

ESTIMATION OF BLOOD LOSS DURING ELECTIVE
SURGERY AT KENYATTA NATIONAL HOSPITAL

A DISSERTATION IN PART FULFILMENT FOR THE
DEGREE OF MASTER OF MEDICINE (SURGERY) OF
THE UNIVERSITY OF NAIROBI

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DECLARATION.

This dissertation is my original work and has not been presented in any other University.

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DEDICATION

This dissertation is dedicated to my mother for her love and support and my dear wife Serah for her understanding, support and endurance.

LIST OF ABBREVIATIONS

ADP	-	Adenosine Diphosphate
Dept.	-	Department
gm	-	grammes
g/dl	-	grammes per decilitre
HB/Hb	-	Haemoglobin
HCT	-	Hematocrit
Intra-op	-	Intra operative
IP	-	In-patient
Kg	-	Kilogramme
KNH	-	Kenyatta National Hospital
LFTs	-	Liver Function Tests
min	-	minutes
mls	-	millilitres
PCV	-	Packed Cell Volume
ORIF	-	Open reduction and internal fixation
PRE - OP	-	Pre-operative
POST - OP	-	Post-operative
s.d	-	Standard deviation
U/E/C	-	Urea/ Electrolytes/ Creatinine
U.O.N.	-	University of Nairobi
Wt	-	Weight

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SUMMARY

Blood loss from major surgery is a great challenge which has become even more significant considering the unavailability of blood for replacement during surgery. It was therefore prudent to determine the amount of blood lost during various major operations for purposes of planning about which surgical units need more attention in terms of provision of blood conservation equipment and those that need more blood units stored for their surgeries. Therefore this study was done to assess blood loss during elective surgery this would go a long way in furnishing Kenyatta National Hospital with this vital information. The study enrolled 65 cases which included major general surgical and orthopaedic, cardiothoracic and neurosurgical operations.

It was found that some surgical units requested blood and infrequently utilised it as their operations had minimal intra-operative blood losses. It was also found that pharmacological agents for minimising blood loss were not used. The overall mean estimated blood loss for all the cases was 492.77mls.

INTRODUCTION

Surgical procedures are inevitably associated with some degree of bleeding. The amount of blood loss may vary widely between different surgical procedures; these would be due to surgical as well as non-surgical factors, which include the haemostatic mechanisms of the body.⁷

Major surgery, which is defined as a procedure in which a body cavity is penetrated and exposed or in which substantial impairment of physical or physiological functions is produced, is generally associated with significant blood loss. Examples of major surgical procedures include laparotomy, thoracotomy, craniotomy, joint replacement and limb amputations.¹

As these surgeries have evolved, with the rapid advancement in science and technology, blood loss minimisation and strategies for blood conservation have become more and more an essential part of modern surgical practice.²⁷

Certain devices like diathermy or electrocautery and certain biological materials like cellulose were incorporated into surgery to aid in controlling bleeding intra- operatively, which was hitherto difficult to manage.⁷

Towards the end of the last century, there was a growing recognition and respect of the wishes of the patients; for example, the followers of Jehovah witness faith do not accept blood transfusion. This has brought about the concept of 'bloodless surgery' where blood conservation strategies are emphasized. These include the use of cell salvage methods, hypotensive anaesthesia and perioperative pharmacotherapies like the use of erythropoietin to stimulate red blood cell synthesis.²⁸

Significant blood loss in surgery usually may result in a decision to transfuse blood. However blood transfusion is becoming less and less popular due to the risk of viral contamination²⁹. Again due to this kind of scenario, interest has been rising concerning blood loss and its minimisation.

It is therefore a result of this awareness that there was a need to create a system for surgeons to be able to access information on blood loss for various procedures in

Kenyatta National Hospital operating theatres. It will also raise the need for emphasising on strategies to reduce blood loss during surgery.

... involved in one way or the other with ...
... of some substances and body ...
... to maintain the body's ...

... as follows

Transportation

... from the lung and returns from the digestive ...
... it is also oxygenated and transports metabolic waste ...
... for elimination of carbon dioxide ...
... of oxygenated blood to drive.) Blood also ...
... from the endocrine organs to their target organs

Temperature

... appropriate body temperature by absorbing and distributing ...
... the body and to the skin surface for distribution of the excess.

... the normal pH in body tissues. Many blood proteins and ...
... to prevent excessive or abrupt changes in blood pH ...
... normal cellular activities. Additionally blood acts as the ...
... "alkaline reserve" of bicarbonates

... fluid volume in the circulation of water such as sodium ...
... such as albumin act to prevent excessive fluid loss ...
... the tissue spaces. As a result the fluid volume in the ...
... to support efficient fluid circulation in all parts of ...
... the body

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LITERATURE REVIEW

Functions of Blood

Blood performs various functions, all involved in one way or the other with substance distribution, regulating blood levels of some substances and body protection. These functions overlap and interact to maintain the body's homeostasis. ²

Some of these functions are as follows:

Distribution

This involves delivering oxygen from the lung and nutrients from the digestive tract to all the body cells. It is also concerned with transporting metabolic waste from all cells to elimination sites (to the lungs for elimination of carbon dioxide and to the kidneys for excretion of nitrogenous waste in urine.) Blood also transports hormones from the endocrine organs to their target organs.

Regulation

Blood maintains the appropriate body temperature by absorbing and distributing heat throughout the body and to the skin surface for distribution of the excess.

Blood also maintains the normal pH in body tissues. Many blood proteins and other solutes act as buffers to prevent excessive or abrupt changes in blood pH, which could jeopardise normal cellular activities. Additionally blood acts as the reservoir for the body's 'alkaline reserve' of bicarbonates.

Maintenance of adequate fluid volume in the circulation of salts such as sodium chloride and blood proteins such as albumin act to prevent excessive fluid loss from the blood stream into the tissue spaces. As a result the fluid volume in the blood vessels remain ample to support efficient blood circulation to all parts of the body.

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Protection

In order to prevent blood loss when a blood vessel is damaged, platelets and plasma proteins initiate clot formation.

Within the blood are white blood cells, antibodies, and complement proteins, which help defend the body against foreign invaders such as bacteria and viruses².

Since blood serves many important functions as stated above, its loss therefore has significant implications on the body and its normal functioning. Haemostasis, which refers to control of this bleeding, is therefore absolutely essential.

Bleeding from surgical or pathological injury may cease only if the defect in the vessel wall is surgically repaired or naturally if the blood clotting mechanism is working normally. Most peri-operative haemorrhage is a result of surgical causes but acquired and inherited defects of coagulation mechanism are enough to cause concern.³

Haemostasis depends on the proper working of the separate components of the haemostatic mechanism.³

- Vessel wall integrity and repair
- The function and adequate numbers of platelets
- The formation of a stable fibrin clot following the activation of plasma coagulation factors
- Controlled fibrinolysis

Defects in any of these may result in a bleeding tendency and in any given patient multiple defects may coexist.

During surgery, bleeding is mainly because of breach of the blood vessel walls.

In major surgery the amount of blood loss depends on various factors. One of these, being the body cavity being operated. For example there is generally a higher amount of blood lost following a thoracotomy than a laparotomy. But this also is dependent on the specific operation which is being undertaken.

Additionally there is an expected higher loss during cardiac surgery and major vascular surgery like the repair of an aortic aneurysm ⁴.

Some major operations like craniotomies for intracranial tumours are technically quite demanding and generally take much longer to perform than other forms of surgery. The longer the duration of the operation increases the risk of more bleeding from the dissected tissues.

In Spinal surgery, the patient's position on the operating table has an influence on the blood lost during the surgery. An increase in the intra abdominal pressure in the prone position of the patient may significantly increase the bleeding from the operative site ⁵.

In some pelvic and lower abdominal operations the use of subarachnoid anaesthesia with agents like Bupivacaine has assisted in minimising blood loss by creating anaesthetic hypotension ⁶.

Minimising Blood loss during surgery

One of the oldest methods of reducing or arresting profuse bleeding during surgery at least temporarily is digital pressure applied to a cut vessel. An example is the Pringle manoeuvre in which the Hepatic artery occluded in the hepatoduodenal ligament as a method of controlling bleeding from a transected cystic artery or from the surface of the liver.⁷ The finger as a vascular clamp, is the least traumatic haemostat. Other clamps are known to cause vascular intimal wall damage.

Ligatures of various types may be used to good effect to permanently arrest bleeding vessels.

