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Comparison of postoperative data and survival in patients with and without rupture in infra-abdominal aortic aneurysms: 23 years experience

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Abstract:

Infrarenal abdominal aortic aneurysms are responsible for high rates of rupture-associated morbidity and mortality and can be treated by open or endovascular surgery. We compared the postoperative data and vital functions of the patients who had undergone open surgery for ruptured and non-ruptured infra-renal abdominal aortic aneurysms.

Between January 1996 and March 2019, 84 patients (62 males, 22 females) underwent open surgical repair because of infrarenal abdominal aortic aneurysm in 2 separate hospitals in our region. The mean age of our patients was 71.5 ± 6.4 years (range 48-81 years). The patients were divided into two groups. Group I patients were composed of 45 patients and these patients were taken under elective conditions before the rupture occurred. The number of patients in Group II was 39 and these patients were operated after rupture. Group II patients underwent surgical treatment in emergency conditions and in an unstable hemodynamic state. In Group II patients, the duration of intensive care unit and hospitalization was higher than Group I. In addition, hospital costs were higher in Group II patients. 26 patients (30.9%) in Group II and 5 patients (5.9%) in Group I died in the early and postoperative period.

According to this retrospective study, operative repair before rupture in infra-renal abdominal aortic aneurysms decreases morbidity and mortality rates, statistically. Therefore, patients who are diagnosed with infra-renal abdominal aortic aneurysm and do not reach the surgical conditions should be followed up as closely as possible and should be operated before rupture when the surgical indication is established.

Key words: Abdominal Aortic Aneurysm, Rupture, Emergency Surgery, Mortality, Early Diagnosis.

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Introductıon:

Infra-renal abdominal aortic aneurysms (IR-AAA) are one of the most common diseases of the aorta characterized by an infra-renal aortic diameter of 3 cm and over which are life-threatening. IR-AAA occur in around 2.3 % of the general population, and as much as 5.96 % of men over the age of 60 years, and can cause thousands of deaths each year (1,2). More than 15,000 people die each year of ruptured abdominal aortic aneurysm in 2013, the Centers for Disease Control ranked it the 15th leading cause of death in the United States in adults 60 to 64 years of age (3-7).

There is an accurate correlation between aneurysm diameter and rupture (8). When the infra-renal aorta diameter is 7 cm and above, the risk of rupture in 5 years increases compared to the diameter of 7 cm and below (9). Mortality and rupture risk in abdominal aortic aneurysms are directly

related to the size of the aneurysm and the annual growth rate (1,10). The mortality rate of the patients who were transferred to the hospital because of ruptured IR-AAA and taken to emergency operation is around 40% (11). However, in elective conditions, postoperative mortality rates in these cases with open surgical treatment vary between 1% and 10% (12).

The aim of this study was to compare the results of patients who underwent surgery for ruptured or non-ruptured IR-AAA in a 23-year period and to emphasize the importance of close follow-up and early diagnosis in patients with IR-AAA.

Materıals and Methods:

Study design

This is a retrospective study conducted by analysis of the medical records of 84 patients treated with open repair of IR-AAA from January 1996 to March 2019. Endovascular treatment was not included in this study. This procedures could not be performed due to the lack of experienced personnel to perform emergency interventional procedures for ruptured patients who need urgent intervention. Patients were operated in cardiac arrest, ruptured or non-ruptured clinical conditions. The data obtained from the records of 2 hospitals in our region were analyzed. Of the 84 patients operated for IR-AAA, 62 were male (73.8%) and 22 were female (26.2%). The mean age of our patients was 71.5 ± 6.4 years (range 32-81 years). Patients were divided into two groups: Group I (n = 45 patients; operated without rupture) and Group II (n = 39 patients; operated after rupture developed).

Setting and data sources, ethics

Hospital archive files and hospital registration system records were used and the data of patients were analyzed retrospectively. In patients, demographic and clinical characteristics were investigated such as symptoms, duration of symptoms, diagnostic methods, preoperative hemodynamic and mental status, aneurysm characteristics, aneurysm complications, operation datas, the use of blood and blood products, complications of aneurysm and surgical, and in postoperative follow-up period, duration of mechanical ventilation, intensive care and discharge times, hospital costs, early complications, additional morbidities, and the results were recorded. The study was approved by the institutional review board of Regional Training and Research Hospital. All procedures were performed in accordance with the Declaration of Helsinki.

