MANAGEMENT OF SEVERE HEAD INJURY AT THE KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNIT; REVIEW OF PRACTICE AMONG CRITICAL CARE PRACTITIONERS

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A DISSERTATION PRESENTED IN PART FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTERS DEGREE IN ANAESTHESIA, UNIVERSITY OF NAIROBI

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DECLARATION

I declare that this research thesis I is my original work and has not been submitted for a degree award in any university.

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This proposal has been submitted for the degree of Masters of Medicine in Anesthesiology with ~~my~~ approval as a university supervisor.

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DEDICATION

To my family and especially my parents who taught me to draw my strength from God and not from men,

Peter & Edith Bhoyyo

ACKNOWLEDGEMENT

A famous quote from the bible goes 'To whom much is given, Much shall be expected'. This belies the fact that we are constantly drawing from the wells around of those who have walked in the very same steps we now take.

Sincere appreciation goes to my supervisor Dr. P. Olang' for his guidance in the formulation of my thesis, Dr. T. Chokwe for his tireless efforts to ensure we all succeed and to my Post Graduate colleagues…you're the best.

Finally my gratitude also goes Mr. Robinson Njoroge my able statistician and the Kenyatta National Hospital, Ethics and Research Committee for enabling me carry out the study.

ABBREVIATIONS

BTF - Brain Trauma Foundation

CCU - Critical Care Unit

CSF - Cerebrospinal Fluid

EEG - Electroencephalograph

GCS - Glasgow Coma Score

ICP - Intra-cranial Pressure

KNH - Kenyatta National Hospital

mmol/lt- millimols per liter

mmHg - millimeters of Mercury

mOsm/kg H2O – milliosmoles per kilogram of water

MRI - Magnetic Resonance Imaging

SHI - Severe Head Injury

SHO - Senior House Officer

SIADH- Syndrome of Inappropriate Antidiuretic Hormone secretion

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SUMMARY

Severe head injury represents a major contributor to patients in the CCU where their care falls under a multi-disciplinary team requiring immense resource utilization. Currently about 20% of mortality in the Kenyatta National Hospital, Critical Care Unit (KNH-CCU) can be directly attributed to severe head injury. Outcome of care heavily depended on the correct management of secondary insults after the initial injury which must begin at the primary trauma survey.

The objective of the study was to review the current management of patients with severe head injury in the critical unit by the anaesthesia and neurosurgery practitioners, and to compare it with recommended Brain Trauma Foundation guidelines on the care of severely head-injured patients.

The study was a cross-sectional, survey in which a self administered questionnaire was used to collect data from critical care practitioners in Kenyatta National Hospital Critical Care Unit. Consent was duly obtained prior to the study from each of the participants who comprised both anesthesia and neurosurgery practitioners, and there were both consultants and senior Post Graduates students in each category.

Data from the 53 practitioners sampled mainly focused on various aspects of severely head-injured patient care. Majority of practitioners comprised the anesthesia providers. The Glasgow Coma Scale was found to be a key clinical assessment and evaluation tool among 80% of participants sampled. On further evaluation of key secondary insults contributing to poor outcome, responses were compared to Brain Trauma Foundation guidelines and the survey revealed only 20% of practitioners correctly managed hypotension. Hypoxia was correctly managed by 69% and blood glucose and carbon dioxide levels were 63% and 54% respectively. Key challenges in patient care revealed many resource limitations with limited CCU bed space and delayed surgical intervention standing out.

Conclusions and Recommendations:

Severe head injury management in the KNH-CCU did not meet recommended international guidelines (BTF) and a protocol was necessary to guide current management practices.

1.0 INTRODUCTION AND LITERATURE REVIEW

The Kenyatta National Hospital (KNH) is the leading teaching and referral hospital in Kenya. Critical care support has been, and still is considered part of the anaesthesia practitioners' domain.

Severe head injury (SHI) only represents a minority sub-set of patients from a larger group with head injury, with distinction of severity made on the basis of the Glasgow Coma Score. From medical records review at KNH, head injury patients represented about 0.02 % of all admissions to the hospital in 2008. Of these head injured patients, about 50% were admitted to the critical care unit where their specific mortality rate was noted to be 17% with the overall mortality rate for the critical care unit being 44%[1]. It can be seen that head injury remains a major cause of preventable death and morbidity in young adults especially.

Clinical outcome of such patients remains varied and dependent on a host of factors. Focus of the critical care giver has been firmly grounded on management of secondary insults to the brain, following the initial trauma event[2]. These insults are best prevented rather than treated, and have been the subject of many research studies on critical care of traumatic brain-injured patients. Rapid evaluation and initiation of therapy are life saving for patients with SHI[3].

Recognized principles of management of SHI are applied within the critical care unit (CCU), with each member of the multi-disciplinary team augmenting the role of the other. Current management strategies in KNH-CCU have not been subjected to such a review, which will help highlight roles of other specialty professions to avoid over-dependence on the anaesthesia practitioner.

Head injuries may be classified in various ways such as nature of insult - penetrating vs blunt; concomitant - isolated vs multiple trauma; and timing – primary vs secondary. Primary injuries occur at the site of trauma and are beyond the control of the critical care provider. Secondary injuries refer to any added insults that augment the initial injury, and it is this point that remains the focus for intensive therapy in the CCU[2]. These insults include cerebral ischemia, increased intra-cranial pressure (ICP), systemic hypotension, hypoxia, hyperpyrexia, hypo/hypercapnia and hypoglycemia, all of which have been shown to independently worsen survival after SHI[4].

The Glasgow Coma Score[5] (GCS) still remains the universally applied method to assess the severity of head injury and will be used in this study. The overall score is predictive of outcome but the motor component remains most predictive of the three modalities assessed (*Appendix 1).*

Other scoring systems such as the Virginia Prediction Tree[6] take into account variables not assessed by the GCS such as the level of consciousness to strengthen overall predictions made. Drug intoxication, hypoxia, hypotension or hypothermia among other confounders may depress initial scores[4].

PATHOPHYSIOLOGY OF SEVERE HEAD INJURY

It will be in order to review mechanisms of cranio-cerebral trauma as an initial event in complex sequelae that follows severe head injury[2,7]. The primary brain injury is the result of direct mechanical damage that occurs at the time of trauma. Most injuries arise as a result of road traffic accidents, which cause acceleration-deceleration injury. Mechanism of injury occurs via transfer of energy to the cranium and its contents. In blunt injury, shear strains created by angular acceleration-deceleration forces result in diffuse axonal injury whose physiologic hallmark is loss of consciousness. The cranial impact may either give rise to a concussion, in which a brief loss of consciousness is not followed by obvious neurologic sequelae, or coma which is clinically defined as a deeper state of unconsciousness.
Acceleration-deceleration forces when severe may lead to lacerations and/or contusions and other compound injuries. Gross lesions may underlie sites of blows (*coup* contusion) or at sites remote from the site of impact (*contrecoup* injury). Direct injury commonly disrupts the cranial vault and adjacent meninges with its associated structures. Skull fractures are of importance as they trigger epidural bleeding and compound varieties may serve as a port of entry for infective agents[7].

Penetrating injuries produce direct disruption and laceration of brain tissue with almost similar results as for direct injury but of varied severity. Disruption of blood vessels commonly results in mass lesions due to accumulated hemorrhage[7].

SECONDARY BRAIN INJURIES

Secondary brain injury occurs after the initial trauma and is defined as the damage to neurons due to the systemic physiologic responses to the initial injury[2], which remains the ultimate focus for critical care support. Clinical management is firmly grounded on successful prevention, detection and treatment of secondary insults to the injured brain[2]. These processes may be initiated at the time of injury or at any point thereafter, and will always tend to worsen the already existing injury. A number of biochemical processes have been postulated to contribute to propagation of neuronal injury[7]. They initiate an inflammatory cascade which results in worsening edema with vasogenic, cytotoxic and osmotic components. Some of the biochemical markers that have been found to contribute greatly include glutamate, aspartate, cytokines as well as free radicals[8].

Incidence of secondary injury is in direct proportion to severity of primary injury, but this does not exclude the possibility of seemingly minor primary injury leading to devastating subsequent secondary phenomena such as an unchecked intracranial hematoma leading to death. Neurologic disturbance produced by the primary insult tends to be maximal at the onset after which a stable post injury phase follows, in which the deficits may show some resolution. Secondary insults on the other hand will invariably worsen neurologic status of the patient, but more important is the fact that these insults are preventable or treatable[9]. Common insults include intra-cranial bleeds, hypoxia, ischemia, increased intra-cranial pressure, infection, electrolyte and metabolic derangements.

Intracranial hematomas are classified according to anatomic site within the brain or in relation to meningeal membranes. As they enlarge, they produce compression of adjacent structures as well as shifts in brain tissue. Subsequent rises in ICP tend to exhaust the volume buffering capacity of the cranial contents[9].

Hypoxia may follow central depression of respiration as a result of reduced levels of consciousness, or direct injury to thoracic respiratory apparatus, or neurogenic, pulmonary edema or combinations of the above.

