Evaluation of coronary artery disease and other risk factors in patients with abdominal aortic aneurysm

Abdominal aort anevrizmalı hastalarda koroner arter hastalığı ve diğer risk faktörlerinin değerlendirilmesi

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Background: This study aims to investigate the relationship between abdominal aortic aneurysm (AAA) and coronary artery disease (CAD) along with other risk factors.

Methods: One hundred sixty-three patients with AAA (145 males, 18 females; mean age 64.4±8.9 years; range 39 to 88 years) who underwent surgery in our clinic between January 1998 and December 2008 were included in the study, and the patient records provided by the hospital were retrospectively assessed.

Results: The most common accompanying risk factors were hypertension (79.8%), smoking (70.6%), CAD (50.3%) chronic obstructive pulmonary disease (COPD) (36.8%), a high serum urea level (9.2%), and peripheral artery disease (2.5%). Patients were grouped according to the presence of CAD and then compared in terms of risk factors. When groups were compared in terms of age, symptoms, length and diameter of the aneurysm, hypertension, COPD, serum urea level, duration of intensive care unit stay, time to discharge, and complications, no significant differences were observed between the groups. However, the number of cigarette smokers in the CAD group was significantly higher than those in the non-CAD group. The coronary artery bypass graft procedure was mostly performed in patients with higher aneurysm diameters in the CAD group.

Conclusion: In the evaluating the correlation between aortic aneurysm and CAD, along with the other risk factors, smoking was found to be significantly higher in patients with CAD among the AAA patients. The coronary artery bypass graft procedure was found to be more necessary for the patient group with higher aneurysm diameters.

Key words: Abdominal aortic aneurysm; aortic surgery; coronary artery disease/epidemiology/risk factors; hypertension.

Amaç: Bu çalışmada abdominal aort anevrizması (AAA) ile koroner arter hastalığı (KAH) ve diğer risk faktörleri arasındaki ilişki araştırıldı.

Çalışma planı: Ocak 1998 - Aralık 2008 tarihleri arasında kliniğimizde ameliyat edilen cerrahi sınırlardaki AAA'lı 163 hasta (145 erkek, 18 kadın; ort. yaş 64.4±8.9 yıl; dağılım 39-88 yıl) çalışmaya dahil edildi ve hastane tarafından sağlanan hasta kayıtları geriye dönük olarak incelendi.

Bulgular: En sık eşlik eden risk faktörleri hipertansiyon (%79.8), sigara kullanımı (%70.6), KAH (%50.3), kronik obstrüktif akciğer hastalığı (KOAH) (%36.8), yüksek serum üre seviyesi (%9.2) ve periferal arter hastalığı (%2.5) idi. Hastalar KAH varlığına göre gruplandırıldı ve risk faktörleri açısından karşılaştırıldı. Gruplar yaş, semptomlar, anevrizma çapı ve boyu, hipertansiyon, KOAH, serum üre seviyesi, yoğun bakım ünitesinde kalış süresi, taburcu olana kadar geçen süre ve komplikasyonlar yönünden karşılaştırıldığında gruplar arasında anlamlı bir fark saptanmadı. Bununla beraber, KAH grubunda sigara içenlerin sayısı KAH'siz gruba göre anlamlı düzeyde daha yüksekti. Koroner arter bypass greftleme işlemi genellikle KAH grubundaki anevrizma çapı daha yüksek olan hastalarda yapıldı.

Sonuç: Aort anevrizması ile KAH ve diğer risk faktörleri arasındaki ilişki araştırıldığında, AAA'lı hastalar arasındaki sigara kullanımı, KAH'li hastalarda anlamlı olarak daha yüksek bulundu. Koroner arter bypass greftleme işleminin anevrizma çapı daha yüksek olan hasta grubunda daha gerekli olduğu tespit edildi.

Anahtar sözcükler: Abdominal aort anevrizması; aort cerrahisi; koroner arter hastalığı/epidemiyoloji/risk faktörleri; hipertansiyon.

