Comparison between the height of spinal block and the incidence of hypotension among surgical patients

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Abstract

Hypotension is one of the common complications of spinal anesthesia; caused by sympathetic blockade leading to reduced cardiac output. Hypotension may be associated with the height of spinal block and can reduce blood flow to organs thereby leading to cardiovascular collapse which may eventually lead to cardiac arrest if appropriate action is not taken. This study examines the relationship between the height of spinal block and development of hypotension. One hundred (100) ASA I and II patients whose surgeries were below the umbilicus and done under spinal anesthesia were enrolled for the study. Patients that had hypotension were recorded and the heights of block were also recorded. Eleven patients (11) had hypotension (11%) overall. The incidence of hypotension among groups T_6, T_8 and T_{10} were 25% (7), 18.75% (3)s and 2.04% (1) respectively with a p-value of 0.5 which was not statistically significant. This study has shown that the incidence of hypotension is directly proportional to the height of spinal block though it is not statistically significant at T_6 and below.

Introduction

Spinal anesthesia is one of the anesthetic options for surgeries below the umbilicus. It has the advantage of the patient being able to control his airway and remain fully awake during the procedure, thereby reducing the complications of using airway devices such as endotracheal tube laryngeal mask airway, *etc*.[1] Spinal anesthesia can be complicated by hypotension, shivering, nausea/vomiting, bradycardia, high spinal among other complications. The incidence of hypotension ranges from 16-33%,[2] and this may be 7.4% up to 75%.[3] The mechanism of hypotension during spinal anesthesia is due to vasodilation and sympathetic blockade.[2,3] The incidence of sympathetic blockade is more with higher levels of spinal block which reduces cardiac output and thus reduction in blood pressure.[3] This becomes significant with spinal blockade above T_6.[4,5] Factors that affect the height of the block are speed of spinal injection, level of injection, baricity of the local anesthetic agent used, position after injection among others.[6,7] Hypotension resulting from spinal anesthesia may lead to nausea and vomiting, cardiovascular collapse, and even cardiac arrest.[3] Hypotension can be prevented by the use of intravenous fluid at 10-20 mls/kg for preloading, prophylactic use of vasopressors such as ephedrine or phenylephrine and controlled head up position after spinal injection.[8] This study seeks to establish the relationship between height of block and development of hypotension following spinal anesthesia.

Materials and Methods

This was a randomized, prospective, double blinded cross-sectional study which was carried out at Aminu Kano Teaching Hospital, Kano, North Western Nigeria among100 ASA I and II patients of either sex between the ages of 18 and 65 years. Patients that were scheduled for urological, gynecological, lower limb orthopedic and general surgery elective procedures under Subarachnoid Block (SAB) were chronologically recruited into this study. Patients with hypersensitivity to bupivacaine, obstetric patients, patients with a body mass index ≥35kg/m^2, mute and psychiatric patients, patients with coagulopathy, fixed cardiac output, non-consenting patients were excluded from the study. Institutional ethical committee approval was sought and approval was obtained.

All patients were seen, reviewed and examined a day before surgery to assess their fitness to undergo anesthesia. Routine investigations such as Full Blood Count (FBC), Urea, Electrolytes and Creatinine (U/E/Cr), urinalysis and Fasting Blood Glucose (FBG) were reviewed. The procedure was explained to the patients in detail and an informed consent for participation was obtained. The weight and height of all patients were taken. None of the patients was premedicated and all of them were asked to fast overnight. On the morning of surgery, temperature of the operating room was kept at 26^{o}C[9] by setting the theatre air conditioners and monitoring with Comark instrument WT4 wall thermometer. The anesthetic machine in the operating theatre was checked and all resuscitation equipment and drugs such as laryngoscopes, endotracheal tubes, adrenaline and atropine were kept handy.

The baseline vital signs of patients were recorded using a multi-parameter monitor (DASH 4000 GE) as they arrived into the theatre. Among the vitals taken were Pulse Rate (PR), Non-Invasive Blood Pressure (NIBP) with Mean Arterial Pressure (MAP), Electrocardiogram (ECG), Peripheral Oxygen Saturation (SpO_2) and peripheral body temperature. The core temperature (tympanic) was recorded using an electronic thermometer (Braun thermoscan ear thermometer IRT 4520). An appropriately sized IV cannula was inserted followed by a 20-mls/kg normal saline preload at room temperature 20-30 minutes before SAB.