Preoperatively the use of tourniquets may be advocated especially for limb surgery to significantly minimise blood loss during surgery.⁷

Thermal agents have been used for years to achieve haemostasis. Heat is known to cause protein denaturation, which results in large areas of tissue coagulation. Electrocautery is transmitted from the instrument by conduction directly to the tissue. In electrocautery an alternating current is used to induce heat.⁷

At the other extreme end of the thermal scale is the use of cooling as a haemostat. It has been used to control bleeding in the mucosa of the oesophagus and stomach.⁷ Direct cooling with iced saline is effective and acts by increasing local intra-vascular haematocrit and reducing the blood flow by vasoconstriction. Extreme cooling in surgery also referred to as cryogenic surgery has been used especially in gynaecology and neurology. The temperature range used in this form of surgery, is between -20 to -180° C. This freezing results in denaturation and dehydration of lipid molecules of the vessel wall causing cryogenic necrosis. However the walls of major arteries behave differently. They may be frozen but revert to normal function when thawing occurs so they do not actually undergo the necrosis seen in smaller vessels.⁷

More recently chemical agents have been used in haemostasis. They vary in their mechanisms to bring about haemostasis. Some are vasoconstrictive, while others have

coagulant properties whereas others have hygroscopic properties, which increase their bulk and assist in clogging up destroyed blood vessels.⁷

Adrenaline has been employed for a long time in the arresting of bleeding in some surgeries, for example in tonsillectomies.⁷ However its role is limited by the fact that it may enter the circulation and result in adverse systemic effects.

Some examples of local haemostatic agents are like Gelfoam which is made of Gelatin. Oxidised cellulose products like surgicel and oxycel are used to good effect as they act by transmitting pressure against the wound surface and the interstices provide scaffolding on which the clot can organise.⁷

Other pharmacological agents like aprotinin have been used to reduce blood loss.

The use of aprotinin was demonstrated in a prospective double blind, randomised and placebo controlled study by R. Jesershek et al who found that there was a significant reduction in blood loss in major orthopaedic surgery like revision arthroplasty of the hip and knee in patients given a high dose of aprotinin. The mean ultra-operative blood loss was reduced from 1957 mls to 736 mls.⁸

In a study amongst anaemic Jehovah witness patients' alternative approaches to the management of anaemia of these patients was advocated as opposed to the conventional option of transfusion.⁹ For example, other than emphasis on meticulous surgical techniques the use of pharmacological agents like antifibrinolytic agents e.g. Tranexamic acid and aminocaproic acid was emphasised in order to reduce intraoperative blood loss. Other methods of minimising blood loss advocated for this special group of patients include cell salvage and haemodilution.⁹

Under the United Kingdom guidelines for blood transfusion for elective surgery, a study was conducted on over 10,000 patients undergoing a wide range of surgical procedures. Blood loss estimates were documented as shown below..

Type of operation	Estimated blood loss
Primary hip arthroplasty	907 mls
Primary knee arthroplasty	764 mls
Revision hip arthroplasty	1531 mls
Bilateral hip arthroplasty	2020 mls
Vertebral arthrodesis	890 mls
Coronary artery bypass	890 mls

These blood loss estimates were computed according to the principles of Mercurialli.¹⁰

Odumala A.O et al found in a prospective study of 242 patients who underwent operative treatment for hip fractures that mean blood loss was 422 mls with 35.5% of patients losing more than 480 mls which was considered excessive in their study. It was also realised that, there was a higher amount of blood loss during surgery amongst registrars and middle level surgeons compared to consultants. The junior surgeons were 1.5 times more likely to lose more blood than their consultants. However this finding was statistically insignificant.¹¹

Goodnough L. T. et al in a 3-year retrospective study to investigate the cost effectiveness of intra-operative cell salvage in patients undergoing elective abdominal aortic aneurysm repair found that there was less need for autologous transfusion with salvage than without, this translates to cost saving as well.¹²

Blood loss in surgery, it was found, varies substantially between institutions. This was realised in a European overview of 3996 total hip and knee procedures. Median value of loss was 1944 mls for primary hip surgery and 1934 mls for knee arthroplasty. Whereas it was 2875 mls and 2528 mls for revision hip and knee arthroplasty, respectively.¹³

The national blood service in the UK recommends certain blood conservation methods in surgeries. For example surgeons may consider the use of fibrin glues and sealants during operations.¹⁴

Anaesthesiologists may on the other hand consider use of hypotensive anaesthesia to minimise bleeding. Aprotinin infusion may also be commenced at the end of surgery if appropriate.¹⁴

Estimating Blood loss during surgery

- One of the ways of measuring blood loss during surgery is by calculating the increase in weight of swabs, towels and drapes made wet intra-operatively by blood. It is estimated that one-gram weight gain in a swab is a result of one millilitre of blood loss. This method is useful where blood lost is not in the suction bottle but in gauzes and towels. However this method is thought to underestimate blood loss by about 25%¹⁵
- Measuring blood in the suction bottle is simple but its drawback is that it cannot measure what is in the swabs and drapes.¹⁶ In 1924, Gatch and Little reported the calorimetric method of measuring blood loss during surgery. Blood loss is diluted with a known volume of water contained in the tubes or washing machine. All sponges, towels, packs and instruments washed, hydrochloric acid added to convert haemoglobin to acid haematin. The concentration is later compared to the known standards of the calorimeter and the haemoglobin value determined. The use of this method is waning because it is unreliable as errors result from the chemical change in the haematin on standing errors due to lint and fat, which interprets with optical density¹⁷.
- Another method uses a washing reservoir, which contains a given amount of water. Blood stained swab from a patient are added to the reservoir and bubbles of compressed air promote even mixing of the haemoglobin. A detector consists of a lamp and photocell, which measures the concentration of diluted haemoglobin that the blood is calculated as follows:

$$\text{Concentration of Hb in the reservoir} = \frac{\text{Total amount of Hb in the blood soaked swabs}}{\text{Volume of the reservoir}}$$

$$\text{Total amount of Hb in the lost blood} = \frac{\text{Amount of Hb in the reservoir}}{\text{Volume of lost blood}}$$

Therefore:

$$\text{Volume of blood lost} = \frac{\text{Amount of Hb in the reservoir}}{\text{Patients Hb concentration}}$$

This method is useful especially when the exact measurement of blood loss is by the Snelling and Shaw method (1984).¹⁸

The volume of whole blood lost was equal to the sum of volume administered during the surgical procedure and post-operatively till the patient became stable haemodynamically. This added to the volume completed to raise the Hb to the pre-operative level.

$$510 \times \text{weight (preoperative Hb - postoperative)} / 100\text{ml}$$

In some facilities the postoperative Hb and preoperative Hb are used to calculate the amount of blood lost during surgery with the aid of the above equation which was based on the preceding work of Mollison (1979).¹⁹ This was possible and quite useful especially where estimation was very difficult as in those undergoing skin grafting where the oozing pattern on to drapes and towels cannot be qualified.

Specific gravity method which is very similar to the haemoglobin method and depends on the relatively constant measure of blood specific gravity¹⁷. The average specific gravity of blood is 1.056.

Blood is collected, as it is lost in reservoir with a known volume of water. As blood is added to the water the specific gravity increase and change can be proportioned against volume.

Serial haematocrit calculation can also be used to measure the blood lost during surgery²⁰. A change in the level of haematocrit occurs continually as a result of shift in the body fluids when blood loss occurs, but the true haematocrit can be seen only within 48 – 72 hours.

Replacement of lost blood with fluids reduces haematocrit and doing serial HCT would give rough estimates blood loss. Some centres use serial HCT for the calculation of acceptable blood loss transfusion.

$$\text{Acceptable blood loss} = \frac{\text{HCT starting} - \text{HCT acceptable} \times \text{Blood volume}}{\text{Average HCT (Average of Starting and Acceptable)}}$$

The adult volume of blood = 75mls/Kg

This method of estimation is useful only when blood loss is significant. It can give inaccurate results due to hemodilution or hemoconcentration depending on the level of hydration.

- The use of the electrical method for measurement of blood loss relies on the fact that blood is a conductor of electricity because of its composition of electrolytes. A modified Wheatstone bridge is used to measure conductivity in this method. It is able to measure a loss of as little as 1 millilitre of blood lost. This method is however not practical for application in routine surgery.²¹

STUDY RATIONALE

Blood loss is an inevitable event in surgery. Determining the amount of blood lost for various elective surgeries is important for the following reasons.

First and foremost, it will enable the surgical team to plan for the surgery in terms of how much blood to set aside for each procedure pre-operatively. This will also enable the institution towards creating a maximum blood-ordering schedule. This will eventually improve the efficiency of distributing blood units to other departments of the hospital, which may need this scarce item more.

It was also important to carry out this study to enable the institution identify which surgical units have more significant blood losses during surgery so as to provide a framework for planning for the introduction of newer or more efficient methods of blood loss minimisation in these units.