Ischemia is closely related to hypoxic injury but represents a more localized sequence of events leading to regional (brain) hypoxia. Focal ischemia at sites of contusion may follow traumatic sub-arachnoid hemorrhage, which induces vasospasm. Global ischemia may also occur and may follow systemic hypotension or reduction in cerebral perfusion pressure due to increased ICP. Systemic hypotension at admission is associated with an almost 150 % increase in mortality in such patients with SHI[10]. Threshold for hypotension has been taken as mean arterial pressure of below 90mmHg[11]. Hypotension and hypoxia are major contributors to secondary brain injury, both of which greatly augment each other. They may occur during the early post traumatic period and serve as the major determinants of outcome according to Miller and colleagues[12]. These findings have been further evaluated and validated by the Traumatic Coma Data Bank study[5] which demonstrated that pre-hospital hypotension was an independent predictor of poor outcome. During the first 24 hours after severe head injury cerebral blood flow is less than half that of normal subjects and may approach ischemic threshold [13].

Other secondary complications of traumatic brain injury include infections and electrolyte disturbances. Local infections tend to follow penetrating injuries which disrupt skull and/ or brain tissue. They may also be iatrogenic, especially with the use of invasive, intracranial devices. Systemic infections typically involve the respiratory, genitourinary and skin (especially with open wounds). Resolution of infection may result in improvement of neurologic outcome.

Electrolyte disorders are common with those affecting sodium levels being of a higher incidence. These include syndrome of inappropriate anti-diuretic hormone secretion (SIADH), cerebral salt wasting syndrome; iatrogenic causes, diabetes insipidus among others[9].

Severe head injuries also induce a generalized state of catabolism with net loss of nitrogen. This creates a strain on endogenous metabolic reserves with negative effects on the patient's nutritional status. Catecholamine-induced cardiovascular effects increase oxygen demand, and myocardial ischemia may be a possible occurrence following closed head injury[9].

MANAGEMENT OF SEVERE HEAD INJURY

PRIMARY TRAUMA SURVEY

Concomitant spine injury has been found to occur in up to 60% of cases of SHI so cervical spine immobilization should be borne in mind. This is then followed by ensuring an adequate airway and breathing, then appropriate volume resuscitation which may require wide bore vascular access. The ABC of resuscitation[14] aids in avoiding both hypoxia and hypotension, two of the most important secondary insults known to occur early in the course of SHI. In addition, a primary neurologic survey assesses both the level of consciousness as well pupillary characteristics.

SECONDARY TRAUMA SURVEY

After the ABCD's of resuscitation are adequately achieved, a full neurologic examination is then carried out[14]. The best GCS score after resuscitation is thought to give the most useful SHI classification and carries prognostic significance[5]. The overall score should take into consideration the presence of other confounders that may depress initial scores such as chronic diseases, intoxications, hypotension, hypothermia among others[4].

INITIAL MANAGEMENT

Preventive strategies basically involve avoidance of both hypoxia and hypotension, correction of surgically amenable injuries and finally, identification and management of concomitant insults.

As part of early ventilatory intervention, intubation of patients with a GCS of 8 and below is considered standard in maintaining a viable airway. Up to 50% of patients in a retrospective case control study were found to have varying degrees of hypoxia in the field, which was a major contributor to morbidity and mortality. Therefore early intubation where indicated must be adhered to [14]. Pre-cautionary measures to reduce risk of inadvertent pulmonary aspiration of gastric contents as well as blunting of stressor responses during intubation, must be considered.

Hyperventilation should be a short term intervention, as other measures to reduce ICP are put in place. Skippen and colleagues[16]found out that in some cases, the vasoconstriction induced by hyperventilation aggravates brain ischemia; after SHI, cerebral blood flow is reduced to about half that of normal brain in the first 24 hours. Muizelaar and group[17], in a prospective randomized clinical study, further found out that hyperventilation was associated with a worse neurologic outcome compared to patients in whom normocapnia, which is the recommended standard, was maintained (35-40 mmHg).

Restoration of effective circulatory volume and blood pressure is also a principle step in management of SHI. According to the Brain Trauma Foundation (BTF) guidelines, a desirable mean arterial pressure (MAP) is equal to or above 90mmHg, with cerebral perfusion pressure (CPP) maintained at 70mmHg or above, and the threshold for diagnosing increased intracranial pressure (ICP) being above 20mmHg sustained for above five minutes[17].

Previous guidelines recommended varying degrees of dehydration to reduce cerebral edema, which was thought to overlook the importance of CPP in preventing secondary brain ischemia. Furthermore, cerebral water content and cerebral edema were not altered by hydration status as found in experimental conditions[18]. *Mannitol* has been used for its volume depleting diuretic effect. Some authorities reserve its use for cases where signs of transtentorial herniation have been demonstrated.

Computed tomography of the head is still considered a key diagnostic and management tool in acute head injury. It should be strongly considered in all patients with a GCS below 15 with loss of consciousness; an amnestic episode; focal neurologic deficits and those with basilar and/or depressed skull fractures [7].

MANAGEMENT IN THE CRITICAL CARE UNIT

Head injury management in the CCU is focused on preventing, detecting and correcting secondary insults. Girling outlined five key principles that should guide the ongoing management of the head injured patient in the critical care unit as normotension, normoxia, normocapnia, normothermia and normoglycemia[2]. Electrolyte homeostasis may also be added to this group for completion, with special emphasis on normal serum sodium. General nursing care must also be optimized for maximum benefit of the entire care package.

There is insufficient data to make recommendation for one pressor agent over another, but the principle aim remains a mean arterial pressure of at least 70mmHg, which is consistent with optimal cerebral perfusion targets. Central venous pressure has been strongly disputed by some authorities as an end point measure to guide fluid replacement as there is no correlation between it and intravascular volume[19,20].

Invasive hemodynamic monitoring may be required due to the fact that some agents have the potential for cerebral vasoconstriction which may adversely affect cerebral blood flow, an undesired end result. More recent studies have found benefits in the role of *L-arginine* as a cerebral vasodilator in an attempt to address the above concerns[21].

Hypoxemia is defined as oxygen saturation of less than 90% and is associated with a worsened outcome. Ventilation of patients with SHI should be optimized to achieve both normoxia at levels above 70mmHg and normocapnia. Oxygen loading is dependent primarily on hemoglobin concentration, position of the oxygen-hemoglobin dissociation curve and oxygen saturation. Current guidelines call for use of the lowest level of positive end-expiratory pressure that maintains adequate oxygenation and prevents end-expiratory alveolar collapse where possible[22]. When not possible, a compromise is made in favor of the brain to avoid hypoxia. Inadequate analgesia and/or sedation contribute to increased oxygen demand, despite patients having depressed levels of consciousness. Continuous pulse oxymetry is a standard and serial arterial blood gas analysis should strive to maintain oxygen saturations above 94%.

Muscle paralysis has been used to optimize ventilation in limited circumstances. Its application however, should clearly take into account risks and possible benefits to the patient on an individualized scale[7].

Normothermia is another target in management of patients with SHI. Management of fever should be actively and aggressively done as it increases cerebral blood flow, cerebral metabolic oxygen requirements and oxygen utilization. Achieving normal temperatures may involve use of pharmacologic as well as physical means[2].

The brain is an obligate glucose user. Decreased cerebral blood flow occurs following SHI resulting in an increase in anaerobic metabolism, which is worse in hyperglycemia which on its own is associated with an increase in cerebral metabolism. Dextrose infusions should be avoided whenever possible and target blood sugar levels should lie between 4-8mmols/l. SHI results in a generalized hyper-metabolic and catabolic state. Early enteral nutrition maintains the gut mucosal integrity, boosts immuno-competence[23], and attenuates the metabolic response to stress[7].

Routine stress ulcer prophylaxis has been used to avoid erosive gastric lesions common in such patients following traumatic injury to the head.

All the five key principles of care of SHI patients as summarized by Girling[2] can be offered in any intensive care unit, but additional monitoring may be helpful in guiding management. ICP monitoring falls under this category, as up to 60% of patients with SHI were found to have varying levels of increased ICP[24/25]. BTF guidelines suggest that there are inadequate data to make ICP monitoring a treatment standard; though at the same time its importance should not be dismissed entirely.

Hyponatremia is not uncommon in the course of SHI. Aetiology as well as treatment modalities differ (*Appendix 3*). Hyponatremia and hypomagnesemia lower the seizure threshold, and in experimental brain injury hinders recovery in the latter. Hypernatremia may also occur in the course of SHI management.

Deep vein thrombosis and pulmonary embolism are frequent complications in head-injured patients. The incidence of DVT in patients with SHI not on thromboprophylaxis is reported to be as high as 54%[26]. Prophylaxis is relatively contraindicated in SHI but may be used 72 hours after injury if clotting tests are normal. Sequential compression devices should be used whenever possible, in all patients with SHI[7].

Control of raised intracranial pressure can be achieved by a number of supportive measures[2/9]. Propped-up position of about 30^0 improves venous drainage and reduces ICP. Venous outflow from the brain should not be obstructed. This elevation has also been shown to lower ICP without reduction in cerebral perfusion pressure and/or blood flow, and to reduce the risk of ventilator associated pneumonia[27].

Deep sedation up to a Ramsay score (*Appendix 2*) of about 6 has been found to reduce cerebral metabolism.

Short term hyperventilation may be used to gain control while other methods (e.g. *mannitol*) are given time to take effect especially in rapidly deteriorating patients; or during therapeutic or diagnostic procedures to stem rises in ICP [7].

A serum osmolality of 310-320 mOsm/kg H2O is targeted and may involve the use of various osmotic agents. *Mannitol*, a hyperosmotic agent is typically used.

