

**INCIDENCE OF, AND RISK FACTORS FOR, HYPOTENSION
DURING SPINAL ANESTHESIA FOR CESAREAN SECTION AT THE
KENYATTA NATIONAL HOSPITAL.**

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DECLARATION

This dissertation report is my own original work and to the best of my knowledge has not been presented for a degree/ diploma award in any other university.

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DEDICATION

To my wife Catherine, and my two sons Simon and George who have inspired me greatly and offered their endless support.

LIST OF ABBREVIATIONS

U.O.N: University of Nairobi.

E.R.C-K.N.H: Ethical Research Committee of Kenyatta National Hospital

ASA: American Society of Anesthesiologists

Ksh; Kenya Shillings.

C.S.F: cerebrospinal fluid.

B.P: blood pressure

E.C.G: electrocardiogram

MmHg: millimeters of mercury

COP- colloid oncotic pressure

RL- ringer lactate

BMI-Body mass index

Kg –Kilogram

Cm-centimeter.

K.N.H –Kenyatta National Hospital.

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ABSTRACT

Objective - This study was undertaken to determine the incidence of, and risk factors for, hypotension during spinal anaesthesia for Cesarean Section at Kenyatta National Hospital.

Design - A cross-sectional, prospective, non-randomized observational study.

Setting - Kenyatta National Hospital maternity theatres.

Subjects- Women having spinal anaesthesia for emergency or elective Caesarean Section.

Methods- An initial blood pressure was taken immediately after the injection of local anesthetic and then every 2.5 minutes for the first 10 minutes. Observation of occurrences or non occurrences of hypotension (systolic blood pressure equal to or below 90 mmHg) within the first 10 minutes of the routine anaesthetic care was noted.

Results- In this study where 112 full-term pregnant women received successful spinal anaesthesia for Cesarean Section from February 1 to April 31, 2009, at The Kenyatta National Hospital, the incidence of hypotension was 64%. The factors associated with the development of hypotension in the present study included maternal height < 155 cm (p.value =0.008) and sensory level higher than T5 (p-value =0.007). The main preventive strategies used to reduce the incidence of hypotension in mothers undergoing elective or emergent cesarean section included left uterine displacement (100%), prophylactic ephedrine (82.1 %), and fluid loading with crystalloids or colloid (83.0%,17%) respectively. Although nausea and vomiting often accompanies hypotension in the parturient, the incidence in this study was only 20%.

Conclusion-We found in this study,that the incidence of hypotension in at The Kenyatta National Hospital was 64.%,and that the factors associated with development of hypotension included maternal height < 155 cm and sensory level higher than T5.

INTRODUCTION

The choice of anaesthesia for Caesarean Section should be made by balancing women's preference with the risks and benefits of a particular technique to the mother and her baby. There appears to be fewer adverse outcomes in general with the use of regional techniques compared to general anaesthesia (1).

Maternal hypotension is the most frequent complication of a spinal anaesthetic with an incidence approaching 100% in the absence of preventive measures. Untreated severe hypotension can pose serious risks to both mother (unconsciousness, loss of airway reflexes, pulmonary aspiration, apnea or even cardiac arrest) and the baby (impaired placental perfusion leading to hypoxia, fetal acidosis and neurological injury) (2) .

The strategies currently used to minimize or prevent maternal hypotension during spinal anaesthesia for CS include: (a) Ensuring proper maternal position with the uterus displaced off the inferior vena cava (left uterine displacement),(b) Infusion of fluids to increase effective blood volume, (c) Administration of a vassopresor such as ephedrine(1).

Physical interventions such as leg wrappings are also used and may act by minimizing venous pooling of blood in the legs (3).

All these methods aim to maintain blood pressure by increasing venous return to the heart or increasing peripheral vascular resistance, or both. There is, however, no established ideal technique.

LITERATURE REVIEW

The most recent triennial Confidential Enquiry into Maternal Deaths in the United Kingdom 2006-2008 (Department of Health, 2008) has shown a decline in maternal mortality related to anaesthesia. This has been attributed to a growing preference for using regional anaesthesia for most obstetric surgical procedures.

Studies have shown significant advantages of regional anaesthesia compared with general anaesthesia, reporting improved neonatal Apgar scores and less postoperative maternal morbidity (4, 5). Furthermore, remaining awake to witness the birth of their infant appeals to most pregnant women, and they can be accompanied by a partner, a relative or a friend during an awake procedure.

Since the early 1980s, spinal anaesthesia has emerged as the preferred regional technique for most surgical procedures. Subarachnoid anaesthesia provides a dense and predictable block, since the local anaesthetic agent is injected directly into the cerebrospinal fluid (CSF) that surrounds the nerve roots. It has a quicker onset, and associated with fewer complications when compared with epidural anaesthesia. (6)

Furthermore, it reduces the possibility of a 'patchy' block, encountered in approximately 5–10% of epidurals, which is attributable to fatty tissue and fibrous septa within the epidural space hindering the spread of local anaesthetic(4).

Indeed, spinal anaesthesia is administered to at least 80% of women having Caesarean Sections in the USA and the majority of elective Caesarean operations in the UK (7, 8). In practice, if the patient already has a working epidural in situ, it will be topped up. Most "emergency" cases allow enough time that, with the agreement of the surgeon, a spinal will be performed. Although this is controversial, it has been shown that 80 - 88% of American anesthesiologists would do a spinal for "emergent"Caesarean section. (9)

A spinal produces a more rapid onset of peripheral nerve block, including a more rapid sympathetic block, which causes peripheral vasodilatation and hypotension which is frequently more severe than that associated with epidural anaesthesia. Care is needed in patients who are less able to tolerate this situation (e.g. pre-eclampsia, aortic stenosis, Eisenmengers' syndrome). In these circumstances, the anaesthetic technique must be tailored to the individual case, and many would suggest that if the patient wishes to be awake, a slow gentle introduction of epidural anaesthesia, perhaps with invasive hemodynamic monitoring, is preferable to spinal anaesthesia, as it gives greater control (10) .However, it has been shown that a combined spinal/epidural technique is safe in preeclampsia. (11)

A strict aseptic technique is followed, using a needle of 24 standard wire gauge or less to enter the subarachnoid space. After establishing an indwelling intravenous cannula, the patient adopts either the sitting or lateral position and flexes her lumbar spine. It has been shown that the sitting position is quicker, and that these patients require less ephedrine for the prevention of hypotension (12)

The sub-arachnoid space is accessed by introducing the spinal needle between the spinous processes of two lumbar vertebrae. The 'solid' spinal cord usually terminates at the level of the second lumbar vertebra, so it is routine practice to puncture the dura mater below this level (e.g.L3/4, L4/5). The endpoint of the technique is the appearance of CSF in the hub of the spinal needle.(13) A suitable volume of local anaesthetic is then injected over 20 seconds into the CSF, during which the patient may perceive a sensation of warmth in dependent areas(e.g. perineum).

