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CORRELATION OF BODY MASS INDEX, VERTEBRAL COLUMN LENGTH AND HIP-SHOULDER WIDTH RATIO WITH THE SPREAD OF SUBARACHNOID BLOCK IN ELECTIVE LOWER SEGMENT CAESAREAN SECTION.

Anaesthesiology

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ABSTRACT

The spread of local anaesthetics in the subarachnoid space for a given dose of a local anaesthetic drug is affected by various factors. Therefore, the prospective observational study was designed to correlate body mass index, vertebral column length and hip-shoulder width ratio with the spread of subarachnoid block in term parturients posted for elective lower segment caesarean section. Hundred term parturients undergoing elective cesarean section were enrolled in this prospective observational study, Spinal anesthesia was performed with 10 mg (2 ml) of 0.5% hyperbaric bupivacaine in L2-L3 or L3-L4 interspace using a 25 G Quincke needle. The cephalad spread (loss of pinprick discrimination) was assessed up to 30 minutes after spinal anaesthesia. Pearson and Spearman's correlation coefficient was used to analyze the relationship between age, weight, height, body mass index (BMI), VCL (C7-Sacral hiatus and C7-iliac crest), HSR and the spread of spinal anesthesia. The correlation of the spread of the spinal anaesthesia with weight, BMI & HSR was found to be significant (p 0.05) in our study. We conclude that there is significant correlation of weight, body mass index, hip width, shoulder width and hip-shoulder width ratio with the spread of subarachnoid block in term parturients undergoing elective lower segment caesarean section.

KEYWORDS

Subarachnoid block, Vertebral column length, 0.5% hyperbaric bupivacaine

INTRODUCTION:

Regional anaesthesia is the preferred anaesthetic technique for lower segment caesarean section. Many of the physiological changes that occur during pregnancy predict the spread of subarachnoid block in parturients (1). Furthermore, subarachnoid block offers less neonatal exposure to potentially depressant drugs and allows early bonding between mothers and their newborns, as mothers are awake throughout the procedure (2).

Effective surgical anaesthesia is the primary objective of spinal technique and it must be accomplished while minimizing maternal and neonatal side effects. Inadequate sensory blockade will cause parturient to suffer from pain and requires supplementary analgesia while excessive blockade will lead to unwanted sympathetic inhibition and undesirable side effects such as nausea, vomiting and delayed motor recovery. Moreover, hypotension which is the most common side effect of sub arachnoid block can adversely affect maternal and neonatal outcomes.

The spread of local anaesthetics in the subarachnoid space for a given dose of a local anaesthetic drug is affected by various factors. Patient's age, weight, height, body mass index, posture of the patient, vertebral column length, baricity of the local anaesthetic agent, technique of injection has shown to affect the spread of subarachnoid block by hyperbaric local anaesthetic solution. Pregnancy itself is one of the factors influencing the distribution of local anaesthetic solutions in cerebrospinal fluid since hormonal and anatomical changes occur during pregnancy. At term, there is increase in hormone relaxin which leads to widening of hips and relaxation of pubic symphysis (3). Hence, a considerable variability in the maximal dermatomal extent of anaesthesia can be expected after subarachnoid block with hyperbaric local anaesthetic agent in term parturients. Mark Norris significantly correlated the spread of hyberbaric bupivacaine with the height and weight (4). Ting-ting et al found a positive correlation of the spread of subarachnoid block with the vertebral column length (5). Similarly, Lamon AM et al in 2017 and Chao A et al in 2020 studied the effect of body mass index and the spread of subarachnoid block in term parturients (6,7).

Therefore, the prospective observational study was designed to correlate body mass index, vertebral column length and hip-shoulder width ratio with the spread of subarachnoid block in term parturients posted for elective lower segment caesarean section.

MATERIAL AND METHODS:

After obtaining approval from the Institutional Research Ethical board and written informed consent, this prospective observational study was conducted from Nov 2018 to Aug 2020. In the study by Canturk M. et al (3), the minimum considered 5% level of significance and 80% power value then require sample size will be 97. Considering 10% dropouts due to requirement of rescue position or general anaesthesia it can be suggested to consider 100 subjects included in this study. A total of 100 parturients aged 18–40 years, at term (≥ 37 weeks gestation), American Society of Anaesthesiologists (ASA) physical status I and II, undergoing elective cesarean section under spinal anaesthesia, were assessed for eligibility. Parturients with medical comorbidities (hypertension, cardiac disorders, renal and hepatic disorders), obstetric comorbidities (preeclampsia/eclampsia, gestational diabetes mellitus, twin pregnancy), and fetal abnormalities were excluded from the study. Patients having a contraindication to spinal anaesthesia and known allergy to study drugs were also excluded from the study.

