INCIDENCE AND RISK FACTORS OF ACUTE KIDNEY INJURY AFTER EMERGENCY LAPAROTOMY AT KENYATTA NATIONAL HOSPITAL

UNIVERSITY OF NAIROBI

A dissertation submitted in Partial Fulfillment for the award of Master of Medicine in General Surgery, University of Nairobi.

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STUDENT'S DECLARATION

I, the undersigned, declare that this dissertation is purely my own original work and has not been presented for a degree in any other university. Wherever I have used another person's work, I have accordingly acknowledged and referenced.

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This research proposal was submitted at the department of surgery meeting held on 22nd October 2020 at the University of Nairobi. It was subsequently approved by Kenyatta National Hospital-University of Nairobi, Ethics and Research Committee (KNH-UON ERC) on 1st February 2021. The dissertation is hereby submitted for examination with my approval as the chairman, department of surgery.

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DEDICATION

This research work is dedicated to all my teachers in surgery, colleagues, and patients for making this study possible.

I also wish to dedicate it to my beloved family and friends who have supported me in one way or another towards the accomplishment of this research project.

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LIST OF ABBREVIATIONS AND ACRONYMS

AKI	ACUTE KIDNEY INJURY
AKIN	ACUTE KIDNEY INJURY NETWORK
CKD	CHRONIC KIDNEY DISEASE
ESRD	END STAGE RENAL DISEASE
IGFBP-7	INSULIN-LIKE GROWTH FACTOR BINDING PROTEIN-7
K.N.H	KENYATTA NATIONAL HOSPITAL
KDIGO	KIDNEY DISEASE: IMPROVING GLOBAL OUTCOMES
KIM-1	KIDNEY INJURY MOLECULE-1
NGAL	NEUTROPHIL GELATINASE-ASSOCIATED LIPOCALIN MOLECULE
RIFLE	RISK, INJURY, FAILURE, LOSS AND END STAGE RENAL DISEASE
SCr	SERUM CREATININE
TAC	TEMPORARY ABDOMINAL CLOSURE
TIMP-2	TISSUE INHIBITOR OF METALLOPROTEINASES-2
UON	UNIVERSITY OF NAIROBI

OPERATIONAL DEFINITION OF TERMS

Acute kidney injury: Serum creatinine increase (SCr) by ≥ 0.3 mg/dl (≥ 26.5 μmol/l) within 48 h; or an increase in SCr to ≥ 1.5 times the baseline value, that is supposed to have happened within the first 7 days; or volume of urine < 0.5 ml/kg/h for 6 h. In this criteria, AKI is also staged for severity.

Chronic kidney disease: kidney damage or glomerular filtration rate (GFR) < 60 ml/min/1.73$m^2$for 3 months or more, irrespective of cause.

Emergency Laparotomy: surgical procedure involving a large incision through the abdominal wall to gain access into the abdominal cavity. The operation is usually performed within 1 hour of decision to operate.

Major vascular abdominal injury: abdominal injuries involving the abdominal aorta.

ABSTRACT

Background: Acute kidney injury (AKI) is one of the most under-diagnosed post-operative complications and yet associated with increased morbidity and mortality. It is influenced by both patient and procedural factors.

Study design: This was a prospective observational cohort study.

Objective: To establish the incidence and risk factors of acute kidney injury in patients undergoing emergency laparotomy at Kenyatta National Hospital.

Methodology: Convenience sampling was used to recruit 201 adults requiring emergency laparotomy and who met the inclusion criteria. The patients' biodata and pre-determined physiological parameters were captured before, during and after surgery. Data collected was entered into Microsoft Excel, and thereafter exported to SPSS version 23 for analysis. The incidence of AKI was reported as a proportion, while the AKI stage was determined and reported as frequencies and proportions. Univariate analysis of the risk factors was done via chi-square tests, and the statistically significant factors were subjected to multivariate analysis with the use of logistic regression. Odds ratio, as well as relative risk with their 95% interval of confidence, were reported where applicable. All statistical tests were considered significant if the p-value wasless than 0.05.

RESULTS: The mean age of the patients was 40.1 (SD 15.8) years, with a male a notable male predominance. The overall incidence of AKI in this study was 18.4%, with a 10%, 11.4% and 8.5% prevalence of AKI at 12, 24 and 48 hours after surgery. Age >60 years, diabetes mellitus, hypertension, duration of anaesthesia >3 hours and requirement for blood transfusion were found to be the risk factors of AKI in this study.

CONCLUSION: Patients with advanced age, pre-existing diabetes mellitus and hypertension, those undergoing major surgery and who receive Peri-operative red cell transfusion are at increased risk of developing post-operative AKI. Thus, they require close monitoring and early institution of renal protective strategies.

1.0: INTRODUCTION

AKI commonly occurs in hospitalized patients. It is associated with increased cost of care, longer hospital stays and increased in-patient mortality (1). Among the diverse perioperative organ injuries, it occurs more frequently and has considerable adverse effect on surgical outcomes (2).

Most studies on Peri-operative AKI have focused on cardiac and major vascular surgery where incidence is comparatively higher (3) . However, AKI is not restricted to cardiovascular surgery and its frequency in other surgical settings in underappreciated (4).

A large proportion of emergency general surgical procedures carried out in the Kenyatta National hospital are abdominal surgeries. Perioperative AKI has profound effect on patients' outcomes and experiences. Its associated with longer hospital stays, increased healthcare costs and higher risk of chronic kidney disease (5).AKI following emergency laparotomy has been shown to be associated with adverse patient outcomes including increased in-patient mortality and length of hospital stay(6)(7).

While many cases of Peri-operative AKI remain reversible within days to weeks, studies over the past few years suggest a strong association between AKI and progression into chronic kidney Disease (CKD). It is now known that even minor alterations in post-operative serum creatinine levels have prognostic significance, being related to longer stays in hospitals and high mortality (8)

The CKD and ESRD burden in Africa was recently evaluated in a meta-analysis and systemic review of 98 studies involving 98,432 individuals. The prevalence of CKD stages 1-5 and 3-5 was found to be 15.8% and 4.6%, respectively. In high risk populations, the prevalence of the aforementioned chronic kidney disease stages was even higher at 32.3% and 13.3%,respectively (9).In lower income countries, individuals with ESRD have inadequate access to appropriate treatment. Effective approaches are thus required for prevention, early detection and management of AKI so as to mitigate its short and long term effects (10).

There has been an evolution in the definition of AKI over the last few years so as to improve accuracy in reporting incidence and outcomes of AKI and enhance comparability of studies. The Kidney disease: improving global outcomes (KDIGO) classification, which is a merger of previous classification systems, was utilized in this study for the diagnosis of AKI. Estimated GFR was calculated using the chronic kidney disease epidemiology collaboration equation (CKD-EPI) which takes into account patients age, sex, race and serum creatinine.

Statement of the problem

Emergency laparotomy is an important surgical procedure that is frequently carried out at the Kenyatta national hospital. Since post laparotomy acute kidney injury is associated with adverse patient outcomes, Prevention, prompt detection and institution of proven treatment strategies are vital to avoid its detrimental effects. The objectives of this study was therefore to determine the incidence as well as the risk factors of AKI following emergency laparotomy.

2.0: LITERATURE REVIEW

Surgery remains a major cause of AKI in hospital in-patients. While the incidence of perioperative AKI varies depending on the specific type of surgery, it is now known that 30%-40% of all of the cases of AKI during hospitalization are seen in the operative setting(11)

With the recent introduction of novel biomarkers in AKI diagnosis, it has further been divided into two (2) subgroups, 'subclinical AKI' and 'functional AKI'. Increased levels of an AKI biomarker, without meeting KDIGO criteria, is defined as subclinical AKI. Where AKI meets the KDIGO criteria but does not result in an increase in biomarker levels, it is called 'functional' AKI(12).

