ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF ANESTHESIOLOGY

OVERVIEW OF PATIENTS, PERIOPERATIVE CARE AND OUTCOME OF AORTIC ANEURISM REPAIR IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2024 GC.

By - Tensaye Kebede (MD)

A Research Thesis Submitted to Addis Ababa University School of Medicine, Department Of Anesthesiology, Critical Care and Pain Medicine in Partial Fulfillment of the Requirement For Specialty Certificate in Anesthesiology, Critical Care and Pain Medicine.

ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE SCHOOL OF MEDICINE

DEPARTMENT OF ANESTHESIOLOGY, CRITICAL CARE AND PAIN MEDICINE

RESEARCH THESIS

OVERVIEW OF PATIENTS, PERIOPERATIVE CARE AND OUTCOME OF AORTIC ANEURISM REPAIR IN TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA.

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Contents

1. Abbreviations and Acronyms

AA- Aortic aneurysm

TAA- Thoracic aortic aneurysm

AAA – Abdominal Aortic Aneurism

AKI – Acute kidney injury

C AAA – complex abdominal aortic aneurism

EVAR – Endovascular aneurismal repair

ICU – Intensive care unit

Sx AAA – symptomatic abdominal aortic aneurism

MI – Myocardial infarction

TASH – Tikur Anbessa Specialized hospital

GA – general anesthesia

ETT – endotracheal tube

BP – blood pressure

SBP – systolic blood pressure

DBP – diastolic blood pressure

DM – diabetes mellitus

2. Acknowledgment

First and foremost, I am immensely thankful to my thesis advisors, Dr. Ananya Abate and Dr. Bonsa Habulu, for their unwavering support, invaluable guidance, and expert mentorship throughout this journey. Their insightful feedback, encouragement, and dedication have been instrumental in shaping this thesis and enhancing my research skills. I would like to express my deepest gratitude to several individuals who have contributed to the completion of this research thesis.

3. List of tables

4. Abstract

Background: Open aortic aneurism repair is a high-risk surgery with significant perioperative morbidity and mortality. There are no studies previously done in Ethiopia on this topic.

Objective: This study aims to describe patient characteristics, perioperative care, and outcomes of patients undergoing open aortic aneurysm repair in Tikur Anbessa Specialized Hospital, Ethiopia.

Method: A retrospective observational study of patients consecutively operated between January 2017, and May 2024, was performed. We characterized patients, perioperative care, and outcomes.

Results: During the study period, 50 patients underwent aortic aneurysm repair 5 patients were excluded, from the 45 cases that were included the majority were elective cases (88.9%). 5(11.1%) were ruptured aortic aneurysm repair (2 descending thoracic and 3 infrarenal abdominal aortic aneurysm). The mean age was 54.74 years, with a range from 17 to 76 years. 33.3% were age above 65 years. The commonest site was an infrarenal abdominal aortic aneurysm (n=36, 80%) followed by suprarenal and descending thoracic aneurysms (n=3, 6.7%) both. Preoperative comorbidities included chronic hypertension (48.9%), asthma (8.9%), valvular heart disease (13.3%), diabetes mellitus (4.4%), heart failure (4.4%), and ischemic heart disease (8.9%). Most patients were on beta-blockers preoperatively (81%), and some were smokers (7.1%). Intraoperative management involved general anesthesia using endotracheal tubes, with propofol (76.2%) and fentanyl (73.8%) being common induction agents and isoflurane (88.1%) as the main inhalational agent for maintenance. The mean estimated blood loss was 1498.21 ml, and patients received an average of 3321.43 ml of crystalloid. 39(86.6%) patients were transfused intraoperatively, 25 with only PRBC and 11 PRBC with FFP and platelets, 3 with PRBC and FFP. The mean diameter of aortic aneurysms was 6.4±1.6 cm. Postoperative care included transfer to the ICU, with a mean length of stay of 4.07±3.36 days. The most common complications were acute kidney injury (21.4%) and respiratory (16.7%). 6(13.3 %) patients had in-hospital death 4 of which were male, 2(33.4%) are age > 65. The factor associated with AKI is cross-clamp time >90 minutes. Ischemic heart disease was associated with respiratory complications and in-hospital mortality (p 0.038, AOR 35.7).

Conclusion: This study has extensively described patient demographics, perioperative practices, and postoperative outcomes of patients undergoing aortic aneurysm repair in this hospital. Noteworthy

differences in patient demographics compared to other settings, alongside a comparatively higher mortality rates than western setups, highlight areas warranting further exploration.

5. Background

An aortic aneurysm is the abnormal enlargement of a segment of the aorta, which has the potential to expand further and rupture. It is diagnosed when the diameter of the affected segment increases by at least 50% compared to what is expected for healthy individuals of the same age and sex. Aortic aneurysms are categorized by their size, location, shape, and underlying cause. [15]

Thoracic aortic aneurysms (TAA) have an estimated incidence rate of at least 5-10 per 100,000 person-years. The estimated incidence of abdominal aortic aneurysm (AAA) ranges from 4.2% to 11% annually. TAAs can be classified based on location as root or ascending aortic aneurysms (60% of TAAs), Descending aortic aneurysms (35% of TAAs), Aortic arch aneurysms (10% of TAAs, and Thoraco-abdominal Aortic Aneurysm: This type involves descending thoracic aortic aneurysms that extend to include the abdominal aorta. [15][9]

Despite advancements in understanding and managing AAA, it remains a significant health threat due to its high mortality rate of 80% in cases of rupture unrepaired. [9] With ruptured TAA, mortality was 48.4% at 30 days after repair, and unrepaired TAA has a mortality of near to 100%.[16].Screening for AAA in elderly men has been shown to reduce AAA rupture and associated mortality by 50% in large-scale randomized studies. [9]

Elective open AAA repair is recommended for patients with symptomatic AAA or asymptomatic AAA meeting specific criteria based on diameter or other characteristics. . The increasing use of endovascular AAA stent graft repair has shifted the focus of open AAA repair towards patients with more complex cases, particularly those with juxtarenal or suprarenal aneurysms. [4]

Individuals with complex aneurysms tend to have more preoperative health issues. The combination of technical complexity and a higher prevalence of preoperative comorbidities likely contributes to increased likelihood of postoperative complications and mortality. [2]

6. Statement of the problems

Aortic aneurysm is a common, progressive, and potentially fatal disease with partly unknown etiology if untreated, the aortic wall weakens and can no longer endure the pressure from the blood flow, leading to progressive dilation and eventual rupture.

