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CLINICAL OUTCOMES OF OPEN ABDOMINAL AND THORACO-ABDOMINAL AORTIC ANEURYSM REPAIRS AT A LEVEL 1 TRAUMA CENTER IN KARACHI: IMMEDIATE AND MID-TERM PERSPECTIVES

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Abstract

Background: *Abdominal and thoracoabdominal aortic aneurysms (AAA/TAAA) are progressive, life-threatening dilatations of the aorta, associated with mortality rates ranging from 3–8%. In resource-limited settings, open surgical repair (OSR) remains the more durable and feasible treatment option.*

Objectives*: to describe patient characteristics, clinical presentations, and surgical outcomes of AAA and TAAA patients treated at Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi.*

Study Design: *A retrospective observational study.*

Place and Duration of study. *a tertiary care hospital between January 2019 and December 2023.*

Methods: *This retrospective observational study included 24 adult patients (≥18 years) who underwent open surgical repair for abdominal or thoracoabdominal aortic aneurysms (AAA/TAAA) at a tertiary care hospital between January 2019 and December 2023. Patients with co-existing aortic dissection were excluded. Data were collected using a pre-designed proforma covering demographics, clinical presentation, and surgical outcomes. Early (≤30 days) and mid-term complications, 1-year survival, and mortality rates were analyzed.*

Results*: A total of 20 patients underwent open surgical repair for abdominal aortic aneurysm (AAA), with a mean age of 53.6 years. All were symptomatic, most commonly presenting with abdominal pain (75%) and a median symptom duration of 1.5 months. The mean operative time was 7.3 hours, median blood loss was 700 mL, and mean hospital stay was approximately 10 days. Immediate postoperative complications included acute kidney injury (10%), pneumonia (10%), and one acute coronary event. Early complications included ileus (15%) and surgical site infection (15%), along with isolated cases of wound dehiscence and graft infection. Late complications comprised incisional hernia (n=2), sexual dysfunction, intestinal obstruction, and lower limb ischemia (n=1 each). The overall 1-year survival rate was 72.7%. Additionally, four patients with thoracoabdominal aortic aneurysms (TAAA) underwent surgery, with a 1-year survival rate of 50%.*

Conclusion: *Open surgical repair remains a durable and effective treatment option for AAA and TAAA in resource-limited settings, with acceptable complication and survival rates.*

INTRODUCTION

An abdominal aortic aneurysm (AAA) is a progressive and potentially lethal degenerative disorder that occurs in up to 8% of men over 65 years old[1]. Whereas thoraco-abdominal aneurysms (TAAA) is much rare having an incidence of around 5.9 cases per 100,000 population per year[2]. It involves a focal enlargement of the abdominal aorta, with the artery's diameter increasing to more than 1.5 times its normal size, typically exceeding 30 mm, as observed in imaging studies[3]. While AAA often remains asymptomatic, its rupture can be fatal, leading to about 200,000 deaths globally each year[4]. Common risk factors for AAA include advanced age, male gender, a history of high blood pressure, coronary artery disease and chronic obstructive pulmonary disease, smoking, and a family history of the condition[5]. Additionally, individuals with connective tissue disorders such as Marfan Syndrome and Ehlers-Danlos Syndrome are at heightened risk for developing AAA and TAAA. Interestingly, diabetes mellitus is not considered a risk factor for AAA, due to mechanisms that are not fully understood[6].

Abdominal aortic aneurysms (AAAs) are often asymptomatic and typically not detectable through physical examination, remaining unnoticed until they are incidentally identified during radiologic evaluations conducted for other reasons[7]. Ultrasonography serves as the primary imaging modality for both the diagnosis and screening of AAAs, as well as for the follow-up surveillance of the condition. In cases where the aneurysm's size, as detected by ultrasonography, suggests the need for surgical intervention, a computed tomography (CT) scan is generally employed to provide a more detailed assessment[8]. The European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines recommend that small asymptomatic aneurysms—defined as 30-55 mm in men and 30-50 mm in women—should be monitored through routine ultrasound surveillance. Conversely, aneurysms that are symptomatic, large (>55 mm in men and >50 mm in women), rapidly expanding (expansion rate of > 6 to 8 mm per year) or ruptured necessitate prompt surgical management. This management can be approached either via open surgical repair (OSR) or through Endovascular Aneurysmal Repair (EVAR), depending on the specific clinical scenario[9].

