified Bromage scale).
- Total duration of motor block: Return to Grade 0 of modified Bromage scale

Table 3: Modified Bromage scale

MODIFIED BROMAGE SCALE	
Grade 0	No motor block.
Grade 1	Inability to raise extended leg, able to move knees and feet.
Grade 2	Inability to raise extended leg and move knees, able to move feet.
Grade 3	Complete motor block, unable to move legs or feet.

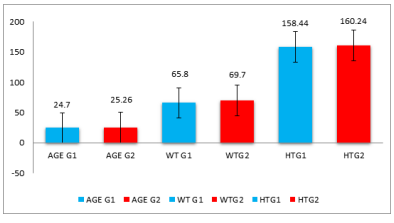
RESCUE PLAN
Whenever the mean BP was below 20% of base line of mean blood pressure, it was considered hypotension and 6mg injection mephentermine was given intravenously with IV fluids as required.Whenever heart rate went below 50 per minute, bradycardia was considered and 0.5mg of atropine was administered intravenously.

RESULTS
COMPARISON OF DEMOGRAPHIC CHARACTERISTICS:
Hundred women with singleton pregnancies, 50 in each group, were analyzed. Age, weight and height characteristics of both groups were comparable .

Table 4: Comparison of demographic parameters between two groups:

Parameters	Group I (n=50)	Group II (n=50)
	Mean ± SD	Mean ± SD
Age in years	24. 7±2.78	25.26±3.36
Weight in kg	65.8±10.91	69.3±12.60
Height in cm	158.24±7.41	160.24±6.897

Graph 1: Comparison of mean values of age, weight and height between two groups



The age of parturients ranged from 20-35 years. Their mean age in group I was 24.7 (SD 2.78) years, in group II was 25.26 (SD 3.36)

years.

The weight of parturients ranged from 50-100 kg. The mean weight in group I was 65.8(SD 10.91) and in group II was 69.3 (SD 12.60) kg.

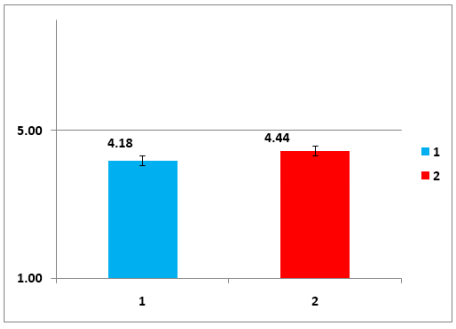
The height of parturients ranged from 145-175cm. The mean height in group I was 158.24(SD7.41) and in group II was 160.24 (SD 6.897) cm. Hence, age, weight and height were comparable in all the two groups.

COMPARISON OF SENSORY BLOCKADE
COMPARISON OF TIME TO ONSET AT T5 (in minutes)

Table 5: Comparison of means of time to achieve adequate block (T5)

GROUPS	MEAN	SD	P VALUE
1	4.18	1.17	0.26
2	4.44	0.99	

Graph 2: Comparison of mean time to achieve adequate block in both groups



The difference in mean time to achieve adequate block was greater in group 2 and was statistically not significant (P = 0.26).

COMPARISON OF MAXIMUM LEVEL OF SENSORY BLOCKADE ATTAINED

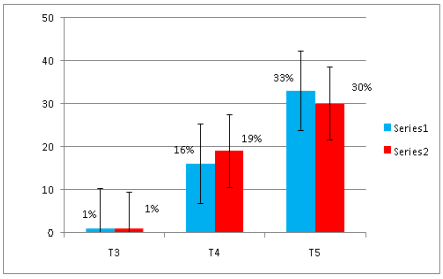
The block was achieved at T4 in 16 patients (32%) in the group whose anaesthesia was dosed based on height and weight and in 19 (38%) in the group with dosages based on height alone.

Table 6: Comparison of maximum sensory levels obtained between two groups:

Level of Blockade	Group I	Group II
T3	1 (2%)	1 (2%)
T4	16 (32%)	19(38%)
T5	33 (66%)	30(60%)

Fisher Exact probability: 0.83515621

Graph 3: Comparison of maximum sensory blockade level attained in both groups:



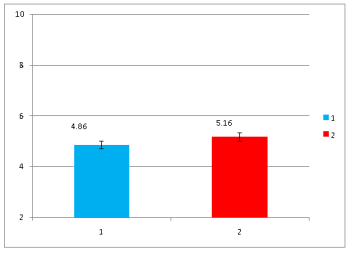
The level of sensory block obtained in both the groups were comparable and statistically insignificant and most of the parturients had an average blockade level of T5 (Fisher Exact probability: 0.84)

COMPARISON OF TIME TAKEN TO ACHIEVE MAXIMUM LEVEL OF SENSORY BLOCK (in minutes)

Table 7: Comparison of time taken to achieve maximum level of sensory block:

GROUP	MEAN	SD	P VALUE
1	4.86	1.49	0.27
2	5.16	1.22	

Graph 4: Comparison of time taken to achieve maximum level of sensory block:



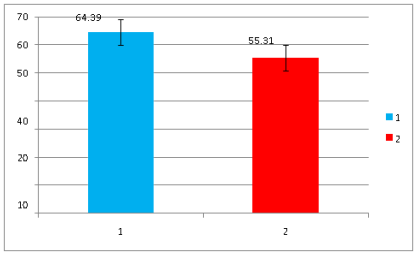
The difference in the time taken to reach maximum level of sensory blockade was more in group II but it was statistically not significant (p value 0.27).