In the 20th century, the rates of hospitalization and death due to AAAs rose in Western nations. While improvements in diagnostic methods, like ultrasonography, may have played a role in this trend, the increase in AAA-related mortality and morbidity likely indicates a genuine rise in incidence, attributed in part to growing risk factors such as smoking and aging. [11]

Until the 1990s, aneurysms were treated by open surgical repair (OSR). The introduction in 1991 of endovascular aneurysm repair (EVAR) has led to changes in access to surgery, quality of care and economic costs. [11] The mainstay of AAA repair in Ethiopia is open surgical repair. These topics have been inadequately investigated in Ethiopia. [11]

7. Significance of the study

According to local data available, there are no studies done regarding the characteristics, perioperative management, and outcomes of patients undergoing open AAA repair in Ethiopia. We intended to carry out this study as it will add a huge knowledge and advances in the perioperative management of these patients.

8. Literature review

8.1. Incidence

At the global level, the incidence and rates are higher in developed versus developing nations. Still, regional assessments reveal increases in prevalence for some regions especially developing countries, despite a significant lack of data in most regions. [10]

The prevalence of thoracic and abdominal aortic aneurysms varies between the two types. Thoracic aortic aneurysms (TAA) are less common than abdominal aortic aneurysms (AAA) In the case of TAAs, they are classified based on the segment involved, with 60% affecting the aortic root and/or ascending aorta, 40% involving the descending aorta,<10 % involving the arch and the thoraco-abdominal aorta. On the other hand, abdominal aortic aneurysms are more prevalent, especially in older individuals, with the incidence rising rapidly after the age of 55 in men and 70 in women. The prevalence of AAAs is around 5% among men over 65 years of age who are screened by ultrasound. [12]

8.2. Risk factor

Risk factors for abdominal aortic aneurysms include smoking, age, hypertension, hyperlipidemia, and atherosclerosis, with men being 10 times more likely than women to have an abdominal aortic aneurysm of 4 cm or greater. Additionally, individuals with a family history of abdominal aortic aneurysms have a 30% increased risk, with their aneurysms tending to do so at a younger age and carrying an advanced risk of rupture compared to sporadic cases. [12]

Current smoking, specifically, appears to have the topmost effect, with evidence of a dose-response whereby higher day-to-day cigarette intake is associated with a higher risk of AAA. Although the mechanisms through which smoking increases AAA formation are unclear, multifactorial effects on atherosclerosis and overall vascular homeostasis may be implicated. It's important to note that roughly 900 million smokers live in developing nations, accounting for 70 of global consumption, which stems from the aggressive marketing conditioning of tobacco companies in these areas. [10]

Cases with abdominal aortic aneurysms (AAAs) frequently tend to be older and have several accompanying health conditions. Known risk factors for AAA development include age over 65, smoking, and a positive family history of AAA. Smoking stands out as the most consistent and modifiable factor linked to faster AAA growth, while hypertension also contributes to this growth. [4]

Various risk factors were identified for perioperative mortality within 30 days after AAA repair, including age, smoking, lung function, pre-existing heart issues, and elevated serum creatinine levels. Additionally, factors like hospital case volumes, the type of graft used, and the experience level of the surgeon can also impact outcomes. [4]

8.3. Outcomes

The global mortality rate for ruptured abdominal aortic aneurysms is almost 41%, and most of the factors affecting the outcome of management of ruptured aortic aneurysms are not within the surgeon's control. Whereas the mortality for unruptured abdominal aortic aneurysm is 4%. A study conducted in Stockholm, Sweden, investigated the incidence and mortality rates associated with ruptured thoracic aortic aneurysms (TAA). The findings revealed an overall mortality rate ranging from 97% to 100%. Additionally, for those ruptured TAA cases that underwent surgical repair within six hours, the mortality rate was 50%. Despite the persistently high mortality rates associated with ruptured aortic aneurysms, advancements in medical technology, surgical techniques, and critical care have resulted in improved outcomes for patients. Collaborative efforts among healthcare professionals across various specialties, such as surgeons, anesthesiologists, intensivists, and nurses, have played a significant role in enhancing survival rates. Continuous research, innovation, and a multidisciplinary approach are ongoing in the medical community to further improve the management and outcomes of this challenging condition. [1][17][14]

Postoperative complications encompass acute kidney failure, acute lung problems, colonic ischemia, heart issues, lower limb blood clots, extended intestinal paralysis, and paralysis due to spinal cord issues. [4]

There were differences in short-term outcomes between male and female patients. Specifically, women were more likely to require an unplanned reoperation related to the repair compared to men. Additionally, women were less likely than men to be discharged home versus a rehabilitation facility. However, there was no statistical difference in other major adverse events (MAE) outcomes except for reoperation, in which a higher percentage of women required a reoperation compared to men. [13]