Surgical Technique

All patients in Group I and Group II undergo general anesthesia, open repair was performed with trans-peritoneal approach an incision in the midline. Aort and iliac arteries were explored and then proximal and distal clamping were performed. In ruptured patients, vessel exploration was performed after controlled the bleeding with suprarenal, hiatal or thoracic clamping. Only aortic tube grafts were used for surgical repair in cases where the aneurysm was limited to the abdominal aorta and did not reach the iliac arteries. Aortic bifurcation graft was used for surgical repair in severe calcification of aortic bifurcation and in cases involving iliac arteries of aneurysms. The graft was extended to the femoral level in the absence of appropriate arterial structure after aneurysm, in the presence of technical difficulties associated with deep pelvic anastomosis, and in the presence of severe concomitant obstructive iliac disease. In the majority of patients an inferior mesenteric artery was anastomosed onto aortic graft. In all patients, the aneurysmal incision was wrapped around the graft and closed with the omentum pedicle. Drains were placed in the retroperitoneal region and the douglas cavity. The retroperitoneal site was closed with sutures and separated from the abdominal cavity. All patients were followed up in the intensive care unit until their vital functions were stabilized.

Definitions

Extubation time was evaluated as long-term mechanical ventilation support in cases longer than 12 hours. Patients in the ICU longer than 3 days were considered as extended ICU support. Acute renal failure was diagnosed if it increased more than 1.5 times the baseline value in serum creatinine, or a decrease in basal value greater than 25% or less than 0.5 mL / kg / h for urine output. The reoperation requiring revision was defined by the presence of hemorrhagic drainage over 1000 cc in the first 24 hours and a decrease in hemoglobin values. Hospital expenses of over $ 5,000 were considered excessive and undesirable financial hospital costs. Deaths were classified as hospital early mortality (< 72 hours after operation) and overall mortality (1 month). Besides, systemic arterial hypertension was defined as pressure greater than 140 x 90 mmHg or continuous use of antihypertensive; diabetes

mellitus as fasting glycemia > 106 mg/dL or use of hypoglycemics; smoking as prior or current use of tobacco or derivatives; and peripheral arterial occlusive disease as an ankle-brachial index < 0.9 or evident clinical signs of arterial occlusion.

Statistical Analysis

The statistics of our study was performed with SPSS 17.0 statistics standard version program. All data were showed as mean, standard deviation, and percentage. In the comprasion of variables datas between the groups, Chi-Square and Independent Samples T-test were used. Before T-test, Levene test was performed for all datas for the investigation of equality of variance and the results were interpreted according to equality of variance. Fischer's exact test was performed to compare categorical data, and p-value less than 0.05 was considered as statistically significant.

Results:

Table 1 lists the demographic and clinical characteristics of the patients and risk factors for both groups of patients. There was no statistical difference between groups except smoking habit (p> 0.05). The number of smokers in Group II was higher, this difference was statistically significant. The majority were male (n = 62; 73.8%) and the mean age of the patients was 71.5±6.4 (range 48-81 years).

In the first presentation, 79 patients (94%) had abdominal pain and 80 patients (95.2%) had a pulsatile mass in the abdominal region. 60 patients (71.4%) had anorexia and weakness, 22 patients (26.2%) had back pain, 16 patients (19%) had chest and back pain, 11 patients (13.1%) had pain in the legs, and Group I had no symptoms in 5 patients. Group II patients without symptoms were not present. In Group I, the duration of the symptoms was 105.1 ± 72.2 (range 80-311) days, while in Group II the duration of the symptoms was 92 ± 73.8 (range 78-345) days (except for complaints of rupture day). There were no differences between the groups in terms of the onset of symptoms and symptoms (p>0.05).

In addition to the patient's complaints, history and physical examination for diagnosis, all patients in Group II and 43 of the Group I patients underwent duplex ultrasonography at admission (Fig. 1A). Computed tomography (Fig. 1B) was performed on 69 (82.1%) patients to confirm the diagnosis, to fully determine the aneurysm level and accurately measure the aneurysm diameter. Patients with high creatinine levels, suspected rupture in duplex ultrasonography, hemodynamic instability and severe abdominal pain were operated without computed tomography (Table 1).

Table 1: Demographic and clinical characteristics of the patients.