All forms of seizure activity tend to increase cerebral metabolism and ICP. Seizure prophylaxis according to American College of Chest Physicians[7] (2002) should be administered to patients with SHI for 7 days post injury, with *phenytoin* being the typical agent used.

There is evidence that temperatures below 35°C will impair brain oxygenation, but generally there is agreement that cooling will result in decrease in ICP.

Surgical means include cerebrospinal fluid drainage, craniectomy and lobectomy being the commoner ones.

Alternative head injury protocols have also been studied. Rosner and colleagues[28] adopted the use of a cerebral perfusion pressure (>70mmHg) targeted approach rather than an ICP oriented one. Another study by Swedish neurocritical care physicians in Lund[29], after further evaluation, discredited the Rosner group and proposed a unique treatment modality based on ICP modulation. Cruz and associates[30] focused on use of jugular bulb oxyhemoglobin saturation. This jugular bulb protocol aimed at maintaining normal ICP and cerebral perfusion pressures, as well as normal coupling between cerebral blood flow and oxygen consumption-to normalize cerebral oxygen extraction.

These additional modalities are often expensive, time consuming and generally practical only in the research setting. Girling[2] in his review quotes the CPP-oriented protocol as the most widely used and accepted protocol, though use of multi-modality monitoring has its role in certain situations.

2.0 JUSTIFICATION

Severe head injury is a major cause of morbidity and mortality in the critical care unit. In 2008 1001 patients were admitted to Kenyatta National Hospital, critical care unit, with severe head injury contributing almost 40% of the deaths in the unit, and 25% of total deaths due to severe head injury in the hospital in general.

Challenges in the management are related to the prevention, detection and treatment of secondary insults to the brain. Whatever the form of the insult, the net result is a decline in neurological picture, with avoidance of hypoxia and hypotension standing out as key principles in the pathway to achieving success. The clinical course of severe head injury is very dynamic with continually changing pathological processes. The secondary insults that unfold in the ensuing period after the initial trauma, therefore, require a combined effort of a multi disciplinary team to face up to the challenge of providing optimum care to severely head-injured patients. This involves immense resource utilization far beyond critical care support already in place. Various protocols of management do exist worldwide, but emphasis is laid upon application of key principles of management which allows for comparison with other critical care units. These principles primarily aim to achieve and maintain normal limits in most if not all clinical parameters assessed.

No such study has been done to assess current management of severe head injury in KNH-CCU, and this review will aid to highlight the challenges faced. It will not only strengthen efforts in improving the outcome of managing such patients, but also provide a basis for further research on the dynamic subject of traumatic brain injury, and practical ways of improving the current working protocols.

3.0 OBJECTIVES

Research question:

How is the management of severe head injuries by practitioners at the critical care unit, Kenyatta National Hospital?

Broad Objective

To describe, the practice of severe head injury management by critical care unit practitioners, in Kenyatta National Hospital.

Specific Objectives

1. To review the supportive care of patients with severe head injury by Anaesthesia practitioners in the critical care unit, Kenyatta National Hospital.
2. To review the supportive care and monitoring of patients with severe head injury by Neurosurgery practitioners in the critical care unit, Kenyatta National Hospital.
3. To identify challenges faced by critical care practitioners in the management of patients with severe head injury in the critical care unit, Kenyatta National Hospital.

4.0 METHODOLOGY

Study design

The study was designed as a cross-sectional study that involved the administration of questionnaires to critical care practitioners at the Kenyatta National Hospital.

Study site

The study was carried out at the Kenyatta National Hospital, a tertiary care, university affiliated hospital. It remains the main level 6 referral institution in Kenya, with the largest critical care unit with a 21 bed capacity. About 1000 critical care patients were seen at the institution with severe head injury representing about 20% of the critically ill patients in 2008.

Target population

Anesthesia and neurosurgery practitioners at Kenyatta National Hospital, Critical Care Unit comprised the study population. They included consultants in both specialties and senior residents studying for their Masters degree in either anesthesiology or neurosurgery programs. The consultants included 25 anaesthesiologists and 9 neurosurgeons. The post-graduate students included 17 senior residents in the anesthesia program; while the neurosurgery program included 2 senior registrars and 5 senior residents.

Sample size

A minimum sample size of 58 practitioners was considered sufficient to describe management at the critical care unit, Kenyatta National Hospital with a 95% confidence and an accuracy margin of +/- 5%. Given the paucity of data on the management of severe head injuries in KNH, the survey sample size calculation that was associated with the largest sample size of practitioners needed was applied.

In this study the sample size was calculated using the formula[31].

$$n = \frac{z^2 pq}{d^2}$$

where

n was the sample size

z was the standard normal deviation at the required confidence level, which was *1.96* p was the proportion in the target population estimated to have characteristics being measured. Since the current management practices were not known, a conservative p value of 50% (0.5) was used to yield the largest sample size.

q was 1-p=0.5

d was the level of statistical significance set = 0.05.

Therefore:

$$n = \frac{(1.96)^2 \times (0.5) \times (0.5)}{(0.05)^2}$$

$$=384$$

Finite Population Correction (FPC) Factor:

From a head count there were a total of 58 practitioners in the critical care unit. Since the calculated sample size above was over 5% of the study population (N) the formula for finite population correction (FPC) factor was applied[32]. The sample size equation solving for *n* (new sample size) when taking the FPC into account was:

$$n = \frac{n}{1+n/N}$$

ere

n = the desired sample size after Finite Population Correction Factor was applied

n = the desired sample size (when the population > 10,000) which was 384 from the above calculation

N = the estimate of the population size, included both practitioners in anaesthesia and neurosurgery in KNH. The consultants included 25 anaesthesiologists and 9 neurosurgeons. The post-graduate students included 17 senior residents in the anesthesia program; while the neurosurgery program included 2 senior registrars and 5 senior residents. This gave a sum total of 58.

Calculating the new sample size for PIs_1 using the formula above, was found to be:

$$n = \frac{384}{1+(384/58)}$$

$$= 57.92$$

Therefore the desired sample size for the study was 58 critical care practitioners.

Sampling

Participants in this study were recruited using the stratified random sampling method due to the heterogeneity of the critical care practitioners. They were stratified according to professional cadre by which a sampling frame of all the practitioners was developed. After division of the study population into groups, individual participants were recruited randomly. The principal investigator then approached and enrolled the practitioners who fit the inclusion criteria.

Inclusion criteria was:

1. Senior postgraduate residents undertaking their Masters of Medicine in anaesthesiology.
2. Senior postgraduate residents undertaking their Masters of Medicine in neurosurgery.
3. Consultant Anesthesiologists working in Kenyatta National Hospital.
4. Consultant Neurosurgeons working in Kenyatta National Hospital.

Exclusion criteria was:

1. Those declining to participate in the study.
2. Junior postgraduate residents in both Anaesthesia and Neurosurgery programs.

Data collection procedure and tools

A close ended questionnaire (*Appendix 6*) was filled by the selected participants working in the critical care unit, after informed consent was obtained. All questionnaires were administered by the principal investigator and information in data forms verified thereafter for completeness. The participant was then requested to submit the questionnaire back to the investigator on the same day. The data was then recorded electronically, analyzed and presented in both graphical and text formats.

Data management

After obtaining informed consent, questionnaires were administered to the randomly selected participants. The data was then stored in an SPSS database in a password protected computer. All data was backed-up in an external hard drive. Data quality was maintained by conducting consistency and range checks by the study statistician. In order to maintain confidentiality of the respondents, they were not required to enter their names onto the questionnaires.

Data analysis

Demographic data:

Demographic data of the study participants was presented in tabular form. These data included age, gender, and professional cadre among others.

Data on management aspects of severe head injury:

These data collected were categorical. The various aspects of severe head injury management were in the form of proportions and were presented in form of tables, bar graphs and pie charts. Statistical Package for Social Sciences (SPSS) *Version 15* software was used in all analysis.

Data dissemination

The study provided data on the management practices in severe head injury in CCU-KNH. The results of this study was disseminated to fellow colleagues and the Kenyatta National Hospital/University of Nairobi, Ethics and Research Committee, and was intended to create awareness on the critical care management of severe head injury. It is also anticipated that the results of the study may be published in a regional journal or other appropriate forum.

Ethical considerations:

1. The nature and purpose of the study was explained to the participants in the study and consent obtained.
2. The study had no harmful effects on the participants, patients or the hospital in general.
3. Confidentiality was maintained at all stages of the study.
4. Approval for the study was sought from Kenyatta National Hospital-University of Nairobi, Ethics and Research Committee prior to the whole exercise.
5. There were no cost implications to the participants at any point during the study.
6. Findings from the study were availed to the Ethics Committee of KNH and the University of Nairobi.

5.0 RESULTS:

Respondents in the survey comprised practitioners in both anesthesia and neurosurgery professions. Figure 1 illustrates the gender distribution with females comprising 28% and males 72% respectively. Neurosurgery was made up only of the males but both genders were present in anesthesia, with males being more than the females.

