ADDIS ABABA UNIVERSTY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

SCHOOL OF MEDICINE

DEPARTMENT OF ANESTHESIOLOGY

TITLE: PREVALENCE AND ASSOCIATED FACTORS OF UNPLANNED POSTOPERATIVE ADMISSIONS TO SICU AMONG POSTOPERATIVE ADULT SURGICAL INTENSIVE CARE UNIT PATIENTS AT TIKUR ANBESSA SPECIALIZED TEACHING HOSPITAL

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A RESEARCH PAPER SUBMITTED TO THE DEPARTMENT OF ANESTHESIOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR POSTGRADUATE PROGRAM IN ANESTHESIOLOGY.

NOVEMBER 2019

ADDIS ABABA, ETHIOPIA

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Title of Research project	prevalence and associated factors of unplanned postoperative admissions to SICU among postoperative adult surgical intensive care unit patients atTikur Anbesa SpecializedTeaching Hospital
Study type	Prospective hospital based cross-sectional study
Duration of the project	From 1st April to 31st October 2019
Study area	Tikur Anbesa Specialized Hospital SICU, Addis Ababa, Ethiopia
Sample size	110
Total cost	20,000ETB
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Acknowledgment

I would like to thank the department of Anesthesiology for giving me the chance to carry out this research. I also want to forward my deepest gratitude to my advisors Dr Rediet Shimeles and Dr Fetiya Alferid from the department of Anesthesiology for their valuable comments, advises and encouragement for this research accomplishment and I also acknowledge all members of the department of anesthesiology for their help and encouragement.

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Acronyms

AAU Addis Ababa university

AOR Adjusted Odds Ratio

ASA American society of Anesthesiologists

CI Confidence Interval

ETB Ethiopian Birr

GC Gregorian calendar

HDU High Dependency Unit

ICU Intensive Care Unit

MICU Medical Intensive Care Unit

OR Odds Ratio

PACU Post Anesthetic Care Unit

PICU Pediatric intensive care unit

SICU Surgical Intensive Care Unit

SPSS Statistical Package for the Social Sciences

TASH Tikur Anbesa Specialized Hospital

UIAs Unplanned Intensive care Admissions

ABSTRACT

Introduction: *Postoperative admission to the intensive care unit (ICU) is commonly planned and regarded as an important component to a safe and effective pathway for prevention, early recognition and timely management of life-threatening complications occurring in the immediate postop period.(1) Frequently, post-operative intensive care Unplanned ICU Admission(UIA) is required in an unplanned manner due to complications related to anesthesia or surgery or underlying illnesses unmasked during procedures.(9) Unplanned ICU admission (UIA) is associated with a negative outcome like increased medical costs, length of hospital stay and mortality(2) and has been shown to be an important safety measure of anesthesia and surgical care.(3) There are currently no data available on Unplanned Intensive Care Admissions in Ethiopia. I undertook this prospective review of postoperative admissions to the Intensive Care Unit of the Tikur Anbesa Specialized Teaching Hospital to know the prevalence and associated factors of unplanned intensive care admissions.*

Materials and Methods: *This prospective cross-sectional study was conducted in the intensive care unit of Tikur Anbesa Specialized Hospital from April to October 2019. A special form was designed and filled for those patients who admitted unplanned to the intensive care within 48 hours of surgical procedures. All patients admitted to the SICU within 48 hours after operation were included. Ward admissions to the ICU (after 48 hours postoperative admission surgery), ICU admissions directly from the emergency department and Patients who were already admitted to the intensive care unit before surgery were excluded.*

Objective: *The aim of this study is to identify the prevalence and associated factors of unplanned postoperative intensive care unit admissions.*

Results: *From April 1 to October 31, 2019, a total of 110 patients were admitted to the surgical ICU after surgery; Of these, 87 patients (79.1%) were of the planned ICU admission group, and 23 patients (20.9%) were of the unplanned ICU admission group. The main reason for ICU admission were due to cardiovascular disturbance 6(26.1%) and for monitoring after resuscitations 6 (26.1%)* followed by *for respiratory events 4(17.4%). With adjusted multivariate analysis revealed that anesthesia given by anesthesiology residents (p=0.015, AOR=2.222, 95%*

confidence interval 1.472-20.556) and surgical time of more than four hours (p =0.024, AOR 2.145, 95% CI 0.177-25.992) were independent predictor factors.

Conclusion: *This study shows an association of longer surgical time and anesthesiology residents with unplanned ICU admission after surgery.*

Keywords*: Prevalence, Unplanned admission, intensive care unit, Perioperative care.*

1. INTRODUCTION

1.1. Background: ICU beds are a scarce hospital resource, and various factors affect the decision to admit a patient to the ICU or HDU or PACU, including severity of co-existing disease, need for ICU specific interventions, the type of operations, the institutional policy or bed availability.(1) There are several guidelines for ICU admissions, but no universally accepted criteria for admitting surgical patients to the ICU. Patients are admitted to critical care unit from theatre in two categories; planned admissions for whom the anesthetist and surgical team decided preoperatively that the critical care unit admission would be necessary and unplanned admissions for which the need for critical care unit admission was not anticipated preoperatively. Most admissions to the ICU are planned or anticipated before the scheduled case, with the aims of preventing postoperative complications and enhancing functional recovery. Anticipation of the requirement for postoperative admission to a critical care area well in advance of surgery helps with resource allocation with the planning of staffing levels and avoidance of unfavorable outcome.(1,10)

In spite of advances in the field of anesthesiology, there are occasions when postoperative intensive care is required in an unplanned manner resulting from unexpected complications from anesthesia or surgery or unmasking of illnesses by procedures or anesthesia. These admissions are collectively referred to as Unplanned Intensive Care Unit (ICU) Admissions (UIAs) who are identified to require critical care within operating theatre room, within the post anesthesia care unit or within 48 hours of ward admission.(1,9)

Unplanned admissions can have a significant impact on the efficient running of a critical care area and may even prompt cancellation of other elective cases, premature discharge or non-clinical transfer of other ICU patients. Elective surgery should be postponed if the appropriate level of post-operative care is unlikely to be available.(1,2,3)

For clinicians and healthcare managers, unplanned ICU admission has become a valid indicator to assess patient safety in surgical patients and can be used in cost-effective benchmarking as well as in root cause analysis of perioperative adverse events.[1] Compared with direct or planned admission to ICU, unplanned ICU admission is associated with a significantly higher risk of death beyond the expected consequences of comorbidities; age, type of surgery and

emergency status.(1,2,4) An unplanned admission to an intensive care unit within 48 hours of surgery is an event that most patients and physicians would consider to be an important adverse outcome. Such an unfavorable outcome results from an amalgamation of inherent risk factors surrounding a combination of coincidences and even misjudgments in the perioperative period. The multifactorial interaction of patient, anesthesia and surgical variables determines overall patient risk. Early recognition and intervention remain the key to avoidance of unfavorable outcome.(9)

Unplanned post-surgical admissions to ICU have various implications to the hospital, staff, patients and their relatives. (16,17) These include;

1. Increased cost of patient care that was earlier not anticipated. This is due to the added ICU care of the patient and prolonged hospital stay. This is translated to the hospital as a care provider and the patient's relatives.

2. Due to the time taken between patient transfers from theatre to the ICU, there is a backlog of other patients who were scheduled to make use of the same theatre. ICU staff has to make unexpected reorganization for the unexpected admission.

3. The patients and relatives are emotionally affected by the unplanned post-surgical ICU admission unlike the planned admission where the patient is already counseled of what to expect post-surgery. Counseling then has to be done both for the patient and relatives to explain reasons for the admission.

4. Infections and mortality are also higher in the unplanned post-surgical patients than in the planned patients.

Analyses of UIAs are helpful in assessing the standard of peri-operative management, quality of anesthetic care and also planning and allocation of ICU resources. There has been an increase in the number of unplanned admissions to critical care units, which impacts on the allocation of resources, affecting mortality.(15)

The number of unplanned admissions should be low. Less than 5% could be taken as a gold standard.