Parameters	**Group I (n=45)**	**Group II (n=39)**	**P-value**
Age (year)	70.9±6.3	71.1±5.3	0.784
Gender (male/female) (n)	28/17	34/5	0.234
Body Mass Index			
<25 kg/m^2	20 (44.4)	18	
≥25 kg/m^2	25 (55.6)	21	
Diagnosis methods (n, %)			
Duplex ultrasonography	43 (95.5)	39 (100)	0.534
Computed tomography	41 (91.1)	28 (71.8)	0.794
Arteriography	21 (46.6)	17 (43.6)	0.657
Hypertension (n, %)	34 (75.5)	30 (76.9)	0.301
Diabetes Mellitus (n, %)	12 (26.6)	10 (25.6)	0.619
Ejection Fraction (n, %)			
<50	15 (33.3)	12 (30.7)	0.566
≥50	30 (66.7)	27 (69.3)	0.321
Coronary artery disease (n, %)	25 (55.5)	22 (56.4)	0.078
Platelet Count (n, %)			
<150.000 K/mm^3	8 (17.8)	9 (23.1)	0.112
≥150-200.000 K/mm^3	37 (82.2)	30 (76.9)	0.401
Prothrombine time (second) (n, %)			
>14 s.	4 (8.9)	5 (12.8)	0.899
≤14 s.	41 (91,1)	34 (87,2)	0.701
Abdominal pain (n, %)	42 (93.3)	37 (94.8)	0.443
Aneurysm diameter (cm) (n, %)			
3-7	20 (44.4)	10 (22.2)	0.590
7-10	23 (51.1)	25 (64.1)	0.347
>10	2 (4.4)	4 (10.3)	0.277
Mean aneurysm diameter (cm)	6,12 ± 3,47	6,82 ± 3,36	0.490

Smoking history (n, %)	32 (71.1)	37 (94.8)	**0.001**
Hyperlipidemia (n, %)	26 (57.7)	25 (64.1)	0.468
Ischemia on ECG (n, %)	14 (31.1)	11 (28.2)	0.377
Peripheral Arterial Disease (n, %) (ankle-brachial index 0.7-1)	15 (33.3)	13 (33,3)	0.582
Renal Dysfunction (n, %)	4 (8.9)	3 (7.7)	0.234
Obesity (n, %)	19 (42.2)	16 (41)	0.246
Chronic Obstructive Pulmonary Disease (n, %)	7 (15.5)	10 (22.2)	0.710

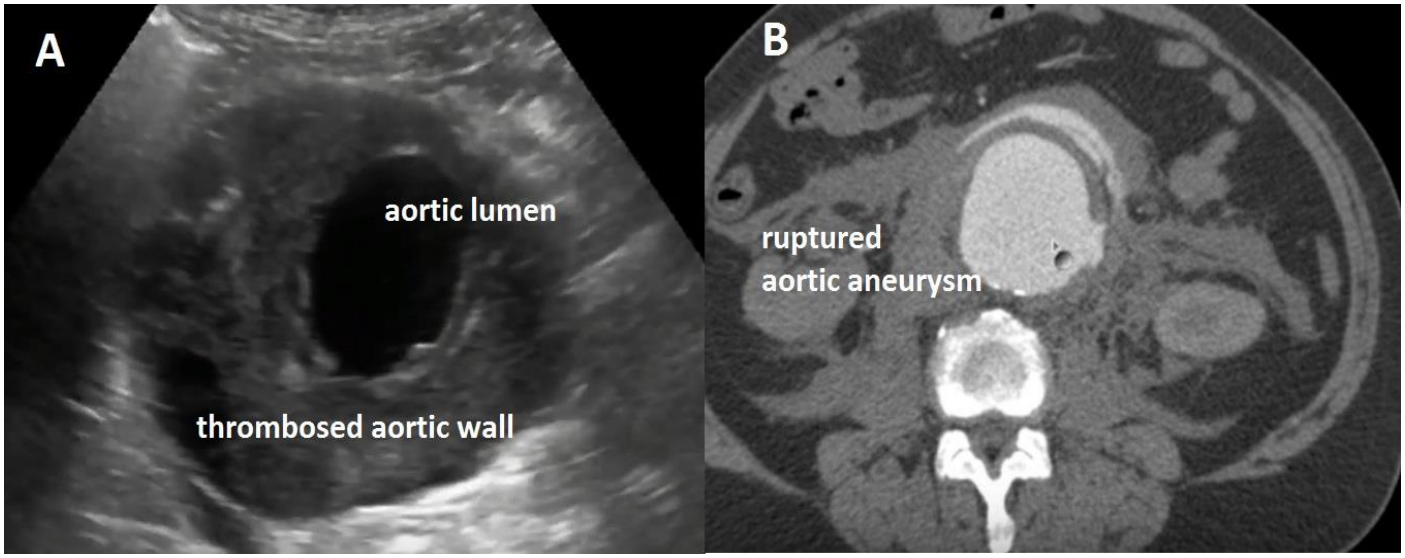

Figure 1A: The preoperative duplex ultrasonography: image of a patient with an abdominal aortic aneurysm of approximately 10 cm.