Fig 1:GENDER DISTRIBUTION OF RESPONDENTS

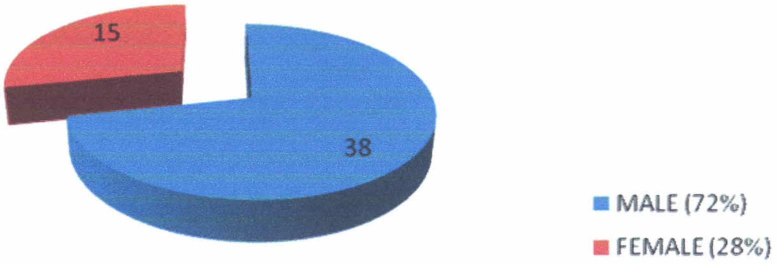
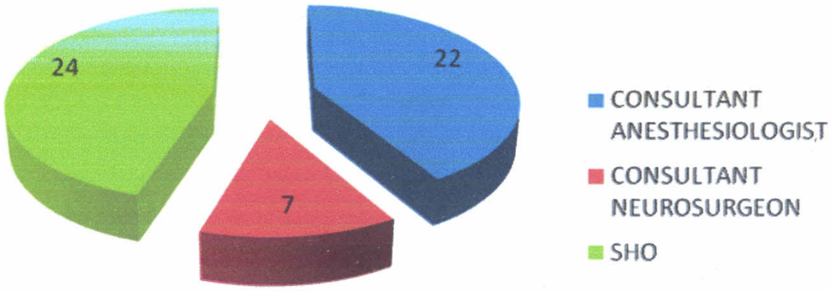


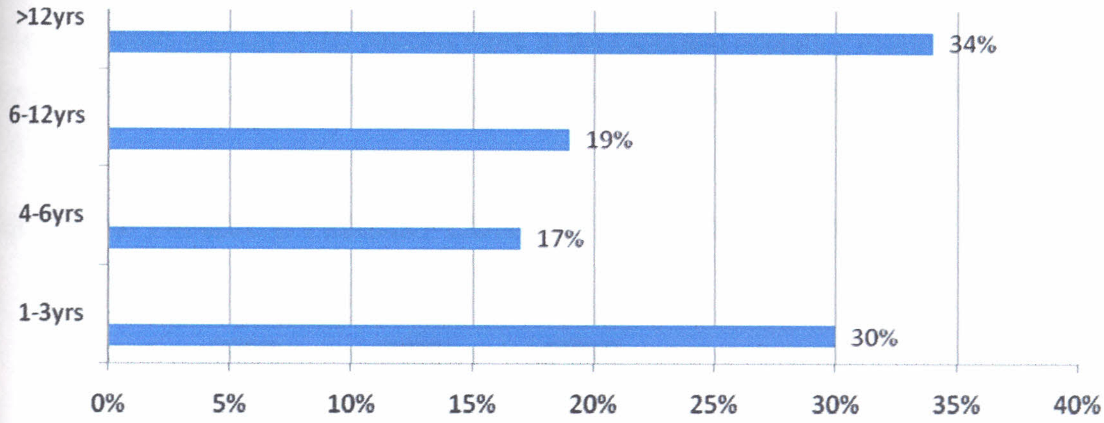
Figure 2 illustrates the cadres of the practitioners sampled. The SHO's had representation in both anesthesia and neurosurgery, and they comprised 45% of the sample surveyed. Consultant anesthetists and neurosurgeons were 42% and 13% respectively. Total number of practitioners sampled was 53, representing a 91% response rate of the calculated sample.

Fig 2:PROFESSIONAL CADRE



The practitioners sampled had varying levels of experience with regard to the management of SHI as illustrated in Figure 4. 34% of the respondents had over 12years experience; 30% had experience ranging between 1 -3 years, while within the 4 – 12 year categories were 36%.

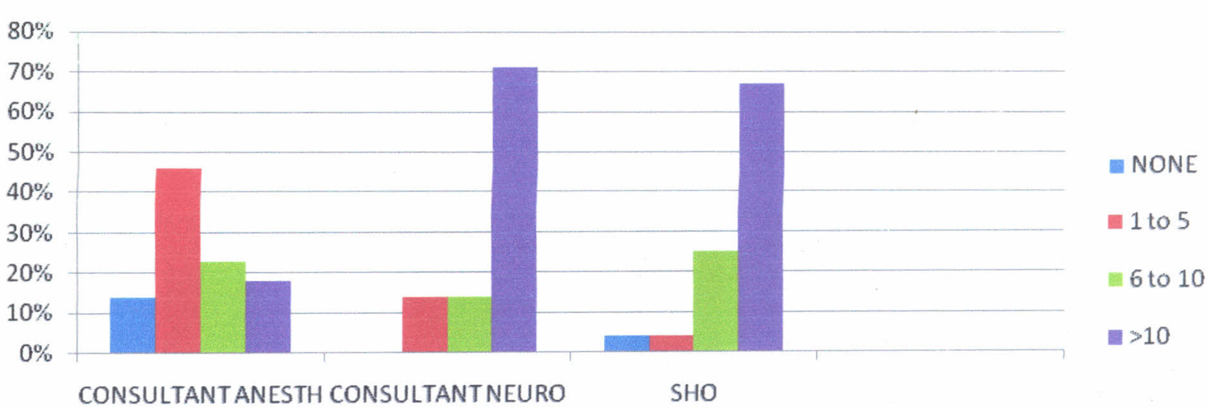
Fig 3:YEARS OF MANAGING PATIENTS WITH SEVERE HEAD INJURY



Data was collected on the approximate number of patients with SHI managed in a month, and Figure 5 illustrates the distribution among the consultants and SHO's. 46 % of the consultant anesthetists managed between 1 – 5 patients with 14% stating that they had not actively managed any patient in the previous one month of data collection.

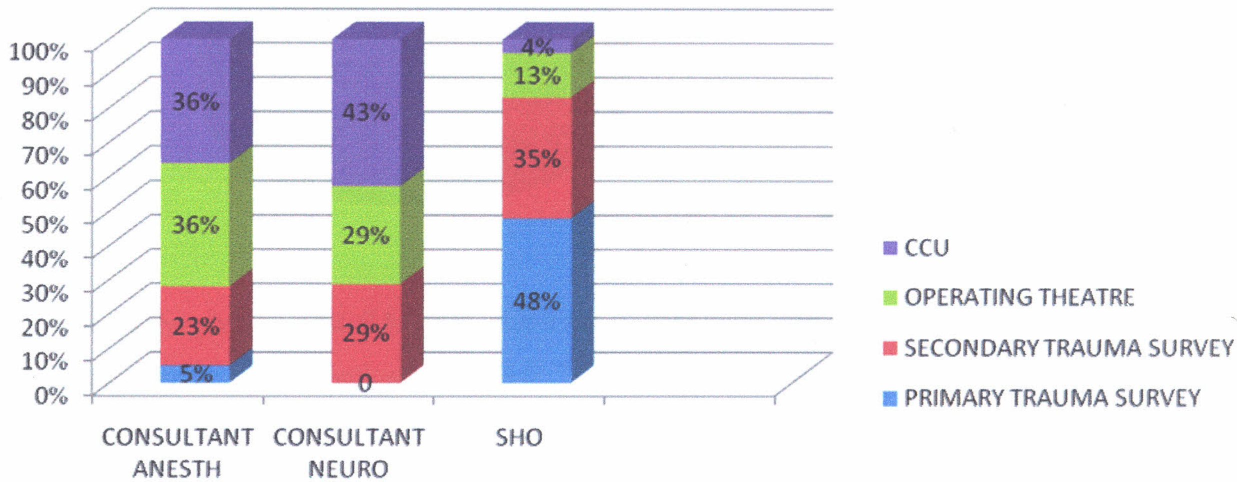
71% of the consultant neurosurgeons managed over 10 patients in a month with equal proportions managing 1 – 5 and 6 – 10 patients with SHI. 68% of the SHO's sampled were involved in management of over 10 patients with SHI, with 8% managing 5 patients and below.

Fig 4: NUMBER OF PATIENTS WITH SHI MANAGED IN ONE MONTH



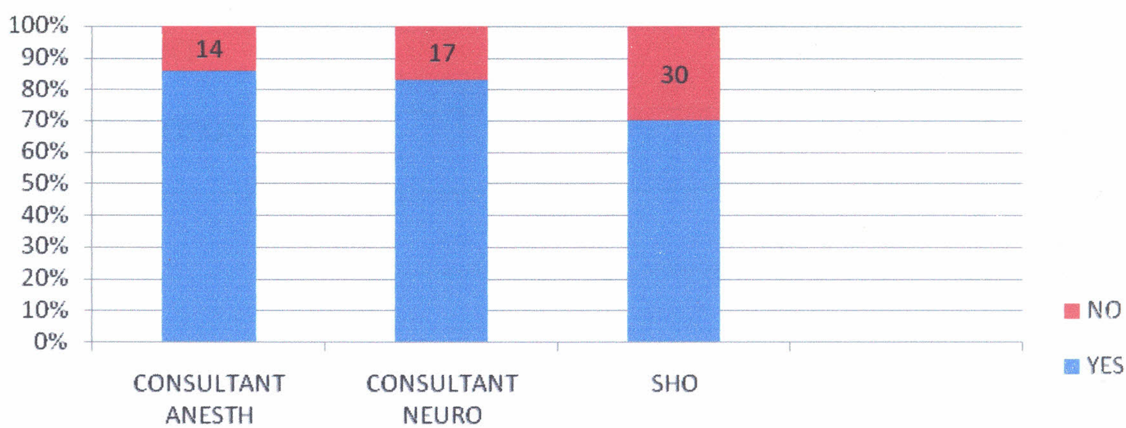
Patients with SHI are managed at various stations within the hospital setting. Four stations were sampled and responses regarding where each practitioner most frequently made primary contact and managed patients with SHI, were analyzed and illustrated in Figure 6. 48% of the SHO's sampled managed SHI first at the primary trauma survey, while 4% managed patients first in the CCU. The consultants managed SHI patients more in the CCU and operating theatres, as compared to the primary trauma survey setting. Comparative proportions among the respondents are shown in Figure 6.

