

Analgesic Effects of Intrathecal Heavy Bupivacaine with Fentanyl Using Height-Weight Adjusted Dose and Standard Dose for Caeserean Section

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Abstract—Subarachnoid block is a widely used anaesthetic technique for caesarean section which offers many advantages to both mother and the baby. The study evaluates the duration of analgesia and the total dose of analgesic given with 24hours following spinal anaesthesia. This is a prospective, randomised, double-blind study, as we compared height-weight adjusted dose using Harten's chart versus fixed dose of bupivacaine with fentanyl. The time of first analgesic request was longer in the adjusted dose group (8.7hours) than the fixed group (7.67hours), which implies having prolonged time of analgesia and reduction in total amount of opioids given to the patient within 24hours.

Index Terms—Subarachnoid block, Height and weight, Adjusted dose, Standard dose, Caesarean section.

1. Introduction

Subarachnoid block is a widely used technique for elective and emergency Caesarean section. It offers many advantages to the mother and the baby [2]. Therefore, patient aware of her environment, little or no requirement for airway intervention/protection of airway reflexes, reduction in blood loss, early ambulation, reduced probability of drug related CNS depression and the continuation of analgesia in the postoperative period, better foetal outcome in terms of reduction in the foetal distress and birth asphyxia [2], [4]. Subarachnoid block is associated with some undesirable side effects [3]. Among which are severe hypotension, difficulty in breathing, nausea, vomiting, and delayed motor block recovery. These side-effects are common, especially with increasing dose of 0.5% hyperbaric bupivacaine. Hypotension is the commonest side-effect with both maternal and neonatal consequence. The reported incidence of spinal hypotension in parturients is 70% to 80% [3], when pharmacological prophylaxis is not used [3]. In severe cases, hypotension can result in unconsciousness, apnoea, and cardiac arrest in parturients and may also impair placental perfusion and compromise foetal outcome [3]. Left uterine displacement, leg elevation, preloading/co-loading with intravenous fluids, prophylactic administration of

vasopressors, are some of the frequently employed strategies to prevent hypotension [3].

The intrathecal dose of hyperbaric bupivacaine effectiveness in 95% (ED95) of spinals for Caesarean section has been established to be 11.2mg, 0.06mg/cm of height, or even more recently 12.6mg of hyperbaric bupivacaine [5]. Limiting the intrathecal dose of anaesthetic (LA) to doses as low as 6-7mg of hyperbaric bupivacaine has been proposed in order to minimize the complication rate, but this comes at an increased risk of inadequate anaesthesia and therefore may require the use of combined spinal-epidural technique to assure the desired level of effectiveness [5].

The level of block of the spinal anaesthesia can be influenced by: The volume of local anesthetic injected, baricity of the local anaesthetic, total dose, type of local anaesthetic solution, injection site level, rapidity of injection, parturients characteristics (age, height and weight). The height and weight play an important role in determining the level of block, the approach is supported by pharmacodynamic data that suggest that the onset time for achieving an adequate sensory level for surgery increases linearly with height and decreases with increasing weight [5]. Clinical observation confirms that weight and height are significant variables in predicting the final level of the block [6].

In the study conducted by Harten, they found that dose of hyperbaric bupivacaine calculated using patients' height and weight can provide satisfactory anaesthesia for caesarean section with decreased incidence and severity of maternal hypotension and reduction in ephedrine requirement [6].

The purpose of the study was to evaluate the total analgesic given within 24hours between the two groups using Harten chart for weight-height adjusted dose of heavy bupivacaine with fentanyl to provide adequate anaesthesia for Caesarean section, good postoperative analgesia with minimal opioid consumption and spinal induced complications.

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2. Material and Methods

The Ethics Review Committee of Federal Medical Centre, Lokoja, Kogi State (now known as Federal Teaching Hospital, Lokoja, Kogi State) gave approval. Study was conducted in the Department of anaesthesia from 2nd February, 2021 to 16th February, 2023. Recruiting one hundred and four (104) women with term, singleton pregnancy of American Society of Anaesthesiologists physical status classification of I and II, scheduled for elective Caesarean Section under subarachnoid block technique were included in this prospective, randomized and double blind study.

Exclusion criteria are Patients with antepartum haemorrhage, patient refusal for spinal anaesthesia, those weighing < 50kg or > 110kg, those taller than 180cm or shorter than 140cm, pre-existing hypertension or pregnancy induced hypertension, those with American Society of Anaesthesiologists physical status III or IV and any other contraindications to spinal anaesthesia.

Participants fulfilling the inclusion criteria were enrolled into this study after obtaining both verbal and written informed consent for both the surgery and the research. Recruited patients were randomised into two (2) groups using simple randomisation method on the ward during the Pre-anaesthetic review.

One hundred and four pieces (corresponding to the calculated sample size) of square ballot papers measuring 4cm X 4cm with fifty-two ballot papers labelled A and fifty-two labelled B, corresponding to the two (2) groups was generated. The papers were rolled up and kept in a small open box. The ballot papers were shuffled and the patients were asked to pick a ballot paper from the box. The ballot papers was then re-shuffled after each pick. The patient picked the ballot paper and handed it over to the resident doctor who was blinded to the group allocation (to prevent bias).