1B: The preoperative contrast computed tomography image of a patient with a ruptured abdominal aortic aneurysm.

In Group I, 36 patients (80%) were operated under elective conditions and 9 (20%) patients were operated urgently. The patients with infrarenal abdominal aortic diameters of 9 or 10 cm with severe abdominal pain were urgently treated in Group I. In Group II, 36 patients (92.3%) were operated urgently. Because 3 patients did not accept the emergency operation, they were operated approximately twelve hours after admission to hospital. There was a statistically significant difference between the groups in terms of emergency operation ($p<0.05$). In the preoperative period, all patients in Group I was stable in hemodynamic status, while 30 (76.9%) patients in Group II were unstable. Preoperative consciousness assessment, all patients in Group I was conscious. In Group II, 13 (33.3%) patients were confused and 8 (20.5%) were unconscious. In Group II, 9 patients (23.1%) were operated on hemodynamic shock. There was a significant difference between the groups in terms of the hypodynamic status, consciousness and shock ($p<0.001$).

Laparotomy was performed in all patients and the abdominal aorta was reached by opening the retroperitoneal region. Three cross-clamp was placed in the abdominal aorta in the infra renal region and both iliac arteries (Fig.2). Aneurysm sac was opened and appropriate graft implantation was performed. For all patients; aorta-biiliac in 51 patients (60.8 %), aorta-bifemoral in 26 patients (30.9 %) and 7 patients (8.3 %) underwent aortic tube graft (Dacron or PTFE graft material) interposition (Fig.3). Mostly, there was enough distance to place a cross clamp in the inferior-renal region. Other cross-clamp fields are shown in Table 2. The inferior mesenteric artery was sutured to the implanted graft material in 77 patients (91.6%). In 7 patients (8.4%), the diameter was thin or the retrograde flow was inadequate, so they were ligated. When the operation was completed, 16 patients could not receive distal peripheral pulses in extremities. Peripheral emboli related to abdominal aortic plaque were detected, and embolectomy was performed with Fogarty catheter. In 3 patients femoropopliteal graft bypass had to be performed as an additional surgery. Table 2 shows the comparison between the operative characteristics of the groups of patients treated with open surgery.

Table 2: Operative data.

Parameters (n, %)	Group I (n=45)	Group II (n=39)	P-value
Duration of surgery (min)	4.2 ± 2.2	5.6 ± 2.4	NS
Mean used graft diameters (n, %)			
tube graft	4 (4.8)	3 (3.6)	NS
"Y" graft (bi-iliac/bi-femoral)	41 (48.9)	36 (42.9)	NS
Cross-clamp region (n, %)			
infra-renal	43 (51.2)	34 (40.5)	NS
supra-renal	1 (1.2)	4 (4.8)	NS
thoracic aorta	1 (1.2)	1 (1.2)	NS
Rupture location (n, %)			
left posterior retroperitoneum	0	25 (29.8)	
right posterior retroperitoneum	0	11 (13.1)	
right anterior abdomenin	0	3 (3.6)	
Perioperative bleeding (n, %)	1 (1.2)	6 (7.1)	**<0.01**
Disseminated intravascular coagulopathy (n, %)	1 (1.2)	2 (5.1)	NS
Limb ischemia (n, %)	2 (2.4)	3 (3.6)	NS
Ureteral injury (n, %)	0 (0)	1 (4,2)	NS
Repair due to colon ischemia (n, %)	1 (1.2)	5 (5.9)	**<0.05**

Figure 2: The aneurysm exploration and clamped abdominal aorta and iliac arteries in a patient who underwent laparotomy for abdominal aortic aneurysm.

