What are the Prevalence of Abdominal Aortic Aneurysm in Patients with Chronic Obstructive Pulmonary Diseases and the Characteristics of These Patients?

Kronik Obstrüktif Akciğer Hastalığında Abdominal Aort Anevrizması Prevelansı ve Hastaların Özellikleri Nelerdir?

Ulku Aka Akturk[1], Nagihan Durmus Kocak[1], Suleyman Akturk[2], Mert Dumantepe[3], Aysun Sengul[4], Mehmet Arif Akcay[5], Makbule Ozlem Akbay[1], Feyyaz Kabadayi[1], Dilek Ernam[1]

ABSTRACT

Objective: To determine the prevalence of abdominal aortic aneurysm (AAA) in patients with chronic obstructive pulmonary disease (COPD) and to assess the characteristics of these patients.

Materials and Methods: Stable COPD patients (age, >40 years) were included in the study between January 2014 and June 2014. Patients with acute exacerbations and a previous lung resection were excluded. Data regarding demographic characteristics were recorded. The modified Medical Research Council (mMRC) dyspnea scale was used to assess the severity of breathlessness. The COPD Assessment Test (CAT) was performed. Abdominal aortic diameter was measured using abdominal ultrasonography (AUS), and AAA was diagnosed as an aortic diameter of ≥30 mm at the renal artery level.

Results: In total, 82 patients were examined. AAA was detected in five (6.1%) patients. Diabetes mellitus, hypertension, and coronary artery disease were present in four patients with AAA. The average mMRC score was 3.2±0.4, and the mean CAT score was 18.4±6.0. Aneurysmal diameter was >50 mm in four patients and 37 mm in one patient. Statistically significant differences were found between patient with AAA and those without AAA with respect to the mean abdominal aortic diameters at the renal artery and iliac artery levels (p=0.012 and 0.002, respectively).

Conclusion: Our findings suggest that AAA is associated with COPD, with a prevalence rate of 6.1%. AAA is usually asymptomatic until a clinical status of rupture, which is associated with a higher mortality risk. Early diagnosis of AAA is lifesaving. In COPD patients, AAA might be easily determined using AUS, which is a noninvasive and relatively cheap procedure.

Keywords: Aortic aneurysm, chronic obstructive pulmonary disease, ultrasonography

ÖZ

Amaç: Kronik obstrüktif akciğer hastalığı (KOAH) olan hastalarda abdominal aort anevrizması (AAA) sıklığının ve hasta özelliklerinin değerlendirilmesi.

Gereç ve Yöntem: Ocak ve Haziran 2014 tarihleri arasında başvuran, stabil dönemdeki KOAH hastaları (>40 yaş) çalışmaya alındı. Akut alevlenme döneminde olan veya geçmişte akciğer rezeksiyonu olan hastalar çalışma dışı bırakıldı. Demografik veriler kaydedildi. Dispne şiddetini değerlendirmek için modified Medical Research Council (mMRC) skalası, semptomlar için ise COPD Assessment Test (CAT) kullanıldı. Abdominal Ultrasonografi (AUS) ile ölçülen abdominal aort çapı renal arter seviyesinde ≥30 mm ise AAA tanısı kondu.

Bulgular: Çalışmaya toplam 82 hasta alındı. Beş (%6,1) hastada AAA saptandı. Bu hastaların 4'ünde diabetes mellitus, hipertansiyon ve koroner arter hastalığı mevcuttu. Ortalama mMRC skoru 3,2±0,4 iken CAT skoru 18,4±6,0 idi. Anevrizma çapı 4 hastada 50 mm üstü, 1 hastada ise 37 mm üstü saptandı. Abdominal aort çapları renal arter ve iliak arterler düzeyinde, AAA olan ve olmayan grupta istatistiksel olarak anlamlı farklı bulundu (sırasıyla, p=0,012 ve 0,002).

Sonuç: Çalışmamızda KOAH hastalarında AAA prevelansı %6,1 bulunmuş olup AAA ile KOAH hastalığının ilişkili olabileceğini düşündürmektedir. AAA yüksek mortalite riski taşıyan ve rüptür gelişimine kadar genellikle asemptomatik seyreden bir hastalıktır. Erken tanı hayat kurtarıcıdır. KOAH hastalarında AAA tanısı non invaziv ve nisbeten ucuz bir yöntem olan AUS ile kolaylıkla konulabilir.