Open Surgical Repair (OSR) remains the standard and widely practiced method for managing Abdominal Aortic Aneurysms (AAA) and Thoracoabdominal Aortic Aneurysms (TAAA). While AAA is typically approached via a midline abdominal incision, TAAA repair generally requires a left thoracoabdominal incision to provide adequate exposure. OSR is associated with a 30-day mortality rate of approximately 3% for AAA and up to 8% for TAAA, with potential complications involving the cardiac, pulmonary, renal, and gastrointestinal systems[2,10,11]. A study by Rehman et al. reported an in-hospital mortality rate of 4.8% after AAA repair, with acute kidney injury as the most common complication (11.9%)[12]. While Endovascular Aneurysm Repair (EVAR) and Thoracic Endovascular Aortic Repair (TEVAR) offer advantages such as lower perioperative mortality, shorter hospital stays, and reduced blood loss, they require lifelong surveillance with serial CT scans to detect complications like endoleaks or graft migration[10,11]. These follow-up demands, along with high costs and radiation exposure, pose significant challenges in resource-limited settings. In public sector hospitals across lower-middle-income countries like Pakistan, where access to advanced imaging and consistent follow-up is often constrained, OSR remains a more practical and durable treatment option—especially for younger patients and those with complex aneurysms such as TAAA.

The objective of this study was to describe patient characteristics, clinical presentations, and surgical outcomes of AAA and TAAA patients treated at Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi. Despite extensive global data, there is limited information from public sector hospitals in lower-middle-income countries like Pakistan. This work fills that gap, providing insights to improve AAA/TAAA management in resource-limited settings.

Methods:

Study design and settings:

This retrospective observational study included all adult patients aged 18 years or older who underwent open surgical repair for abdominal aortic aneurysm (AAA) or thoracoabdominal aortic aneurysm (TAAA) at the Department of Vascular and Endovascular Surgery (DVES), Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Karachi. Patients with co-existing aortic dissection were excluded.

Data collection and sampling technique:

Consecutive sampling technique was used, and data was collected for all cases admitted between January 2019 and December 2023. Relevant information was extracted from hospital admission notes, radiology reports, outpatient follow-up records, and operative reports. When electronic records were incomplete, patients were contacted via phone to obtain follow-up data. All collected data were securely stored in a password-protected online database. A pre-designed pro forma was used for systematic data collection. Variables included demographic characteristics, clinical presentation, morphological and etiological characteristics of aneurysms, surgical details, and postoperative outcomes. **Early outcomes** were defined as those occurring within 30 days postoperatively, while **mid-term outcomes** were assessed for up to one year following surgery.

Data Analysis:

Statistical analysis was performed using IBM SPSS Statistics Version 24. Continuous variables were reported as means with standard deviations, while categorical variables were expressed as frequencies and percentages. The normality of data was assessed using the Shapiro-Wilk test. For normally distributed continuous variables, comparisons were made using independent sample t-tests or ANOVA as appropriate. For categorical variables, Chi-square tests were applied, with Fisher's exact test used when Chi-square assumptions were not met. Non-parametric data were analyzed using the Mann-Whitney U test. A p-value of less than 0.05 was considered statistically significant.

Results:

Abdominal Aortic Aneurysm

A total of 20 patients underwent open surgical repair for AAA over the last five years, including 19 infra-renal and 1 para-renal aneurysm. No juxta- or suprarenal AAA cases were operated during the study period. The mean age was 53.6 ± 13.5 years, with 80% of patients being male. Abdominal pain was the most common presenting symptom (75%), with a median symptom duration of 1.5 months (mean: 7.7 ± 14.6 months). Hypertension and smoking history were present in 55% and 45% of patients, respectively. Pre-operative characteristics of patients are summarized in Table 1.