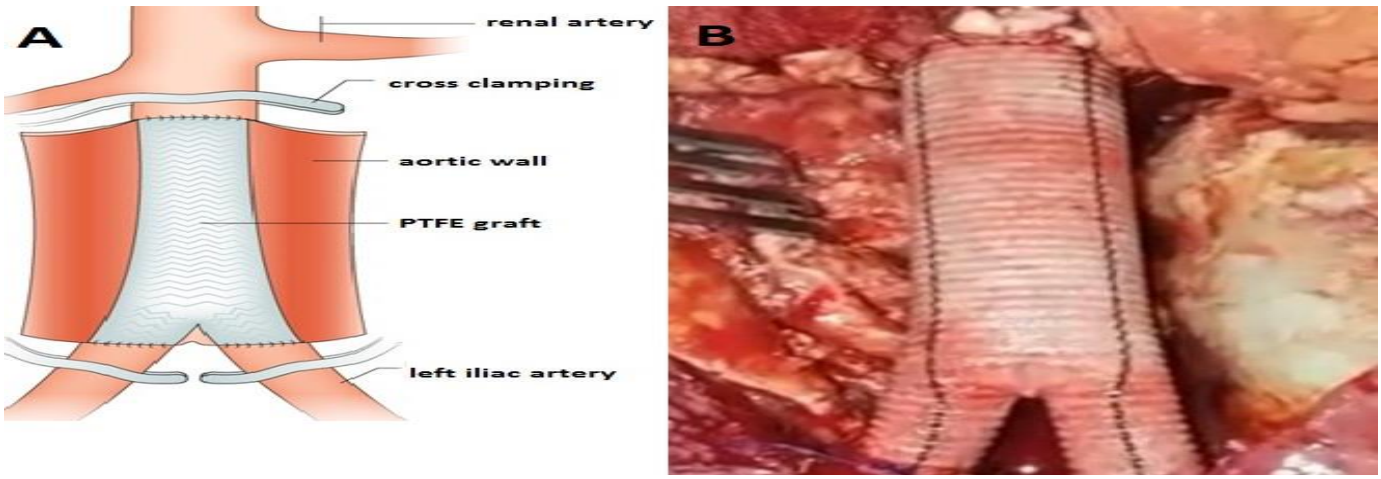

Figure 3A: The schematic figure showing the placement of the clamp sites and bi-iliac graft for abdominal aortic aneurysm open surgery.

3B: The operative image showing aorta-biiliac graft implantation at the end of the operation in a patient with abdominal aortic aneurysm.

Mean duration of mechanical ventilation was 8.1 ± 4.2 hours in Group I, the distribution was between 0 and 24 hours; it was 93.2 ± 39,4 hours in Group II, the distribution was between 2 and 960 hours and the difference was significant. Group II had prolonged ventilation in 14 patients and this was statistically significant (p <0.001).

Although the mean operation time was higher in Group II patients, there was no statistically significant difference between the groups. Mean duration of the intensive care unit was 2.5±1.7 days in Group I; it was 5.9±2.1 days in Group II, and the difference was significant. The duration of hospital stay was higher in Group II than Group I, and this was statistically significant (p <0.05). Undesirable financial hospital costs were lower in group I patients. Over $ 5000 hospital costs were found in 11 patients in Group II and 2 patients in Group I. This difference between groups was important (p=0.01) (Table 3).

A significant difference was observed in global survival in Group I patients. In the analysis of all treated patients, 30-day mortality was not different between the groups. However, hospital mortality was higher in Group II patients than in group I (p=0.001).

In the evaluation of renal dysfunction and acute renal failure; there were differences between the two groups. Renal damage associated with increased creatinine levels and decreased urine output affected both groups. Renal dysfunction was higher in Group II patients, but in each group 2 patients with fluid replacement therapy improved their renal damage. However, 8 patients in Group II developed acute renal failure (p<0.001). The BUN and creatine levels were very elevated in these patients with anuria and dialysis was started. Except for patients with early mortality, acute renal failure developed in 20 of 26 patients who died in the first 30 days (Table 3).

Table 3: Postoperative complications and morbidities.

