Full Length Research Article

Surgical Treatment of Infrarenal Abdominal Aortic Aneurysms: Is rupture important in terms of surgical complications?

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We evaluated the outcomes of patients with ruptured and non-ruptured infrarenal abdominal aortic aneurysms, who have undergone open surgical repair during the 16 years period, and emphasized the necessity of early diagnosis. Fifty patients (36 males, 14 women) were performed open surgery for infrarenal abdominal aortic aneurysms, average age 64.47±10.48 years (ranging from 24 to 94 years) at our clinic between January 1996 and January 2012, were evaluated retrospectively. The patients were divided from two groups as nonruptured (Group I) and ruptured (Group II). Twenty six of patients were operated without rupture and most of these patients in elective conditions and hemodynamically stable. Twenty-four of them were operated with rupture and most of these in emergency conditions and hemodynamically unstable. Twelve patients (50%) in Group II and 1 patient (3,8%) in Group I were died in postoperative term. The mortality rate was 1-5% in Group I, 50% in Group II. For this reason, the programs must be enhanced for the detection of patients with early diagnosis in their abdominal aortic aneurysm before devoloping rupture, and screening tests must be performed on people with advanced age and people who have high risks of developing aneurysms, and appropriate interventions must be planned for patients who require that.

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

INTRODUCTION

Abdominal aortic aneurysms (AbAA) are the most common aortic vessel diseases that generally defined by an infrarenal aortic diameter of 3 cm or larger (Guirguis-Blake et al., 2014; US Preventive Services Task Force, 2014). In all population, it has seen at a rate of 1-4%, and especially after 60 years of age (4-11%). They cause 16,000 deaths annually in the United States (Ashton et al., 2002; Kocher et al., 2004; Chun et al., 2013). While the 5-year rupture risk of aneurysm diameter 4 cm or less is about 4%, the risk of rupture in patients with a diameter of 7 cm or more is up to 75% (Hollier and Wisselink, 1996). The risk of mortality and rupture in abdominal aortic aneurysms is directly dependent on the size of the aneurysm and the amount of annual growth. Besides, the mortality rates before reaching the hospital in these patients are 59-83% (Guirguis-Blake et al., 2014; Chaikof et al., 2009). The perioperative mortality risk of ruptured abdominal aortic aneurysms patients who can reach the hospital and undergo emergency surgery is over 50%. (Mell et al., 2012). However, in elective conditions, the death rates after surgery in abdominal aortic aneurysms

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which the open surgery treatment is applied are about 1-5% (Koçak and Özyazıcıoglu, 2004).

The aim of this study is to compare and evaluate the surgical results of ruptured and nonruptured cases operated for infrarenal abdominal aortic aneurysms in our clinic for 16 years.

MATERIALS AND METHODS

Between 1996 and 2012, 88 patients (as cardiac arrest, ruptured, non-ruptured and ruptured during diagnosis) were admitted to our hospital with abdominal aortic aneurysm. Fifty of these patients could have undergone surgery. After obtaining approval of Regional Ethics Committee with compliance to the principles of the Declaration of Helsinki, 50 patients, who were operated with the diagnosis of infrarenal AbAA in our institute between January 1996- January 2012 were incorporated into our study. Patients were divided into 2 groups as nonruptured (Group I; n=26 patients) and ruptured (Group II; n=24 patients). The average age of patients was 64.47 ± 10.48 (rate: 24-94 years), and 36 of them (72%) were male.

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, early complications, additional morbidities, and the results were recorded.

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. All patients were followed up in the intensive care unit until their vital functions were stabilized. The duration of extubation was assessed as prolonged mechanical ventilation support in cases of more than 12 hours. In the intensive care unit, the duration of stay was more than 3 days, and it was accepted as extended intensive care support. Patients who died within 30 days of the operation or before discharge were considered early surgical mortality.

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

Demographic and clinical characteristics of the patients are shown in Table 1. The proportion of patients with Chronic Obstructive Pulmonary Disease (COPD) was significantly higher in ruptured group ($p < 0.01$). The other demographic and clinical features were similar for both groups ($p > 0.05$).