Fig 5:MOST FREQUENT PRIMARY CONTACT IN SHI MANAGEMENT



The adequacy of GCS as an assessment tool in the management of SHI was done and responses illustrated in Figure 7. Generally, 80% felt that GCS was an adequate assessment tool, while 64% of the respondents who did not feel it was an adequate tool comprised SHO's.

Fig 6: ADEQUACY OF GCS



The GCS assesses 3 aspects namely verbal response, eye opening and motor response. Practitioners in the survey were asked to state the GCS modality that held the greatest predictive value and correctness of response is shown in Figure 8. 87% correct response rate was obtained from the SHO's while the consultant anesthetists had a correct response rate of 38%.

Fig 7:GCS CATEGORY WITH GREATEST PREDICTIVE VALUE

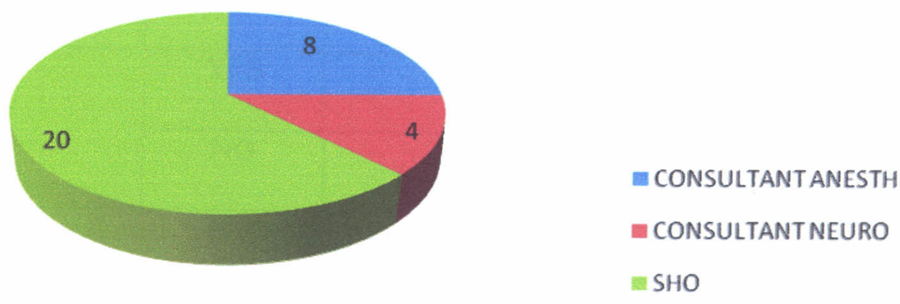


Table 1 shows the preferred GCS level at which the practitioners sampled would have adopted an active airway intervention in patients with SHI. 74% of the respondents felt they would electively intubate these patients at a GCS level of ≤6 – 7.

Table 1:GCS LEVEL FOR ELECTIVE INTUBATION

CADRE	GCS LEVEL	PERCENT (%)
CONSULTANT ANESTHETIST	≥3 – 5	9
	≥6 – 7	73
	≥8	18
CONSULTANT NEUROSURGEON	≥6 - 7	67
	≥8	33
SHO	≥3 – 5	5
	≥6 - 7	81
	≥8	14

Further on, 88% of the practitioners sampled agreed that there was a role for active airway intervention despite a favorable GCS level. In terms of applicability of GCS in regular assessment of SHI, Table 2 illustrates the responses for each of the three indications for GCS in management of SHI.85% of the respondents sampled used the GCS as a clinical prognostic aid in the management of SHI.

Table 2:APPLICATION OF GCS

INDICATION	Response	CONSULTANT Anesthetist (%)	CONSULTANT Neurosurgeon (%)	SHO (%)
Grading SHI	YES	100	86	100
	NO		14	
Assessing Clinical/ Neurological Progress	YES	95.5	100	100
	NO	4.5		
Prognostic Tool	YES	91	71	92
	NO	9	29	8

Management of SHI may or may not be guided by a protocol. Figure 8 illustrates practices of respondents in this regard, with emphasis on their care of patients with SHI in KNH-CCU. 63% of the SHO's relied on a protocol-guided management of SHI. In contrast among the consultant anesthetists and neurosurgeons, 63% and 67% respectively, did not base their care on a protocol for SHI management. Table 3 shows the relationship between years of practice and use of a protocol. A non-statistical significance by *Fischer's exact test* yielded a *p value* of 0.091

Table 3: Experience and Protocol-guided management

Years of practice	Protocol guided SHI management		*p-value*
	Yes	No	
1-3 yrs	11	5	*0.091*
4-6 yrs	5	3	
6-12 yrs	4	6	
>12 yrs	4	11	
Total	24	25	

In SHI management, various strategies can be used to control raised ICP. Figure 9 illustrates responses regarding role of the various control strategies. Table 5 shows the relationship between years of practice and responses on recommended MAP in SHI patients with a response of ≥80mmHg was considered correct. While figure 9, further illustrates the number of patients managed in a month against the recommended levels in MAP.

Table 5: Years of practice and responses to recommended MAP

Years of practice	Recommended levels- MAP(Normotension) (mmHg)				Total
	40-50	51-69	70-79	=>80	
1-3 yrs	0	1	8	4	13
4-6 yrs	0	2	3	4	9
6-12 yrs	0	1	7	1	9
>12 yrs	1	5	9	1	16
Total	1	9	27	10	47

Fig 9: SHI patients and correct MAP targets

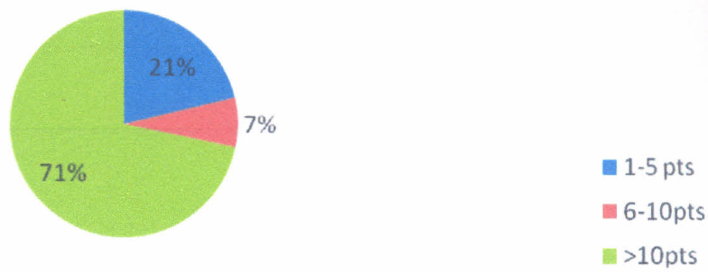
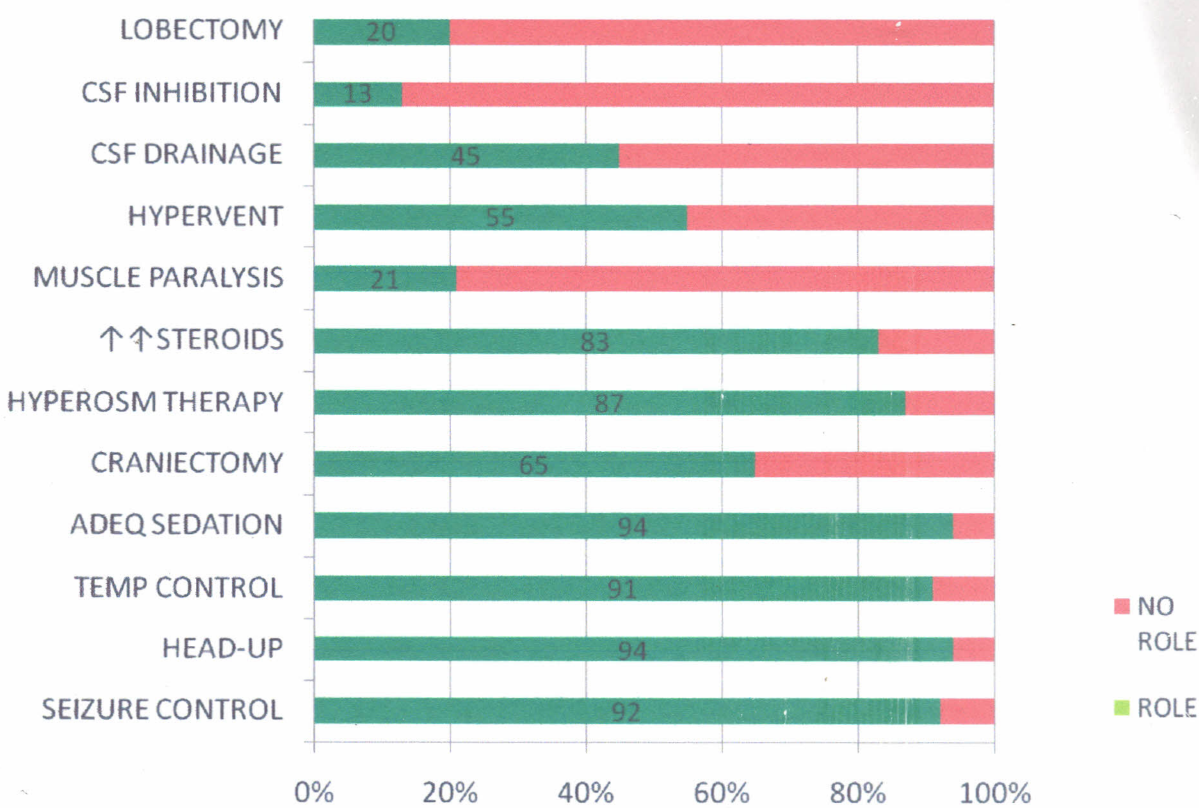


Fig 10: MEASURES TO CONTROL RAISED ICP



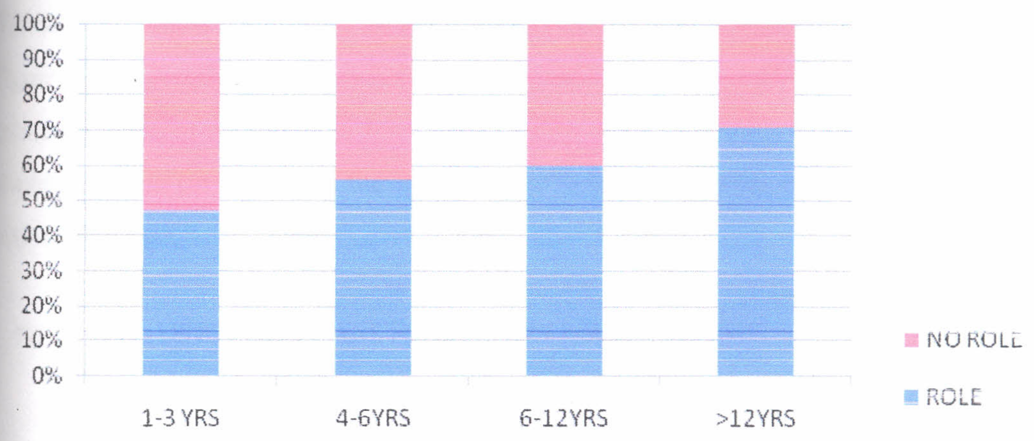
Information regarding hyperventilation was related to correctness of response in the recommended levels of normocapnia in SHI and this information is shown in Table 6. A larger proportion of SHO's not finding role for hyperventilation had the recommended normocapnia levels in mind in the care of SHI.