Subclinical AKI is not a harmless phenomenon. Current evidence suggests up to a quarter of patients that fail to meet the traditional serum-creatinine-based criteria for the diagnosis of AKI are nonetheless likely to have acute tubular damage (13)

The AKI duration is also of prognostic significance. In a prospective study, patients were categorized patients according duration of AKI (1st group: 2 days, 2nd group: 3–6 days and 3rd group: 7 days). In the post-operative period, a total of 98 patients (1st group: 34, 2nd group: 30

and 3rd group: 34) of the 318 studied developed AKI. The in-patient mortality was greater and ICU stay longer in those who had AKI (14)

KDIGO CLASSIFICATION

Stage 1

Increased sCr × 1.5 to 1.9 baseline or >0.3 mg/dl from baseline or urine output <0.5ml/kg/h for 6 to 12 h

Stage 2

Increase sCr × 2.0 to 2.9 baseline or urine output <0.5ml/kg/h for 12 h

Stage 3

Increased sCr × 3 baseline or ≥4mg/dl or initiation of RRT OR GFR decrease <35ml/min/1.73m^2 for patients <18 yrs of age, or urine output<0.3 ml/kg/h for 24 h or anuria for 12 h

2.1 : PATHOGENESIS OF PERI-OPERATIVE ACUTE KIDNEY INJURY

Hypo-perfusion, inflammation and neuroendocrine responses are all thought to be contributing factors in the evolution of post-operative AKI. Perioperative hypovolemia is frequent and is a consequence of routine nil per mouth regimes, pathology associated fluid losses, insensible losses and the vasodilation and cardiac depression caused by anesthesia (15).

In the healthy adult, the kidney receives nearly a quarter of the cardiac output, with oxygen delivery in excess of 80 ml/min per 100g of tissue. However, there is differential supply of blood as well as well as oxygen extraction between the renal cortex and the medulla. While it extracts only 18% of the delivered oxygen, the renal cortex receives more than 90% of the renal blood volume. The renal medulla on the other hand receives 0.03ml/min/g of tissue and extracts almost 80% of the total oxygen delivered. Medullary oxygenation is thus balanced by a set of regulatory mechanisms that match utilization and supply of oxygen. Failure of these control mechanisms increases the susceptibility of the region of the medullar to hypoxic injury (16).

In low perfusion states, the kidneys switch on auto-regulatory mechanisms designed to guarantee constant renal blood flow and GFR in the wake of unstable mean arterial pressure and fluid status.

The mechanisms include afferent arteriole dilatation and efferent arteriole vasoconstriction, achieved through prostaglandin signaling and the renin-angiotensin-aldosterone systems (RAAS) activation and secretion of angiotensin II, respectively. If renal hypo-perfusion is persistent or goes below the auto-regulatory range, intrinsic release of vasoconstrictors from the renal sympathetic system causes vasoconstriction in the afferent arterioles leading reduced renal blood supply and subsequent ischaemia of the renal tubules as well as reduction in glomerular filtration rate (17).

Apart from hypo-perfusion, perioperative AKI can also result from inflammation, both systemic and local. Both the trauma of the actual operation and surgical stress lead to release of cytokines which are thought to induce tubular injury. The etiology of this inflammation is multifactorial and includes activation of the RAAS system, renal microcirculatory dysregulation, increase in oxidative stress, cytokine mediated injury, endothelial cell injury, and upregulation of apoptosis (18).

Medications used in the perioperative period can also contribute to AKI. Ischaemic kidneys are highly vulnerable to injurious stimuli such as nephrotoxins, non-steroidal anti-inflammatory medications and sepsis (19).NSAIDs disrupt renal auto-regulation by inhibiting the enzyme cyclooxygenase, thus inhibiting the synthesis of renal prostaglandins. This consequently causes unchallenged afferent and efferent arteriolar constriction by angiotensin II in a state of sustained renal hypo-perfusion, diminishing renal blood supply and glomerular filtration.

With increasing use of gentamicin for surgical prophylaxis in place of cephalosporins with the aim of reducing clostridium difficile infection, a meta-analysis and systemic review involving 18,354 patients to assess AKI risk in gentamicin based surgical prophylactic regimens , in comparison to regimens having no gentamicin showed antibiotic prophylaxis regimen with gentamicin put patients at a significant risk of developing post-operative AKI ((RR 2.99; 95% CI:1.84, 4.88) in orthopedic surgery. In the other types of surgery, the outcomes were inconclusive (20)

Another study involving 12,482 adults who underwent surgery (orthopedic, urology, vascular, gastrointestinal, and gynecology) found the change of surgical prophylaxis regimen from cefuroxime to flucloxacillin and gentamicin was indeed associated with a 94% increase in post-operative AKI in patients undergoing orthopedic procedures. The alteration in antibiotic policy has not revealed a significant increase the risk of AKI in the rest of the groups (21).

The effects of AKI are not isolated to the kidneys alone. It is currently recognized as a multipronged disease process that is systemic which can cause remote injury in other organs like lungs, heart, the liver, the brain and the gastrointestinal system. The concept of organ "cross-talk", while still poorly understood, is thought to involve interaction between an ischaemic kidney and organs that are at a distant through mechanisms such as activation of inflammatory cascades, Cell adhesion molecule and cytokine-chemokine expression, apoptosis, trafficking of leukocyte, oxidative stress and apoptosis dysregulation, which ultimately result in distant organ damage (22).

2.2 : AKI IN GASTROINTESTINAL SURGERY

The association between emergency abdominal surgery and Peri-operative acute kidney injury has been well elucidated. A prospective study assessed a total of 239 patients undergoing emergency laparotomy. The cohort also included patients who underwent re-operations. The primary effects studied were the incidence of AKI and death before discharge. 95 patients, translating to 39.7%, developed acute kidney injury. An in-patient mortality of 33.7% (32 patients) was noted in the AKI group compared to 4.9% (7 patients) who are non AKI group. AKI was noted in 81.1% of all mortalities, but none occurred when it resolved within 48 h of surgery(6)

A retrospective study evaluated 251 patients who underwent laparotomy and temporary abdominal closure (TAC) by negative pressure wound therapy for post-operative acute kidney injury. Overall, 57% of the subjects had AKI within a week of the surgery. With overall mortality of 14%, the researchers found the incidence of AKI reached a peak at 48 hours after TAC, and a direct relationship between in-patient mortality and stage of AKI was found (7)

To determine risk factors and outcomes of perioperative AKI in non-cardiovascular surgery,1200 consecutive patients were evaluated. 81 patients (6.7%) developed AKI. Age, diabetes mellitus, revised cardiac index, and ASA physical status were found as independent predictors of AKI. Significant cardiovascular (33.3% versus11.3%) adverse effects and a higher in-patient death rate (6.1% versus 0.9%) were noted in the AKI patients compared with patients without acute kidney injury (2)

A similar incidence rate of AKI was found in a multicenter prospective study involving 870 patients over 40 years who had major non-cardiac surgery. The authors utilized the KDIGO

classification system. AKI was noted in 5.6% of the patients, with pre-operative hypertension and intra-operative red cell transfusion emerging as independent risk factors (23).

