

**INCIDENCE OF POST DURAL PUNCTURE HEADACHE IN
ELECTIVE CESAREAN SECTION PATIENTS FOLLOWING SPINAL
ANESTHESIA AT KENYATTA NATIONAL HOSPITAL**

**A DISSERTATION SUBMITTED IN PART FULFILMENT OF THE
REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER
OF MEDICINE IN ANAESTHESIA OF THE UNIVERSITY OF
NAIROBI.**

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MAY 2009

DECLARATION

This thesis is my original work and to my knowledge has not been presented for a degree in any other university.

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All those who contributed positively to this work are highly appreciated.

DEDICATION

I dedicate this work to my dear wife Nadine and my beloved sons Tony and Thierry.

LIST OF ABBREVIATIONS

ASA	- American Society of Anesthesiologists
BP	- Blood pressure.
cc	- cubic centimeter
C/S	- Caesarean section
CSF	- Cerebral Spinal Fluid
EBP	- Epidural blood patch
g	- gram
Hrs	- Hours
IM	- Intramuscular
Ip No	- In Patient Number
IV	- Intravenous
Kg	- Kilogram
KNH	- Kenyatta National Hospital
Kshs	- Kenya Shillings
Mg	- Milligram
NSAIDS	- Non-steroidal anti- inflammatory drugs
PDPH	- Post Dural Puncture Headache
PLPH	- Post Lumbar Puncture Headache
PO	- Per Os
REC	- Research and Ethics Committee
SPSS	- Statistical Package for Social Sciences
SPO₂	- Percentage of Arterial Oxygen Saturation
TDS	- Three times Daily
UON	-University of Nairobi.

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SUMMARY

Title

Incidence of PDPH in elective cesarean section patients undergoing spinal anesthesia at KNH.

Background

Post dural puncture headache (PDPH) is an iatrogenic complication of neuraxial anesthesia and results from the puncture of the dura mater¹. As female sex and young age are purported risk factors, the complication is common in the obstetrical population, who frequently receives epidural or spinal analgesia and anesthesia during labour and delivery^{1, 2}. This study assessed the incidence, onset time and severity of PDPH and other symptoms associated with PDPH, in elective cesarean section patients undergoing spinal anesthesia at KNH.

Methods

This was a prospective observational descriptive study.

ASA I and ASA II patients scheduled for elective C/S under spinal anesthesia were consecutively recruited into the study provided an informed consent was obtained. The study was carried out at the maternity theatre and maternity wards of KNH. Patients were contacted by telephone, on the 14th day postoperatively after they had been discharged from hospital. One hundred and twelve participants were recruited in the study. The study was conducted for a period of 6 months. Approval to conduct the study was obtained from KNH/UON ethics and research committee. An interviewer administered data sheet was used as the main instrument for data collection. Data analysis was done using Statistical package for social sciences version

15.0 software for windows. Data was analyzed and presented in tables, and pie charts.

Results

The incidence of PDPH in elective C/S mothers following spinal anesthesia at KNH maternity theatre was 47.5% and the mean age of the mothers was 29.3years. Orientation of the needle bevel perpendicularly to the longitudinal dural fibres was associated with 2.6 times more risk of developing PDPH compared to parallel orientation. This was statistically significant, (p-value 0.013).

Onset of headache after dural puncture among the patients who developed PDPH was 84.5% on the first day, 12.1%, and 1.7% on the second and third days respectively.

Headache severity was found to be mild in 29.3%, moderate in 69% and severe in 1.8% of the patients.

Out of the 58 mothers who developed PDPH, 12 had other symptoms associated with PDPH: 5 had neck stiffness; 2 had nausea, 2 had vertigo, 1 had blurred vision and 1 had low back pain. One mother had both low back pain and agitation.

INTRODUCTION

Post dural puncture headache (PDPH) is an iatrogenic complication of neuraxial anesthesia and results from the puncture of the dura mater¹. The signs and symptoms of PDPH result from loss of cerebrospinal fluid, traction on the cranial contents, and reflex cerebral vasodilatation¹. As female sex and young age are purported risk factors, the complication is common in the obstetrical population, who frequently receives epidural or spinal analgesia and anesthesia during labour and delivery^{1, 2}. Young women with a lower body mass index and those who are pregnant have the highest risk of developing headache after lumbar puncture^{3,4}.

The following definite demographic risk factors were identified, based on Class II evidence: younger age, female gender, and headache before or at the time of the lumbar puncture^{2,3}.

PDPH occurs twice as often in women as in men². Most of the increased frequency in women is during the child-bearing years^{2, 3}. The highest frequency is in the 18- to 30-years age group². The frequency is less in children younger than 13 years and in both men and women older than 60 years^{2, 3}.

The incidence of post-dural puncture headache was 66% in 1898^{5,6}. This alarmingly high incidence of post-spinal headache was likely attributable to the use of large gauge, medium bevel, cutting spinal needles (figure 2. needles 5, 6 and 7)⁵. In 1956, with the introduction of 22G and 24G needles, the incidence was estimated to be 11%⁵.

Today the use of fine gauge pencil-point needles, such as the Whitacre and Sprotte has produced a greater reduction in the incidence of post-dural puncture headache, which varies with the type of procedure and patients involved⁵. It is related to the size and design of the spinal needle used, the experience of the personnel performing the dural puncture, and the age and sex of the patient^{5, 7, 8}.

Anesthetists have been active in attempting to reduce the incidence of post-spinal headache⁵. Reducing the size of the spinal needle has made a significant impact on the incidence of post-spinal headaches⁵. The incidence is 40% with a 22G needle; 25% with a 25G needle; 2%–12% with a 26G Quincke needle; and <2% with a 29G needle^{5, 9, 10, 11}.

This study assessed the incidence, severity, and onset time of PDPH, in elective cesarean section patients who had spinal anesthesia at KNH.

LITERATURE REVIEW

Definition of terms

Spinal dura mater

Spinal dura mater is a tube extending from the foramen magnum to the second segment of the sacrum⁵. It contains the spinal cord and nerve roots that pierce it. The dura mater is a dense, connective tissue layer made up of collagen and elastic fibres. The classical description of the spinal dura mater is of collagen fibres running in a longitudinal direction. This had been supported by histological studies of the dura mater⁵. However, recent light and electron microscopic studies of human dura mater have contested this classical description of the anatomy of the dura mater⁵. These studies describe the dura mater as consisting of collagen fibres arranged in several

layers parallel to the surface. Each layer or lamella consists of both collagen and elastic fibres that do not demonstrate specific orientation. The outer or epidural surface may indeed have dural fibres arranged in a longitudinal direction, but this pattern is not repeated through successive dural layers⁵. Recent measurements of dural thickness have also demonstrated that the posterior dura varies in thickness, and that the thickness of the dura at a particular spinal level is not predictable within an individual or between individuals⁵. Dural perforation in a thick area of dura may be less likely to lead to a CSF leak than a perforation in a thin area, and may explain the unpredictable consequences of a dural perforation⁵.

Cerebrospinal fluid

CSF production occurs mainly in the choroid plexus, but there is some evidence of extrachoroidal production⁵. About 500 ml of CSF is produced daily (0.35 ml min^{-1})⁵. The CSF volume in the adult is approximately 150 ml, of which half is within the cranial cavity⁵. The CSF pressure in the lumbar region in the horizontal position is between 5 and 15 cm H₂O. On assuming the erect posture, this increases to over 40 cm H₂O⁵.

Spinal anaesthesia

Spinal anaesthesia is induced by injecting small amounts of local anaesthetic into the cerebro-spinal fluid (CSF)¹². The injection is usually made in the lumbar spine below the level at which the spinal cord ends (L2) within the subarachnoid space. Spinal anaesthesia is easy to perform and has the potential to provide excellent operating conditions for surgery below the umbilicus¹². If the anaesthetist has an adequate knowledge of the relevant anatomy, physiology and pharmacology; safe and satisfactory anaesthesia

can easily be obtained to the mutual satisfaction of the patient, surgeon and anaesthetist¹².

Physiology of spinal anesthesia

Local anaesthetic solution injected into the subarachnoid space blocks conduction of impulses along all nerves with which it comes in contact, although some nerves are more easily blocked than others¹². There are three classes of nerves: motor, sensory and autonomic¹². Stimulation of the motor nerves causes muscles to contract and when they are blocked, muscle paralysis results¹². Sensory nerves transmit sensations such as touch and pain to the spinal cord and from there to the brain, whilst autonomic nerves control the calibre of blood vessels, heart rate, gut contraction and other functions not under conscious control¹².

Anatomy relevant to spinal anesthesia

The spinal cord usually ends at the level of L2 in adults and L3 in children¹². Dural puncture above these levels is associated with a slight risk of damaging the spinal cord and is best avoided¹². An important surface landmark to remember is that a line joining the top of the iliac crests is at L4 to L5¹².

The structures that the needle will pierce through before reaching the CSF are: the skin, Subcutaneous fat which has variable thickness, supraspinous ligament which joins the tips of the spinous processes together, interspinous ligament which is a thin flat band of ligament running between the spinous processes, ligamentum flavum which is quite thick, up to about 1cm in the middle and is mostly composed of elastic tissue¹². It runs vertically from

lamina to lamina. When the needle is within the ligaments it will feel gripped and a distinct "give" can often be felt as it passes through the ligament and into the epidural space¹². The epidural space contains fat and blood vessels. The dura and lastly, the subarachnoid space. This contains the spinal cord and nerve roots surrounded by CSF¹².