A Commonly used dose is 7.5 mg (1.5mls) of 0.5% heavy bupivacaine with 0.5 ml (25micogram) of fentanyl (14).After removing the spinal needle; the patient adopts the supine position, usually with left lateral tilt. The local anaesthetic then disperses within the CSF, providing the onset of anesthesia usually within 10 minutes, heralded by both motor and sensory changes. (13)

Pregnant women are more susceptible to hypotensive episodes because of the pressure of the gravid uterus on the inferior vena cava with reduced venous return from the lower extremities hence decreased cardiac output, a situation known as 'aortocaval compression' (14). A central neuraxial block may exacerbate the supine hypotension of pregnancy through several physiological mechanisms associated with interruption of sympathetic neural tone. The sympathetic outflow, which extends from T1 to L2, can be disrupted by the action of local anaesthetic. The ensuing vasodilatation in the affected dermatomes and myotomes reduces systemic vascular resistance, leading to decreased systemic blood pressure. Should the sympathetic efferents to the myocardium (T1 to T4) become blocked, both heart rate and stroke volume will decrease, and hypotension will be made worse by the reduction in cardiac output. (15)

In a study where 807 full-term pregnant women received successful spinal anesthesia for Cesarean Section at Siriraj Hospital Thai from July 1 to December 31, 2004, the incidence of hypotension was 65.1%. (14) In another prospective cross sectional study carried out from November 1, 2004 to July 31, 2005 in Thailand where 722 parturients underwent Cesarean Section under spinal anesthesia the reported incidence of hypotension and bradycardia was 52.6% and 2.5% respectively. (15)

Although there is some variation, most workers define hypotension as a maternal systolic blood pressure below 70% to 80% of baseline recordings or an absolute value of less than 90 mmHg to 100 mmHg, or both (2).

Traditional approaches to minimizing the effects of sympathetic block have included the use of a fluid preload before the spinal anaesthetic, and the incremental intravenous administration of a sympathomimetic agent (e.g. ephedrine) thereafter. In recent years, however, the value of fluid loading has been contested. Different fluid volumes (16) and different rates of administration (17) have failed to show any significant reduction in hypotension.

Fluid administration may indeed generate problems. Intravascular colloid oncotic pressure is reduced in pregnancy, making obstetric patients more predisposed to pulmonary oedema. Furthermore; the temporary dilutional effects of fluid may exacerbate the existing physiological anemia of pregnancy, leading to a reduction in fetal oxygen delivery (18). Finally, fluid loading may induce atrial natriuretic peptide release via atrial stretching. This peptide causes a humoral vasodilatation and diuresis, and can potentiate the neurogenic hypotensive effects of spinal anaesthesia (18).

The use of sympathomimetic agents to correct hypotension is widespread and has been extensively investigated. Ephedrine is the most popular choice, although metaraminol, methoxamine or phenylephrine may also be used. It has been suggested that a constant infusion of ephedrine (titrated to effect) is more beneficial than intermittent boluses of the drug (19).

Some authors have looked at using vasoconstrictors alone and abandoning the use of any fluid preload. Although their results are favorable there are no absolute recommendations relating to the prevention and management of hypotension during spinal anesthesia (20).

The prevention of spinal hypotension appears more likely to decrease the frequency and severity of associated adverse maternal symptoms than the treatment of established hypotension. Untreated severe hypotension can pose serious risks to both mother (unconsciousness, pulmonary aspiration, apnea or even cardiac arrest) and the baby (impaired placental perfusion leading to hypoxia, fetal acidosis and neurological injury)(2).

Some studies have shown that women with preeclampsia and those having Caesarean Section under combined spinal/epidural technique are unaffected by hypotension making routine prophylaxis with fluid preloading and ephedrine probably unnecessary in this particular patient group (21). Women in established labor who subsequently undergo spinal anaesthesia seem similarly unaffected by hypotension (22).

In a study done to assess the effects of prophylactic interventions for hypotension following spinal anaesthesia for Caesarean Section where 75 trials (a total of 4624 women) were included, it was found that crystalloids were more effective than no fluids (relative risk (RR) 0.78, 95% confidence interval (CI) 0.60 to 1.00; one trial, 140 women, sequential analysis) and colloids were more effective than crystalloids (RR 0.68, 95% CI 0.52 to 0.89; 11 trials, 698 women) in preventing hypotension following spinal anaesthesia at Caesarean Section. No differences were detected for different doses, rates or methods of administering colloids or crystalloids. (23)

Comparative studies of ephedrine and phenylephrine in prevention of hypotension after spinal anaesthesia for Caesarean Section have lacked a consensus on dose equivalence. A study to determine the minimum vasopressor dose for each of these drugs, demonstrated a potency ratio of 81.2 (95% CI 73.0-89.7) for equivalence between phenylephrine and ephedrine in prevention of hypotension after spinal anaesthesia for Caesarean section.(24)

In another study ephedrine sulfate was administered to 44 healthy parturients undergoing repeat elective cesarean delivery under spinal anesthesia. The results suggest that prophylactic ephedrine infusion is safe and desirable in healthy parturient undergoing cesarean section under spinal anesthesia. (25)

A randomized, double-blinded dose-finding study of intravenous ephedrine for prophylaxis against hypotension in 80 women who received an intravenous crystalloid preload and spinal anesthesia for elective cesarean delivery, concluded that the smallest effective dose of ephedrine to reduce the incidence of hypotension was 30 mg. (26)

However, this dose did not completely eliminate hypotension, nausea and vomiting, and fetal acidosis, and it caused reactive hypertension in some patients, and did not improve neonatal outcome. (26)

A prophylactic bolus of ephedrine 12 mg intravenously given at the time of intrathecal block, plus rescue boluses, leads to a lower incidence of hypotension following spinal anaesthesia for elective Caesarean section compared to intravenous rescue boluses alone. (27) Reviewed trials report no serious adverse events on use of ephedrine .In two trials, maternal hypertension and tachycardia were associated with ephedrine administration in a dose-related fashion (28).No differences were seen in the incidence of fetal acidosis when ephedrine was compared with phenylephrine in the prevention of hypotension for spinal anaesthesia although the issue of increased risk of fetal acidosis has been raised when ephedrine is used to treat, rather than prevent, hypotension (29).

From prospective trials, it is clear that lowering the spinal dose improves maternal hemodynamic stability (30).

