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Prevalence of abdominal aortic aneurysm among stage 3-4 chronic kidney disease patients aged 55 years and older

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Abstract. *The risk of cardiovascular disease begins to increase from the early stages of chronic kidney disease (CKD). Abdominal aortic aneurysms are the most common arterial aneurysms of peripheral arterial diseases. The frequency of abdominal aortic aneurysm varies according to the population studied. This study aimed to determine the prevalence of abdominal aortic aneurysm in patients with stage 3-4 CKD and investigate CKD is a risk factor for abdominal aortic aneurysm formation.*

Methods. *Patients aged 55 years and older who were followed up in the internal medicine outpatient clinics were enrolled. Two hundred CKD patients with glomerular filtration rates between 15-59 mL/min per 1.73 m² were included in the study group, and 110 patients with glomerular filtration rates of 60 mL/min per 1.73 m² or above were assigned to the control group. An ultrasonography device with a 3.5 MHz probe was used for screening. Abdominal aortic diameters of 3 cm and above were accepted as abdominal aortic aneurysms.*

Results. *Eighteen patients in the study group (9%) and four in the control group (3.6%) had an abdominal aortic aneurysm. The prevalence of abdominal aortic aneurysms was higher in the CKD group. However, the difference was not statistically significant (p=0.078). Moreover, the median aortic diameter was 21.8 mm (14-44 mm) in the study group, compared to 21.0 mm (14-46 mm) in the control group. The prevalence of the abdominal aortic aneurysm was 14.9% in stage 4 CKD patients and 6% in stage 3 CKD patients (p=0.038).*

Conclusion. *An abdominal aortic aneurysm is more common in patients with CKD although it does not reach statistical significance. The median aortic diameter was significantly wider in CKD patients compared to the control group. The prevalence of abdominal aortic aneurysm increased with an increase in the CKD stage.*

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Поширеність аневризми черевної аорти серед пацієнтів з хронічною хворобою нирок у віці понад 55 років

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Резюме. Ризик серцево-судинних захворювань зростає з ранніх стадій хронічної хвороби нирок. Аневризми черевної аорти є найпоширенішими артеріальними аневризмами. Частота аневризми черевної аорти змінюється залежно від досліджуваної популяції. Наше дослідження мало на меті визначити частоту аневризми черевної аорти у пацієнтів з хронічною хворобою нирок (ХХН) 3-4 стадії та дослідити, чи є ХХН фактором ризику формування аневризми черевної аорти.

Методи. Двісті пацієнтів з ХХН III-IV стадій, віком понад 55 років були включені до групи дослідження та 110 пацієнтів того ж віку зі швидкістю клубочкової фільтрації 60 мл/хв на 1,73 м² або вище були включені до контрольної групи. Для скринінгу був використаний ультразвукографічний прилад із зондом 3,5 МГц. Абдомінальні аорти діаметром 3 см і вище вважались аневризмами черевної аорти.

Результати. У вісімнадцяти пацієнтів дослідницької групи (9%) та чотирьох контрольної групи (3,6%) діагностована аневризма черевної аорти. Частота аневризм черевної аорти була вищою серед хворих на ХХН, однак різниця не була статистично значущою ($p = 0,078$). Більше того, середній діаметр аорти у досліджуваній групі становив 21,8 мм (14-44 мм) порівняно з контрольною групою 21,0 мм (14-46 мм). Частота діагностики аневризми черевної аорти становила 14,9% у пацієнтів з ХХН IV стадії та 6% у хворих ХХН III стадії ($p = 0,038$).

Висновки. Аневризма черевної аорти частіше зустрічається у пацієнтів з ХХН, хоча статистично не відрізняється. Середній діаметр аорти був значно ширшим у пацієнтів з ХХН. Поширеність аневризми черевної аорти зростала зі збільшенням стадії ХХН.

Ключові слова: хронічні захворювання нирок, аневризма черевної аорти, ультразвукографія, поширеність.