The resident doctor opened the paper and pencil down the alphabet picked on the patient study proforma. Spinal anaesthesia was given according to the ballot paper picked with the patients in group A, belonging to the adjusted dose group, dose was calculated using the adjusted dose of height-weight for 0.5% heavy bupivacaine with fentanyl 10mcg (0.2ml) while group B fell to the standard dose group using 12.5mg (2.5ml) of the 0.5% heavy bupivacaine with fentanyl 10mcg (0.2ml).

To avoid potential patient selection and allocation bias, both patients and the researcher were blinded to the randomisation schedule and identity of the study drugs. The researcher was blinded to the randomisation schedule and identity of the study drugs. The research focused on organizing, recruiting and training junior residents on their different roles in the study, so as not to influence the data that were obtained and which was analyzed by the researcher.

A pre-operative assessment was done in the ward, a day before surgery. A detailed history (which included history of presenting complaint, intercurrent medical illnesses, medication currently taken, past medical history with exposure to anaesthesia, complications from surgery with anaesthesia, review of systems, history of denture with loose teeth(s), social history (alcohol intake and smoking), allergy to drugs with history of last meal) and preoperative assessment was

conducted. Physical examination of the patient was carried out and which includes: respiratory rate (RR), pulse rate (PR), blood pressure (BP), weight and height (in centimeter for the height and kilogramme for the weight), was recorded. Relevant investigations were requested, also normal fasting guideline of 6 hours to solid foods and 2 hours to clear fluid before surgery was observed by the patients. Questionnaires were filled and consent was signed for taking part in the research work, after thorough explanation to the patient. Patient was premedicated with oral ranitidine 150mg on the night before surgery while intravenous metoclopramide 10mg and ranitidine 50mg was administered two hours before surgery.

Anaesthetic work-station and airway equipment checked (in case the spinal anaesthesia failed, to be able to convert to general anaesthesia without delay) while drugs for general anaesthesia was made available in case of failed spinal anaesthesia. Patients were transported from the ward with a stretcher, in left lateral position, to the theatre. World Health organization check-list was conducted on the red-line of the theatre, after that, patients were taken to the operating room.

In the operating suite, Standard monitoring as baseline vital signs was taken, which comprised of Non-invasive blood pressure (NIBP), electrocardiography (ECG), Arterial oxygen saturation and pulse rate (using Pulse oximeter) using multi-parameter monitor (MEDELA PM modular, GE Medical systems, Information, Technology, Inc.8200w. Tower Ave, Milwaukeean, USA). An intravenous access was secured with cannula size 16G and wedge was applied at the right side of the patient hip, to prevent aorto-caval compression while lying down in supine position. Patient was pre-loaded with 15ml/kg of normal saline over 30minutes and helped into sitting position with back flexed while investigator gloved and scrubbed aseptically, then the drugs was withdrawn. (0.5% hyperbaric bupivacaine + 10mcg fentanyl, according to the group picked by the patient).

Patient back was cleaned with chlorhexidine and then methylated spirit, afterwards, draped. An interspace was picked by palpating the iliac crest and imaginary line drawn, which is the tuffier's line (is the imaginary line joining the superior-posterior borders of the iliac crests, identified as the landmark) its transverse body of the L4. The interspace below it was L4/L5 while interspace above it was L3/L4 interspace. A desired interspace was chosen and infiltrated with plain 2ml of 1% Lignocaine using 23G hypothermic needle. A 25G/26G pencil-mouth or Quicken spinal needle was used to perform the spinal anaesthesia using the midline approach to locate the subarachnoid space evidence by feeling of a give after the trocar withdrawn to observed a continuous and free flow of cerebro-spinal fluid from the hub of the spinal needle and the hyperbaric bupivacaine with fentanyl already drawn was injected. The spinal needle was withdrawn and injection site was dressed with sterilized gauge and adhesive tape.

Also, patient were re-positioned into supine condition one minute after performing the spinal anaesthesia with the continuous monitoring of the vital signs, which include pulse rate (PR), non-invasive blood pressure, mean arterial pressure (MAP), arterial oxygen saturation and the electrocardiography,

was recorded every minute in the first ten minutes, then every two minutes for another ten minute, afterwards, then every five minutes till end of surgery.

Oxygen was given to the patient via nasal prong at 3L/minute and discontinued once the baby was delivered except there was complications. In case of bradycardia (heart rate less than 60 beats per minute) 0.6mg Atropine was given, while if hypotension (decrease in baseline systolic blood pressure of more than 30%) [12], [18]. occurred was treated with intravenous normal saline, ephedrine/Phenylephrine and shivering by covering the patient with blanket, intravenous infusion of warmth normal saline, 600mg Paracetamol. If the shivering persisted after the above treatment, then patient was given 25mg pethidine (once the baby have been delivered). Other complications that arose was treated accordingly.