When comparing perioperative mortality rates, cAAA repair tends to exhibit higher rates than infrarenal AAA repair (3.6% vs 1.2%). Earlier studies on juxtarenal AAA repair in 1986 displayed a mortality rate of 7.9%. Subsequent large-scale studies spanning from 1993 to 2008 revealed decreasing mortality rates, ranging from 5.7% to 5.8%. Notably, some studies showed no significant difference in mortality between juxtarenal and infrarenal aneurysm repair. Repairing complex abdominal aortic aneurysms (cAAA) often leads to higher postoperative complications, notably an increased risk of renal dysfunction, which occurs more frequently after this type of aneurysm repair compared to standard procedures (21% vs 8.7%). A meta-analysis of juxtarenal aneurysms also reported an 18% rate of renal dysfunction, with 3.3% requiring dialysis, although the definition of postoperative renal dysfunction varied across studies. Predictors of renal complications included elevated preoperative creatinine levels and prolonged renal ischemia time, consistent with findings from other studies. Besides renal issues, patients undergoing cAAA repair also experienced higher rates of cardiac and pulmonary complications. [2]

The duration of renal or visceral ischemia was the only predictive factor for perioperative renal, cardiac, and respiratory complications. Intraoperative blood loss was also predictive of cardiac problems, indicating the lack of established best practices for renal protective strategies. [2]

While short-term outcomes may improve with endovascular repair, long-term data on survival, graft integrity, and complications are limited. Long-term survival after cAAA repair was acceptable, consistent with prior data on open juxtarenal aneurysm repair. However, technical predictors didn't influence long-term survival in our cohort. [2]

The operative mortality rates for patients undergoing contemporary Sx-AAA repair seem to be improved compared to previous reports in the literature. However, despite the lower operative mortality, both the occurrence of major adverse events and long-term survival outcomes appear to be intermediate when compared with E-AAA and R-AAA repairs. Previous series indicate a trend towards decreased operative mortality in recent Sx-AAA repair cases, likely attributed to enhanced perioperative care and increased utilization of endovascular aneurysm repair. The hospital mortality rates were 1.7% for E-AAA repair, 1.3% for Sx-AAA repair, and notably higher at 34.7% for R-AAA repair. Major adverse event (MAE) rates were 20%, 35%, and 63% for E-AAA, Sx-AAA, and R-AAA repairs, respectively. [3]

Elective AAA repairs in developed countries usually exhibit mortality rates of 4-8%, while emergency repairs carry significantly higher rates of 85-90%. Acute kidney injury occurred in 18.9% of patients post open AAA repair, with some cases requiring renal replacement therapy (RRT). The decision to initiate RRT was discretionary and showed a correlation between certain types of aneurysms and the development of acute kidney injury. However, the duration of aortic cross-clamp time did not significantly contribute to renal failure post-repair. [4]

EVAR demonstrated a lower rate of perioperative heart attacks, potentially contributing to improved 30-day survival. At 2-year and longer follow-ups, EVAR and open repair showed comparable all-cause mortality and late AAA-related mortality. [5]

In a contemporary series of AAA repairs, a considerable percentage required suprarenal cross-clamping, leading to increased operative duration, blood product use, mechanical ventilation time, ICU and hospital stays, and overall complication rates compared to repairs with infrarenal clamping. Interestingly, despite the complexity, skilled nursing facility placement needs were similar irrespective of the cross-clamping level. Moreover, 30-day mortality rates didn't significantly differ based on intraoperative cross-clamping, indicating that in experienced hands, complex repairs involving suprarenal cross-clamping with frequent adjunctive grafts can be performed with acceptable morbidity and mortality rates. Studies analyzing these complex repairs have showcased low 30-day mortality rates, although variability exists in the need for adjunctive renal and visceral grafts, impacting overall aneurysm complexity and outcomes. Different approaches, such as intraoperative renal cooling, have been explored to protect renal function during prolonged suprarenal cross-clamping, although evidence supporting these measures remains inconclusive. [7]

Patients with multiple high-risk factors, particularly severe renal dysfunction, showed significantly higher mortality rates post-surgery. Interestingly, the short-term mortality rates for high-risk patients undergoing traditional open surgery were comparable to or better than those reported for high-risk patients treated with endovascular grafts. However, the study revealed poor long-term survival rates among high-risk patients undergoing surgery. Their survival was significantly reduced as the number of risk factors increased, and even the presence of a single high-risk factor showed markedly lower long-term survival rates. Comparing the longevity of high-risk patients who underwent surgery versus those managed nonoperatively, the study highlighted poor survival rates for those considered high-risk, irrespective of the approach—operative or nonoperative. [8]

9. Objectives

9.1. General objective

- This study aims to describe patients, perioperative care, and outcomes of patients undergoing open aortic aneurysm repair in Tikur Anbessa Specialized Hospital, Ethiopia.

9.2. Specific objectives

- To describe patient characteristics and perioperative care of open aortic aneurysm repair.
- To assess in-hospital mortality associated with open repair of aortic aneurysms in TASH, Addis Ababa, Ethiopia.
- To assess major adverse outcomes associated with open repair of aortic aneurysms in TASH, Addis Ababa, Ethiopia.

10. Method

10.1. Study design

Single-centered retrospective observational study

10.2. Study area and period

The study was carried out at TASH, the largest referral hospital in the country with 700 beds. Tikur Anbessa Specialized Hospital is the primary teaching facility for clinical and preclinical training in most disciplines. It is also an institution that provides specialized clinical services to the entire country that are not available at other public or private institutions. The study period was from January 2017 to May 2024.

10.3. Population

10.3.1. Source population

All patients that have undergone elective vascular surgery during the study period.