Introduction. Cardiovascular conditions are the most important cause of morbidity and mortality in patients with chronic kidney disease (CKD). Deaths related to the heart are 20-30 times more common in patients with CKD compared to individuals without renal disease in the same age group [1]. The risk of cardiovascular disease starts to increase from the early stages of chronic kidney disease [2]. The incidence of cardiovascular disease increases with CKD progression [3].

According to the American College of Cardiology/American Heart Association (ACC/AHA) Practice Guidelines, peripheral arterial diseases include lower extremity peripheral artery disease, renal artery disease, mesenteric artery disease, and arterial aneurysms [4]. An aneurysm is defined as the irreversible enlargement of an artery by 50% above its expected diameter. Abdominal aortic aneurysms (AAA) are among the most commonly encountered arterial aneurysms [5]. The frequency of AAA varies according to the population studied. Imaging studies show that the prevalence of AAA in people over

60 years is between 4-8% [6]. Known risk factors for AAA are: advanced age, male sex, family history of AAA, arterial aneurysms in other parts of the body (especially femoral and popliteal), smoking, coronary artery disease, and hypertension [7]. In the United States, about 15000 deaths per year are due to aortic aneurysms, 9000 of which are related to AAA [8]. The majority of patients with AAA are asymptomatic. Thus, AAA is frequently detected incidentally. Approximately one-third of untreated AAA cases result in a rupture.

On the other hand, the majority of patients with aneurysm rupture die before reaching the hospital. Mortality is also high in patients who undergo emergency surgery, and the total mortality rate in AAA rupture is 85-95% [9, 10]. United States Preventive Services Task Force (USPSTF) has shown that AAA screening may reduce AAA-related mortality by 43% in men aged 65-74 years [11]. Screening studies to detect and treat aneurysms without rupture are increasing. Considering the cost of screening studies, it is essential to identify the populations that should be screened. USPSTF recommends that men aged 65-75 years, who have smoked at any stage of their life, should be screened once-only for AAA by ultrasonography [11].

Ultrasonography (USG) has a sensitivity of 95-100% and a specificity of approximately 100% in AAA detecting [12]. Because of its high sensitivity, speci-

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ficity, reliability, and low cost, USG is the preferred screening method proven by large randomized trials.

Although there are many studies related to coronary artery disease and heart failure in CKD patients, peripheral arterial diseases have not been adequately studied. This study was planned based on the hypothesis that the risk factors in CKD also play a role in the etiopathogenesis of AAA.

This study aimed to determine the incidence of AAA in CKD stage 3-4 patients aged 55 years and older and investigate whether CKD is a risk factor for AAA formation.

Methods. Patients who were followed up in Ankara University Medical Faculty Internal Medicine outpatient clinics and agreed to participate in the study were included in the study. Participants with a poor general condition, unstable renal function, known active infection, and whose aortic diameter could not be measured by USG were excluded.

Glomerular filtration rate (GFR) was calculated in all patients. Aortic diameter measurement with USG was performed only on patients who agreed to participate in the study. GFR was calculated from the Modification of Diet in Renal Disease (MDRD) formula using creatinine value, age, sex, and race. The formula is: $186 \times \text{creatinine} - 1.154 \times \text{age} - 0.203 \times 0.742$ (if female) $\times 1.210$ (if black). Two hundred CKD patients with GFR values between 15-59 mL/min per 1.73 m² were evaluated in the study group, while 110 participants with GFR 60 mL/min per 1.73 m² and above were included in the control group.

In patients with a history of smoking, cigarette exposure (in years) was calculated by multiplying the number of cigarettes smoked (package) and the duration of smoking (years). Body mass index was obtained by dividing the body weight in kilograms by the square of the height in meters. The degree of proteinuria was determined by checking the protein/creatinine ratio in the urine spot. Additionally, family history concerning AAA was queried. However, it was not included in the analyses since most of the participants could not provide sufficient information.