Anahtar Kelimeler: Aort anevrizması, kronik obstrüktif akciğer hastalığı, ultrasonografi

[1]Department of Chest Disease, Süreyyapaşa Chest Disease and Thoracic Surgery Training and Research Hospital, İstanbul, Turkey
[2]Department of Cardiology, Private Yüzyıl Hospital, Kocaeli, Turkey
[3]Department of Cardiovascular Surgery, Medical Park Gebze Hospital, Kocaeli, Turkey
[4]Department of Chest Diseases, Derince Training and Research Hospital, Kocaeli, Turkey
[5]Department of Radiology, Süreyyapaşa Chest Disease and Thoracic Surgery Training and Research Hospital, İstanbul, Turkey

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Correspondence to: Ulku Aka Akturk

E-mail: drulkuakturk@yahoo.com

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Introduction

Abdominal aortic aneurysm (AAA) is defined as a permanent dilatation of the abdominal aorta and becomes visible when the diameter is ≥3 cm below the renal artery level. It is usually asymptomatic until a clinical status of rupture, which is associated with a higher mortality risk and requires emergency surgical intervention. However, only 10%-25% of individuals with ruptured AAAs survive until hospital discharge [1, 2].

Although the etiology of AAA remains unclear, atherosclerosis, degenerative changes in collagen and elastin fibers in the tunica media, and chronic inflammation are presumed to be responsible factors [1, 3]. Age, smoking status, and family history are the most important predisposing factors [2, 3]. The prevalence of AAA has been reported to be between 3% and 8%, and the incidence increases in concordance with age [1, 2]. Deaths associated with AAA in United States increased approximately 20% in 1991 when compared with that in 1979; however, the increase is presumed to be in concordance with the increase in ultrasonography use. Abdominal ultrasonography (AUS) is a noninvasive and relatively cheap procedure that is nearly 100% effective for detecting clinically important aneurysms [1, 2].

Chronic obstructive pulmonary disease (COPD) is an important cause of morbidity and mortality worldwide. It is characterized with progressive airway obstruction because of chronic inflammation in the lungs. Recent epidemiological studies have shown that considerable chronic comorbidities, mainly cardiovascular diseases, contributed to COPD [4, 5]. Although several studies suggest that COPD is associated with AAA development and engenders an additional risk factor for AAA rupture when smaller aneurysms are present, the literature regarding a potential association between the presence of COPD and AAA remains limited [4, 6-8]. Furthermore, there is no prevalence study that reflects an epidemiological status of Turkey.

We conducted a preliminary study by performing AUS in a cohort of COPD patients to detect the prevalence of AAA and to assess the characteristics of patients with the diagnosis of AAA at a single center in Turkey.

Materials and Methods

The study was conducted in a single tertiary referral thoracic center by a cross-sectional design after the approval of the local institutional human research committee and followed the ethical guidelines given in the Declaration of Helsinki.

Stable COPD patients who were aged >40 years and had COPD diagnosis, according to the global initiative for chronic obstructive lung disease (GOLD) 2014 Guidelines, for at least 1 year were included in the study between January 1, 2014 and July 1, 2014, after an informed consent was obtained from each participant [9]. Using the GOLD criteria, COPD was defined as patients with dyspnea, chronic cough, or sputum production and a history of exposure to risk factors for the disease (tobacco smoke, smoke from cooking at home and heating fuels, occupational dusts, and chemicals) with a spirometric criterion for airflow limitation (i.e., post-bronchodilator forced expiratory volume during the 1st second (FEV_1) divided by forced vital capacity (FVC) of <70%) [9].

Table 1. Demographic characteristics of COPD patients with and those without AAA

Patient characteristics	Without AAA (n=77) n (%)	With AAA (n=5) n (%)	p
Sex			
Male	67 (87)	4 (80)	0.51
Female	10 (13)	1 (20)	
Age (mean±SD), year	66.2±9.4	65.2±8.2	0.87
Smoking status			
Smoker	24 (31.2)	3 (60)	
Former smoker	45 (58.4)	2 (40)	0.36
Never smoked	8 (10.4)	0	

AAA: abdominal aortic aneurysm; COPD: chronic obstructive pulmonary disease; SD: standard deviation

Spirometry was performed on all COPD patients (SpiRE zan 100-gpı 3.00 pulmonary spirometer, nSpire Health Inc.), and 20 min after inhalation (using 400 µg salbutamol with e-metered dose inhaler), the measurement was repeated [10]. All pulmonary function tests (PFT) were performed by the same technician and with the patients in a sitting position. The patients with acute exacerbations and a previous lung resection and who have AUS suboptimal were excluded. The patients were questioned for clinical, demographical characteristics and comorbid diseases. Post-bronchodilator PFT and radiological examination with AUS for aneurysmal diagnosis were performed.

