A STUDY COMPARING ESTIMATED BLOOD LOSS BETWEEN SPINAL ANAESTHESIA AND GENERAL ANAESTHESIA ON WOMEN UNDERGOING ELECTIVE CAESARIAN SECTION AT KNH

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A Dissertation Submitted in partial fulfillment of the requirement for the award of the degree in Masters of Medicine in Anaesthesia of the University of Nairobi

2010

DECLARATION

This dissertation is my original work and has not been to my knowledge submitted for research in any other university

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ACKNOWLEGEMENTS

Acknowledgements are few but well deserved. First to Dr T Chokwe my supervisor in this study for his patience, understanding and guidance without whom this study would never have been accomplished.

To the staff of the maternity theatre, especially the nurses for their encouragement and cooperation during the course of the study.

To the high diploma students in anaesthesia who helped me with the collection of data

To all my fellow residents whose criticism was highly valuable in the performance of this study.

To the consultants at Kenyatta National Hospital especially Dr J. Maina the HOD in anaesthesia department for allowing me to do more clinical work in the maternity theatre and hence collect my data, and Dr A Kibet for your intellectual stimulation and friendship.

DEDICATION

To LUCINA KWAMBOKA, my mother, for the raising me to whom I am today: you are the best may the Almighty God bless you and keep thee.

ABBREVIATIONS

Hb	Hemoglobin
CS	Caesarean Section
CPD	Cephalopelvic Disproportion
GA	General Anaesthesia
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency syndrome
KNH	Kenyatta National Hospital
LUSCS	Lower Uterine Segment Caesarean Section
PMTCT	Prevention of Mother to Child Transmission
WHO	World Health Organization

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SUMMARY

This was a prospective descriptive correlational study done at Kenyatta National Hospital, Nairobi province. Kenya to compare the estimated blood loss during spinal anaesthesia and general anaesthesia for patient undergoing elective caesarian section.

A total of 70 patients were included in the study, 35 in each group. There pre operative hemoglobin levels were noted and post operative hemoglobin levels were then checked on the third post-operative day. Observation and estimation of blood loss was based on the formula developed by Snelling and Shaw.

In the present there was no significant difference in the two groups as regards blood loss. However, patients in the spinal anaesthesia tendered to have no significant drop in hemoglobin level as 48.6% had no change in the spinal group while this was 37.1% in the general anaesthesia group. No patients were transfused during the study.

It was therefore concluded that in skilled hands both techniques can be used for the provision of safe anaesthesia for obstetrics patients.

INTRODUCTION AND LITERATURE REVIEW

Caesarean section

Definition

Caesarean section is one of the operative methods of delivery. A baby is born through an incision in the mother's abdomen and uterine wall. Cesarean sections, also called c-sections or cesarean deliveries, are performed whenever abnormal conditions complicate labor and vaginal delivery, threatening the life or health of either the mother, the baby or both.

It has been suggested that the term is derived from the lex caesarea, a decree said to have continued under the rule of the Caesars from the time of Numa Pompilius (715-672 BC) requiring that before burial of any women dying in late pregnancy the child be removed from the uterus. The term probably derives from the Latin word caedere, "to cut" (past participle caesum, "cut").1

This can be done as an emergency operation or can be done as an elective case. Elective cesarean deliveries can include medically and obstetrically indicated procedures that generally occur before labor. Elective caesarean deliveries can also include procedures for which there is no clear medical or obstetric indication. (1)

Indications of Caesarean Section (1, 2)

Fetal Distress

Cephalopelvic Disproportion

Uterine Inertia

Placenta Previa:

abruptio placentae Premature Separation of the Placenta

Mal-position and Malpresentation:

Pre-eclampsia-Eclampsia:

Cord Prolapse:

Previous Uterine Incision:

Other Indications: Unusual and infrequent indications for cesarean section include a tumor obstructing the birth canal, a prior extensive vaginal plastic operation, active herpes genitalis, prevention of mother to child in HIV patients and severe heart disease or other debilitating condition, maternal choice.

Methods of Caesarean Section

The types of cesarean section in modern use are: (1)

(1) Classic cesarean section,

(2) Low cervical cesarean section,

(3) Extra peritoneal cesarean section.

Classic Cesarean Section:

This is the simplest to perform. However, it is also associated with the greatest loss of blood, and it leaves a scar that may dehiscence in a subsequent pregnancy. The currently accepted indications for classic cesarean section are placenta previa (because the incision in the corpus usually avoids the low-lying placenta); transverse lie and premature delivery. It is also preferred if there is need for extreme haste, because it offers the quickest means of delivering the baby. In performing the classic procedure, a vertical incision is made in the corpus; a scalpel is used to enter the uterine cavity; and the incision is enlarged with bandage scissors. Since the incision is relatively high in the uterus, the head is rarely accessible. Accordingly, the feet are grasped and brought through the incision. The remainder of the delivery is accomplished using the several maneuvers appropriate to breech delivery. After removal of the placenta and membranes, the uterine defect may be repaired with layers of an absorbable natural or synthetic suture. (1) Low cervical cesarean section.

It is also referred as the lower uterine segment cesarean section (LUSCS) or cervical cesarean section. Before labor, when the cervix is closed, uneffaced, and located at about the level of the ischial spines, a transverse uterine incision (which is made 3/4-1 inches [2-3 cm] superior to the symphysis pubis is made in the lower uterine segment. When the cervix is fully dilated and retracted, the anterior lip is just superior to the symphysis and the incision just superior to the symphysis is through the cervix. The bladder fold of peritoneum is picked up with tissue forceps and incised transversely. By means of finger dissection through the loose areolar tissue, the bladder is separated from the anterior aspect of the uterus interiorly for a distance of 3-4 cm. The bladder is held away from this denuded area by a specially designed bladder retractor, and a transverse incision about 2 cm long is made through the anterior uterine wall. The membranes are left intact, but no real damage follows if they should be ruptured. Using bandage scissors, the operator enlarges the transverse incision in a crescent-shaped path that extends superiorly at the lateral extremities to avoid the uterine vessels. The operator can usually deliver the baby's head

by elevation from the uterine cavity with the hand combining it with moderate fundal pressure by the assistant. The uterine incision generally is repaired using 2 layers after achievement of hemostasis. (1)

Extraperitoneal Cesarean Section.

This procedure, designed for use in infected or potentially infected patients, was introduced before the modern era of antibacterial agents and blood transfusion. The procedure is time-consuming and may not be effective in preventing spillage into the peritoneal cavity, because the peritoneum often is perforated even by the expert. Although the operation was virtually discarded more than 20 years ago, the question has recently been raised whether it might not be applicable for the potentially infected patient. The data are still too meager for evaluation, and at present most obstetricians perform cesarean hysterectomy if the uterus is frankly infected; if it is only potentially infected, they perform low cervical cesarean section with prophylactic antibiotic coverage. (1)

Complications of Cesarean Section

Average maternal morbidity and mortality rates after cesarean section suggest that the risk from the operation per se is very small. Some large series with no postoperative deaths have been reported. In other series, incidences of mortality have ranged from 40 to 80 per 100,000 cases. In general, it is reasonable to conclude that the risk of death following cesarean delivery is at least twice the risk following vaginal delivery. Such figures are difficult to interpret, however, because of the great variability of indications and complications.(3, 4)

Postoperative infection.