The blood loss determination for different surgeries may also be used as modality for regular medical audit in the various disciplines of surgery.

OBJECTIVES OF THE STUDY

General Objective

To estimate the amount of blood loss during major elective surgery in Kenyatta National Hospital.

Specific Objectives

- I. Determine the intraoperative blood loss by the gauze rolls and suction bottle method for every operation performed.
- II. Document the different methods used in theatre for blood loss minimization.

DESIGN AND METHODOLOGY

DESIGN

This is a hospital-based study. It was based on patients operated in the main theatres of Kenyatta National Hospital

STUDY AREA

The study was carried out in the main theatres of Kenyatta National Hospital.

STUDY PERIOD

This project was carried out between January 2006 and March 2006.

ETHICAL ASPECTS

This study was commenced upon the approval of the ethical and research committee of the Kenyatta National Hospital.

Informed consent was obtained from the patients.

The privacy and confidentiality agreement with the patients was fully respected.

STUDY POPULATION

Inclusion Criteria

All consenting adult male and female patients of between 15 years and 85 years of age undergoing major elective surgery in the main theatres in Kenyatta National Hospital during that period defined except those in the exclusion group as stated below. The major surgeries to be studied are as follows - all general surgical cases , urological, major orthopaedic, cardiothoracic and neurosurgical operations.

EXCLUSION CRITERIA

- i. Patients operated in the main theatres as emergencies
- ii. Patients with known or suspected bleeding disorders or patients on anticoagulant therapy
- iii. Patients who underwent closed procedures such as passage of sound, manual anal dilatation, endoscopy etc.
- iv. Procedures, which are done in minor theatres or side rooms.
- v. Patients who did not consent to the study

SAMPLE SIZE DETERMINATION

This is a semi-qualitative study.

Blood loss during elective surgery is assumed to follow a normal distribution. Going by the central limit theorem underlining the normal distribution, a minimum sample of 30 subjects is required in order to estimate blood loss during surgery.

In this study, however 65 patients were studied to increase reliability of the outcome.

SAMPLING PROCEDURES

Patients who satisfied the selection criteria were randomly selected until the sample size was reached.

DATA COLLECTION

The principal investigator did the routine evaluation of the patients and performed the appropriate investigations.

PROCEDURE

The theatre staff were duly informed about the study being conducted. For every operation the following was done;-

The method for estimating loss was by the gauze swabs, towels and drapes and suction bottle method. Before every operation was started the gauzes, towels and drapes were weighed using a scale that measures up to 5 unit grammes. At the end of the surgery when the above were soaked with blood they were then weighed again using the same weighing scale. The weight gain in grammes was then tabulated. It is estimated that one gram weight gain in a swab for example is a result of one millilitre of blood lost^[15]. The total blood loss also included the amount of blood collected in the suction bottle if any was used. Additionally the kind of blood loss minimisation method used during the operation was also documented.

The above information was used in the designed questionnaires.

STUDY LIMITATIONS

1. The weighing scales used had a graduation unit of 5gms so it was difficult to assess blood loss of less than 5mls. However, close estimations were made to reduce the margin of error.
2. Difficulties in estimating blood loss on the floor.
3. During long operations, gauze swabs, rolls, dried due to atmospheric factors increasing inaccuracy during weighing.

DATA HANDLING

The data was entered into a computer using SPSS data entry program. All data was analysed using the SPSS/ PC for windows program and involved descriptive statistics like mean, population distribution etc where applicable in an effort to answer the objectives of this study. For each operation performed the estimated blood lost was documented. The duration of the surgery, the methods used for reducing blood loss that were utilised.

BUDGET

DETAILS	AMOUNT (KSH)
Literature Search	10,000.00
Questionnaire preparation	5,000.00
Proposal writing/editing	5,000.00
Data Collection	5,000.00
Data Analysis	10,000.00
Draft dissertation printing	5,000.00
Final dissertation printing	10,000.00
Research assistant fee	15,000.00
Contingencies 10%	<u>6,500.00</u>
TOTAL	<u>71,500.00</u>

The principal investigator financed the budget.

4. RESULTS

A total of 65 surgical cases were studied. The patients had an age range between 16 - 81 years with a mean of 48.75 years +/- 18.56 years (s.d)

Different operations were performed in the five surgical units as shown in table 1. All the operations were done by consultants in the respective disciplines.

The haemoglobin measurement was done for all patients before surgery. These ranged from 9.0 g/dl – 17.4 g/dl with a mean of 12.6 g/dl.

29% of patients had haemoglobin of less than 12 g/dl. See figure 2.

All patients had platelets measured. Only one patient had a lower than normal count. ($113 \times 10^9/L$) otherwise all other patients had a range of 188 – $504 \times 10^9/L$.

Urea levels were also evaluated for and ranged between 2.0 to 11.7mmol/L (Normal values = 2.5 – 8.3 mmol/L).

The postoperative haemoglobin ranges 9.1 to 15.0 g/dl; the median was 11.90 g/dl. About 60 % of patients had a postop Hb of less than 12.4 g/dl. Only 15% had a postop Hb of more than 13.7g/dl. When compared with pre-operative Hb levels, there was a mean difference of 0.93 g/dl ($p < 0.001$).

The duration of operation during these surgeries was also recorded with the shortest time being between 60 and 90 minutes (one hour and fifteen minutes) and the longest was six hours. Majority of the operations (56.9%) took over 1 ½ hours to complete about ¼ of these took over 3 hours. all neurosurgical operations studied took over 3 hours (see table 2).

Diathermy was used in all the surgical operations. It was observed that in orthopaedic surgery diathermy was used for shorter durations more so in the first five or so minutes of the surgery.

Anaesthetists used general anaesthesia more than regional anaesthesia. In this study, only 13.8% of patients were operated using spinal anaesthesia. These were orthopaedic and urology patients. (See table 5)

Intra-operative blood transfusion

A total of 10 patients (15.4%) received blood transfusion intra-operatively. their blood loss ranged between 500 mls to 1,515mls. Only 30% of those got 2 or more units intra-operatively.

Only 5 patients got transfusion within 24 hours of surgery. All except one got transfused after blood loss of more than 1100 mls was noted intra-operatively. They had already received 1- 2 units intra-operatively. The exceptional patient got blood as requested by the anaesthetist as the patient appeared pale immediately postoperatively despite a preoperative Hb of 10g/dl and an intraoperative loss of 410 mls.

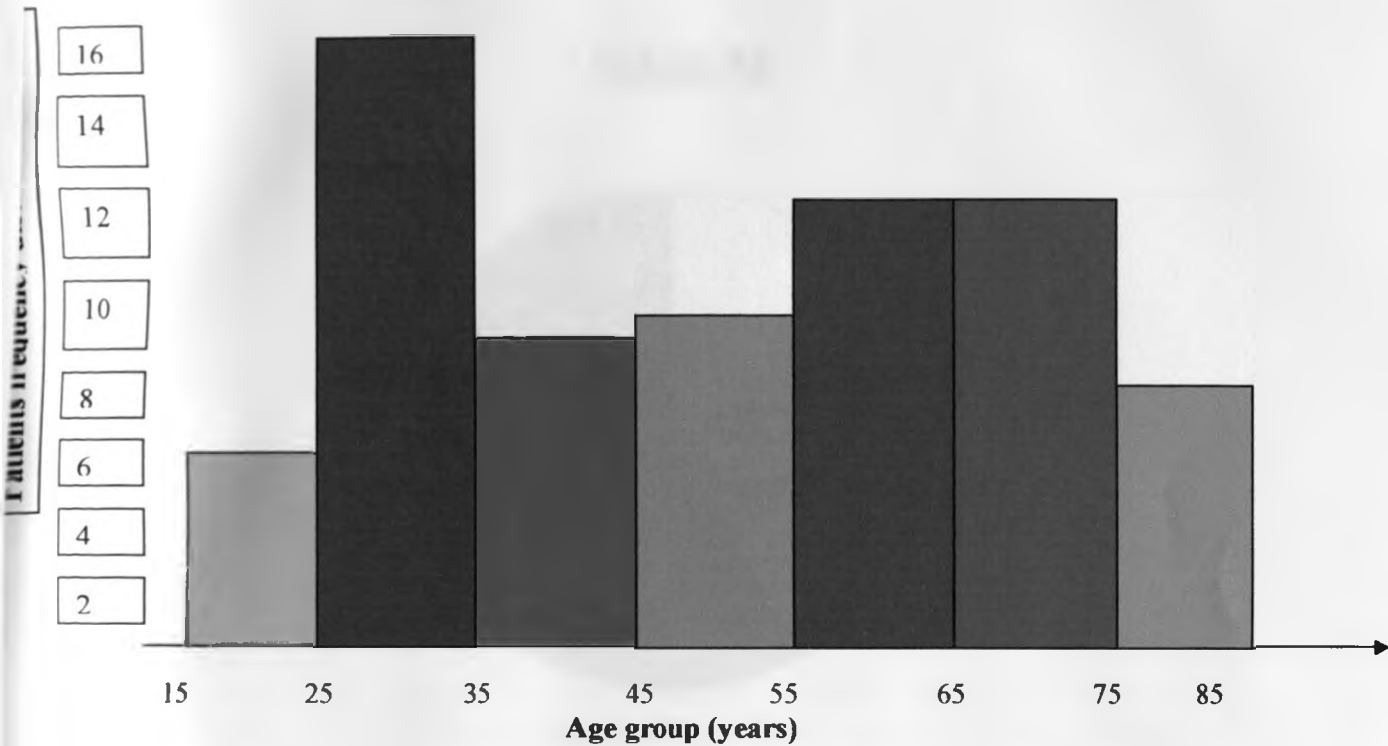
A total of 76 units of whole blood had been cross matched for the surgeries cumulatively. Only 19 units were transfused. (Requests ranged from 1 – 4 units) see table 4 / figure 4