1.2. Statement of the problem

UIA is a validated clinical quality indicator and is defined as "all patients unexpectedly admitted to the ICU from a lower level of care in the hospital". (3) The indicator was developed by the Australian and New Zealand College of Anesthetists and the Australian Council on Healthcare Standards and has been recommended as a measure of patient safety (avoidable incidents in anesthesia) and effectiveness of care (lack of planning) (1,3). Used as a screening tool, it can detect patients who possibly suffered from an avoidable iatrogenic complication (24). Rose et al (25) reported that 1–9% of all ICU admissions were unplanned.

An ICU admission after surgery is not inherently a negative outcome. A smooth transition from preoperative assessment, intraoperative management, and postoperative disposition to critical care can be well orchestrated, evidence based, and demonstrate improved patient outcomes.(33-35) UIAs, however, are associated with an increased risk for negative outcomes including increased mortality.(35) Despite best efforts by clinicians, some patients decompensate due to circumstances outside the clinician's control and require ICU care. An UIA can still be a better alternative than not recognizing a patient who would benefit from critical care management. The goal is a low, stable rate of UIAs to accommodate patients who unexpectedly need upgrade of care while safeguarding the patient population where postoperative ICU admission can either be anticipated earlier or be avoided together.

Suboptimal clinical decision-making has immediate consequences for patients and the system of care:

(a) Inadequate postoperative monitoring and evaluation results in unrecognized/undertreated clinical decompensating that may lead to morbidity or mortality, and

(b) A mismatch between nursing and other provider staffing occurs as clinical decompensating creates preventable, unplanned high acuity for the SICU and excess staffing on the ward that is avoidable. For instance, if a patient is scheduled for an operation followed by SICU and ward admission, resources are allocated to those areas.

However, if the patient decompensates and requires SICU admission, rapid resource reallocation and mobilization are required. Before operative procedures, the most likely clinical course is communicated, which includes postoperative disposition. Patient and family distress and dissatisfaction may result when there is deviation from the expected. Unplanned SICU admissions (UIAs) are disruptive to the system and threaten safe, timely, effective, efficient, and patient-centered care because of misallocation of resources and unfulfilled family expectations.(9) The ICU can be alerted in advance for those cases that the anesthetist or the

surgeon feels that the risk factors already identified will necessitate ICU admission post operatively.

1.3. Significance of the study

The critical care unit at this institution continues to admit a sizeable number of patients from theatre who were primarily not scheduled to be admitted pre-operatively. In such circumstances the unit administration and staff have to reorganize themselves within a short time in order to receive a very sick patient from theatre and manage them. These unplanned transfers to ICU can prolong hospital stay, place additional pressure on ICU resources, increase the cost of hospitalization and leads high mortality rate. More importantly, they have a strong impact on the patient and family.(28) These situations can be avoided if the risk factors for critical care admission post-operation are identified and corrected earlier.

A formal booking system is necessary for documentation and planning of the type of patient to be received in the ICU which is not available in my institution and even though what the anesthesiologist or surgeon feels should be the ideal management for each individual patient.

No similar study had been undertaken in TASH SICU regarding unplanned ICU admissions post operation. This prospective study will be undertaken to review the UIAs in the intensive care unit of TASH, the main tertiary referral center in the country. The objectives of this study is to analyze the rate of UIAs in the SICU, the types of peri-operative complications and reasons for ICU admission and outcomes. Characterizing the surgical patients in the ICU will help to identify those patients who require postoperative ICU treatment. This study can be also used to identify the most prevalent surgeries and patient characteristics prone to unplanned postoperative ICU admissions. Interventions to better anticipate critical care delivery for these patients may be developed and implemented either in a larger study or at an individual hospital which lead to more efficient allocation of resources when the ICU facilities are over-stretched or overburdened. It will also provide valuable insight into our standards of anesthetic practice and allow us to implement changes in our practice and continue to assess the impact of these changes. The secondary objective was future planning for accommodation, equipment and staffing in the SICU. It can help us prepare formal booking system for all planned surgical patients.

2. LITRATURE REVIEW

ICU settings are expensive and have limited resources, and ICU patients suffer from unfamiliar circumstances and excessive procedures.[1-4] Thus, the decision to admit a patient to the ICU after surgery should be undertaken cautiously, taking into consideration the effective use of limited resources and the comfort of patients. The concept of 'unplanned intensive care unit admission' (UIA) was first used in the United States as a surrogate marker for patient safety and has potential for use in other countries [1,2]. Several studies indicated that UIA was associated with higher incidence of intraoperative adverse events such as cardiac arrest and hemodynamic instability; moreover, it was related to increased risk of respiratory failure and mortality, and prolonged hospital stay [3,4]. Previous studies reported that American Society of Anesthesiologist physical status classification (ASA PS class), male sex, advanced age, and surgery duration contributed significantly to UIA [4,5].

A four year study in a Nigerian University Teaching hospital by Okafor et al. revealed that operations on the head and neck were the leading cause of unplanned post-operation admissions to ICU although the study excluded emergency operations. This study reported two main reasons for UIAs, surgical factors in the majority (n=20/26) and anesthetic factors (n=6/26) in the remainders .Three of the six cases relating to anesthetic factors were failures to intubate leading to asphyxia whilst the causes were not mentioned in the three other cases. Mortality rate was 30.7%. In this study they recommended careful screening of patients so that the more complex cases are handled by the most experienced surgeons and anesthetists. Consultants are experienced in both surgical and anesthetic fields are play a vital role in teaching the trainees. They should be available to perform and assist in the more complex operations that may arise as emergencies. In this study complicated cases in all disciplines were done as elective cases and were therefore handled by the consultants with the assistance of their trainees in respective fields.(7)

A 6 month prospective study in RIPAS Hospital, Brunei, Darussalam between June 2011 and November 2011, the rate of UIA is 0.27%(13/4900).The mean age of the UIA patients was 48 years (range 8 to 82). They found that 46% of UIAs were related to cardiovascular disturbances, 31% due to respiratory system disturbances, 7% due to metabolic problems and 14% due to massive blood loss and massive transfusion. Respiratory causes necessitating ICU admissions included hypoventilation, atelectasis, pneumonias, upper airway obstruction or a combination of these factors. After admission, eight patients were mechanically ventilated in the ICU. Reasons for mechanical ventilation ranged from hemodynamic instability, poor respiratory effort or

respiratory failure, poor GCS or abdominal surgery. Three patients were admitted for intensive monitoring purposes only. One patient who had suffered a peri-operative myocardial infarction needed percutaneous coronary intervention (PCI). Another patient proceeded to further detailed cardiac work-up. Two patients received inotropic circulatory support. Five admissions were related to anesthetic complications (2 failures to intubate leading to asphyxia whilst the causes were not mentioned in the three other cases). There were two surgery related complications, namely massive blood loss. The remaining six cases were underlying illnesses that were unmasked or precipitated in the peri-operative period. The average duration of ICU stay was 4.5 days (range 1-24 days) and mortality rate was 15.3%.(9)

A 6 month (from June 1,2002 to November 30,2002) prospective study done in Mumbai, India shows that the incidence of UIA was 0.58%. Respiratory problems were responsible for 36 (47.4 %) of the 76 unplanned I C U admissions. Cardiac problems accounted for 21 (27.6 %) whereas 2 (2.6 %) admissions were attributable to neurological problems. Problems such as hypothermia were responsible for 7 (9.2 %) admissions. A combination of two of the aforementioned problems was responsible for 10 (13.2 %) of the 76 unplanned admissions. Among respiratory problems, hypoventilation due to respiratory fatigue was encountered in 28 of the 36 patients. Pneumonia was uncommon and was encountered in only 1 patient. Upper airway obstruction which did or could produce stridor or laryngospasm was found in 3 patients. Difficult tracheal intubation leading to unplanned I C U admission was encountered in 4 patients. Among cardiac problems, pulmonary oedema accounted for 1 admission; prolonged hypotension with ionotropic support for 18 admissions and dysrhythmia for 2 unplanned I C U admissions. In this study, they found that respiratory problems were the main reason for unplanned intensive care admission (primary reason in 47.4% and contributory reason in another 13.2%). The mortality rate was 13.7%.They have found that persistent tachycardia, major bleeding, and hypotension requiring use of vasoactive drugs were the main AEs leading to UIA.(10)