A USG device with a 3.5 MHz probe was used to screen abdominal aortic aneurysm. In the supine position, transverse and anteroposterior diameters of the infrarenal and suprarenal aorta were measured using the B-mode grayscale ultrasonographic projection. An abdominal aortic diameter of 3 cm and above was accepted as an aneurysm.

Patients' hemoglobin, hematocrit, blood chemistry (creatinine, albumin, calcium (Ca), inorganic phosphorus (P), high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglyceride (TG), C-reactive protein (CRP), parathormone (PTH), and protein/creatinine ratios in the spot urine taken in the morning were recorded.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS Inc., Chicago, IL, USA). For categorical data, the Chi-square test was used for comparison of independent groups (study vs. control), and the Student T-test was used for numerical data. Percentage/ratio and mean \pm standard deviations were presented for descriptive statistics. Spearman's correlation test was used to evaluate the relationship between an abdominal aortic diameter and study variables. The odds ratio (OR) and its 95 % confidence interval (CI) was calculated using multiple logistic regression analysis. A p-value <0.05 was considered statistically significant.

Before starting the study, approval was obtained from the ethics committee of Ankara University Medical Faculty.

Results. The study group consisted of 134 men (67%) and 66 women (33%). The ages of the patients ranged from 55 to 86 years (median age 66 years). There were 71 men (64.5%) and 39 women (35.5%) in the control group, and their ages ranged from 55 to 85 years (median age 65 years). There was no significant difference between the groups regarding age, sex, and body mass index distribution. While there was no significant difference between albumin, CRP, LDL, and TG values between the two groups, there was a statistically significant difference concerning protein/creatinine ratio, hemoglobin, hematocrit, Ca, P, PTH, and HDL values. When the patients were asked for the presence of atherosclerotic heart disease, hypertension, diabetes, and cerebrovascular events, no difference was found between the two groups in terms of the existence of atherosclerotic heart disease, diabetes, or cerebrovascular event. Still, the number of patients diagnosed as hypertension was significantly higher in the study group. Hypertension was present in 85.5% of the study group and 60% of the control group (p < 0.001). The rate of smoking and the amount of tobacco use were similar in both groups. The demographic and clinical characteristics of the patients included in the study are summarized in Table 1.

Table 1

Demographic characteristics of the patients included in the study

Parameter	Study group	Control group	p
Age	66 (55-86)	65 (55-85)	0.185
BMI	26.45 (16.98-45.91)	27.68 (20.28-36.79)	0.064
Creatinine (mg/dl)	1.7 (0.8-6.7)	0.84 (0.5-1.2)	<0.001
Creatinine clearance (ml/min per 1.73 m ²)	40.0 (15.0-59.0)	85.0 (64.0-150.0)	<0.001
Protein/creatinine	0.39 (0.04-17.00)	0.11 (0.1-0.90)	<0.001
Hemoglobin (g/dl)	12.30 \pm 2.04	14.10 \pm 1.60	<0.001

Table 1 continuation

Parameter	Study group	Control group	p
Hematocrit (%)	36.0 (21.0-66.0)	42.2 (30.0-54.0)	<0.001
Albumin (g/dl)	4.2 (1.7-5.1)	4.2 (3.4-5.1)	0.189
Calcium (Ca) (mg/dl)	9.1 (6.7-11.0)	9.3 (7.5-10.6)	0.044
Phosphorus (P) (mg/dl)	3.6 (2.1-9.0)	3.3 (1.9-4.7)	<0.001
CaxP	32.9 (17.8-77.0)	30.5 (17.6-43.8)	<0.001
PTH	79.6 (18.0-508.0)	48.6 (12.5-148.0)	<0.001
CRP (mg/L)	4.30 (0.22-135.00)	4.00 (0.30-46.40)	0.062
LDL (mg/dl)	101 (34-253)	111 (57-202)	0.095
HDL (mg/dl)	41 (22-91)	45 (11-78)	0.011
Triglyceride (mg/dl)	135 (38-995)	131 (52-699)	0,387
History of atherosclerotic heart disease	100/200 patients (50%)	55/110 patients (50%)	1.000
History of hypertension (HT)	167/200 patients (83.5%)	66/110 patients (60%)	<0.001
Duration of HT (years)	8 (0-40)	1 (0-30)	<0.001
History of diabetes mellitus (DM)	90/200 patients (45%)	52/110 patients (47.3%)	0.701
Duration of DM (years)	0 (0-43)	0 (0-30)	0.453
History of cerebrovascular event	21/200 patients (10.5%)	7/110 (6.4%)	0.224
History of tobacco use	96/200 patients (48%)	46/110 patients (41.8%)	0.296
Tobacco (pack x years)	0 (0-165)	0 (0-100)	0.464
Abdominal aortic diameter (mm)	21.8 (14.0-44.0)	21.0 (14.0-46.0)	0.004