The surgical unit which requested blood and least needed it intraoperatively within twenty four hours of surgery was urology. As an example in retropubic prostatectomy 2 units were requested in each case and none used a single unit. It was closely followed by orthopaedics where 17 units were requested and only 1 was transfused.

The estimated blood loss from all the study operations ranged from 115 – 1515 mls. The estimated mean blood loss was 492.77mls.

In general it was noted that longer operations were visited upon by higher losses of blood. Operations which took less than 1 ½ hours lost an average of 316.76 mls. While those that took longer than 1 ½ hours lost 625.95 mls.

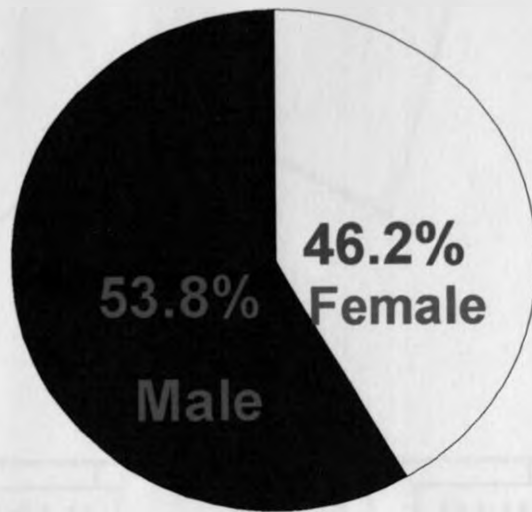
Figure 1a



FREQUENCY OF PATIENTS AGAINST AGE

The patients who underwent the surgical procedures ranged in age from 16 – 81 years.
The mean age was 48.75 years.

Figure 1b



Male: Female Distribution

The distribution above shows a slightly higher proportion (7.6%) of males to females in the study population