Maximum sensory level was assessed using bilateral loss of cold sensation to touch using methylated spirit swab while motor assessed by asking her to lift leg through thirty (30) degrees using modified Bromage scale [26], at least score 3 (almost complete, able to move feet only) and preferably score 4 (complete block, unable to move feet/knees) [26]. Time for onset of block, time to sensory blockade greater dermatome T5 within ten minutes, quality of sensory and motor block was noted. If desired level was not achieved within ten (10) minutes, then, 10⁰ (ten degree) head down tilt was applied to achieve improved block height [12].

Adjusted Dose Regimen of Hyperbaric Bupivacaine 0.5% used for spinal anaesthesia for caesarean section. Values in millilitres.

Pt Weight Kg	Pt 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	2.0				
60	1.4	1.6	1.7	1.8	2.0	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	2.0	2.2	2.3	
75		1.4	1.5	1.7	1.9	2.0	2.1	2.3	2.4
80		1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.3
85			1.5	1.6	1.8	1.9	2.1	2.2	2.3
90			1.4	1.6	1.7	1.9	2.0	2.2	2.3
95				1.5	1.7	1.8	2.0	2.1	2.3
100				1.5	1.7	1.8	1.9	2.1	2.2
105				1.5	1.7	1.8	1.9	2.0	2.2
110						1.7	1.8	2.0	2.2

If discomfort persists, boluses of ketamine (0.25mg/kg) was administered in divided doses. If these measure fails, then, general anaesthesia was administered, and such patient was excluded from the study. The skin incision was allowed when

the targeted spinal block reached fourth/fifth thoracic dermatome (T4 to T5) level.

Oxytocin, 5iu was given intravenously once baby was delivered and continued as infusion, using 40iu to 50iu of oxytocin in 500ml of normal saline. In the ward, postoperative pain was assessed by using pain assessment tool (Visual analogue scale, when there was moderate pain score, equal/greater than 3 and intravenous Pethidine 50mg was given) while the time to first analgesic was noted and the total analgesia given within 24 hours of the surgery, was compared with both groups. Blood loss was estimated and urine output quantified. Neonatal assessment was done by attending midwife who was blinded to the patient's group allocation using Apgar score at one minute and at five minutes.

Information was collected with forms designed for the study. Analysis was presented in tables and figures. Student's t-test was used to compare the analgesia (sensory loss at T5 or greater within ten minutes of spinal anaesthesia) with minimal complication between the two groups using mean $\pm$ standard deviation (continuous information) and Chi-square for categorical analysis. The null hypothesis was rejected at $P < 0.05$ while statistical analysis was done using statistical package for social sciences (SPSS) version 23.

3. Results

A total of one hundred and four parturient (104) were recruited into the study. They were randomised into two groups of fifty-two (52) each. The subjects in group A received adjusted dose of heavy bupivacaine based on weight and height with 10mcg (0.2ml) of Fentanyl while the fixed group (group B) subjects received a fixed dose of 12.5mg (2.5ml) of heavy bupivacaine with 10mcg (0.2ml) of Fentanyl, both given intrathecally.

All variables measured in continuous terms were subjected to normality test to determine the appropriateness of implementing t test to detect whether there were significant differences between groups' Anthropometric characteristics, pre-operative vital signs, dose of analgesia given in the first 24 hours, intra-operative assessment, and time to first analgesic given. Mann-Whitney U test was used as a substitute to t test, the variables were not normally distributed.

A. Demography of Study Participants

Table 1 shows the demography and anthropometric characteristics of the patients across the two groups. There was no significant difference in the median age of group A (Median =27.00, n=52) and that of group B (Median =28.00, n=52), $p=0.727$. Similarly, there was no significant difference in the

Table 1

Summary of participants' anthropometric characteristics					
Variables	Study Group		Mann Whitney U [*]	Z	P
	Group A	Group B			
	Median (IQR)	Median (IQR)			
Age in Years	27.00 (7.00)	28.00 (5.00)	1298.50	-0.349	0.727
Weight	85.00 (15.0)	83.50 (5.00)	1293.00	-0.392	0.695
Height	1.70 (0.10)	1.75 (0.05)	683.00	-4.446	<0.001
BMI	27.78 (3.62)	26.23 (3.09)	899.50	-2.957	0.003
Gestation	39.00 (1.00)	39.00 (1.00)	1199.00	-1.101	0.271

* Mann-Whitney Statistics was utilized because the variables were not normally distributed using Kolmogorov-Smirnov test statistic

median weight of the two groups (Median =85.00, n=52 versus Median=83, n=52; $P=0.695$); and in the median gestation period of the two groups, $p=0.271$. However, the median height of group B (Median =1.75, n=52) was significantly greater than that of group A (Median =1.70, n=52), $p < 0.001$. While the median BMI of group A (Median =27.78, n=52) significantly outweigh that of group B (Median =26.23, n=52).