Table 6: Normocapnia and role of hyperventilation

Recommended levels- Normocapnia		Hyper ventilation	
		NO ROLE	ROLE
35-45mmHg	Consultant Anesthesiologist	44%	56%
	Consultant Neurosurgeon	50%	50%
	SHO	77%	23%

But when years of practice was related to correctness of targets in maintenance of normocapnia, in Figure 11, it was found that the practitioners with longer experience generally found role for hyperventilation in SHI management.

Fig 11: Years of practice and Role of Hyperventilation



Other supportive care measures applied in patients with SHI in general were also considered in the survey. Not shown in Table 7 were the measures with a 100% response rate among all practitioners sampled. These were skin care, chest physiotherapy, stress ulcer prophylaxis and the use of CVP to guide fluid therapy. Other supportive care measures are shown in Table 7.

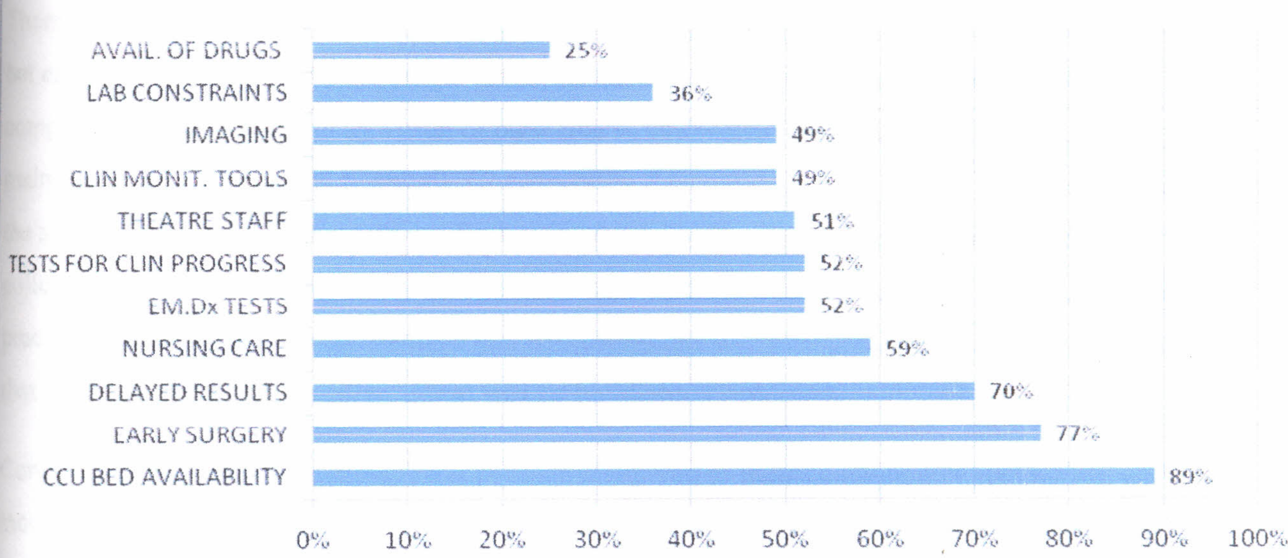
Table 7: SUPPORTIVE CARE MEASURES

SUPPORTIVE CARE MEASURE	CONSULTANT ANESTHETIST (%)	CONSULTANT NEUROSURGEON (%)	SHO
INDWELLING URINE CATHETER	100	100	96
ENTERAL FEEDS	86	100	92
THROMBOSIS PROPHYLAXIS	95	86	83

CT scanning has a role in several stages of SHI management, and responses were obtained its application in the evaluation of SHI patients. All the consultant neurosurgeons and SHO sampled felt it was appropriate to routinely perform a CT scan in all SHI patients. Only among the consultant anesthetists was role felt for it in other situations as shown in the table. It was to be routinely repeated for all SHI patients in 48hrs or earlier following the initial scan, and there was also role for routine CT scanning even with improvement of the patient's neurological status.

Various challenges were faced by the practitioners surveyed, and the responses are illustrated in Figure 12. Different challenges held different weight with overall responses graphically presented. 89% of respondents felt unavailability of CCU bed for admission was a major challenge while on the end of the spectrum, 25% felt availability of pharmacologic agents was a major challenge.

Fig 12: CHALLENGES IN SEVERE HEAD INJURY MANAGEMENT



5.0 DISCUSSION:

Management of SHI has been a subject of immense debate in the past and present. This survey will hopefully highlight aspects probably unique to SHI care in CCU-KNH, and discuss issues arising from them.

SHI management is best carried out in a specialized setting, the critical care unit. In Kenya, ICU remains under the guidance of anesthetists mainly, while in limited situations intensivists have taken charge. By considering the neurosurgery practitioners as well, the sample of respondents in the study represented two key members of the patient care team. Anesthesia practitioners form the bulk of the care givers' profession which was evident from the results. SHO's formed the bulk of the total respondents, and though they were not stratified into their respective professions, their group provided a basis of comparison with consultants on a number of key issues surveyed.

SHO's performed their duties under the guidance of their respective consultants, whom they consulted on challenges encountered and obtained solutions with respect to care of the SHI patient. Therefore, none of the SHO's can truly be said to have managed a patient with SHI single-handedly, but each played their part in the bigger team picture. SHO's appeared to manage more patients compared to the consultants by virtue of their role as first-on-call care givers, which is the norm in main Teaching and Referral hospitals. Consequently they comprised the bulk of the respondents with the shortest experience in the survey, further emphasizing the dependence they had on their senior colleagues, the consultants for mentorship in clinical care of patients in general. Issues concerning practices by the consultant anesthetists and neurosurgeons will be discussed together, while those that appear to be unique to either group will be highlighted separately.

Consultant anesthetists managed fewer patients compared to their neurosurgery colleagues, with more roles standing out in the CCU and operating theatres. This was in comparison to the primary trauma survey in which the role of SHO's in general appeared much more evident form responses analyzed. Consultant neurosurgeons stated their role as being more evident in the CCU leaving a clear gap in the primary trauma survey, in which the SHO's role stood out more clearly. This lack of participation may have a bearing on the overall care and general outcome of patients with SHI, but this was not the focus of the survey. Medical records showed that SHI contributed to about 38.6% of the mortality in CCU[1], a statistic that was not revealed directly from findings in the survey, but can probably point out shortfalls in SHI care stemming from the primary trauma care of these patients at initial contact. CCU support revolves around successful prevention, detection and treatment of secondary insults to the injured brain[2].

Secondary insults may be initiated at any point of SHI and it is with this in mind that there are benefits to the patient outcome when probably more participation by the consultants in the primary trauma management of SHI can be realized. Hypoxia and systemic hypotension are probably the two most important of the secondary insults and must be actively prevented and aggressively treated. Miller[12] and others[10] have demonstrated the role of hypotension and hypoxia in the early post-traumatic period in augmenting each other. They further added that the two especially were major determinants of outcome, an objective that can only be best achieved at the primary contact setting.

Consultants in both professions surveyed had managed patients with SHI for longer than the SHO's, and this is more objective in assessing experience than the number of patients seen in the previous one month of the survey. Experience has bearing on individual practices with regard to SHI management. The survey did not take into account various attributes of the training received by each of the consultant anesthetists or neurosurgeons. This determined the trend of responses regarding use of a protocol in SHI management as no factor analyzed including years of practice had a significant role in determining use of a protocol. More than half of all consultants did not base their management practices on a protocol of any kind in contrast to the SHO's despite the apparent general non-conformity to its use. Varying backgrounds in training also resulted in a non-uniformity of units used to measure various physiologic parameters. There appeared to be an apparent confusion in the conversion of blood glucose levels into mmol/Lt from other units, which may have led to errors in responses given to explain incorrectness of response in significant proportions. While it is clear that it is easier to detect desaturation as a percentage when evaluating hypoxia, a significant proportion of respondents found it challenging to objectively recommend appropriate levels of oxygen tensions as would be derived from a blood gas analysis in mmHg. Blood pressure was the parameter that stood out in terms of the quality of responses obtained regarding recommended levels in the adult patient with SHI. Blood pressure as a physiologic parameter is well understood in principle, but it is probable that the challenge in its assessment stems from the background knowledge of what variable to evaluate. Blood pressure can be assessed using the systolic, diastolic and mean. The MAP was used in the survey and when compared to recommended targets by the BTF[11], which state that hypotension was a MAP of ≤80mmHg; it was found that it yielded most incorrect responses. Correctness of recommended MAP appeared to be more directly related to number of SHI patients managed by a practitioner; but the same could not be said for length of years of practice which probably depended more on one's background training. Whether that can be understood as a lack knowledge in appropriate blood pressure control in SHI patients or a lack of understanding of the questionnaire statement, will be a key note to keep in mind.