Women known to be at risk for infection include those who have had premature rupture of the membranes or prolonged labor, those who have undergone invasive methods of monitoring, or those who have undergone trial or failed forceps delivery. Other risk factors that may be sufficient to warrant use of prophylactic antibiotics are anemia and obesity. Infants of women at risk for postoperative infection are also at risk for infection, and cultures of both mother and baby are required. Both aerobic and anaerobic coverage are needed. Several agents have proved effective, although the least expensive effective agent should be used. The usual schedule is to administer antibiotics intravenously immediately after clamping the cord and repeated doses at 4-6-hour intervals for the next 24 hours. (3, 4)

Peri-operative hemorrhage

Recent reports from the World Health Organization estimate at least a half million maternal deaths worldwide per year, with a significant proportion attributed to severe bleeding. WHO in its report 'beyond the numbers,' published in 2004 (5) looked at numbers of maternal deaths and at the principle causes. It noted that 80% of maternal deaths globally are directly due to obstetric causes and 20% due to indirect causes. Hemorrhage is the leading cause of direct maternal deaths accounting for 28%. Although most patients tolerate the normal blood loss associated with delivery without hemodynamic consequences, occasionally blood loss may be excessive and lead to maternal and fetal compromise. The most common causes of third trimester bleeding are placenta previa, abruptio placentae, and uterine rupture. Postpartum hemorrhage, which complicates approximately 10% of deliveries, is most often due to uterine atony, retained placenta, placenta accreta, and uterine inversion.(4)

Postpartum bleeding is physiologically controlled by constriction of interlacing myometrial fibers that surround the blood vessels supplying the placental implantation site. Uterine atony exists when the myometrium cannot contract.(1) Atony is the most common cause of postpartum hemorrhage (50% of cases).(1) Predisposing causes include excessive manipulation of the uterus (which can occur when surgery is prolonged) , general anesthesia (particularly with halogenated compounds), uterine over distention twins or polyhydramnios), prolonged labor, grand multiparity, uterine leiomyomas, operative delivery and intrauterine manipulation, oxytocin induction or augmentation of labor, previous hemorrhage in the third stage, uterine infection, extravasation of blood into the myometrium (Couvelaire uterus), and intrinsic myometrial dysfunction.(1)

Halogenated anesthetics and administration of drugs that tend to relax the uterus, such as β-sympathomimetic agonists, and magnesium sulfate, interfere with interlacing myometrial fibers that surround the blood vessels.(1,6)

Changes in maternal physiology during pregnancy and the anesthetic challenges that impact on blood loss during cesarean section

From early on in the first trimester of pregnancy a woman's physiology changes rapidly. This is mainly due to the production of the progesterone hormone by the placenta(6) that maintains the pregnancy. It physiological role stems from the fact that it relaxes smooth muscle. The challenges that face an anesthetist are mainly the cardio-vascular, central nervous system and hematological. (6.7) this are the ones likely to influence blood loss during the conduct of anaesthesia.

Hematological

The blood volume expands from 60-65mls /kg to 80-85mls/kg (6). The magnitude of the increase varies according to the size of the woman, the number of pregnancies she has had, the number of infants she has delivered, and whether there is one or multiple fetuses(7). This is mainly due to the expansion of plasma volume. Red cell volume increases linearly but not as much as plasma volume. Haemoglobin decreases from 14g/dl to 12g/dl thus the hematocrit decreases. The increase is needed for extra blood flow to the uterus, extra metabolic needs of the fetus, and increased perfusion of other organs, especially the kidneys. Extra volume also compensates for maternal blood loss at delivery. (6,7) Heamatological changes return to normal by the sixth day of the post partum period. (7)

Haemostatic

A state of hypercoagulability exists in pregnancy. The levels of several blood coagulation factors are increased during pregnancy. During normal pregnancy, fibrinogen concentration increases about 50 percent to average about 450 mg/dL late in pregnancy, with a range from 300 to 600(2,6,7). Other clotting factor activities that are increased appreciably during normal pregnancy are factor VII, factor VIII, factor IX, and factor X.(7) Usually the level of factor II is increased only slightly, whereas activities of factors XI and XIII are decreased. Fibrinolytic activity is depressed during pregnancy and labor, although the precise mechanism is unknown. Plasminogen levels increase concomitantly with fibrinogen levels, causing an equilibration of clotting and lysing activity. Coagulation and Fibrinolytic systems undergo major alterations during pregnancy. understanding these physiologic changes is necessary to manage two of the more serious problems of pregnancy hemorrhage and thromboembolic disease both caused by disorders in the mechanism of haemostasis. (8, 9, 10)

The platelet count remains unchanged throughout most of pregnancy, but it may be slightly reduced in the third trimester with increased activity in vivo. The platelet count increases in the postpartum period, probably because of activation of hemostasis at the time of delivery. The incidence of low platelet counts in normal pregnancy is approximately 8%. However, it appears that mild thrombocytopenia during the latter part of pregnancy is not associated with adverse sequelae. It has been suggested that obstetric management of parturients with stable platelet counts above 50,000 × 109 should be no different from that of normal parturient. In addition, although the cutoff for initiation of neuraxial anaesthesia was considered to be 100,000 × 109 in the past, this level is no longer considered absolute. Currently, most anesthesiologists feel comfortable initiating a regional technique with platelet counts above 75,000 × 109 and with counts between 50,000 and 75,000 if the level is stable and clinical laboratory abnormalities or signs of a coagulopathic state are absent. (11, 12)

Uterine blood flow

Uterine blood flow increases progressively during pregnancy and reaches a mean value of 500 to 700mL by term. Blood flow through the uterine vessels is high and has low resistance; this change in resistance occurs most dramatically after 20 weeks of gestation. Uterine blood flow lacks auto regulation (vessels are maximally dilated during pregnancy), and uterine artery flow is therefore dependent on maternal blood pressure and cardiac output. Any factors that alter blood flow through the uterus will adversely affect the fetal blood supply. Uterine blood flow is determined by the following relationship:

$$\text{Uterine blood flow} = \frac{\text{Uterine arterial pressure} - \text{Uterine venous pressure}}{\text{Uterine vascular resistance}}$$

Uterine blood flow decreases during periods of maternal hypotension, which can occur as a result of hypovolemia, hemorrhage, aortocaval compression, and sympathetic blockade. Similarly, uterine hypercontractility (or conditions that increase the frequency or duration of

uterine contractions) and changes in uterine vascular tone, as seen in hypertensive states, may also adversely affect blood flow.

Anesthetics may dramatically influence uterine blood flow either by alterations in perfusion pressure or by changes in uterine vascular resistance. Sympathetic blockade after neuraxial regional techniques may reduce maternal blood pressure, and the decrease in pressure will affect uterine blood flow. (6) This reduction in uterine blood will therefore reduce the net blood loss during surgery

Methods to reduce blood loss during surgery

All surgical procedures have an inherent risk of blood loss. The most important means of minimizing hemorrhage is control of bleeding from arteries and veins by the surgeon. However, modification of the control systems which maintain arterial pressure haemostasis and positioning may assist the surgeon. The anaesthesist therefore has to play a key role and plan a technique that will minimize the blood loss so as not to compromise hemodynamic status of the patient. There is no place for use of a tourniquet in cesarean section. Cardiopulmonary bypass and blood saver can be used but the cost and risks involved also make it impractical. Controlled hypotensive anaesthesia has been used especially in orthopeadics` and head and neck surgery to reduce blood loss with differing results. There are both pharmacological and non-pharmacological methods of producing hypotension during surgery but in obstetrics they present challenges to both placental and foetal perfusion.(13)

Positioning

The positioning of the part to be operated above the level of the heart usually ensures a bloodless field on the part that is being operated. This is commonly used in the head and neck surgery. This however may not be practical as a technique to reduce blood loss during cesarean section.

Pharmacological

One of the recommended anaesthetic technique is that of controlled hypotensive anaesthesia where there is deliberate lowering of blood pressure below the preoperative values with significantly compromising other physiological functions. The ideal drug for controlled hypotensive anaesthesia should have the following characteristics:

Be very short acting,

Have a predictable dose-response curve to allow for fine control of arterial blood pressure.

It should not induce steal phenomena or uncouple oxidative metabolism.