B. Intra-Operative Vital Signs

In Table 2, the intra-operative vital signs of participants were compared across the two groups as presented. The results revealed that while the median percentage for the Saturated Peripheral Oxygenation of participants in group B (Median =99.61, n=52) significantly outweighed that of group A (Median =99.18, n=52), $U=76.50$, $Z= -3.549$, $P = <0.001$; the median MAP of participants in group A (Median =82.76, n=52) significantly outweighed that of group B (Median =78.15, n=52), $U=88.00$, $Z= -3.424$, $P = <0.001$. Similarly, the mean Systolic Blood Pressure of participants in group A (116.63 ± 3.83) was significantly greater than that of group B (109.93 ± 6.63), $t = 4.161$, $P = <0.001$; also, with the mean Diastolic Blood Pressure of participants in group A (70.23 ± 2.36) being significantly greater than that of group B (63.92 ± 6.79), $t = 4.252$, $P = <0.001$. The heart rate between the two groups were not statistically significant.

C. Block Characteristics

Table 3, shows the block characteristics of the two groups. The dose of bupivacaine with fentanyl compared with time to loss of sensation to both cold sensation after it was injected intrathecally. The results revealed that, on the average, group B had significantly more median Dose of Bupivacaine 0.5% (Median =12.50, n=52) than group A (Median =10.50, n=52), $U = 1326.00$, $Z = -9.35$, $P = <0.001$. Group A also took more median time to loss of cold sensation in minutes (Median=5.00,

n=52) than group B (Median =3.00, n=52), $U = 2063.50$, $Z = -3.94$, $P = <0.001$. The results however revealed no difference in the median Dose of Fentanyl added in microgram between group B (Median =10.00, n=52) and group A (Median =10.00, n=52), $U = 2626.00$, $Z = -1.01$, $P = 0.310$.

The level of block assessed at T4 with the maximum block height was greater with group B than group A. The results revealed that significant difference only occurred in the level of block assessed between the two groups ($P= 0.003$).

D. Apgar Score

Table 4 shows the babies' Apgar score taken at one and five minutes after delivery. There was no significant difference between the two groups with the $p = 0.136$.

Table 4 Apgar score				
Minute	4	Group A	Group B	P
104	52(8/10)	52(8/10)	52(8/10)	0.136
104	52(10/10)	52(10/10)	52(10/10)	

E. Dose of Analgesia (Pethidine) Given and First Analgesic Request with in First 24 Hours

Table 5 show the Time to first Analgesic given, which was compared between the two groups. Median time to first Analgesic given for group A (Median =8.0hours, n=52) significantly outweighed that of group B (Median =7.4hours, n=52), $U=654.50$, $Z= -4.012$, $P = <0.001$. While the Dose of Analgesia given to participants in the first 24 hours was compared across the two groups. The median dose of Analgesia (Pethidine) given to participants in group B in milligram (Median =150mg, n=52) significantly outweigh that given to participants in group A (Median =100mg, n=52), $U = 456.00$, $Z = -6.412$, $p = <0.001$.

Table 2 Comparison of summary of intra-operative vital signs of participants' between the two groups					
Variables	Study Group		M_W U ^a	Z	P
	Group A	Group B			
	Median (IQR)	Median (IQR)			
Heart Rate (BP)	87.55 (4.71)	86.45 (3.70)	211.50	0.114	0.909
MAP (mmHg)	82.76 (2.41)	78.15 (6.92)	88.00	3.424	0.001
SPO ₂ (%)	99.18 (0.18)	99.61 (0.32)	76.50	3.549	<0.001
SBP (mmHg)	116.63 (± 3.83) ^{M($\pm$SD)}	109.93 (± 6.63) ^{M($\pm$SD)}	-	4.161 ^t	<0.001
DBP (mmHg)	70.23 (± 2.36) ^{M($\pm$SD)}	63.92 (± 6.79) ^{M($\pm$SD)}	-	4.252 ^t	<0.001

* Mann-Whitney Statistics; M($\pm$ SD): mean and standard deviation; t: independent sample T statistic was used for variables with normal distribution data series.

Table 3 Summary of participant's block characteristics					
Variables	Study Group			χ^2	P
	N (104)	Group A	Group B		
Time to loss of cold sensation (minutes)	104	5(+/-2)	3(+/-0.2)	3.94	<0.001
Level of Block Assessed (10minutes after spinal)					
T4	10	1 (10.0)	9 (90.0)	-	0.003 ^f
T5	39	17 (43.6)	22 (56.4)		
T6	49	17 (34.0)	32 (66.0)		
Others	6	2 (33.3)	4 (66.7)		
Maximum Block Height					
T4	49	11 (22.4)	38 (77.6)	-	<0.001 ^f
T5	49	30 (61.2)	19 (38.8)		
Others	6	2 (33.3)	4 (66.7)		
Head Down tilt Used					
Yes	8	4 (50.0)	4 (50.0)	-	1.000 ^f
No	96	48 (50.0)	48 (50.0)		

Table 5
Comparison of participants' dose of analgesia given and first analgesic request in the first 24 hours