Parturients were explained about anthropometric measurements and spinal anaesthesia (SA) a day prior to surgery. Parturients were kept fasting for six hours for both solids and liquids. All demographic parameters like age, weight in Kg, height in centimetres and BMI were noted. On the day of surgery, intravenous (IV) cannulation was done with an 18-gauge cannula in the pre-anesthetic room, and anthropometric measurements were taken by the anesthesiologist who was not involved in giving spinal anesthesia and data collection. Vertebral column length was measured from the C7 prominence to Sacral hiatus (VCL1 = C7-SH) and to Iliac crest (VCL2 = C7-IC) in a sitting position. Hip width was measured as the highest point between two iliac crests, and shoulder width was measured between the two acromion processes. Hip/shoulder width ratio was calculated. Ringer Lactate solution @10 mL/kg was infused over 30 minutes before SA in the pre-operative room. Patient was shifted to the operating room, and baseline values of hemodynamic variables [Heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP),ECG, Mean arterial pressure (MAP), SPO2] were recorded.

Spinal anesthesia was performed by an anesthesiologist who was not involved in anthropometric measurements. Subarachnoid block was given to term parturients under all aseptic precautions with 25G Quincke's spinal needle at L3-L4 interspace using a midline approach. After confirming free and clear flow of CSF with the bevel of the spinal needle turned cephalad, 2 ml of 0.5 % hyperbaric bupivacaine was injected over 10 seconds without barbotage. All the parturients who were given subarachnoid injection of hyperbaric bupivacaine were given 10 degrees head low position measured with goniometer for 10 minutes and then were placed supine on a horizontal operation table with 15 degrees left uterine displacement and the operation table kept horizontal until the end of the surgery was noted. 4-6 L/min of Oxygen was administered via Hudson's face mask to all patients as standard protocol until delivery. A 24 G needle prick was used to assess the cephalad spread of subarachnoid block at both mid-clavicular lines, by loss of pin-prick discrimination test at 5, 10,15, 20, 25 and 30 minutes after subarachnoid block was recorded. Level of blockade was defined as dermatome level at which there was loss of pinprick discrimination as tested from the anaesthetized area and continued cephalad. The number of blocked segments were observed starting from fifth sacral vertebra up to the maximum cephalad spread. The level of adequate block was considered when spinal anaesthesia reached sixth thoracic dermatome level. Once the peak dermatomal level that reached up to T6, then 15 degrees Trendelenburg's position was given to the parturient. If the peak dermatomal level was inadequate, general anaesthesia with endotracheal intubation was administered and the case was withdrawn.

Data collected was entered in Microsoft Excel. Mean and standard deviation of quantitative variables is shown. Categorial and discrete data were presented as tables, and continuous data represented by graphs. Paired t test was used to assess statistical significance for discrete and categorial data. Association between variables was analysed by Pearson and Spearman's correlation coefficient. A p value < 0.001 was considered as highly significant statistically.

RESULTS:
Table 1 shows, the mean age of the parturients was 25.72 ± 3.3 years. No significant correlation was found between age and time to achieve peak dermatomal level post spinal anaesthesia (p - 0.056). The average weight of the parturients was 66.12 ± 12.25 kg. The average height of parturients was 156.41 ± 7.55 cm. The average BMI of parturients was27.09± 4.91 kg/m^2. There is inverse relationship between weight and time to achieve peak dermatomal level, with increase in weight there is decrease in time to achieve the peak dermatomal level (p - 0.036). No significant correlation was found between height and spread of subarachnoid block (p - 0.036). About 38 % parturients were had normal BMI followed by 33% were overweight & 29% were obese.

There is significant correlation between BMI and the time required to achieve peak dermatomal level (p - <0.001) & negative value suggest inverse relationship (fig 1). No significant correlation was found between the spread of subarachnoid block with vertebral column length for VCL1 (p - 0.796) as well as VCL2 (p - 0.325).(fig 2&3) There was a significant correlation between the ascend of level of subarachnoid block with hip width, shoulder width and hip-shoulder width ratio (p <0.001) (Fig 4).

The desired level T6 was achieved by all the parturients at 25 minutes post spinal anaesthesia. The maximum parturients (45%) achieving L1 and T12 was at 1 minute. Maximum parturients achieving L2 (3%) at 1min, 36% parturients reached T10 a 2min and 42% parturients reached T8 at 3min.

