International Journal of Medical Anesthesiology

E-ISSN: 2664-3774
P-ISSN: 2664-3766
www.anesthesiologypaper.com
IJMA 2019; 2(2): 40-43
Received: 28-05-2019
Accepted: 30-06-2019

Shirisha G
Postgraduate, Department of Anaesthesiology, Critical Care and Pain Medicine, Meenakshi Medical College and Research Institute, Enathur, Kanchipuram, Tamil Nadu, India

PS Shanmugam
Professor, Department of Anaesthesiology, Critical Care and Pain Medicine, Meenakshi Medical College and Research Institute, Enathur, Kanchipuram, Tamil Nadu, India

Corresponding Author:
Shirisha G
Postgraduate, Department of Anaesthesiology, Critical Care and Pain Medicine, Meenakshi Medical College and Research Institute, Enathur, Kanchipuram, Tamil Nadu, India

The relationship of patient characteristics to Cephalad spread of spinal anaesthesia after giving 0.5% hyperbaric bupivacaine in Infraumbilical surgeries

Shirisha G and PS Shanmugam

DOI: https://doi.org/10.33545/26643766.2019.v2.i2a.28

Abstract

Background and Aims: Patient characteristics may explain variability of spinal anaesthesia spread to certain extent. Aim- if there is any relationship between patient characteristics – Age, gender, weight, height, body mass index, abdominal girth, vertebral column length (C7-S5) and the cephalad spread of spinal anaesthesia.

Methods: In this Randomized Prospective Study, 100 patients of ASA 1 and 2 undergoing elective infraumbilical surgeries were selected. The above mentioned parameters were recorded. 3.5ml of 0.5% hyperbaric bupivacaine was injected in L3-L4 space. Cephalad spread was assessed for loss of temperature sensation and loss of pinprick discrimination at particular intervals and level was recorded. Descriptive statistics, Linear regression analysis and multiple regression analysis were used.

Results: Females, height and abdominal girth in females showed significant ($p = 0.000$), ($p = 0.01$), ($p = 0.01$) association.

Conclusion: Height, Gender (female) and abdominal girth in females were significantly correlated with the cephalad spread of anesthesia.

Keywords: Spinal anaesthesia, patient characteristics, cephalad spread

Introduction

Spinal anaesthesia is widely preferred nowadays but its spread is highly unpredictable. In clinical practice it is hard to isolate one factor and quantify its effect on the spread of spinal anaesthesia from the others. Individuals have differing body shapes. We expect that these characteristics which are practically obtainable measurements may explain the variability of spinal anaesthesia spread to a certain extent. They can be useful to clinicians for quick assessment of spread of spinal anaesthesia level in individual patients to avoid high block level and also inadequate level of block resulting in patient discomfort. The aim of this study was to find out if there is any relationship between patient characteristics –Age, gender, weight, height, body mass index, abdominal girth and vertebral column length (C7-S5) and the cephalad spread of spinal anaesthesia.

Materials and Methods

The present study was conducted at Meenakshi medical College and Hospital, Kanchipuram from January 2018 to Aug 2019 on 100 ASA 1 and ASA 2 patients scheduled for elective infraumbilical surgeries after getting approval by the institutional ethical committee and written informed consent from the patients. It was a Randomized prospective study done by lottery method. Patients with age between 18-60 years, Patients with weight 45 to 99 kgs. ASA 1 and ASA 2 patients scheduled for elective infraumbilical surgeries were included in the study. Patients who were excluded from the study were patients with contraindications to spinal anaesthesia, History of allergy to bupivacaine, Patients older than 55 yrs, Patients with cardiovascular diseases, Patients with diabetic neuropathy, Patients with neurological disorders altering sensation, Pregnant patients, History of spinal surgeries, vertebral column abnormalities, failed spinal. Pre anesthetic check-up was carried out pre operatively with a detailed history, general physical examination and systemic examination. Airway assessment and spinal column examination were done. Routine investigations were done. Preoperatively, Nil per oral status was confirmed - 8 hours. The procedure of subarachnoid block was explained and the patient was informed to communicate to the Anesthesiologists about perception of any pain or discomfort.