Doses of intrathecal bupivacaine between 5 and 7 mg are sufficient to provide effective anaesthesia. Low-dose spinal anaesthesia as part of a combined spinal-epidural technique is a valuable method in improving maternal and fetal outcome during anaesthesia for operative delivery. (30)

In other studies Lower limb compression was more effective than control in preventing hypotension, although different methods of compression appeared to vary in their effectiveness. Two trials have shown Esmarch bandages appear to have a larger treatment effect than the use of inflatable boots or compression stockings (31). The use of thromboembolic deterrent stockings may decrease the incidence of hypotension and, incidentally, provide protection against thromboembolism, which remains a major cause of maternal mortality (32).

In a prospective study to identify risk factors for hypotension after spinal anaesthesia for Caesarian Section, non-modifiable risk factors included (i) body mass index more than 35 and (ii) patient height < 155 cm ;and modifiable risk factors included (i)dose of heavy bupivacaine and (ii)level of sensory blockade equal to or higher than T5. Usage of high dose of heavy bupivacaine and maximum level of spinal blockade higher than T5 were two modifiable risk factors associated with hypotension during spinal anaesthesia. Avoidance of high block and lower dose of heavy bupivacaine can reduce the incidence and severity of hypotension after spinal anaesthesia(33).

JUSTIFICATION OF THE STUDY

Spinal anaesthesia is now commonly used at Kenyatta National Hospital for Caesarean Sections. 2646 Caesarean Sections were done between January and September 2008. (Appendix III-Table 6). Of these, 1066 (40.3%) were done under spinal anaesthesia using the KNH protocol. Spinal anaesthesia for Caesarean Sections avoids risks associated with general anaesthesia and facilitates effective postoperative pain relief. The commonest side-effect of spinal anaesthesia is maternal hypotension with an incidence approaching 100% in the absence of preventive measures. Untreated severe hypotension can pose serious risks to both mother and the baby with poor outcomes.

No audit on the incidence and risk factors associated with hypotension in spinal anaesthesia for Caesarean delivery has been carried out locally despite the increasing application and use of regional techniques for surgery.

This study evaluated the incidence of, and risk factors for, hypotension during spinal anaesthesia for Caesarean Section at KNH.

The results of this survey may be used as a basis for further studies in spinal anaesthesia for Caesarean Section as well as to improve on the current KNH spinal anaesthesia protocol for Caesarean Section.

OBJECTIVES

Broad Objectives:

To determine the incidence of ,and risk factors for, hypotension during spinal anesthesia for Cesarean Section at The Kenyatta National Hospital.

Specific Objectives:

1. To determine the incidence of maternal hypotension during spinal anaesthesia for Cesarean Section.
2. To assess risk factors for hypotension during spinal anaesthesia for Cesarean Section.
3. To assess adverse effects associated with hypotension during spinal anesthesia for Cesarean Section.
4. To assess the main preventive strategies used to reduce the incidence of hypotension during spinal anesthesia for Cesarean Section.

METHODOLOGY

1. Study design:

Cross-sectional, prospective, non-randomized, observational study.

2. Study Population

All women having spinal anaesthesia for Caesarean Section at The Kenyatta National Hospital.

3. Site of Study.

Kenyatta National Hospital Maternity theatres.

4. Sampling

Sequential non-random sampling of women who were to receive standardized spinal anaesthetic as per the protocol for Cesarean Section at The Kenyatta National Hospital.

5. Sample Size Calculation.

Sample size calculation was done using the following formula (44).

Part I

$$n = \frac{z^2 \cdot p \cdot q}{d^2}$$

Where:

n = (the approximate sample size for this study)

z = 1.96 (per table of the area under the normal curve for the given confidence level of 95 %)

d = 0.05 (the margin of error and estimate should be within 5% of the true value)

p = 52.6% (the incidence of hypotension reported in previous study (25))

q = 1-p

Therefore:

$$n = \frac{(1.96)^2 * (0.52) * (1 - 0.52)}{(0.05)^2}$$

$$n = \frac{0.9589}{0.0025}$$

$$n = 383.56$$

Part II

If the population to be studied is less than 10,000 (In our case 1066 C/S patients underwent spinal anesthesia at the Maternity theatres from January to September 2008 which gives us an average of approximately 118 C/S cases per month (i.e 1066/9).), then part II of the formula which uses the required sample size got from part I of the formula will be applied.

$$nf = n / (1+n/N)$$

Description:

nf = is the desired sample size when the population studied is less than 10,000.

n: the sample size required if the population would have been more than 10,000(384 in our case got from part I of the formula).

N = the estimated population size. In our case this is the estimated number of C/S cases done under spinal anesthesia in at KNH per month; i.e approximately 118.

Therefore

$$nf = n / (1+n/N)$$

$$= 384 / (1+384/118)$$

$$= 96$$

Hence the calculated minimum number of patients required for the study was 96.

6. Inclusion Criteria:

- All consenting ASA class I or II patients undergoing elective or emergency Cesarean section (CS) at term under spinal anaesthesia at the labour ward theatres of The Kenyatta National Hospital.

7. Exclusion Criteria:

- Pregnancy induced hypertension.
- Diabetic patient undergoing Cesarean Section.
- Those who have received combination of spinal block with other type of anesthesia.
- Multiple Pregnancies.
- Standard contra-indications to regional anaesthesia (e.g. local infection, coagulopathy, some types of severe cardiac disease, e.g. fixed output cardiac disease and severe fetal distress).
- Patients with hypotension due to ante partum haemorrhage or sepsis coming for Caesarian section.
- Any Patient noted to have unexplained hypotension (systolic BP below 90mmHg) or hypertension (systolic BP above 140mmHg) before the block.

8. Study Procedure.

The KNH protocol (see appendix IV) for spinal anaesthesia for Cesarean Section was followed by the responsible anesthetic team for all women included in the study.

a). Preparation for spinal anaesthesia.

1. Pre-operative review was done for elective cases in the ward and at the receiving area for emergency cases by the anaesthetist on the respective anaesthetic team.
2. The pre-operative review focused on explanation of the procedure, looked for specific contraindications to spinal anaesthesia and obtained informed consent.
3. At the time of the procedures, for each patient, (the team leader either the doctor or clinical officer anaesthetist) ensured that all anaesthetic equipment and drugs available and ready for general anaesthesia and emergency resuscitation as per the protocol.

b). The Process of Preloading.

1. I.V access with cannula G 16 or 18 was fixed.
2. Pre-load with 500-1000mls crystalloid or if not much time, colloid 500mls, was done in about 10 minutes.

c). Monitoring process and Parameters.

1. Intra-operative monitoring included the standard ECG, heart rate, pulse oximetry respiration, temperature and blood pressure before, during and after the spinal anaesthesia.
2. Baseline blood pressure, heart rate, ECG rhythm and saturation were noted before the block.
3. Communication with the patient was maintained throughout the procedure.

d). Spinal block.