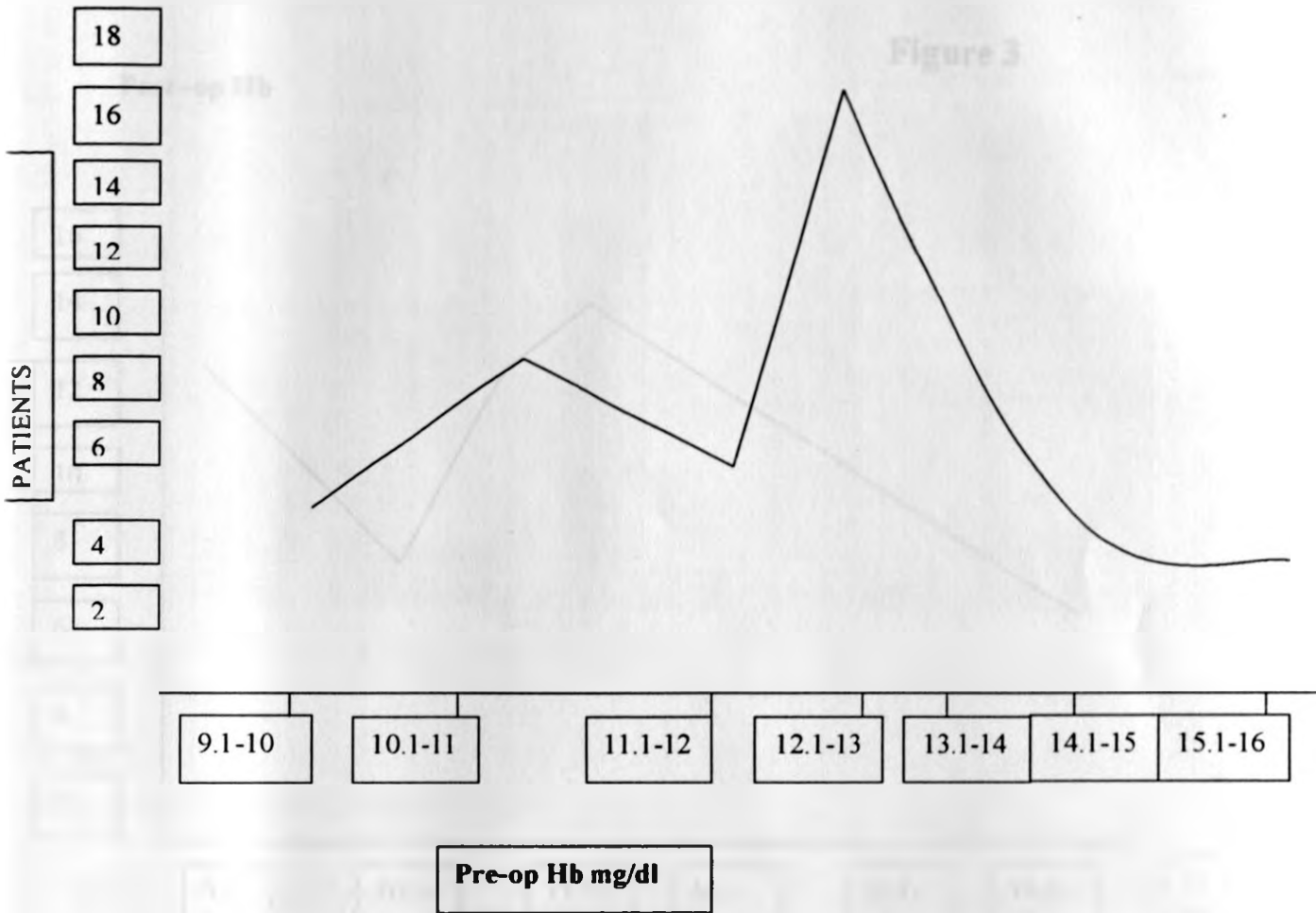


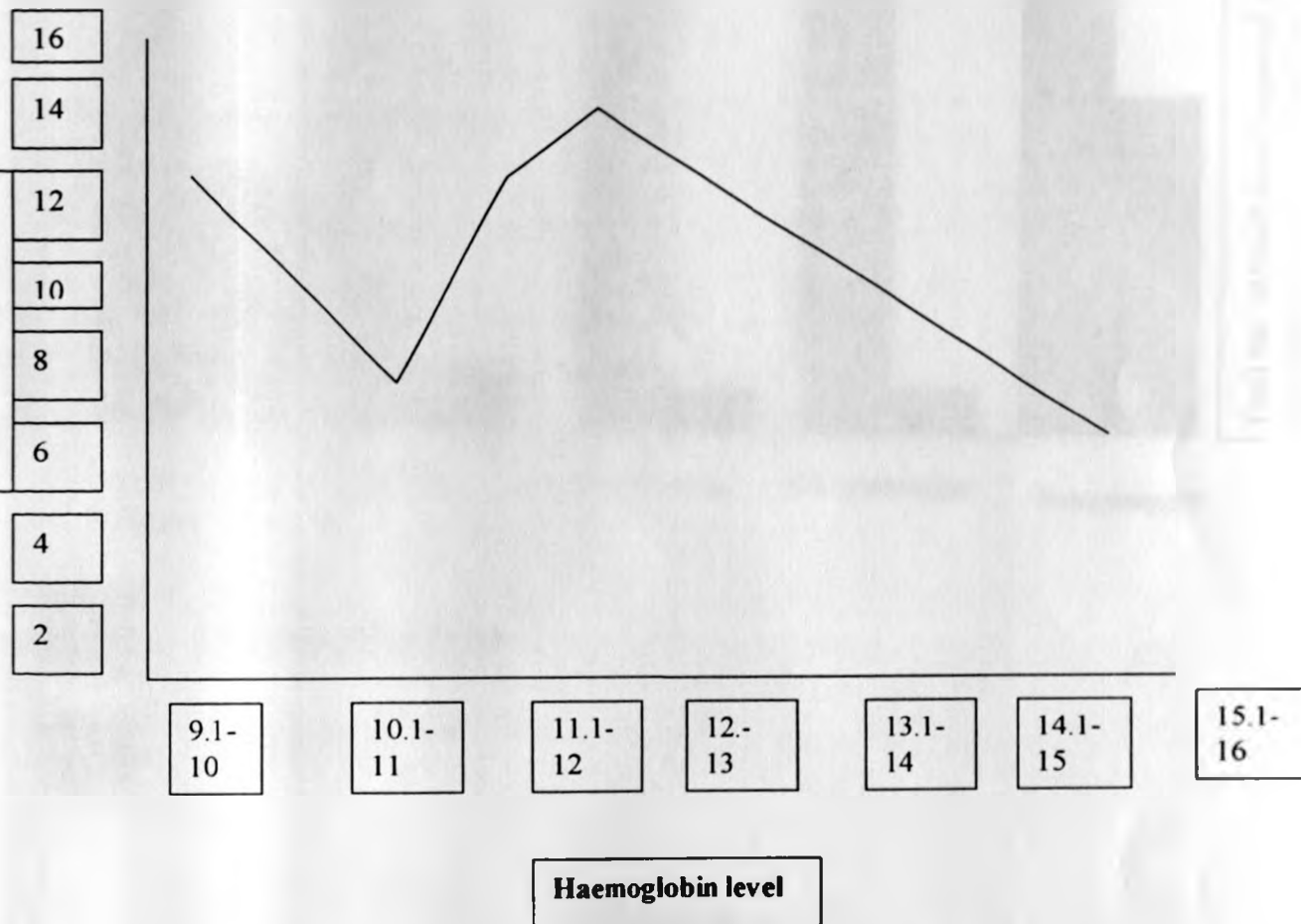
Figure 2

PRE-OPERATIVE HAEMOGLOBIN LEVELS

Majority of the patients studied had a pre-operative Hb of above 12 g/dl (above 71%). only 1 patient had a pre-operative Hb of less than 10g/dl (9.3 g/dl). He underwent open reduction and internal fixation using a Knail for a fracture of the femur.

Figure 3

Post-op Hb



POST OPERATIVE HAEMOGLOBIN LEVELS

The post-operative Hb median was 11.90g/dl. About 60% of the patients had a post-op Hb of less than 12.4g/dl. The mean difference with the pre-operative values was 0.93g/dl (p<0.001).

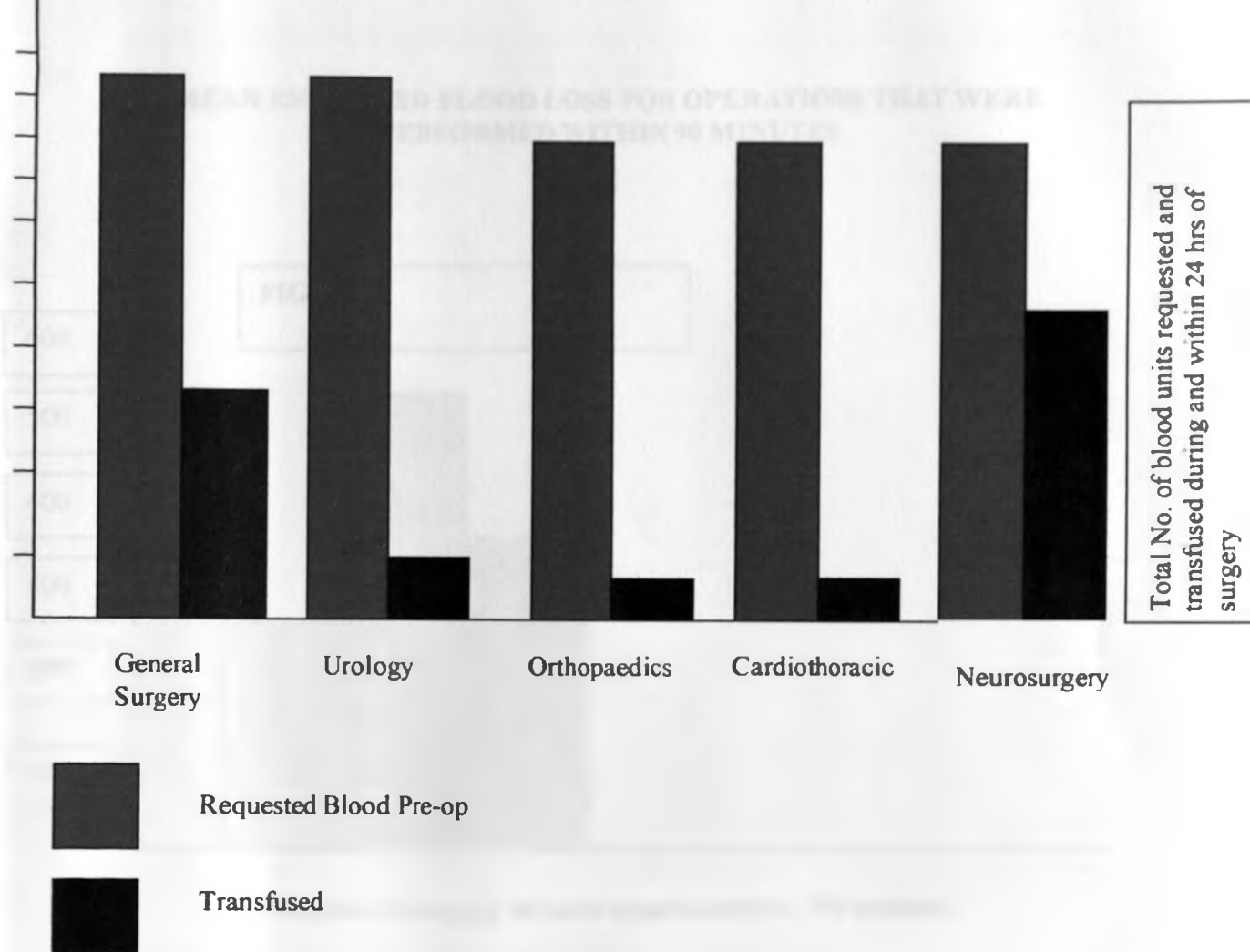
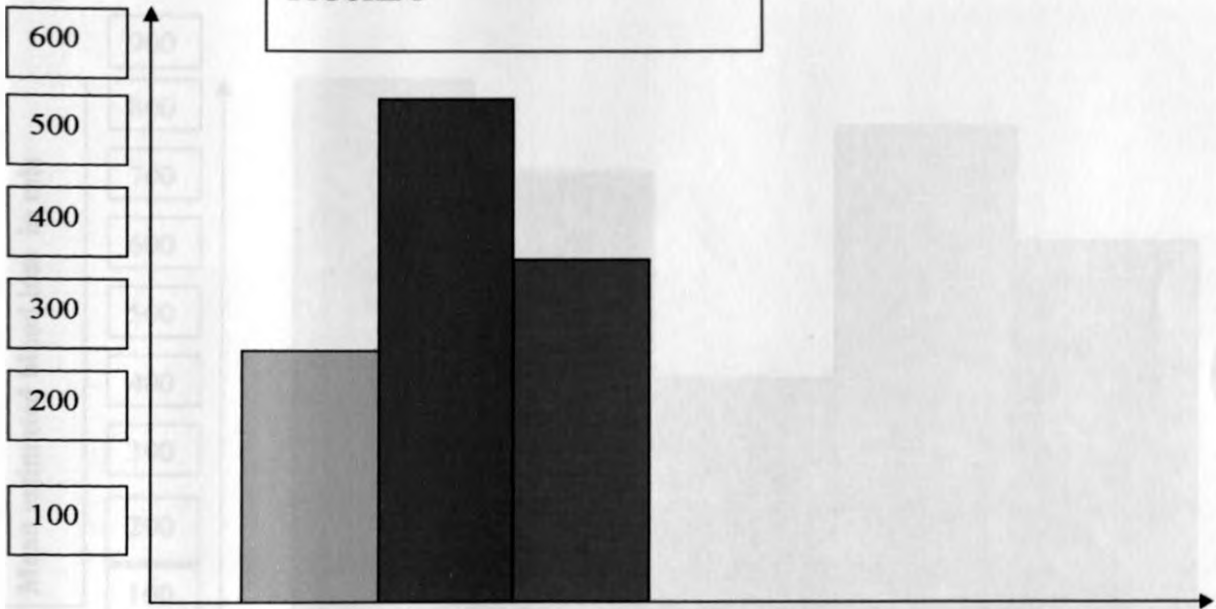


Figure 4
BLOOD TRANSFUSION AND ITS REQUEST IN SURGICAL UNITS




The total number of blood units ordered pre-operatively in the 65 cases studied was 76 units. Each surgical unit requested blood and only 19 units (25% of the total) were transfused. In neurosurgery 63.6% of ordered blood was transfused whereas in orthopaedics only 5.8% of the requested blood was utilized.