They were premedicated with Tab. Alprazolam 0.5mg and Tab. Pantoprazole 40mg orally 10:00 pm at night before surgery. Age, gender, weight, height and body mass index, was recorded for 100 patients. Patient was shifted to operation theatre.
Anaesthetic Monitors-Non-invasive BP, Pulse Oximeter and Electrocardiogram were connected and IV access was established with 18 gauge venflon. Baseline values were noted – pulse rate, blood pressure, saturation SPO_2.Patient was placed supine and abdominal girth was measured at the level of umbilicus during the end of expiration using a measuring tape. Patient was placed in sitting position and the vertebral column length was measured from C 7 vertebra to the sacral hiatus using a measuring tape. During spinal anaesthesia, all patients were placed in the right lateral decubitus position. The L3-L4 interspace was entered and using a 25 gauge quincke needle 3.5 ml of 0.5% hyperbaric bupivacaine was injected into the subarachnoid space over 15 seconds. After the procedure, patients were placed supine on the straight horizontal operating table, 180° parallel to the ground.
The cephalad spread was assessed in both the mid clavicular lines using cotton dipped in spirit for loss of temperature sensation and a 25 gauge needle for loss of pinprick discrimination. The testing was proceeded from caudal to cephalad cotton dipped in spirit was applied for approximately 2 seconds before a negative determination reached. 3 pin prick touches were used at each dermatome for loss of pin prick discrimination.
If a discrepancy in sensory level was found between the left and right sides, the patient was excluded from further study. The testing was done after giving spinal at the intervals of 2 mins,4 mins,6 mins,8 mins,10 mins and 15th minute and level achieved was recorded, until the spinal spread remained unchanged for 3 consecutive assessments. The total number of spinal anaesthesia block segments was recorded from S5 to the segment of spinal anaesthesia spread. Motor block was also assessed by modified bromage scale at the above mentioned intervals. I-free movement of legs and feet, II- just able to flex knees with free movement of feet, III-Unable to flex knees but with free movement of feet, IV- Unable to move legs and feet. Both testing (loss of temperature sensation and loss of pin prick discrimination) and recording of dermatomal level and motor block achieved was done by another anesthesiologist who was unaware of the previously measured characteristics of the particular patient.
Surgery was started after the assessment. If hypotension (systolic B*P*< 90 mm Hg / decrease of more than 20% below the baseline value / MAP < 60 mm Hg,) occurred, it was treated by administration of Ringer lactate 250ml bolus over 10min and Inj ephedrine 6mg IV. This was repeated whenever BP falls. Decrease in heart rate <50/min or 20% of baseline were considered as bradycardia. This was managed by 0.6-0.3mg Inj atropine IV. Respiratory rate <8/min and SPO_2 <90% was considered as respiratory depression. It was managed by IPPV, intubation or bag and mask ventilation.

Results

Descriptive statistics was used for non-parametric evaluation.
Linear regression analysis was performed for age, weight, gender, height, BMI, abdominal girth, vertebral column length and spread of spinal anaesthesia and the combined linear contribution was tested by multiple regression analysis.

Table 1: In this study out of 100 patients, 55 were males and 45 were females.

Parameters	Mean ± SD
Age	43.27 ± 9.64 years.
Height	166.66 ± 10.33 cms.
Weight	67.57 ± 11.24 Kgs.
Body mass index	24.10 ±4.93.
Abdominal Girth Males	80.07 ± 9.56 cms.
Abdominal Girth Females	94.04 ± 12.76
Vertebral column length	51.30 ± 2.60 cms

Table 2: Association of Variables with Cephalad Ascend Of Spinal Anaesthesia (Simple Linear Regression)

Parameters		Odds ratio	95% CI	P value
Age		-0.005	-0.025 to 0.015	0.61
Male		-0.008	-0.032 to 0.009	0.56
Female		-0.072	-0.068 to 0.035	0.00*
Height		-0.061	-0.075 to 0.047	0.00 *
Weight		-0.010	-0.027 to 0.007	0.25
BMI		-0.057	-0.020 to 0.094	0.00
Abdominal girth	Males	-0.004	-0.017 to 0.012	0.78
	Females	-0.070	-0.070 to 0.032	0.01*
Vertebral length		-0.023	-0.096 to 0.050	0.54

CI- confidence interval

Table 3: Adjusted Association of Variables with Cephalad Ascend of Spinal Anaesthesia (Multiple Linear Regression)