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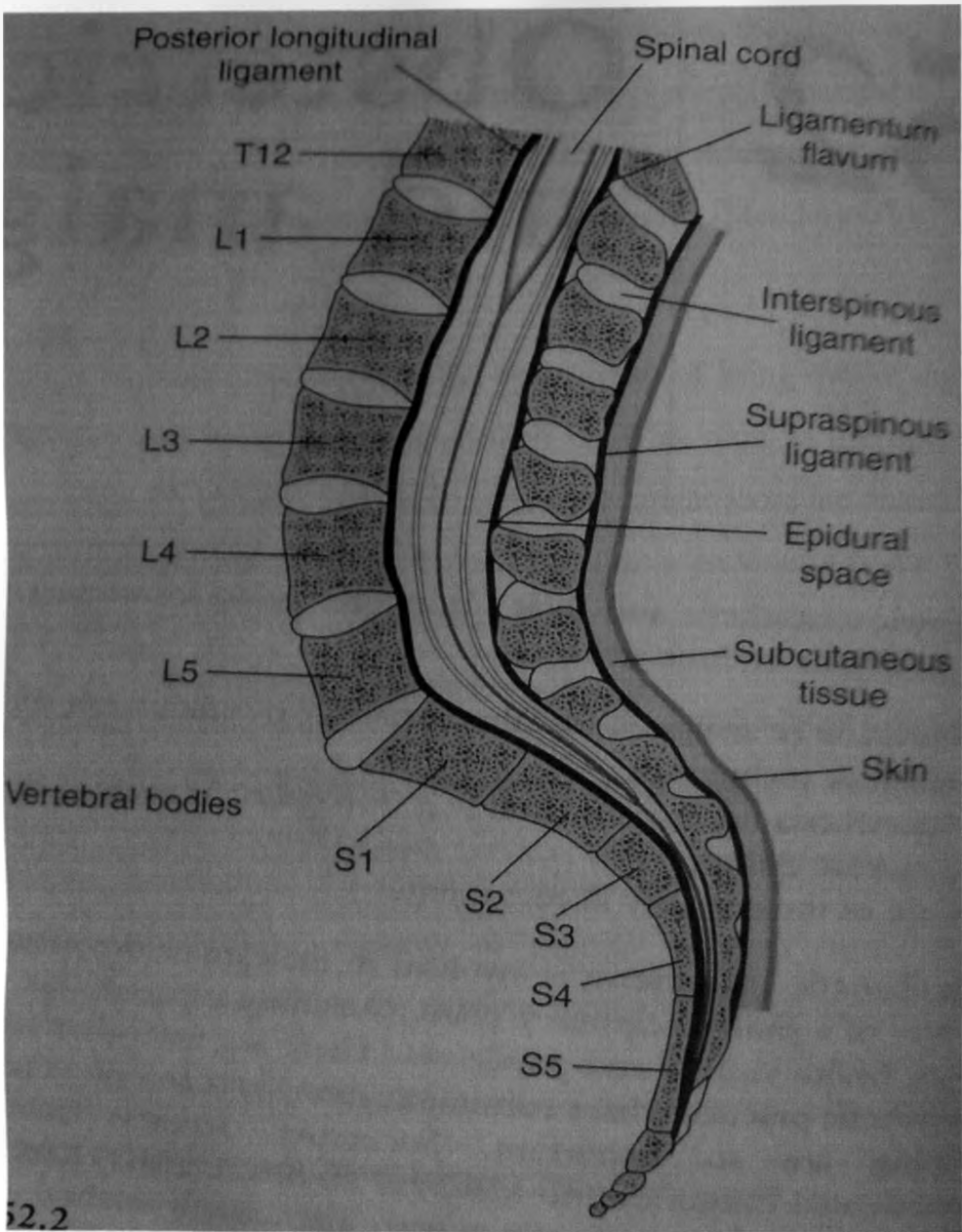


Figure 1. The structures that the needle will pierce through before reaching the CSF.

The Advantages of Spinal Anaesthesia

There are several reasons for preferring spinal anaesthesia to general anaesthesia for Caesarean section. Babies born to mothers having spinal

anaesthesia may be more alert and less sedated, as they have not received any general anaesthetic agents through the placental circulation¹³. As the mother's airway is not compromised, there is a reduced risk of aspiration of gastric contents causing chemical pneumonitis (Mendelson's syndrome)

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Many mothers also welcome the opportunity of being awake during the delivery and being able to feed their child as soon as the operation is completed¹³. If the baby is born with a low apgar score the anaesthetist is free to resuscitate the baby. Spinal anaesthesia provides a better neonatal out come after c/s for foetal distress¹⁴.

Cost. Anaesthetic drugs and gases are costly and the latter often difficult to transport. The costs associated with spinal anaesthesia are minimal¹².

Patient satisfaction. If a spinal anaesthetic and the ensuing surgery are performed skilfully, majority of patients are very happy with the technique and appreciate the rapid recovery and absence of side effects.

Respiratory diseases. Spinal anaesthesia produces few adverse effects on the respiratory system as long as unduly high blocks are avoided¹².

Diabetic patients. There is little risk of unrecognised hypoglycaemia in awake patients. Diabetic patients can usually return to their normal food and insulin regime soon after surgery as they experience less sedation, nausea and vomiting¹².

Muscle relaxation. Spinal anaesthesia provides excellent muscle relaxation for lower abdominal and lower limb surgery¹².

Bleeding. Blood loss during operation is less than when the same operation is done under general anaesthesia. This is because of a fall in blood pressure and heart rate and improved venous drainage with a resultant decrease in oozing¹².

Splanchnic blood flow. Because it increases blood flow to the gut, spinal anaesthesia may reduce the incidence of anastomotic dehiscence.

Visceral tone. The bowel is contracted during spinal anaesthesia and sphincters are relaxed although peristalsis continues. Normal gut function rapidly returns following surgery¹².

Coagulation. Post-operative deep vein thromboses and pulmonary emboli are less common following spinal anaesthesia¹².

When one is familiar with the technique, spinal anaesthesia can be very swiftly performed¹².

Disadvantages of Spinal Anaesthesia

It may be difficult to perform the spinal injection as the pregnant uterus will impede lumbar flexion and, if labour has started, the mother may be unable to remain still when having contractions¹³.

Sometimes it can be difficult to find the dural space and occasionally, it may be impossible to obtain CSF and the technique has to be abandoned. Rarely, despite, an apparently faultless technique, anaesthesia is not obtained.

Hypotension may occur with higher blocks and the anaesthetist must know how to manage this situation with necessary resuscitation drugs and equipment immediately at hand¹².

Some patients are not psychologically suited to be awake, even if sedated, during an operation¹². Likewise, some surgeons find it very stressful to operate on conscious patients¹².

Even if a long-acting local anaesthetic is used, a spinal is not suitable for surgery lasting longer than approximately 2 hours¹². Patients find lying on an operating table for long periods uncomfortable.

There is a theoretical risk of introducing infection into the sub-arachnoid space and causing meningitis¹². This should never happen if equipment is sterilised properly and an aseptic technique is used¹².

Indications for Spinal Anaesthesia

Spinal anaesthesia is best reserved for operations below the umbilicus e.g. hernia repairs, caesarean section, gynaecological and urological operations and any operation on the perineum or genitalia and all operations on the lower limbs are possible¹².

Contra-indications to Spinal Anaesthesia.

Most of the contra-indications to spinal anaesthesia apply equally to other forms of regional anaesthesia.

These are:

Inadequate resuscitation drugs and equipment. No regional anaesthetic technique should be attempted if drugs and equipment for resuscitation are not immediately at hand¹².

Clotting disorders. If bleeding occurs into the epidural space because the spinal needle has punctured an epidural vein, a haematoma could form and compress the spinal cord¹².

Hypovolaemia from whatever cause e.g. bleeding, dehydration due to vomiting, diarrhoea or bowel obstruction. Patients must be adequately rehydrated or resuscitated before spinal anaesthesia or they will become very hypotensive¹².

Patient refusal. Patients may be understandably apprehensive and initially state a preference for general anaesthesia, but if the advantages of spinal anaesthesia are explained they may then agree to the procedure¹².

Children. Although spinal anaesthesia has been successfully performed on children, this is a highly specialized technique best left to experienced paediatric anaesthetists¹² and must be combined with sedation.

Scars on the back near the site of lumbar puncture lest infection be introduced into the epidural or intrathecal space¹².

Septicaemia. If a patient is septicaemic, they are at increased risk of developing a spinal abscess¹². Epidural abscesses can, however, appear spontaneously in patients who have not had spinal/epidural injections especially if they are immuno-deficient: e.g., patients with AIDS, Tuberculosis and diabetes¹².

Anatomical deformities of the patient's back. This is a relative contraindication, as it will probably only serve to make the dural puncture more difficult¹².

Neurological diseases. The advantages and disadvantages of spinal anaesthesia in the presence of neurological disease need careful assessment. Any worsening of the disease post-operatively may be blamed erroneously on the spinal anaesthetic¹² and therefore, best avoided

in progressive neurologic disease. Raised intracranial pressure, however, is an absolute contra-indication as a dural puncture may precipitate coning of the brain stem¹².

Complications of spinal anesthesia are:

Postural puncture headache is the most common complication of spinal anesthesia¹⁵.

Backache. The next common complication of spinal anesthesia is backache secondary to needle insertion that has caused periosteal trauma or rupture of the ligament structures with or without intraligamentous hematoma¹⁶. Backache secondary to traumatic needle insertion can be treated symptomatically and will diminish within a short period of time¹⁶.

Cardiovascular complications.

The incidence of hypotension following spinal anesthesia is 10-40%¹⁵.