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Abdominal aortic aneurysm (AAA) is the dilatation of the aorta due to the deterioration of the aortic wall structure with a loss of elastin and muscle cells along with extracellular matrix degradation. Abdominal aortic aneurysm is defined by an aorta with an infrarenal diameter of >3.0 cm.[1,2] A smaller number of medial elastin layers in the infrarenal aorta constitutes a predisposing factor for the development of an aneurysm in this region.[3] The incidence of AAA has increased over the last two decades due to the growing elderly population, an increase in cigarette smoking, the implementation of aneurysm screening programs, and the development of new diagnostic methods. The primary risk factors for AAA include advanced age, male gender, cigarette smoking, hypertension, atherosclerosis, and a family history of AAA.[4,5]

The rupture rate increases with aortic diameter. An aortic diameter of >5 cm has been associated with an increase in the risk for rupture.[6] The prevalence of rupture-related mortality has been reported to be 40-50% among AAA patients who underwent surgical intervention and up to 90% in AAA patients who did not undergo surgery.[4,7] Generally, an abdominal aorta diameter of >5 cm is considered to be an indicator for surgery. However, most patients who underwent surgery had an aneurysm of >6 cm in diameter.[4] The most frequent complications affecting the postoperative morbidity and mortality include cardiac and respiratory complications and renal dysfunction.[8] Coronary artery disease (CAD) is a leading cause of morbidity and mortality in patients who have undergone elective AAA repair.[9,10] The incidence of CAD has been reported to vary from 46 to 71% in AAA patients.[10] In patients with an infrarenal aortic diameter of >2.0 cm, the risk of cardiovascular events and the rate of total mortality have been reported to increase.[11] Routine preoperative coronary angiography is a recommended procedure in AAA patients to minimize the risk of cardiac mortality.[10] Preoperative identification of patients at risk can decrease the mortality and morbidity rates. The present study aimed to investigate the correlation of aneurysm diameter at surgical margins and risk factors with CAD. Determining patients who require further examination for CAD by assessing the correlation between CAD, AAA, and other risk factors was also investigated.

PATIENTS AND METHODS

Patients

A total of 163 patients (145 males, 18 females; mean age 64.4±8.9 years; range 39 to 88 years), who underwent elective surgery for infradiaphragmatic abdominal aortic aneurysm at the Kartal Koşuyolu Training and Research Hospital between January 1998 and December 2008 were included in the study. After obtaining approval from the local ethics committee of the hospital, patient records were retrospectively evaluated according to demographic data, operation types, concordant diseases, and risk factors. Patients who underwent elective surgery were stratified into groups according to their aneurysm diameter, aneurysm length, and age. The groups were then evaluated in terms of the presence of CAD. Patients with a ruptured AAA or those suffering from an aortic dissection were excluded from the study. Patients were diagnosed with AAA using magnetic resonance imaging (MRI), computed tomography (CT), or ultrasonography (US). Cardiac functions were evaluated using surface echocardiography in addition to routine examinations. Patients with segment motion disorders, an ejection fraction value of lower than 50%, ischemia symptoms, or CAD risk factors detected via myocardial perfusion scintigraphy were scheduled for coronary angiography. Coronary angiography was performed on 140 patients with suspected coronary artery disease. Twenty-three patients without risk factors who did not undergo coronary angiography and 58 patients who had a normal coronary angiography were grouped together and named the non-coronary artery disease group. Among patients admitted to the hospital due to chest pain, 86 were diagnosed with AAA after it was suspected during a routine physical examination. Patients were then divided into groups in order to be evaluated in terms of CAD according to age, aneurysm diameter, and aneurysm length.

Surgical technique

Abdominal aortic aneurysm repair was performed in patients by a median or paramedian laparotomy with a transperitoneal approach. Surgical methods included aortic tubular graft interpositioning (end-to-end anastomosis) and aortobifemoral bypass (proximal end-to-end and distal end-to-side anastomosis). A simultaneous conventional coronary artery bypass graft (CABG) procedure was performed in five patients due to a high risk of rupture (aneurysm diameter >7 cm and hematoma of the vascular wall). Additionally, an endovascular abdominal aortic aneurysm repair (EVAR) procedure was performed in five suitable patients. These patients were not included in the study.