A single‐center prospective study conducted in Rabat, Morocco over 2 years (between January 1, 2014 and December 31, 2015) and involve analysis of 15,372 elective surgical procedures was performed. They defined UIA as an ICU admission that was not anticipated preoperatively but was due to an AE occurring within 5 days after elective surgery. There were 75 UIA (0.48%) recorded during the 2‐year study period. The average age of patients was 54.64 ± 18.02 years, no sex predominance, and the majority of their patients had ASA classes 1 and 2. In this study, abdominal and trauma surgeries were the most common procedures implicated on UIA with respective percentages of 30.7% and 29%. Nearly 80% of them were performed under general anesthesia (GA). Regarding the causes of UIA, they observed that 44 UIA (58.7%) were related to surgical AE, 24 (32%) to anesthetic AE, and 7 (9.3%) were related to postoperative AE caused by care defects. The intraoperative major bleeding and postoperative peritonitis were the main surgical AEs. They led to UIA in 24% and 13.3% of cases. Furthermore, anesthetic AEs were mainly cardiovascular in intraoperative period and respiratory in recovery period. The decision to transfer the patient to the ICU was taken in the operating room in 45.3% of cases, in the

PACU in 18.7%, and in the hospital unit in 36% of cases(11).These results were close to those found b Phyu Phyu T et al(8). Nearly 72% of them have benefited from a MV and 40% required blood transfusion. Vasoactive drugs were used in 57.3% of cases.(12)

A study done by Manjula et al. at Seth G.S Medical College and K.E.M Hospital Parel Mumbai for a period of two years between 2005 and 2006 analyzed various factors that lead to unplanned post-operation admissions to the critical care units. Post-operative review was carried out to determine the cause for the unplanned admission to the CCU. These patients were further classified into four major categories:

Category 1. Related to central nervous system; unexpected depressed level of consciousness or new cerebrovascular accident. Category 2. Related to the cardiovascular system; pulmonary oedema, prolonged hypotension requiring inotropic support, arrhythmias or cardiac arrest. Category 3 Related to respiratory system; respiratory depression, low Po2, high pCO2, atelectasis, pneumonia or airway obstruction. Category 4. Related to metabolic system; fluid disturbances or electrolyte imbalances. In this study the main factors that served as significant predictors of critical care unit admissions were males aged more than 60 years, ASA Grading III or IV, abdominal explorations, emergency operations, history of intra-operative arrhythmias, major blood loss and hypotension requiring inotropic support. These factors were also significant in predicting an unfavorable outcome including death of patients or prolonged critical care unit stay. These factors also constituted a challenge rather than routine critical care management. The study recommended the involvement of consultants in both anesthesia and surgery during these operations.(16)

In a prospective cross-sectional study conducted at Kenya national hospital in 2011GC with 86 patients with UIAs, general anesthesia had a significant admission numbers to the unit. This would relate well to the type of operations that required admission post-operation. These were operations that had to be done under general anesthesia. Laparotomies (blunt and penetrating abdominal injuries) were the major operations leading to post-operation admission to the unit. This contributed 56.9% of all admissions. This is a significant relationship($P<0.05$). This also has a relationship with excessive blood loss and longer operations.

Pre-operative and intra-operative blood loss was another contributing factor to post-operative admission to the unit. Those patients who lost more than 2000mls of blood in total whether pre-operatively or intra-operative contributed 46% of the total number of patients admitted. Pre-operative blood loss in this study included pre- and post-partum hemorrhage, retained placenta and both blunt and penetrating abdominal injuries. Another factor that was explored in this study was whether the ASA classification was a factor in predicting post-operation admission to the ICU. ASA I and II patients contributed 79.1% of the patients that were admitted to the ICU post-operatively. These were patients that would have been discharged to their wards but due to other factors they complicated and had to be admitted to the ICU. Operations that took more than

three hours contributed 41.9% of the admissions to the unit. In this study it was not statistically significant($p>0.05$).(18)

An earlier study by B. Osinaike with D. Aderinto evaluated ICU admissions post- operation in a teaching hospital in Lagos, Nigeria over a three month period between June and August 2007. The prevalence of UIAs was 0.58%. They characterized the patients so as to determine those pre-operation, intra-operation and the immediate post-operation risk factors that predict unplanned admissions to the ICU. Risk factors identified in order of priority were; duration of anaesthesia more than 120 minutes, anaesthesia provided by a senior registrar, surgery performed by a senior registrar and increasing ASA classification. This study had also recommended the involvement of consultants in both specialties during these operations.(36)

In data extracted from National Anesthesia Clinical Outcomes registry in United States, Quinn et al, the incidence of UIA was 0.12%(3479/2,910,738) and have found an association of advanced age and higher ASA class with UIA after surgery and vascular and thoracic procedures were mostly implicated in the UIA and bowel resection, and repair of hip fractures was the most common surgery involved. They have found that the main causes of UIA were cardiovascular and respiratory distress requiring intubation. Mortality rate in this study was 0.64%.This study concluded and recommended a thorough preoperative evaluation and preoperative optimization of patients whenever possible, early recognition of complications, timely intervention and timely intensive care and monitoring are essential to improve outcomes.(4)

3. OBJECTIVES AND QUESTIONS OF THE STUDY

3.1. General objective

- To know the prevalence and associated factors of unplanned postoperative admissions at TASH- SICU, Addis Ababa, Ethiopia

3.2. Specific objectives

- To determine the prevalence of unplanned postoperative ICU admissions
- To describe the causes of of unplanned postoperative ICU admissions
- To determine outcome of unplanned postoperative ICU admissions
- To investigate factors associated with unplanned postoperative admissions to the intensive care unit (ICU)
- Recommendations on the basis of the above findings

3.3. Research questions

- What are the characteristics of patients with unplanned postoperative admission to SICU of TASH?
- What is the prevalence for unplanned postoperative admission in the TASH SICU?
- What is the commonest reason for unplanned postoperative admission to SICU of TASH?
- What is the mortality rate of the unplanned SICU admissions?

4. METHODOLOGY

4.1. Eligibility criteria

4.1.1. Inclusion criteria

All postoperative adult patients (elective and emergency) admitted to SICU within 48 hours of surgical operation during the study period. For patients who underwent operations more than twice during the study period, data from only the first surgery was included in the study.

4.1.2. Exclusion criteria

1. Patients already in the ICU before surgery during the study period.

2. Ward admissions to the ICU (after 48 hours postoperative admission surgery) and ICU admissions directly from the emergency department before surgical interventions.

3. Those patients who were referred to the unit from other hospitals after any surgical procedure.

4.2. Ethical consideration

The proposal was reviewed and approved by the research and ethics committee of department of Anesthesiology, AAU. The nature and purpose of the study was explained to the participant if possible or to the available next of kin of the patient to be included in the study and consent obtained. Data collection instrument was not include names, addresses or any other identifying information about the study participant.

4.3. Study Area

The study was conducted in Ethiopia, Addis Ababa, at SICU of TASH. TASH is one of the largest referral and teaching governmental hospital in Ethiopia located in Addis Ababa, capital city of Ethiopia, accommodating referred patients from all over the country and has most specialties apart from transplantation surgery. The surgical ICU at our hospital is a 6‑bedded unit with about 178 admissions per year (5). There are two operating theaters dedicated to elective surgery with 13 operating rooms. At TASH, there is one main ICU (but no high dependency unit), Constitutes of six medical, four PICU and six surgical ICU. The MICU and the PICU are run by internal medicine and pediatrics departments respectively and SICU by anesthesiology department. It has also separate cardiac (4 beds) and neonatal(12 beds) ICUs. There is no intensivist in our hospital but currently one fellow in intensive care is there.

4.4. Source population

All postoperative (both elective and emergency) patients at Ttikur Anbassa Specialized Teaching Hospital.