Table 1 : Parturients characteristics

Patients Characteristics	Mean ± SD
Age (y)	25.72 ± 3.3487
Height (cm)	156.41 ± 7.5587
Weight(kg)	66.12 ± 12.2543
BMI(kg/m^2)	27.09 ± 4.9126
Hip width (cm)	35.28 ± 3.8134
Shoulder width (cm)	34.11 ± 3.4550
Hip/Shoulder width ratio	1.03 ± 0.0424
VCL1 (cm)	51.05 ± 4.5513
VCL 2 (cm)	44.62 ± 3.9830

Table 2 : The parturients characteristics and their correlation with the cephalad spread of spinal anesthesia

Patients Characteristics	Loss of pinprick discrimination	
	r	P*
Age (y)	-0.192	0.056
Height (cm)	-0.519	<0.001
Weight(kg)	0.210	0.036
BMI(kg/m^2)	-0.612	<0.001
Hip width (cm)	-0.643	<0.001
Shoulder width (cm)	-0.520	<0.001
Hip/Shoulder width ratio	-0.437	<0.001
VCL1 (cm)	-0.026	0.796
VCL 2 (cm)	0.099	0.325

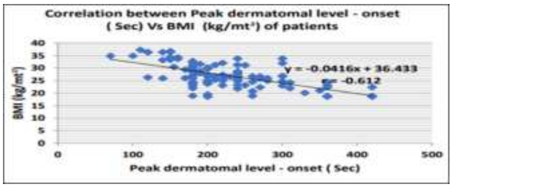

Fig 1: The correlation between BMI and the spread of spinal anesthesia.

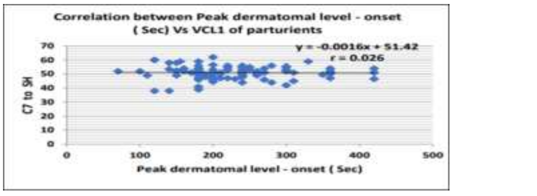

Fig 2: The correlation between VCL 1 and the spread of spinal anesthesia.

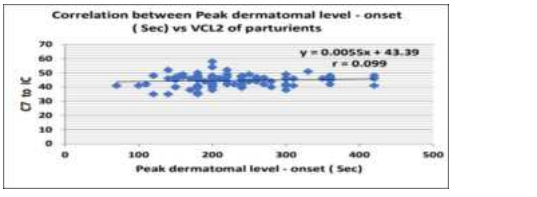

Fig 3: The correlation between VCL 2 and the spread of spinal anesthesia.

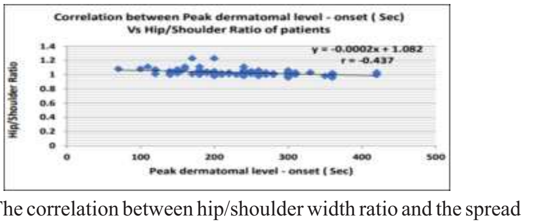

Fig 4 : The correlation between hip/shoulder width ratio and the spread of spinal anesthesia.

DISCUSSION:
The spread of spinal anesthesia is unpredictable, so a higher level of block may cause hemodynamic instability, while inadequate block may increase the incidence of general anesthesia leading to higher rates of morbidity and mortality.(8) Several factors such as the dose and characteristics of local anesthesia, parturients anthropometric measurements, intraabdominal pressure, and changes in the anteroposterior diameter of the spine affect the extent of spinal anesthesia in obstetric patients. (9) Other factors include pregnancy-induced physiological, biochemical, hormonal, and anatomical changes, which can also influence the spread of spinal anesthesia. (10) Excessive block or incomplete surgical anesthesia highlights the importance of finding appropriate individualized doses of local anesthetic.

The correlation of the spread of the spinal anaesthesia with weight, BMI & HSR was found to be significant, while age, VCL1 & VCL 2 had no significant correlation in our study. Similar finding was also found in study conducted by Ni TT et al in 2014 (5) and Eun Ju Kim et al in 2020 (7), there was no correlation between age and the spread of subarachnoid block. The study conducted by Mehmet Canturk et al in 2018 (3) and F Canturk in 2016 (11) found no correlation between height of the parturient and the spread of subarachnoid block. Previous studies done by Agnes M Lamon et al in 2007 (6), H. wang et al in 2018 (12) and Miyoshi et al in 2020 (13) also show significant correlation between BMI of the parturients undergoing lower segment caesarean section and the spread of subarachnoid block. The study conducted by Ni TT et al (5) showed a statistically significant correlation between the vertebral column and the cephalad spread of spinal anesthesia.