Data of age, sex, smoking status and duration, presence of comorbidity, PFT, and arterial blood gas analysis results of the patients were recorded. The modified Medical Research Council (mMRC) dyspnea scale was used to assess the severity of breathlessness [11]. COPD assessment test (CAT) was performed [12].

All COPD patients were classified according to the GOLD stage. The GOLD stages of all COPD patients were determined by assessing symptoms (CAT score), breathlessness (mMRC grade), spirometric classification, and risk of exacerbations [9]. When there were discrepancies between CAT and mMRC scores, the worse one was used for determining the GOLD stage.

AUS on empty stomach was performed on all patients by the same radiologist (General Electric Logic 7, Germany device with 3.5-MHz convex probe). Abdominal aortic diameter was measured with AUS at diaphragm level and bilateral renal artery and iliac artery level. Plaque formation, aneurysm, and thrombus presence and dimensions were recorded. AAA was diagnosed as an aortic diameter ≥3 cm at the renal artery level in AUS.

Statistical analysis

Definitive statistical data of the sociodemographic and clinical variables were indicated as frequency, percentage, average, and standard deviation (SD). To compare continuous variables with non-normal distribution, non-parametric tests (Mann-Whitney U test) were used. A p value of <0.05 was considered significant.

Statistical analysis was made with Statistical Package for the Social Sciences version 17.0 (SPSS Inc., Chicago, IL, USA).

Results

According to the study criteria, 88 patients were included in the study; however, six patients were excluded because of suboptimal AUS evaluation. Table 1 and 2 show the characteristics of COPD patients with and without AAA. The mean age of the patients was 66.2±9.3 years, and 71 (86.6%) patients were males and 11 (13.4%) were females.

Findings of COPD patients with AAA

AAA was detected in five (6.1%) patients. The average age of the patients with AAA was 65.2±8.2 years, and four (80%) were males and one (20%) was female. Three (60%) patients were smokers and two (40%) were former smokers; the average duration of smoking was 50±18.7 pack-years. Four patients with AAA had diabetes mellitus (DM), hypertension (HT), and coronary artery disease (CAD). The mean absolute FVC value was 1.56±0.3 L, mean

Table 2. Distribution of COPD patients with and those without AAA according to clinical and radiological parameters

Patient characteristics	Without AAA (n=77) n (%)	With AAA (n=5) n (%)	p
FEV_1 (absolute/L)	0.96±0.5	0.82±1.9	1.0
mMRC (mean±SD)	3.0±0.9	3.2±0.4	0.92
CAT (mean±SD)	18.4±6.0	21.0±8.9	0.48
GOLD			
A	1 (1.8)b	0	
B	13 (22.8)	0	
C	0	2 (40)	
D	43 (75.4)	3 (60)	
Aortic diameters (mean±SD)			
Diaphragm level, mm	19.7±3.3	21.2±2.5	0.22
Renal artery level, mm	16.9±3.3	26.6±11.5	0.01
Iliac artery level, mm	15.6±3.0	32.9±21.7	0.01

AAA: abdominal aortic aneurysm; CAT: COPD Assessment Test; COPD: chronic obstructive pulmonary disease; FEV_1: forced expiratory volume at 1st second; GOLD: global initiative for chronic obstructive lung disease; mMRC: Modified Medical Research Council; SD: standard deviation

absolute FEV_1 was 0.82±1.9 L, and FEV_1/FVC was 30±13.8 (Table 2). The average mMRC score was 3.2±0.4, and the mean CAT score was 18.4±6.0. According to the GOLD staging system, two patients were in group C and three were in group D. The mean abdominal aortic diameter was 21.2±2.5 mm at the diaphragm level, 26.6±11.5 mm at the renal artery level, and 32.9±21.7 mm at the iliac artery level (Table 2). Aneurysm localization was at the renal artery level in three (60%) patients and at the iliac artery level in two (40%) patients. Plaques were observed in the abdominal aorta in all patients, and thrombi were demonstrated in three (60%) patients. Aneurysmal diameter was >55 mm in four patients and 37 mm in one patient. Three patients whose aneurysmal diameters were >55 mm underwent endovascular treatment at the cardiovascular surgery department; the patient with the aneurysmal diameter of 37 mm was closely followed up using serial AUS.