The survey did not take into account the active area of duty of respondents within the hospital. The include the operating theatres, CCU and administrative responsibilities, some of which may not pla the consultants in close contact with SHI patients on a daily basis. Despite the bias created by this reality, data obtained was still analyzed with the premise that the responses were in reference to the care that would be given to any patient with SHI by the respondent, whether they be in active CCU duty or not. For the consultant anesthetists who are mainly based in the operating theatres rather thai the CCU, the care offered to such patients while undergoing surgical interventions is in principle par of a continuum of their long-term care in the CCU; with the principles applied therefore, remaining standard irrespective of their point of care within the hospital setting.

GCS still remains a key tool[5] in the assessment and evaluation of SHI. It can also be used to grade severity of injury, assess progress as was evident from responses obtained in general from the survey. In terms of adequacy, more weight was placed on the GCS by the consultants compared to the SHO's which could have arisen from the years of experience they had in management of SHI which gave them the benefit of better judgment in that respect. On the other hand the SHO's manage more significant number of patients in the primary trauma setting, meaning that other factors need consideration that may not be revealed by a survey such as this. Despite most respondents not accepting the role of GCS as a prognostic tool, Teasdale[5] showed that best GCS score after resuscitation was most useful in classifying SHI and held prognostic significance in the early post-traumatic period.

GCS has its shortfalls despite its universal utilization in SHI, but remains a key clinical tool among the practitioners sampled. Years of experience strengthened the role of GCS among the consultants since it served as a better communication tool to other members of the overall care team in SHI compared to suggested alternatives such as the Virginia Prediction Tree[6] (VPT). This tool and several others tended to encompass more comprehensive assessments but were too complicated for regular use and dissemination of information regarding the patient to other cadres of health care workers in the CCU.

According to the BTF[11] guidelines, airway support is recommended at a GCS level of <8. There was still a notable deviation from this among practitioners sampled in both professions and across the cadres. Due to the nature of their work in the operating theatres, the anesthetists demonstrated a lower threshold to electively intubate compared to their neurosurgery colleagues based on GCS level. Chestnut and colleagues demonstrated the deleterious effects of hypoxia especially when left unchecked, which invariably leads to a poorer neurological outcome in SHI. Standardization on the use of GCS is not only in airway management, but other aspects of management need to find their rightful place in the overall care of patients with SHI. Hypoxia must be prevented at all costs as emphasized by Miller in the formative years of research in management of SHI.

Girling[2] in his review of CCU care of SHI emphasizes the key role played by five parameters in the management of these patients. The only one of these parameters not assessed was temperature. The general trend of responses in the survey indicated a lack of standardization in evaluation of the adult patient with SHI. This had a bearing on individual practitioners' background and current training. The basic aim of the survey was not to critique one group of respondents over the other but to illustrate the variability of practice patterns even with clinical measures deemed standard in care of a patient with SHI.

Normocapnia according to the BTF[11] ranges between 35 -40mmHg. This parameter deserves mention as its control has gained favor much more recently compared to the other parameters earlier discussed. Majority of the consultants on both the anesthesia and neurosurgery groups did not clearly state recommended levels if normocapnia in SHI patients in general. Further on, though it appeared from responses that there was a role for hyperventilation in control of raised ICP, majority of those stating the recommended targets expected felt this role was limited compared to other supportive measures. Levels too high or too low as studied by Skippen *et al* have been shown to have adverse effects on cerebral blood flow dynamics not uncommon in the injured brain following trauma. Control of carbon dioxide levels falls in the same light as all other supportive care measures applied to the patient with SHI. Each clinical intervention has a role which requires to be defined not only in general terms but in the context of the individual patient with SHI. Though not the focus of the study, the practices surveyed in management of SHI may allow weaknesses and strengths to be identified and appropriate amendments to be made.

When we consider control of raised ICP, more consultant anesthetists saw a role for sedation over muscle paralysis, in contrast to the neurosurgeons. Both strategies have their role in control of raised ICP but according to the American College of Chest Physicians[7], shift in management in the last decade has laid more emphasis on sedation rather than muscle paralysis as a routine measure to reduce the brains metabolic demand and subsequently help in the control of ICP. Muscle par-may help reduce raised ICP but significant adverse effects regarding its long term use have been strongly demonstrated.

Consultant neurosurgeons did rank role of anti-convulsants highly in the control of raised ICP, which is recommended in all patients with SHI by the American College of Chest Physicians, for a period of 7 -10days. The survey did not assess situations in which the various practitioners used the various supportive measures but mainly dwelt on a fact finding approach on practices in place at the KNH-CCU. The end-points that were to be achieved in the use of the supportive strategies were not evaluated in the survey and where a role was found for them from the responses obtained probably gave a general idea that most practitioners were at least aware of them.

Challenges faced in the management of SHI are several and responses to various categories were analyzed with the key issue arising in KNH in general being unavailability of CCU admission space. Most other challenges highlighted resource constraints in the various stages of SHI management. Whether these challenges affected outcome of patients cannot be ascertained by the survey, but will allow understanding of the clinical scenarios the practitioners have to contend with in the care of patients with SHI.

7.0 CONCLUSION:

Several of the Brain Trauma Foundation guidelines are in practice from the responses obtained from the practitioners sampled. Despite the survey not directly assessing principles behind the practices in SHI management, it allowed a general understanding of current practices on the ground and highlighted various strengths and weaknesses in the care of these patients.

There is a strong case to push for more involvement by the consultant anesthetists and neurosurgeons in the primary trauma survey of patients admitted with SHI. Optimal and supervised care right at the onset would allow the full benefits of the entire care package to be realized while reducing on any unforeseen adverse effects of treatment to the patient during their care. This care is beyond that already seen to be offered in the CCU.

Variability in the responses, some being more divergent than expected shows that each practitioner has their own say based on held knowledge, when various issues in management of SHI are considered as shown by the survey. While due respect is accorded to each practitioner in this regard, a unifying factor ought to be achieved in the provision of overall care. A standardized care package for patients with SHI would help give guidance to use of various clinical strategies and provide a common basis of comparison and evaluation in the course of care especially within the CCU.

The survey did not sample all the practitioners in the two categories, and neither did it review practices in all aspects of SHI care. It also focused on the care givers' side rather than the patients themselves, and so direct conclusions cannot be drawn at this stage regarding outcome of care based on information obtained in the brief survey. This therefore opens up numerous possibilities in range of studies that can be further conducted in the highly dynamic subject of severe head injury.

9.0 RECOMMENDATIONS:

- A working protocol to guide management of SHI in KNH-CCU. This document should not only be comprehensive but accessible to all members of the care team
- Further studies on patients with SHI to bring out more objective correlative data on care given to the outcomes obtained. Continuous research will add to the body of knowledge which would allow refinement of any management protocols in place.
- Address the challenges faced in the care of patients with severe head injury both at departmental level and hospital administrative levels, with note given to the weight they bear and resources available
- Encourage correct standards of practice by all care givers

LIMITATIONS OF STUDY

Not all anesthesia and neurosurgery practitioners were included in the survey and therefore their views were not included in the analysis, but effort was made to make the sample as representative as possible.

Several omissions were present in certain sections of the questionnaire due to inability to provide answers by respondents concerned. This was noted and conclusions and analysis made on those valid entries alone. Confidentiality was assured in the course of data collection.

Not all aspects of SHI management were considered in the survey, but the structure of the data collection tool was made as inclusive as possible to allow several observations and conclusions to be drawn.

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APPENDIX 1

GLASGOW COMA SCORE

GLASGOW COMA SCORE	*EYE OPENING*	*BEST VERBAL EFFORT*	*BEST MOTOR EFFORT*
1	NONE	NONE	NO RESPONSE TO PAIN
2	TO PAIN	NON SPECIFIC SOUNDS	EXTENSOR POSTURING
3	TO VERBAL STIMULI	INAPPROPRIATE WORDS	FLEXOR POSTURING
4	SPONTANEOUSLY	CONFUSED	WITHDRAWS TO PAIN
5	-	ORIENTED	LOCALIZES PAIN
6	-	-	FOLLOWS COMMANDS

APPENDIX 2

RAMSAY SEDATION SCORE

1	*ANXIOUS, AGITATED OR RESTLESS*
2	*CO-OPERATIVE, ORIENTED, TRANQUIL*
3	*RESPONDS TO COMMANDS ONLY*
4	*ASLEEP BUT BRISK RESPONSE TO GLABELLAR TAP OR LOUD AUDITORY STIMULUS*
5	*ASLEEP, SLUGGISH RESPONSE TO GLABELLAR TAP OR LOUD AUDITORY STIMULUS*
6	*NO RESPONSE*