The outcomes of AKI on mortality and long term effects on kidney function were evaluated in patients who underwent abdominal surgery. Of the 390 patients selected for the study, 72 (18.5%) developed AKI post-operatively. Renal complications and mortality following hospital discharge were noted to be more often in patients who developed AKI (47.2 versus 22.0%, and 47.2 versus 20.5%, respectively) with an average follow up period of 38 months(24)

There is a great variation in AKI risk across the wide range of intra-abdominal surgeries. Utilizing the American college of surgery national surgical quality improvement Programme (ACS NSQIP-2005–2010), a study retrospectively evaluated over 450,000 in-patients who had undergone different types of intra-abdominal general surgery procedures. The overall AKI incidence was just over 1%, which ranged from 0.2% in appendectomy and 0.3% in gastric bypass patients to 2.6% in small bowel resection and 3.5% in exploratory laparotomy. Of the total patients who had acute kidney injury, 31.3% were dead in 30 days, compared to 1.9% of AKI free patients. However, this study had a higher threshold for the definition acute kidney, defining AKI as a creatinine level increase of more than 2 mg/dL over the initial measure and/or requiring renal replacement therapy (25)

In a cohort of 219 patients having major surgery (22.8% exploratory laparotomies, 37.4% simple mastectomies and 16.4% total thyroidectomies), the investigators found that at 24 hours and 7 days post op, the incidence of AKI was at 18.7% and 17.4% respectively. A considerably higher in-patient mortality was found among individuals who developed AKI (20.4% vs 5.3%) (26)

The risk factors, incidence and long term AKI outcomes after hepatobiliary surgery were evaluated. 7.6% of the 131 patients studied developed AKI. The researchers found the AKI group had considerably higher MELD-Na score, lower level of albumin, and much longer stay in hospital after surgery than the AKI free group. With a median follow up of 6months, the approximated glomerular filtration rate (eGFR) in patients who developed AKI was remarkably lower than that in the AKI free group, although no differences were noted in the baseline eGFR (27)

Peri-operative acute kidney injury is a reliable predictor of adverse outcomes following non-cardiovascular paediatric surgical procedures. A prospective cohort study evaluated a total of 93

patients aged less than 15 years. Approximately 35% of the subjects developed AKI within 24 h of surgery. The crude mortality for the cohort was 12.1% with no mortality recorded in those without AKI(28)

2.3 : DIFFICULTIES IN THE DIAGNOSIS OF PERIOPERATIVE AKI

Since they are unique to the kidney and easy to measure, serum creatinine and urine output remain key to the diagnosis of AKI. However, their use in the perioperative setting may have its limitations.

Urine output is frequently reduced in the perioperative period. This is thought to be due to slowed fluid distribution, reduced clearance and the effect of anesthesia medications, thus making urine output less reliable in the diagnosis perioperative AKI (29).

Serum creatinine is also not without limitations. There is often a high variability in the synthesis and excretion of creatinine into the circulation with differences in age, sex, dietary intake, and muscle mass resulting in remarkable variations in the serum creatinine. There is also a considerable delay from injury to the required diagnostic rise in serum creatinine, with Creatinine levels beginning to rise only after the glomerular filtration rate is reduced by half. Levels of serum creatinine, therefore, do not portray real-time changes in GFR. Rather, levels of serum creatinine need time to accrue, the so called “creatinine blind” window, before they can be noticed as abnormal, hence resulting diagnostic delay (30).

2.4 : NOVEL BIOLOGIC MARKERS OF AKI

The drawbacks associated with urine production and serum creatinine in the diagnosis of AKI, including their inability to distinguish structural kidney damage from functional hemodynamic triggers of a reduced GFR, has led to investigations into the reliability of new biologic markers to improve the early diagnosis of AKI. These new markers include: neutrophil gelatinase-related lipocalin molecule (NGAL), kidney injury molecule-1 (KIM-1), Cystatin C, Tissue inhibitor of metalloproteinases-2 (TIMP-2) and insulin-like growth factor binding protein-7 (IGFBP7).

The novel biomarkers were assessed for their utility in Peri operative AKI in numerous studies. They have been found to be reliable in predicting AKI demonstrating an early rise in their

concentration when compared with conventional serum markers. Researchers have also found them to be prognostically significant (31)(32)

RISK FACTORS FOR PERI-OPERATIVE AKI

The risk of developing post-operative AKI is either patient or procedure related. Patient related risk factors, including advancing age, high blood pressures, diabetes mellitus, heart failure, peripheral and cerebrovascular disease as well as pre-existing chronic kidney disease, have been found to be more strongly related with post-operative mortality than surgical factors (33)

3.6 million American veterans undergoing diverse surgical procedures were investigated for both procedure and patient related factors. Cardiac surgery was found to have the highest post-operative AKI risk, followed by general, thoracic, orthopaedic, vascular, urologic and ear, nose and throat surgery. Older age group, hypertension, black race, lower rate of estimated glomerular filtration and diabetes mellitus were noted to be the major patient related factors in the same study (4).

Several studies have explored the effect of procedure related factors in Peri-operative AKI after abdominal surgery.

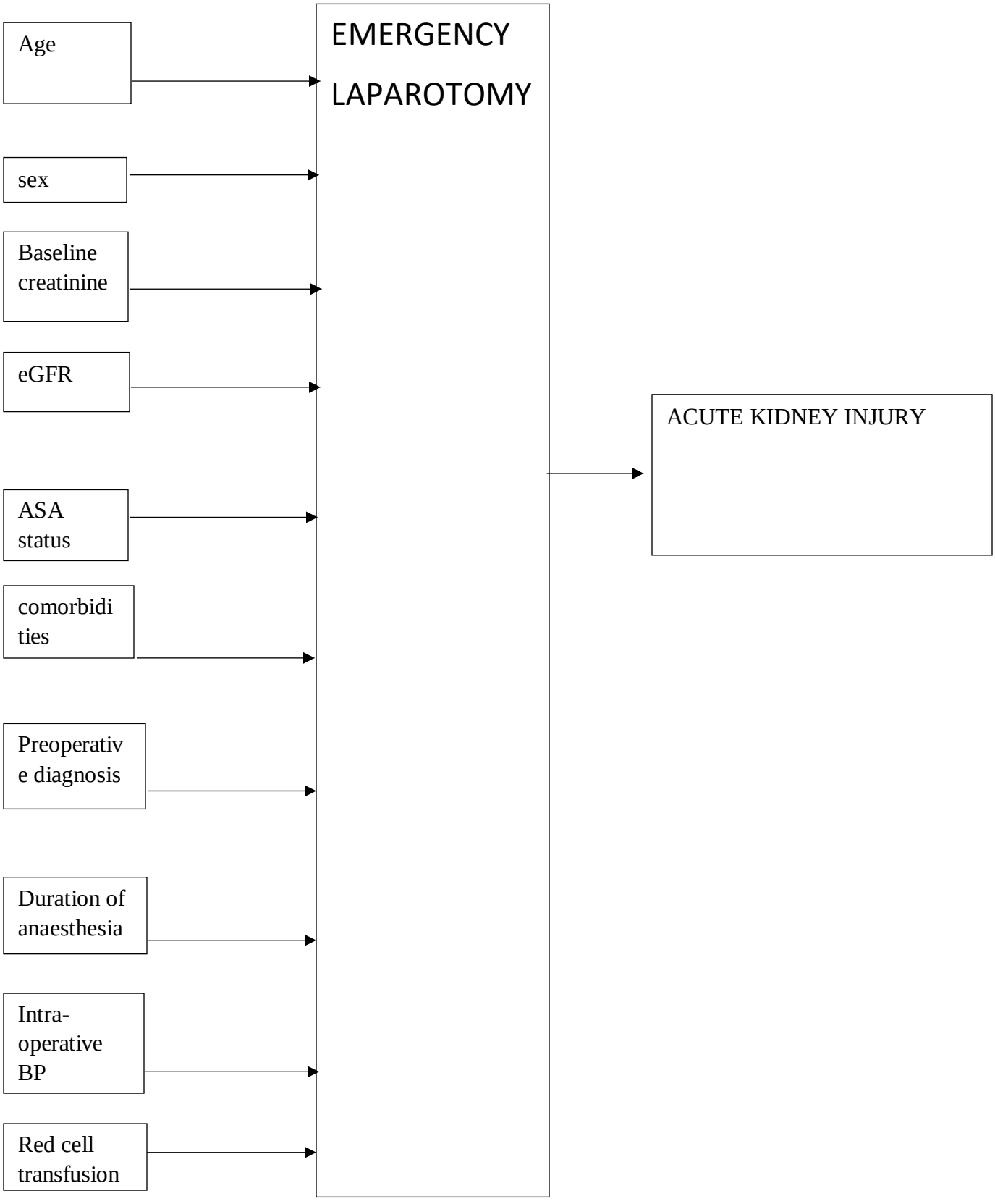
A study utilizing the AKIN classification evaluated 595 patients who had elective esophageal cancer surgery in a tertiary university hospital. Risk factors for AKI were found to be high BMI, low level of serum albumin preoperatively, use of ACEI or ARB during the preoperative period, large colloid infusion during surgery, and high postoperative day 2 C-reactive protein(34)

446 subjects having partial liver resections have been retrospectively evaluated. The model for end stage liver disease (MELD) score, the presence of non-dialytic chronic kidney disease, preoperative biliary obstruction, perioperative hemodynamics instability, hemorrhage and sepsis were found to be the danger factors of AKI in these patients (35).