1. The spinal block was performed as per KNH protocol. (For purpose of this study heavy bupivacaine 0.5% 1.5mls (7.5mg) +25µg fentanyl was used) .In cases where the block failed the patient was given GA.
2. Once the block was performed the patient was made to lie down with a slight left lateral tilt.
3. A prophylactic dose of 5mg ephedrine i.v. was given immediately and repeated as necessary. If hypotension was symptomatic (nausea, confusion, somnolence etc), epinephrine (1cc of the 1:10,000) was added into the infusion fluid and ran rapidly.

4. An initial blood pressure was taken immediately after the intrathecal local anesthetic injection and then every 2.5 minutes for the first 10 minutes. Thereafter, every 5 minutes. This was recorded in the routine anaesthetics chart.

e). Precautions taken for Patients with hypotension coming for Caesarian section.

1. The anaesthetic team urgently mobilized all available personnel.
2. The team made a rapid evaluation of the general condition of the woman including vital signs (pulse, blood pressure, respiration, temperature).
3. All shock patients were immediately treated with an IV infusion of fluids.
4. The team made an order for immediate blood grouping and cross-matching.
5. Delivery by Caesarean section under general anesthesia was made as soon as possible.

9. Data Analysis.

Data collected was presented descriptively (%): T-test and Chi-square test were used in univariate analysis to compare continuous data and categorical data respectively. Multivariate logistic regression was performed on the variables and p-value < 0.05 was considered significant. The main outcome variable of interest was the incidence of maternal hypotension (Observation of occurrences or non occurrences of systolic pressure less than or equal 90, within the first 10 minutes of the routine anaesthetic care) and was presented descriptively a percentage.

10. Bias Minimization:

- Sampling bias: No bias was expected since only women that met the inclusion criteria were included in this survey.
- Measurement bias: The questionnaire was closed ended hence none was expected. The blood pressure was taken using electronic blood pressure measuring devices. This eliminated many of the errors in blood pressure measurement that human beings can generate.
- Information bias: Only the responsible anaesthetic team filled the questionnaire. This ensured the accuracy of the data.

11.Ethical Considerations:

1. This was an observational study.
2. The author of the study did not perform the spinal block but observed hemodynamic changes associated with routine anaesthetic care.
3. The study did not constitute an additional burden to the patient both cost wise and medically.
4. Confidentiality was maintained by use of anonymous questionnaire.
5. Treatment was not withheld from those who declined to participate in the study.
6. Written informed consent was obtained from the participant.
7. Permission to carry out the study was obtained from Kenyatta National Hospital /U.O.N Ethics and Research Committee.
8. Precautions were taken for all patients with hypotension coming for Caesarian Section

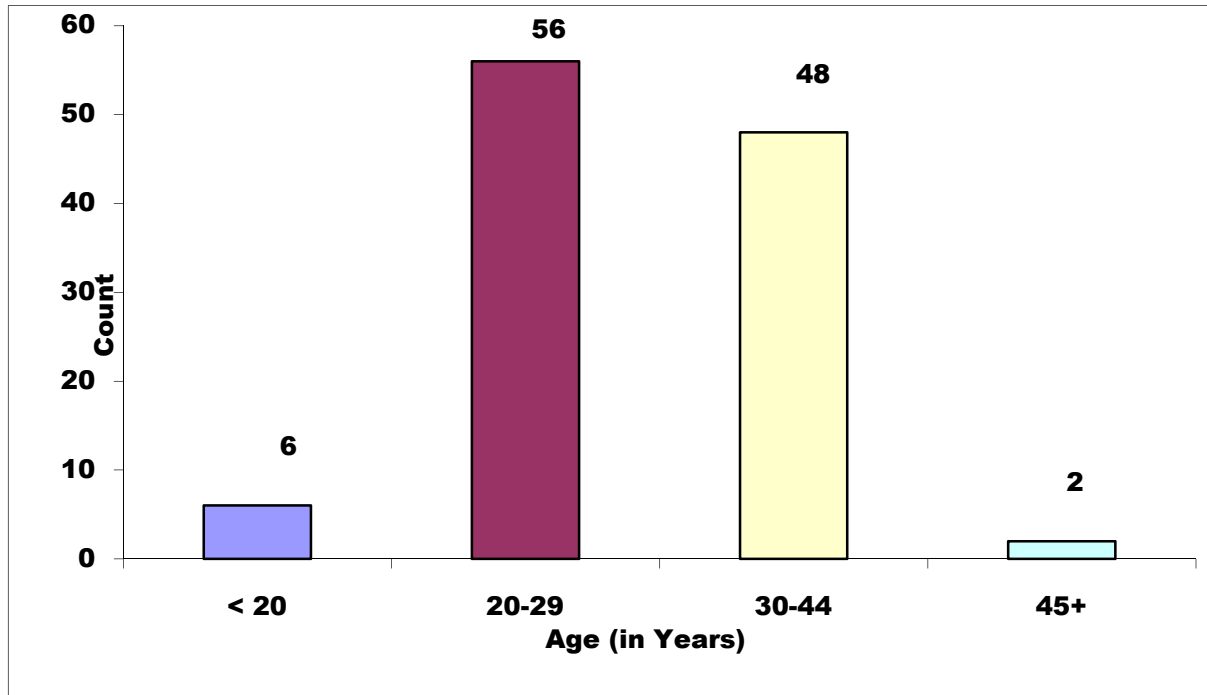
RESULTS

A total of 112 mothers were included in the study. The demographic data is shown in Table 1. Most of the patients were ASA physical status 1 and 2 (53%, 47%) and 51.2% underwent emergency surgery. The mean weight was 67.8 kg, the mean height was 156.6 cm, the mean BMI was 27.8 and the mean age was 29 years. The median age was 29 years and the median weight was 66 kg. The BMI ranged between 17.1 and 45.8 and the height ranged between 134 and 172 cm. The age ranged from 17 to 46 years.