Table 1 Patient Characteristics

Variables	AAA (N=20)	TAAA (N=4)
Gender		
Male	16 (80%)	3 (75%)
Female	4 (20%)	1 (25%)
Comorbidities		
Hypertension	11 (55%)	4 (100%)
Coronary Artery Disease	5 (25%)	0
Diabetes Mellitus	0	1 (25%)
Chronic Obstructive Pulmonary Disease	0	0
Others*	3 (15%)	0
None	5 (25%)	0
Smoking	9 (45%)	0
Symptoms		
Abdominal pain	15 (75%)	3 (75%)
Pulsatile abdominal mass	5 (25%)	2 (50%)
Flank pain	2 (10%)	1 (25%)

Leg pain	1 (5%)	0
Ejection Fraction		
Normal (≥50%)	10 (50%)	4 (100%)
Impaired (30-49%)	6 (30%)	0
Severely impaired (<30%)	0	0
Sac Rupture		
None	10 (50%)	0
Contained rupture	8 (40%)	3 (75%)
Frank Rupture	1 (5%)	0
Nature of Surgery		
Elective	17 (85%)	2 (50%)
Emergency	3 (15%)	1 (25%)

*Others include Tuberculosis, Psoriasis and Asthma

Contained rupture of the aneurysmal sac was observed in 40% of patients, while one patient presented with a frank rupture. Emergency surgery was performed in 3 patients; the rest underwent elective repair. The mean aneurysmal dimensions were 7.7 × 4.9 × 5.4 cm (anteroposterior × transverse × craniocaudal). The average duration of surgery was 7.3 ± 2.3 hours, with a median intraoperative blood loss of 700 mL. The inferior mesenteric artery was ligated in 45% of cases. One case involved a para-renal aneurysm, requiring re-implantation of the celiac trunk, superior mesenteric artery, inferior mesenteric artery, and both renal arteries onto a Dacron graft. The mean ICU stay was 4.6 ± 6.5 days (median: 3 days), and the average total hospital stay was 9.95 ± 7.9 days (median: 7 days).