Intraoperative Hypotension was assessed for association with Peri-operative AKI following elective non-Cardiac surgery in a retrospective cohort study involving 5,127 patients. Suboptimal intraoperative Mean arterial pressure less than 60 mmHg was found to be associated with post-operative AKI (36).

On the nature of abdominal surgery, whether open or minimally invasive, a retrospective study evaluated 450 patients that had abdominal surgery and found no differences in the laparotomy and laparoscopy groups when it comes to the incidence of post-operative AKI. Data from ACS–NSQIP, involving 121 Centers and a total of 152,244 different operations was utilized to develop an AKI danger index for patients having General surgical procedures. They found Age >or equal to 56years, Male gender, active congestive heart failure, Ascites, hypertension, emergency surgery, Intraperitoneal surgery, renal insufficiency–mild or moderate, diabetes mellitus–oral or insulin therapy dependent as major risk factors (37)

3.0: CONCEPTUAL FRAMEWORK



4.0: STUDY JUSTIFICATION

A huge proportion of emergency General Surgical procedures carried out at Kenyatta National hospital are abdominal surgery. Perioperative AKI has profound effect on patients' outcomes. It is associated with increased short and long-term mortality, longer in patient period, increased healthcare costs and higher risk of chronic kidney disease. There is paucity of local data on the subject.

Prevention, prompt detection and institution of proven treatment strategies are vital to avoid the detrimental effects of Peri-operative AKI. The outcomes of this study will aid clinicians in the early identification of patients at increased risk of perioperative acute kidney injury so that definitive measures at mitigation as well as treatment of established AKI can be put in place.

5.0: STUDY QUESTION

What is the incidence and risk factors of acute kidney injury after emergency laparotomy?

6.0: OBJECTIVES

6.1: Broad Objective

To determine the incidence and risk factors of acute kidney injury (AKI) after emergency laparotomy.

6.2: Specific objectives

1. To determine the incidence of AKI after emergency laparotomy.
2. To determine the risk factors and stage of AKI after emergency laparotomy.

7.0: METHODOLOGY

7.1: Study design

This was a prospective observational cohort study.

7.2 : Study area

The study was conducted at the accident and emergency (resuscitation A, resuscitation room B, room 9), the 3 general surgical wards (5A,5B,5D) and the surgical ICU of KNH. This is a 2000 bed national teaching and referral hospital which serves as the teaching hospital for the UoN, College of Health Sciences, for both the undergraduate and postgraduate programs.

7.3 : Study population

Adults undergoing emergency laparotomy, who had no preexisting kidney dysfunction nor major vascular abdominal injury and who give written consent were recruited.

7.4 : Sample size Determination and Formula

$$n = \frac{Z^2 P (1-P)}{d^2}$$

Where

n= desired sample size

P= expected true proportion (39% based on a prospective study, Dewi et al., 2018) that evaluated a total of 239 patients undergoing emergency laparotomy

D= Desired precision (0.05)

Z= value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI)

$$\frac{1.96 \times 1.96 \times 0.39 (1-0.39)}{0.0025}$$

n is therefore equal to **365**

7 .5: Sampling Procedure

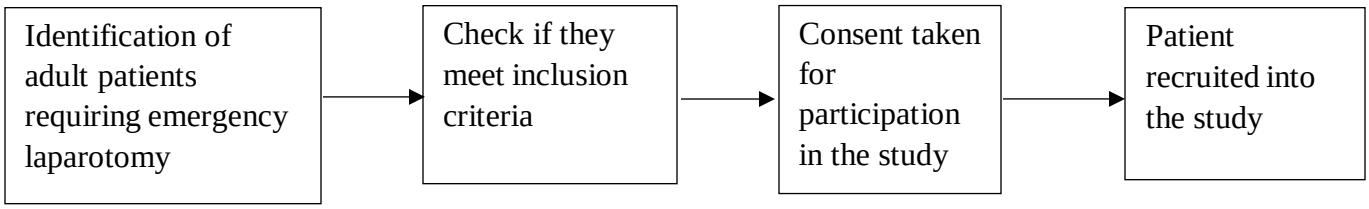
Convenience sampling of patients who met the inclusion criteria was done. A total of 201 patients were recruited. The study was explained to the eligible patient by the researcher or the research

assistant and Informed written consent was sought from the patient. Those who agree to consent were recruited into the study.

Eligible candidates recruited into the study provided the principal researcher/ research assistant with bio-data which was recorded in the data sheet. Venepuncture was performed and samples of venous blood taken under aseptic technique. The samples were analyzed for serum creatinine within 15 minutes of reaching the laboratory.

7.6 : Recruitment and Consenting Procedures

Adults patients requiring emergency laparotomy and who met the inclusion criteria and who gave a written consent were recruited.



7.7 : Inclusion criteria

1. All adults undergoing emergency non-vascular emergency laparotomy, and
2. Who have no pre-existing chronic kidney dysfunction
3. Who give a written Consent

7.7.1 : Exclusion criteria

1. Patients with chronic kidney dysfunction (estimated glomerular filtration rate <60)
2. Any patient who declines to give a written informed consent
3. Patients under 18 years of age.

7.8 : Study Data Variables

7.8.1 : Dependent Variable

- Acute kidney injury

7.8.2 : Independent Variable

- Age
- Sex
- Base line serum creatinine
- Estimated glomerular filtration rate
- Pre-operative diagnosis
- Patient comorbidities: hypertension, diabetes mellitus, ischaemic heart disease, congestive heart failure, cerebrovascular disease, chronic obstructive pulmonary disease, cirrhosis, solid and Haematological malignancy

7.9 : Data Collection Procedure

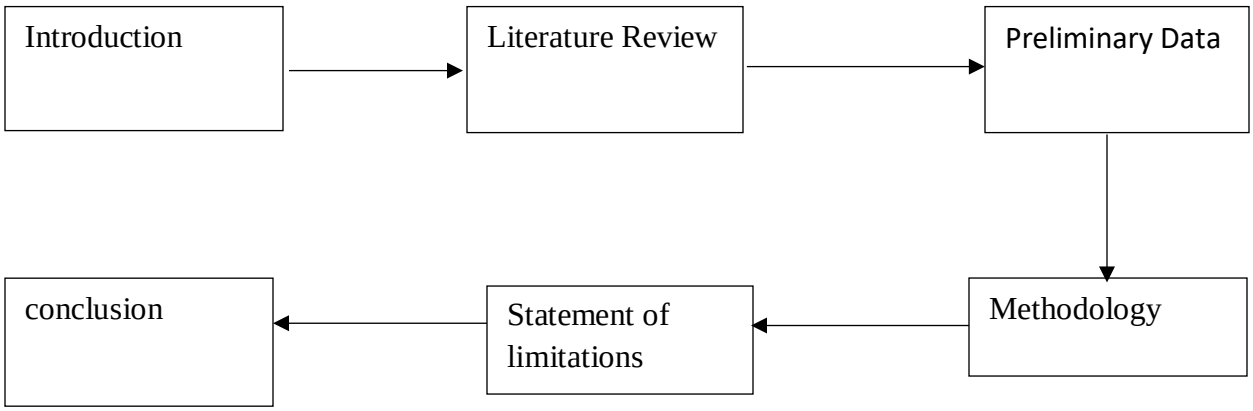
The principal researcher or the research assistant collected the entire specimen using standard procedure. Patients bio-data were matched with both laboratory request form and specimen bottle labeling and was confirmed both at the bedside and upon specimen reception at the laboratory. All specimens were delivered at the laboratory within fifteen (15) minutes of collection. At the laboratory, specimen handling and processing were done by a qualified laboratory technologist with knowledge and experience in specimen handling and processing. The serum creatinine levels in micromoles/liter were measured in all samples received.