TABLE 1- Demographic data (n= 112)

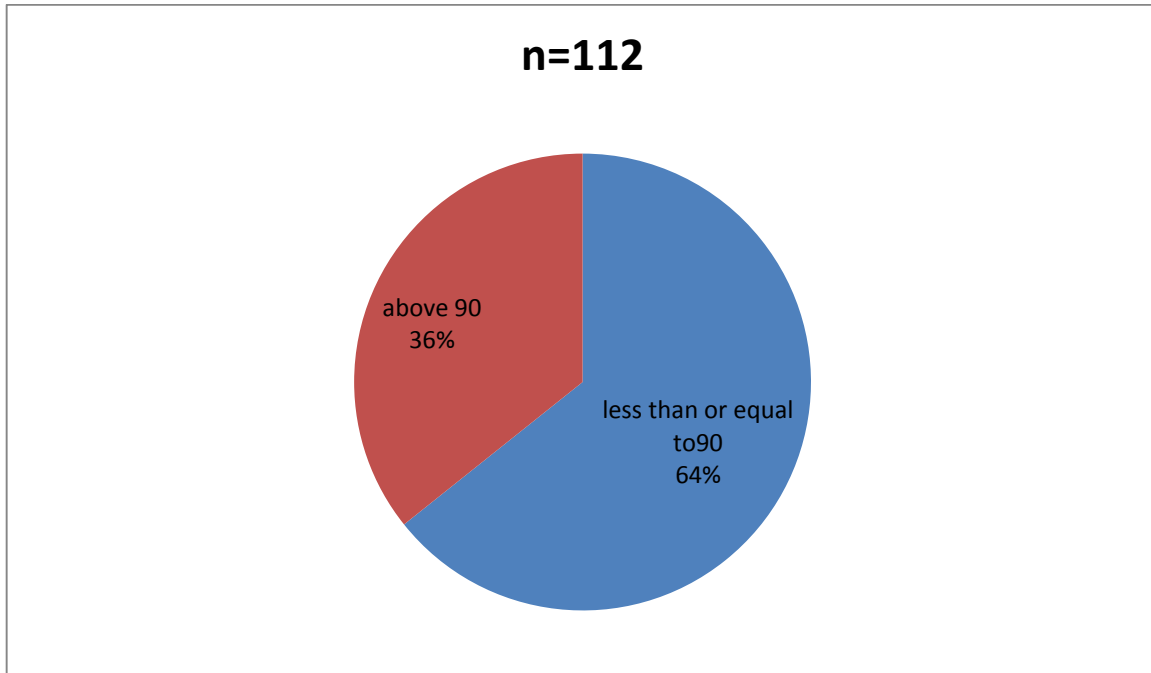
	Mean	Median(min,max)
Age	29	29 (17;46)
BM (kg)	67.8	66 (42;110)
Height (cm)	156.6	(134,172)
BMI (kg/m ²)	27.6	(17.1,45.8)
ASA I;II %	53%:47%	
Elective;Emergency %	48.8%:51.2%	

Figure 1: Age distribution (n = 112)



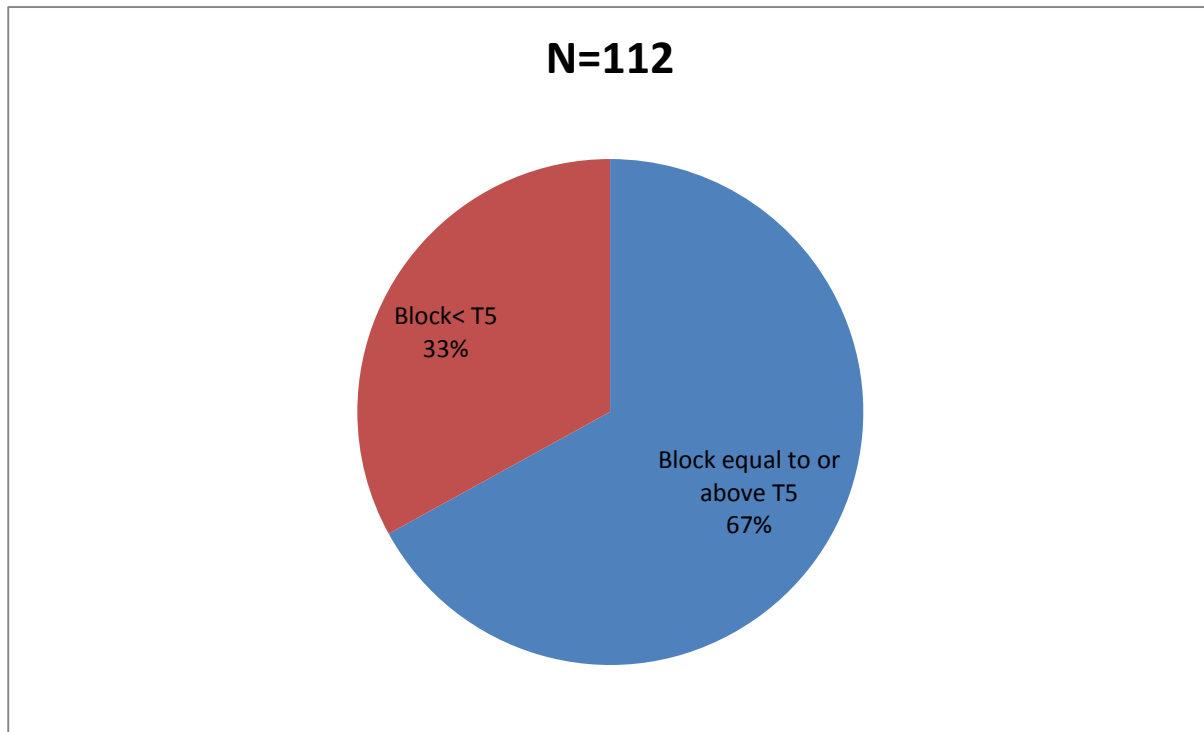
The age ranged between 17 and 46 years. The majority mothers 56 (50.0%) were in the 20–29 age group, followed by 48 (42.9%) mothers in 30–44 age group, and 2(1.8%) and 6(5.4%) were in above or equal to 45 years and below 20 years respectively.

Figure 2: Incidence of Hypotension (systolic BP in mmHg)



Seventy two patients who represented 64 % experienced systolic blood pressure of less than or equal to 90 mmHg and forty patients representing 36 % experienced systolic blood pressure above 90 mmHg within the first 10 minutes after intrathecal injection of the routine spinal anesthetic.

Figure 3: Maximum level of spinal block.



75 (67 %) of patients had maximum level of spinal block above or equal to T5 and 37 (33%) had maximum level of spinal block below T5.

Table 2- Multiple logistic regression and variables associated with hypotension

Variable	Grouping	Hypotension		p-value	95% CI for OR
		No	Yes		
Age	<35	18(25.1%)	56(74.9%)	0.098	0.92,2.80
	≥ 35	7(16.8%)	31(83.2%)		
Height	≥ 155	32(45%)	39 (55%)	0.008	1.19,3.14
	<155	8(18.8%)	33(81.2%)		
Analgesic level	<T5	11(29.1%)	26(70.9%)	0.007	1.18,2.84
	≥ T5	15(19.5%)	60(80.5%)		

Patient’s height of less than 155 cm increased the incidence of hypotension (p-value = 0.008), the same effect was seen with sensory level of T5 or higher (p- value = 0.007).