In the first admission, 45 (90%) patients had abdominal pain, 28 (56%) patients had a pulsatile mass in the abdomen, 21 (42%) patients had loss of appetite and fatigue, 14 (28%) patients had waist and side pain, 14 (28%) patients had chest and back pain, 9 (18%) patients had hematuria, oliguria or anuria, 8 (16%) patients had foot pain, 5 (10%) patients had bruising in feet, 4 (8%) patients had limb sensory and motor disfunction, 4 (8%) patients had fever. 5 (10%) patients in Group I were asymptomatic. Duration of symptoms in G roup I was 165,03 ± 290,09 days, range the disturbution was between 1 day and 3 years; duration of symptoms in Group II; 8.24 ± 13.81 days, the distribution was between 3 hours and 60 days ($p < 0.001$).

Table 1. Demographic and clinical characteristics of the patients.

Parameters	Group I	Group II	P-value
Age (year)	64.83±11.33	64.04±9.57	0.784
Gender (male) (n,%)	18 (69,2%)	20 (83,3%)	0.234
Hypertension (n,%)	20 (76,9%)	21 (87,5%)	0.301
Ejection Fraction			
<50	9 (34,6%)	10 (41,6%)	0.566
≥50	17(65,4%)	14 (58,4%)	0.321
Coronary artery disease (n,%)	20 (76,9%)	19 (79,1%)	0.078
Platelet Count			
<150.000 K/mm^3	5 (19,2%)	6 (25%)	0.112
≥150-200.000 K/mm^3	21 (80,8%)	18 (75%)	0.401
Prothrombine time (second)			
>14 s.	2 (7,7%)	3 (12,5%)	0.899
≤14 s.	24 (92,3%)	21 (87,5%)	0.701
Smoking history (n,%)	16 (61,5%)	21 (87,5%)	0.088
Hyperlipidemia (n,%)	13 (50%)	12(50%)	0.468
Ischemia on ECG (n,%)	12 (46,1%)	8 (33,3%)	0.377
Peripheral Arterial Disease (n,%)	10 (38,5%)	8 (33,3%)	0.582
Renal Dysfunction (n,%)	6 (23,1%)	8 (33,3%)	0.234
Obesity (n,%)	4 (15,4%)	6 (25%)	0.246
Chronic Obstructive Pulmonary Disease (n,%)	3 (11,5%)	10 (41,7%)	**0.010**
Diabetes Mellitus (n,%)	2 (7,6%)	2 (8,3%)	0.619

Figure 1A-B. Preoperative computed tomography images of two patients. Nonruptured abdominal aortic aneurysm in A and ruptured abdominal aortic aneurysm in B.

For diagnosis, after the patient's history and physical examination, abdominal ultrasound was performed for 42 of all patients (84%) as a first and rapid detection. Towards diagnosis or in addition to the tests for 44 (88%) patients computed tomography (Figure. 1), for 28 (56%) patients angiography, for 6 (12%) patients magnetic resonance imaging were performed. 5 (10%) patients were operated only by evaluating with ultrasonography.

In Group I, 23 (88,5%) patients electively, 3 (11,5%) patients urgent; in Group II, 21(87,5%) patients urgently, 2 (8,3%) patients elective urgently and 1 (4,2%) patient electively underwent operation (p <0.01). In the preoperative period as hemodynamic status, all patients in Group I were stable, 12 (50%) patients in Group II were unstable (p <0.001). Preoperative evaluation of consciousness, all patients in Group I was consciousness. In Group II, 7 (29,2%) patients were confused, 5 (20,8%) of the patients were unconscious. In Group II, 7 (29,2%) patients were received to operation on the statement of shock, 5 (20,8%) patients were operated on the statement of pre-shock (p <0.001).