Cardiac arrest has been reported in healthy patients during administration of spinal anesthesia¹⁵.

Urinary retention. As the sacral autonomic fibres are among the last to recover following a spinal anaesthetic, urinary retention may occur¹². If fluid pre-loading has been excessive, a painful distended bladder may result and the patient may need to be catheterised¹².

High spinal block. If the block is high then patient may complain of tingling or even weakness of the upper limbs¹³. Even though some of the intercostal muscles will be paralysed, the diaphragm is unaffected and the patient should be managed with slight head-up tilt, oxygen and reassurance¹³.

Total spinal. Very rare; if too large a dose of local anaesthetic is given, there may be a total spinal with paralysis of all respiratory muscles and respiratory arrest¹³. There is an associated loss of consciousness and severe hypotension and bradycardia¹³. This should really only be seen as a complication of epidural anaesthesia when a relatively large dose of local anaesthetic is injected into the subarachnoid space in error¹³.

Permanent neurological complications are extremely rare^{12,15}. Many of those that have been reported were due to the injection of inappropriate drugs or chemicals into the CSF producing meningitis, arachnoiditis, transverse myelitis or the cauda equina syndrome with varying patterns of neurological impairment and sphincter disturbances¹². Damage to an epidural vein can lead to the formation of an epidural haematoma that compresses the spinal cord¹². This is most unlikely in a patient with a normal clotting profile. If inadequate sterile precautions are taken, bacterial meningitis or an epidural abscess may result although it is thought that most such abscesses are caused by the spread of infection in the blood¹². Finally, permanent paralysis can occur due to the "anterior spinal artery syndrome"¹² which is associated with severe hypotension during spinal anaesthesia.

Spinal needles

Spinal needles are usually 9cm (3.5 inches) long and should have a close fitting stylet, a smooth lining and transparent hub, so that the flow of CSF is faster and can be identified quickly¹⁷. The needle should produce minimal trauma and the smallest hole in the dura matter.

There are several spinal needle designs, but four of them are commonly used in clinical practice².

1. Quincke needle (figure 2). It is a standard needle with a medium cutting bevel and an orifice at the needle tip. Its advantages are that CSF is identified as soon as it enters the subarachnoid space, paraesthesias and neurotrauma are less likely and it is cheaper compared to atraumatic needles. Its disadvantages include a high incidence of PDPH compare to atraumatic needles.
2. Whitacre needle (figure 2). It is a pencil point or atraumatic needle. It has a small orifice and a diamond shaped tip.
3. Sprotte needle (figure 2). It is also atraumatic needle and is a modification of the whitacre needle with a longer lateral opening. It has a conical tip and the orifice is up to 0.5mm from the needle tip. The advantages of atraumatic needles include, less incidence of PDPH than the medium bevel cutting needles. However, paraesthesias have been observed with the use of pencil point needles. The problem of slow CSF flow and paraesthesias seen with pencil point needles has promoted the search for novel needle design .E.g. atraucan needle.
4. Atraucan needle (figure 3). It has a narrow cutting tip and atraumatic bevel and orifice at the tip of the needle. It has less paraesthesia compared to whitacre and sprotte needles. It is easy to use and has low PDPH rates.

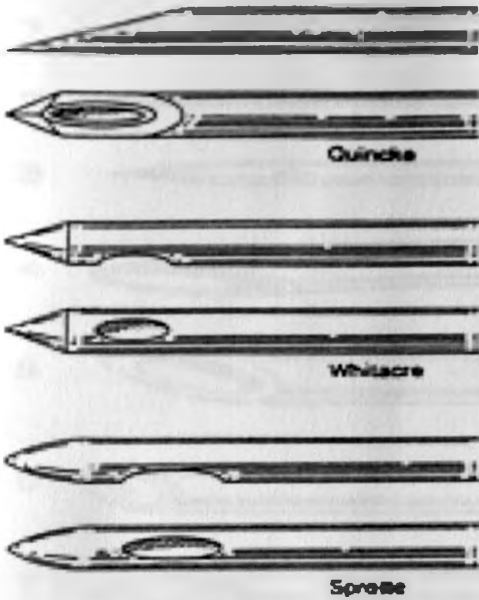


Figure 2. Three types of spinal needle tips: the Quincke, Whitacre, and Sprotte. From: Peterman SB. Postmyelography headache rates with Whitacre versus Quincke 22-gauge spinal needles. *Radiology* 1996; 200:771–778².

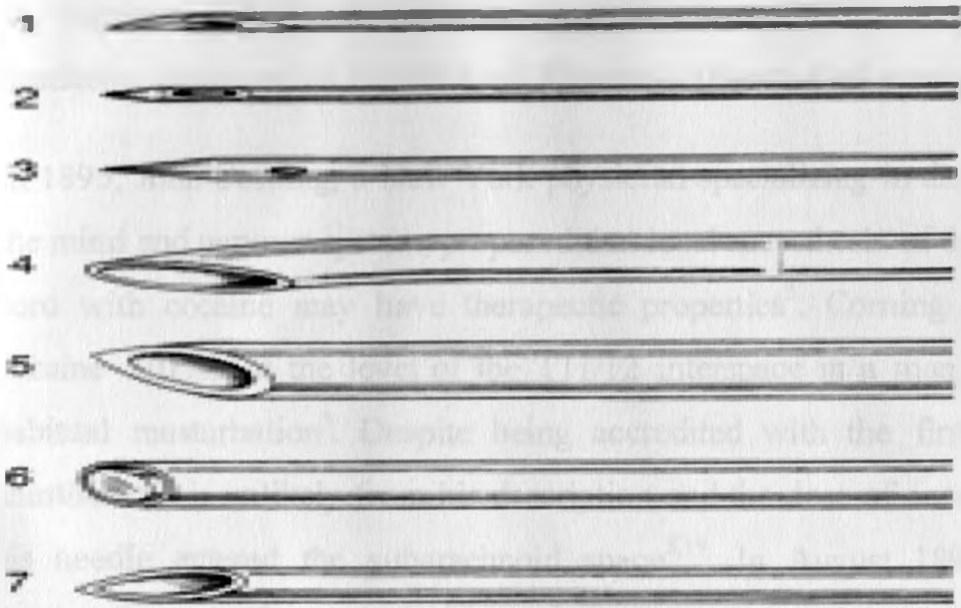


Figure 3. Graphical representations of epidural (needle 4) and spinal needle tip design. Note the large orifice and conical tip of the Sprotte Needle 2, compared with the small orifice and diamond tip of the Whitacre Needle 3. Needles 5, 6 and 7 were provided by the Sheffield Anaesthetic Museum and are an indication of the style of spinal needles used in the past. 1, 26G Atraucan Double Bevel Design; 2, 26G Sprotte Style Pencil Point; 3, 22G Whitacre Style Pencil Point; 4, 16G Tuohy Needle; 5, 17G Barkers Spinal Needle; 6, Large Gauge Spinal Needle; 7, 18G Crawford Needle⁵.

History of obstetric anaesthesia

Spinal anaesthesia developed in the late 1800s⁵. In 1891, Wynter and Quincke aspirated cerebrospinal fluid (CSF) from the subarachnoid space for the treatment of intracranial hypertension associated with tuberculous meningitis^{5, 18}. The catheters and trochars used were probably about 1 mm

in diameter and would certainly have led to a post-dural puncture headache. However, all Quincke and Wynters' subjects died soon after.

In 1895, John Corning, a New York physician specializing in diseases of the mind and nervous system, proposed that local anaesthesia of the spinal cord with cocaine may have therapeutic properties⁵. Corning injected cocaine 110 mg at the level of the T11/12 interspace in a man to treat habitual masturbation⁵. Despite being accredited with the first spinal anesthetic, it is unlikely from his description and the dose of cocaine that his needle entered the subarachnoid space^{5,19}. In August 1898, Karl August Bier, a German surgeon, injected cocaine 10–15 mg into the subarachnoid space of seven patients, himself and his assistant, Hildebrandt^{5,6}. Bier, Hildebrandt and four of the subjects all described the symptoms associated with post-dural puncture headache. Bier surmised that the headache was attributable to loss of CSF⁵. By the early 1900s, there were numerous reports in the medical literature of the application of spinal anaesthesia using large spinal needles. Headache was reported to be a complication in 50% of subjects. At that time, the headache was said to resolve within 24 hrs⁵.

Ether anaesthesia was introduced into obstetric practice in 1847, shortly after Morton's public demonstration⁵. Despite the obvious advantages of regional anesthesia for the relief of labour pain, it was not until a Swiss obstetrician in 1901 used intrathecal cocaine for the relief of pain in the second stage of labour that regional anaesthesia for obstetrics was popularized⁵. Though both vomiting and a high incidence of post-dural puncture headache were noted, it was the high mortality rate in Caesarean deliveries performed under spinal anaesthesia (1 in 139) that led to the

abandonment of this technique in the 1930s. The period from 1930 to 1950 has often been referred to as the 'dark ages of obstetric anaesthesia', when natural childbirth and psycho -prophylaxis were encouraged⁵.

In 1951, Whitacre and Hart developed the pencil-point needle, based on the observations of Greene in 1926⁵. Developments in needle design since that time have led to a significant reduction in the incidence of post-dural puncture headache⁵. However, dural puncture headache remains a disabling complication of needle insertion into the subarachnoid space⁵.

Clinical presentation of post dural puncture headache.

According to the Headache Classification Committee of the International Headache Society, headache after lumbar puncture is defined as "bilateral headaches that develop within 7 days after a lumbar puncture and disappears within 14 days^{4, 20}. The headache worsens within 15 min of resuming the upright position, disappears or improves within 30 min of resuming the recumbent position".