Table 3: Intravenous fluid preload. (n = 112)

Intravenous Fluids	Frequency	Percent
Colloids	19	17.0
Crystalloids	93	83.0
None	0	0
Total	112	100

Crystalloids were administered to 93mothers representing 83 per cent.

Table 4: Prophylactic Drugs used (n = 112)

Drugs Used	Frequency	Percent
Ephedrine	92	82.1
Adrenaline	20	17.9
Total	112	100

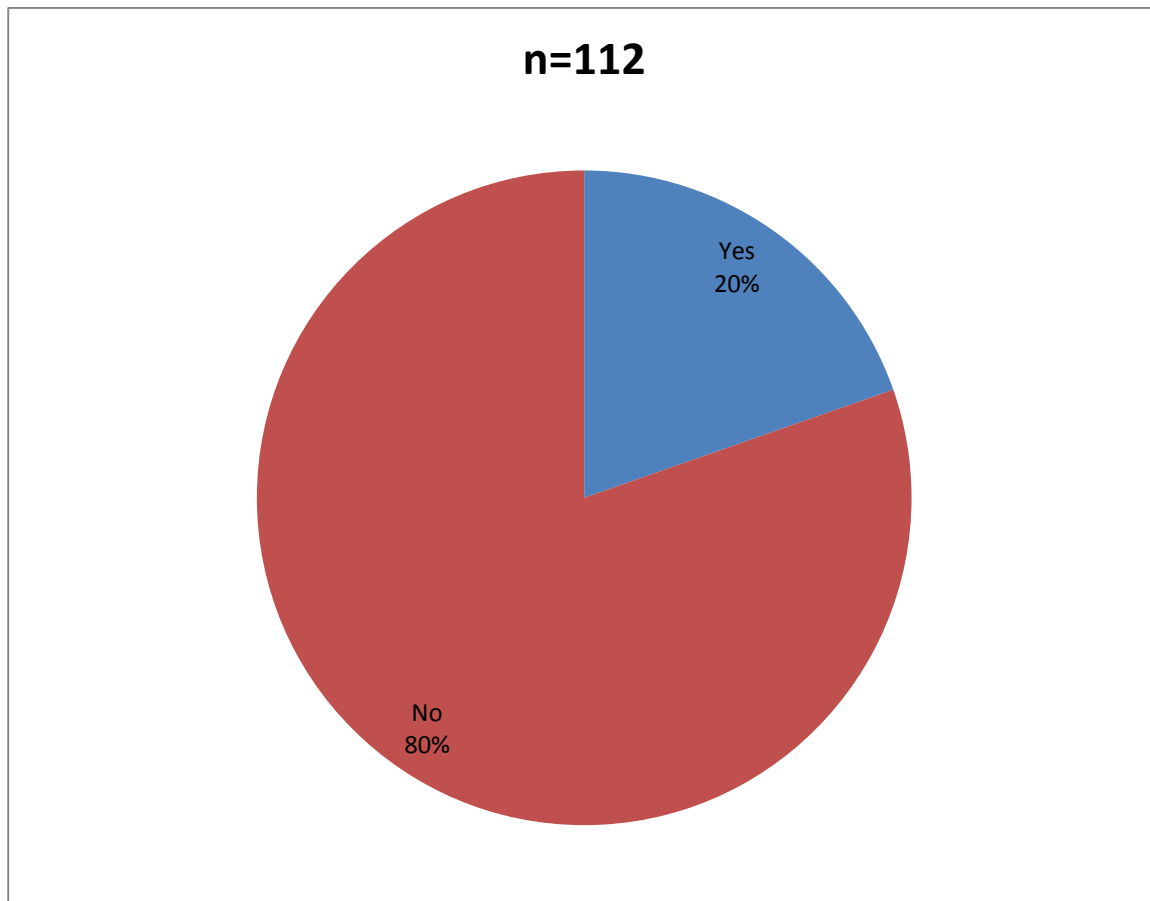
Prophylactic ephedrine was given to 82.1% of the mothers. Prophylactic Adrenaline was given to 20 mothers (17.9%).

Table 5: Physical Method used (n = 112)

Method Used	Frequency	Percent
Left uterine displacement done	112	100
No left uterine displacement done	0	0
Total	112	100

Left uterine displacement was done to 100 % of parturients undergoing elective or emergency Cesarean Section delivery under spinal anaesthesia .

Figure 4 – Nausea and Vomiting associated with Hypotension.



80 % of the mothers did not develop nausea and vomiting associated with hypotension following spinal anaesthesia. 20% of the mothers developed Nausea and vomiting associated with hypotension.

Discussion

The commonest side-effect of spinal anaesthesia is hypotension, which is often accompanied by nausea or vomiting, or both. Hypotension after spinal anaesthesia for Caesarean section remains a common and potentially serious complication, despite the use of left uterine displacement, prophylactic ephedrine, and fluid loading (35).

Spinal anaesthesia is now commonly used at Kenyatta National Hospital for Caesarean Sections. 2646 Caesarean Sections were done between January and September in 2008. (appendix III-table 6), of these, 1066 (40.3%) were done under spinal anaesthesia using the KNH protocol. No audit on the incidence of hypotension, despite the increasing application of spinal anaesthesia for Caesarean delivery, has been carried out at The Kenyatta National Hospital.

In this study where 112 full-term pregnant women received successful spinal anaesthesia for Caesarean Section from February 1 to April 31, 2009, at The Kenyatta National Hospital, the incidence of hypotension was 64%. This compares favorably with the incidence of hypotension of 65.1% in a similar study done at Siriraj Hospital Thai. (14).

Our incidence of hypotension is however lower than the study of Neti et al(36), (73.3%).One reason for this could be that, they performed their study by defining maternal hypotension as the SBP < 100 mmHg or a decrease of more than 20% of baseline SBP.

Most of the patients were ASA physical status 1 and 2 (53%, 47%). 51.2% as emergency, and 48.8% as Elective, Caesarian Section. It is encouraging to note that Kenyan anaesthetists working at KNH preferred to use spinal anesthesia in 51.2% of "emergency" cases. Although this is controversial, it has been shown in another study, that 80 - 88% of American anesthesiologists would do a spinal for "emergent "Caesarean section. (9)

One parameter that has statistically significant differences associated with development of hypotension in the present study included maternal height < 155 cm (p-value= 0.008). In a prospective study to identify risk factors for hypotension after spinal anesthesia for Caesarian Section, patient height < 155 cm was identified as a non-modifiable risk factor (30). In this study, the mean height was 156.6 cm with a range between 134 and 172 cm. One explanation for our finding may be the amount of local anaesthetic agents in terms of milligram and total volume in relationship to height. This is because a previous study by Mark et al (47) concluded that height did not affect the spread of hyperbaric spinal anesthesia. The Kenyatta National Hospital protocol for spinal anesthesia for Cesarean section recommends a dose of 7.5 mg (1.5mls) of 0.5% heavy bupivacaine with 0.5 ml (25micogram) of fentanyl for spinal anaesthesia to all patients regardless of their height.