Statistical analysis

Data was analyzed using SPSS software for Windows 13.0 (SPSS Inc, Chicago, IL, USA). Continuous variables

Table 1. The distribution of patients according to age, aneurysm length, and diameter

Groups	n	%
Age (year)		
<50	14	8.6
51-60	36	22.1
61-70	71	43.6
>70	42	25.8
Aneurysm diameter (cm)		
≤5.0	24	14.7
5.1-6.0	43	26.4
6.1-7.0	37	22.7
7.1-8.0	30	18.4
>8.0	29	17.8
Aneurysm length (cm)		
≤6.0	59	36.2
>6.0	104	63.8

were expressed as mean ± standard deviation while categorical variables were expressed as a percentage. Independent variables were compared using Student's t-test. The Mann-Whitney U-test and Pearson's chi-square test were used for categorical variables. A *p* value of <0.05 was considered statistically significant.

RESULTS

The mean aneurysm length in patients was 7.31±2.02 cm (range 4.8-20.0 cm). The mean aneurysm diameter was 7.05±2.15 cm (range 3.0-20.0 cm). The distribution of patients according to age along with aneurysm length and diameter is presented in table 1. The most common risk factors for AAA were hypertension (79.8%), cigarette smoking (70.6%), CAD (50.3%), chronic obstructive pulmonary disease (COPD) (36.8%), high serum urea levels (9.2%), and peripheral arterial disease (PAD) (2.5%). Among all patients, 135 were symptomatic (84.9%). The most frequently encountered symptoms were abdominal pain and chest pain. A CABG procedure was performed in 37 patients out of 82 AAA patients with comorbid CAD. A coronary stent was implanted in two patients. The remaining patients received medical therapy. Early mortality was 2.5% (n=4).

Patients were divided into groups according to the presence of CAD and the groups were compared in terms of risk factors (Table 2). No significant difference was found between the groups in terms of age, symptoms, hypertension, COPD, or uremia. When the groups were compared regarding cigarette smoking,

Table 2. The distribution of risk factors in abdominal aortic aneurysm patients according to the presence of coronary artery disease

	Coronary artery disease					
	Total	Absent		Present		
	n	n	%	n	%	*p*
Age group (year)						
<50	14	10	71.4	4	28.6	0.123
51-60	36	22	61.1	14	38.8	
61-70	71	29	40.8	42	59.2	
>70	42	20	46.3	22	53.7	
Aneurysm diameter (cm)						
≤5.0	24	12	50.0	12	50.0	0.826
5.1-6.0	43	19	44.2	24	55.8	
6.1-7.0	37	20	54.1	17	45.9	
7.1-8.0	30	15	50.0	15	50.0	
>8.0	29	15	51.7	14	48.3	
Aneurysm length (cm)						
≤6.0	60	27	45.0	33	55.0	0.171
>6.0	103	54	52.4	49	47.6	
Symptomatic	135	66	48.9	69	51.1	0.783
Smoking	112	47	42.0	65	58.0	0.012*
Hypertension	127	57	44.9	70	55.1	0.075
Chronic pulmonary obstructive disease	59	27	45.8	32	54.2	0.606
Uremia (>2 mg/dL)	14	9	64.3	5	35.7	0.214
Prolonged intensive care (>2 days)	66	33	50.0	33	50.0	0.686
Complication	62	29	46.8	33	53.2	0.844

* p<0.05.

Table 3. The duration of stay in intensive care unit and time to discharge of patients according to the presence of coronary artery disease

	Coronary artery disease		
	Present	Absent	
	Mean±SD	Mean±SD	*p*
Duration of stay in intensive care unit (day)	3.0±3.0	2.6±1.2	0.689
Time to discharge (day)	8.9±6.6	8.6±4.5	0.742

SD: Standard deviation.