Variables	Study Group		M	W U*	Z	P
	Group A	Group B				
Time to first Analgesic request						
Mean (hour)	8.70	7.67	654.50	4.01		<0.001
Standard error of mean (hour)	0.21	0.90				
Minimum value (hours)	6.0	6.40				
Maximum value (hour)	12.0	9.0				
Median (IQR)	8.0(2.0)	7.4(0.80)				
Dose of Analgesia given in the first 24 hours	100.0 (50.00)	150.0 (0.00)	456.00	6.412		<0.001

* Mann-Whitney Statistic

F. Comparison of Heart Rate

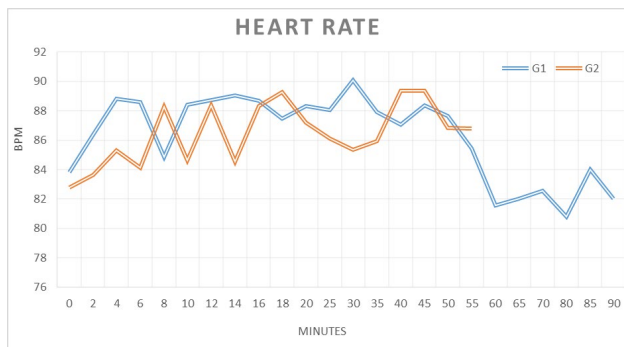


Fig. 1. Trend lines for intra-operative heart rate in both adjusted dose group (G1) and Fixed dose group (G2)

Figure 1 shows the trend lines for the heart rate for the adjusted group and the fixed group as the surgical procedure progresses over time. The heart rate for the adjusted group was slightly higher than the heart rate from the fixed group for several of the time points. The test within subject effect on heart rate was insignificant over the course of the surgery ($F=0.114$, $P=0.909$). This effect was not significantly modified (dependent) on the treatment group of study participant.

G. Comparison of Systolic Blood Pressure (SBP)

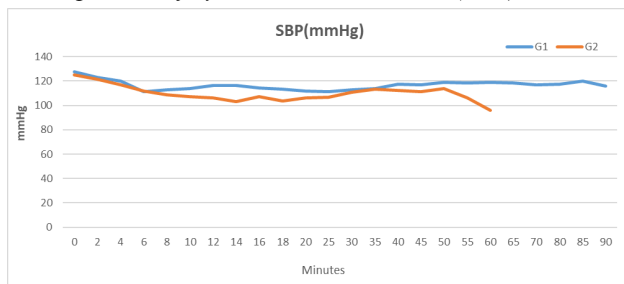


Fig. 2. Trend lines for Intra-operative Systolic blood pressure in both Adjusted dose group (G1) and Fixed dose group (G2)

Figure 2 shows the trend lines for the systolic blood pressure for the adjusted group and the fixed group as the surgical procedure progresses over time. The systolic blood pressure for the adjusted group was slightly higher than the systolic blood pressure from the fixed group for several of the time points. The test within subject effect on systolic blood pressure was significant over the course of the surgery ($F=4.161$, $P=0.001$). This effect was significantly modified (dependent) on the treatment group of study participant.

H. Comparison of Diastolic Blood Pressure (DBP)

Figure 3 shows the trend lines for the diastolic blood pressure

for the adjusted group and the fixed group as the surgical procedure progresses over time. The diastolic blood pressure for the adjusted group was slightly higher than the diastolic blood pressure from the fixed group for several of the time points. The test within subject effect on diastolic blood pressure was significant over the course of the surgery ($F=4.252$, $P=0.001$). This effect was significantly modified (dependent) on the treatment group of study participant.

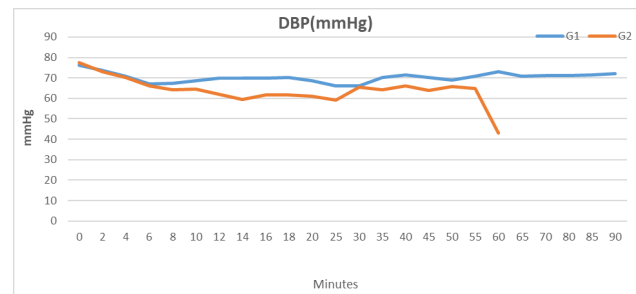


Fig. 3. Trend line for Intra-operative diastolic blood pressure in both Adjusted dose group (G1) and Fixed dose group (G2)

I. Comparison of Mean Arterial Pressure (MAP)

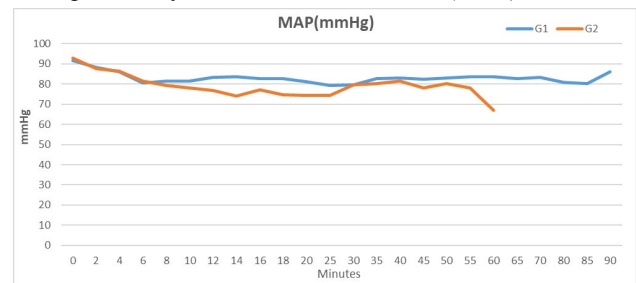


Fig. 4. Trend lines for Intra-operative mean Arterial Pressure in both Adjusted dose group (G1) and Fixed dose group (G2)

Figure 4 shows the trend lines for the mean arterial pressure for the adjusted group and the fixed group as the surgical procedure progresses over time. The mean arterial pressure for the adjusted group was slightly higher than the heart rate from the fixed group for several of the time points. The test within subject effect on mean arterial pressure was significant over the course of the surgery ($F=3.424$, $P=0.001$). This effect was significantly modified (dependent) on the treatment group of study participant.