Characteristics of headache after lumbar puncture

The onset of headache after lumbar puncture is usually within 24–48 h after dural puncture^{4, 21, 22}, but contrary to the above definition, it could be delayed by up to 12 days, indicating that the time points in the definition are random^{4, 23}. Although the headache may rarely present immediately after dural puncture, its occurrence should alert the doctor to an alternative cause such as a rise in intracranial pressure, with associated displacement of intracranial structures⁴. The postural nature of the headache is very characteristic and the symptoms are usually self-limiting, but sometimes it may be severe enough to immobilize the patient^{4, 23}.

Headache after lumbar puncture is usually dull or throbbing in nature, and can start in the frontal or occipital region, which can later become generalized^{4, 5}. It is possible for the pain to radiate to the neck and shoulder area, and could be associated with neck stiffness⁴. Head movements exacerbate the pain and any manoeuvres that increase intracerebral pressure, such as coughing, sneezing, straining or ocular compression, may also worsen the symptoms⁴. Other associated symptoms include lower back pain, nausea, vomiting, vertigo and tinnitus and, rarely, diplopia due to cranial nerve palsy and even cortical blindness^{4, 24}.

Headache usually resolves within a few days, but the longest reported headache after lumbar puncture lasted for 19 months⁴.

Diagnosis of postdural puncture headache.

This is essentially a clinical diagnosis and the history of a dural puncture and the postural nature of the headache with associated symptoms usually confirm the diagnosis⁴. If a diagnostic lumbar puncture is performed, it may show a low cerebrospinal fluid (CSF) opening pressure, a slightly raised CSF protein and a rise in CSF lymphocyte count^{4, 25}. Magnetic resonance imaging of the brain may show diffuse dural enhancement with evidence of sagging, descent of the brain and brain stem, obliteration of the basilar cisterns and enlargement of the pituitary gland⁴.

Differential diagnosis of post dural puncture headache.

Diagnoses that may present similar to post dural puncture headaches include intracranial tumours, intracranial haematoma, pituitary apoplexy,

cerebral venous thrombosis, migraine, chemical or infective meningitis and nonspecific headache⁵. It has been estimated that 39% of parturients report symptoms of headache unrelated to the dural puncture following delivery⁵.

Pathophysiology

The exact pathophysiology of headache after lumbar puncture is unclear⁴. However, it is most probably related to the "hole" left in the dura after the needle has been withdrawn, resulting in persistent leak of CSF from the subarachnoid space⁴. This leakage results in a fall in intracranial CSF volume and CSF pressure.

Although the loss of CSF and lowering of CSF pressure is not disputed, the actual mechanism producing the headache after lumbar puncture is not clear⁴. There are two possible explanations. Firstly, the low CSF volume depletes the cushion of fluid supporting the brain and its sensitive meningeal vascular coverings, resulting in gravitational traction on the pain-sensitive intracranial structures causing classical headache, which worsens when the patient is upright and is relieved on lying down^{4, 26}. Secondly, the decrease in CSF volume may activate adenosine receptors directly, causing cerebral vasodilatation and stretching of pain-sensitive cerebral structures, resulting in headache after lumbar puncture^{4, 23}.

Factors contributing to the development of headache after lumbar puncture and how to prevent them.

Needle size: The size of the dural tear is directly proportionate to the amount of CSF leakage⁴. As a smaller needle diameter produces a smaller tear in the dura, there is less potential for leakage and incidence of headache after lumbar puncture⁴. The incidence of headache is 70% if the needle size is between 16 and 19G, 40% if the needle size is between 20 and 22G and 12% if the needle size is between 24 and 27G^{4, 27}. Although smaller needles are satisfactory for spinal and epidural anaesthesia and for myelography, for diagnostic lumbar puncture, the use of a needle with a diameter <22G may not be practical (unless only a small volume of fluid is needed), as the time for transduction of the opening pressure using the manometer may be too long and the flow rate may be too slow^{4, 28}. Needles <22G take >6 min to collect 2 ml of fluid and a similar period is required for measuring pressure and even then the measurement may be inaccurate. In practice, therefore, a 22G needle is the smallest size that should be used for diagnostic lumbar puncture^{4, 29}.

Direction of bevel: As the collagen fibres in the dura matter run in a longitudinal direction, parallel to the long or vertical axis of the spine, the incidence of headache after lumbar puncture is less if the needle is inserted with the bevel parallel to the dural fibres, rather than perpendicular^{4,30}. This "separates" the fibres rather than cutting them, thus facilitating closure of the hole on needle withdrawal⁴. If the needle is at right angles to the collagen fibres, the cut in the dural fibres, previously under tension, would then tend to retract, resulting in a bigger dural tear,

thus increasing the likelihood of CSF leakage and the incidence of headache after lumbar puncture⁴.

Needle design: There is convincing evidence in the anaesthesia literature that headache after lumbar puncture is reduced using non-cutting (atraumatic) needles⁴. These atraumatic needles have a diamond-shaped tip and the orifice is situated up to 0.5 mm from the needle tip⁴. As these needles cause temporary separation rather than cutting the elastic fibres, which then recoil after removal of the needle, the damage to the dura is less with atraumatic needles^{4, 30}. This considerably reduces the incidence of headache and the need for medical intervention. The literature on diagnostic lumbar puncture has been conflicting until recently⁴. Three randomized, double-blind controlled studies concluded that atraumatic needles considerably reduced the incidence of headache after diagnostic lumbar puncture, although they were associated with a higher failure rate than the standard needles⁴.

Replacement of the stylet: The standard procedure is to replace the stylet before withdrawing the needle when a non-cutting needle is used⁴. In a study of 600 patients, the incidence of headache was 5% in patients whose stylet was replaced as compared with 16% in the patients whose stylet was not reinserted^{4, 31}. It is thought that the higher incidence in the second group is due to a strand of arachnoid that may enter the needle with the CSF and when the needle is removed the strand could be threaded back through the dural defect and produce prolonged CSF leakage⁴.

Number of lumbar puncture attempts: As the number of dural punctures directly relates to the size of the dural damage, making fewer

attempts at dural puncture could be associated with lower incidence of headache after lumbar puncture. However, no studies have been conducted⁴.

Factors not influencing the incidence of headache after lumbar puncture:

The volume of the spinal fluid removed is not a risk factor for headache after lumbar puncture^{4, 26}.

There is no evidence that any duration of bed rest after lumbar puncture has a role in preventing headache⁴.

Improving hydration by increased fluids (either oral or intravenous) has not been shown to prevent headache after lumbar puncture^{4, 32}.

Mostly, lumbar punctures are performed with patients lying on their side, although it is considered to be quicker and technically easier with the patient sitting upright^{4, 33}. So far, there is no convincing evidence to suggest any particular position to reduce the incidence of headache after lumbar puncture, and it depends mainly on the choice of the doctor unless it is to measure the CSF pressure, where the patient should be in the supine position⁴.

The incidence of headache after lumbar puncture does not depend on the CSF opening pressure, CSF analysis or the volume of CSF removed^{3, 4}.

Management

If a patient develops headache after lumbar puncture with characteristic features, they should be encouraged to lie in a comfortable position, which

is mostly in the supine position owing to the postural nature of the symptoms⁴. Supporting treatment such as rehydration, simple analgesics, opioids and anti-emetics may control the symptoms in milder cases⁴. Generally, >85% of headaches after lumbar puncture will resolve without any specific treatment^{4, 5}.

However, if conservative measures fail to resolve headaches after lumbar puncture, then specific treatment is indicated 72 h after the onset of pain, as it would avert the catastrophic complications of subdural haematoma and seizures that could be fatal⁴.

The aim of specific management of headache after lumbar puncture is to replace the lost CSF, seal the puncture site and control the cerebral vasodilatation⁴. Several therapeutic measures have been suggested to treat headache after lumbar puncture based on these strategies⁴.

Epidural blood patch: The concept of the epidural blood patch was developed after the observation made on patients who had "bloody tap", in whom the incidence of headache was low⁴. Once blood is introduced into the epidural space, it will form a clot and seal the perforation, thus preventing further leak of CSF⁴. This procedure has a success rate of about 70–98% and can be repeated if it fails to resolve the symptoms at the first attempt^{4, 5}.

Epidural saline: It was noted that after a blood patch treatment, there was a rapid resolution of symptoms, which could not be explained purely by the sealing effect on the puncture site^{4, 5}. This brought the concept of possible compression of the thecal sac with presumed increase in subarachnoid

pressure owing to the volume of blood introduced^{4, 5}. The same effect was expected on using saline, which is relatively inert and sterile, and epidural saline bolus or infusions were advocated in some regimens based on this hypothesis, with variable results^{4, 5}.

Epidural dextran 40: It has not been extensively studied for the treatment of headache after lumbar puncture and is not in current use⁴. However, in a series of 56 patients with headache, who failed to respond to treatment including epidural blood patch, relief of headache was accomplished in all patients within 24 h after injection with 20 ml of dextran 40 epidurally^{4, 5}.

Epidural, intrathecal and parenteral opioids

A number of authors have advocated the use of epidural, intrathecal or parenteral morphine; the majority of these reports are either case reports or inadequately controlled trials⁴.

Fibrin glue

Alternative agents to blood, such as fibrinous glue, have been proposed to repair spinal dural perforations⁵. There is, however, a risk of the development of aseptic meningitis with this procedure⁵.

Intrathecal catheters

After accidental dural perforation with a Tuohy needle, it has been suggested that placement of a spinal catheter through the perforation may provoke an inflammatory reaction that will seal the hole⁵. Evidence to support this claim is conflicting⁵.