Parameters	**Group I (n=45)**	**Group II (n=39)**	**P-value**
Prolonged mechanical ventilation (n, %)	1 (1.2)	14 (16.6)	**<0.001**
Neurological complications (n, %)	1 (1.2)	11 (13.1)	**0.003**
>1000 cc blood transfusion (n, %)	4 (4.8)	18 (21.4)	**0.01**
Reoperation requiring revision (n, %)	1 (1.2)	9 (10.7)	**0.01**
Renal dysfunction (n, %)	4 (4.8)	15 (17.9)	**<0.001**
Post-procedure acute renal failure (n, %)	0 (0)	8 (9.5)	**<0.001**
Undesirable financial hospital costs (over $ 5000)	2 (2.4)	11(13.1)	**0.01**
Death (n, %) Hospital mortality Overall mortality (1 month)	 5 (5.9) 1 (1.2)	 26 (30.9) 1 (1.2)	 **0.001** 0.409
Amputation (n, %)	1 (1.2)	2 (2.4)	0.547
Systemic infection (n, %)	5 (5.9)	6 (7.1)	0.438
Surgical site infection (n, %)	7 (8.3)	8 (9.5)	0.329
Sepsis (n, %)	1 (1.2)	1 (1.2)	0.249
Myocardial infarction (n, %)	1 (1.2)	2 (2.1)	0.428
Parenteral nutrition therapy (n, %)	8 (9.5)	7 (8.3)	0.569
Peripheral edema (n, %)	11 (13.1)	10 (11.9)	0.303
Deep vein thrombosis (n, %)	0 (0)	1 (1.2)	0.453
Pulmonary embolism (n, %)	0 (0)	1 (1.2)	0.200
Pneumothorax (n, %)	1 (1.2)	1 (1.2)	0.200
Length of hospital stay (days)	9.5±3.1 (range 6-15)	16.7±4.1 (range 11-22)	**<0.05**
Lenght of ICU stay	2.5±1.7 (range 1-5)	5.9±2.1 (range 4-10)	**<0.05**

In Group II patients, the amount of bleeding was higher in the postoperative period. Therefore, more blood and blood products were given to these patients. In addition, reoperations were higher in Group II patients than in Group I, and these results were statistically significant (Table 3) (p=0.01).

In addition to these results, complications occurred in every two groups related to many systems (cardiac, respiratory, neurological, etc.). There was no statistical difference between the groups, but neurological complications are higher in Group II than Group I (Table 3).

Discussion:

IR-AAA begins at a few cm below the renal arteries, and it includes the three layers of the artery wall: intima, media, and adventitia. The prevalence of vascular disease is more common in men of increasing age than in women. The disease generally consists of 3 phases under the name of development, growth and rupture. The most important risk factors are smoking, male gender and family history. IR-AAA is a multifactorial disease and genetic factors play an important role in the development of aneurysms (13). Morphologically, if these aneurysms occur in the dilatation of the entire circumference of the arterial structure, they are called fusiform, whereas only a portion of the vascular structure expands locally, they are called saccular aneurysms. Aneurysmal growth is related to increased metabolic activity in both the aneurysmal wall and the intraluminal thrombus (1,10,13). Rupture occurs when the mechanical stress acting on the wall exceeds the wall strength, with rupture of the aneurysm causing intraabdominal hemorrhage. The mortality rate of ruptured aneurysms varies between 65-85 % and approximately half die before applying to the hospital (14,15). Although there is a risk of rupture in small-scale aneurysms, there is an accurate correlation between the increase in diameter and the risk of rupture. Although results for elective repair have improved over the last decades, there remains a non-negligible morbidity and mortality associated with aortic surgery.

Open surgical treatment has been defined since 1951 and continues to be performed. However, this treatment is also associated with morbidity, mortality, long-term hospitalization and blood transfusion. Mortality rates associated with elective surgery may range from 5 to 10% (14,16). Endovascular treatments have been in development since 1991 as an alternative option for high-risk patients who cannot be subjected to open surgery. Nowadays, with the accumulation of experience and development of safer and more flexible prostheses, endovascular treatment can be considered the method of choice, even for patients whose surgical risk assessments and anatomic characteristics are favorable for the conventional open surgical technique (15-17). Although endovascular surgery has been performed in the hospitals in our region from time to time in hemodynamically stable and non-ruptured patients, this interventional treatment method has not entered the treatment application procedure fully in our hospital. Since there was no possibility of endovascular intervention in our ruptured patients (due to economic insufficiency and lack of experienced staff), we performed open surgical method in all ruptured patients.

In spite of developing technology and modernization of follow-up methods, diagnostic evaluation of abdominal aortic aneurysm in our region and in our country, follow-up until the day of surgery, preoperative evaluation, surgical approach and postoperative care and pre-rupture diagnosis rates are still low. Nearly half of the patients who had undergone open surgery due to abdominal aortic aneurysm for 23 years were still operated in ruptured condition. The number of patients who can be operated in the pre-rupture and pre-arrest term is much lower than the number of patients admitted to the hospital, due to the low level of socio-economic and socio-cultural levels of the region.