It should have elimination partway that is independent of hepatic and renal functions.

It should have little or no interaction with other drugs used during anaesthesia.

There is no such ideal agent that available for the reduction of arterial blood pressure. However, different drugs have been used safely by modifying physiological responses to reduce blood pressure and hence blood loss during surgery. Nevertheless, this has to be used in combination and therefore become impractical during caesarean section. Spinal and epidural anaesthesia have been used to control blood pressure. The local anaesthetic blockade of sympathetic efferent nerves of the spinal cord results in arterial and venous vasodilatation in the area of the block. This causes pooling of blood in the dependent areas and reduction of cardiac output by reduced venous return. This will result in reduction of blood loss during surgery. (13)

Factors that may affect blood loss intraoperatively

One of the risk factors is age with elderly women tending to loose more blood than expected. In a study by Ohkuchi et al on the effect of maternal age on blood loss during parturition among 10,053 women, they found that a maternal age of $\geq$ 35 years was an independent risk factor for excess blood loss irrespective of the mode of delivery, even after adjusting for age related complications such as leiomyoma, placenta previa, and low lying placenta.(14)

In another study in Denmark that was intended to estimate the incidence of intraoperative surgical complications during cesarean section, revealed utero-cervical lacerations and blood loss of more than 1 liter as the most frequent complications. (15)

This was also explored in a Nigerian study which also showed that ante- partum hemorrhage and pre-eclampsia were predictable indicators for major blood loss and transfusion. Other risk factors for blood transfusion that the study verified included pre operative packed cell volume, the ASA grading and status of the attending anaesthetisiologist.(16)

General Anaesthesia

The Greek philosopher Dioscorides first used the term anesthesia in the first century AD to describe the narcotic-like effects of the plant mandragora. The term subsequently was defined in

Bailey's An Universal Etymological English Dictionary (1721) as "a defect of sensation" and again in the Encyclopedia Britannica (1771) as "privation of the senses." (17)
The present use of the term to denote the sleeplike state that makes painless surgery possible is credited to Oliver Wendell Holmes in 1846. The conduct of general anaethesia involves three main components, i.e. Narcosis, analgesia and muscle relaxation. The first general anesthetics were destined to be inhalation agents.(17)

Non-flammable inhalational anaesthetics

All modern volatile anesthetics cause concentration-related decreases in arterial pressure
The mechanism by which these anesthetics reduce arterial pressure differs among anesthetics. Decreases in arterial pressure produced by halothane and enflurane can be primarily attributed to reductions in myocardial contractility and cardiac output. In contrast, decreases in arterial pressure associated with isoflurane, desflurane, and sevoflurane anesthesia occur as a result of reductions in LV afterload.(13)

Intravenous anaesthesia

Induction agents

Intravenous anesthesia followed the invention of the hypodermic syringe and needle by Alexander Wood in 1855. Early attempts at intravenous anesthesia included the use of chloral hydrate (by Oré in 1872). Progress in the development of intravenous depended on the elimination myocardial and respiratory depressants effects associated with inhalational agents. Intravenous agents such as benzodiazepines, opiates, ketamine and etomidate had this advantage. The use of etomidate waned because it tended to cause adrenal suppression. The release of propofol, in 1989 was a major advance in outpatient anesthesia because of its short duration of action. However, barbiturates still remain intravenous induction agents in use (17).

Effects of general anaethesia on the uterus

Halothane reduces muscle tone in the pregnant uterus thus increasing the risk of postpartum haemorrhage; the effects of ergometrine on the parturient uterus are diminished with the use of halothane. This was shown by a study in South Korea by Soo and colleagues. It also indicate that all the volatile anesthetics have inhibitory effects on the contractility of the human uterus (18)

Spinal Anaesthesia

The technique of spinal anaesthesia has been in use for more than a century when August Bier first experimented on spinal block in 1898 with cocaine. However, it wasn't until the 1940s when Adriani and associates established safe, standardized techniques that this method of analgesia became popular in obstetrics. By the mid-1950s, over half a million subarachnoid blocks had been performed in pregnant patients in the United States.(19)

Regional anaesthesia techniques have several advantages, including a decreased risk of failed intubations and aspiration of gastric contents, avoidance of depressant agents, and the ability of the mother to remain awake and enjoy the birthing experience. In addition, it has been suggested that blood loss is reduced under regional anesthesia for cesarean delivery. (6) However, general anesthesia has the advantages of speed of induction, control of the airway, and superior hemodynamics control. With regional epidural anaesthesia, the anaesthetic is infused into the space around the mother's spinal column, whilst with regional spinal anaesthesia, the drug is injected as a single dose into the mother's spinal column (sub-arachnoid space). Because of the small doses used, there is little risk of local anesthetic toxicity and minimal transfer of drug to the fetus. In addition, failures (including incomplete or patchy blocks) are very infrequent with spinal anesthesia. Disadvantages of this technique include the finite duration of anesthesia and a higher incidence of hypotension (20). Hyperbaric bupivacaine is the most commonly used agent for spinal anesthesia when performing cesarean sections. Its duration of action of 1.5 to 2 hours is perfectly matched to the duration of surgery in most cases.

Blood loss estimation

There are several methods of estimating blood loss in a patient undergoing surgery. These methods have both advantages and disadvantages and there applicability varies in different clinical settings

1 Volumetric and Gravimetric (28,29)

Weigh a dry swab.

Weigh blood soaked swabs as soon as they are discarded and subtract their dry weight (1ml of blood weighs approximately 1gm).

Subtract the weight of empty suction bottles from the filled ones.

Estimate blood loss into surgical drapes, together with the pooled blood beneath the patient and onto the floor.

Note the volume of irrigation fluids; subtract this volume from the measured blood loss to estimate the final blood loss

Serial Hematocrit Determination (30)

Changes in the hematocrit occur continually as a result of shift in body fluids when blood loss occurs, but this shift is not immediate and the true hematocrit can only be seen after 48 to 72 hours. Intraoperatively unless blood loss is significant it is replaced by intravenous fluids to maintain the vital signs within normal ranges. Doing serial hematocrit levels gives a rough estimate of blood loss. This however may be inaccurate depending on the level of hemodilution or hemoconcetration with the replacement of lost blood with IV fluids.

Measurement of hemoglobin levels pre and post- operatively

According to Snelling and Shaw (1984),(31) the volume of blood loss is equal to the sum of volume administered during procedure and post-operatively till a patient is stable. This is the added to the volume calculated to increase postoperative Hb to the preoperative level using a formula they developed based on Mollison (1979):

510/70 x weight of patient x (preoperative Hb –post operative) /100ml

Mollison had observed that red blood cells from one unit of blood (510mls, selected arbitrary) would raise hemoglobin of a 70Kgs adult by 1-1.25g/dl thereafter averaged to 1gm/dl. (32)

Electric method

This method depends on the fact that blood is an electrolyte solution of fairly constant composition. It is a conductor and specific conductivity of a solution can be used as an index of electrolyte concentration. This in turn increases with increasing amount of added blood. Saline solutions should not be used by surgeons. A Wheatstone bridge is used to measure the conductivity. It is temperature compensated and is capable of measuring loss of one milliliter of blood. However, it cannot be used during routine surgery but for research purposes only. (29)

METHODOLOGY

Justification for the study

Caesarean section is one of the most common procedure that will be done in any hospital. In the last several years the numbers of caesarean sections have been on the increase. However, as with any surgical procedure it has an inherent risk, the most important being excessive blood loss. The use of blood and blood products has greatly improved the out come of patients whose lives would have been threatened with massive blood loss. If blood transfusion can be avoided all together because of the risk of transmission of infection especially HIV/AIDS, the measures than can reduce excessive blood loss should be utilized. Several studies have been done especially as regards blood loss in patients undergoing regional anaesthesia for orthopedics procedures. Few have been done on pregnant mothers in the developing world and nonc so far in Kenya considering the different approaches to the practice of medicine in the two settings this study aims to ascertain whether there is any demonstratable advantage and if so how this can be advocated for use in the district level.