10.3.2. Study population

All patients that underwent open AA repair during the study period.

10.4. Inclusion and exclusion criteria

10.4.1. Inclusion criteria

Age >/= 18 and undergone open aortic aneurism repair during the study period.

10.4.2. Exclusion criteria

Patients with incomplete data.

10.5. Sample size

Using single proportion formula

$$\mathrm{ni} = \frac{z^2_{1-\frac{\alpha}{2}} \times \mathrm{p} \times (1-\mathrm{p})}{\mathrm{d}^2}$$

Where

ni = Initial estimated sample size

Z = Confidence level (alpha, α)

P = prevalence

d = marginal error

- A study done in 2020 was used for in-hospital mortality after abdominal aortic aneurism repair, which was 16.6 %, With a confidence level of 95 %(z=1.96) and, 5% margin of error(d=0.05).

- $\frac{z^2_{1-\alpha/2} \times \mathrm{p} \times (1-\mathrm{p})}{\mathrm{d}^2}$, $\frac{(1.96)^2 0.166(1-0.166)}{(0.05)^2} \approx 212.7$
- Since the population is <10,000, the correction formula was used to get the final sample size
- $nf = \frac{ni}{1+ni/N}$ Where nf – final sample size

  ni– initial sample size

  N – Sampled population
- $nf = \frac{213}{1+\frac{213}{50}} = 40$
- Adding a 10% non-respondent rate makes the sample size 44

10.6. Sampling procedure

All patients who fulfill the inclusion criteria was included and a convenience sampling method was used. 50 patients were identified from the OR register and ICU HMIS register and 5 were excluded because of incomplete data.

10.7. Study variable

10.7.1. Dependent variable:

- In-hospital mortality
- Morbidity

  Length of ICU stay

  AKI

  MI

  Bowel ischemia

  Arrhythmia

  Paraplegia

  Pulmonary thromboembolism

  DVT

10.7.2. Independent variable:

- Demographics
- Sex
- Age
- Comorbidity
  - Hypertension
  - Diabetes
  - CHF
  - COPD
  - Asthma
- Type of aneurysm: ruptured vs unruptured
- Elective vs emergency
- Site of aneurysm
- Preoperative factors

  - Baseline creatinine
  - Maximum creatinine
  - Smoking
  - Preoperative medications
  - Position of aneurism
  - Maximum aneurism diameter
- Intraoperative factors
  - Intraoperative blood loss
  - Time of cross-clamp
  - Intraoperative Crystalloid
  - Intraoperative transfusion
  - Intraoperative heart rate
  - Intraoperative drugs used
  - Intraoperative monitoring

10.8. Operational definition

- In hospital mortality: any death postoperatively before patient was discharged from the hospital
- Major adverse event: one or more complications postoperatively (AKI, MI , hospital acquired pneumonia, Mesenteric ischemia, DVT, PE) as diagnosed by treating physician written on patients progress note.

10.9. Data collection procedure

Patient's medical charts were identified from the surgical OR log book and SICU register and were accessed after getting ethical approval from the ethical committee. For data collection structured English questionnaire adopted and modified from Tsakani, G. et al, 2017 was used. [4] The data was collected using the questionnaire by the primary investigator.

10.10. Data analysis procedure

Data was checked for completeness and was entered into SPSS 27 software for analysis. Descriptive analysis was done for the Socio-demographic and clinical characteristics of the participants. Bivariate analysis and linear regression were done for each predictor variable and continuous outcome variable. Bivariate, and multivariate binary logistic regression was done for categorical outcomes Statistical significance p-value less than 0.05 was taken as a determinant factor.

10.11. Data quality assurance

Data was checked for completeness and was cleaned on daily basis by the primary investigator.

10.12. Ethical clearance

Ethical clearance and support was obtained from the Department of Anesthesiology Critical Care and Pain Medicine, Addis Ababa University College of Health Science.

11.Result

During the study period, 50 aortic aneurysm repairs were done, and 5 were excluded because of inadequate records. 45 patients (19(42.2%) male and 26(57.8%) female), who had aortic aneurysm repair were included. Elective (n=40, 88.9%),and Emergency (n= 5, 11.1%). 15.7%(n=3) of the male patients had ruptured(emergency) aortic aneurysm repair . 5(11.1%) of them were thoracic aortic aneurysms of which 2 were ascending and 3 were descending thoracic aneurysms and the others were abdominal aortic aneurysms (n=40, 88.9 %), (36, 80 % infrarenal). The mean age of the participants was 54.44 ± 16.342 years, with a median age of 58 years. The age range spanned from 17 to 76 years. 33.3% of the patients are above the age of 65(n=15).

Preoperative medical comorbidities were found in 29(64.4%), and included chronic hypertension (n=22, 48.9%), asthma and IHD (n=4, 8.9%), valvular heart disease (n=6, 13.3%) diabetes mellitus, and heart failure (n=2, 4.4%).

Most of the patients (n=36, 80%) were on beta-blockers preoperatively, some were on aspirin and statin (n=11, 24.4%), and calcium channel blockers (n=15, 33.3%). 3 of the patients were smokers (6.7%)

The mean aortic aneurysm diameter was 6.64 cm ± 2.27 (ranges. from 2.7 to 18cm).