Abbreviations: BMI: Body mass index, Ca: Calcium P: Phosphorus, PTH: Parathormone CRP: C-reactive protein, LDL: Low-density lipoprotein, HDL: High-density lipoprotein HT: Hypertension, DM: Diabetes mellitus

An abdominal aortic aneurysm was detected in 18 (9%) patients in the study group and 4 (3.6%) patients in the control group. 18 (18/22, 81.8%) of the patients with abdominal aortic aneurysm were male,

and 4 (4/22, 18.2%) were female ($p = 0.107$). The AAA was more common in patients with CKD, but the difference was not statistically significant ($p = 0.078$) (Table 2).

Table 2

AAA frequency in the study and control groups

Group	AAA present patient	AAA absent patient	Total
Study	18 (9%)	182 (91%)	200 (100%)
Control	4 (3.6%)	106 (96.4%)	110 (100%)
Total	22 (7.1%)	288 (92.9%)	310 (100%)
P = 0.078			

Abbreviations: AAA: Abdominal aortic aneurysms

However, the median aortic diameter was 21.8 mm (14-44 mm) in the study group and 21.0 mm (14-46 mm) in the control group ($p = 0.04$).

When the patients in the study group were evaluated regarding the stage of CKD, the prevalence of AAA in stage 4 CKD was significantly higher than that in stage 3. While 10 (14.9%) of the 67 CKD stage 4 patients had AAA, the condition was present

in 8 (6%) of the 133 patients with CKD stage 3 ($p = 0.038$).

Patients with AAA and non-AAA in the whole group were compared concerning the studied variables. While creatinine clearance, hemoglobin, hematocrit, and albumin values were significantly lower in patients with AAA, protein/creatinine ratio, PTH, and CRP were substantially higher (Table 3).

Table 3

Comparison of patients with AAA and without AAA in terms of study parameters

Parameter	With AAA	Without AAA	p
Age	68 (55-81)	65 (55-86)	0.172
BMI	25.90 (17.60-45.90)	27.05 (16.98-43.86)	0.269
Creatinine (mg/dl)	1.8 (1.0-4.2)	1.3 (0.5-6.7)	0.002
Creatinine clearance (ml/min per 1.73 m ²)	32 (15.0-81.0)	51.5 (15.0-150.0)	0.002
Protein/creatinine	0.57 (0.10-8.00)	0.17 (0.04-17.00)	0.031