Broad objective

To compare the estimated blood loss during spinal anaesthesia and general anaesthesia for patient undergoing elective caesarian section.

Specific objectives

To determine factors that contributes more than necessary blood loss.

To compare the preoperative and the post operative hemoglobin levels in the two study groups.

To identify which population of the sampled group required blood replacement.

To determine whether the duration of surgery had any influence on blood loss.

Study design

This was a prospective descriptive correlational study

Study area

The study was done at Kenyatta National Hospital, Nairobi province, Kenya

Study population

Pregnant women undergoing elective caesarean section at KNH during the course of the study. The hospital has allocated three days in the week i.e. Monday, Wednesday and Friday for

elective caesarean section. It has also put guidelines that only a maximum of four c/s can per performed though occasionally more patients are done due to backlog of cases.

Sample size

The sample size was determined to compare the difference in the maternal blood loss during spinal anaesthesia and general for patients undergoing elective caesarean section. The sample size formula for comparing means was used to determine the required sample as follows.

$$n = 2\{Za+Zb\}2S2$$
$$L2$$

Where n is the number of patients,

S is the standard deviation,

And L is the smallest difference in blood loss considered meaningful to be detected if is observed.

This considers a significance level of a=0.05 and a power of 80% (i.e. b=1- 0.80). According to Kolatat T, et al (20) Compared to general anaesthesia, women having either an epidural anaesthesia or spinal had a lower estimated maternal blood loss {WMD (weighted mean difference or standard deviation) -84.79 millilitres, 95% CI -126.96 to -42.63, 279 women}.

And assuming the effect size to be 40 mls (the difference in blood loss considered meaningful to be detected at 95% significance level. 70 patients will be required for the study, 35 in the group of spinal anaesthesia and 35 in the general anaesthesia group .

$$n=\frac{2\{1.96+0.84\}}{402}284.792 = 70.45$$

Inclusion

Women who were scheduled for elective caesarean section for any indication.

Exclusion criteria

The patients who were scheduled for emergency were excluded from the study

The women who declined to be included in the study were excluded.

Private patients who were scheduled for elective CS were also excluded.

Women who had failed spinal anaesthesia and had to be converted to general anaesthesia

Pregnant women scheduled for CS and known to have a bleeding disorder or are on anticoagulation therapy.

Ethical considerations

This was an observational study on the conduct of anaesthesia and blood loss during cesarean section at Kenyatta National Hospital.

It was non invasive and did not confer an additional risk or cost to the patient

Informed written consent was sought from the participants of the study

Confidentiality of the research i.e. that the individuality shall never be disclosed.

Study was only undertaken after approval by the Kenyatta National Hospital research and ethics committee.

Data collection

All the patients to be included in the study were visited on the eve of the operation day. They were then be randomized into two groups irrespective of the indication for surgery. Since four patients are scheduled on each particular surgery day, two were in the spinal anaesthesia group and two in the general anaesthesia group. This was done alternatively with the first patient being in the spinal anaesthesia group. The anaesthesist who was giving the anaesthesia was also informed on the technique of anaesthesia that the patient was to undergo according to their consent. Their consent was then sought. As per KNH protocol, there hemoglobin levels were noted and other relevant clinical indices as per the questionnaire. This also included blood for grouping and cross match. This information was then entered in the data sheet (see appendix 1). Hemoglobin levels were then checked on the third post-operative day. Observation and estimation of blood loss was based on the formula developed by Snelling and Shaw.

FORMULA FOR BLOOD LOSS

Volume of blood loss= sum of volume administered during procedure and post-operatively till a patient is stable + The volume calculated to increase postoperative Hb to the preoperative level

Data presentation and analysis

Information collected was be verified and stored in soft and electronic copies.

The SPSS (Statistical Package for the Social Sciences) program was used for data analysis. The information has then been presented in tables, bar graphs and pie charts as appropriate.

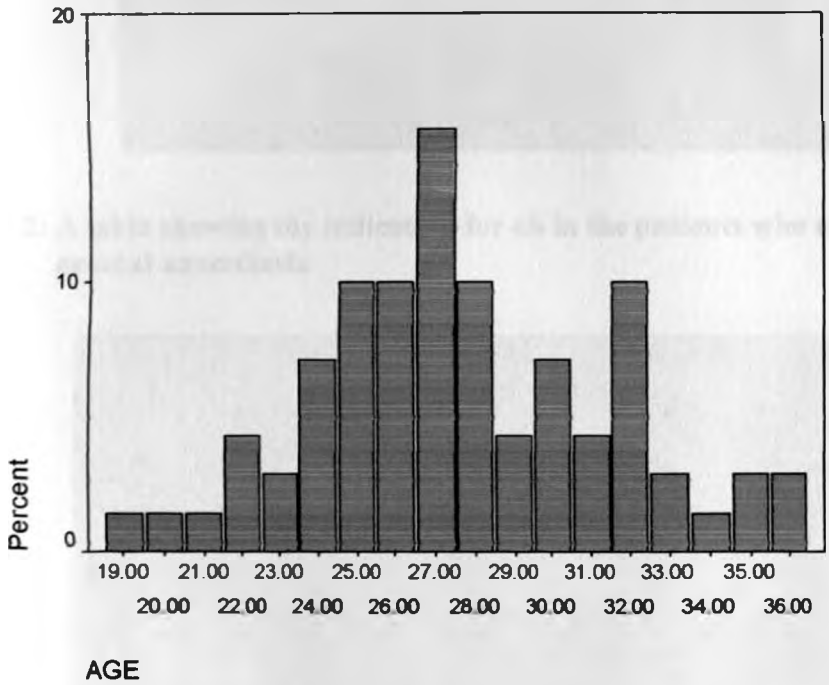
Study duration

The study was carried out between September 2009 to march 2010

RESULTS

A total of 70 patients were included in the study, 35 in each group. The age varied from a minimum of 19yrs and maximum age of 36yrs. The following bar graph showed the age distribution of the patients in the study.

Figure 1: Bar graph showing the age distribution of the patients who were included in the study.



In the patients who underwent spinal anesthesia majority were in the repeat cesarean section accounting for 62.9% in the whole group as shown in table 1. In the general anaesthesia group, they accounted for 71.4% as shown in table 2.

Table 1: A Table showing the indication for c/s in the patients who underwent spinal anaesthesia.

	Frequency	Percent	Cumulative Percent
Repeat Cs	22	62.9	62.9
CPD	5	14.3	77.1
PMTCT	4	11.4	88.6
Multiparous	2	5.7	94.3
Others	2	5.7	100.0
Total	35	100.0	

Table 2: A table showing the indication for c/s in the patients who underwent general anaesthesia

	Frequency	Percent	Cumulative Percent
repeat cs	25	71.4	71.4
Cpd	2	5.7	77.1
PMTCT	6	17.1	94.3
Multiparous	1	2.9	97.1
Others	1	2.9	100.0
Total	35	100.0	

Most of the operations in the study were done by senior registers as shown in table 3 in the spinal anaesthesia group. This accounted for 65.7%. This could be due to the fact that all elective cesarean section are allocated to the senior registers and consultants with residents assisting when the patients are many. The same pattern is also replicated in the general anaesthesia group as shown in table 4.