Caffeine: A few studies and some case reports have recommended oral and intravenous caffeine as a therapeutic option, although the recurrence of headache after caffeine treatment is frequent⁴.

Sumatriptan

Sumatriptan is advocated for the management of migraine and recently, for post-dural puncture headache⁵. There have been only a few case reports where sumatriptan was used successfully to manage post-dural puncture headache⁵.

DDAVP (desmopressin acetate), intramuscular administration before lumbar puncture was not shown to reduce the incidence of post-dural puncture headache⁵.

ACTH (adrenocorticotrophic hormone) has been administered as an infusion ($1.5 \mu\text{g kg}^{-1}$), but inadequate statistical analysis prevents assessment of the value of ACTH⁵.

Surgical closure of the dural gap: There are case reports of persistent CSF leaks that are unresponsive to other therapies, being treated successfully by surgical closure of the dural perforation. This is clearly a last resort treatment^{4, 23 25}.

JUSTIFICATION:

Spinal anesthesia is increasingly becoming the preferred anesthetic technique for elective cesarean section in KNH. However there is an inevitable risk of PDPH after spinal anesthesia. PDPH may cause discomfort and this may result in increased rejection of regional anesthesia by patients. Patients with PDPH are forced to stay in bed which predisposes them to deep vein thrombosis and osteoarthritis. Long term stay in hospital due to PDPH results in increased cost to patients.

If the incidence of this complication is not minimized it has a potential to act as a draw back.

Anesthetists have been active in attempting to reduce the incidence of post spinal headaches by reducing the size of the spinal needle⁵. In KNH we use the Quincke point needles which are cutting needles. The pencil point (atraumatic needles like whitacre or sprotte) needles are not available in KNH. The Quincke point needle 25G is the needle that is commonly used. The quoted incidence of PDPH after spinal anesthesia in obstetric patients using 25G Quincke point needle is 25%^{5,9,10}. Many factors influence the incidence of PDPH. These Include: Size and design of the spinal needle used, patient population, clinical setting, and criteria used to define PDPH and the experience of the operator^{5, 7, 8}.

Thus, exact incidence for PDPH from other institutions may not be directly compared with one from our institution.

The actual incidence of PDPH in elective C/S after spinal anesthesia at KNH is not known since no study has been carried out previously to address this subject.

A common question remains: What is the incidence of PDPH in elective Cesarean section mothers after spinal anesthesia at KNH?

The findings of this study will be used in:

-Suggesting means of further reducing the incidence of PDPH.

-improving the existing methods of management of PDPH.

-providing a window for future research on this subject.

AIMS AND OBJECTIVES

Research question

What is the incidence of post dural puncture headache in elective cesarean section patients following spinal anesthesia at Kenyatta National Hospital?

Broad objective: To assess the Incidence of post dural puncture headache in elective cesarean section patients following spinal anesthesia at KNH.

Specific objectives:

- 1. State the incidence of PDPH.**
- 2. Determine the onset time of postdural puncture headache.**
- 3. Evaluate the severity of post dural puncture headache.**
- 4. Evaluate other symptoms associated with post dural puncture headache.**

RESEARCH METHODOLOGY

STUDY AREA AND POPULATION

The study was based at Kenyatta National hospital maternity theatre and maternity wards. The study population comprised elective cesarean section patients who had spinal anesthesia at the maternity theatre.

Maternity theatre is exclusively set aside for obstetrics related operations at KNH, of which C/S is inclusive. The theatre has two operating rooms. Elective C/S operations are scheduled three times a week, on Monday, Wednesdays and Fridays from 8am to 5pm. Generally, an average of 2700 patients undergo cesarean section annually at the maternity theatre. There are, on average, 180 cases of elective C/S patients that undergo spinal anesthesia per year (As noted from the maternity theatre records for two years from January 2007 to December 2008). There are 3 different wards where patients scheduled for elective C/S are admitted preoperatively. Post operatively C/S patients are hospitalized in the, same wards of admission, for a minimum of three days before they are discharged.

STUDY DESIGN

This is a prospective observational descriptive study.

SAMPLING AND SAMPLE SIZE

Sampling

This study adopted a consecutive sampling method whereby ASA I and ASA II elective cesarean section mothers who had spinal anesthesia were included in the study, provided an informed consent was obtained. All patients stood equal chances of being involved in the study.

Sample size

The Sample size was determined by the following formula by Fisher et al³⁴ which is in two parts:

$$\text{Part I ; } n = t^2 \times p (1-p)/m^2$$

$$\text{Part II ; } nf = n/ (1+n/N)$$

$$\text{Part I ; } n = t^2 \times p (1-p)/m^2$$

Description

n = required sample size.

t = confidence level at 95% (standard value of 1.96)

P = estimated prevalence of PDPH which is put at 25% (The quoted incidence of PDPH after spinal anesthesia in obstetric patients using 25G Quincke point needle is 25%^{5,9,10}). The 25G Quincke point spinal needle is the type of spinal needle that is routinely used for spinal anesthesia at Kenyatta National Hospital, maternity theatre.)

m = margin of error at 5% (standard value 0.05)

Therefore:

$$n = 1.96^2 \times 0.25(1-0.25)/0.05^2$$

$$n = 3.8416 \times 0.25 \times 0.75/0.0025$$

$$n = 0.7203/0.0025$$

$$n = 288.$$

Part II

If the population to be studied in a year is less than 10,000 (In our case 180 which is the number of elective C/S patients that undergo spinal anesthesia at the maternity theatre per year), 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 (288 in our case got from part I of the formula).

N = the estimated population size, in our case which is the estimated number of C/S that undergo spinal anesthesia in KNH per year which is 180.

Therefore

$$\begin{aligned}nf &= n / (1 + n/N) \\ &= 288 / (1 + 288/180) \\ &= 110.8 \text{ which is rounded off to } 111\end{aligned}$$

Hence the estimated number of patients required to achieve the desired sample size was 111.

ELIGIBILITY CRITERIA

Inclusion criteria

ASA I and ASA II mothers scheduled for elective cesarean section who:

- had spinal anaesthesia and accepted to be enrolled into the study after informed consent.

Exclusion criteria

ASA I and ASA II elective cesarean section mothers who had spinal anesthesia that:

- did not consent.
- had failed spinal anesthesia and general anesthesia was substituted.
- developed complication, other than PDPH, during or/ after surgery that required ICU admission.
- Mothers who had pre-existing chronic or recurrent headache.

MATERIALS, METHODS AND DATA COLLECTION

The approval to carryout the study was obtained from the KNH/UON ethics and research committee.

Elective cesarean section mothers scheduled for spinal anesthesia were visited preoperatively, in their respective wards of admission, on the evening before the day of operation, by the principal investigator. They were explained to, about the aims of the study and were requested to sign an informed consent. All mothers who consented were enrolled consecutively in the study. Data collection sheet for recording the information required was fixed in the patient's file after being recruited into the study. Perioperatively, the anesthetist who was giving the spinal block was requested to fill in the following information in the data collection sheet : Patient's Names, IP number, Age, Parity, needle design, size and orientation and number of attempted dural punctures and the time at which spinal anesthesia was given. Post operatively the patients were visited by the principal investigator, in their respective wards of admission, every day till they were discharged from the hospital in order to record the incidence, onset time and severity of PDPH and other symptoms associated with PDPH. After discharge, patients received a telephone call on the 14th post operative day by the principal investigator, to evaluate for delayed onset headache. A total of 112 patients were recruited in this study.

Cesarean section under spinal anesthesia was conducted according to the standard protocol for KNH as follows: Patients IV access was secured with cannula gauge 18. Patients were preloaded with 500ml to 1000mls of crystalloid. Physiologic monitors were attached to the patient and baseline BP, pulse, SPO₂ and respiration were noted. Patients were positioned for

Lumbar puncture in seated or lateral decubitus position. Posterior superior iliac spines were identified bilaterally and a line was drawn joining them perpendicular to the spine. This line passes through the L4. L3/L4 interspace and L4/L5 interspace were marked. After putting on sterile gloves the site of LP was disinfected with antiseptic solution (povidone iodine and /or methylated spirit). Lignocaine 2%, 1-2cc was infiltrated into each interspace using the 5cc syringe and smaller needle (Gauge 23). Using the bigger needle (Gauge 21) as an introducer, lumbar puncture was done with the bevel of the spinal needle (quinke type) facing laterally. Having established free flow of CSF through the needle 1.5-2mls of 0.5% plain bupivacaine with 25µg of fentanyl was administered. A sterile dressing was placed on the site of puncture and gently the patient let to lie down with a slight left lateral tilt. Patient's ECG, pulse rate, oximetry and blood pressure were monitored and recorded throughout the procedure. BP was monitored initially, and every 2.5 minutes until delivery, there after BP was monitored every five minutes. Ephedrine 5mg IV was given (as prophylaxis against hypotension) and repeated as necessary. Test for maximum level of block of at least T6 was required and was determined by pinprick or cold cotton sensation. O₂ was administered by nasal prong at 2litres/minute to ensure SPO₂ >95%. Prophylactic anti-emetics were given (metochlorpramide 10mg IV). A screen was put between the patient and the surgeon and verbal contact with the patient was maintained. Post operatively patients were treated as usual with bed rest, hydration, analgesics (i.e. NSAIDS, opioids and paracetamol) and re-assurance if they developed headache. The standard pain management protocol given to every C/S patient post operatively at KNH is as follows: Diclofenac 75mg im tds for 3days and pethidine 100mg im tds for 3days. On

discharge patients are given 1g of paracetamol PO Tds for 3days. Supporting treatment such as rehydration, simple analgesics, opioids and anti-emetics may control the symptoms in milder cases⁴ but do not prevent the occurrence of PDPH. PDPH can only be prevented by factors that replace CSF, sealing off the puncture site and control cerebral vasodilatation⁴. On the other hand, the analgesics are given routinely to every C/S patient postoperatively to manage pain in general not specifically targeting PDPH. Our study, being purely observational, was carried out in consideration that all patients were given a standard pain management and we did not influence or change any treatment given to patients.