The demographic characteristics of our patient groups were approximately similar. Risk factors that we found and similar to the literature were hypertension, smoking, coronary artery disease, hyperlipidemia, peripheral arterial disease, renal dysfunction, chronic obstructive pulmonary disease, obesity, and diabetes mellitus (15-17). The prevalence of IR-AAA has been reported to be 4 times higher in men over 60 years of age (5,6). In our study, the number of male patients was more than 3-fold compared to female patients (73.8% versus 26.2%).

In addition to the size of the aneurysm, hypertension, smoking, and chronic obstructive pulmonary disease have been reported to increase the risk of rupture (18,19). Other studies have shown that IR-AAA has a strong relationship with male gender, tobacco use, and chronic obstructive pulmonary disease combination (18,20). In these combinations, the loss of elastin caused by tobacco use may be considered to be effective in the development of aneurysms (20, 21). In our study, chronic obstructive pulmonary disease, the number of male patients and the rate of smokers were higher in Group II patients. But, only the ratio of smokers was statistically significant (p=0.001).

Abdominal aortic aneurysms may inevitably result in rupture if treated with one of the surgical or endovascular methods. The risk of rupture-related 5-year mortality in aneurysms less than 5 cm in

diameter varies from 5 to 14%. If the diameter exceeds 5 cm, this risk may increase between 47% and 53% (2-4). If the diameter reaches 7 cm or more, the risk of death associated with rupture in these aneurysms reaches approximately 75% (6). There were 29 (74.4%) patients in Group II and 25 (55.5%) patients in Group I with an aneurysm diameter of 7 cm or more. This result shows us; risk of rupture and mortality are increased in patients with delayed diagnosis and a higher diameter.

Most of the ruptured IR-AAA patients die before they can be hospitalized, and only 10% can be delivered to the hospital (20,21). Despite significant improvements in surgery, anesthesia, and postoperative critical care, the postoperative mortality rate of ruptured abdominal aortic aneurysm (RAAA) has remained at 40% to 50% for several decades. However, operative mortality in elective surgery-treated abdominal aortic aneurysms decreased to 1-5% levels, decreasing compared to previous years (22). Our clinical results confirm these results. In our patients, the mortality rate in ruptured Group II patients was significantly higher than in Group I in accordance with previous studies (30.9% versus 5.9%). Although it can be easily diagnosed by physical examination and simple ultrasound examination, the low number of patients brought to the hospital before rupture shows the unconsciousness and socio-cultural insufficiency of the patients in our region. In fact, more than 90% of our patients in each of the 2 groups had at least a complaint as abdominal pain. For advanced age and male patients, IR-AAA screening programs have been developed to assess simple complaints in many countries (23).

Generally, ultrasonography, computed tomography, magnetic resonance imaging and angiography methods are used for diagnosis in these patients. While prevalence ultrasonography value is preserved, computed tomography is often used to accurately determine the diameter of the aneurysm and to determine the location and presence of rupture. Magnetic resonance imaging was chosen especially for patients with impaired renal function, but computed tomography is still the most commonly used diagnostic tool (24). Computed tomography is generally preferred against magnetic resonance imaging because it can be diagnosed quickly and adequately.

Acute renal failure following ruptured abdominal aortic aneurysm repair is common and multifactorial. In many studies, it has been shown that the rates of postoperative acute renal failure are high in patients with ruptured IR-AAA (25-27). In order to reduce postoperative acute renal failure and associated mortality, it is important to prevent massive bleeding and to maintain operational bleeding control and systemic perfusion. Our study demostrated, as compatible with previous studies, that 8 of 39 patients in rupture IR-AAA patients develop acute renal failure after aneurysm repair surgery and that the severity of acute renal failure and ruptured IR-AAA status are associated with increased in-hospital mortality in IR-AAA patients who develop postoperative acute renal failure.