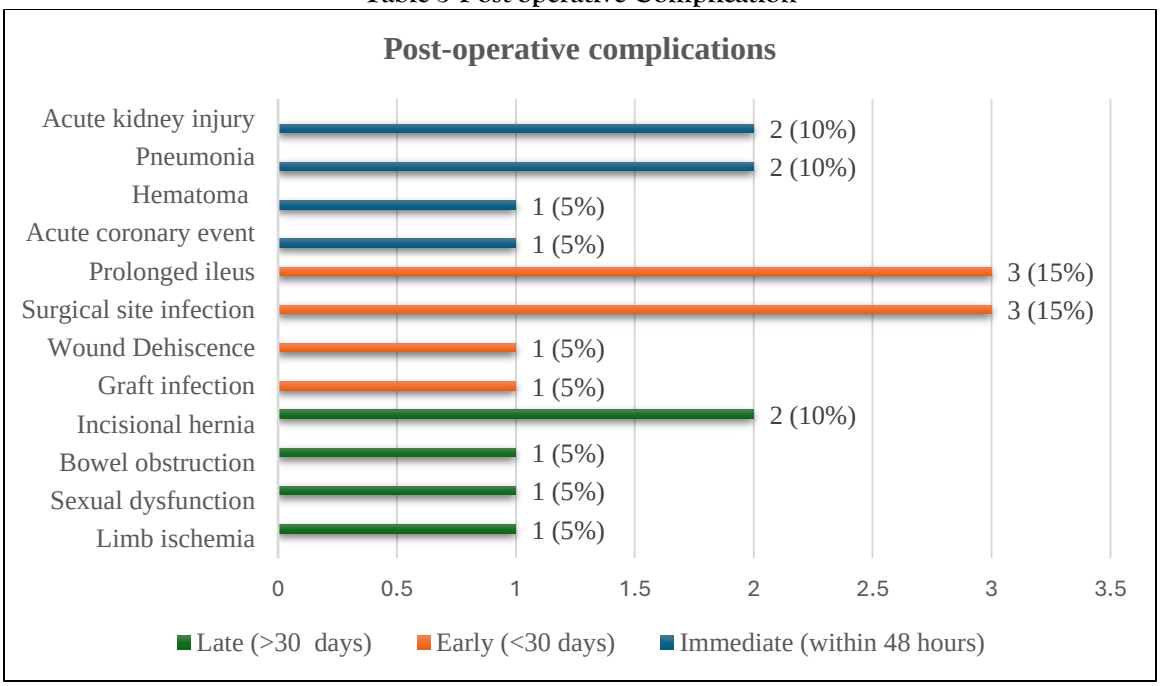
Table 2 Peri-operative Characteristics

	AAA	TAAA
Antero-posterior dimension (cm)	7.7 ± 14.6	9.6 ± 6
Transverse dimension (cm)	4.9 ± 1.7	7 ± 2
Cranio-caudal dimension (cm)	5.4 ± 2.5	13.5 ± 7.5
Duration of surgery (hours)	7.3 ± 2.3	15.8 ± 0.8
Estimated blood loss (mL)	916 ± 757	2500
Length of ICU stay (days)	4.6 ± 6.5	6 ± 1
Length of hospital stay (days)	9.95 ± 7.9	21 ± 7.9

Postoperative complications occurred in a subset of patients, highlighting the complexity associated with open abdominal aortic aneurysm repair. Among **immediate complications**, acute kidney injury and pneumonia were the most common, each observed in 10% of cases. One patient developed an abdominal collection, and another experienced an acute coronary event in the immediate postoperative period.

Early postoperative complications included wound infections and ileus, each affecting three patients. Single cases of wound dehiscence and graft infection were also reported. During **1-year follow-up**, two patients developed Isolated cases of sexual dysfunction, bowel obstruction, and lower limb ischemia were also noted during long-term follow-up.

Table 3 Post-operative Complication



One intra-operative death occurred in a patient with a ruptured abdominal aortic aneurysm, resulting in a 30-day mortality rate of 5% (1 out of 20). During the subsequent one-year follow-up period, two additional patients were confirmed to have died. Of the remaining cohort, 8 patients were confirmed to be alive at one year, while 9 were lost to follow-up. Excluding those with unknown outcomes, the 1-year survival rate among patients with available follow-up data was **72.7**% (8 out of 11).

Patients with contained ruptures had significantly shorter surgery durations (5.8 ± 0.9 hours) than those without rupture (8.6 ± 2.7 hours, $p = 0.021$), while blood loss, hospital stay, and ICU stay did not differ significantly. Patients with normal ejection fraction (≥50%) had longer hospital stays compared to those with mildly reduced EF (14.1 ± 10.1 vs. 5.8 ± 1.3 days, $p = 0.039$). Larger antero-posterior aneurysm size correlated with shorter operative time ($r = -0.676$, $p = 0.045$), and greater cranio-caudal dimension was strongly associated with shorter hospital stay ($r = -0.938$, $p = 0.006$). ICU and hospital stays were positively correlated ($r = 0.843$, $p < 0.001$). Some findings, particularly regarding rupture-related surgery duration, EF, and aneurysm size correlations, are inconsistent with existing literature, likely due to small sample size and confounding factors, warranting cautious interpretation.

Thoraco-abdominal Aortic Aneurysm

During the study period, four patients underwent surgical repair for thoraco-abdominal aortic aneurysms (TAAA), classified according to the Crawford system as type II (n=1), type III (n=1), and type IV (n=2). The mean age of the TAAA cohort was 43.8 ± 2.6 years, with 75% male. All patients had a history of hypertension, and none reported smoking. Three patients presented with contained rupture of the aneurysmal sac, with one requiring emergency surgery. Demographic characteristics of TAAA patients are summarized in Table 1.