Data analysis

The collected data was kept in a safe place for data entry process. After cross checking the questionnaires for any missing entries a data base was designed in MS Access which allowed the research to set controls and validation of the variables. On completion of the data entry exercise the data was exported in a statistical package for social sciences (SPSS-Version 15.0 soft ware for windows) for analysis and for inferential statistics.

Descriptive analysis

Nominal measurements - mode was determined for central tendency.

Ordinal measurements - mode, median were determined for central tendency. For variability; percentages and range were determined.

Inferential analysis

Inferential analysis was used to correlate various variables.

Data presentation

Data presentation is in the form of tables, charts, and graphs.

Bias minimization

Sampling bias

The study involved all consenting elective cesarean section patients scheduled for spinal anesthesia in maternity theatre at KNH. Patients were consecutively enrolled in the study and stood equal chances of being included in the study.

Measurements bias

This was minimized by using a well coded and standardized data sheet.

Information bias

This was minimized by adhering strictly to the definition of terms outlined in the study.

ETHICAL CONSIDERATIONS

- This study was purely observational and did not undertake extra invasive procedures, apart from the primary scheduled procedure.
- The approval to carry out the research was obtained from the KNH/UON ethics and research committee.
- The nature and purpose of the research was explained to the research participants.
- Informed consent was obtained for each participant recruited into the study.
- The study respected the right of the participant to refuse participation.
- It was made clear that there would be no cost associated with participating in the study.
- The researcher respected the right of each individual to safeguard his or her personal dignity.
- At any time during the course of the research, the respondent was free to withdraw consent /participation without any penalty.
- The information obtained from each participant was treated confidentially.
- All participants' questions regarding the study were answered appropriately.

EXECUTION

MAIN STUDY

The approval to carry out the study was obtained from the KNH/UON ethics and research committee.

The study was carried out for a period of 6 months. Data was collected in maternity theatre and maternity wards where patients were followed up on daily basis and contacted by telephone on the 14th post operative day after discharge. Data obtained was analyzed, presented and a final report compiled accordingly.

QUALITY CONTROL

To avoid missing data, all the data sheet were checked for completeness by the researcher before starting any data entry and analysis.

DUTIES OF PERSONNEL

Researcher

In order to ensure that the objectives of the study were realized, the researcher, Collected data, analyzed data and ultimately compiled the final research document.

Research supervisor

During the course of the study, the research supervisor performed the following roles: Guided and directed the researcher during the study.

STUDY LIMITATIONS

Despite the study having been successfully carried out, it was not without some limitations/problems encountered during the study period.

On a few occasions there was short supply of either spinal needles or local anesthetic, so anesthetists had to resort to giving General Anesthesia on those days.

The data provided by anesthetists, concerning the orientation of the needle bevel and the number of dural puncture attempts during administration of spinal anesthesia, was assumed to be correct.

All in all the study was able to answer the research questions and the conclusions related to the study objectives.

RESULTS

A total of 122 mothers were recruited in the study. All patients were ASA I and ASA II mothers who had elective C/S under spinal anesthesia. Results are summarized below.

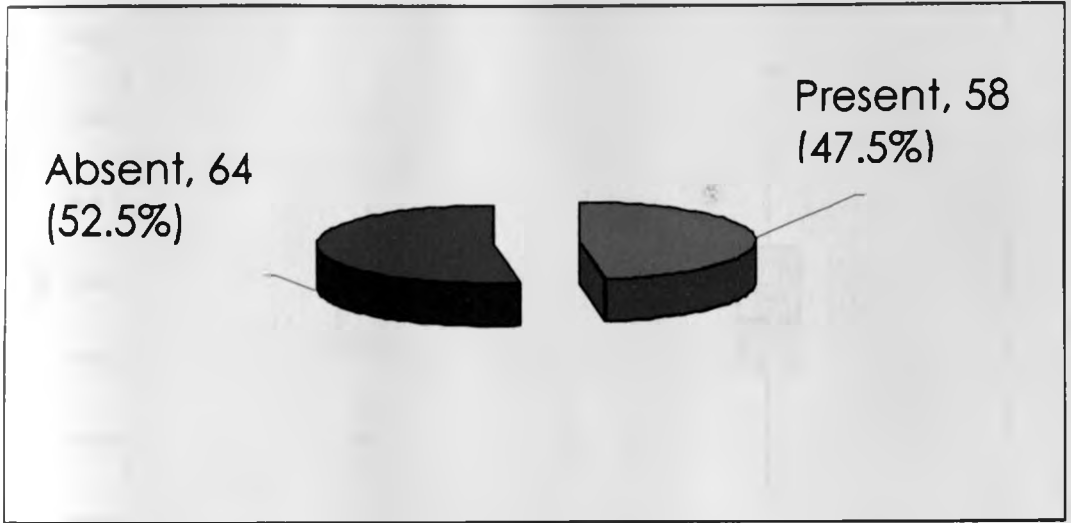
Table 1: Age Distribution of the patients included in the study (n = 122)

Age (in Years)	Frequency	Percentage
< 20	5	4.1
20 – 29	63	51.6
30 – 39	48	39.3
40 +	6	4.9
Total	122	100.0

The majority of mothers 63 (51.6%) were in the 20–29 years age group, followed by 48 (39.3%) mothers in 30–39 years age group, and 6(4.9%) and 5(4.1%) were in above 40 years and below 20 years respectively.

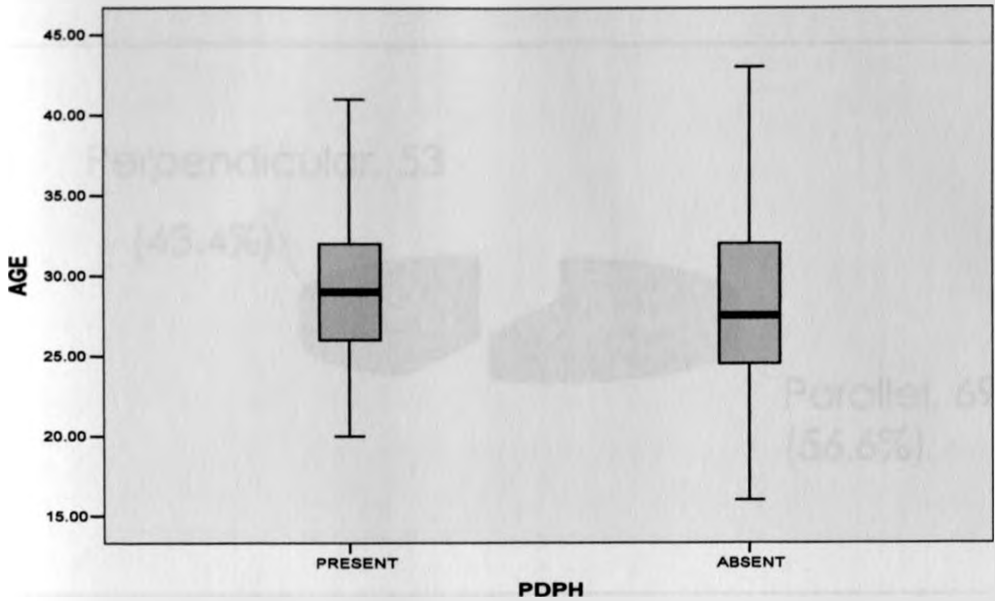
The mean age of the study patients was 29.03 years, median age of 29 years and their ages ranged between 16 and 43 years.

Figure 4: Incidence of PDPH (n = 122)



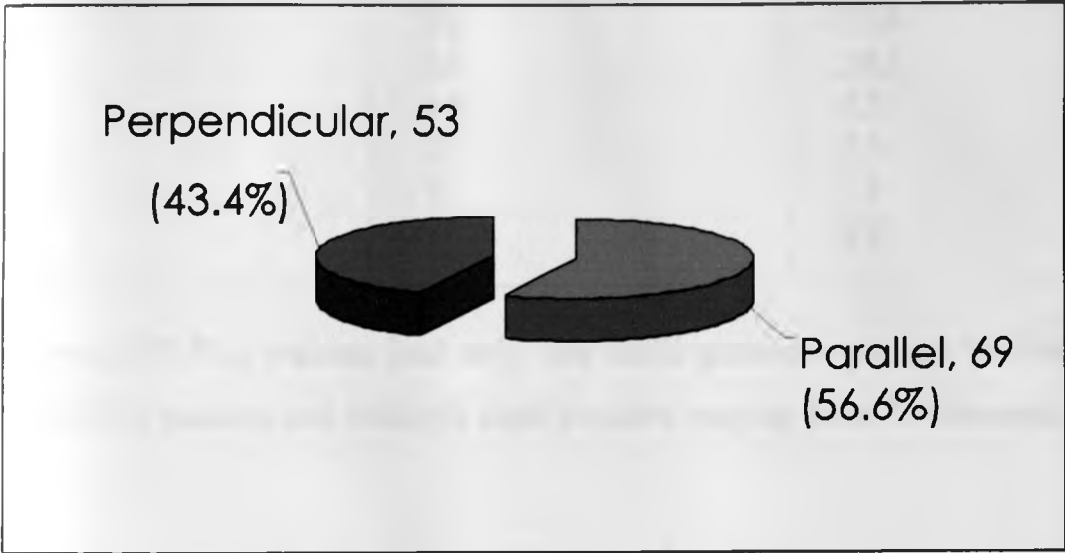
Fifty eight patients, who represented 47.5%, experienced post dural puncture headache. Sixty four patients, representing 52.5%, did not experience any headache.