Table 3: A table showing the surgeon level of experience in the spinal anaesthesia group

	Frequency	Percent	Cumulative Percent
year one of masters program	1	2.9	2.9
year two of masters program	7	20.0	22.9
year three of masters program	4	11.4	34.3
senior registar	23	65.7	100.0
Total	35	100.0	

Table 4: A table showing the surgeon level of experience in the general anaesthesia group

	Frequency	Percent	Cumulative Percent
year two of masters program	4	11.4	11.4
year three of masters program	5	14.3	25.7
senior registrar	26	74.3	100.0
Total	35	100.0	

The next two tables show the estimated blood loss in the spinal anaesthesia (tab 5) and general anaesthesia (tab 6). Only one patient had blood loss in the category of 701 to 1000mls in the spinal anaesthesia group and none in the general anaesthesia group. In the spinal anaesthesia group 77.1% were in the category of 300-500mls, while they comprised 80% in the general anaesthesia. One patient had blood loss than 300mls in the spinal group.

Table 5: A table showing estimated blood loss in the spinal anaesthesia group

	Frequency	Percent	Cumulative Percent
less than 300mls	1	2.9	2.9
300 to 500mls	27	77.1	80.0
501 to 700mls	6	17.1	97.1
701 to 1000mls	1	2.9	100.0
Total	35	100.0	

Table 6: A table showing estimated blood loss in the general anaesthesia group

	Frequency	Percent	Cumulative Percent
300 to 500mls	28	80.0	80.0
501 to 700mls	7	20.0	100.0
Total	35	100.0	

Figure 2: A pie chart showing the blood loss in the spinal anaethesia group

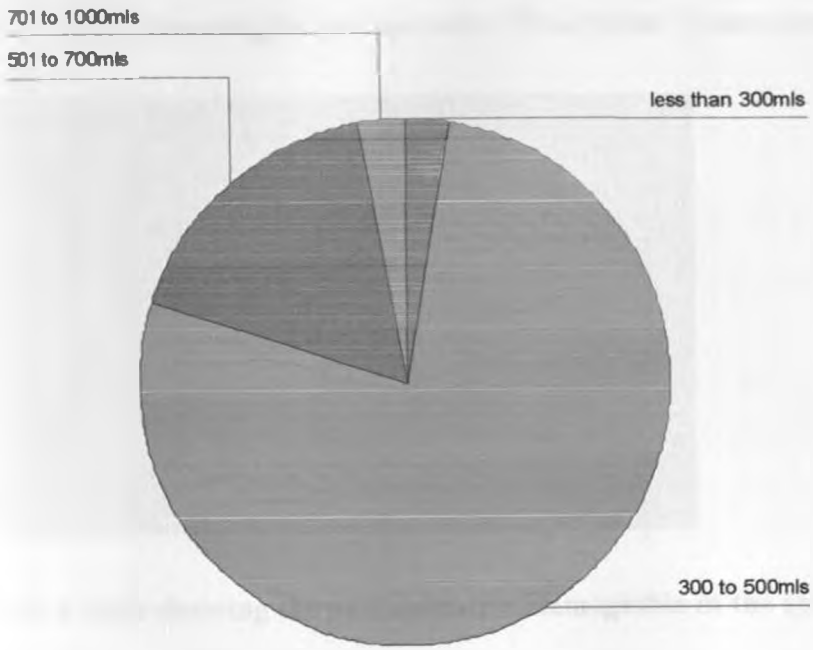
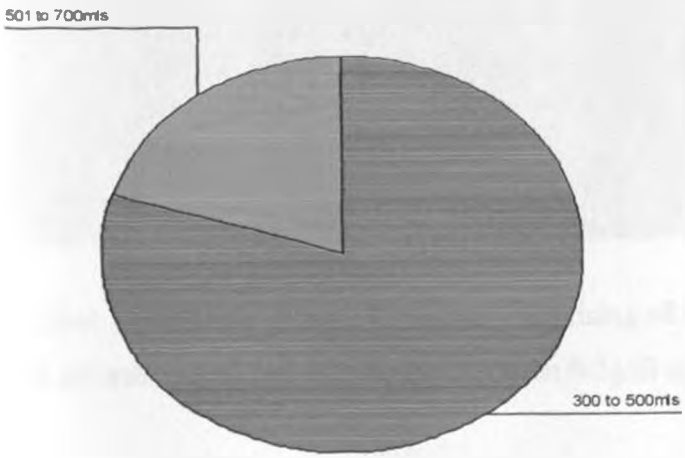


Figure 3: A pie chart showing the blood loss in the general anaethesia group



The next table (table 7) shows the distribution of preoperative hemoglobin in the spinal anaesthesia group. Only one patient had an hemoglobin level of less than 10g/dl while the majority 57.1 % having an Hb of between 10-11g/dl. Table 8 shows the post operative hemoglobin in the same group. Six patients representing 17.1% of the patients had an Hb level

below 10g/dl. 62.9% had an Hb range between 10-11g/dl. Only one patient had an hemoglobin level between 12-13g/dl compared to 7 patients pre operatively.

Table 7: A table showing the pre operative Hemoglobin in the spinal anaesthesia

	Frequenc y	Percent	Cumulative Percent
less than 10g/dl	1	2.9	2.9
10-11g/dl	20	57.1	60.0
11-12g/dl	7	20.0	80.0
12-13g/dl	7	20.0	100.0
Total	35	100.0	

Table 8: A table showing the post operative Hemoglobin in the spinal anaesthesia

	Frequency	Percent	Cumulative Percent
less than 10g/dl	6	17.1	17.1
10-11g/dl	22	62.9	80.0
11-12g/dl	6	17.1	97.1
12-13g/dl	1	2.9	100.0
Total	35	100.0	

In the spinal anaesthesia group 17 patients comprising 48.6% had no change in the hemoglobin while 18 patients (51.4) had a change of between 0-2g/dl as shown in table 9.

Table 9: A table showing hemoglobin level difference in the spinal anaesthesia group

	Frequency	Percent	Cumulative Percent
None	17	48.6	48.6
0-2g/dl	18	51.4	100.0
Total	35	100.0	

Table 10 shows the distribution of pre operative hemoglobin in the general anaesthesia group. 20 patients representing 57.1% had Hb level between 10-11g/dl, while 8 patients representing 22.9% had hemoglobin level between 12-13g/dl.

Table 11 shows the distribution of post operative hemoglobin in the general anaesthesia group. The patients with hemoglobin level less than 10g/dl were 10 (28.6%) and only one patient had Hb between 12-13g/dl. Majority of the patient were in the category 10-11g/dl i.e. 60%.

Table 10: A table showing the pre operative Hemoglobin in the general anaesthesia

	Frequency	Percent	Cumulative Percent
10- 11g/dl	20	57.1	57.1
11 -12g/dl	7	20.0	77.1
12 -13g/dl	8	22.9	100.0
Total	35	100.0	

Table 11: A table showing the post operative Hemoglobin in the general anaesthesia

	Frequenc y	Percent	Cumulative Percent
less than 10g/dl	10	28.6	28.6
10 -11g/dl	21	60.0	88.6
11 -12g/dl	3	8.6	97.1
12 -13 g/dl	1	2.9	100.0
Total	35	100.0	

In the general anaesthesia group 13 patients (37.1%) had no change in hemoglobin level while 18 patients (51.4%) had a change of 0-2g/dl. Four patients representing 11.4% had a change of between 2-4g/dl as shown in table 12 and fig 4.