Colon ischemia is an important complication of open or endovascular repair of abdominal aortic aneurysm. The incidence of colonic ischemia was decreased after endovascular intervention (28,29). However, it can still be seen in ruptured abdominal aortic aneurysm surgery. The retroperitoneal rupture of giant abdominal aortic aneurysm makes the mesentery more elongated and deformed, compromising its blood flow and thus increasing the risk of mesenteric ischemia such as colon ischemia. Besides, colonic hypoperfusion may also develop due to increased intraabdominal pressure in ruptured patients. Colon ischemia following aortic reconstruction is a severe complication with an incidence of 1% to 2% of the operated patients; this infrequent complication will be lethal for nearly half of these patients. Commonly, colon ischemia may be an intraoperative observation or an early postoperative finding. Colonic ischemia was observed in 5 of our ruptured patients and in 1 of the other patient group. These ischemic bowel segments were resected by the general surgery clinic. However, 3 of the ruptured patients died in the postoperative period.

Perioperative hemorrhage is one of the most important problems that we may encounter during surgery especially in ruptured aneurysm repair. In ruptured patients; hemodynamic unstability, insufficient bleeding control due to emergency surgical exploration, elimination of the press of the hematoma after opening the abdomen and increased tendency to haemorrhage due to liver hypoperfusion relation to hypotension may cause more bleeding. Perioperative bleeding was observed in 6 patients in Group II and 1 in Group I patients. This difference was statistically significant. The amount of blood, blood products and volume enhancing fluid is given to the ruptured patients according to the amount of perioperative bleeding. Excessive blood and fluid replacement may impair hematological parameters in patients. It may also cause an increase in renal damage. For these reasons, careful surgical exploration and controlled fluid and blood replacement should be considered.

Spinal cord ischemia after open surgical repair for ruptured aneurysm is a rare event. Therefore, in patients with ruptured IR-AAA, neurological problems may be seen due to cerebral events during and after surgery. Hypotension, low cardiac output, atherosclerotic cerebral vascular disease, emboli associated with carotid system can often cause responsible neurological deficits. In our series, 11 patients in Group II had neurological pathologies. This rate was very high compared to Group I patients. Because both the hemodynamic parameters of the elective patients are stable and there is sufficient time to investigate the comorbid conditions for the operation, neurological problems are rare in elective patients. Only 1 of our group I patients had transient neurological problems. Of these 11 patients, 7 had trans-ischemic attacks, 3 had right or left hemiplegic findings, and 1 patient had facial paralysis.

There was a significant difference between the groups in terms of the duration of the intensive care unit and hospital stay. Ruptured patient group have long intensive care periods due to long duration of operation and anesthesia, prolonged mechanical ventilation periods, increased amount of postoperative bleeding, reoperations due to hemorrhage, additional operations due to colon ischemia, the need for close observation due to neurological complications. The prolongation of intensive care periods naturally increases the length of hospital stay. It is a fact that prolongation of hospital stay will also increase the financial expenditure. Group II patients had more additional surgical procedures, blood and fluid replacement and different drug types to ensure hemodynamic stabilization. These additional procedures led to an increase in hospital spending. Undesirable financial hospital costs were lower in group I patients. Over $ 5000 hospital costs were found in 11 patients in Group II and 2 patients in Group I. This difference between groups was important (p=0.01) (Table 3).

Conclusıon:

- IR-AAA, though uncommon, should be considered in any patient presenting with abdominal and lower back pains.
- Open surgical repair before rupture in elective conditions can be performed with a mortality rate as low as 5.9 % in IR-AAA.
- The rates of morbidity and mortality of patients with rupture are higher than non-rupture group.
- The most important and cheapest parameter for reducing morbidity and mortality in elderly patients diagnosed with abdominal aortic aneurysm is close follow-up of patients.
- Screening by ultrasound in patients over 65 years of age is important in the diagnosis and monitoring of this disease.
- We recommend abdominal imaging with basic modalities like ultrasonography in the workup of abdominal pain of undifferentiated aetiology to facilitate earlier identification of these vascular problems which can timely inform definitive management.

Disclosures:

Ethical Approval

This study was ethically approved by local ethics committee of Regional Training and Research Hospital Ethics Committee (date: March 01, 2019).

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No funding was received in this study.

Authors' contributions

Bilgehan Erkut conceived and planned this work and wrote the manuscript with support from Azman Ates. Both authors collected and analyzed the data. Bilgehan Erkut helped supervise the findings of this work and assisted with data collection. All authors read and approved the final manuscript.

Conflict of Interest disclosure

We declare that there is no conflict of interest in our article

Research registration unique identifying number

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There is no guarantor in this study
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Consent

Written consent was provided by participants or their relatives.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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