Table 4. The distribution of coronary artery bypass grafts performed in coronary artery disease patients according to aneurysm diameter

	CAD	CABG performed	
	n	n	%
Aneurysm diameter (cm)			
≤5.0	12	6	16.2
5.1-6.0	24	8	21.6
6.1-7.0	17	11	29.8
7.1-8.0	15	7	18.9
>80	14	5	13.5
Total	82	37	100.0

CAD: Coronary artery disease; CABG: Coronary artery bypass grafting.

it was determined that the number of smokers was significantly higher in the CAD group than the non-CAD group (p=0.012). There was also no significant difference between the groups in terms of duration of intensive care unit stay and hospital stay (p=0.686; table 3). In addition, no significant difference was observed between the groups regarding the prevalence of complications during hospital stay (p=0.844). The distribution of CABG performed in CAD patients according to aneurysm diameter is presented in table 4. Although the patient group with an aneurysm diameter between 6.1 and 7.0 cm had the highest number of CABG procedures, there was no significant difference between the groups (p=0.330).

DISCUSSION

In our study, we aimed to identify predictive factors for CAD apart from the currently known risk factors in patients who underwent elective AAA repair in our clinic over the last 10 years. The risk factors include age of >70 years, a history or presence of angina pectoris, hypertension, COPD, previous myocardial infarction, heart failure, stroke, renal failure (serum creatinine >2 mg/dL), and diabetes mellitus.[12] Besides age, cigarette smoking, the presence of hypertension, and CAD, we evaluated parameters including aneurysm diameter, aneurysm length, the presence of symptoms, COPD, uremia, prolonged intensive care, the presence of complications, the duration of stay in an intensive care unit, and the time to discharge. There was no significant relationship between the presence of CAD and the parameters, except for cigarette smoking.

The prevalence of AAA has been reported to increase with age. Individuals with ages ≥ 60 years are more affected by this disease.[6,13] The natural course of the aneurysm is progressive expansion and rupture. To prevent rupture formation and decrease the mortality risk, it is essential to operate on the patient at the proper time, and aneurysm diameter is an important factor for determining this time.[14] Comorbid diseases and pathologies, which affect mortality and morbidity rates, are frequently encountered in AAA patients. Therefore, they should be determined in the preoperative period. Risk factors should be analyzed and related supportive therapy should be initiated over a period of time.[15]

Respiratory, renal, and cardiac problems have been reported to be the most frequent postoperative comorbid diseases.[16,17] In a study conducted by Erentuğ et al.[17] on 95 AAA cases who underwent elective surgery, the rate of concurrent risk factors was reported to be 78.9% for cigarette smoking, 66.3% for COPD, 42.1% for CAD, 37.8% for hypercholesterolemia, and 8.4% for diabetes mellitus. The same study emphasized that CAD is one of the most important risk factors; therefore, it is crucial to perform a preoperative CAD evaluation in all patients. Dawson et al.[16] followed up 165 patients who underwent AAA repair and uncovered previously undiagnosed cardiac, respiratory, and renal comorbidities in 19%, 57% and 29% of patients, respectively. In the same study, medical optimization by a renal physician reduced postoperative renal impairment while optimization by a cardiologist reduced respiratory complications. Adequate control of postoperative wound pain is mandatory for the mobilization of sputum, which would, in turn, reduce the risk of pulmonary complications. In the current study, the most common risk factors for AAA were hypertension (79.8%), cigarette smoking (70.6%), CAD (50.3%), chronic obstructive pulmonary disease (COPD, 36.8%), high serum urea level (9.2%), and PAD (2.5%).

Many studies have suggested that the preoperative evaluation of CAD is especially important due to the higher prevalence in AAA patients,[18] reported as 48% by Golden et al.,[19] 55.7% by Hosokawa et al.,[20] 53% by Bayazit et al.,[21] and 53.3% by Dawson et al.[16] Similarly in our study, 50.3% of 163 patients who were scheduled for surgical repair had comorbid CAD. However, the

prevalence of AAA in patients with known CAD has been reported to be about 5-8%.[22] The underlying factors in the pathogenesis of AAA and atherosclerosis were identified as being similar in a 20-year follow-up study of 8000 males.[2] Therefore, investigating the risk factors of CAD in AAA patients could be beneficial for the early diagnosis and prevention of further surgical complications.