4.5. Study population

All the patients admitted to the critical care units within the study period who met the inclusion criteria were included in the study

4.6. Study design

Prospective cross-sectional study of all patients in the Tikur Anbesa Specialized Hospital surgical ICU with postoperative admissions (elective and emergency) to SICU during the study period.

4.7. Sample size and sampling

The sample size was all the patients who were admitted to the critical care unit during the study period. This involved consecutive sampling of all patients admitted to the TASH SICU from theatre who met the inclusion criteria.The Sample size was determined by the following formula:

Part I; n = t2 x pq/m2

Part II; n f= n / (l+ n /N)

Where:-

n = required sample size.

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

p= prevalence of the characteristic being studied for this study is 50% as there is no similar study to take their prevalence of unplanned postoperative ICU admissions.

q= prevalence of the population without the characteristic being studied (i.e. 1-p)

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

Therefore: n = 422 including that of 10% probability of missing data

Part II

the population to be studied in a year is less than 10,000 (In our case 150 which is the estimated number of postoperative SICU admissions per year at TASH SICU excluding patients admitted from emergency), then part II of the formula which uses the required sample size got from part I of the formula was applied,

nf = n/ (1+n/N)

Description: nf = is the desired sample size when the population studied is less than 10,000.

Therefore: nf=110

4.8. Data collection and questioner development

Data collection tool: to identify those patient with unplanned admissions to SICU in the study period, Structured Questioner developed from different published research papers (1,4,7,10,18) and tested before used. Data was collected for 6 months by a designated SICU attached residents

for all included patients including those admitted outside the scheduled surgery hours after trained by the principal investigator for one day during each month of ICU attachment. Transfer of data was done as soon as the patient was admitted to the ICU or as soon as was feasible and completed during transferred time. Anesthetic chart and the surgeons´ notes was transferred to a data collection form (appendix 1) that will be later analyzed so as to interpret the pre-operative, intra-operative and post- operative state of the patient and the reason for request to admit to ICU. For each patient; demographics (age, sex), and ASA PS class were recorded. Preoperative coexisting medical diseases cardiovascular, respiratory, hepatic, renal, neurologic and endocrinology were recorded. Duration of anesthesia and surgery (min), intraoperative hypotensive events, blood transfusion (whether conducted or not, and amount), and estimated blood loss during surgery (amount, ml) were recorded. An intraoperative hypotensive event was defined as hypotension with an indication for vasopressor administration during surgery. Intraoperative massive bleeding is defined as 35% of blood loss for an adult patient. Duration of ICU stay (number of days), mechanical ventilator care upon admission ICU (whether performed or not), and outcome (death within the ICU after surgery) were also recorded.

4.9. Study variables

The dependent variable of the study was unplanned postoperative ICU admission. The analyzed independent preoperative variables included patient demographics, comorbidities and operative factors. All patients were classified according to the American Society of Anesthesiologists (ASA) classification. Operative factors were evaluated by surgical site, duration of surgery, treatment during operation, type of anesthesia, blood loss, duration of surgery intraoperative blood transfusion, intraoperative events, and the emergency state.

4.10. Operational definitions

1. Planned ICU admission: patients for whom the anesthesiologist decided pre-operatively that intensive care unit admission would be necessary.(1)

2. Unplanned ICU admission: those whose need for intensive care admission was not anticipated pre-operatively but were admitted to critical care due to some problem recognized in the operating room or in the immediate post-operative period(within 24 hours).(1)

3. Intraoperative hypotension: a decrease of the systolic Blood pressure by 20% from baseline and requires vasopressors.

4. Massive blood transfusion defined as replacement of a blood volume equivalent within 24 hours or greater than 10 units within 24 hours or transfusion of more than 4 units in one hour or replacement of 50% of blood volume in 3-4 hours or a rate of blood loss greater than 150 ml/hour.(WHO; clinical blood transfusion,2014)

5. Delayed awakening: defined as (even though no uniform consensus definitions) the failure to regain consciousness 30-60minutes of multifactorial causes after general anesthesia (association of American medical colleges; a simulation case for anesthesia learners,2017).

6. Prolonged surgery: operative time greater than 6 hours (British Journal of plastic surgery, 1999)

4.11. Data quality assurance

Overall data collection process and completeness of Data collection was monitored and checked by the principal investigator. All completed questionnaires were checked for completeness and consistency during data management, storage and analysis.

4.12. Data processing and Statistical analysis

A statistician was appointed by the principle investigator to analyze the data collected. All completed questionnaires were coded. Development of data entry templates, data cleaning, processing, analysis and the overall data management was done by the principal investigator and biostatistician. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software, version 20.0. Descriptive statistics were calculated on patient parameters. The description involved use of frequencies (n) and percentages (%)) for categorical variables (e.g., sex, ASA physical status, nature of operation, comorbidities) and mean with standard deviation for continuous variables (e.g., duration of ICU stay, age, or transfusion/bleeding volume). A bivariate logistic regression model was fitted to the data to determine which independent variables were associated with increased odds for an unplanned postoperative ICU admission. A reference group was provided for each characteristic and designated with an odds ratio (OR) of 1. Variables with $p < .25$ were incorporated into the multivariate logistic regression to test for independence. Results from the multivariate logistic regression models were reported as adjusted odds ratio (AOR) along with 95% Confidence Interval (CI) to assess strength and statistical significance of associations, respectively. Only AORs with 95% CI not including 1.00 in their range and p value < 0.05 were considered statistically significant.

4.13. Dissemination and utilization of the result

The study result will be presented to Addis Ababa University, School of Medicine, Department of Anesthesiology and documents will be disseminated to all responsible bodies in the study area, for the hospital where the study is conducted, FMOH and Addis Ababa university school of Medicine. It will be also disseminated to the scientific community through seminars, workshops, and conferences of health professionals association and publications in peer-reviewed scientific journals.

5. RESULTS

There were 130 SICU admissions during the study period, and 110 met the study criteria among them 23 were UIAs giving prevalence of 21% of the postoperatively admitted patients(23/110) and 0.67% of all surgical procedures done over the study period(23/3420) and 87 patients were planned admissions (79.0%; 87/110). The characteristics of the 110 patients are summarized in Table 4.

5.1. Pre-operative variables

The distribution of patients in the age groups of 26 – 45 and 15-25 years, was 52 (64.4 %) and 32 (29.1 %) respectively and in the age groups 46-65 and above 65 years accounting for 23 (20.9 %) and 4(3.6%) admissions respectively. The mean age of patients was 35.9 +-13.5 years. Males accounted for 66 (60%) %) and females for 44 (40 %) of the total number of post-operative admissions to the intensive care unit. It was found that out of the 110 admissions, the maximum number of patients belonged to A S A – 2 - 63 (57.2 %), followed by A S A – 1 - 25 (22.7 %), by A S A – 3- 20 (18.2%) and by A S A – 4- 2 (1.8%). About 40 (36.4%) patients had no comorbidities, 25 (22.7%) patients have associated trauma, 13 (11.8%) patients have hypertension, 8 (7.3%) patients with cardiac problem, 9 (8.2%) have diabetes, 5 (4.5%) patients with respiratory problems and 10 (9.1%) patients with other comorbidities. (table 1)

Table 1. Preoperative characteristics the study Patients (n = 110)

Variables	Category	planned+ unplanned(n=110) n(%)	Unplanned(n=23) n(%)
Age	15-25	**32(29.1%)**	**7(30.4)**
	26-45	51(46.4%)	10(43.5)
	46-65	23(20.9%)	5(21.7)
	>=65	4(3.6%)	1(4.3)
Sex	Male	66(60%)	**14(60.9)**
	Female	44(40%)	9(39.1)
ASA physical status	1	**25(22.7%)**	5(21.7)
	2	63(57.3%)	12(52.2)
	3	20(18.2%)	**6(26.1)**
	4	2(1.8%)	0
Comorbidity	Cardiac Respiratory DM Trauma Hypertension None Others	8(7.3%) 5(4.5) 9(8.2%) 25(22.7) 13(11.8%) 40(36.4%) 10(9.1%)	2(8.7) 2(8.7) **3(13.0)** 1(4.3) 2(8.7) 11(47.8) 2(8.7)