Table 12: A table showing hemoglobin level difference in the general anaesthesia group

	Frequency	Percent	Cumulative Percent
None	13	37.1	37.1
0 -2g/dl	18	51.4	88.6
2- 4g/dl	4	11.4	100.0
Total	35	100.0	

Figure 4: A pie chart showing hemoglobin level difference in the general anaesthesia group

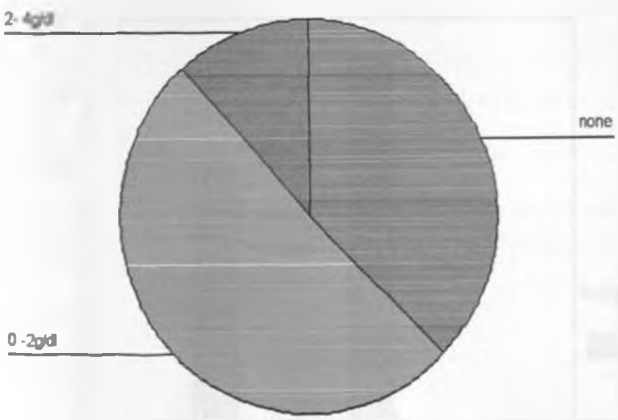


Figure 5and 6 shows the hemoglobin level difference and the surgeon level of experience in the general anaesthesia group and spinal anaesthesia groups respectively. Most of the patients with hemoglobin level difference between 0-2g/dl seem to be in senior registrar category. However, this could be due to the fact that most of the operations were performed by senior registrars. This is also reflected in table 13 where 11 patients had a change of 0-2g/dl.

Table 13: A table comparing the hemoglobin level difference and the surgeon level of experience in the spinal anaesthesia group

	year one of masters program	year two of masters program	year three of masters program	senior registrar	
None	1	2	2	12	17
0-2g/dl		5	2	11	18
	1	7	4	23	35

Figure 5: A bar graph comparing the hemoglobin level difference and the surgeon level of experience in the general anaesthesia group

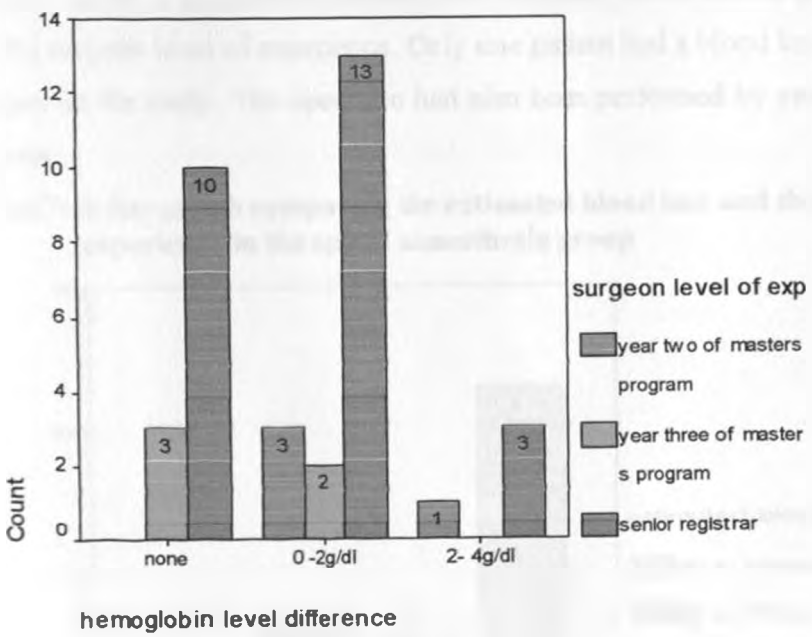


Figure 6: A bar graph comparing the hemoglobin level difference and the surgeon level of experience in the spinal anaesthesia group

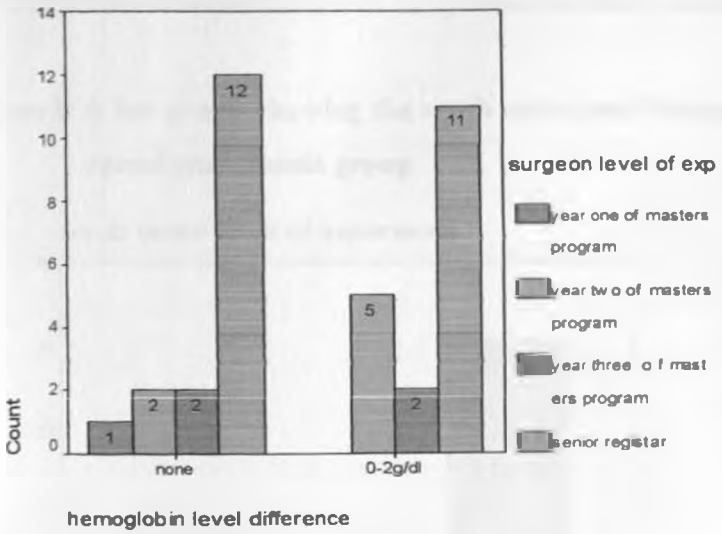


Figure 7 shows a comparison between the estimated blood loss in the spinal anaesthesia group and the surgeon level of experience. Only one patient had a blood loss of between 700- 1000mls category in the study. The operation had also been performed by year one of masters residency program.

Figure 7: A bar graph comparing the estimated blood loss and the surgeon level of experience in the spinal anaesthesia group

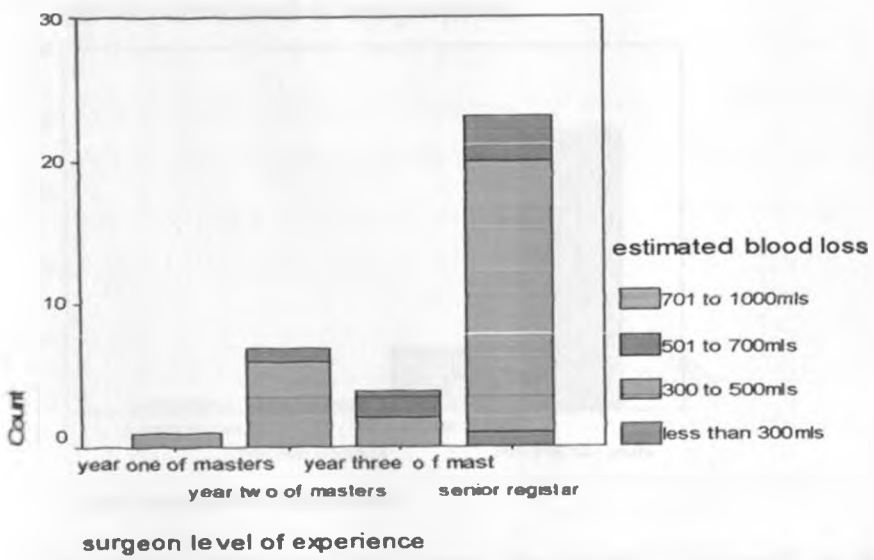


Figure 8 and 9 shows the scrub nurse level of experience in the two groups which are almost mirror images of one another. It is only in the general anaesthesia group that one operation was

assisted by a student nurse. These are qualified nurses who are training for theatre specialization. More than 77% in the general anaesthesia group and 88% in the spinal anaesthesia group were done by nurses who had more than two years experience in maternity theatre.