Roger et al.[9] investigated the effect of CAD on morbidity and mortality in 131 patients who underwent elective AAA repair. Their study revealed that the patients that had uncorrected CAD were associated with a nearly twofold increased risk of death and a fourfold increased risk of cardiac events. In several studies, the importance of preoperative assessments for improving survival rates of AAA patients after surgical repair has been reported.[9,21] Quigley et al.[23] showed that cardiac intervention followed by expedient aneurysm repair in 20 patients was associated with zero mortality. These results indicate that preoperative coronary revascularization is the feasible approach in the coexistence of AAA and CAD.

Myocardial infarction has been reported to be responsible for 37% of early postoperative mortality.[24] D'Angelo et al.[25] have reported a 30-day mortality rate of between 0-5% with five-year survival rates between 65-70% after elective AAA repair. More than a third of long-term deaths resulted from cardiac diseases.[25] In the current study, early mortality was determined to be 2.5%. Takahashi et al.[26] reported that 40.3% of 159 patients had comorbid CAD, and coronary angiography was performed in 91% of them. Since the patients who underwent elective AAA repair in our clinic over the past 10 years were mainly evaluated using coronary angiography, we can say that the presence of CAD was reliably determined. Furthermore, the number of patients in our study was appropriate for interpretation and comparison with the literature. Concordant with the literature, the rate of coronary angiography evaluation was 85.9%.

In the present study, cigarette smoking was found to be a significant risk factor for CAD. Cigarette smoking has been determined to be an important risk factor in many studies investigating the coexistence of AAA and CAD and the associated risk factors.[2,4-6] Since cigarette smoking is the most easily modified parameter among risk factors, encouragement to quit smoking might result in a reduction in risk for both AAA and CAD.

The treatment for patients with CAD can be percutaneous transluminal coronary angioplasty, CABG, or medical treatment on the basis of the severity of disease. In the present study, CABG was performed in 37 of 82 AAA patients with comorbid CAD. A coronary stent was implanted in two patients. The remaining patients received medical therapy. Takahashi et al.[26] performed CABG in 4.4% of 159 patients who underwent elective AAA repair and percutaneous transluminal coronary angioplasty in 8.8%. Hosokawa et al.[20] determined CAD in 68 of 122 AAA patients using coronary angiography, and prophylactic percutaneous coronary intervention or CABG surgery was performed in 16 out of 68 patients. In the same study, a positive correlation between patients having an aneurysm diameter of >6.0 cm and those requiring CABG or percutaneous coronary intervention was found. In the present study, 22.6% of AAA patients required CABG, and the aneurysm diameter was >6.0 cm in 62.1% of 37 patients in whom CABG was performed. Although there was no significant difference between the groups, CABG was performed mostly in the patient group with an aneurysm of 6.1-7.0 cm in diameter. Myocardial damage was investigated by Schouten et al.[12] in high-risk patients undergoing elective endovascular or open infrarenal AAA repair. Endovascular therapy seems to be associated with less perioperative adverse cardiac events compared with open surgery in patients with three or more cardiac risk factors, irrespective of the extent of underlying coronary artery disease. Nevertheless, EVAR of AAA is feasible for a selected group of patients. The appropriate surgical approach should be determined considering each individual's characteristics and comorbid diseases.[8,27-29]

In conclusion, in the present study, AAA patients who were admitted to our clinic over the last 10 years were investigated retrospectively, and treatment outcomes and risk factors were evaluated. We can suggest that a preoperative detailed evaluation of factors affecting the mortality and morbidity rates along with possible complications in patients is needed, especially in the presence of CAD. Following this up by taking appropriate measures can decrease mortality rates in AAA repair. Coronary angiography should be performed in cigarette smokers before AAA surgery, and abdominal USG should be performed in CAD patients who are cigarette smokers. Moreover, since cigarette smoking is the most easily modified parameter among risk factors, patients should be encouraged to quit smoking.

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