5.2. Operative variables

54 (49.1 %) patients underwent neuro- surgery, 26 (23.6 %) patients underwent gastrointestinal procedures, 17 (15.5 %) patients underwent cardiothoracic surgery , gynecological/obstetrics, ENT and orthopedic operations each contribute 4 (3.6%), 1 (0.9%) patient undergo urologic procedure. 62 (56.4 %) patients admitted to intensive care unit underwent elective surgery whereas 48 (43.6 %) of the 110 post-operative intensive care unit admissions followed surgery performed on an emergency basis. In this study 104 (94.5 %) of the 110 patients who underwent post-operative ICU admission were administered general anesthesia, patients who were operated under regional anesthesia and sedation were 3 (2.7 %) each. The duration of surgery was less than 120 minutes in 18 (16.4 %) of the 110 cases. Surgery lasted between 120 and 240 minutes in 62 (56.4 %) cases; between 240 and 360 minutes in 20 (18.2 %) cases and more than 360 minutes in the remaining 10 (9.1 %) of the 110 cases. The mean duration of surgery was 200 +- 105.23 minutes. Seventy one patients (64.5 %) received transfusions during the operation and the mean blood loss was 1113 +-901.98 mL. During the operation, 40 patients (36.4 %) were administered vasopressor due to intraoperative hypotension.

Forty six (41.8 %) patients were operated by surgical residents only and 64 (52.8 %) by both residents and consultants. Fifty seven patients were received anesthesia by anesthesiology residents supervised by consultants, 27 (24.5 %) and 26 (23.6 %) patients by anesthesiology residents and non-physician anesthesia providers respectively.(table 2)

Table 2: Characteristics of Patients Related to Anesthesia and Surgery

Variables	Category	Planned + unplanned n(%)	Unplanned(n=23) n(%)
Nature of operation	Elective	**62(56.4%)**	**14(61)**
	Emergency	48(43.6%)	9(39)
Operation sites	Gastrointestinal	27(24.5%)	4(17.4)
	Neurosurgical	54(49.1%)	9(39)
	Cardiothoracic	**17(20.0)**	3(13)
	Orthopedics	4(3.6%)	1(4.3)
	Gyn/obs	4(3.6%)	3(13)
	ENT	4(3.6%)	3(13)
Anesthesia type	General Anesthesia	104(94.5%)	**19(82.6)**
	Regional anesthesia	3(2.7%)	1(4.3)
	Sedation	3(2.7%)	3(13.0)
Blood loss(estimated)			
<500 ml		23(20.9%)	**6(26.1)**
500-1000 ml		**45(40.9%)**	**6(26.1)**
1000-1500 ml		22(20.0%)	4(17.4)
1500-2000 ml		8(7.3%)	3(13.0)

>2000 ml	12(10.9%)	4(17.4)
Duration of surgery		
<120 min	18(16.4)	6(26.1)
120-240 min	62(56.4)	**7(30.4)**
240-360 min	**20(18.2)**	**7(30.4)**
>360 min	10(9.1)	3(13.0)
Duration of anesthesia		
<120 min	15(13.6)	6(26.1)
120-240 min	**55(50.0)**	**11(47.8)**
240-360 min	26(23.6)	5(21.7)
>360 min	14(12.7)	1(4.3)
Intraoperative blood transfusion Yes	**71(64.5)**	**13(56.5)**
No	39(35.5)	10(43.5)
Operated by Resident only	46(41.8)	**12(52.1)**
Resident with consultant	64(58.2)	11(47.8)
Anesthesia given by resident with consultant	57(51.8)	8(34.8)
Non physician providers	26(23.6)	6(26.1)
Residents only	27(24.5)	**9((39.1)**
Intraoperative events		
A. Intraoperative hypotension	40(36.4)	5(21.7)
B. Hypoxia (desaturation, spo2<92%)	3(2.7)	3(13.0)
C. Cardiac arrest	1(.9)	0
D. Massive bleeding	1(.9)	0
E. Massive bleeding with intraop hypotension	10(9.1)	3(13.0)
F. Others	2(1.8)	2(8.7)
G. No complication	53(48.2)	9(39.1)
Intraoperative blood transfusion Yes	71(64.5%)	
No	39(35.5%)	

5.3. ICU admission

In this study 87 (79.1 %) of the total 110 postoperative I C U admissions were planned of which 48 (55.2%) were after elective and 39(44.8%) were after emergency procedures while the remaining 23 (20.9 %) admissions were unplanned of which 14 (60.9%) were after elective and 9 (39.1%) after emergency procedures. The main reason for ICU admission was for monitoring after resuscitations 39(35.5 %) , 29 (26.4 %) due to cardiovascular disturbance, 13 (11.8 %) due to neurologic ditorarations, 12 (10.9 %) due to respiratory events, 8 (7.3 %) after massive transfusion and prolonged surgery each. Majority of the patients were admitted from operation theaters (97.3 %) while 2.7 % from surgical wards. Among the 110 admitted patients, 60 (54.5

%) of them uses mechanical ventilator while the remaining 50 (45.5 %) didn't use mechanical ventilator.

Among the 110 I C U admissions, 50 (45.5 %) patients had a stay of 24-48 hours; 36 (32.7 %) patients 2-7 days; 12 (10.9 %) patients 7 to 15 days; 5 (4.5 %) patients 15 to 21 days while 7 (6.4 %) patients had a stay of more than 21 days. The mean ICU length of stay was 6.4 +- 8.1 days (1-45 days). After staying at ICU, 85 (77.3 %) of the patients were discharged to the ward and 25 (22.7 %) died in the ICU.(table 3)

Table 3. Postoperative variables of the study patients

Variables Category	**Total(N=110)**	Unplanned(n=23)
Admission status Planned	87(79.1%)	23
Unplanned	23(20.9%)	
Admitted from		
Operative theaters	107(97.3%)	20(87%)
Surgical wards	3(2.7%)	3(13%)
Reason for ICU admissions		
Cardiovascular events	35(31.8%)	6(26.1%)
Respiratory events	12(10.9%)	4(17.4%)
Monitoring	39(35.5%)	6(26.1%)
Neurological conditions	13(11.8%)	2(8.7%)
Prolonged surgery	8(7.3%)	0
Massive transfusion	2(1.8%)	4(17.4%)
Delayed awakening	1(.9%)	1(4.3%)
Mechanical ventilator use (upon admission)	60(55%)	15(65%)
Reason for mechanical ventilator use		
1. Hemodynamic instability	28(25.4)	5(21.7%)
2. Poor respiratory effort or respiratory failure	26(23.6)	7(30.4%)
3. Neurologic condition/air way protection	6(5.5)	3(13%)
4. Not used	50(45.5)	8(35%)
Length of stay in ICU		
24-48 hours	50(45.5%)	7(30.4%)
2-7 days	36(32.7%)	9(39.1%)
7-15 days	12(10.9%)	2(8.7%)
15-21days	5(4.5%)	3(13%)
>21days	7(6.4%)	2(8.7%)
Patient outcome		
Transferred	85(77%)	19(82.6%)
Died	25(22.7%)	4(17.4%)

5.4. Comparison between planned and unplanned postoperative admissions

The mean age of the planned and the unplanned group is almost similar (35.8 vs.36.3 years respectively). In the unplanned admission group, total ICU stay longer than that in the planned admission group (8 days vs. 6 days respectively). ASA class distribution slightly differs between groups. There is similar distribution with ASA 1 and ASA 2. But a slight variation in ASA 3 (26% vs. 16%). The ASA PS class score of the unplanned group was lower than that of the planned group. Comorbidities also differed between groups, with a slightly greater proportion of patients in the unplanned group presenting with cardiovascular diseases and diabetes mellitus. The proportions of respiratory and neurologic diseases did not differ between groups.