Parameters		Odds ratio	95% CI	P value
Age		-0.002	-0.017 to 0.013	0.80
Male		0.072	0.042 to 0.165	0.28
Female		0.120	0.178 to 0.032	0.00*
Height		-0.107	-0.185 to -0.030	0.01*
Weight		0.060	-0.039 to 0.158	0.23
BMI		-0.149	-0.412 to 0.115	0.27
Abdominal girth	Males	-0.011	-0.035 to 0.014	0.29
	Females	-0.102	-0.189 to -0.039	0.01*
Vertebral length		0.030	-0.027 to 0.086	0.30

Discussion

The Patient factors which affect the spread of local anaesthetics include: Age, Height, Position, Spinal column configuration and CSF volume [1, 2]. In the present study, age was not significantly (p=0.61; p=0.80) associated with the cephalad spread. At extremes of age there are small but significant increases in maximum spread, rate of onset of motor block and cardiovascular instability, regardless of the solution used [3-5]. Hirabayashi [6] compared groups of adolescents and young adults matched in all respects except age and found significantly greater block height in the younger group. In a study conducted by Canturk *et al.* [7], Pearson bivariate correlations shows that the age was not significantly associated with cephalad spread (r=0.102; p= 0.437). In another study by Wei *et al.* [8] conducted on pregnant subjects, univariate correlation reveals no significant association between age and cephalad spread (r=0.05; 95% CI 0.177 to 0.178; p=0.957).
In the present study, female subjects were significantly (p=0.000; p=0.000) associated with the cephalad spread. The spread of hyperbaric solutions may be influenced by differences in body shape while the patient in the lateral position. Males tend to have broader shoulders than hips so

that the spinal column has a 'head up' tilt in the lateral position, whereas the reverse is true in females. However, the patients are turned supine immediately after injection so this effect is likely to be small. Differences in CSF density may be more relevant. This is higher in males and will reduce the baricity of the local anaesthetic solution, thereby limiting the cephalic spread. Females have more of abdominal girth due to fat deposition and the fat encroaches the epidural space also. They have wider hips than shoulders [9].

In the present study, height was significantly (p=0.000; p=0.01) associated with the cephalad spread. It has been suggested that taller patients would display less cephalad spread. Indeed, minimum effective doses have been calculated for Caesarean section (0.06 mg cm−1 height), [10] but no correlation between height and spread has been found in term parturients [11]. Only one of the many studies that have looked at the effect of height has shown more extensive spread in shorter patients [12]. The main reason for this is most of the difference in height between adults is due to the length of the lower limb long bones, not the spine. When spinal length (i.e. distance from C7 to the sacral hiatus) was related to block height, a much better correlation was obtained [13].

Similar to the present study, a study conducted by Canturk *et al*. [14] showed significant association between height and cephalad spread (r= -0.572; p= 0.0001). In another study conducted by Wei *et al*. [15] (r=0.446; 95% CI0.597 to 0.271; p=<0.001) there was a significant association between height and cephalad spread. In a study done by Pargger *et al*. [16] No linear correlation was found. In contrast, multiple regression analysis revealed that height (P<0.01) was significantly contributed to the spread of anaesthesia. A squared multiple comparison coefficient between 0.10 and 0.21, however, is an indication that the predictive value of the combined variables remained rather low. Although the height accounts for only 10.6% of the variation in vertebral column length, a statistically significant correlation exists between height and vertebral column length [11]. Therefore, the block level should be related to height, which has been supported by two studies [10, 16].

Further, in the present study the weight and BMI was not significantly correlated with the cephalad spread of spinal anesthesia.It is often suggested that epidural fat compresses the dural sac, reduces CSF volume and results in the greater spread observed in obese patients [19]. However, these studies used plain solutions, which are known to produce wider variability in block height, [20] and studies with hyperbaric solutions have failed to show a significant relationship [11, 12]. In addition, it is recognized that the level of injection in obese patients is often higher than intended, [21] and this can result in greater cephalad spread. Finally, when an obese patient is lying in the lateral position, the distribution of adipose tissue may alter the alignment of the vertebral canal. The positive relationship between obesity and distribution of sensory block has been evaluated in many studies [22]. A previous study demonstrated that CSF volume in obese patients is reduced by using magnetic resonance images [23]. In obese patients reduced CSF volume is a result of increased intra-abdominal pressure or increased epidural fat. If the inferior vena cava is occluded by increased abdominal pressure due to the weight of the abdominal contents in obese patients, blood flow increases through the lumbar vertebral plexus, and the extradural vein distends. Since a distended extradural vein is known to compress the CSF space, the volume of CSF is often reduced in obese patients, meaning that the spread of local anesthetics can be increased. Similar to the present study, the studies done by Canturk *et al*. [7] and Wei *et al* [8]displayed no significant association between BMI and cephalad spread of spinal anesthesia.