7. 10: Quality Control

This was ensured by adhering to the standard aseptic procedure during venipuncture. KNH medical laboratory is certified by International Organization for Standardization (ISO 15189: 2012) ensuring quality and competence in the laboratory. Collected samples were analyzed using the criteria established by Clinical and Laboratory Standards Institute (CLSI).

Biolis 50i Superior clinical chemistry analyzer was utilized to measure serum creatinine in this study. It is the standard machine for medium and large laboratories for both routine and special chemistry.

7.11: Flow of the study



7.13 : Data Management and Analysis

Data was checked for completeness and accuracy prior to entry into the Microsoft Excel Spreadsheet, thereafter transferred to the SPSS version 23 for analysis.

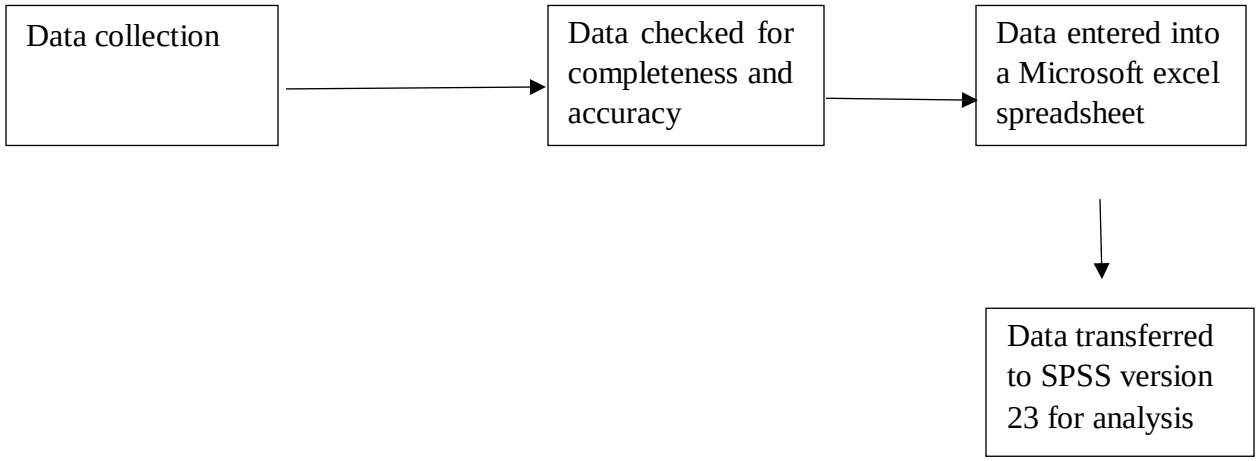
Demographic characteristics as well as clinical characteristics of the patients were analyzed and presented as frequencies and proportions for categorical data, and as means with standard deviations for continuous data.

The incidence of AKI was reported as a proportion of those patients that developed AKI over the total sample size, while the AKI stage was determined and reported as frequencies and proportions as well.

The risk factors were analyzed at univariate with the use of chi-square tests, and those factors that were significant were subjected to multivariate analysis with the use of logistic regression.

Odds ratio as well as relative risk with their 95% confidence interval were reported where applicable. All statistical tests were considered significant if p-value < 0.05.

7.14 : Data analysis plan



7.15 : Ethical Considerations

Permission to conduct this study was sought from KNH and UoN Ethics Research Committee as well as the KNH administration.

The purpose of the study was explained well to the potential participants and questions raised concerning study were tackled comprehensively before enrollment. Participation in this study was voluntary and the participants were free to opt out at any stage if they decided to.

Confidentiality was maintained throughout the study. Data from the study was accessible only to principal researcher, research assistant and data analysis manager. All data was stored in password protected drive.

8.0: Study Results: Dissemination Plan of Study Findings

The study results will be disseminated to the UoN repository and the KNH/ UoN research ethics committee, to the Department of surgery, University of Nairobi, and to the study participants. The research paper will be submitted for publication to relevant journals.

9 .0: Study limitations and de-limitations

This study has certain inherent limitations. It was a single centre observational study and the demographics of this cohort are not necessarily applicable to a wider population

A total of 201 patients were recruited in this study. This was short of the initially planned study population of 365 patients. This study was in part conducted at the height of the Covid-19 pandemic where lock down restrictions have resulted in reduction in patient numbers in all hospital departments. The low numbers may also be explained by a change in policy in the institution where this study was done where only patients with referral letters from lower level facilities were admitted thus patients who would otherwise directly come to KNH may have received care in a peripheral facility.

Changes in serum creatinine (SCr) was utilized for the diagnosis of AKI and urine output has been excluded as an additional diagnostic parameter

The study has also its own strength. Data input was done at the appropriate timing by the lead researcher or the research assistant who are both qualified medical doctors. The cohort size was also relatively large.

10.0: RESULTS

PATIENT'S DEMOGRAPHICS

The mean age of the patients was 40.1 (SD 15.8) years, where the minimum was 19.0 years and the maximum was 83.0 years. The median age was 35.0 (IQR 27.0 – 50.0) years. 80% of patients were between 21 and 60 years. 62% of subjects were male while 38% were female.

Table 1: Socio-demographic characteristics of patients undergoing emergency laparotomy at Kenyatta National Hospital between January and December 2021 (*N=201)*

		Frequency *(n=201)*	**Percent**
Age	≤20	4	2.0
	21 – 30	78	38.8
	31 – 40	36	17.9
	41 – 50	34	16.9
	51 – 60	14	7.0
	61 – 70	27	13.4
	>70	8	4.0
Sex	Male	126	62.7
	Female	75	37.3
ASA	2	15	7.5
	3	186	92.5

Various clinical parameters were recorded pre, intra and post-operatively. The mean baseline serum creatinine was 98 μmol/l while the mean was 91.8 ml/min/1.73m². Notable reduction in mean post-operative serum creatinine was seen overtime from 95.3 to 88.2 mmol/l at 12 and 48 hours' post-op, respectively. The average duration of anaesthesia was 2.7 hours.