Scrubbed and using aseptic technique, with the patient in sitting position, a skin wheal was raised with 2 mls of 1% plain lidocaine. Lumbar puncture was performed by the researcher between the 3rd and 4th lumbar intervertebral space using a 25G pencil point (Whitacre) spinal needle. After confirming free flow of cerebrospinal fluid, 3 mls of 0.5% heavy bupivacaine (Marcaine Spinal Heavy 0.5% aspen) at room temperature was injected into the subarachnoid space. Patients were made to lie supine immediately after injection, with a pillow under the shoulder to control cephalad

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spread of the local anesthetic. Appropriate level of sensory block (target level of T_6-T_{10}) was ensured, documented and kept in a sealed box. as well as establishment of motor block by a research assistant who did not further participate in the study. The researcher was blinded to the level of the block till the end of the study. Pulse rate, NIBP, MAP, SpO_2, ECG and temperature were monitored immediately after institution of the SAB and subsequently at 5-minute intervals till the end of surgery and into the recovery period until discharge to the ward.

All consented patients who had hypotension (a drop of 20% MAP from baseline) after institution of the block were recorded by the researcher and 500 mls of intravenous saline was given as a rush, and subsequently ephedrine boluses if required. Patients who developed nausea and vomiting were to be treated with IV metoclopramide 10 mg stat. Bradycardia (heart rate of less than 60 beats per minute) was to be treated with IV atropine 0.5mg. Patients with SpO_2 of less than 94% received oxygen 100% at 4 L/min via nasal prongs. Postoperatively, patients continued to be monitored by recovery nurses until complete block regression.

Patient demographics, incidences of nausea, shivering and hypotension (including its treatment with 0.9% saline) were all recorded. The data obtained was analyzed using SPSS version 18.0 for windows statistical software. Analysis of Variance (ANOVA) was used to compare the incidence of hypotension to the height of spinal block, incidence of nausea and height of block for groups T_6, T_8 and T_{10}, a p-value of <0.05 was considered statistically significant. Student's t-test was used for analysis of continuous variables and Chi square test for categorical variables. Values were expressed as numbers, means and standard deviations and the results presented in the form of tables.

Results

Table 1 shows the demographic profile of the patients, including the mean age, height, weight, and BMI for both groups. All of the individuals evaluated ranged in age from 18 to 65 years. In groups T_6, T_8 and T_{10}, the mean ages were 33.3±11.2 years, 34.9±12.7 years and 36.5±14.2 years, respectively. There was no statistically significant difference between the groups (p=0.58). The mean weight of patients in kg in group T_6 was 71.4±8.04, while that of group T_8 was 71.15±9.32 and for T_{10} was 70.9±10.7 with a p value of 0.98 which was not statistically significant. The mean height of patients in meters in group T_6 was 1.70±0.05; while in group T_8 was 1.71±0.05 and it was 1.72±0.05 for group T_{10} with a p value of 0.24 also not statistically significant. The mean BMI for group T_6 was 24.90 kg/m^2, while that in group T_8 was 24.61 kg/m^2 and for T_{10} was 24.31 kg/m^2, with a p value of 0.66. Neither the difference in height, weight nor BMI among the three groups was statistically significant.

The preoperative mean Pulse Rate (PR), Mean Arterial Blood Pressure (MAP), and peripheral and core body temperatures are shown in Table 2 for groups T_6, T_8 and T_{10}. The mean PR for groups T_6, T_8 and T_{10} were 101.2±10.9 bpm, 101.4±10.8 bpm and 98.2±10.6 bpm, respectively, with a p value of 0.36 which is statistically not significant. The mean MAP for groups T_6, T_8 and T_{10} were 101.58±6.89 mmHg, 101.46±6.47 mmHg and 101.38±6.28 mmHg respectively with a p value of 0.99 also not statistically significant. The preoperative mean peripheral temperatures for groups T_6, T_8 and T_{10} were 36.58±0.13ºC, 36.57±0.12ºC and 36.59±0.13ºC respectively, with a p-value of 0.80 showing no statistical difference. The preoperative core temperature was 37.29±0.14ºC for group T_6, 37.27±0.13ºC for group T_8 and 37.30±0.15ºC for group T_{10}, with a p value of 0.71, with no statistical difference. At different time periods, these alterations were shown to be comparable in both groups.

As shown in Table 3, the incidences of hypotension in groups T_6, T_8 and T_{10} were 7 (25.00%), 3 (18.75%) and 1 (2.04%), respectively, with p-value of 0.5 and no statistical significance. The incidences of nausea in groups T_6, T_8 and T_{10} (Table 3), were 6 (21.43%), 3 (18.75%) and 1 (2.04%), respectively, with a p-value of 0.66 which was statistically insignificant.

Table 4 depicts the occurrence of shivering in relation to the height of spinal block. Of the 49 patients who shivered, 24

Table 1. Patients' socio-demographic characteristics (mean±SD).