In the present study the abdominal girth in males (p=0.78) was not significantly correlated with the cephalad spread of spinal anesthesia but in females (p=0.01) it was significantly correlated. Many studies have shown significant association between abdominal girth and cephalad spread of anesthesia [14, 15, 24, 25]. When patients changed position from right lateral decubitus to supine after the spinal anesthesia procedure, intra-abdominal pressure and epidural space pressure increased [26]. Larger abdominal girth results in a more significant increase in intra-abdominal pressure. An increase in intra-abdominal pressure, which would cause the lumbosacral cerebrospinal fluid volume to decrease and cephalad spread of bupivacaine mixed solution, could result in increased spread of spinal anesthesia [27]. A probable mechanism of decreased lumbosacral cerebrospinal fluid volume due to increased intra-abdominal pressure could be inward movement of soft tissue in the intervertebral foramen, which would displace lumbosacral cerebrospinal fluid [18, 27].

Furthermore, in this study there was no significant association between vertebral column and cephalad spread of spinal anesthesia. Similar to this study, Wan Rahiza *et al*. [28] spinal column length and the spread of anaesthesia was not significantly correlated. However many studies showed contrasting reports as that of the present study. Zhou *et al*. [25] showed that vertebral column length was the other main relevant factor to the spread of spinal anesthesia. Logic might suggest that there would be less cephalad spread of spinal anesthesia for a fixed amount of local anesthetic in taller patients. Indeed, a study has shown that vertebral column length is significantly correlated with spinal anesthesia spread [13].

Conclusion

In this study, based on linear and multiple regression analysis the height, gender (female) and abdominal girth in females were significantly (p<0.000; p<0.00; p=0.01) correlated with the cephalad spread of anesthesia. The values [OR (-0.061) and 95% CI (-0.075 to -0.047); [OR (-0.107) and 95% CI (-0.185 to -0.030)] and [OR (-0.072) and 95% CI (-0.068 to 0.035); [OR (-0.120) and 95% CI (-0.178 to 0.032);and [OR (-0.070) and 95% CI (-0.070 to 0.032 [OR (-0.102) and 95% CI (-0.189 to 0.039). Futher,the remaining parameters like age, weight, BMI, abdominal girth in males and vertebral column length were not significantly correlated with the cephalad spread of anaesthesia.

References

1. Nicholas M Greene: Distribution of local anesthetic solution within the sub arachnoid space, Anaesth Analg. 1985; (64):715-730.
2. Hogan Q, Toth J. Anatomy of soft tissues of the spinal canal. Reg Anesth Pain Med. 1999; 24:303-10
3. Veering BT, Burm AG, van Kleef JW, Hennis PJ, Spierdijk J. Spinal anesthesia with glucose-free bupivacaine: effects of age on neural blockade and