Harten et al (48) showed that adjusting the dose of hyperbaric bupivacaine to the patient's height decreased the incidence and severity of maternal hypotension. Doses of hyperbaric bupivacaine between 5 and 7 mg have been shown to be sufficient to provide effective spinal anaesthesia for Caesarian Section (30).

Another factor that has statistically significant differences associated with development of hypotension in the present study included maximum level of sensory blockade higher than T5 (p-value=0.007). 75 (67 %) of patients had maximum level of spinal block above or equal to T5 and 37 (33%) had maximum level of spinal block below T5. The K.N.H protocol recommends at least T6. Maximum level of spinal blockade higher than T5 has been identified as one of the modifiable risk factors associated with hypotension during spinal anesthesia.(33)

The physiological explanation is that the higher the level of sensory blockade, the more autonomic blockade occurs, causing more vasodilatation and more hypotension. The sympathetic outflow runs from T2-L1. The cardio-accelerator nerve fibers are located at T1-T4. Blockade above T4 level may lead to negative inotropic and chronotropic effects on the heart thus causing hypotension (46).

Low-dose spinal anaesthesia as part of a combined spinal-epidural technique has been recommended as a valuable method of avoiding high spinal blocks, thus improving maternal and fetal outcome during anaesthesia for operative delivery. (30)

The main preventive strategies used to reduce the incidence of hypotension during spinal anesthesia for Cesarean Section at The Kenyatta National Hospital included left uterine displacement, prophylactic ephedrine and fluid loading with crystalloids or colloid.

In this study, 83.0 % of the women received crystalloids and 17% received colloids for preloading prior to spinal anaesthesia. One previous trial found that crystalloids were more effective than no fluids and colloids were more effective than crystalloids in preventing hypotension following spinal anaesthesia at Caesarean Section .No differences were detected for different doses, rates or methods of administering colloids or crystalloids (23).

This study reveals that K.N.H anesthetists use crystalloids more than colloids for fluid loading, although both are recommended in the protocol. The reason may be the fact that colloids are less readily available and more expensive, therefore used sparingly for those urgent cases that do not allow enough time for crystalloid preload. A more recent study by Carvelho et al (49) concluded that Hetastarch co-loading is as effective as pre-loading for the prevention of hypotension after spinal anesthesia for cesarean delivery. Surgery need not be delayed to allow a predetermined pre-load to be administered before induction of spinal anesthesia.

In this survey, prophylactic dose of 5mg ephedrine i.v. was given immediately after intrathecal injection to 82.1 % of parturient undergoing elective or emergency Cesarean Section. Prophylactic epinephrine was administered to 17.9% of parturient. The erratic availability of ephedrine in the hospital during the period of study could have contributed to the use of epinephrine, although it is not recommended in the K.N.H protocol as a prophylactic vasoconstrictor. The protocol only recommends use of epinephrine (1cc of the 1:10,000) into the infusion fluid, when hypotension is symptomatic (nausea, confusion, somnolence etc).

K.N.H protocol recommends the multimodal approach on use of both prophylactic fluid preload and vasoconstrictors. Some authors have looked at using vasoconstrictors alone and abandoning the use of any fluid preload. Although their results are favorable, there are no absolute recommendations relating to the prevention and management of hypotension during spinal anesthesia (20).

Lastly, left uterine displacement was applied in 100 % of parturients undergoing elective or emergency Cesarean Section delivery under spinal anaesthesia. In literature, ensuring proper maternal position with the uterus displaced off the inferior vena cava reduces the pressure of the gravid uterus on the inferior vena cava and hence increases the venous return. (14)

Although in parturients nausea and vomiting often accompanies hypotension, the incidence in this study was at 20%. The metoclopramide given preoperatively probably played a major role in preventing nausea and vomiting (45).

Conclusion

We found that the incidence of hypotension (defined as the lowest systolic blood pressure less or equal to 90 mmHg) in the current study at The Kenyatta National Hospital is 64 %.

The parameters that have statistically significant association with development of hypotension in the present study include maternal height < 155 cm, and sensory blockade above T5.

The use of left uterine displacement, prophylactic ephedrine, and fluid loading with crystalloids were the main preventive strategies being used in The K.N.H protocol.

The incidence of nausea and vomiting that often accompanies hypotension in this study was 20%.

RECOMMENDATIONS.

1. Development of a second protocol on Low-dose spinal anaesthesia as part of a combined spinal-epidural technique at The K.N.H.
2. Re-evaluation of the current K.N.H protocol on spinal anaesthesia for C/S to adopt the recommendation by Neti et al (36) of adjusting the dose of hyperbaric bupivacaine in relation to the patient's height.
3. Re-evaluation of the current K.N.H protocol on spinal anaesthesia for C/S to adopt the recommendation by Carvahho et al (49) of Hetastarch co-loading.
4. Ephedrine or phenylephrine should be made readily available in the maternity theaters.
5. Colloids such as Hetastarch should be made readily available in the maternity theaters.

STUDY LIMITATIONS

1. One weakness of this survey is the incomplete recording of data. More so, the management of hypotension in the present study depended upon the individual judgment of responsible personnel.
2. The study needed more time to recruit a larger sample size.

Appendix 1: DATA CAPTURE INSTRUMENT

This survey questionnaire should be filled by the anaesthetic team after successful spinal anaesthesia after using KNH protocol only. See the dermatome map part of protocol.

Note if the c/s is Elective or Emergency on top of these questionnaire.

1. What is this patient's

Age?

Weight?

Height

2. Prophylactic intravenous fluids used:

• colloids;

• Crystalloids

None

3. Prophylactic drugs used:

• sympathomimetics; ephedrine

• other

If other, please specify

4. Prophylactic physical method used:

• leg bindings;

• compression stockings;

• Other maneuvers.

If other please specifies:

5. What was the lowest systolic pressure(in mmHg)recorded before delivery after intrathecal injection

Above 90 .