The mean aneurysm dimensions were significantly larger compared to the abdominal aortic aneurysm (AAA) group, measuring 9.6 × 7.0 × 13.5 cm (anteroposterior × transverse × craniocaudal). This increased complexity was reflected in longer operative times, with a mean duration of 15.8 ± 7.5 hours, and prolonged postoperative care, with an average ICU stay of 6 ± 1 days and a total hospital stay of 21 ± 7.9 days. Perioperative characteristics are detailed in Table 2.

Postoperative outcomes showed considerable morbidity and mortality in this subgroup. One patient died on postoperative day 2 due to cardiopulmonary arrest. Among survivors, complications included acute kidney injury and atelectasis in one patient, and chest hematoma in two others; all three recovered and

were discharged. However, one patient died three months after surgery due to pulmonary complications. Overall, the 1-year survival rate for the TAAA subgroup was 50%, highlighting the increased risk associated with these complex aneurysms.

Discussion:

Abdominal aortic aneurysm (AAA) and thoracoabdominal aortic aneurysm (TAAA) are associated with significant morbidity and mortality. In this retrospective study of 20 patients undergoing open surgical repair, the mean age was 53.6 ± 13.5 years—much younger than the average of 69 years reported in Western studies such as Day et al.[13] This age difference may reflect selective exclusion of older, high-risk patients in lower-middle-income countries due to limited resources and poorer perioperative survival. Most patients were male (80%), with hypertension (55%) and smoking (45%) as common risk factors. While hypertension prevalence aligns with global data, smoking was underreported compared to international studies, where prevalence exceeds 90%[13, 14]. All patients in our cohort were symptomatic, likely due to the absence of routine screening and limited access to diagnostic imaging in resource-constrained settings, resulting in delayed diagnosis once aneurysms become symptomatic[15].

The mean aneurysmal dimensions in our cohort were 7.7 × 4.9 × 5.4 cm, consistent with previously published data. Rehman et al. reported a mean diameter of 8.0 cm in a similar Pakistani population[12]. The mean operative time in our study was 7.3 ± 2.3 hours, with a median estimated blood loss of 700 mL. These findings reflect a mix of elective and emergency cases. In comparison, Barakat et al. reported a significantly shorter mean operative time of 2.58 hours but a much higher median blood loss of 1500 mL and a median transfusion requirement of 6 units in ruptured AAA cases[17]. The mean hospital stay in our cohort was approximately 10 days, comparable to previous reports from both local and international literature[12,17].

Immediate postoperative complications in our cohort included acute kidney injury (AKI) and pneumonia, each occurring in 10% of patients. Additionally, one patient experienced an acute coronary event, and another developed an abdominal collection. Rehman et al. reported a comparable AKI rate of 11.9% following open infra-renal AAA repair in Pakistan[12]. In a large international registry, AKI rates were reported as 1.9%, 1.4%, and 4.6% for asymptomatic, symptomatic, and ruptured AAA cases, respectively, while the corresponding myocardial infarction rates were 2.9%, 2.8%, and 6.8%[18]. These early complications highlight the physiological burden of open surgical repair and underscore the importance of careful perioperative optimization and vigilant postoperative monitoring.

Early postoperative complications (within 30 days) included ileus and surgical site infections in 15% of patients each, with isolated cases of graft infection and wound dehiscence. None required surgical re-intervention. In comparison, a UK study reported early re-operations in 5.8% of patients, mainly for bleeding, ischemia, or obstruction[19]. Lee et al. noted a 5.6% incidence of ischemic colitis after AAA repair, with higher complication rates in patients who underwent IMA re-implantation[20]. In our study, the IMA was ligated in 45% of cases; no significant difference in GI complications was observed between ligated and non-ligated groups. This suggests that selective IMA ligation may be safe when guided by intraoperative assessment, though larger studies are needed to confirm this.