Table 2: Clinical characteristics of patients admitted for emergency laparotomy at Kenyatta national hospital between January and December, 2021 (N=201)

	Mean (SD)	Median	Min - Max
Baseline serum creatinine (µmol/l)	98.0 (37.0)	93.2 (82.0 – 106.4)	38.0 – 365.0
Estimated glomerular filtration rate (mL/min/1.73m²)	91.8 (28.9)	90.0 (68.4 – 111.5)	14.8 – 160.5
Heart rate(beats/minute)	96 (15)	93 (86 - 103)	61 – 142
Systolic blood pressure (mmhg)	122 (15)	120 (113 - 130)	63 – 176
Post-operative serum creatinine			
12 hours	95.3 (31.0)	96.0 (78.0 – 110.0)	32.0 – 369.0
24 hours	92.3 (31.9)	90.0 (72.0 – 100.0)	23.0 – 350.0
48 hours	88.2 (28.7)	81.0 (70.1 – 97.0)	34.4 – 274.0
Pre-operative HB	13.3 (2.4)	13.2 (12.0 – 14.5)	5.0 – 22.1
Duration of anaesthesia	2.7 (0.7)	2.5 (2.0 – 3.0)	1.5 - 4.5

Majority (28.9%) of patients in this study had intestinal obstruction, followed by penetrating abdominal trauma that accounted for 17.4%. Only one patient with strangulated epigastric hernia that required resection was recruited in this study.

Table 3: Indications of emergency laparotomy at Kenyatta National Hospital between January and December,2021 (N=201)

	Frequency	Percent
Blunt abdominal trauma	30	14.9
Intestinal obstruction	58	28.9
Intra-abdominal abscess	4	2.0
Penetrating abdominal trauma	35	17.4
Perforated appendicitis	24	11.9
Perforated colon tumor	6	3.0
Perforated duodenal ulcer	20	10.0
Perforated gastric tumour	1	0.5
Perforated gastric ulcer	8	4.0
Perforated small bowel	10	5.0
Strangulated epigastric hernia	1	0.5
Strangulated inguinal hernia	4	2.0

Approximately 15% of patients had hypertension while 12% had diabetes mellitus. Only 2% of subjects had a pre-existing solid malignancy. 9.3% of patients had intraoperative hypotension but only 1% required intra-operative vasopressors. 12.4% required red cell transfusion either intra-op or post operatively.

The overall incidence of AKI in this study was 18.4%

Table 4: Risk factors of AKI after emergency laparotomy

		Frequency *(n=201)*	**Percent**
Hypertension	Yes	30	14.9
	No	171	85.1
Diabetes	Yes	25	12.4
	No	176	87.6
Ischaemia heart disease	Yes	1	0.5
	No	200	99.5
Congestive heart failure	No	201	100.0
Cerebrovascular disease	Yes	1	0.5
	No	200	99.5
Chronic obstructive pulmonary disease	Yes	2	1.0
	No	199	99.0
Cirrhosis	Yes	1	0.5
	No	200	99.5
Solid malignancy	Yes	4	2.0
	No	197	98.0
Haematological malignancy	Yes	1	0.5
	No	200	99.5
Intraoperative hypotension	Yes	19	9.5
	No	182	90.5
Erythrocyte transfusion	Yes	25	12.4
	No	176	87.6
Vasoactive drugs use	Yes	2	1.0
	No	199	99.0

Table 9: incidence of AKI after emergency laparotomy at Kenyatta National Hospital between January and December, 2021 (N=201)

Laboratory		
	Frequency	**Percent**
AKI	37	18.4
No AKI	164	81.6

Table 6: Prevalence of AKI after emergency laparotomy at Kenyatta National Hospital between January and December, 2021 (N=201)

Laboratory		
	AKI	**No AKI**
12 hours	20 (10.0)	181 (90.0)
24 hours	23 (11.4)	178 (88.6)
48 hours	17 (8.5)	184 (91.5)

The prevalence of AKI post operatively. 10%, 11.4% and 8.5% of patients had AKI at 12, 24 and 48 hours after surgery

Age >60 years, diabetes mellitus, hypertension, duration of anaesthesia >3 hours and requirement for blood transfusion were found to be the risk factors of AKI in this study

Table 7: Association of socio-demographic and clinical characteristics among patients with AKI after emergency laparotomy (N=201)

	n	**AKI, *n (%)***	**No AKI, *n (%)***	**OR (95% CI)**	**p-value**
Age in years					
<60	165	14 (37.8)	151 (92.1)	Reference	
≥60	36	23 (62.2)	13 (7.9)	19.1 (8.0 – 45.7)	**<0.001**
Diabetes					
Yes	25	21 (56.8)	4 (2.4)	52.5 (16.0 – 171.9)	**<0.001**
No	176	16 (43.2)	160 (97.6)	Reference	
Hypertension					
Yes	30	20 (54.1)	10 (6.1)	18.1 (7.3 – 45.0)	**<0.001**
No	171	17 (45.9)	154 (93.9)	Reference	
Duration of anaesthesia					
≤3.0 hours	164	3 (8.1)	161 (98.2)	Reference	
>3.0 hours	37	34 (91.9)	3 (1.8)	608.2 (117.7 – 3143.3)	**<0.001**
Erythrocyte transfusion					
Yes	25	10 (27.0)	15 (9.1)	3.7 (1.5 – 9.0)	**0.003**
No	176	27 (73.0)	149 (90.9)	Reference	

We evaluated the stage of AKI at 12, 24 and 48 hours after surgery. All the patients who developed the outcome of interest in this study had either stage 1 or stage 2 disease, with no patient developing stage 3 AKI. A proportion of patients who developed AKI did not meet the criteria for staging (serum creatinine increase was <1.5 times the baseline)

Table 8: staging of AKI

	Total	**Stage 1**	**Stage 2**
12 hours	9	6	3
24 hours	7	5	2
48 hours	7	6	1

11.0: DISCUSSION

Surgery remains a major cause of acute kidney injury (AKI) in hospital in-patients. While the incidence of perioperative AKI varies depending on the specific type of surgery, 30%-40% of all of the cases of AKI during hospitalization are seen in the operative setting(11)

This was a prospective observational study of 201 patients whose aim was to evaluate the incidence and risk factors of acute kidney injury after emergency laparotomy.

The overall incidence of post-operative AKI in this cohort was 18.4%. This was considerably lower than the rate reported by two other prospective studies that also evaluated the incidence of AKI after emergency laparotomy, which found an overall incidence of 39.7 and 57%, respectively(6)(7). The former study was carried among non-African (Caucasian) population with a median age of 68 years. This was considerably older than our cohort which had a median age of 40 years. The latter study evaluated critically ill patients and included patients requiring re-operation after the initial laparotomy, a proportion of whom required open abdomen management with temporary abdominal closure. Re-operation is an independent risk factor for post-operative acute kidney injury(38)

The incidence of post-operative AKI found in our cohort was higher than that found in a retrospective study utilizing the American College of Surgeon national surgical quality improvement (NSQIP) data that revealed an overall AKI incidence of 3.5 % in post laparotomy patients. However, this study had a higher threshold for the definition acute kidney than was utilized in our study(25)

Our study finding in terms of incidence of post-operative acute kidney injury mirror those of a Nigerian study that evaluated patients undergoing a host of general surgical procedures(26). They found an overall AKI incidence of 18.7% and 17.4% at 24 hours and 7 days' post op. However, only 22.8% of this patients underwent laparotomy.

The risk factors of post-operative AKI can be patient or procedure related. We found Age >60 years, preexisting diabetes mellitus and hypertension, duration of anaesthesia >3 hours and requirement for blood transfusion to be the risk factors in this study.

Several studies have found age as an independent risk factor for post-operative acute kidney injury. Grams et al found advancing age as independent risk factor of post-operative AKI in their retrospective analysis of 3.6 million American veterans undergoing both cardiac and non-cardiac surgery. The overall AKI incidence in this cohort was 11.8%(4). O'Connor et al in their systematic review and meta analysis of 16 studies evaluating post operative AKI after major abdominal surgery also found older age (>59 years) as a risk factor(39).