It has been performed that for all patients; 30 of them (60%) aorto-biiliac bypass (Figure. 2), 12 of them (24%) aorto-bifemoral bypass, 8 of them (16%) abdominal aorta
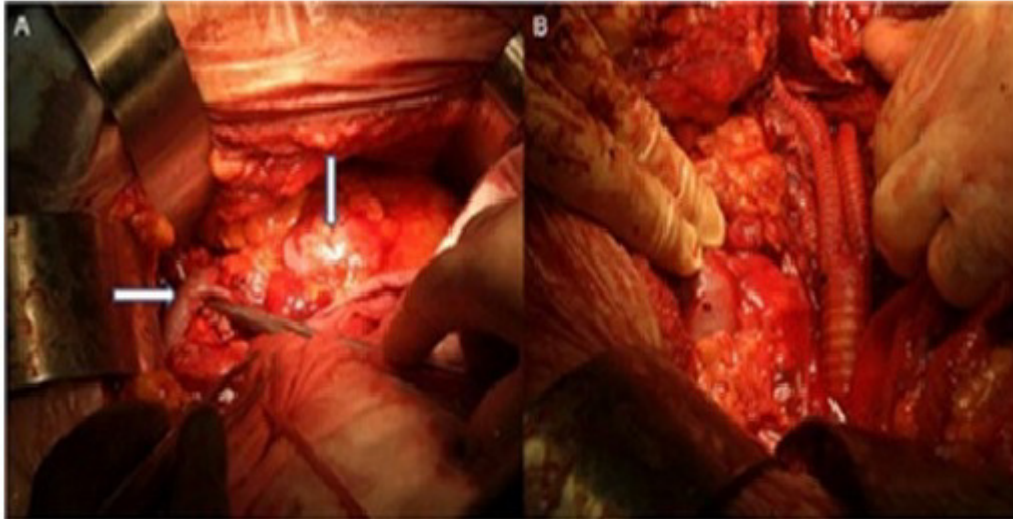
Figure 2A-B. Operation image of a patient. A: Horizontal arrow illustrates to the left renal vein and vertical arrow aneurysm. B: Applied aortobiiliac graft.

Table 2. Early surgical complications.

Parameters (n, %)	Group I	Group II	P-value
Perioperative bleeding	0 (0%)	6 (25%)	**<0.01**
Disseminated intravascular coagulopathy	0 (0%)	6 (25%)	**<0.01**
>1000 cc blood transfusion	4 (15,3%)	10 (41,6%)	**<0.001**
Reoperation related bleeding	2 (7,6%)	4 (16,7%)	0.247
Limb ischemia	2 (7,6%)	3 (12,5%)	0.409
Amputation	1 (3,8%)	0 (0%)	0.547
Ureteral injury	0 (0%)	1 (4,2%)	0.453
Colon ischemia	1 (3,8%)	3 (12,5%)	**<0.05**

tube graft interposition. Clamp levels were suprarenal in 3 (6%) patients and 1 (2%) thoracic; these four patients were in Group II. Inferior mesenteric artery was anastomosed by the grafting 42 (84%) patients and inferior mesenteric artery was occluded in 8 (16%). Peripheral embolectomy was performed in 14 (28%) patients and femoro-popliteal bypass was performed in 1 (2%) as an additional surgery.

Mean duration of mechanical ventilation was 8.02 ± 48.24 hours in Group I, the distribution was between 0 and 24 hours; it was 93.17 ± 239,46 hours in Group II, the distribution was between 2 and 960 hours and the difference was significant (p <0.001). Mean duration of the intensive care unit was 3.00 ± 2,29 days in Group I, the distribution was between 0 and 11 days; it was 7,25 ± 11,63 days in Group II the distribution was between 0 and 47 days and the difference was significant (p <0.001). There was no significant difference between two groups in terms of the discharge time of the both groups' patients who were alive after the operation.