Surgical characteristics differed between groups, with gynecological and ENT procedures were higher in unplanned patients 13 % each vs. 1% each in the planned group. In the ICU, ventilator therapy higher in the unplanned than in the planned group (65% vs. 52%).There is almost a similar average durations of surgery and anesthesia with the planned group (202.6 min and 225.6 min, respectively) and unplanned group (189.9 min and 216.0 min, respectively). Estimated intraoperative blood loss in the unplanned group was higher than that in the planned group (1241.3 vs. 1079.3 ml). Intraoperative transfusion was higher in the planned group (67% vs.57%).The mortality rate in the planned group was 24% higher than that in the planned group (17.4%).

Table 4. Frequency distribution of patient of postoperative ICU admission at TASH-SICU, 2019.

Patient characteristics	Planed(n=87)	Unplanned(n=23)
Age(years)		
Mean age	35.8+-13.3	36.3+-14.6
15-25	25(28.7%)	7(30.4%)
26-45	41(47.1%)	10(43.5%)
46-65	18(20.7%)	5(21.7%)
>=65	3(3.4%)	1(4.3%)
Sex(male/female)	52(59.8%)/35(40.2%)	14(60.9%)/9(39.1%)
ASA physical status		
1	20(23%)	5(21.7%)
2	51(58.6%)	12(52.2%)
3	14(16.1%)	6(26.1%)

4	2(2.3%)	0(0.0%)
Department		
GI	19(21.8%)	3(13.0%)
Neurosurgery	45(51.7%)	9(39.1%)
Cardiothoracic	14(16.1%)	3(13.0%)
Orthopedics	3(3.4%)	1(4.3%)
Obstetrics/Gynecology	1(1.1%)	3(13.0%)
Ear-nose-throat	1(1.1%)	3(13.0%)
Urology	1(1.1%)	0(.0%)
Vascular	3(3.4%)	1(4.3%)
Type of surgery		
Elective	48(55.2%)	14(60.9%)
Emergency	39(44.8%)	9(39.1%)
Type of anesthesia		
General	85(97.7%)	19(82.6%)
Regional	2(2.3%)	1(4.3%)
Sedation	0	3(13.0)
Reason for admission		
Cardiovascular event	23(26.4%)	6(26.1%)
Massive transfusion	4(4.6%)	4(17.4%)
Postop respiratory failure	6(6.9%)	6(26.1%)
Neurologic condition	11(12.6%)	2(8.7%)
Monitoring	35(40.2%)	4(17.4%)
Delayed awakening	1(1.1%)	0
Prolonged surgery	7(8.0%)	1(4.3%)
Comorbidity		
Cardiac	6(6.9%)	2(8.7%)
Respiratory	4(4.6%)	1(4.3%)

DM	6(6.9%)	3(13.0%)
Trauma	24(27.6%)	1(4.3%)
Hypertension	12(13.8%)	1(4.3%)
None	29(33.3%)	11(47.8%)
Others	6(6.9%)	4(17.4%)
Outcome		
Transferred	66(75.9%)	19(82.6%)
Died	21(24.1%)	4(17.4%)
Anesthesia time(min)	225.75+-109.60	216.09+-114.69
Surgery time(min)	202.59+-105.63	189.78+-105.39
Intraoperative hypotensive events	42(48.3%)	8(34.8%)
Estimated blood loss during surgery(ml)	1079.3+-847.89(100-5400)	1241.3+-1094.89(500-3500)
Transfusion during surgery	58(66.7%)	13(56.5%)
Use of ventilators in ICU	45(51.7%)	15(65.2%)
Duration of ICU stay (d)	5.9+-7.9(1-40)	8.00+-8.43(2-65)
Death in-ICU	21(24.1%)	4(17.4%)

Data are given as: mean ± standard deviations, number and percent in brackets, a: median (maximum- minimum), . ASA PS: American Society of Anesthesiologists physical status, DM: diabetes mellitus, GI: Gastrointestinal, ICU: intensive care unit, d= days

5.5. Unplanned postoperative admitted patients

There were twenty three UIAs representing 17.7% (23/130) of all ICU admissions. A total of 3420 surgical procedures (both elective and emergency) excluding pediatrics procedures were performed giving an UIA rate of 0.67%. Among those patients, 14 were men (60.9%) and 9 were women (39.1%) with sex ratio (male/female) of 1.55:1. The mean age of patients was 36.35 ± 14.63 years. The ASA status distribution from 1 to 4 was 21.7%, 52.2%, 26.1% and .0% respectively. In this study, neuro-surgery accounted for the largest absolute number of unplanned ICU admissions with 9 (39.1% of total) followed by GI 4 (17.3 %), cardiothoracic 3 (13.0%), ENT 3 (13.0%), GYN/OBS 3 (13.0%.) and orthopedics one patient (4.3%).(table 5) This is not

based on as a percentage of caseload. 14 operations were electives, and 9 were emergency surgeries. 19 patients received general anesthesia (GA), 3 patients received sedation and one patient regional anesthesia. The decision to transfer the patient to the ICU was taken in the operating room in 91.3(21/23) of cases, and in the surgical wards in 8.7%(2/23) of cases. The mean ICU stays was 8 days (range, 1-45 days). Most patients were admitted to the ICU due to cardiovascular (6, 26.1 %) and respiratory events (6, 26.1 %). Monitoring after surgery (17.4 %) and massive blood transfusion (17.4 %) were the next most common reasons for admission to the ICU. In this study, the causality of the mortality was not discussed. However, in the group of patients with an unplanned transfer to ICU, 4 died (17.4 %), 19 transferred (82.6 %). There is mortality difference between elective (2 died from 14, 14.3 %) and emergency (2 died from 9, 22.2 %) surgeries among unplanned admissions.There is also difference in ventilator requirement between emergency (5/9) and elective (10/14) UIAs.

Table 5: Type of procedure leading to unplanned Intensive Care Unit admission

Type of procedure	n	%
Neurosurgery	9	39.1
Gastrointestinal procedures	4	17.3
Cardiothoracic	3	13.0
Gynecological/obstetrics	3	13.0
Ear-Nose-Throat	3	13.0
Orthopedics	1	4.3

5.6. Associated factors of unplanned ICU admission

5.6.1. Unadjusted Binary logistic regression Analysis: A total 110 cases were included in the logistic regression analysis model without any missing cases. Unadjusted binary logistic regression analyses of the outcome variable, unplanned postoperative ICU admission, and each potential predictor variables were made. All the independent variables individually included into the model. In bivariate analysis, patients with cardiac comorbidity ($p < 0.001$) and, ASA physical status 3 ($p = 0.0042$), neurosurgical surgical procedures ($p = 0.008$), General anesthesia ($p=0.045$), duration of surgery more than 4 hours ($p = 0.013$), intraoperative blood loss in the range 1500-2000ml ($p=.0023$), intraoperative hypotension with massive bleeding ($p=.034$) and anesthesia provided by anesthesiology residents ($p=0.12$) were associated with unplanned postoperative admission.

5.6.2. Adjusted Multivariate Logistic regression Analysis

Variables which were significantly associated with UIA during the bivariate analysis were entered to the multivariate Logistic regression model. None of the preoperative variables were associated with UIA. With adjusted multivariate analysis revealed that anesthesia given by anesthesiology residents ($p=0.015$, AOR=2.222, 95% confidence interval 1.472-20.556); this can be due to that residents are more exposed to critical cases at their duty times and surgical time of more than four hours ($p =0.024$, AOR 2.145, 95% CI 0.177-25.992); expected, were independent predictors of unplanned postoperative ICU admission. In addition, procedures done by surgical residents with consultants are less

likely to be admitted unplanned (p=0.013, AOR= .013,95%CI.001-.393) compared to procedures done by residents only(reference group). Patients with intraoperative blood loss of1500-2000 ml are less likely to be admitted unplanned(p=0.039,AOR=0.045,CI0.002-0.851) compared to the those with blood loss less than 500 ml(reference group) and this can be due to that ICU bed is prepared ahead of the procedure with the physicians expectation of major bleeding or it could be the unknown baseline hematocrit.