J. Comparison of Arterial Oxygen Saturation (SPO₂)

Figure 5 shows the trend lines for the arterial oxygen saturation for the adjusted group and the fixed group as the surgical procedure progresses over time. The arterial oxygen saturation for the fixed group was slightly higher than the

arterial oxygen saturation from the adjusted group for several of the time points. The test within subject effect on arterial oxygen saturation was significant over the course of the surgery ($F= 3.549, P=0.001$). This effect was significantly modified (dependent) on the treatment group of study participant.

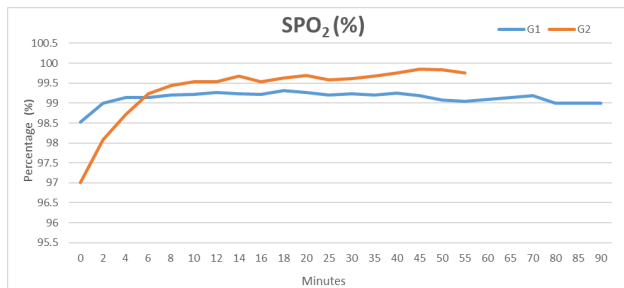


Fig. 5. Trend lines for Intra-operative arterial oxygen saturation in both Adjusted dose group (G1) and Fixed dose group (G2)

4. Discussion

The results of this study showed that adjusting the doses of intrathecal hyperbaric bupivacaine according to Harten chart, resulted in significant level of sensory block with prolonged duration of the postoperative analgesia. Also, there was significantly longer time for first analgesic request and reduction in the total amount of analgesia (opioid) given within 24 hours for the adjusted dose group. The adverse effects were less minimal in the adjusted dose group than the fixed group.

The median time to loss of cold sensation for the target spinal block of fifth thoracic vertebral (T₅) was significantly prolonged in the adjusted group (5minutes) compared to the fixed group (3minutes) within ten minutes of assessment after spinal anaesthesia.

The median time to loss of cold sensation for the target spinal block of fifth thoracic vertebral (T₅) was significantly prolonged in the adjusted group (5minutes) compared to the fixed group (3minutes) within ten minutes of assessment after spinal anaesthesia.

This is in agreement with the results obtained from the study by Subedi et al [11] which was carried out among one hundred and four parturients in Nepal, where they found that the median onset of time for the target spinal block of T₅ was significantly ($P = 0.01$) prolonged in adjusted dose group than in the fixed dose group (6minutes versus 4minutes).

This is probably because the dose adjustment used in adjusted group and fixed group was similar to the dose used in our study. Also, Harten et al in their study conducted in United Kingdom among eighty-four parturients found out that the onset time to adequate sensory blockade was longer in the adjusted dose group (8minutes) than in the fixed dose group (6 minutes). Probably the dose used in their study was not far from the dose used in our study.

In tandem with our study, Sabale conducted a randomized study in India, with one hundred and ten parturients. They found that the mean time for effective sensory block to fifth thoracic vertebra dermatome was more and prolonged in adjusted dose group (group H) compared to the fixed dose group (group F). This could be probably the mean total volume

of drug administered to the adjusted group (group H) was smaller than the mean total amount of drugs given to the fixed group (group F).

Similarly, in a study by Kumar using eighty-one singleton term parturients with half of the parturients receiving the calculated dose and the other half receiving fixed dose of intrathecal 0.5% bupivacaine. They found the onset of sensory block was early and faster in the fixed group but the level of block was not confined to the desired one. This could be probably as a result of influence.

The document starts here. Copy and paste the content in the paragraphs. of height on the spread of spinal anaesthesia, in the study group who are all Asians and the Asian women who are shorter in stature.

Also similar to our findings was the study by Khalid et al who compared spinal anaesthesia in sixty singleton parturients using dosage based on height and weight adjusted and height only. They found that the median time to achieve adequate block was significantly longer in the adjusted dose group based on weight and height even though block level did not differ between the groups.

In contrast, Gupta et al who compared spinal block characteristics on height and weight based dosage against fixed dosage in a study conducted on eighty-eight parturients in Asia. They found that there was no statistical significant difference between the two groups (Adjusted and Fixed) in the onset of spinal anaesthesia to target level of T₅. In their study, dose adjustment for both groups were almost the same in strength dosage, and also the lateral decubitus position used to administer spinal anaesthesia from their methodology probably could have had effect on the sensory blockade. In the lateral recumbent position, there is better spread of local anaesthetics, thus resulting in better sensory blockade.

Similarly, study carried out in Saudi Arabia by Cenkowski, found out there were no difference in the time of onset block and adequate quality of block assessed with the conventional dose group (fixed group) and the low dose group (adjusted group) when compared.