pharmacokinetics. Anesth Analg. 1987; 66:965-70
4. Pitkanen M, Haapaniemi L, Tuominen M, Rosenberg PH. Influence of age on spinal anaesthesia with isobaric 0.5% bupivacaine. Br J Anaesth. 1984; 56:279-84
5. Racle JP, Benkhadra A, Poy JY, Gleizal B. Spinal analgesia with hyperbaric bupivacaine: influence of age. Br J Anaesth. 1988; 60:508-14
6. Hirabayashi Y, Shimizu R, Saitoh K, Fukuda H. Spread of subarachnoid hyperbaric amethocaine in adolescents. Br J Anaesth. 1995; 74:41-5
7. Canturk M, Hakki M, Kocaoglu N. Hip/Shoulder Width Ratio Alters the Spread of Spinal Anesthesia: A Prospective Observational Study. Ulutas Med J. 2018; 4(1):32-37
8. Wei CN1, Zhang YF1, Xia F1, Wang LZ1, Zhou QH2. Abdominal girth, vertebral column length and spread of intrathecal hyperbaric bupivacaine in the term parturient. Int J Obstet Anesth. 2017; 31:63-67.
9. Schiffer E, Van Gessel E, Gamulin Z. Influence of sex on cerebrospinal fluid density in adults. Br J Anaesth. 1999; 83:943-4.
10. Danelli G, Zangrillo A, Nucera D *et al*. The minimum effective dose of 0.5% hyperbaric spinal bupivacaine for cesarean section. Minerva Anestesiol. 2001; 67:573-7.
11. Norris MC. Patient variables and the subarachnoid spread of hyperbaric bupivacaine in the term parturient. Anesthesiology. 1990; 72(3):478-82.
12. Pitkanen MT. Body mass and spread of spinal anesthesia with bupivacaine. Anesth Analg. 1987; 66:127-31.
13. Hartwell BL, Aglio LS, Hauch MA, Datta S. Vertebral column length and spread of hyperbaric subarachnoid bupivacaine in the term parturient. Reg Anesth. 1991; 16(1):17-9.
14. Canturk M, Hakki M, Kocaoglu N. Hip/Shoulder Width Ratio Alters the Spread of Spinal Anesthesia: A Prospective Observational Study. Ulutas Med J. 2018; 4(1):32-37.
15. Wei CN1, Zhang YF1, Xia F1, Wang LZ1, Zhou QH2.Abdominal girth, vertebral column length and spread of intrathecal hyperbaric bupivacaine in the term parturient. Int J Obstet Anesth. 2017; 31:63-67.
16. Pargger H, Hampl KF, Aeschbach A, Paganoni R, Schneider MC. Combined effect of patient variables on sensory level after spinal 0.5% plain bupivacaine. Acta Anaesthesiol Scand. 1998; 42(4):430-4.
17. Loubert C, Hallworth S, Fernando R *et al*. Does the baricity of bupivacaine influence intrathecal spread in the prolonged sitting position before elective cesarean delivery? A prospective randomized controlled study. Anesth Analg. 2011; 113:811-7.
18. Greene NM. Distribution of local anesthetic solutions within the subarachnoid space. Anesth Analg 1985; 64:715730-30
19. Pitkanen MT. Body mass and spread of spinal anesthesia with bupivacaine. Anesth Analg. 1987; 66:127-31
20. Logan MR, McClure JH, Wildsmith JA. Plain bupivacaine: an unpredictable spinal anaesthetic agent. Br J Anaesth. 1986; 58:292-6.
21. Broadbent CR, Maxwell WB, Ferrie R, Wilson DJ, Gawne-Cain M, Russell R. Ability of anaesthetists to identify a marked lumbar interspace. Anaesthesia 2000; 55:1122-6
22. Leino KA, Kuusniemi KS, Palve HK, Tiusanen HT, Tuppurainen TT. The effect of body mass index on the spread of spinal block in patients with rheumatoid arthritis. J Anesth. 2011; 25:213-218.
23. Hogan QH, Prost R, Kulier A, Taylor ML, Liu S, Mark L. Magnetic resonance imaging of cerebrospinal fluid volume and the influence of body habitus and abdominal pressure. Anesthesiology. 1996; 84:1341-1349.
24. 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; 13(4):e0195137.
25. Zhou QH, Zhu B, Wei CN, Yan M. Abdominal girth and vertebral column length can adjust spinal anesthesia for lower limb surgery, a prospective, observational study. BMC Anesthesiol. 2016; 24:16:22.
26. Shah JL. Effect of posture on extradural pressure. Br J Anesth 1984; 56:1373-7
27. Hogan QH, Prost R, Kulier A, Taylor ML, Liu S, Mark L. Magnetic resonance imaging of cerebrospinal fluid volume and the influence of body habitus and abdominal pressure. Anesthesiology 1996; 84:1341-9
28. Wan Rahiza WM, Raha AR, Muhd Helmi A, Nadia MN, Muhammad M, Azmil Farid Z, *et al*. Correlation between spinal column length and the spread of subarachnoid hyperbaric bupivacaine in the term parturient, Southern African Journal of Anaesthesia and Analgesia. 2010; 16(3):30-33.