Figure 5: Age distribution by occurrence PDPH



The mean age of those with Headache was 29.3 years and those without was 28.7 years. There was no statistical significance between the mean ages of the two groups and occurrence of PDPH between the two groups (P-value = 0.931).

Figure 6: Orientation of the Needle bevel in relation to longitudinal dural fibres (n = 122)



Spinal anesthesia performed with the needle orientation in relation to the long axis of the spine was parallel in Sixty nine (56.6%) patients and perpendicular in 53(43.4%) patients. Only Quincke point needles G25 were used to administer spinal anesthesia in all the cases.

Table 2: Distribution of Number of Dural Puncture attempts (n = 122)

Attempts	Frequency	Percentage
1	70	57.4
2	36	29.5
3	10	8.2
4	3	2.5
5	2	1.6
6	1	0.8

Seventy (57.4%) patients had only one dural puncture attempt the rest, 52(42.6%) patients had multiple dural pictures ranging from 2-6 attempts.

Table 3: Occurrence of PDPH and the number of dural puncture attempts

Attempts	PDPH		OR (95% CI)	p-value
	Present, n (%)	Absent, n (%)		
> 1	26 (50.0)	26 (50.0)	1.2 (0.6 – 2.4)	0.639
1	32 (45.7)	38 (54.3)		

Patients who had more than one attempt were 1.2 (0.6-2.4) times more likely to develop PDPH. However, this was not statistically significant ($p>0.05$).

Table 4: Association between the Occurrence of PDPH and Orientation of spinal needle.

Orientation	PDPH		OR (95% CI)	p-value
	Present, n (%)	Absent, n (%)		
Perpendicular	32 (60.4)	21 (39.6)	2.6 (1.2 – 5.3)	0.013
Parallel	26 (37.7)	43 (62.3)		

The frequency of PDPH was related to the direction of the bevel during introduction of the spinal needle. This was statistically significant, p-value 0.013. Patients who were administered spinal anesthesia when the spinal needle bevel was directed perpendicular to the longitudinal dural fibres were 2.6 times (95% CI) more likely to develop PDPH compared to when the needle bevel was oriented parallel. ($p < 0.05$).

Table 5: Onset of PDPH (n = 58)

Attempts	Frequency	Percentage
24 hrs	50	84.5
48 Hrs	7	12.1
72 Hrs	1	1.7
> 3 - < 14 days	0	0

Of the 58 mothers who had PDPH, majority, 50(84.5%) developed headache on day one post dural puncture. Seven (12.1%) mothers developed headache on the second day post dural puncture. Only one (1.7%) mother developed headache on the third day post dural puncture. No mother was noted to have onset of headache after 3days through to the 14th day post dural puncture.

Table 6: Classification of PDPH according to its severity (n = 58)

Attempts	Frequency	Percentage
Mild	17	29.3
Moderate	40	69.0
Severe	1	0.8

Out of the 58 mothers who developed PDPH, 17 (29.3%) mothers had mild headache, majority 40 (69%) mothers had moderate headache and only 10 (0.8%) mothers had severe headache. All the mothers responded well to conservative management of bed rest, good rehydration, IM Opioids and NSAID. The patient who developed severe headache had associated agitation that necessitated the patient to be restrained because she had developed altered consciousness. She too responded well to conservative management. No patient required the use of an epidural blood patch.

Table 7: Other Symptoms associated with PDPH (n = 58)

symptom	Frequency	Percentage
None	46	79.3
Neck stiffness	6	10.3
Nausea	2	3.4
Vertigo	2	3.4
Low Back Pain	1	1.7
Agitation	1	1.7
Blurred vision	1	1.7

Of the 58 mothers who developed PDPH, 46 (79.3%) had no other symptoms associated with PDPH. 12 mothers had at least one symptom associated with PDPH. One mother had both neck stiffness and low back pain. The frequencies of symptoms were as follows: Six (10.3%) for Neck stiffness, two (3.4%) for nausea, two (3.4%) for vertigo, one (1.7%) for low back pain, one (1.7%) for agitation and one (1.7%) for blurred vision.

Discussion

PDPH is a common complication for parturients undergoing neuraxial blockade. Female sex, pregnancy and young age are purported to be associated with increased risk of developing PDPH following dura puncture^{1,2}.

The study has shown the incidence of PDPH in elective C/S patients following spinal anesthesia at KNH. Only Quincke point needles G25 were used to administer anesthesia in all the cases. The Quincke type is the standard needle with a medium cutting bevel and an orifice at the needle tip. In a metanalysis of obstetric studies, Peter et al in 2003, noted that atraumatic needles and smaller diameter needles were associated with lower frequencies of PDPH compared to cutting needles and larger diameter needles respectively³⁷.

The mean age of study patients was 29.3years. This mean age group lies within 18-30 years age group which is associated with the highest frequency of PDPH^{5, 9, 10}. Vallejo et al in their study noted a mean age of 32.1years in the 172 patients in whom spinal anesthesia was performed using G25 Quincke point needles³⁹.

In this study the incidence of PDPH was 47.5%. This is higher than the reported average of 25% associated with the use of G25 Quincke needle. Similar studies have been done in C/S mothers under spinal anesthesia using G25 Quincke point needles. Anju et al noted an incidence of PDPH of 20% in a group of 25 C/S mother in whom G25 Quincke needles were used for spinal anesthesia³⁵. Nafui et al in their study done in a teaching hospital in Ghana (West Africa) noted a much smaller incidence of PDPH

of 4% in a group of 46 C/S mothers in whom G25 Quincke point needles were used³⁸. The above two studies had fewer cases 25 and 46 mothers respectively as compared to our study of 122 mothers. Vallejo et al noted an incidence of PDPH of 8.7% in a group of 172 elective C/S mothers using 25G Quincke needles³⁹. In all the above studies the incidence of PDPH was much lower compared to our study. The incidence of PDPH is related to the size and design of the spinal needle used, the experience of the personnel performing the dural puncture, and the age and sex of the patient^{5, 7, 8}.

The mean age of the mothers who developed headache was 29.3years and for those who did not develop headache was 28.7years. There was, however, no statistical significance in the occurrence of PDPH between the mean ages of the two groups (p-value=0.931). Both the mean age groups lie within the 18-30year young age which is associated with a high incidence of PDPH².

The needle orientation in relation to longitudinal dural fibres during lumbar puncture was parallel in 56.6% and perpendicular in 43.4% of the cases in this study. The frequency of PDPH was related to the direction of the bevel during introduction of the spinal needle. Patients who were administered spinal anesthesia when the spinal needle bevel was directed perpendicularly to the longitudinal dural fibres were 2.6 times (95% CI) more likely to develop PDPH compared to when the needle bevel was oriented parallel. This was statistically significant, p-value 0.013. Lybecker et al had a similar observation³⁰. They noted that the incidence of PDPH among patients in whom the bevel was inserted parallel to the

longitudinal dural fibres was 0.56 times the incidence among patients in whom the bevel was inserted perpendicularly to the longitudinal dural fibres³⁰. It is presumed that parallel orientation separates the dural fibres whereas perpendicular cuts the dural fibres their by creating bigger hole in the dura⁴.

In this study 57.4% patients had only one dural puncture attempt. The rest 42.6% had multiple dural punctures ranging between 2-6 times. Anju et al in their study in a group 25 patients, who had spinal anesthesia using 25G Quincke needles, all had one dural puncture attempt. In their study all the procedures were performed by the same anesthesiologist with enough experience³⁵. In our study different anesthesiologists performed the procedures and some of them with little experience. At the Kenyatta National Hospital, being a teaching hospital, some of the spinal anesthesia procedures were performed by Registered Clinical officer (anaesthesia) students, and junior postgraduate (anaesthesia) students some of whom had little experience. This is reflected in the high frequency of dural puncture attempts noted in this study. However all the procedures were done under the supervision of a senior anesthesiologist. Vallejo et al in their study done in Magee hospital (a teaching hospital like KNH) in a group of 172 C/S mothers who had spinal anesthesia using G25 Quincke needle only 5 patients had 2 dural puncture attempts the rest had one attempt³⁹.

It has been shown that PDPH is more common if two verified punctures into the subarachnoid space are made⁴⁰. Patients who had more than one attempt were 1.2 times more likely to develop PDPH. However, this was

not statistically significant ($p>0.05$). Lybecker et al in their study also did not find any statistically significant association between PDPH and the number of attempted dural punctures ($p=0.091$)³⁰.

In our study, onset of headache occurred in 84.5% of the patients in the first day, 12.1% of patients on the second day and 1.7% on the third day after dural puncture. Anja et al in their study noted that the onset of headache was within 24 hrs to 72hrs after dural puncture³⁵. The onset of headache after lumbar puncture is usually within 24-48hrs after dural puncture, but could be delayed up to 12days⁴. This is consistent with our study.