Table 6: Adjusted multivariable logistic regression analysis of predictive variables to postoperative UIAs among adult surgical patients at SICU of TASH, AA, 2019.

Variables	Category	unplanned	planned	AOR(CI)	P value
		n(%)	n(%)		
ASA physical status	1(Ref)	5(21.7)	20(23.0)	1	
	2	12(52.2)	51(58.6)	1.483(.339-6.491)	.601
	3	6(26.1)	16(18.4)	.896(.115-6.981)	.916
comorbidities	Trauma(Ref)	1(4.3)	24(27.6)	1	
	Cardiac	3(13.0)	18(20.7)	.247(.009-6.885)	.410
	Diabetics	3(13.0)	6(6.9)	.229(.006-8.902)	.430
	Others	5(21.7)	10(11.5)	.578(.008-39.889)	.800
	None	11(47.8)	29(33.3)	.063(.003-1.144)	.062
Anesthesia provider	Residents with consultants (Ref)	8(34.8)	49(56.3)	1	
	Non physician providers	6(26.1)	20(23.0)	2.121(.288-15.645)	.461
	Resident only	9(39.1)	18(20.9)	2.222(1.472-20.556)	.015*
Operation done by	Resident (Ref)	12(52.2)	34(39.1)	1	
	Resident with consultant	11(47.8)	53(60.9)	.013(.001-.393)	.013*
Blood loss	<500 ml(Ref)	6(26.1)	17(19.5)	1	
	500-1000 ml	6(26.1)	39(44.8)	.906(.130-6.296)	.920
	1000-1500 ml	4(17.4)	18(20.7)	.595(.049-7.164)	.683
	1500-2000	7(30.4)	13(14.9)	.045(.002-.851)	.039*
Type of anesthesia	General(Ref)	19(82.6)	85(97.7)	1	
	Regional	4(17.4)	2(2.3)	.642(.043-9.668)	.749
Duration of surgery	<120 min(Ref)	6(26.1)	11(12.6)	1	
	120-240 min	11(47.8)	52(59.8)	1.248(.148-10.500)	.839
	240-360 min	6(26.1)	24(27.6)	2.145(.177-25.992)	.024*

*Significant at <0.05(Independent predictors of post- operative unplanned ICU admission) , AOR= adjusted odds ratio, CI= 95% confidence interval, Ref=reference

6. DISCUSSION

Considering that Ethiopia is a developing country, the cost factor in patient care is always prohibitive. The cost of stay in surgical intensive care unit is 3-4 times more expensive than ward care. (32) The human costs in terms of quality of life after surviving I C U care are equally important. Unplanned transfers to ICU can prolong hospital stay, place additional pressure on ICU resources, increase the cost of hospitalization and leads high mortality rate. More importantly, they have a strong impact on the patient and family.(28) With this background, this study evaluated unplanned ICU admissions from the operating room. This study is, to my knowledge, the first in Ethiopia to focus specifically on UIA following an elective and emergency surgery in adult patients.

The prevalence of UIA among all postoperative SICU patients was 21%(23/110) which is lower than 37.3% reported by Bhat et al. in India in 2002.(10) and higher than 10.82% reported by another study.(12) The wide variation in the incidence of UIAs may represent differences in the methods of data collection, study's prospective or retrospective character, inclusion criteria, differences amongst populations, sample size or duration of study, definition of the UIA, or even institution's practices.[4,7,8,9,12) Differences in the institutions' practices such as their standard operating procedures and levels of awareness are important. In some surveys, emergency and elective surgeries were not included and UIA was defined as UIA within 1 or 2 days after surgery (2,4,6). In this study, the focus was on UIA occurring after elective and emergency surgery within 48 hours. The reason to choose 48 hours as a cutoff period was because it corresponds on average to have perioperative events following surgery (10).

In this study most of the UIA patients were males (61%) which could be large number of minor gynecological operations in women. This is similar finding with the study done by in India.(10) But against the finding of the study conducted in Brunei Darussalam In 2011 (9) were majority were females (9/13 postoperative unplanned admissions) and in another study where there was no sex difference. (12)

In this study, the average age of patients was 36.3+-14.6 which is lower than reported by a prospective study done in morocco in 2017(54.64 ± 18.02 years).(12) and by b Phyu Phyu T et al.(9) and the majority of the patients had ASA classes 2. These results were close to other studies.(9,12) and Suggesting that significant critical incidents may occur in patients with relatively few co-morbidities and in whom clinicians might not expect the occurrence of critical incidents. But against the studies which found a higher ASA PS class and advanced age were associated with a greater likelihood of unplanned ICU admission following surgery.(4,28)

Although emergency operations were more frequent in ICU admissions in some studies(26), the rate of elective operations was greater in our study(14/23) which is similar to the study in

Morocco.(12) Phyu Phyu et al. reported that there was no difference between emergency and elective procedures.(9)

In this study majority of the unplanned patients undergone general anesthesia (82.6%) which is similar to the study that reports 97.6% of the total 207 patients admitted to anesthetic intensive care unit in the post operative period had been administered General anesthesia, while only 1.9% of patients had been administered regional anesthesia for surgery.(6) This is also similar to other studies.(3,4,12)

Neurosurgical patients were more likely to have an unplanned ICU admission as an absolute total number of surgeries for each surgical specialty. But other studies have shown that abdominal and trauma surgery patients were more likely to have a UIA than other patients.(1,12) Quinn et al. have also found that vascular and thoracic procedures were mostly implicated in the UIA.(4)
In this study cardiovascular disturbances accounted for 26 %, monitoring for 26%, respiratory disturbances for 17.4% were the most common reasons for ICU admissions among the unplanned ones. Keith Rose and colleagues also found that respiratory events were the main reason for unplanned critical care admissions and ventilator management.(25) and other similar results have been found in literature. Quinn et al. have found that the main causes of UIA were cardiovascular and respiratory distress requiring intubation.[4] While Bhat et al. (10)have found that persistent tachycardia, major bleeding, and hypotension requiring use of vasoactive drugs were the main AEs leading to UIA. There are also other similar findings with Phyu Phyu et al.(9) and Haller et al., 2005.(1

The ASA PS scores in the unplanned group were higher than those in the planned group(26.1% vs 16.1% in ASA 3) and another studies showing that the ASA PS class risk factor related to unplanned ICU admission. (1,26) In this study intraoperative hypotension was higher in planned patients. However, the incidence of intraoperative hypotension did not differ between groups in another study may be likely that the incidence of intraoperative hypotension was relatively low(26).

In addition, frequency of ventilator therapy in the ICU, were higher within the unplanned group(65.2 vs 51.7%), suggesting that this group comprised relatively more complicated cases. Meanwhile, the rate of presence of comorbidities of cardiac disease, hypertension, and trauma was lower in the unplanned than the planned group, probably because clinical experience leads anesthesiologists to predict increased risks of postoperative complications for patients with a history of cardiovascular disease, and accordingly to prepare for ICU admissions with such patients . This finding is similar to a retrospective study conducted in Korea in 2015 on Clinical Outcome and Prognosis of Patients Admitted to the Surgical ICU after Abdomen Surgery (27).