We found pre-existing diabetes mellitus as a risk factor for post operative AKI in our study. A smililar finding was reported in studies evaluating patients undergoing both cardiac and non cardiac surgery(33). Kheterpal et al. utilized the American college of surgeons-National surgical quality improvement data to evaluate the risk factors of post operative AKI in patients undergoing a host of general surgical procedures. Like our study, they found pre-existing diabetes mellitus as an independent risk factor for post operative AKI(37)

Other studies have also reported diabetes mellitus as a risk factor for post opertaive acute kidney injury. Wang et al evaluated the impact of diabetes mellitus on development of post operative AKI in patients undergoing coronary artery bypass graft and found it as an independent risk factor(40). Similar findings were reported by Kim et al. in their review of patients undergoing partial nephrectomy(41)

We also found pre-existing hypertension as a risk factor for post opertive AKI in our cohort. Several other studies, encompassing various fields of surgery have reported the same finding(4)(33)(42)(37)

Major surgery, thus necessitating longer duration of anesthesia is an established risk factor for post operative AKI with the highest incidence reported after major cadiac and general surgical procedures(15)(43). This finding has been replicated in our study. We found duration of anesthesia of >3.5 hours as in independent risk factor for development of AKI after emergency laparotomy

On univariate analysis, we found perioperative red cell transfusion as a risk factor for post-operative acute kidney injury in our study. Similar findings, especially after cardiac surgery, have been widely reported in the literature. Freeland et al.retrospectively analysed 241 patients who underwent cardiac surgery and found post operative blood transfusion as an independent risk factor

for AKI(44). Kindzelski et al as well as Liu et al reported intraoperative erythrocyte transfusion as a risk factor for post operative AKI(45)(46)

We did not find gender as a predictor of AKI in our study. However, other studies evaluating patients after cardiac surgery and in critically ill non cardiac surgery have reported male gender as a risk factor for post operative acute kidney injury(44)(47)

12:0: CONCLUSION:

Post-operative acute kidney injury was relatively common in our study, being found in 18.4% of patients. Patients with advanced age, pre-existing diabetes mellitus and hypertension, those undergoing major surgery and who receive Peri-operative red cell transfusion are at increased risk of developing post-operative AKI. These patients therefore require not only close monitoring but early institution of renal protective strategies.

13:0: RECOMMENDATIONS

A larger prospective trial may be required to establish other risk factors that were not found in this study. The said study will also assess the outcomes of this patients in terms of length of hospital stay, organ specific complications and in-hospital mortality.

We recommend that patients at increased risk of developing post-operative acute kidney injury be given close monitoring and early institution of renal protective management strategies.

14.0: STUDY TIMELINE

Activity	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July 2021	Aug 2021	Sept 2021
Proposal development												
Scientific and ethical approval												
Data collection												
Data analysis												
Thesis writing and submission												
Manuscript development												

15:0: STUDY BUDGET

Components	Unit of Measure	Duration/ Number	Unit Cost (Kshs)	Total Cost (Kshs)
Personnel				
Research Assistant	**1**	**1**	**30,000**	**30,000**
Statistician	**1**	**1**	**35,000**	**35,000**
Printing				
Consent Form	**365**	**1**	**4,000**	**4,000**
Final Report	**3**	**1**	**5,000**	**15,000**
Diagnostic Services				
Lab fees	**365**	**1**	**182,500**	**182,500**
Other costs				
ERC Fees	**1**	**1**	**2,000**	**2,000**
Records Access Fee				
Poster Printing	**1**	**1**	**2,500**	**2,500**
Total				**271,000**

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ANNEXES

ANNEX 1: INFORMED CONSENT

Incidence, risk factors and early post-operative complications of acute kidney injury after emergency laparotomy at Kenyatta national hospital

ENGLISH VERSION

Introduction

This informed consent form is for adult patients undergoing emergency abdominal surgery. We are requesting these patients to participate in this research project whose title is "Incidence, risk factors and early post-operative complications of acute kidney injury after emergency laparotomy at Kenyatta national hospital"

The principal investigator is: Dr. Mohamed Dahir Elmi, currently undertaking Master of Medicine in General Surgery at the University of Nairobi.

Lead Supervisor

Dr. ELLY NYAIM OPOT
MBChB (U.O. N), M. Med Surgery (U.O.N) FCS(ECSA)
Senior Lecturer in General Surgery
Department of Surgery
University of Nairobi.
Consultant General Surgeon
Kenyatta National Hospital.
Signed: ……. Date: …….

This informed consent has three parts:

1. Information sheet (to share information about the research with you)

2. Certificate of Consent (for signatures if you agree to take part)

3. Statement by the researcher

You will be given a copy of the full informed consent form

PART 1: information sheet

Introduction

My name is Dr. Mohamed Dahir Elmi, a postgraduate student at university of Nairobi pursuing Master of Medicine in General Surgery. My work place is at Kenyatta national hospital.

Purpose of the research

With the aim of improving the care of patients undergoing emergency abdominal surgery, I am conducting a study to evaluate the incidence, risk factors and associated early post-operative complications of acute kidney injury in these patients. The information from this research will help us identify those at risk of this condition, which is associated with adverse outcomes so as to ameliorate its effects by deploying preventive strategies and instituting early treatment.

Study participation

I am inviting you to participate in my study. You will be given an opportunity to ask questions before you decide. Participation in this study is voluntary. If you agree to participate, you will be asked to sign a consent form. No payments will be made due to your participation in the study.

Benefits of participation

Participation in this study will help us evaluate your risk of developing Peri-operative acute kidney injury. If you develop the condition you will be put on the standard treatment protocol. The results of this research will help us manage patients who develop Peri-operative acute kidney by identifying them early and putting them on the right treatment.

Risk of participation

Your involvement in this research will be through filling of a data collection form and the

collection of blood samples for analysis. Complications of venipuncture can include bruising at the puncture site and arterial puncture or laceration. When done correctly, however, these complications are rare. All venipunctures in this study will follow best practice guidelines and will be carried out by the principal investigator or his assistant who are qualified medical doctors with 7 years of experience each.

Right to decline or withdraw

You are free to withdraw from the study at any time. The refusal to participate or withdraw from the study will not in any way compromise the quality of care and treatment you receive.

Confidentiality

Any information that is obtained from you in this research will be treated with utmost confidentiality. The patient's name shall not be used.

Sharing of results

Knowledge gained from this study will be shared with other experts through conferences and publications. Confidentiality will be maintained.

Cost and compensation

There shall be no extra cost incurred by you from participation in the study and there is also no compensation.

Contacts of relevant parties

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Lead Supervisor
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Part 2: Consent form

I confirm that the aim of this study and my role as a participant have been properly explained to me by Dr. Mohamed Dahir Elmi. I also acknowledge that I have read and understood the contents of this consent form/ the contents of this form have been read to me and I understood well the information contained there off, as a result I agree to the conditions explained and give consent for my participation

Sign.....

Ip/op no.....

Date.....

Witness.....

Sign.....

Date.....

If the patient/ participant is illiterate

I've been a witness to the accurate reading and explanation of the contents of consent form and that our concerns and questions have been addressed comprehensively by the researcher and/ his assistant, I confirm that the participant has given consent to participate in the study willingly.

Witness name.....

Thump print .....

Date.....

Contact: Dr. Mohamed Dahir Elmi
Cell no: 0711 603997

Part 3: statement by the researcher

I have gone through the information sheet/ consent form with the participant and/ translator explaining all the details in a manner that he/she understands best. The participant has also been made aware of the following

- The information given by him/her will be treated with confidentiality
- The result of data analysis from this study will be published in medical literature to be shared for academic purposes so as to help in decision making, planning and possibly change practice in management of patients with Peri-operative acute kidney injury
- That participation or refusal to participate in the study does not compromise quality of care he/she will receive

I have given the participant an opportunity to ask questions concerning the study and that I have answered the questions correctly and in manner that the participant fully understood. I confirm that there was no coercion of the participant towards giving consent as this was voluntarily done.

A copy of this informed consent has been provided to the participant

Name of researcher.....

Signature of researcher.....

Date.....