However, they placed the parturient in the low dose group in the trendelenburg position in-order to ensure adequate block height targeted.

Also, not in the agreement with our findings, study conducted by Katarzyna, carried out a prospective double blinded study comparing fixed dose to adjusted dose of intrathecal bupivacaine in one hundred and thirty-four parturients. They found out that there was no difference in the time of the spinal blockade and the onset time to loss of cold sensation in the two group. This probably could be as a result of the lateral direction of the spinal needle orifice before and during the administration of their intrathecal injection and the parturients sits ten to fifteen seconds after administered the injection.

Postoperative pain after Caesarean section results in an unpleasant outcome for women and may result in delayed ambulation prolonged time for discharge from hospital, poor bonding with the newborn, low satisfaction scores and delayed breastfeeding. In this study, the time to first analgesic request was significantly prolonged in group A (adjusted group)

compared to the group B (Fixed group) with the mean hours of first opioid requested of 8.70 hours versus 7.67 hours respectively. The minimum value of the first postoperative analgesia given was 6 hours in the adjusted group and 6.40 hours for the fixed group (group B). Katarzyna, also agreed with our findings in their study. They observed a longer time to first analgesic request in the adjusted dose group using height-weight based dose of the Harten chart (3.6 hours) in comparison to the fixed dose group (3.5 hours). This is attributed to the similar dose of bupivacaine used as compared to our study but the drugs were injected laterally and the parturient sat for ten to fifteen second before laid in supine position. Similarly, in the study conducted by Braga, found that there was longer duration of postoperative analgesia as compared in both groups. The time interval was lesser (177.21 $\pm$ 51.10) than the mean time of our study. This is probably due to the 0.5ml saline added to the drug in their methodology which reduced the dose concentration, as one of the factors that influenced spinal anaesthesia. They concluded that the local anaesthetic activity of opioids, albeit weak may increase the anti-nociceptive effect when these agents are applied intrathecally.

Pethidine as an opioid analgesic, is widely used to manage acute pain in immediately postoperative period. It is a vital component in the multimodal analgesic approach to acute pain management. However, there is widespread concerns about its vomiting and nauseating side effects, which could cause uterine sutured wound breakdown when given as Post Caesarean section analgesia in larger dose and quantity. This study showed that the total Pethidine consumption in 24 hours was significantly higher in fixed dose group (150.00) than the adjusted dose group (100.00 with p value of < 0.001).

On the contrary, Katarzyna, found that same dose of morphine was used in both fixed group and adjusted dose group within 24 hours as postoperative analgesia (20mg) but not statistically significant ($p = 0.109$). Possibly the above was as a result of laterally direction of the needle orifice during intrathecal injection. Also, the patient remained seated for 10-15 seconds after administration of the drugs before placed supine.

The dose of local anaesthetic is reduced by about one third in pregnant women compared to non-pregnant women for various reasons. Several studies have been conducted to establish the minimal but adequate dose of intrathecal bupivacaine for Caesarean section to limit the adverse effects related to spinal anaesthesia but none have quoted for absolute value.

Spinal anaesthesia induced hypotension is an established complication that may not be eliminated. In a study conducted by Ilori *et al* titled "The efficacy of the volume of hyperbaric Bupivacaine used and its influence on spinal anaesthesia induced hypotension during Caesarean section". This was carried out among one hundred and thirty one (131) parturients at the Obstetric theatre of the University of Calabar Teaching Hospital, Calabar, Nigeria. It was concluded that the magnitude of the incidence of hypotension during Caesarean section was related to the volume of 0.5% hyperbaric bupivacaine used and the height of block. In this study, volume of hyperbaric bupivacaine used was dependent on the height of patient based

on the anaesthetist discretion, which was not standardized, analysis of the volume used compared to the height of patients.

In contrast to the finding of this study, Katarzyna used 140 parturients, it was reported that there were no differences found in the rate of hypotension between the groups. In their conclusion, no statistical differences were found between the groups in the frequency of hypotension, bradycardia, nausea and vomiting. Probably due to the fact that, weight was not included as a factor determining dosage in their dose-adjusted group. The influence of the body weight on the subarachnoid spread of local anaesthetic has been debated but still not clear which factor most contributed to it. Although, obesity does not appear to influence the ED₉₅ dose, it was suggested that body mass index (BMI) may increase the risk of spinal-induced hypotension.

Also, incidence of hypotension was similar in study carried out by Alam, which was to assess the frequency of maternal hypotension during spinal anaesthesia by comparing fixed dose with height and weight-adjusted dose of hyperbaric 0.5% bupivacaine among eighty (80) parturients. They found that where the same two-factor adjustment strategy (height and weight) was compared with a fixed dose regimen of 10mg of hyperbaric bupivacaine, there was no significant differences found regarding effectiveness and hypotension ratio between the groups. Probably, due to the dose of bupivacaine used in both groups (fixed and adjusted dose group) was almost the same in amount for the study. These of importance in the minimum effective dose calculated for Caesarean section, which was 9mg of hyperbaric bupivacaine. This is lower compared with the fixed dose (10mg) used in our study.