Figure 8: A bar graph showing the scrub nurse level of experience in the patients in the spinal anaesthesia group

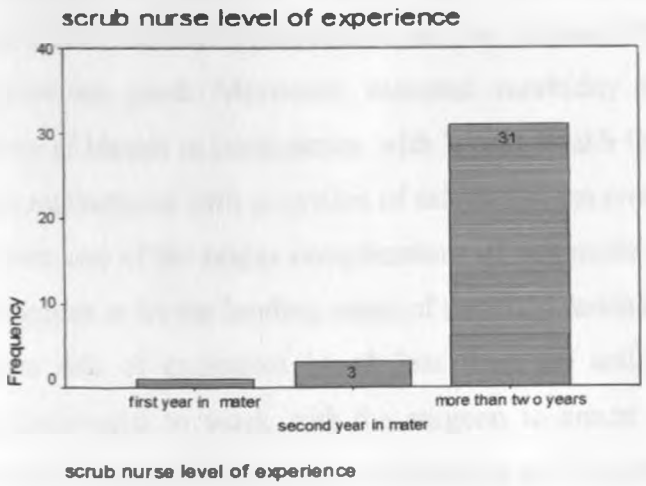
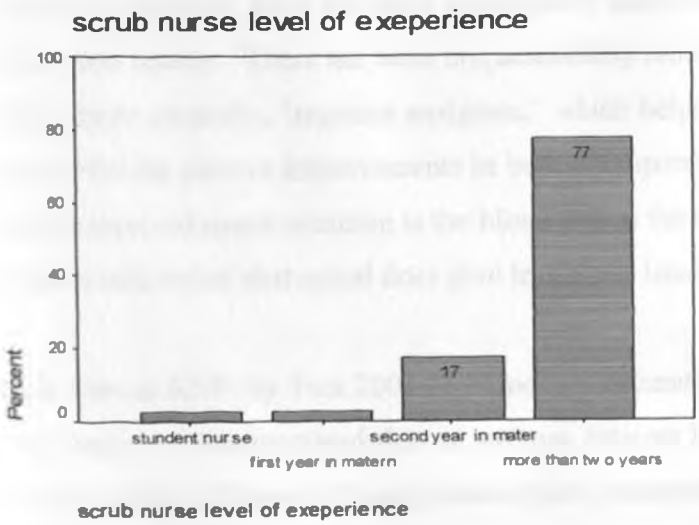


Figure 9: A bar graph showing the scrub nurse level of experience in the patients in the general anaesthesia group.



Finally no patients were transfused during the period of the study in the two groups and all procedures lasted approximately 30 minutes to one hour during the duration of the study.

DISCUSSION

Kenyatta National Hospital is one of the two tertiary referral hospitals that offer medical training, the other being The Moi Teaching and Referral Hospital. It therefore has a critical role on the practice of medicine in the whole country. In addition to other courses, it offers facilities to the University of Nairobi and Kenya medical training college for training of anaesthesiologists both at higher diploma and post-graduate level.

One of the most common surgical procedures that they will be called to give anaesthesia for is caesarean section. This can be either electively or as an emergency. A look at global and local trends shows that this procedure is on the increase. This ensures that the maternal and fetal outcomes are good. Moreover, maternal morbidity and mortality are grave outcomes and Ministry of Health in conjunction with World Health Organisation has come up with guidelines of safe motherhood with provision of safe caesarean section services being one of the pillars.

However, one of the major complications of any mode of delivery is postpartum hemorrhage. It also happens to be the leading cause of maternal mortality. In any surgical procedure there is the inherent risk of excessive blood loss than the anticipated. It is therefore the role of the anaesthesiologist to work with the surgeon to ensure this does not happen. Two anaesthesia techniques are available: General anaesthesia and Regional anaesthesia.

There are several studies that have looked at blood loss in the two techniques especially in orthopedics' procedures. Very few have studies have analyzed blood loss in obstetrics operations and so far none locally. There has been unquestionably renewed interest in regional anaesthesia, or perhaps more correctly, "regional analgesia," which helps build interest in perioperative pain medicine. With the current improvements in both intraoperative general and regional anesthesia, one that has received much attention is the blood loss in the two techniques of anaesthesia. There is a common held belief that spinal does give less blood loss than general anaesthesia.(21).

In a study done at KNH by Tura 2004 on blood loss estimation on patients undergoing skin graft following burns, he demonstrated that on average patients lost 170mls per each percent of area excised and grafted. However these patients were undergoing a different type of surgery and were all done under general anaesthesia. (22).

In a study by Zafarul Ahsan et al on the influence of anesthesia on blood loss during prostatic resection, they found out that blood transfusion requirement was similar in both groups and no hypotensive episodes were recorded. Although previous studies have suggested that spinal anaesthesia reduces blood loss during prostatic resection, however, their present study failed to demonstrate this association. (23). In the current study it has also been demonstrated that no difference existed as relates blood transfusion as no patients were transfused.

In a study comparing the outcomes of Spinal anesthesia vs General anesthesia in patients undergoing radical retro pubic prostatectomy, those receiving spinal anesthesia had less overall blood loss, shorter time in the postoperative holding area, better peri-operative pain outcome in the postoperative holding area and lower postoperative sedation score. (24). In the present there was no significant difference in the two groups as regards blood loss. However, patients in the spinal anaesthesia tendered to have no significant drop in hemoglobin level as 48.6% had no change in the spinal group while this was 37.1% in the general anaesthesia group.

A review by Afolabi on anaesthesia choices for cesarean section and their outcome concluded that there appeared to be reduced blood loss with the use of regional anesthesia, however, and this applied to both spinal and epidural forms. However, the review did not find a difference in the need for blood transfusions, therefore reduced blood loss may be relevant, as wound healing is slower in people with anemia.(25) The studies in the review were generally small and there was no way to blind the physicians caring for mothers or their infants as to the method of anesthesia, which may introduce biases. (25).

A prospective randomized trial organized to compare the effectiveness of general and regional anesthesia for cesarean section, found that the success rates of epidural anaesthesia and spinal anaesthesia were lower than general anaesthesia. However, general anaesthesia resulted in significantly more blood loss, lower postoperative hematocrit, and higher proportion of patients who had postoperative hematocrit < 30 per cent than regional anaesthesia group. (26) In the current study the post operative hemoglobin less than 10g/dl is higher in the general anaesthesia group (28.6%) than the spinal anaesthesia group (17.1%).

H. A. Brant, in 1966 observed that at caesarean section, actual blood lost was approximately twice the amount estimated by the surgeon. This was also true for vaginal deliveries. Alterations in the pulse rate and blood pressure were often late signs. From a practical point of view, therefore. these observations warn us against placing too much reliance on estimates of blood loss. particularly as the amount increases. They may also explain why the amount of blood transfused is often inadequate. (27)

Experience of the scrub nurse and the duration of surgery in the two groups had similar distribution and hence could not be assessed as independent risk factors to compare the two groups.

An outlier in the results was one patient in the spinal anaesthesia group who had blood loss in excess of 700mls. She was a 36yr old para1+0 who had been done repeat cesarean. The surgery was performed by year one student of the masters program assisted by a nurse of more than two years experience in maternity theatre. Her hemoglobin dropped from 12.6g/dl to 10.5g/dl. The only independent risk factor that could account for this is her age as has been shown by the study of Ohkuchi et al where maternal age equal or greater than 35yrs is an independent risk factor irrespective of the mode of delivery. The surgeries performed by year one residents were too few as to be analysed statistically.

CONCLUSION

It was found that for patients undergoing elective cesarean under either general anaesthesia method or spinal anaesthesia method no significant difference existed in the amount of blood loss. However patients who underwent general anaesthesia tendered to have a significant drop in the hemoglobin.

It was also found that with good preparation and care of patients there was no need for unnecessary blood transfusion as patients in both groups never received any transfusion but remained hemodynamically stable.

RECOMMENDATIONS

In skilled hands both techniques can be used for the provision of safe anaesthesia for obstetrics patients.

A large multicentre study in different hospitals both private and public in the country should be done to give insight into these findings as the number of patients in this study were few.

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APPENDICES

Appendix I: Consent Form

A) Information to patient /guardian

I am a post graduate student in anaesthesia carrying out a study comparing blood loss estimation in patients undergoing general anaesthesia versus spinal anaesthesia for elective caesarian section at KNH.

The study will focus on patients admitted to the obstetrics department of Kenyatta national hospital scheduled to undergo elective caesarean section.

The areas of focus will be:

i. The indication for the caesarean section
ii. The pre operative and post operative hemoglobin levels
iii. The estimated blood loss during the procedure as documented in the anaesthetic chart
iv. The intervention carried out i.e. blood transfusion if any

Participation in the study is voluntary with no monetary reward,

Participation will not affect quality of care

Failure to participate in the study will not affect care given.

The information gathered from this study will be used in strict confidence to advancing medical knowledge and that noting will be published or discussed in public to identify the participant.