Intraoperative characteristics

All the surgeries were done under GA using ETT, commonly used induction agents were propofol (n=33,73.3%), ketamine (n=8,17.8%), and thiopental(n=4,8.9%), opioids were predominantly fentanyl(n=34,75.6%) and morphine(n=10,22.2%), tramadol in 1 patient(2.2%). vecuronium (n=33,76.4%),succinylcholine (n=10,22.2%) and pancuronium (n=1,2.2%) were the muscle relaxants used for induction. The most commonly used inhalational agent for the maintenance of anesthesia was isoflurane (n=39, 86.7%) followed by halothane (n=3, 6.7%) and sevoflurane (n=2, 4.4%). Morphine (n=25, 55.6%) and fentanyl (n=10, 22.2%) were the most given analgesia for maintenance of anesthesia, others were remifentanil, and intravenous paracetamol (n=2, 4.4%), epidural bupivacaine (n=3, 6.7%) tramadol (n=1, 2.2%). Vecuronium (n=40, 88.9%) was the most commonly used muscle relaxant for maintenance of anesthesia. Pancuronium (n=2, 4.4%), cisatracurium and atracurium (n=1, 2.2%) were also used.

All patients had ECG, pulse oximetry, and non-invasive BP. Most patients had arterial lines (n=37, 82.2%) and some had central lines (n=8, 17.8%). Temperature monitoring is rarely used and none had EtCO2 monitoring.

The duration of surgery ranges from 90 to 420 minutes (mean = 245 ± 74) and the total duration of anesthesia ranges from 120 to 480 minutes (mean = 288±80).

Duration of aortic cross-clamp time ranged from 30 min to 160 min (mean=75.5±29.4 min). 26.7 %(n=12) had cross-clamp time >90 minutes. The proximal cross clamp site was infrarenal on 36, 20 % of patients.

The mean estimated blood loss was 1567.21 ml± 1174, the range of blood loss varied widely, from 50 ml to 5400 ml. 17.8%(n=8) had blood loss >2500ml and 33.3%(n=15) had blood loss between 500 and 1000 ml. Patients received an average of 3321.43± 1380 ml of crystalloid, with a median of 3000.00 ml. The range of crystalloid administered ranged from 500 ml to 7000 ml. On average, 1 ± 1.6 unit of FFP was transfused per patient, with a range of 0 to 6 units. The mean number of PRBC units transfused was 2.47± 1.67 units, with a range of 0-8. Patients received an average of 0.89 ± 1.6 platelet units, the range of platelet units transfused varied from 0 to 5 units. In total 86.7% (n=39) received blood transfusion and 28.9% (n=13) received component transfusion.

The cardiovascular parameters

Lowest heart rate(HR) ranged from 40 to 98 bpm (mean = 68.8±14.9), highest HR ranged from 65 to 130 bpm (mean = 96.8±15.2), lowest systolic blood pressure (SBP) ranged from 70 to 110 mmHg (mean = 85±10), highest SBP with a range of 100 to 200 mmHg(mean = 142±20), lowest diastolic BP (DBP) ranged from 40 to 80 mmHg (mean = 54±7.5), highest DBP ranged from 60 to 120 mmHg(mean = 81.9±13.3), lowest mean arterial pressure (MAP) ranged from 45 to 75 mmHg(mean = 60.4±6.6), and highest MAP ranged from 60 to 130 mmHg(mean = 94.7±15). Intraoperative urine output ranged from 0.4 -5.9ml/kg/hr. (mean =2.74 ± 1.6 ml/kg/hr.). Vasopressor use consisted of noradrenaline (n=33, 73.3) and adrenaline (n=11, 24.4%). Antihypertensive used include nitroglycerine (n=14, 31.1%) and labetalol (n=6, 13.3%). Other drugs were used including atropine (n=5, 11.1%) and mannitol (n=22, 48.9%).

Postoperative care

All patients were transferred to the intensive care unit (ICU) postoperatively. 10 (22.2%) patients were transferred unextubated. All of the thoracic aneurysms were transferred unextubated. The average duration of postoperative mechanical ventilation was 0.77 ± 2.6 days (range 0 - 17).

The most common complications were AKI (n=10, 22.2%) and respiratory (hospital-acquired pneumonia) (n=7, 15.8%). IHD is a significant factor associated with respiratory complications (p value=0.016, AOR=25.9, 95%CI1.81, 371.7). 6(13.3%) patients had in-hospital death of which 4 were male, and 2 were age > 65. IHD is a factor associated with in-hospital mortality (p value=0.038, AOR=35.7, 95%CI 1.21, 1054) Less common complications were myocardial infarction and DVT (n=2, 4.4%) and mesenteric ischemia and PTE (n=1, 2.2%). 17(37.8%) patients had one or more major adverse events in 44.4% of patients with suprarenal x-clamp position had MAE, but no independent variable has a significant association. The factor associated with AKI from multivariate logistic regression is x clamp time more than 90 minutes (p value= 0.024, AOR 11.27, 95%CI 1.37, 92.28).

Table 1. The bivariate logistic regression of association between independent variable and in hospital mortality