Of the 58 mothers who developed headache, 40% had moderate headache, 29.3% had mild headache and 0.8% had severe headache. Similar studies have classified headache according to severity. Anja et al in their study, the severity of headache was mild in the entire 9 C/S mother who developed PDPH³⁵. Nafui et al in their study most patients rated their headache as mild to moderate on a 10-cm visual analog scale³⁸. Kuntz et al in their study, of the 107 patients who developed headache, the severity of PDPH on the 1st day of occurrence was mild in 54%, moderate in 31% and severe in 15%³. The criterion for the determination of the severity of headache was different for each of the studies quoted above thus they are not easy to compare though there is some consistency with our study.

Out of 58 mothers who developed PDPH, 11 had at least one symptom associated with PDPH. One mother had both neck stiffness and low back pain. The frequencies of symptoms were as follows: Six (10.3%) for Neck

stiffness, two (3.4%) for nausea, two (3.4%) for vertigo, one (1.7%) for low back pain, one (1.7%) for agitation and one (1.7%) for blurred vision. Ahmed et al in their review on PDPH noted that the following symptoms were associated with PDPH: neck stiffness, low back pain, nausea, vomiting, vertigo and tinnitus and, rarely, diplopia due to cranial nerve palsy and even cortical blindness⁴. This is consistent with our study; however, the association of agitation to PDPH was not mentioned in their review contrary to our study and may have been an isolated incident unrelated to PDPH.

Conclusion.

1. The incidence of PDPH in elective C/S mothers following spinal anesthesia at Kenyatta National hospital maternity theatre was 47.5%.
2. The mean age of elective C/S mother who had spinal anesthesia in our study was 29.3 years. There was no statistical significance between age and incidence of PDPH among the patients who developed headache and those who did not.
3. Orientation of the needle bevel perpendicularly to the longitudinal dural fibres was associated with 2.6 times more risk of develop PDPH compared to parallel orientation. This was statistically significant, p-value 0.013.
4. Multiple dural puncture attempts during administration of anesthesia were associated with 1.2 times more risk of development of PDPH as compared to one dural puncture attempt. However this was not statistically significant.
5. Onset of headache after dural puncture among the patients who developed PDPH occurred in 84.5% on the first day, 12.1%, and 1.7% on the second and third day of the patients respectively.
6. Headache severity was found to be mild in 29.3%, moderate in 69% and severe in 1.8% of the patients who developed PDPH.
7. Out of the 58 mothers who developed PDPH, 12 had other symptoms associated with PDPH; 5 had neck stiffness; 2 had nausea, 2 vertigo, 1 had blurred vision and 1 had low back pain. One mother had both low back pain and agitation.

Recommendations

1. Introduction of small gauge atraumatic spinal needles to be used for mothers undergoing spinal anesthesia in Kenyatta National Hospital may reduce the incidence of PDPH.
2. Anesthesiologists should adhere to directing the needle bevel parallel to the long axis of the spine during lumbar puncture as is provided in the KNH maternity theatre protocol for administration of spinal anesthesia.
3. PDPH in mothers should first be classified according to severity and thereafter managed accordingly.
4. A long term prospective study on the risk factors associated with severity of headache and duration of PDPH in C/S mothers undergoing spinal anesthesia in KNH should be conducted. This will help the anesthetists to minimize the severity of PDPH and to be able to estimate the duration of follow-up for those mothers that will have developed PDPH.

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APPENDICES

Appendix 1: Criteria of post dural puncture headache³⁵.

1. Occurred after mobilization.
2. Aggravated by erect or sitting position and coughing, sneezing or straining.
3. Relieved by lying flat.
4. Mostly localized in occipital, frontal or generalized.

Appendix 2: Table 8 headache severity²².

Mild	No limitation of activity, No treatment required.
moderate	Limited activity, regular analgesic required.
Severe	Confined to bed, anorexic, unable to feed the baby.

Appendix 3: American Society of Anesthesiologist (ASA) Physical status Classification³⁶.

Class I: A normal healthy patient.

Example: 21 year old with mild sports related injury.

Class II: Patient with mild systemic disease.

Example: 46 years old with mild essential hypertension with inguinal hernia. Also includes diabetes mellitus not complicated with organ system involvement.

Class III: Patient with severe systemic disease that is not incapacitating.

Example: Young subjects with diabetes mellitus producing mild chronic renal failure and peripheral vascular disease or patient with moderately severe chronic obstructive pulmonary disease.

Class IV: A patient with incapacitating life threatening systemic disease.

Example: 74 year old man with cardiomyopathy and congestive cardiac failure limiting activity.

Class V: A moribund patient who is not expected to survive for 24 hours with or without operation.

Example: A hypotensive patient with a ruptured aortic aneurism

Class E: A patient undergoing an emergency operation (the 'E' added to the classification number)

Example: Patients with ruptured, ectopic pregnancy or acute appendicitis

Appendix 4: Quality of evidence ratings for therapeutic modalities²

Class I. Evidence provided by one or more well-designed randomized controlled clinical trials.

Class II. Evidence provided by one or more well-designed clinical studies, such as case-control, cohort studies, etc.

Class III. Evidence provided by expert opinion, nonrandomized historical controls, or reports of one or more.

Appendix 5: Consent Explanation

My names are Dr Samuel Muhumuza, a postgraduate student in anesthesia at the University of Nairobi. You will undergo an elective C/S under spinal anesthesia. I am doing a study of which you are about to be explained to in full details before agreeing to participate in it.

Study

The purpose of the study is to assess the incidence of post dural puncture headache in elective C/S patients following spinal anesthesia at KNH.

What is PDPH?

This is the headache which can occur any time within 2weeks after spinal anesthesia. It is a common minor complication which the anesthetist aims at preventing. Although different prevention methods have been used to reduce its incidence it still continues to occur. This is why more research continues to be done in order to prevent it.

Reasons for the study

The incidence of PDPH after elective C/S following spinal anesthesia is known in some hospitals elsewhere. We do not know the incidence of PDPH after elective C/S following spinal anesthesia at KNH.

The finding of this study will be used to suggest means of further reducing the incidence of PDPH and to improve the existing methods of management of PDPH.

Participation in the study

Your participation in this study will be voluntary and you can decide to withdraw at any stage without any penalty.

The study is purely observational, non invasive and there will be no cost associated with participating in the study.

Participating in this study will not interfere with the regular management before, during, and after operation.

Study approval

This study is conducted with the approval of the Kenyatta National Hospital scientific and Ethical Review committee.

Procedure

The principal investigator will give you the explanation of the study. The anesthetist who will administer spinal anesthesia will also collect data, before and during operation on behalf of the principal investigator. Post operatively you will be followed up by the principal investigator, to assess PDPH; every day till you are discharge from hospital and you will be contacted on phone on 14th day post operatively to evaluate for late onset headache.

Confidentiality

Your identity will be protected with utmost confidentiality during the study and only initials will be used in reference to the participants of the study

Thank you.

Appendix 6: Consent Form

I.....have understood the explanation of this study:

‘INCIDENCE OF POST DURAL PUNCTURE HEADACHE IN ELECTIVE CESAREAN SECTION PATIENTS FOLLOWING SPINAL ANESTHESIA AT KENYATTA NATIONAL HOSPITAL’ from Dr Samuel Muhumuza

I freely choose to participate in this study and I understand that whether or not I participate will not affect the care that I will receive. I also understand that I may at any point choose to withdraw from the study.

Signed.....

Date.....

Witnessed.....Date.....

Appendix 7: Consent Form (Kibali Cha Ruhusa)

Mimi,....., nimeelewa kuhusu utafiti huu;

‘ INCIDENCE OF POST DURAL PUNCTURE HEADACHE IN ELECTIVE CESAREAN SECTION PATIENTS FOLLOWING SPINAL ANESTHESIA AT KENYATTA NATIONAL HOSPITAL’ kutoka kwa Dr Samuel Muhumuza.

Ninakubali kuhusika kwa utafiti huu, na ninaelewa kuwa nisipokubali ama nikikubali, hautabadilisha matibabu yangu. Pia ninaelewa ya kwamba ninaweza kujitoa kwa utafiti huu wakati wowote.

Signed.....

Date.....

Witnessed.....Date.....

Appendix 8: Data Sheet Form

Section A: Patient Identification

Serial number.....In patient number.....

Name.....Date.....Contact Telephone number.....

Section B: Sociodemographic Data

Age in years.....Sex..... Parity

Section C: Maternity Theatre Data

Time at which the spinal anesthesia is given.....

Spinal needle used a) Type (design)..... b) Size.....

Orientation of the needle bevel to the long axis of the spine.

a) Parallel...b) perpendicular..... (Tick where appropriate √)

Number of dural puncture attempts.....

Section D: Follow Up Data In Maternity Wards.

(Tick where appropriate √)

PDPH is a) Present..... b) Absent.....

Time of onset of PDPH after spinal block. (Tick where appropriate √)

a) Within the 1st 24hrs..... b) After 24hrs within 48hrs..... c) After 48hrs within 72hrs.....

d) After 3 days within 14 days.....

Severity of headache (as per appendix 2): (Tick where appropriate √)

a) Mild.....b) Moderate.....c) Severe.....

Other symptoms associated with post dural puncture headache:

a) Neck stiffness.....b)Low back pain..... c)Nausea.....

d)Vomiting..... e) Vertigo.....f) Tinnitus..... g) Doplopia.....



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15th April 2009

Ref: KNH/UON-ERC/ A/202

Dr. Muhumuza Samuel
Dept. of Surgery
School of Medicine
University of Nairobi

Dear Dr. Muhumuza

Research proposal: "Incidence of Post Dural Puncture Headache in Elective Cesarean Section Patients Following spinal Anesthesia at Kenyatta N. Hospital" (P306/11/2008)


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 15th April 2009 –14th April 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

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