Findings of COPD patients without AAA

The average age of the patients without AAA was 66.2±9.4 years. Of the 77 patients, 67 (87%) were males and 10 (13%) were females. Twenty-four (31.2%) patients were active smokers, 45 (58.4%) were former smokers, and eight (10.4%) were never smokers (Table 1). The average smoking duration was 45.0±20.6 pack-years. Comorbidities were detected in 28 (36.4) patients; 13 (38.7%) patients had HT, seven (22.6%) had DM, six (7.8%) had heart failure, and two (6.5%) had CAD. According to PFT parameters, the average absolute value of FVC was 1.57±0.6 L, that of FEV_1 was 0.96±0.5 L, and FEV_1/FVC was 37.6±16.2 (Table 2). The mean mMRC score was 3.0±0.9, and the average mean CAT score was 21±8.9. When the patients were classified according to the GOLD staging system, one (1.8%) patient was found to be in group A, 13 (22.8 %) were in group B, and 43 (75.4%) were in group D. No patient was in group C (Table 2). The mean abdominal aortic diameter was 19.7±3.3 mm at the diaphragm level, 16.9±3.3 mm at the renal artery level, and 15.6±3.0 mm at the iliac artery level. Statistically significant differences were found between patient with AAA and those without AAA with respect to the mean abdominal aortic diameters at the renal artery and iliac artery levels (p=0.012 and p=0.002, respectively) (Table 2).

When we compared the two groups, patients with AAA had more severe COPD than those without AAA. In addition, patients with AAA had higher mean CAT and mMRC scores and FEV_1 values than those without AAA. Patients with AAA were mostly heavy smokers and had a higher rate of comorbidities such DM, HT, and CAD. However, the difference between the two groups according to these parameters was not statistically significant (Table 1, 2). The mean abdominal aortic diameters measured at different levels were higher in patients with AAA than in those without AAA. Aortic diameters measured at the renal and iliac artery levels were statistically higher in patients with AAA than in those without AAA (p=0.012 and p=0.002, respectively).

Discussion

AAA is a life-threatening vascular pathology, particularly if it ruptures. Early diagnosis is vital and may result in a permanent cure. Major risk factors for the AAA development include an age of >65 years, smoking, HT, and a presence of a vascular disease [1-3]. In recent years, COPD has been accepted to be a predisposing factor for AAA development [4, 6-8].

To the best of our knowledge, this is the first national study to reflect data from a cross-sectional trial on the association between COPD and AAA. In this preliminary study, we investigated AAA prevalence in a cohort of stable COPD patients in the study designed by cross-sectional manner and assessed the characteristics of COPD patients diagnosed as having AAA. We found AAA prevalence to be only 6.1% in this cohort that mostly included severe COPD (68.8%). Although the sample size of patients with AAA was too small to compare, they had more severe COPD than those without AAA, according to a poorer mean CAT and mMRC scores and FEV_1 values in patients with AAA than those without AAA. Patients with AAA were mostly heavy smokers and had some comorbidities such DM, HT, and CAD. However, there is no statistically significant difference between the two patient groups according to these parameters because of the small sample size. As a result, our cohort of COPD patients with AAA had characteristics similar to those reported in the literature. Furthermore, the abdominal aortic diameters measured at the renal and iliac artery levels were statistically higher in patients with AAA than in those without AAA (p=0.012 and p=0.002, respectively). Aneurysmal diameters were critical for rupture (>55 mm) in four patients, of which three underwent an endovascular treatment. Thus, unfavorable outcomes of AAA such as rupture and mortality were prevented.

The association between AAA and COPD was first reported by Cronenwett et al. [6] in 1985. They suggested that COPD was more frequent in patients with a ruptured aneurysm. Van Laarhoven et al. [7] examined 362 COPD patients aged >65 years and reported a higher AAA prevalence, with a rate of 9.9%. AAA prevalence was statistically higher in more severe COPD patients (FEV_1<55%) than in milder COPD patients. Moreover, patients with AAA had a more cumulative smoking duration than those without AAA. Meijer et al. [8] suggested that there was an association between COPD and AAA that was independent of the smoking status and that COPD was more

frequent in patients with AAA than in those without AAA. They stated that COPD was underdiagnosed in patients with AAA. Lindholt et al. [13] indicated that AAA screening was cost-effective in their randomized controlled trial that assessed long-term benefits and cost-effectiveness of AAA screening. Giardina et al. [14] also reported AAA screening methods to be cost-effective in their study that analyzed the economical aspect of AAA screening methods in Italy. Ando et al. [4] recently evaluated AAA prevalence in COPD patients by abdominal and thoracic computed tomography in Japan in 2014 and reported that of the 231 patients assessed, 33 had a higher AAA prevalence (14.3%). They also suggested that the higher AAA prevalence was because of the inclusion of COPD patients who were previously diagnosed as having AAA. They found that patients with AAA were older, had more smoking pack-year values, and had less absolute FEV_1 and FEV_1/FVC values than those without AAA.