Mean aneurysm diameter was 6,12 ± 1,47 cm in Group I, the distribution was between 4 and 10 cm; it was 6,82 ± 1,36 cm in Group II, the distribution was between 4 and 9,5 cm. Thirty five (70%) fusiform aneurysms, 7 (14%) saccular aneurysms, 7 (14%) dissecting aneurysms and 1 (2%) mycotic aneurysm were detected in all patients. There was no significant difference between the two groups in terms of characteristics of the aneurysm. However, dissecting and mycotic aneurysms were observed especially in young patients and fusiform aneurysms in elderly patients.

Rupture location was left posterior retroperitoneum in 17 (71%) patients, right posterior retroperitoneum in 6 (25%) patients and right anterior abdomen in 1 (4%) patient. The aneurysm complications were similar in both groups except rupture. It was observed that; aortic wall thrombus in 49 (96%) of patients, thromboembolism in 13 (26%), inflammatory aneurysm in 6 (12%), infectious aneurysm in 1 (2%), aorto-caval fistula in 1 (2%).

The early period surgical complications are showed in Table 2, and the incidence of postoperative complications and morbidity in Table 3. Twelve (50%) patients in Group II, 1 (3,8%) patient in Group I were died (p <0.001). Total mortality rate was %26.

Table 3. Postoperative complications and morbidities.

Parameters (n, %)	Group 1	Group 2	P-value
Prolonged mechanical ventilation	5 (19,2%)	8 (33,3%)	0.151
Prolonged intensive care support	6 (23,1%)	8 (33,3%)	0.234
Neurological complications	2 (7,6%)	8 (33,3%)	**<0.05**
Renal dysfunction	7 (26,9%)	12 (50%)	**<0.05**
Systemic infection	8 (30,7%)	8 (33,3%)	0.438
Surgical site infection	10 (38,5%)	6 (25%)	0.329
Sepsis	3 (11,5%)	5 (20,8%)	0.249
Myocardial infarction	1 (3,8%)	2 (8,3%)	0.428
Parenteral nutrition therapy	8 (30,7%)	7 (29,2%)	0.569
Peripheral edema	9 (34,6%)	10 (41,7%)	0.303
Deep vein thrombosis	0 (0%)	1 (4,2%)	0.453
Pulmonary embolism	0 (0%)	2 (8,3%)	0.200
Pneumothorax	0 (0%)	2 (8,3%)	0.200

DISCUSSION

Despite developing technology, preoperative evaluation, anesthesia, surgical approach and postoperative care, pre-rupture diagnosis rates in patients with abdominal aortic aneurysm are still low in our country. Almost half of the patients who underwent open surgery for abdominal aortic aneurysm during the 16-year period were ruptured aneurysms. The number of patients who died before reaching the hospital and lost during the pre-operative diagnosis is seen as quite large. 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 prevalence of AbAA increases especially after the age of 60 (4-11%), 4 times more in men.In our study, as in other similar studies, the average age was 64.47 and 72% of the patients were male (Ashton et al., 2002; Kocher et al., 2004; Taylor and Porter, 1980).

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 (Hirsch et al., 2006).

In addition to the size of the aneurysm, hypertension, smoking, and chronic obstructive pulmonary disease have been reported to increase the risk of rupture (Koçak and Özyazıcıoglu, 2004, Taylor and Porter, 1980, Sakamaki et al., 2002). Other studies have shown that AbAA has a strong relationship with male gender, tobacco use, and chronic obstructive pulmonary disease combination (Mell et al., 2012; Koçak and Özyazıcıoglu, 2004, Taylor and Porter, 1980, Sakamaki et al., 2002). In these combinations, the loss of elastin caused by tobacco use may be considered to be effective in the development of aneurysms (Koçak and Özyazıcıoglu, 2004, Taylor and Porter, 1980, Sakamaki et al., 2002). In our study, chronic obstructive pulmonary disease (statistically significant), rates of male and smokers were were higher in Group II.

If surgery is not done in AbAA, the natural process is ruptured. Rupture-related 5-year mortality risk for aneurysms less than 5 cm in diameter is between 5 and 14%, and increases to 47 to 53% if the aneurysm diameter is greater than 5 cm (Chaikof et al., 2009). The risk for aneurysms with a diameter of 7 cm or more is about 75% (Hollier and Wisselink, 1996). In our patients, 14 (62,5%) patients in GroupII and 11 (42,3%) patients in Group I had aneurysm diameter of 7 cm or more. This result shows that the risk of rupture increases in patients with late diagnosis and high diameter.