Equal to 90

Less than 90

6. Did this woman receive any rescue treatment? Yes No

7. Was the analgesic level less than or equal to T4? Yes No

8. Did this woman develop any of the following adverse effect?

Anaphylaxis Nausea, vomiting impaired consciousness, dizziness

Cardiac dysrhythmia hypertension requiring intervention none

APPENDIX II

CONSENT EXPLANATION

I Dr David Mwangi Kahoro, MBChB (MOI) a final year Anaesthesia registrar, mobile number 0726316199 will give you the team leader in charge of the specific anesthetic team in maternity theatre a full explanation of my intended study before you sign the consent form.

The Study

The study aims to assess the incidence of and risk factor for hypotension during spinal anaesthesia for cesarean section at KNH.

Confidentiality

The participant's identity will be protected. Only codes will be used for reference.

Participation in the study

Participation will be voluntary and no patients who refuse to participate in the study will be denied any treatment.

No invasive procedures shall be carried out on the participants other than routine anaesthetic care. Data will be collected only during routine KNH protocol for spinal anaesthesia for cesarean section. The study will not be at any extra cost to the patient. No complications are expected to occur as a result of participation in the study.

STUDY CONSENT

Spinal anesthesia is now commonly used for Cesarean Section at Kenyatta National Hospital. Its major adverse effect is hypotension. The objective of this study is to determine the incidence of and risk factors of hypotension during spinal anesthesia for Cesarean Section using routine Kenyatta National Hospital protocol.

There will not be any invasive procedures on your patient other than the one defined in the routine KNH protocol for spinal anaesthesia fro Cesarean Section. Decisions concerning management of your patient will be left to the responsible anaesthetic team, in consultation with you. The consent is therefore only for the purpose of the study. Participation in the study is purely voluntary. Any questions arising in the course of the study can be addressed to me .You will have the freedom to terminate the participation any time you so wish. Your patient cannot be denied treatment for refusing to participate in this study.

I

Having been explained and understood the nature of the study

hereby consents to participate in the study. I clearly state I have explained the nature of the study to the patient and that this consent has been voluntarily obtained.

Signature of Doctor/CO anaesthetic team leader.....Date.....

To the patient before induction of spinal anesthesia:

I have understood the purpose and the importance of the intended research and hereby voluntarily consent to participate.

Signature of the patient.....DATE.....

CONTACT OF INVESTIGATOR

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K.N.H

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APPENDIX III– A table on summary of CS Done between Jan-Sept 2008

Table -6

Month 2008	OPERATION Under spinal anaesthesia	OPERATION Under GA	TOTAL OPERATION	% of c/s under spinal anaesthesia
Jan	23	243	266	8.6
Feb.	68	216	284	23.9
March	95	194	289	32.9
April	117	283	300	39
May	150	155	305	49.1
June	164	123	287	57.1
July	130	159	289	45
August	130	99	229	56.8
Sept	189	108	297	63.6
Total	1066	1580	2646	40.3

This data was analyzed from the KNH maternity theatre record.

APPENDIX IV

KENYATTA NATIONAL HOSPITAL

PROTOCOL FOR CAESAREAN SECTION UNDER SPINAL ANAESTHESIA.

(Prepared by Dr.P.O.R Olang'AND Edited by Dr. D Otieno.)

1. PRE- ANAESTHETIC REVIEW

HISTORY AND PHYSICAL EXAMINATION

Look for specific contraindications to spinal anaesthesia then obtain informed consent. Ensure routine investigation done viz. Haemogram, Urea/Electrolytes, and Grouping & Cross-matching.

2. IN THEATRE.

a) Ensure anaesthetic equipment and drugs available and ready for General Anaesthesia i.e.

- ❖ Working laryngoscope,
- ❖ Working anaesthetic machine with circuit and face masks,
- ❖ Thiopentone, suxamethonium, atropine, ephedrine (diluted to 5 mg/ml), epinephrine (diluted to 1:10,000) all ready for use.

b).Ensure supply of equipment and drugs for anaesthesia i.e.

- Sterile tray for lumbar puncture with regal or raytec,
- Spinal needle G25 or smaller,
- 2cc syringe and 5 cc syringe,
- Heavy bupivacaine 0.5%,
- Fentanyl 50ug/ml,
- Lignocaine 2% (for skin infiltration)
- Crystalloids(Normal saline or Hartmann's solution),

- Colloids (Haesteril 6% ,or Haemacel,or Dextran 70 in saline)
- A pair of sterile gloves,
- Hypodermic needles G21 or larger and G22 or smaller

PROCEDURE

- a). Ensure I.V access with cannula G 16 or 18 if possible.
- b).Pre-load with 500-1000mls crystalloid or if not much time, use colloid 500mls rapidly (about 10 mins).
- c) Attach physiological monitor.
- d).Note baseline BP,Pulse,SpO2 & Respiration.
- e).Position patient for lumber- puncture seated or in lateral decubitus position.
 - Identify posterior superior iliac spines bilaterally and draw a line joining them perpendicular to the spine. This line passes through the L4 vertebra.
 - Mark the L3/L4 interspace and the L4/L5 interspace and infiltrate 1-2cc lignocaine 2% into each interspace using the 5cc syringe and smaller needle.
 - Put the sterile gloves and disinfect the site of lumber-puncture with antiseptic solution (providone iodine and or methylated spirit)
 - Using the bigger needle as an introducer, do a lumber- puncture with the bevel of the spinal needle (Quincke type) facing literally. Free flow of clear CFC marks the end point.
 - Thoroughly shake heavy bupivacaine 0.5% and withdraw 1.5mls (7.5mg) +25µg fentanyl into the 2cc syringe.

- While supporting the spinal needle, firmly fit the syringe onto it and gently aspirate to confirm placement. Gently push in total volume of 2cc of the injected.
 - Place the sterile dressing on the site of puncture and gently let the patient lie down a slight left lateral tilt.
- f) Monitor initial BP then every 2.5 minutes until delivery. Thereafter, every 5 minutes.
- g) Give a prophylactic dose of 5mg ephedrine i.v. and repeat as necessary. If hypotension is symptomatic (nausea, confusion, somnolence etc), add epinephrine (1cc of the 1:10,000) into the infusion fluid and run rapidly
- Administer oxygen by nasal prongs at 2L/Min or by vent mask at 5L/Min to ensure $SpO_2 \geq 95\%$
 - Give prophylactic antiemetic (metochlorpramide, ondansetron or granisetron)
 - Test for the maximum level of spinal block (at least T6 required)
 - Put up a screen between patient and surgeon and maintain verbal contact with the patient.
 - Consider NSAIDs at this stage or post-op.
 - Sedation is rarely necessary but if indeed Midazolam 1-2 mg i.v. is adequate with or without ketamine 25mg.

3. **POST-OPERATIVELY**

Look out for complications such as hypotension, drowsiness, headaches, hypoxia, and urinary retention and manage them appropriately.

APPENDIX V: Ethics Committee Approval Letter.

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