The incidence of vomiting was reduced in this study, with twelve (12) of the parturient having two of the parturient (16.7%) in the adjusted group while ten (10) of the parturient (83.3%) in the Fixed dose group with no significant differences found. More patients experienced nausea, with twenty-eight (28) in total, and twenty (20) of the patients (71.4%) in the fixed dose group than in adjusted group which had 8 patients (28.6%). Intraoperative vomiting during lower abdominal surgery under spinal anaesthesia have a multi-factorial origin and factors such as psychological changes (anxiety) arterial hypotension, hypo-perfusion of the central nervous system, abrupt visceral movements and concomitant opiate administration and the use of oxytocin.

In consonance with the study, Katarzyna, reported that adjusting conventional doses of bupivacaine to patient's height would not prevent nausea and vomiting, with their findings having incidence of nausea and vomiting in the adjusted dose group but vomiting was noted in the fixed group only.

Similarly, the study by Kumar, found out that nausea and vomiting were more frequent in fixed group than adjusted group. This is possibly due to high incidence of hypotension in the fixed group than adjusted group. Also, the high incidence of nausea and vomiting in the fixed dose group could be attributed to the greater reduction in arterial blood pressure in the fixed dose intrathecal block as found by Subedi *et al*. Further reported that the reduction in incidence of nausea and vomiting in parturient where bupivacaine dose was adjusted for height and

weight, with better haemodynamic.

In contrast, the study by Ozoagu, reported that more patients had nausea (15.7% versus 2.9%, $p=0.009$) but there was no vomiting in the either of the groups. These could be due to controlled hypotension, optimized use of neuro-axial, reduced use of intravenous opioids, minimized surgical stimuli and judicious administration of uterotonic agents.

The incidence of shivering as a complication of post-spinal anaesthesia was statistically significant. Four (4) patients (23.5%) in the adjusted group and thirteen (13) patients (76.5%) in the fixed group reported shivering. This is in agreement with the study by Gupta, who reported a statistical significant in the incidence of shivering in fixed group as compared to the adjusted dose group. Their study is also in agreement with the findings that was reported by Harten et al and Subedi et al.

In consonance to this, Ozoagu, showed that spinal anaesthesia affect the efficiency of the homeostatic system, resulting to various degrees of perioperative hypothermia by decreasing the threshold that triggers vasoconstriction and shivering above the level of block as seen in their study, shivering was 17% in the fixed dose group and 6% in the adjusted dose group.

Visceral pain is a common problem in Caesarean section under spinal anaesthesia. There was no incidence of peritoneal discomfort in this study which was similar to the studies conducted by Bogra and Choi, found no pain in the fixed group but visceral pain was not fully abolished with doses of bupivacaine. They concluded that bupivacaine – fentanyl combination leads to abolishment of the visceral pain.

In contrast, the study by Harten, they found two (2) of the parturient (4.4%) in the adjusted group experienced visceral discomfort. Which was similar to the study carried out by Subedi et al, they reported that three (3) of the parturient in dose-adjusted group experienced peritoneal discomfort. This could be due to the reduce amount of bupivacaine dose which was based on height-weight adjusted calculated dose.

No significant differences were found in the Apgar scores at either one or five minute in comparison to the both group with similar scores demonstrated in both group, which was supported by the studies done by Subedi and Harten, assessed the baby outcome and found that there were similar scores in the two groups. Subedi et al concluded that a similar study with a much larger number of patients and an evaluation more sensitive and more objective than the short-term Apgar score might produce more enlightening results. Also, Study by Bogra, reported that there were no effects on the babies with addition of fentanyl to the bupivacaine.

In contrast, Ozoagu, demonstrated a lower Apgar score in the fixed dose group at 1 minute, but showed no difference in both groups at 5 minutes. This was attributed to the high prevalence of maternal hypotension in the fixed group of their study with ability to tolerate placental blood perfusion challenges in the adjusted dose group.

The current study has been able to provide adequate quality of anaesthesia using Harten chart for adjusted weight-height dose of hyperbaric bupivacaine with fentanyl and prolonging the duration of the postoperative analgesia with longer time to

first analgesic request, having minimal dose amount of opioid within 24 hours while reducing the haemodynamic instability associated with spinal anaesthesia and decreasing incidence of adverse effects of subarachnoid block.

The results of this study showed that adjusting doses of hyperbaric bupivacaine in combination with fentanyl to the patient's height and weight using the Harten chart resulted in adequate quality of sensory block and prolonged duration of the postoperative analgesia with longer time for first analgesic request and reduction in the total amount of analgesia (opioid) given within 24 hours while minimizing the untoward side effects in the both groups.

5. Conclusion

The study demonstrated that intrathecal heavy bupivacaine with fentanyl using Harten chart on the basis of weight-height adjusted dose was significantly sufficient to provide sensory and motor block adequate for quality anaesthesia needed for Caesarean section while increasing the duration of postoperative analgesic coverage with longer time before the first analgesic would be requested and giving minimal total dose amount of opioids within 24 hours while decreasing the incidence of complications that could arise from subarachnoid blockade.

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