The hip width (HW) and shoulder width (SW) in our study had a significant positive correlation with the characteristics of sensory block (P < 0.05). The hip/shoulder width ratio (HSR) also had significant correlation with the cephalad spread of spinal anesthesia (P < 0.05). Hip width was also found to have a positive correlation with the cephalad spread of spinal anesthesia (P=0.037) by Cantürk et al. [3]

& they also found a significant correlation of HSR with the spread of spinal anesthesia (0.009) which could be because they correlated HSR only with the maximum sensory block height.

The correlation of VCL was not found to have a statistically significant correlation with the maximum level of sensory block. Also the study conducted by Lee YH et al.(14) found that VCL/AC had a positive correlation with the maximum level of sensory block (P<0.02).

Limitation :

The fixed doses of local anesthetics were used in this study, individualized doses according to patient variables in the parturient may provide better predictive power for the spread of spinal anesthesia. Also the height of the block is not the only measure of adequate anesthesia; hence, further studies should also include time to two-segment regression of the block and correlate it with different patient variables and individualized doses of local anesthetics.

CONCLUSION:

We conclude that there is significant correlation of weight, body mass index, hip width, shoulder width and hip-shoulder width ratio with the spread of subarachnoid block in term parturients undergoing elective lower segment caesarean section.

REFERENCES:

1. Greene NM. Distribution of local anesthetic solutions within the subarachnoid space. Anesth Analg 1985; 64: 715-30.
2. Wan Rahiza V M, Raha AR, Muhd Helmi A, Nadia MN, Muhammad M, Azmil FZ, Azarinah I & Jaafar MZ. Correlation between spinal column length and the spread of subarachnoid hyperbaric bupivacaine in the term parturient, Southern African Journal of Anaesthesia and Analgesia, 16(3):30-33.
3. Cantürk M, Cantürk FK, Dağlı R, Dağlı SS. The spread of spinal anesthesia in term parturient: effect of hip/shoulder width ratio and vertebral column length. International Journal of Clinical and Experimental Medicine. 2016 Jan 1;9(11):21562-7.
4. Norris MC. Height, weight, and the spread of subarachnoid hyperbaric bupivacaine in the term parturient. Anesthesia and analgesia. 1988 Jun 1;67(6):555-8.
5. Ni TT, Zhou Y, Yong AC, Wang L, Zhou QH. Intra-abdominal pressure, vertebral column length, and spread of spinal anesthesia in parturients undergoing cesarean section: An observational study. PLoS One. 2018 Apr 3;13(4):e0195137.
6. Lamon AM, Einhorn LM, Cooter M, Habib AS. The impact of body mass index on the risk of high spinal block in parturients undergoing cesarean delivery: a retrospective cohort study. Journal of anesthesia. 2017 Aug;31(4):552-8.
7. Cho A, So J, Ko EY, Choi D. Spinal anesthesia for cesarean section in a super morbidly obese parturient: A case report. Medicine. 2020 Jul 31;99(31).
8. Morgan GE, Mikhail MS, Murray MJ, Strauss M, Lebowitz H, Boyle PJ Clinical Anesthesiology. 20064th New York McGraw-Hill:304-9
9. Jawan B, Lee JH, Chong ZK, Chang CH. Spread of spinal anesthesia for cesarean section in singleton and twin pregnancies. Survey of anesthesiology Br J Anaesth. 1993:70:639-41
10. Kim JT, Shim JK, Kim SH, Jung CW, Bahk JH. Trendelenburg position with hip flexion as a rescue strategy to increase spinal anesthetic level after spinal block Br J Anaesth. 2007;98:396-400
11. Canturk M, Hakki M, Kocaoglu N. Hip/Shoulder Width Ratio Alters the Spread of Spinal Anesthesia: A Prospective Observational Study. The Ulutas Medical Journal (UMJ). 2018;4(1):32-7.
12. Wang HZ, Chen HW, Fan YT, Jing YL, Song XR, She YJ. Relationship between body mass index and spread of spinal anesthsia in pregnant women: A randomized controlled trial. Medical science monitor: international medical journal of experimental and clinical research. 2018;24:6144.
13. Miyoshi F, Fukushima R, Yokokawa S, Sakuma S, Nomura M, Kinoshita H. Japanese parturient body mass index and the role in initial nerve block height of women undergoing cesarean delivery with spinal anesthesia. Medicine. 2020 Jun 5;99(23).
14. Lee YH, Wang YC, Wang ML, Lin PL, Huang HH. Relationship of abdominal circumference and trunk length with spinal anesthesia level in term parturients JAnesth. 2014;28:202-5