All Medical procedures / observations will be performed by approved medical personnel practicing at KNH and as per standards and practices recognized at the hospital and by the Kenya Medical Practitioners and Dentists Board

B) Consent form

The physician has satisfactorily explained the proposed conduct of anaesthesia, the risks and benefits involved.
I have been given a chance to ask questions and all information that I desired have been satisfactorily answered.

I _____ of _____ having read and been explained to the above information concerning the study, agree to fully participate in the study, with all the procedure that will be performed. My signature below attests to this.

_____ _____
Patients /guardian signature date

Signature of witness/translator/ reader _____ date_____

B) Kibali cha mgonjwa

Mhuduma wa afya amenieleza kwa kina mpangilio wa dawa ya anasthisia nitakayo patiwa, faida na madhara yanayoweza kutokea.
Nimepatiwa fursa ya kuuliza maswali na majibu niliyopewa yanarithisha.

Mimi_____ kutoka _____

Baada ya kusoma na kuelezwa maelezo yote ya utafiti huu, nakubali kushiriki kwa utafiti huo na huduma zote nitakazofanyiwa . sahihi yangu hapa chini inathibithisha haya.

_____ _____
Sahihi ya mgonjwa tarehe

_____ _____
Sahihi ya shahidi/kalimani tarehe

Appendix II: Questionnaire

Serial no .....
Inpatient no .....
Age .....
Parity.....
Weight.....
Height.....

Indication for elective caesarean section.....

1) Repeat caesarean section
2) CPD
3) PMTCT
4) Multiparous
5) Malpositon
6) Malpresentation (breech)

Type of anesthesia:

1) Spinal anaesthesia.....
2) General anaesthesia.....

Surgeon level of experience:

1) Year one of masters program
2) Year two of masters program
3) Year three of masters program
4) Senior registrar
5) Consultant

Scrub nurse level of experience

1) Student nurse
2) First year in maternity theatre
3) Second year in maternity theatre
4) More than two years.

Presence of a surgeon assistant:

2) Yes
3) No

Duration of surgery:

1) less than 30 minutes
2) 30 min to 1 hour
3) 1hour to 1hr 30min
4) More than 1hr 30min

Estimated blood loss from the anaesthetic chart:

1) less than 300mls
2) 300 to 500mls
3) 501 to 700mls
4) 701 to 1000mls
5) More than 1 liter

Preoperative hemoglobin level

1) less than 10g/dl
2) 10- 11g/dl
3) 11-12g/dl
4) 12-13g/dl
5) More than 13g/dl

Post operative hemoglobin level (3rd post –op)

1) Less than 10g/dl
2) 10- 11g/dl
3) 11-12g/dl
4) 12-13g/dl
5) More than 13g/dl

Hemoglobin level difference

1) none
2) o-2g/dl
3) 2-4g/dl
4) >4g/dl

Number of units of blood transfused

1) Zero units
2) One unit
3) Two units
4) Three units
5) More than four units

Appendix III: KNH Protocol for general anesthesia for cesarean section

1. *Administer a nonparticulate antacid. Additional agents such as metoclopramide or an H2 –blocker should be considered in patients at high risk for aspiration or failed intubation.*

2. *Apply routine monitors, including electrocardiography, pulse oximetry, and capnography. Ensurethat suction is functioning and that equipment to correct failed intubation is readily available.*

3. *Position the patient in a manner to achieve left uterine displacement and optimal airway position.*

4. *Denitrogenate with a high flow of oxygen for 3–5 minutes or 4 vital capacity breaths.*

5. *After the drapes are applied and the surgeon is ready, initiate a rapid-sequence induction with thiopental, 4–5 mg/kg, and succinylcholine, 1–1.5 mg/kg. Apply cricoid pressure and continue until correct position of the endotracheal tube is verified and the cuff is inflated. In hypotensive crises, ketamine, 1–1.5 mg/kg, should be substituted for thiopental. A defaciculating dose of muscle relaxant is not necessary.*

6. *Ventilate with 50% oxygen and 50% nitrous oxide and a volatile anesthetic as necessary. Maintain normocarbia and use muscle relaxation as necessary with either a nondepolarizing muscle relaxant or succinylcholine infusion.*

7. *After delivery, increase nitrous oxide to 70%, discontinue or reduce the volatile anesthetic, and administer an opioid and a benzodiazepine. Add oxytocin to intravenous fluids.*

8. *Insert an orogastric tube before completion of surgery.*

9. *Reverse neuromuscular blockade as necessary at completion of surgery.*

10. *Extubate when the patient is awake, the anesthesia is adequately reversed, and the patient is following commands.*

Appendix IV: KNH guide for the Administration of a Spinal Anaesthetic to a patient presenting for an Elective Caesarean section.

1. *Premedicate the patient with 30 ml of a nonparticulate antacid. If the patient has recently eaten, ranitidine 150 mg and/or metoclopramide 10 mg h> may be given.*

2. *Insert a large-bore intravenous cannula, preferably a 16-gauge and prehydrate the patient with 1500-2000 ml of a balanced salt solution immediately before giving the spinal anaesthetic.*

3. *Apply monitors. These should include an ECG, a non-invasive blood pressure monitor and a pulse oximeter.*

4. *Ensure that all equipment is prepared should general anaesthesia be required.*

5. *Ensure that drugs for the administration of a general anaesthetic as well as resuscitative drugs are diluted and ready for immediate use.*

6. *Place the patient in either the lateral decubitus or sitting position and ensure that she is maximally flexed for ease of insertion of the needle.*

7. *After preparing the skin with an antiseptic solution, identify either the L3 or L 4 interspace.*

8. *Inject local anaesthetic into the skin and subcutaneous tissue.*

9. *A 25- or 26-gauge of the non-cutting type is recommended. This can be inserted through an 18-gauge introducer needle. The spinal needle is advanced until loss of resistance is felt and removal of the stylet reveals the presence of clear colourless free-flowing CSF*

10. *After CSF has been identified, local anaesthetic is injected. Commonly, hyperbaric bupivacaine 0.5% is used in a dose/volume which is individualized for the patient's height. Fentanyl 10mcg or morphine 0.25 mg may be added to the solution for postoperative analgesia.*

11. *The patient should then be turned to the supine position and a wedge placed under her right hip. If the blood pressure cannot be maintained, it may be necessary to place the wedge under the left hip.*

12. *Oxygen should be administered by face mask.*

13. *Blood pressure should be monitored every minute for the first 15 min and ephedrine 5-10 mg should be given at the first sign of a decrease in blood pressure.*

Appendix V: Letter from KNH/UON-ERC

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along. Ngong Rd.
P.O. Box 20723, Nairobi
Tel: 726300-9
Fax: 725272
Telegrams. MEDSUP", Nairobi
Email: KNHplan@Ken Healthnet.org

Ref: KNH/UON-ERC/ A/288

13th August 2009

Dr. Josephat Kerema
Dept of Surgery (Anaesthesia)
School of Medicine
University of Nairobi

Dear Dr. Kerema

RESEARCH PROPOSAL: "A PROSPECTIVE CORRELATINAL STUDY COMPARING ESTIMATED BLOOD LOSS BETWEEN SPINAL ANAESTHESIA AND GENERAL ANAESTHESIA ON WOMEN UNDERGOING ELECTIVE CAESAREAN SECTION AT K.N.H." **(P83/3/2009)**

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your above revised research proposal for the period 13th August 2009-12th August 2010.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimen must also be obtained from KNH-ERC for each batch.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

DR. L. MUCHIRI
AG. SECRETARY, KNH/UON-ERC

c.c The Chairperson, KNH/UON-ERC
The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept.of surgery, UON
Supervisor: Dr. T. M. Chokwe, Dept.of Surgery, UON