Mid-term outcomes, assessed at one-year follow-up, revealed a limited number of complications. Two patients (8.3%) developed incisional hernias, while isolated cases of sexual dysfunction, bowel obstruction, and lower limb ischemia were also observed. Erectile dysfunction is a well-recognized complication of open AAA repair, with reported incidence ranging from 7.4% to 79%, as noted by Regnier et al.[21]. Similarly, incisional hernias are a known sequela of abdominal aortic surgery, with Barranquero et al. reporting rates up to 46.5% at a median of two years, particularly in patients with risk factors such as smoking, prior abdominal surgery, and chronic kidney disease[22]. Use of prophylactic mesh techniques—particularly onlay or sublay placements—has been shown to significantly reduce the incidence of incisional hernias following AAA repair[23,24].

Although previous studies have reported that women experience worse outcomes after AAA repair—including higher mortality, longer hospital stays, and more postoperative complications—this trend was not observed in our cohort. However, both cases of incisional hernia in our study occurred in female patients, showing a statistically significant association ($p = 0.043$). While the small sample size limits broad conclusions, this finding highlights the need for sex-specific risk assessment and targeted preventive strategies in long-term postoperative care.

Our study demonstrated a 30-day **mortality** rate of 5% and a 1-year survival rate of 72.7%, consistent with regional and global data. For example, a private-sector hospital in Pakistan reported an in-hospital mortality of 4.8% following AAA repair[12], while a Sri Lankan study noted a perioperative mortality rate of 7.6%, with factors such as aneurysm diameter >7 cm, emergency surgery, smoking history, prolonged aortic cross-clamping, and extended postoperative ventilation associated with poor outcomes[25].

TAAA is a more complex condition than infrarenal AAA, with longer operative times and higher morbidity and mortality. In our study, four patients underwent open TAAA repair, with a mean aneurysm size of 9.6 × 7.0 × 13.5 cm and operative time of 15.8 hours. Postoperative complications included AKI, atelectasis, and chest hematomas. One in-hospital death and one late mortality resulted in a 1-year survival rate of 50%, significantly lower than international reports. A study on open TAAA repair post-EVAR noted a 7.9% incidence of AKI and an 11.1% reintervention rate due to contained bleeding[26]. Respiratory complications are well-documented in open aortic repairs, with Khan et al.'s meta-analysis reporting rates as high as 26% for descending thoracic and thoracoabdominal aneurysms[27]. Elective open repair for thoracoabdominal aneurysms (TAAA) carries an in-hospital mortality risk ranging from 5% to 15%, with reported 1-year and 5-year survival rates of 83% and 64%, respectively[28]. Comparable outcomes have also been observed in the U.S., with 30-day mortality rates of 5.6% and 6.0% for extent IV TAAA and supra-celiac AAA repair, respectively[29].

While endovascular aneurysm repair (EVAR/TEVAR) has gained popularity in high-income settings due to lower immediate morbidity, it demands long-term follow-up, costly imaging, and frequent re-interventions. These factors pose significant challenges in LMICs, where healthcare infrastructure and access to regular surveillance are limited. In contrast, open surgical repair (OSR), though more invasive, provides durable outcomes with lower long-term re-intervention rates. Therefore, in resource-limited countries like Pakistan, OSR remains a more feasible and sustainable option, particularly for patients who may be lost to follow-up or cannot afford repeated procedures[30,31].

Limitations:

This study has several limitations. The small sample size and single-center design restrict the generalizability of the findings. Long-term outcome assessment was limited by a loss to follow-up in 9 of 20 AAA patients, affecting the accuracy of 1-year survival estimates. The small number of TAAA cases (n=4) precluded meaningful subgroup comparisons. Additionally, incomplete or inconsistent clinical documentation may have impacted data quality and the strength of statistical analyses.

Conclusion:

Open surgical repair remains a viable and durable option for the management of AAA and TAAA in resource-limited settings, offering acceptable morbidity and mid-term survival outcomes. Despite the complexity of cases and limited resources, outcomes in our cohort were comparable to international data. Strengthening surgical capacity and perioperative care in public sector hospitals can further improve prognosis, especially where long-term surveillance required for endovascular repair is not feasible.

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Conflict of interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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