Variable	in-hospital death		p-value	COR with 95%CI
	yes	No		
Age in years				
18-65	4(8.89%)	26(57.78%)	1(ref)	
>65	2(4.44%)	13(28.89%)	1	1(0.16-6.19)
Gender				
Female	2(4.44%)	24(53.34%0	0.209	0.313(0.051, 1.921)
Male	4(4.89%)	15(33.33%)	1	
HTN				
Yes	5(11.1%)	17(37.78%)	0.102	6.471(0.69,60.68)
No	1(2.22%)	22(57.78%)	1	
Asthma				
Yes	1(2.22%)	3(6.67%)	0.483	2.4(0.207,27.78)
No	5(11.11%)	36(80%)	1	
DM				
Yes	0(0%)	2(4.44%)	0.99	0(0.)
No	6(13.33%)	37(82.23%)	1	
CHF				
Yes	0(0%)	2(4.44%)	0.99	0(0)
No	6(13.33%)	37(82.23%)	1	
IHD				
Yes	2(4.44%)	2(4.44%)	0.049	9.25(1.01, 84.73)
No	4(8.89%)	37(82.23%)	1	
VHD				
Yes	1(2.22%)	5(11.11%)	0.797	1.360(0.131,14.165)
No	5(11.11%)	34(75.56%)	1	
Smoking				
Yes	1(2.22%)	2(4.44%)	0.319	3.7(0.282,48.621)
No	5(11.11%)	37(82.23%)	1	
Site of aneurysm				
Thoracic	2 (4.44%)	3(6.67%)	0.089	0.167(0.021,1.316)
Abdominal	4(8.89%)	36(80%)	1	
Blood transfusion				
Yes	5(11.11%)	34(75.56%)	0.797	0.735(0.071,6.758)
No	1(2.22%)	5(11.11%)	1	
Component transfusion				
Yes	3(6.67%)	10(22.22%)	0.234	2.9(0.5, 16.76)
No	3(6.67%)	29(64.44%)	1	
Minimum MAP				
>65	5(11.11%)	34(75.56%)	1	
<65	5(11.11%)	1(2.22%)	0.797	1.360(0.131,14.105)

Maximum MAP				
>100	0(0%)	13(28.89%)	0.99	0(0)
<=100	6(13.33%)	26 (57.78%)	1	
X clamp site				
Infrarenal	4(8.89%)	32(71.11%)	1	
suprarenal	2(4.44%)	7(12.56%)	0.390	2.286(0.347,15.04)
X clamp time				
<=90min	2(4.44%)	31(68.89%)	1	
>90 min	4(8.89%)	8(17.78%)	0.032	7.75(0.198, 50.12)
Intraoperative Mannitol				
Yes	4(8.89%)	18(40%)	0.359	2.333(0.382,14.26)
No	2(4.44%)	21(46.67%)	1	
Intraoperative noradrenaline				
Yes	6(13.33%)	27(60%)	0.99	0(0)
No	0(0%)	12(26.67%)	1	
Intraoperative adrenaline				
Yes	4(8.89%)	9(20%)	0.589	1.667(0.261,10.638)
No	4(8.89%)	30(66.66%)	1	
Intraoperative atropine				
Yes	1(2.22%)	4(8.89%)	0.645	1.750(0.161,18.97)
No	5(11.11%)	35()77.78%	1	
Intraoperative nitroglycerine				
Yes	3(6.67%)	11(24.44)	0.294	2.545(0.444,14.55)
No	3(6.67%)	28(62.22%)	1	
Blood loss				
<=1000ml	2(4.44%)	18(40%)	1	
>1000ml	4(8.89%)	21(46.67%)	0.560	1.714(0.280, 10.479)
Type of surgery				
Elective	2(4.44%)	22 (48.89%)	1	
Emergency	4(8.89%)	17(37.78 %%)	0.389	6(0.76,47.35)
Duration of anesthesia				
<=360	4(8.89%)	33(73.34%)	1	
>360	2(4.44%)	6(13.33%)	0.299	2.75(0.408,18.5)
Duration of surgery				
<=240 min	2(4.44%)	18(40%)	1	
>240min	4(8.89%)	21(46.67%)	0.304	2.588(0.423,15.84)
Intraoperative labetalol				
Yes	1(2.22%)	5(11.11%)	0.797	1.36(0.131,14.165)
No	5(11.11%)	34(75.56%)	1	

Table 2.The bivariate and multivariate logistic regression of association between moderately significant independent variable and AKI.

Variable	AKI		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Age in years						
18-65	5(11.11%)	25(55.56)	1		1	
>65	5(11.11%)	10(22.22%)	0.212	2.5(0.592, 10.55)	0.431	2.59(0.242, 27.856)
Gender						
Female	4(8.89%)	22(48.89%)	0.205	0.394(0.093,1.661)	0.406	3.65(0.172,77.47)
Male	6(13.33%)	13(28.89%)	1		1	
IHD						
Yes	3(6.67%)	1(2.22%)	0.029	14.57(1.31, 167.4)	0.99	1591265(0,)
No	7(15.55%)	34(75.56%)	1		1	
Asthma						
Yes	2(4.44%)	2(4.44%)	0.187	4.12(0.502,33.99)	0.669	2.27(0.053,96.25)
No	8(17.78%)	33(73.34%)	1		1	
Smoking						
Yes	2(4.44%)	1(2.22%)	0.096	8.5(0.68,105)	0.34	12.27(0.071,2108)
No	8(17.78%)	34(75.56%)	1		1	
Baseline creatinine						
>1	4(8.89%)	1(2.22%)	0.093	4.235(0.785,22.84)	0.99	29051613(0,)
<=1	6(13.33%)	34(75.56%)	1		1	
Blood loss						
>1000	8(17.78%)	17(37.78%)	0.009	22.66(2.14,239)	0.99	910639785(0,)
<=1000	2(4.44%)	18(40%)	1		1	
Component transfusion						
Yes	5(11.11%)	5(11.11%)	0.105	3.375(0.716, 14.66)	0.561	21.04(0.79,559)
No	8(17.79%)	27(60%)	1		1	
X clamp time						
<=90min	4(8.89%)	29(64.45%)	1		1	
>90 min	6(13.33%)	6(13.33%)	0.012	7.25(1.553, 33.83)	**0.024**	**11.27(1.37,92.3)**
Intraoperative labetalol						
Yes	3(6.67%)	3(6.67%)	0.097	4.57(0.758,27.37)	0.131	6.68((0.568,78.54)
No	7(15.55%)	32(71.11%)	1		1	

Table 3.The bivariate and multivariate logistic regression of association between moderately significant independent variable and in hospital death