COMPARISON OF SENSORY BLOCK DURATION AT T5 IN BOTH GROUPS (in minutes)

Table 8: Comparison of sensory block duration at T5:

GROUP	MEAN	SD	P VALUE
1	64.39	17.65	0.002693
2	55.31	10.04	

Graph 5: Comparison of duration of sensory block at t5 in both groups:



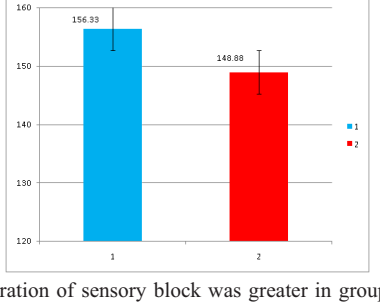
The duration of sensory blockade at T5 was greater in group I and was found to be statistically significant (p value 0.003).

COMPARISON OF TOTAL DURATION OF SENSORY BLOCKADE (in minutes)

Table 9: Comparison of total duration of sensory block:

GROUP	MEAN	SD	P VALUE
1	156.33	20.57	0.047
2	148.88	15.45	

Graph 6: Comparison of total duration of sensory block:



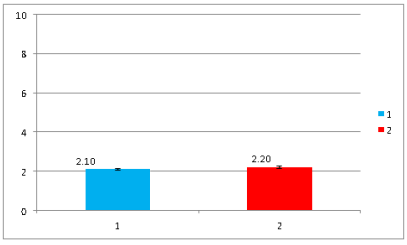
The total duration of sensory block was greater in group I and was statistically significant (p value 0.047)

COMPARISON OF MOTOR BLOCK
COMPARISON OF ONSET OF MOTOR BLOCK (in minutes)

Table 10: Comparison of onset of motor blockade:

GROUP	MEAN	SD	P VALUE
1	2.10	0.5	0.319
2	2.21	0.45	

Graph 7: Comparison of onset of motor block:



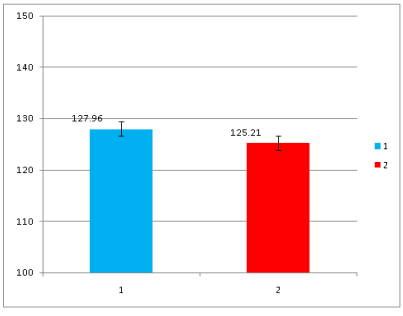
Difference in time for onset of motor block between two groups was not statistically significant (p value 0.32).

COMPARISON OF TOTAL MOTOR BLOCK DURATION (in minutes)

Table 11: Comparison of total motor block duration:

GROUP	MEAN	SD	P VALUE
1	127.96	19.69	0.460
2	125.20	17.56	

Graph 8: Comparison of total motor block duration:



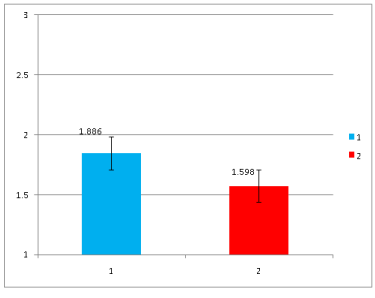
The difference in total motor block duration between two groups was not statistically significant (p value 0.46).

COMPARISON OF MEAN DRUG VOLUME IN BOTH GROUPS (in ml)

Table 12: Comparison of mean drug volume in both groups:

GROUP	MEAN	SD	P VALUE
1	1.886	0.15	5.85
2	1.598	0.09	

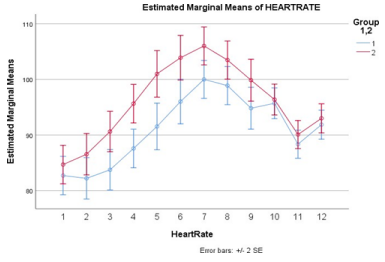
Graph 9: Comparison of mean drug volume in both groups:



Mean of drug volume used was more in group I.

COMPARISON OF HEART RATE

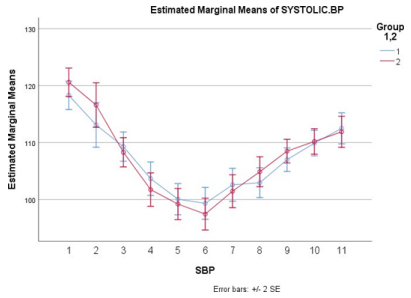
Graph 10: COMPARISON OF HEART RATE



No significant difference was found in mean heart rate between groups.