Patients' demographics	Group T_6 n=28	Group T_8 n=23	Group T_{10} n=49	ANOVA F-statistics	p
Age (years)	33.3±11.2	34.9±12.7	36.5±14.2	0.54	0.58
Weight (kg)	71.4±8.04	71.2±9.37	70.9±10.7	0.02	0.98
Height (m)	1.70±0.05	1.71±0.05	1.72±0.05	1.45	0.24
BMI (kg/m^2)	24.9±2.86	24.6±2.82	24.3±2.78	0.41	0.66

BMI, body mass index.

Table 2. Patients' preoperative vital signs (mean±SD).

Vital signs	Group T_6 n=28	Group T_8 n=23	Group T_{10} n=49	ANOVA F-statistics	p
Pulse rate (bpm)	101.2±10.9	101.4±10.8	98.2±10.6	1.04	0.36
MAP (mmHg)	101.58±6.89	101.46±6.47	101.38±6.28	0.01	0.99
Surface temperature (°C)	36.58±0.13	36.57±0.12	36.59±0.13	0.22	0.80
Core temperature (°C)	37.29±0.14	37.27±0.13	37.30±0.15	0.35	0.71

Table 3. The incidence of hypotension and nausea in relation to the height of spinal block.

Side effects	Group T_6 n=24 (%)	Group T_8 n=16 (%)	Group T_{10} n=9 (%)	χ Test	p
Hypotension	7 (25.00)	3 (18.75)	1 (2.04)	1.41	0.50
Nausea	6 (21.43)	3 (18.75)	1 (2.04)	0.82	0.66

Table 4. The incidence of shivering and the height of spinal block.

Block height (dermatome)	Shivering (%)	No shivering (%)	Chi square of trend	p
T_6 n=28	24 (85.75)	4 (14.25)	37.39	<0.001
T_8 n=23	16 (69.57)	7 (30.43)	37.39	<0.001
ssT_{10} n=49	9 (18.37)	40 (81.63)	37.39	<0.001

Table 5. Incidence of shivering and sex.

	n=100		χ Test	p
	Yes	No		
Shivering	49 (49%)	51 (51%)	0.66	0.42
Male	21 (42.86%)	26 (50.98%)		
Female	28 (57.14%)	25 (49.02%)		

(48.98%) exhibited sympathetic blockade up to T_6; 16 (32.65%), up to T_8; and 9 (18.37%) had sympathetic blockade up to T_{10} dermatomal level. Shivering seems to be more common as the level of block got increased. This correlation between shivering and the height of spinal block was statistically significant (p=0.0001).

Table 5 shows the overall incidence of shivering among both sexes. The incidence among males was 42.86% (n=21) while that of females was 57.14% (n=28) with a p value of 0.42 which was statistically not significant.

Discussion

The incidence of hypotension was found to be 11% in this study. This low incidence could be due to the 20mls/kg preloading with 0.9% saline. Similar finding was reported by Skleba.[3] The incidence of hypotension in the study of Kyokong *et al*.[5] was 36.8% and it was associated with fluid pre-hydration of less than 500mls while determining the incidence and risk factors of hypotension and bradycardia associated with spinal anesthesia. Skelabar reported an incidence of up to 75% in patients who had cesarean section which is a known risk factor for hypotension following spinal anesthesia among obstetric patients.[3,4] The incidence of hypotension in group T_6 was 25% (7), in group T_8 was 18.75% (3) while in group T_{10} was 2.04% (1) with a p value of 0.50 which was not statistically significant. This is supported by Shitemaw *et al*.[4] who reported the incidence of hypotension during subarachnoid block to be in direct proportion to height of post spinal block level above T_6.[4] In this study, patients who developed hypotension responded very well to bolus infusion of 0.9% saline 500 mls.

The overall incidence of nausea was 10% (10) in this study which is lower than the incidence of nausea of 33% reported by Magni *et al*.[10] and this could be attributed to low incidence of hypotension which is a known cause of nausea and vomiting during subarachnoid block.[10] The incidence of nausea was 21.43% (6) in group T_6, 18.75% (3) in group T_8 while group T_{10} had an incidence of 2.04% (1) with p-value of 0.66 which was statistically not significant. No vomiting was recorded; so, no patient received metoclopramide 10 mg as treatment. Patients who suffered bradycardia, a heart rate of less than 60 beats per minute were to receive intravenous atropine 0.5mg for treatment; however, none of the patients develop such. Supplemental oxygen at 4 l/min was to be given via nasal prongs if SpO_2 was less 94% but none was given.

In this study, the incidence of shivering was higher among females (57.14%) than males (42.86%), though the difference was not statistically significant; p value was 0.42. It is a known fact that female shiver more than male during subarachnoid block becaue the tolerance level of thermoregulation in women is lower than in men.[11]

Conclusions

This study has shown that the incidence of hypotension is directly proportional to the height of spinal block though it is not statistically significant at T_6 and below.

Recommendation

Height of spinal block should be limited to the level enough for the proposed procedure. Use of preventive measures of hypotension such as preloading should be instituted.

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