MEAN ESTIMATED BLOOD LOSS FOR OPERATIONS THAT WERE PERFORMED WITHIN 90 MINUTES

FIGURE 5



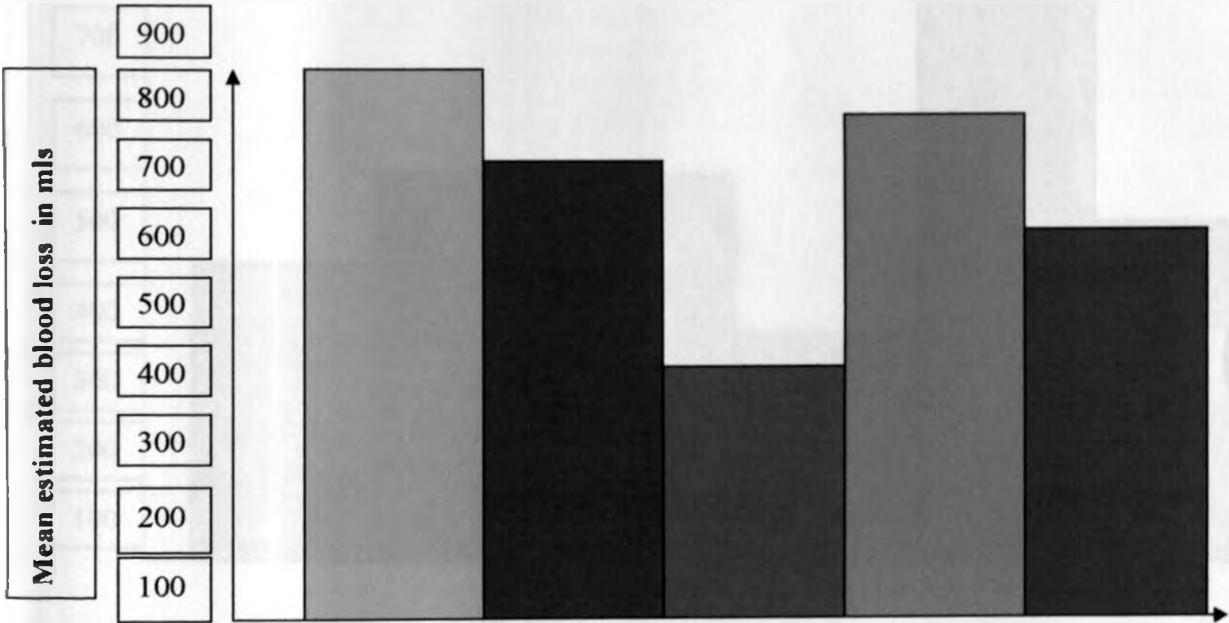
Duration of surgery for each department (61 – 90 minutes)

-  General Surgery
-  Urology
-  Orthopaedics






The mean estimated blood loss for operations which took less than 1 ½ hours shows that there was a higher amount of blood loss during urological procedures (474.17mls) than in the other study unit operations.

MEAN ESTIMATED BLOOD LOSS FOR OPERATIONS WHICH TOOK OVER 90 MINUTES

FIGURE 6



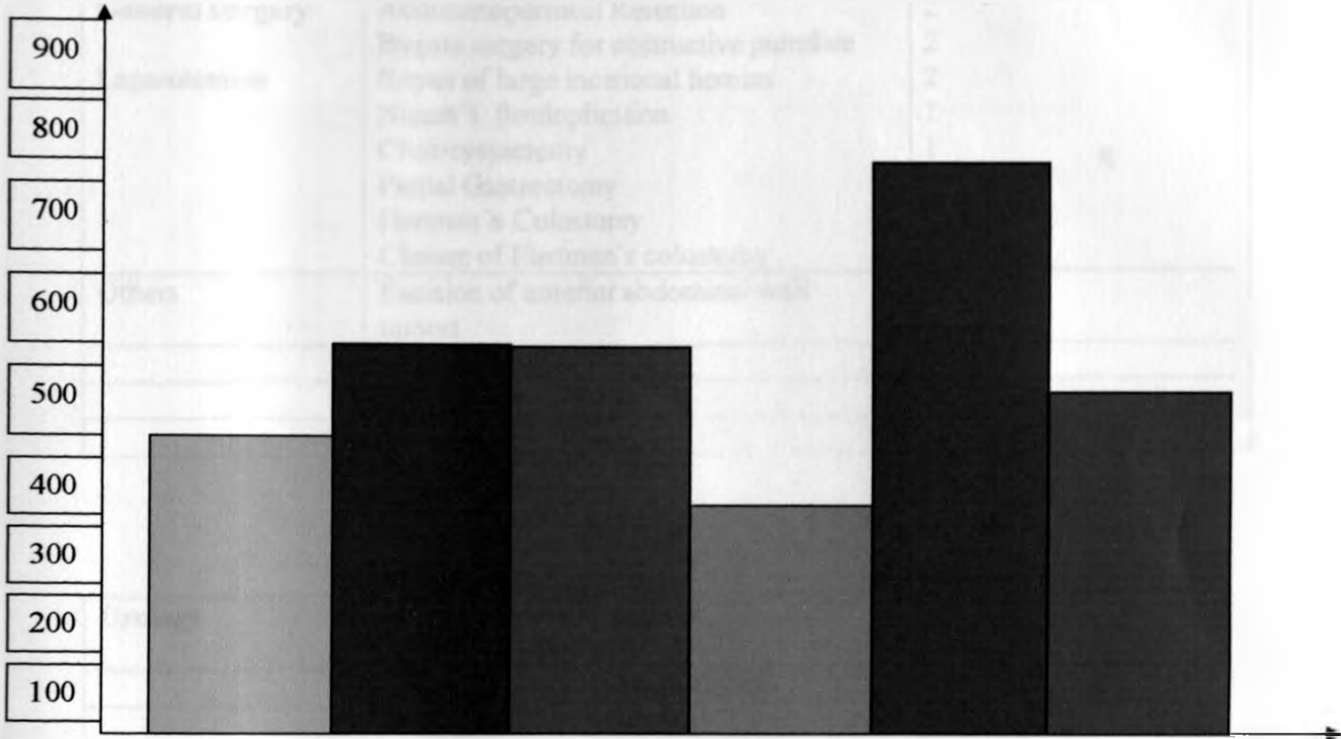
Duration of surgery for each department (above 90 minutes)

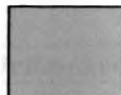





-  General surgery
-  Urology
-  Cardiothoracic
-  Neurosurgery
-  Orthopaedics

A total of 37 cases (57%) took over 1 ½ hours to perform. The highest mean estimated blood loss was seen in general surgery (860.71 mls) this was high because an abdominoperineal resection had a loss of 1190 mls and took 3 hours to perform.

OVERALL MEAN ESTIMATED BLOOD LOSS IN ALL SURGICAL UNITS

FIGURE 7



-  General surgery
-  Urology
-  Orthopaedics
-  Cardiothoracic
-  Neurosurgery
-  Mean estimated blood loss for all departments

The mean estimated blood loss overall for all the cases was 492.77 mls. The surgical unit with the highest mean loss was neurosurgery where 6.1% of the cases were done.

TYPES OF SURGERY PERFORMED

TABLE 1

Department	Type of surgery	Number of operation
General surgery	Abdominoperineal Resection	2
	Bypass surgery for obstructive jaundice	2
Laparotomies	Repair of large incisional hernias	2
	Nissen's fundoplication	1
	Cholecystectomy	1
	Partial Gastrectomy	1
	Hartman's Colostomy	1
	Closure of Hartman's colostomy	2
	Others	Excision of anterior abdominal wall tumors
	Thyroidectomy	5
	Mastectomy	4

Urology	Millin's Retropubic Prostatectomy	7
	Ureteric Re-implantation	2
	Excision of bladder diverticulum	2
	Ureterolithotomy	1

Orthopaedics	Knailing (Femur)	7
	Plating (Femur)	5
	Plating (Tibia)	2
	Orif (Hip)	2
	Arthroplasties(Knee,Hip)	4

Cardiothoracic	Transhiatal Oesophagectomy	5
Neurosurgery	Craniotomies	3
	Cervical spine decompression for spinal malignancy	1

Total number of cases 65

The above table shows the type of operations performed in the respective surgical units. General surgical operations accounted for 36.9% of all the cases studied while neurosurgical cases were 6.15% of the cases.