COMMON SODIUM (Na^+) DISORDERS SEEN IN HEAD TRAUMA

DISORDER	***Na^+***	***DIAGNOSTIC CLUES***	***TREATMENT***
SIADH (Syndrome of Inappropriate ADH secretion)	↓	-↓ SERUM OSMOLALITY -USUALLY EUVOLAEMIC -↑URINE OSMOLALITY	-RESTRICT FREE WATER -IV HYPERTONIC SALINE IF SEVERE
CEREBRAL SALT WASTING SYNDROME	↓	-USUALLY NORMAL SERUM OSMOLALITY -↑URINE OUTPUT -SIGNS OF VOLUME DEPLETION -HEMOCONCENTRATION -↑↑URINE SODIUM	-REPLACE VOLUME WITH NORMAL SALINE -OR HYPERTONIC SALINE -OR ORAL SODIUM
MANNITOL THERAPY	↑	-POLYURIA -↑ SERUM SODIUM -↑SERUM OSMOLALITY	-WITHOLD MANNITOL IF SERUM OSMOLALITY > 320 mOsm/ kg H_2O
DIABETES INSIPIDUS	↑	-POLYURIA (>250ml/hr) -↑SERUM SODIUM -↑SERUM OSMOLALITY -URINE SPECIFIC GRAVITY <1.005	-VASOPRESSIN

APPENDIX 4

INFORMED CONSENT FORM

MANAGEMENT OF SEVERE HEAD INJURY IN KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNIT; A REVIEW OF PRACTICE AMONG CRITICAL CARE PRACTITIONERS

This Informed Consent Form is for practitioners who work in the critical care unit at the Kenyatta National Hospital. You are hereby invited to participate in the above mentioned study

PART I: *Information Sheet*

Introduction

I am Dr. Eric Kibet Bhoyyo, a third year resident in the MMed Anaesthesia program. I am conducting a review on the management of severe head injury in Kenyatta National Hospital Critical Care Unit in part fulfillment of my post-graduate program requirements. I will strive to answer any queries that may arise before and during the course of the intended study.

Purpose of the research

The objective of this survey is to assess the practice of severe head injury management amongst anaesthesia and neurosurgery practitioners in Kenyatta National Hospital, Critical Care Unit. It will further aid in highlighting the challenges faced in trying to improve the care offered to such patients who represent the biggest proportion of admissions to the critical care unit.

Research Intervention

This research will not involve any interventions

Participant selection

You were selected to join the study using the stratified random selection.

Voluntary Participation

Your participation in this research is entirely voluntary. You are free to withdraw from the study.

Duration

The research is intended to take place between February and May 2010. During that time questionnaires will be distributed to all selected participants and submitted back on the same day.

Risks

By participating in this research you will not be exposed to any risk.

Benefits

The benefits from the study are mainly towards improving the care offered to critically ill, severely head-injured patients in the best manner, using the resources at hand.

Confidentiality

The information that I collect from this research project will be kept confidential. Any information about you will have your initials to which a serial number will be assigned instead of your name.

Who to Contact

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, please use the contacts below:

Dr.Bhoyyo Eric Kibet (Researcher) – **0722 563285**; *kb_erik@yahoo.com*

Dr.Patrick Olang' (Supervisor) – **0722 523116;** *patrick.olang@uonbi.ac.ke*

This proposal has been reviewed and approved by the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee.

PART II: ***Certificate of Consent***

I have read the foregoing information. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I hereby consent to participate in this research.

Name of Participant: ....

Signature: .... Date: ....

Statement by the researcher

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher: ………………………………………………………………………..

Signature: ………………………………………………………… Date: ………………………

QUESTIONNAIRE

Below are questions and statements with reference to your practice of management of severe head injury in ICU. Mark the appropriate check boxes provided and make entries where applicable.

Serial Number : .... **Date :** ....

1. **Sex** M ☐ F ☐ **Age** : 25-34yrs ☐ 35-44yrs ☐ 45-54yrs ☐ >55yrs ☐
2. Indicate with a mark your current professional cadre:

   Consultant Anesthesiologist ☐ Consultant Neurosurgeon ☐

   Senior Registrar ☐ Senior House Officer ☐
3. Years of practice with regard to management of patients with severe head injury:

   1-3yrs ☐ 4-6 yrs ☐ 6-12 yrs ☐ >12 yrs ☐
4. Is management of such patients in KNH-CCU guided by a protocol? Y ☐ N ☐
5. Do you get to manage severe head-injured patients on a regular basis? Y ☐ N ☐
6. What is the approximate number of such patients that you see in a month?

   None ☐ 1-5 ☐ 6-10 ☐ >10 ☐

   7-12 are in reference to the use of the Glasgow Coma Score (GCS)
7. In your practice do you regularly use GCS to:-

	YES	**NO**
Grade severity of head injury		
To assess progress during recovery of head injured patients		
To assess prognosis		

8. Of the three components assessed by the GCS, which has the greatest predictive value: Eye opening ☐ Motor response ☐ Verbal response ☐
9. Is the GCS adequate in our current setting to assess adult patients? Y ☐ N ☐

   If NOT adequate, suggest another alternative scoring system:..............................
10. Based on GCS, at which score would you prefer elective intubation/active airway intervention in severely head injured patients? >=3-5 ☐ >=6-7 ☐ >=8 ☐

11. Do you encounter situations in which intubation is done/required despite a favorable GCS?
Y ☐ N ☐

12. Do you feel competent enough to perform tracheal intubation? Y ☐ N ☐

13. At what point of severe head injury management do you frequently first manage such patients?

Primary trauma survey ☐ Secondary trauma survey ☐ Operating theatre ☐ CCU ☐

14. Please tick the current recommended levels guiding principles of management of severely head-injured adults

Normoglycemia (mmol/Lt)	=>2-4	=>4.1-6.9	7-10	>10
Normoxia (mmHg)	=>60-79	=>80-89	=>90-110	=>111
Normotension (MAP- mmHg)	40-50	51-69	70-79	=>80
Normocapnia (mmHg)	<=25	26-34	35-45	=>46

15. Is there a role of blood pressure support using *inotropic* agents in a patient who already has cerebral edema? Y ☐ N ☐

For questions 16-17, use the score format illustrated below for the questions on the next page, and mark as appropriate:

1-Contraindicated **2**-Not necessary **3**-Equivocal/indifferent **4**-Necessary **5**-Mandatory

16. The following management strategies below are used in controlling raised Intracranial Pressure?

Intervention	**1**	**2**	**3**	**4**	**5**	***Intervention***	**1**	**2**	**3**	**4**	**5**
Head-up position						Temperature control					
Adequate sedation						High dose steroids					

Hyperventilation						Craniectomy					
Muscle paralysis						CSF drainage					
Seizure control						Lobectomy					
Hyperosmolar therapy *e.g. Mannitol*						Inhibition of CSF production					

17. How would you rate the following supportive measures used on patients with severe head injury in the critical unit?

SUPPORTIVE MEASURE	1	2	3	4	5	SUPPORTIVE MEASURE	1	2	3	4	5
Thrombosis prophylaxis						Skin care					
Indwelling urine catheter						Chest physiotherapy					
CVP to guide fluid therapy						Enteral feeds					
Stress ulcer prophylaxis						Head-up position					

18. Mark as appropriate with regard to the use of CT scanning in critical care unit:

a. Routine for all severely head-injured patients ☐

b. Routinely repeated for all such patients in 48hrs or earlier ☐

c. Routinely done for all post-operative cases ☐

d. Routinely done even with clinical improvement in neurological status ☐

19. The table below shows some of the challenges faced in the management of severely head-injured patients? Based on your opinion, rate each based on the score format below:

1-Major 2-Minor 3-Not a problem

		1	2	3
Emergency Diagnostic tests	Availability of test			
	Punctuality of results			
	Applicability of results in management			

Delays in instituting definitive intervention					
Follow-up of patients	Availability of appropriate tests to review clinical progress				
	Availability of appropriate clinical monitoring tools				
	Optimal nursing care				
Inter-disciplinary support					
Resource constraints	Diagnostic tools/ aids	Laboratory			
		Imaging			
	Early surgical intervention	Theatre space			
		Theatre Staff			
	Pharmacologic agent availability				
	CCU bed space				

APPENDIX 6

WORK PLAN AND BUDGET

ACTIVITY	2008 July	2009 Sept	2009 Oct	2009 Nov	2009 Dec	2010 Jan	2010 Feb	2010 Mar	2010 Apr	2010 May
Proposal Writing	√	√								
Proposal Presentation			√							
Presentation to Ethical Review Committee				√	√	√				
Data Collection							√	√		
Data Processing									√	
Report Writing									√	
Study Presentation										√

Item	**Total cost (KShs)**
Biostatistician Fee	**15,000**
Stationary & Related printing costs	**10,000**
Internet hours	**1000**
KNH/UoN Ethics & Research Committee fee	**1000**
Phone call costs	**2000**
Miscelleous	**1000**
SUBTOTAL	**30,000**
10% Contingency	***3,000***
GRAND TOTAL	**33,000**

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Ref: KNH-ERC/ A/419

9th March 2010

Dr. Eric Kibet Bhoyyo
Dept. of Surgery/Anaesthesia
School of Medicine
University of Nairobi

Dear Dr. Bhoyyo

RESEARCH PROPOSAL: "MANAGEMENT OF SEVERE HEAD INJURIES AT THE KNH CRITICAL CARE UNIT: A REVIEW OF PRACTICE AMONG CRITICAL CARE PRACTITIONERS" (P346/12/2009

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and **approved** your above revised research proposal for the period 9th March 2010 8th March 2011.

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 specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

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

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

Yours sincerely

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

c.c. Prof. K. M. Bhatt, Chairperson, KNH/UON-ERC
The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The HOD, Records, KNH
Supervisor: Dr. Patrick Olang', Dept.of surgery/Anaesthesia, UON