Variable	In hospital death		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Gender						
Male	4(8.89%)	15(33.34%)	1		1	
Female	2(4.44%)	24(53.33%)	0.209	0.313(0.051, 1.921)	0.462	3.422(0.125, 90.8)
Hypertension						
Yes	5(11.11%)	17(37.78%)	0.102	6.471(0.69,60.68)	0.99	3181742366(0.00,)
No	1(2.22%)	22(48.89%)	1		1	
Ischemic heart disease						
Yes	2(4.44%)	2(4.44%)	0.049	9.25(1.01, 84.73)	**0.038**	**35.7(1.21, 1054)**
No	4(8.89%)	37(82.22%)	1		1	
Baseline creatinine						
≤1	4(8.89%)	36(80%)	1		1	
>1	2(4.44%)	3(6.67%)	0.089	6(0.76, 47.3)	0.523	3.7(0.066, 207.46)
Intraoperative component transfusion						
Yes	10(22.22%)	29(64.44%)	0.234	2.9(0.5, 16.76)	0.208	5.75(0.38, 875)
No	3(6.67%)	3(6.67%)	1		1	
Site of AA						
Thoracic	2(4.44%)	3(6.67%)	1		1	
Abdominal	4(8.89%)	36(80%)	0.089	0.167(0.021, 1.316)	0.682	0.43(0.008, 23.99)
X clamp time						
<=90	2(4.44%)	31(68.89%)	1		1	
>90	4(8.89%)	8(17.78%)	0.032	7.75(0.198, 50.12)	0.310	4.386(0.25, 76.08)
Type of surgery						
Elective	4(8.89%)	36(80%)	1		1	
Emergency	2(4.44%)	3(6.67%)	0.089	6(0.76,47.35)	0.99	7107039211(0.00)

Table 4.The bivariate and multivariate logistic regression of association between independent variable and respiratory complication

Variable	Respiratory complication		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Ischemic heart disease						
Yes	3(6.67%)	4(8.89%)	0.09	27.7(2.307,333.8)	**0.016**	**25.95(1.81,371.7)**
No	1(2.22%)	37(82.22%)	1		1	
Duration of surgery						
<=240 minutes	2(4.44%)	22(48.89%)	1		1	
>240 minutes	5(11.11%)	16(35.56%)	0.170	3.43(0.59, 20.01)	0.861	0.817(0.085, 7.87)
Baseline creatinine						
<=1	5(11.11%)	35(77.78%)	1	4.67(0.619, 35.17)	1	2.525(0.116, 54.9)
>1	2(4.44%)	3(6.67%)	0.135		0.555	
Intraoperative adrenaline use						
Yes	4(8.89%)	7(15.55%)	0.041	5.905(1.07, 32.54)	0.092	5.503(0.756, 40.07)
No	3(6.67%)	31(68.89)	1		1	

Table 5.The bivariate and multivariate logistic regression of association between moderately significant independent variable and major adverse event

Variable	One or major adverse event		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Baseline creatinine						
<=1	13	27	1		1	
>1	4	1	0.07	8.3(0.842,81.95)	0.074	9.005(0.811, 99.9)
Duration of surgery						
<=240 minutes	7	17	1		1	
>240 minutes	10	11	0.206	2.208(0.64, 7.539)	0.344	1.946(0.489, 7.734)
X clamp time						
<=90	10	23	1		1	
>90	7	5	0.094	3.22(0.821,12.63)	0.918	0.888(0.092,8.585)
Intraoperative noradrenaline use						
Yes	15	18	0.093	4.167(0.788, 22.03)	0.099	4.455(0.754,26.33)
No	2	10	1		1	
Intraoperative component transfusion						
Yes	7	6	0.162	2.561(0.684,9.628)	0.180	2.611(0.642,10.625)
No	10	22	1		1	

12. Discussion

The results of the study revealed several key findings regarding patients undergoing aortic aneurysm repair. The majority of participants were female (57.8%) which is very much higher when compared with other similar studies which ranged from 12-26 %. [3, 4, 5, 6, 8] The mean age of 54.74± 16 years, when compared with other studies our patients are younger. The average age in most studies in the western setup ranges from 72 -77 years [5, 6] but in a systematic review of patterns AAA in Africa age range was similar to ours (31-72 years)with a mean age of 56 years.[18] Most surgeries were elective (88.9%), and abdominal aortic aneurysms were more common than thoracic ones (88.9% vs. 11.1%). 7% of the patients were smokers in our population which is significantly lower than 64 -90 % which is found in other settings.

The average size of aortic aneurysm was 6.4 cm ±2.7 cm which is slightly higher than others that range from 5.4- 5.8 cm [7], this may be because of late recognition of these patients and may be the cause for increased mortality in our patients.

Preoperative comorbidities were prevalent, with chronic hypertension being the most common (48.9%) which is lower than the 82 % found in other studies but still, hypertension is the most common comorbidity in the other settings. The fact that hypertension and smoking which are significant risk factors are lower in our setting may indicate that there might be other significant risk factors for our population or may be due to the careful selection of most fit patients as our resource is limited. This in addition to the younger age and female predominance warrants further study to be done.

Beta-blockers were the most frequently used preoperative medication (80%), followed by aspirin (11%) and statins (11%). Similarly, in a study done in England, 84% were on beta blockers but a higher percentage of patients were on aspirin (71%) and statin (62%) which may be because of the higher number of cardiac comorbidity in the patient population. [7] Intraoperative characteristics indicated that surgeries were conducted mainly under general anesthesia, with isoflurane being the most commonly used inhalational agent. Vecuronium was the primary muscle relaxant utilized during both induction and maintenance of anesthesia.