TABLE 2

Duration of surgery as per department

Department		Duration of surgery in minutes		Total
		61-90	above 90	
General surgery	No. of cases	17	7	24
	% within Department	70.8%	29.2%	100.0%
Urology	No. of cases	6	6	12
	% within Department	50.0%	50.0%	100.0%
Orthopaedics	No. of cases	5	15	20
	% within Department	25.0%	75.0%	100.0%
Cardiothoracic	No. of cases	0	5	5
	% within Department	0.0%	100.0%	100.0%
Neurosurgery	No. of cases	0	4	4
	% within Department	0.0%	100.0%	100.0%
Total	No. of cases	28	37	65
	% for all departments	43.1%	56.9%	100.0%

Majority of the cases (56.9%) took longer than 1 ½ hours. All cases studied in cardiothoracic and neurosurgery took longer than 90 minutes. However, 70.8% of the cases in general surgery were performed in less than 1 ½ hours.

TABLE 3

TECHNIQUES OF BLOOD LOSS MINIMISATION IN THE SURGICAL UNITS

Department		Technique of blood loss mirimization used					Total
		diathermy	diathermy & surgicel	diathermy & jungle juice	diathermy & toumiquets	diathermy, surgicel & jungle juice	
General surgery	No. of cases	10	5	3	0	6	24
	% within Department	41.7%	20.8%	12.5%	.0%	25.0%	100.0%
Urology	No. of cases	7	5	0	0	0	12
	% within Department	58.3%		.0%	.0%	.0%	100.0%
Orthopaedics	No. of cases	15	0	1	4	0	20
	% within Department	75.0%	.0%	5.0%	20.0%	.0%	100.0%
Cardiothoracic	No. of cases	5	0	0	0	0	5
	% within Department	100.0%	.0%	.0%	.0%	.0%	100.0%
Neurosurgery	No. of cases	0	1	0	0	3	4
	% within Department	.0%	25.0%	.0%	.0%	75.0%	100.0%
Total	No. of cases	37	11	4	4	9	65
	% total in all Departments	56.9%	16.9%	6.2%	6.2%	13.8%	100.0%

It was found that diathermy was used in all the operations. However the other techniques were used infrequently and depended on their appropriateness during surgery. Surgicel was used in 16.9% of all the cases, mainly in general surgery and neurosurgery.

BLOOD UNITS REQUESTS AND TRANSFUSION

TABLE 4

DEPARTMENT	REQUESTED UNITS	TRANSFUSED UNITS
General surgery	19	8
Urology	19	2
Orthopaedics	17	1
Cardiothoracic	10	1
Neurosurgery	11	7
TOTAL	76	19

The total number of blood units ordered for the operations was 76 units, only 25% of these units were utilized. Neurosurgical cases utilized relatively more blood than any other unit. About 64% of the ordered blood in neurosurgery was utilized compared to only 5.9% in urology.

Type of anaesthesia used during surgery

Anaesthesia	Frequency of patients	Percent	
General anaesthesia	56	86.2	
Spinal anaesthesia	9	13.8	

Table 5

Anaesthetists used general anaesthesia (86.2% of the cases) more than spinal anaesthesia. The latter was used in urology and some orthopaedic operations.

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TABLE 6

BLOOD LOSS CHARACTERISTICS IN THE SURGICAL UNITS

Duration of surgery in minutes	Department	Number of cases	Mean loss (mls)	Range of blood loss (mls)
61 – 90 min	General Surgery	17	264.12	115 – 635
	Urology	6	474.17	265 – 775
	Orthopaedics	5	307.00	150 - 455
Above 90 min	General surgery	7	860.71	320 – 1515
	Urology	6	615.00	305 – 830
	Orthopaedics	15	582.33	260 – 1040
	Cardiothoracic	5	350.00	155 – 490
	Neurosurgery	4	740.00	170 - 1190
Total for all operations		65	492.77	115 - 1515

The mean estimated blood loss for all the cases was 492.77 mls. In cases which took less than 90 minutes, the highest mean loss was in urology (474.17mls). It was generally found that longer operations had higher blood losses. For example, in orthopaedics, the mean loss in operations which took less than 90 minutes was 307.00 mls while those that took longer had a mean loss of 582.33 mls. The highest loss overall was seen in general surgery (1515mls) where a right hemicolectomy with an ileotransverse anastomosis was performed for caecal cancer.

DISCUSSION

Major elective surgery is generally known to result in significant intra-operative blood loss.¹

Various surgical operations result in varying degrees of blood loss. The loss is the main reason for replacement by transfusion of allogeneic blood with its attendant risks in this day and age. As technology advances, many methods of reducing this loss and thus subsequently the need for transfusion are being developed and adopted.²⁹

In this study 5 units of surgery were studied and the main operations conducted in these units were surveyed.

General surgery

In general most operations (70.8%) in this unit were performed within 90 minutes and the blood loss was also low with a mean of 264.12 mls. The main operations were mastectomies and thyroidectomies. These accounted for 37.5 % of all the study operations.

General surgeons used diathermy and surgical whenever they encountered bleeding in the operative site. They however favoured using jungle juice for thyroidectomy and mastectomy before placing the surgical incisions. In other studies the use of the harmonic scalpel has been evaluated for its usefulness in reducing bleeding during thyroidectomy.²² This device is not being used in KNH.

The use of jungle juice which is a preparation of lignocaine 2%, adrenaline 0.1% in a mixture with normal saline, may have contributed significantly in minimising blood loss in both operations by causing vasoconstriction at operative sites and also by improving surgical division by aiding in creating a plane for dissection.

None of these procedures were preoperatively grouped and crossmatched for blood. Going by the blood loss estimated after the operations, being an average of less than 300 mls, this practice is justified.

Urology

In this unit, a total of 12 cases were studied. The majority of these (58.3%) were retropubic prostatectomies for benign prostatic enlargement.

The blood loss from these ranged from 265 – 775 mls with a mean of 448.57 mls. Each of these patients had 2 units of blood prepared and brought to theatre and none was ever transfused. This also included in the immediate postoperative period.

The mean loss is approximately equivalent to a single unit of blood. Probably due lack of this information, and thus an overreliance of historical requesting, 2 units of blood were consistently demanded for by the surgeon. It is likely that newer methods of reducing blood loss like diathermy, surgical and administration of spinal anaesthesia assisted in minimising the resultant loss. In a study by Salonia A et al, they found that there was a significant reduction in blood loss when patients were operated using spinal anaesthesia than general anaesthesia.²³

Orthopaedics

The main operations done in this unit in the study were Knailing for fracture of the femur and Knee and Hip arthroplasties.(55% of all orthopaedic operations studied). Blood loss from Knailing ranged from 260 mls to 490 mls with a mean of 344.28 mls.

Blood loss from Knee arthroplasty was 480 to 495 mls with an average of 487.5mls. This was found to be significantly lower than in some studies done elsewhere¹³. The total Hip arthroplasties studied showed a blood loss range of 890 to 1,040 mls with a mean of 965. This was also found to be significantly lower than in certain studies carried out in Europe.¹³ This discrepancy can be attributed to the fact that the author's study population was relatively smaller compared to the studies mentioned above.

Cardiothoracic Surgery

All the patients in this study unit underwent transhiatal oesophagectomy for cancer of the oesophagus. The mean estimated blood loss was 350 mls. Only one unit of ordered blood was transfused. This was 10% of the total ordered units. This was lower than compared to a study by Tachibara M. et al which showed that 76% of ordered blood was utilized following oesophagectomy²⁴. Meticulous surgical control of bleeding and uninhibited use of diathermy may have contributed to this decreased blood loss.

Neurosurgery

Operations here took an average of 4 hours and 18 minutes to undertake. The average blood loss was 740 mls with a maximum of 1190mls in one operation. 11 units of blood were requested preoperatively in total for all the cases and only 7 units were transfused. Constantini S. et al found that the mean loss from craniotomy was 692.66mls.²⁵ (These were for excision of supratentorial brain tumors.)

These requests of blood were justified going by the considerable losses encountered. Bipolar diathermy and surgical were used in all operations. Jungle juice was infiltrated where incisions were going to be placed.