The majority of patients with ruptured AbAA die before reaching the hospital, only 10% of whom are admitted to the hospital (Sakamaki et al., 2002; Brown and Powell, 1999). Despite advances and improvements in perioperative care and successful open surgical repair, open surgical mortality in rupture AbAA is still 45-50% (Bown et al., 2002). However, in abdominal aortic aneurysms treated with elective surgery, operative mortality decreased to 1-5% compared to previous years (Koçak and Özyazıcıoglu, 2004).Our clinical results confirm these results. One important point in our country-wide trials was that 1/3 of patients with abdominal aortic aneurysms were addmitted to the hospital after rupture (Büket et al., 2003). However, in our study this ratio is about 50%. Despite being able to be diagnosed by physical examination and simple ultrasound examination, approximately half of our patients who underwent surgery after rupture demonstrate the unconsciousness and socio-cultural inadequacy of the patients in our region.Generally, AbAAs are not often diagnosed due to asymptomatic until the development of rupture (Guirguis-Blake et al., 2014; US Preventive Services Task Force,

2014; Ashton et al., 2002). We observed that, 90% of our patients were diagnosed with specific symptoms, %10 of them were asymptomatic. For this reason, screening programs for AbAA have been developed in many countries (Thompson et al., 2009).

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 (Buket et al., 2008). Computed tomography is generally preferred against magnetic resonance imaging because it can be diagnosed quickly and adequately.

Most of our patients had coronary artery disease. The patients who required immediate surgical intervention as angiography were excluded from this study. Coronary artery surgery was recommended 6 weeks before the aneurysm surgery to reduce morbidity and mortality in symptomatic patients. Because aneurysm surgery can be done with low risk in patients who do not require surgical intervention and asymptomatic patients, the necessary cardiac stabilization during surgery was performed in these patients (D'Angelo et al., 1997). Perioperative myocardial infarction was observed in 3 patients in our cases. Two of them were Group II, and the other one was Group I. However, mortality was not observed.In our patients, the morbidity and mortality rates in Group II were higher than in Group I. Factors leading to this condition (hemorrhage, blood transfusion, DIC, renal and neurological damage, multisystem failure, etc.) are compatible with other studies (Chaikof et al., 2009; Hirsch et al., 2006; Brown and Powell, 1999; Darling et al., 1977). Patient death due to myocardial infarction and bowel problems was not seen in our patients. This poor prognosis seen in ruptured patients is an undesirable situation in all centers around the world.

Abdominal aortic aneurysm repair with open surgery have been shown in many studies to reduce morbidity and mortality rates in patients who have undergone repair before rupture (Guirguis-Blake et al., 2014; Thompson et al., 2009; Earnshaw et al., 2004). Patients with abdominal aortic aneurysm, especially those older than 65 years, should be monitored more closely by ultrasonography and/or computed tomography. Because, the more frequently patients are followed, the lower the risk of rupture and surgical mortality (Guirguis-Blake et al., 2014; US Preventive Services Task Force, 2014; Ashton et al., 2002; Chun et al., 2013; Thompson et al., 2009; Norman et al., 2004; Earnshaw et al., 2004; U.S. Preventive Services Task Force, 2005; Mastracci et al., 2007; Lindholt et al., 2010; Thompson et al., 2012).

CONCLUSION

According to our work;

1. Open surgical repair before rupture in elective conditions can be performed with a mortality rate as low as 3.8% in AbAA.

2. The rates of morbidity and mortality of patients with rupture are higher than non-rupture group.

3. 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.

4. Screening by ultrasound in patients over 65 years of age is important in the diagnosis and monitoring of this disease.

5. Abdominal aortic diameter greater than 3 cm should be followed more closely.

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