The average duration of surgery and anesthesia was 243± 74 and 288± 80 minutes, respectively. Intraoperative parameters such as estimated blood loss and crystalloid administration varied widely among patients. Average duration of x clamp time is 75.5 minutes which Is significantly higher than other studies which is 39 minutes. Which may be the reason for increased mortality and morbidity. Cardiovascular parameters, including heart rate and blood pressure, showed considerable variability during surgery. But this factors showed no relation with development of major adverse event and mortality.

Postoperative care involved ICU admission for all patients, with mechanical ventilation required for an average of 0.70 days. The mean length of ICU stay was 4.07 days, which is similar to 4.09 days in a study done in South Africa [4]

In-hospital mortality occurred in 13.3% of cases which is lower than research done in South Africa (16.6%), but higher than in several western countries (4.7-10.5%). Mortality in elective aortic aneurysm repair was 10% which is significantly higher than other settings (1.2- 5.1%).Mortality in the emergency group is 40% which slightly higher than other setups (35.6 – 38.7%).which may be explained by the fact that all of the patients under emergency in our setup are ruptured which is not the case in the other setups. Complication rates were notable, with acute kidney injury (AKI) being the most common (21.4%), which is a bit more than found in other studies(18.9%) for elective surgeries and 20-46% following ruptured ones [8]. Respiratory complications, such as hospital-acquired pneumonia, were also prevalent (16.7%). Factor associated with AKI is x clamp time >90 minutes (p value=0.024, AOR =11.27, 95% CI 1.37, 92.28) similar to other studies, but site of aortic aneurism had no impact [8]. Ischemic heart disease (IHD) was associated with respiratory complications (p value 0.038, AOR 25.9, 95%CI 1.81, 371.7) and in-hospital mortality (p value=0.038, AOR=35.8, 95%CI 1.21, 1054). 37.8% (n=17) patients had one or more major adverse event but no significant association was found with the independent variables.

None of the abdominal suprarenal cross clamp surgeries had in hospital mortality which is lower than other settings which is around 6%, and 44.4% had one or more major adverse event which is lower than the other setup of 61 %, which could be because of better patient's preoperative condition as compared to other studies for example smoking was lower in our population. There is no difference in AKI between sites of cross clamp but in other studies it was higher in suprarenal cross-clamp. [7]

These findings underscore the complexity and challenges associated with aortic aneurysm repair surgery and highlight the importance of preoperative optimization and postoperative monitoring to mitigate complications and improve patient outcomes.

13. Limitations

The biggest challenge faced in carrying out this research was the inadequate clinical records in 5 patients and the small number of cases retrieved, its decided not to separate the different data sets between emergency and elective aneurysm repairs in our sample; therefore, the patient population was heterogeneous. The small sample size also impacted on the ability to carry out univariate or multivariate analyses on the risk associations for the development of complications. Conclusions regarding modifiable risk factors or preventative strategies can therefore not be made but may signal future areas for research. A future study would also assess the long-term outcomes of patients.

14. Conclusion

This study has extensively described patient demographics, perioperative practices, and postoperative outcomes of patients undergoing aortic aneurysm repair in this hospital. Noteworthy differences in patient demographics compared to other settings, alongside a comparatively higher mortality rates than western setups, highlight areas warranting further exploration.

15. Recommendation

Based on the findings of the study the following Recommendations are proposed

1 preoperative assessment and optimization

Given the prevalence of preoperative comorbidities especially hypertension in this case, thorough preoperative evaluation and management of comorbidities should be done to reduce the risk of perioperative complications

2 intraoperative management

Due to the variability of intraoperative parameters such as bleeding and hemodynamic parameters, consistent use of intraoperative monitors including arterial lines is recommended to ensure patient safety

3 postoperative care and complication management

The high rates of complications such as AKI and respiratory complications (HAP) indicate the importance of vigilant postoperative monitoring, early recognition, and management of complications to improve the outcome of patients

4 Identification and modification of risk factors

The Identification of risk factors such as prolonged Cross-clamp time and IHD emphasizes the need for risk stratification and targeted interventions

5 Future research directions

Future studies with larger sample size and longitudinal follow-ups are warranted to further show risk factors and long-term outcomes associated with aortic aneurysm repair.

6 data quality improvement

Efforts should be made to improve the completeness and accuracy of clinical records and systematic patient chart storage should be done as adequate documentation is crucial for a good analysis and drawing meaningful outcomes.

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19.

1. Annex

Annex 1: **Data Collection Check List**

Table 6. Patient characteristics

Identification number				
Variables			If yes(√)	Remarks
1	Sex	Male		
		Female		
2	Age	18 -65		
		Above 65		
3	Comorbidities	Hypertension		
		Diabetes		
		COPD		
		CHF		
4	Medications	Aspirin		
		Clopidogrel		
		Statin		
		Beta blockers		
5	Creatinine	Baseline		
		Maximum		
6	Smoking			
7	Maximum AAA diameter			
8	Site of AAA			

Table 7. Operative characteristics

	Parameter	
1	Intraoperative blood loss	
2	Crystalloid	
3	Packed RBC	
4	Minimum heart rate	
5	Maximum heart rate	
6	Minimum Blood pressure	
7	Maximum Blood pressure	
8	Cross clamp position	
9	Cross clamp time	
10	Induction agents used	
11	Maintenance agents used	

12	On table extubation	
13	Duration of surgery	
14	Duration of anesthesia	
15	Monitors used	
16	Length of ICU stay	
17	Duration of post-operative mechanical ventilation	

Table 8. Major adverse events

Parameter		
1	AKI	
2	MI	
3	Arrhythmia	
4	Mesenteric ischemia	
5	Respiratory	
6	DVT	
7	PTE	
8	In hospital death	