In addition, analysis of patient characteristics within each group showed that total surgery and anesthesia durations, and frequency of transfusion were significantly higher in the planned group than in the unplanned group. This may be due to the tendency to prepare the ICU before surgery

in case of certain operations such as Whipple's operation, lobectomy of the liver, liver tumor resection, and other liver-related surgeries and neurosurgical procedures which are usually related with prolonged surgical time or large estimated bleeding volume. This finding is similar to the study done by Jaesuk et al.(26)

The patients of the unplanned group had longer ICU stays than those of the planned group. This may be explained by the higher mortality rate in the unplanned group, particularly within the first 24 h, may have reduced the duration of ICU stay. This finding was similar to the study done by Jaesuk et al.(26)

The mortality rate of unplanned admissions in our study was 17.4%. This rate is very high compared to that found by Quinn et al. in United states of America which did not exceed 0.64% (4) and even in studies conducted by Pearse et al. (8%). (6), Piercy et al.(3) in Australia (14.5%) and Phyu T et al. in Brunei Darussalam (15.4%). (9) However, the rate found in our study is lower than that found by, Okafor a Nigerian study (30.7%).(7) and Bhat et al. in India (36.2%).(10)) Swann et al. studied 265 patients who were admitted to the ICU postoperatively in Canada, excluding those who underwent neurosurgical operations; of these, 34 were of the UIA group and the mortality rate within 24 h after surgery was 3.5% in the unplanned group and 0% in the planned group.(11)

Our study showed that the mortality rates were higher, among unplanned ones, in patients admitted to the ICU after emergency operations than after elective operations (22 % vs 14%). Time, staff and the conditions provided for elective operations may not always be available for emergency operations. Insufficient preoperative workup and preparation result in a greater mortality rate in emergency patients Intensive care unit admissions. Among 46,539 patients from 498 hospitals across 28 European countries, in-ICU mortality of UIA patients was 8% for elective surgery, and 16% and 22% for urgent and emergency surgery, respectively.(6)

Mortality of patients admitted to the ICU remains high, and the estimated mean overall ICU mortality in some studies is approximately 15% (30) and in a study done in Korea (27) the ICU mortality of patients after abdominal surgery was 9 % and in other studies (2.4%-7.6%). (29, 31) but in this study the mortality of the postoperative patients was 22.7%, higher than all the above studies which may be due to high number of trauma patients but lower than reported by Dr Fetiya (31.5%) in the same ICU.(5)

Result of multivariate analysis showed that, of all the studied variables anesthesia attended by residents ($p=0.015$) and duration of the surgery ($p=0.024$) had significant association with the incidence of postoperative unplanned ICU admission. This finding is against the studies where old age and ASA class are associated with unplanned ICU admission.(4,28) None of the 23 patients who had unplanned admission was found having any significant correlation to: Age, Sex, nature of procedure, site of surgery, presence of comorbidities , ASA class and Type of anesthesia.

7. STRENGTH OF THE STUDY

The structured survey questionnaire was adopted and modified from the study done in Kenya to avail the data.

Lack of literature available in Ethiopia and other developing countries makes this study a stepping stone to various small and large scale studies in this area.

8. LIMITATIONS OF THE STUDY

To optimally assess clinical relevance of this study, some of its limitations deserve to be emphasized and acknowledged.

1. The incidence of UIA was not measured in this study. Additional data regarding total cases per surgical department are needed to calculate UIA rates by service and surgical procedure.

2. Unscheduled admissions in this study may also be erroneously elevated because of definitions and operational, technical, and scheduling difficulties. The definition of unplanned (<48-hour postop) admission is debatable

3. The renovation of the SICU which was started after 3rd month of data collection that affects patient flow. The number of surgical intensive care beds were (6 beds from April to June2019 and 2 beds (sometimes 3 or 4 beds) thereafter due to renovation program.

4. Multiple administrative and clinical databases will be necessary to better identify UIA rates, types, and outcomes. Each database has unique strengths and weaknesses, and combining databases facilitates synergy and more robust analyses.

5. The sample size may be considered small and being a single center study may not allow generalization to the other centers within the country or other countries ICU centers. A study with a higher sample size would be able to overcome these limitations. Nevertheless, this study could serve as baseline data for future quality improvement programs to be implemented in this hospital and can serve as a baseline data for comparisons between centers and also in the future to assess if there are any changes in the trends of UIAs

9. CONCLUSIONS

This study shows that anesthesia attended by residents (p=0.015) and duration of the surgery (p=0.024) had significant association with the incidence of postoperative unplanned ICU admission.

The main reason for ICU admission were due to cardiovascular disturbance 6(26.1%) and monitoring after resuscitations 6 (26.1%) followed by for respiratory events 4(17.4%).

Our analysis of UIA is a quality control exercise. It is useful for us to identify patterns of anesthesia or surgical care requiring improvement.

For the intensivist, anesthesiologist, surgeon, and anyone interested in quality improvement and patient safety, my study provides a valuable snapshot of a vulnerable patient population.

The utility of my study is to identify the most prevalent surgeries and patient characteristics prone to postoperative UIAs. Interventions to better anticipate critical care delivery for those patients may be developed and implemented either in a large study or at an individual hospital.

10. Recommendation

Given the limited data available and the fact that there are a handful of retrospective studies on this topic in the literature, we hope with this study to eventually gain insight into ways we can improve the quality of peri‑operative anesthetic and surgical care and to better allocate ICU resources.

Surgical specialties and procedures with the most unplanned ICU admissions could be areas for quality improvement and clinical pathways in the future.

It would be interesting to link the results of this study to the hospital's administrative databases to trace whether AEs can identified to gain insights into potential preventive strategies.

A more extensive and multi‑center analysis of unplanned postoperative admissions to the ICU is needed in the future.

A formal booking system should be prepared for documentation and planning of the type of patient to be received in the ICU.

11. ACKNOWLEDGMENTS

I am grateful to all staffs of TASH SICU for their cooperation during data collection. I thank Drs Fetiya and Rediet, they are acknowledged for their linguistic advice, suggestions and encouragement. I would also like to thank Ms. Anesa for her advice.

12. ANNEX

12.1. Data Collection toll

1. Medical record number Age/sex Date

2. Admission status: A) Planned B) unplanned

3. Diagnosis ASA classification

4. Comorbidities:

A) Cardiovascular (hypertension, acute coronary syndrome, CHF…)

B) Respiratory (asthma, COPD, pneumonia,…..)

C) Neurologic (stoke, GTC seizure,…)

D) Metabolic (diabetes, thyroid,…)

E) Renal (acute kidney injury, CKD,…)

F) Gastrointestinal

G) Trauma

5. Site (type) of surgery A. Abdomen B. Cardiothoracic C. Vascular D. Neuro E. Orthopedics F. ENT G. Urology H.GYN/OBS I. Others (specify)

6. Nature of operation A. Emergency B. Elective

7. Type of Anesthesia used: a) General anesthesia b) regional anesthesia C. Sedation D. Combined

8. Operation performed by: a) consultant and resident b) resident only

9. Anesthesia provider: A) resident B) resident in supervision with consultant c) non physician anesthesia providers

10. Intra-operative events; a) Hemodynamic instability (require vasopressors)

b) Cardiac arrest c) hypoxia (desaturation<92%)

d) Difficult intubation/ventilation

e) Accidental extubation f) Arrhythmias g) others

11) Estimated blood loose (ml)……

12) Total blood transfused……..

13. Postoperative events: a) Upper airway obstruction/desaturation

b) Delayed awakening c) postop seizure or drop in GCS

d) hemodynamic instability

14. Duration of surgery (incision to dressing)……Duration of anesthesia (induction to reversal)……

15. Reason for transfer to ICU……

A. Respiratory disturbance (hypoxia, pneumothorax, atelectasis, Upper airway obstraction…)

B. Cardiovascular disturbance (shock, arrhythmia, cardiac arrest, Myocardial infraction…)

C. Massive transfusion D. For monitoring only

E. Delayed awakening F. Neurologic impairment (drop in GCS, increased ICP)

16. Admitted from A) Operative theater B) PACU C) Ward

17. In the SICU patient requires:

A. Inotropic support B. MI management C. MV support D. Monitoring only

E. Blood transfusion F. Oxygen support

18. Reason for postoperative mechanical ventilator support:

A. Hemodynamic instability B. Poor respiratory effort or respiratory failure C. Cardiac arrest D. Airway protection

E. Delayed awakening F. Other (specify)

19. Duration of overall stay in ICU:

20. Outcome A) Transferred B) Died C) Still at ICU

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14. DECLARATION

I, the undersigned, graduating class of Anesthesiology residency student declared that this thesis is my original work in partial fulfillment of the requirement for degree.

Name:- _____ Signature:- _____

Place of submission: Addis Ababa University, College Health sciences, School Medicine, Department of Anesthesia**.**

Date of Submission: _____

This thesis work has been submitted for examination with my/ our approval as university advisor(s).

Advisors

Name Signature

_____ _____