CONCLUSION

It was found that some units of surgery in Kenyatta National Hospital requested blood and rarely used it. As an example Orthopaedic surgery in general estimated blood loss from the main operations done ranged from 485 to 1040 mls with an average of 513mls and only a single unit of blood was transfused despite a request of 17 units. This is mainly due to the lack of data on estimated blood losses from these procedures and therefore surgeons over requested for historical rather than scientific reasons. These non utilisation of ordered blood is similar to what is seen in other studies. Vibhute M. et al found a non utilization of 76.86% of ordered blood in elective general surgical cases²⁶. It was 75% in this study for all surgical units overall.

Blood loss minimising techniques used in Kenyatta National Hospital main theatres showed that diathermy was utilized in all operations however surgical and other agents were used only frequently in some units. The reason this was evident was that for example tourniquets were not appropriate for certain operations. Surgical on the other hand may not be useful on bleeding from bone or joints and thus was infrequently used in orthopaedics. There was less than expected use of spinal anaesthesia (13.8%) which has been proved from other literature to reduce bleeding from lower abdominal and lower limb operations.⁶ This might be attributable to the general inclination of anaesthetists to general anaesthesia and the haste of the surgeons to get going with the operations. It was noticed that there was no use of pharmacotherapeutic agents given intraop or preop to minimize blood loss. For example the use of aprotinin in lower limb arthroplasties has been shown to reduce bleeding.⁸

RECOMMENDATIONS

1. A wider study with a larger sample size involving other units of surgery (not studied here) should be done to expand the database on estimated blood loss from major elective operations.
2. A similar study should be carried out in the paediatric group
3. The data from this study should be used to assist in the development of a Maximum Blood Ordering Schedule for Kenyatta National Hospital.
4. Kenyatta National Hospital should consider introducing pharmacotherapies like Aprotinin infusion during surgery to minimize blood loss.
5. KNH theatre anaesthetists should be encouraged to practice spinal anaesthesia especially for lower abdominal and lower limb surgeries.
6. The use of more modern techniques like argon for cautery and use of cell salvage methods may be introduced to assist in further minimizing blood loss.

APPENDIX I

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APPENDIX II. (QUESTIONNAIRE)

**ESTIMATION OF BLOOD LOSS DURING ELECTIVE SURGERY AT
KENYATTA NATIONAL HOSPITAL.**

Demographic Data

Patients Name:.....

Study Number:

IP Number:

Age:

Sex:

Residence:

Occupation:

Ward:

CLINICAL HISTORY

PHYSICAL EXAM:

1. **DIAGNOSIS:**

2. **INVESTIGATIONS:**

FULL HEMOGRAM –

Hb PCV

LFTs

U/E/C:

OTHER INVESTIGATIONS (SPECIFY IF DONE)

.....
.....
.....
.....
.....

3. SURGERY DONE (SPECIFY)

.....
.....
.....

4. DURATION OF SURGERY

TICK WHERE APPROPRIATE

Upto 30 min 30 – 60 min 60 – 90 min 90 – 180 min

Above 3 hours (specify)

5. MATERIALS PRE-OP Wt (gm) POST OP Wt (gm)

- GAUZE SWABS**
- GAUZE ROLLS**
- TOWELS & DRAPES**

|

6. AMOUNT OF BLOOD IN THE SUCTION BOTTLE IN MILLILITRES

.....(mls)

7. ESTIMATED AMOUNT OF ADDITIONAL FLUID INTRODUCED INTO THE OPERATION SITE (IRRIGATION FLUID) IF ANY USED

.....(mls)

8. ESTIMATED AMOUNT OF FLUID (OTHER THAN BLOOD) FROM BODY STRUCTURES FOR EXAMPLE CYSTIC FLUID IF ANY

(mls)

9. THE TECHNIQUE OF BLOOD LOSS MINIMIZATION USED

(Circle where appropriate)

- a. Diathermy
- b. Surgicel
- c. "Jungle juice"
- d. Tourniquets
- e. Others (specify)

10. TYPE OF ANAESTHESIA USED DURING SURGERY

(Circle where appropriate)

- a. General anesthesia
- b. Regional anaesthesia
- c. Others (specify)

11. BLOOD TRANSFUSED (IF ANY) DURING SURGERY AND WITHIN 24 HOURS POST-OP

..... (UNITS)

12. POST-OP INVESTIGATIONS

FULL HEMOGRAM

CONSENT TO THE WILLINGNESS TO PARTICIPATE IN STUDY

Name of patient (print)

Surrogate Physician address

AND Study number

This document DOES NOT guarantee the significance an operation.

PCV Hb
The medical personnel performing at King's National Hospital as per standards and protocols recognized by the said hospital and Royal medical practitioners and Government will conduct all medical procedure observations.

LFTs ...
The physician has satisfactorily explained the proposed observation method(s) or procedure(s), the nature and purpose of study, the risk and benefit involved.

U/E/C ...
I have chosen to ask question. I have all information I desired my questions have been answered satisfactorily.

I agree to participate in the study. I have been told that if I have further questions about the study or my rights as subject I can ask the investigator.

13. COMMENTS

The information you provide will be held in the strict confidence.

Nothing will be published or discussed in a way that can identify you.

My signature below acknowledges that I have read, understood and agreed to this

Signature of patient Date

Signature of witness/donor/reader Date

The nature, known risks, purpose of study to be performed on this patient has been explained to him/her.

Signature of physician Date

APPENDIX III

CONSENT FOR WILLINGNESS TO PARTICIPATE IN STUDY

Name of patient (print).....

Surname First name others

IP NO:.....Study number.....

This document **DOES NOT** guarantees the signatories an operation.

Approved medical personnel practicing at Kenyatta National Hospital as per standards and practices recognized by the said hospital and Kenyan medical practitioners and Dentist Board will conduct all medical procedure/observations.

The physician has satisfactorily explained the proposed observation method(s) or procedure(s), the nature and purpose of study, the risk and benefit involved.

I had a chance to ask question. I have all information I desired my questions have been answered satisfactorily.

I agree to participate in the study. I have been told that if I have further questions about the study or my rights as subject I can ask the investigator.

Information about confidentiality

The information you provide will be held in the strict confidence.

Nothing will be published or discussed in public that can identify you.

My signature below acknowledges that I have read, understood and agreed to the foregoing statements:

Signature of patient:.....Date.....

Signature of witness/translator/reader/.....Date ...

The nature, known risks, purpose of study to be performed on this patient has been explained to him/her.

Signature of physician.....Date.....

KUKUBALI KWA MGOJWA KUHUSISHWA KWENYE UCHUNGUZI

JINA:

NAMBARI YA HOSPITALI:

Mkataba huu si thibitisho kwa mgonjwa kufanyiwa upasuaji.

Utafiti huu utasimamiwa na wauguzi na wafanyikazi wa hospitali kuu ya Kenyatta kuambatana na halmashauri ya baraza la wakaguzi ya nchi ya Kenya, itasimamia utafiti na uchunguzi wote.

Mkaguzi amenielezea mbinu za utafiti zitakazo tumika na uchunguzi utakaofanywa kwa madhumuni ya utafiti huu, manufaa na madhara yake.

Niko na ufahamu wa kutosha kwa sababu nilikuwa na wakati wa kuuliza maswali kuhusu swala hili na nimekubali kuhusishwa kwa maagano ya kuweza kuuliza maswali yoyote mbeleni kuhusu utafiti huu.

Kuhusiana na:

- **Kuhifadhiwa kwa matokeo ya uchunguzi.**
- **Matokeo hayatawai kuchapishwa au kuzungumziwa hadharani kunihusu.**

Sahihi yangu ni hakikisho kuwa nimesoma, kuelewa na kukubaliana na maelezo yote ya daktari kuhusu uchunguzi huu.

Jina la mgonjwa:

Sahihi:

Sahihi ya shahidi/mkalimali: Date:

Jina la Mkaguzi: Date:



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Email: KNHplan@Ken.Healthnet.org

Ref: **KNH-ERC/01/3094**

Date: **25th October 2005**

Dr. Nicodemus M. Mwea
Dept. of Surgery
Faculty of Medicine
University of Nairobi

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Dear Dr. Mwea

RESEARCH PROPOSAL: "ESTIMATION OF BLOOD LOSS DURING ELECTIVE SURGERY AT KENYATTA N.HOSPITAL." (P100/6/2005)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** revised version of your above cited research proposal for the period 25th October 2005 – 24th October 2006. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

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

PROF A N GUANTAI
SECRETARY, KNH-ERC

c.c. Prof. K.M.Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, Faculty of Medicine, UON
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