Using the national data, our preliminary study aimed to detect a possible association between COPD and AAA as there is no such published report in our country. Our results are consistent with those reported in the literature. However, the sample size of patients with AAA is inadequate to compare the patients with or without AAA, and thus, performing an important statistical analysis was not possible to reach a significant conclusion. However, we hope to draw attention to AAA in COPD patients with asymptomatic AAA and to emphasize on the diagnostic role of AUS for AAA. Another important limitation is that our cohorts included mostly severe COPD patients and did not represent patients with different COPD severity stages because our hospital is a tertiary referral center for chest diseases where mostly severe COPD patients are followed up.

This preliminary cross-sectional study reflects the first national data on the association between COPD and AAA. Our findings suggest that AAA is associated with COPD, with a prevalence rate of 6.1%, and patients with AAA had characteristics similar to those reported in the literature; the presence of AAA in COPD patients might be easily determined using AUS as a simple diagnostic tool, so that it is possible to assess which COPD patients have a higher risk for AAA and require treatment. However, further large-scale studies are needed to establish the true aspects of AAA in COPD patients.

Ethics Committee Approval: The study was approved by the local institutional human research committee and followed the ethical guidelines given in the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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References

1. Cornuz J, Sidoti Pinto C, Tevaearai H, Egger M. Risk factors for asymptomatic abdominal aortic aneurysm: systematic review and meta-analysis of population-based screening studies. Eur J Public Health 2004; 14: 343-9. [CrossRef]
2. Fleming C, Whitlock EP, Beil TL, Lederle FA. Screening for abdominal aortic aneurysm: a best-evidence systematic review for the U.S. Preventive Services Task Force. Ann Intern Med 2005; 142: 203-11. [CrossRef]
3. Chun KC, Teng KY, Chavez LA, et al. Risk factors associated with the diagnosis of abdominal aortic aneurysm in patients screened at a regional Veterans Affairs health care system. Ann Vasc Surg 2014; 28: 87-92. [CrossRef]
4. Ando K, Kaneko N, Doi T, Aoshima M, Takahashi K. Prevalence and risk factors of aortic aneurysm in patients with chronic obstructive pulmonary disease. J Thorac Dis 2014; 6: 1388-95.
5. Lindholt JS, Heickendorff L, Antonsen S, Vammen S, Fasting H, Henneberg EW. Natural history of abdominal aortic aneurysm with and without concomitant chronic obstructive pulmonary disease Ugeskr Laeger 1998; 28: 226-33.
6. Cronenwett JL, Murphy TF, Zelenock GB, et al. Actuarial analysis of variables associated with rupture of small abdominal aortic aneurysm. Surgery 1985: 98; 472-83.
7. van Laarhoven CJ, Borstlap AC, van Berge Henegouwen DP, Palmen FM, Verpalen MC, Schoemaker MC. Chronic obstructive pulmonary disease and abdominal aortic aneurysms. Eur J Vasc Surg 1993: 7; 386-90. [CrossRef]
8. Meijer CA, Kokje VB, van Tongeren RB, et al. An association between chronic obstructive pulmonary disease and abdominal aortic aneurysm beyond smoking: results from a case-control study. Eur J Vasc Endovasc Surg 2012: 44; 153-7. [CrossRef]
9. The Global Initiative for Chronic Obstructive Lung disease (GOLD) (the 2014 version), Available from: URL: www.goldcopd.com.
10. Spirometry for health care providers, Global Initiative for Chronic Obstructive Lung Disease (GOLD 2010).
11. Ferris BG. Epidemiology Standardization Project (American Thoracic Society). Am Rev Respir Dis 1978; 118: 1-120.
12. Jones PW, Harding G, Berry P, Wiklund I, Chen WH, Kline Leidy N. Development and first validation of the COPD Assessment Test. Eur Respir J 2009; 34: 648-54. [CrossRef]
13. Lindholt JS, Sørensen J, Søgaard R, Henneberg EW. Long-term benefit and cost-effectiveness analysis of screening for abdominal aortic aneurysms from a randomized controlled trial. Br J Surg 2010; 97: 826-34. [CrossRef]
14. Giardina S, Pane B, Spinella G, et al. An economic evaluation of an abdominal aortic aneurysm screening program in Italy. J Vasc Surg 2011; 54: 938-46. [CrossRef]