ANNEX 2: CONSENT FORM (SWAHILI VERSION)

Fomu hili la makubaliano ni la wagonjwa wazima wanaopata upasuaji dharura ya tumbo lisilo la mishipa. Tunawaomba wagonjwa hawa washiriki katika mradi huu wa utafiti ambao kichwa chake ni "Incidence, risk factors and early post-operative complications of acute kidney injury after emergency laparotomy at Kenyatta national hospital"

Mtafiti mkuu: Dkt. Mohamed Dahir Elmi
Kituo: Kitengo cha Upasuaji, Shule ya Afya, Chuo kikuu cha Nairobi.

Fomu hii ya makubaliano ina sehemu tatu:

- Habari itakayo kusaidia kukata kauli
- Fomu ya makubaliano (utakapo weka sahihi)
- Ujumbe kutoka kwa Mtafiti

Utapewa makala ya fomu hii

SEHEMU YA KWANZA: Ukurasa wa habari

Kitambulizi

Jina langu ni Dkt. Mohamed Dahir Elmi na ninafanya utafiti wa shahada ya juu katika upasuaji kwenye chuo kikuu cha Nairobi. Ninafanya utafiti kwa anwani ya "Peri- operative acute kidney injury and associated early post-operative complication in non- vascular emergency abdominal surgery at Kenyatta national hospital"

Lengo Kuu la Utafiti

Kwa madhumuni ya kuboresha huduma ya wagonjwa wanaofanyiwa upasuaji wa tumbo lisilo ya mshipa kwa dharura, ninafanya uchunguzi hili ili kutahmini tukio, sababu ya hatari na shida za mapema za kuumia kwa figo kwa wagonjwa hawa. Habari kutoka kwa utafiti huu zitatusaidia

kubaini wale walio katika hatari ya hali hii, ambayo inahusishwa na matokeo mabaya ili kurekebisha athari zake kwa kutumia mikakati ya kuzuia na kuanzisha matibabu mapema.

Ushiriki wa hiari / haki ya kukataa

Ningependa kukualika katika ushiriki wa utafiti huu. Utapata nafasi ya kuuliza maswali kuhusu utafiti huu, aidha kutoka kwangu au kutoka kwa msaidizi wangu. Baada ya kuelewa kabisa undani wa maelezo ya utafiti, ushiriki wako utakuwa wa hiari. Iwapo utaamua kutoshiriki katika utafiti, hautanyimwa matibabu. Isitoshe, ukishaamua kushiriki, ni haki yako kukataa kuendelea na ushiriki huo wakati wowote ule bila madhara yoyote.

Taadhimu ya siri

Ujumbe wote utakaotokana nawe utahifadhiwa kwa siri, na utatumika tu na wahusika wa utafiti kwa malengo ya utafiti pekee. Jina lako halitaorodheshwa popote katika utafiti huu; nambari spesheli itatumika katika utambulizi wako. Utumizi wa matokeo ya utafiti huu zitahifadhiwa kwa siri katika maktaba ya Idara ya Upasuaji, Chuo Kikuu cha Nairobi. Kwa minajili ya kuendeleza ujuzi wa Sayansi ya Utabibu, huenda haja ya kuarifu wauguzi wengine kuhusu utafiti huu itokee. Cha muhimu ni kwamba, ruhusa itaombwa kutoka kwa Afisi ya Maadili ya Utafiti inayosimamia utafiti katika hospitali kuu ya Kenyatta na Chuo Kikuu cha Nairobi, kabla ya kutumia matokeo ya utafiti huu katika warsha za Sayansi au kuyachapisha katika majarida ya Sayansi. Nyakati hizo, ujumbe wa kibinafsi hautafichuliwa kamwe.

Madhara

Kuhusika kwako katika utafiti huu kutakuwa kwa kujaza fomu ya ukunsanyaji wa data na ukunsanyaji wa sampuli za damu kwa uchambuzi. Madhara za kutoa damu inaweza kujumuisha michubuko kwenye wavuti na kuchomwa au kukatika kwa mshipa. Wakati unafanywa kwa usahihi, hata hiyo, madhara hizi ni nadra. kukutoa damu kwa utafiti huu zitafuata miongozo bora ya mzaoezi na itafanywa na mtafiti mkuu au msaidizi wake ambao ni madaktari waliohitimu wa matibabu na uzoefu wa miaka 7 kila mmoja.

Gharama/ Malipo

Hakuna gharama ya ziada wala malipo utakayopata kutokana na kushiriki kwako katika utafiti.

Anwani za Wahusika

Ikiwa uko na maswali ungependa kuuliza baadaye, unaweza kuwasiliana na:

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SEHEMU YA PILI: Fomu ya makubaliano

Nimeelezwa utafiti huu kwa kina. Nakubali kushiriki utafiti huu kwa hiari yangu. Nimepata wakati wa kuuliza maswali na nimeelewa kuwa iwapo nina maswali zaidi, ninaweza kumuuliza mtafiti mkuu au watafiti waliotajwa hapa juu.

Jina la mshiriki.....

Sahihi ya mshiriki.....

Tarehe.....

Washiriki wasioweza kuandika na kusoma

Nahakikisha nimesomewa na kuelezwa kuhusu utafiti huu kwa lugha na namna ambaye ninaufahamu vyema. Nimepata nafasi ya kuuliza maswali kuhusu utafiti, nimepata majibu kikamilifu ya maswali haya. nimekata kauli kuhusika kwa utafiti huu kwa hiari yangu.

Sahihi au alama ya kidole ya mshiriki----------

Tarehe.....

SEHEMU YA TATU: Ujumbe kutoka kwa mtafiti

Nimemsomea mshiriki ujumbe kiwango ninavyoweza na kuhakikisha kuwa mshiriki amefahamu Yafuatayo:

- Kutoshiriki au kujitoa kwenye utafiti huu hautadhuru kupata kwake kwa matibabu
- Ujumbe kuhusu majibu yake yatahifadhiwa kwa siri.

- Matokeo ya utafiti huu yanaweza chapishwa ili kusaidia katika kufanya maamuzi, kupanga na kuboresha matibabu wanaopata wagonjwa walio na jeraha la figo baada ya kufanyiwa upasuaji dharura ya tumbo lisilo la mshipa

Ninathibitisha kuwa mshiriki alipewa nafasi ya kuuliza maswali na yote yakajibiwa vilivyo. Ninahakikisha kuwa mshiriki alitoa ruhusa bila kulazimishwa. Mshiriki amepewa nakala ya hii fomu ya makubaliano.

Jina la mtafiti…….

Sahihi ya mtafiti……
Tarehe……

ANNEX 3: DATA COLLECTION SHEET

INCIDENCE AND RISK FACTORS OF ACUTE KIDNEY INJURY AFTER EMERGENCY LAPAROTOMY AT KENYATTA NATIONAL HOSPITAL

1. Preoperative

Patient number

Age

Sex male female

Baseline serum creatinine

Estimated glomerular filtration rate

ASA status

Pre-operative diagnosis

Admission BP and HRBP HR

BP

Comorbidities

Hypertension	yes		no	
Diabetes mellitus	yes		no	
Ischaemic heart disease	yes		no	
Congestive heart failure	yes		no	
Cerebrovascular disease	yes		no	
Chronic obstructive pulmonary disease	yes		no	
Cirrhosis	yes		no	
Solid malignancy	yes		no	

Haematological malignancy yes ☐ no ☐

Preoperative haemoglobin ☐

2. Intra-operative

Duration of anaesthesia ☐

Intraoperative hypotension yes ☐ no ☐

Erythrocyte transfusion yes ☐ no ☐

Vasoactive drugs use yes ☐ no ☐

3. Post-operative

(a) Laboratory investigations

12-hour post-operative serum creatinine

24-hour post-operative serum creatinine

48-hour post-operative serum creatinine