COMPARISON OF SYSTOLIC BP

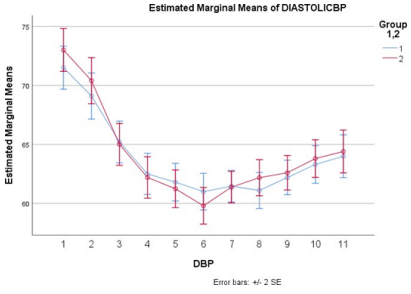
Graph 11: COMPARISON OF SYSTOLIC BP:



No significant difference was found between means of systolic blood pressure between group I and group II.

COMPARISON OF DIASTOLIC BP

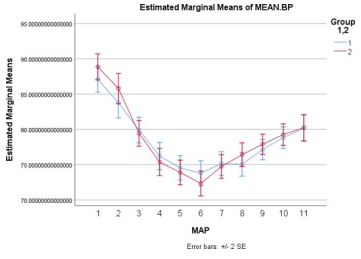
Graph 12: COMPARISON OF DIASTOLIC BP:



No significant difference was there between means of diastolic blood pressure between group I and group II

COMPARISON OF MAP

Graph 13: COMPARISON OF MAP:



No significant difference was there between means of mean arterial pressure between group I and group II.

COMPARISON OF INCIDENCE OF HYPOTENSION

TABLE 13 : COMPARISON OF INCIDENCE OF HYPOTENSION:

Hypotension	Sum of Group1	Sum of Group 2
No	35(70%)	26(52%)
Yes	15(30%)	24(48%)
Grand Total	50	50

p=0.1004

30% in group I and 48% in group II had hypotension showing 18% difference which was statistically insignificant.

COMPARISON OF OTHER ADVERSE EFFECTS

BRADYCARDIA

TABLE 14: COMPARISON OF INCIDENCE OF BRADYCARDIA:

Bradycardia	Sum of Group1	Sum of Group 2
No	49(98%)	47(94%)

Yes	1(2%)	3(6%)
Grand Total	50	50

p value:0.617
2% in group I and 6% in group II had bradycardia which was statistically insignificant.

SHIVERING
TABLE 15: COMPARISON OF INCIDENCE OF SHIVERING

Shivering	Sum of Group 1	Sum of Group 2
No	45(90%)	49(98%
Yes	5(10%)	1(2%)
Grand Total	50	50

p value:0.204
10% in group I and 2% in group II had shivering which was statistically insignificant.

None of them had nausea, vomiting or neurological sequelae.

DISCUSSION

A wide range of bupivacaine dosing regimens has been used for spinal anaesthesia during caesarean section. Fixed dose bupivacaine is commonly used by anaesthesiologists with preloading and use of titrated doses of vasopressors to tackle hypotension. Various studies are there on dose reduction of bupivacaine, of which modifying dose according to height and weight has gained attention recently. Dose adjustment studies considering height as the only parameter has also been done. Studies show that spinal anaesthesia dose requirement is directly proportional to height and inversely proportional to weight. We compared height and weight-adjusted dose of bupivacaine with height adjusted dose in our study.

In routine clinical practice, we tend to use 2.2 ml (11mg) bupivacaine. This study shows that bupivacaine dose for caesarean section can be calculated using height and weight or height alone and at the same time provide adequate sensory blockade in an acceptable time with less adverse effects. In our study, mean of the doses that was used in height and weight adjusted dose group was 1.886ml (9.43mg) and in height adjusted dose group was 1.598 ml (7.99mg).

The difference in time of onset of adequate sensory block (T5) between both group were statistically insignificant. This result was comparable with the study of Leo et al[10] (2009)where time taken to reach adequate anaesthesia in all the 7mg, 8mg and 9 mg 0.5% bupivacaine groups had equally rapid onset.

Mean time to attain maximum sensory blockade was less in height and weight adjusted dose group compared to height adjusted dose group and was not statistically significant, which was comparable with study of Kiran et al [9] (2002).

The mean time to attain complete motor blockade didn't differ between the two groups.

Difference between means of heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were insignificant and were comparable with study of Siddiqui et al [11] (2016).

Hypotension occurred among 30% (15 patients) of the height and weight adjusted dose group and among 48% (24 patients) of the height adjusted dose group but was not statistically significant (p value 1.004).This was comparable with similar study of Siddiqui et al [11](2016) where incidence of hypotension was more in height adjusted dose group.

Other adverse effects like bradycardia were more in group II than in group I, but this was statistically not significant. Shivering was more in group I than in group II, but was not statistically significant. None of them had nausea vomiting or neurological sequelae.

Duration of sensory block at T5 was more in weight and height adjusted group than height adjusted dose group and the difference between two groups were found to be statistically significant(p value 0.003).This was comparable with study of Kiran et al [9](2002)

Total duration of sensory and motor block were more in height and weight adjusted group than in height adjusted group .This was comparable with study of kiran et al [9](2002) where duration of motor block was comparatively more in 10mg group than 8.75 mg and 7.5 mg group.

Although 18% difference in the incidence of hypotension was not statistically significant, it could imply that height and weight based calculation of bupivacaine dose is marginally superior and this difference probably would have resulted in statistical significance if more sample size were taken. So, further studies can be done with higher sample size in this area.

CONCLUSION

Bupivacaine dose for spinal anaesthesia can be calculated based on height and weight or height alone. The study reveals that height and weight based dose can be superior.

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