Table 3 continuation

Parameter	With AAA	Without AAA	p
Hemoglobin (g/dl)	11.7 (8.9-15.1)	13.0 (7.0-18.0)	0.014
Hematocrit (%)	35.0 (26.0-47.0)	39.0 (21.0-66.0)	0.019
Albumin (g/dl)	3.9 (1.7-4.8)	4.2 (1.9-5.1)	0.026
Calcium (Ca) (mg/dl)	9.0 (7.6-10.0)	9.2 (6.7-11.0)	0.086
Phosphorus (P) (mg/dl)	3.5 (2.6-5.5)	3.4 (1.9-9.0)	0.406
Ca x P	31.5	31.6	0.820
PTH	112.5 (34.0-508.0)	61.9 (12.5-487.0)	<0.001
CRP (mg/L)	7.25 (0.75-80.00)	4.00 (0.22-135.00)	0.004
LDL (mg/dl)	97 (47-173)	109 (34-253)	0.103
HDL (mg/dl)	39 (22-91)	43 (11-90)	0.082
Triglyceride (mg/dl)	128 (70-523)	135 (38-995)	0.982
History of atherosclerotic heart disease	11/22 patients (50%)	144/288 patients (50%)	1.000
History of hypertension (HT)	20/22 patients (90.9%)	213/288 patients (74%)	0.076
Duration of HT (years)	6 (0-30)	5 (0-40)	0.152
History of diabetes mellitus (DM)	9/22 patients (40.9%)	133/288 patients (46.2%)	0.632
Duration of DM (years)	0 (0-30)	0 (0-43)	0.898
History of cerebrovascular event	4/22 patients (18.2%)	24/288 patients (8.3%)	0.120
History of tobacco use	15/22 patients (68.1%)	127/288 patients (44.0%)	0.029
Tobacco (pack x years)	35 (0-100)	0 (0-165)	0.021

Abbreviations: BMI: Body mass index, Ca: Calcium P: Phosphorus, PTH: Parathormone CRP: C-reactive protein, LDL: Low-density lipoprotein, HDL: High-density lipoprotein HT: Hypertension, DM: Diabetes mellitus

Smoking and the amount of tobacco used were significantly higher in patients with AAA ($p = 0.029$, $p = 0.021$, respectively).

The correlations between the variables and abdominal aortic diameter were evaluated in the whole group.

The correlations with creatinine value, creatinine clearance, protein/creatinine ratio, hemoglobin, hematocrit, PTH, CRP, and the amount of tobacco used were significant (Table 4).

Table 4

Correlations between study variables and abdominal aortic diameter

Variable	r-value	p-value
Age	0.077	0.175
BMI	-0.031	0.585
Creatinine (mg/dl)	0.149	0.009
Creatinine clearance	-0.166	0.003
Protein/creatinine	0.123	0.031
Hemoglobin (g/dl)	-0.151	0.008
Hematocrit (%)	-0.145	0.011
Albumin (g/dl)	-0.041	0.471
Calcium (Ca) (mg/dl)	-0.098	0.087
Phosphorus (P) (mg/dl)	0.054	0.347
Ca x P	0.026	0.645
PTH	0.209	<0.001
CRP (mg/L)	0.174	0.002
LDL (mg/dl)	-1.100	0.079
HDL (mg/dl)	-0.064	0.263
Triglyceride (mg/dl)	0.018	0.752
Duration of HT (years)	0.071	0.211
Duration of DM (years)	0.16	0.780
Tobacco (pack x years)	0.114	0.045

Abbreviations: BMI: Body mass index, Ca: Calcium P: Phosphorus, PTH: Parathormone CRP: C-reactive protein, LDL: Low-density lipoprotein, HDL: High-density lipoprotein HT: Hypertension, DM: Diabetes mellitus

There was a significant negative correlation between abdominal aortic diameter and creatinine clearance, hemoglobin and hematocrit levels. The significant positive correlation was observed between abdominal aortic diameter and creatinine value, protein/creatinine ratio, PTH, CRP levels, and the amount of cigarette consumption. However, in a multiple logistic regression analysis including all studied variables, the only significant independent variables predicting the presence of AAA were PTH (OR=1.007, 95% CI: 1.003-1.012, $p=0.002$) and CRP (OR=1.026, 95% CI: 1.004-1.048, $p=0.018$) levels.

Discussion. The frequency of AAA varies according to the characteristics of the population studied. In large studies, it was reported as 4-8% among men aged 65 and over, and 0.5-1% in women [13-15]. There is insufficient data in the literature about the frequency of abdominal aortic aneurysms in chronic kidney disease. In our study, the prevalence of AAA in CKD stage 3-4 was 9%, compared to 3.6% in the control group. Since there is no data on the frequency of AAA in Turkey, no comparison could be made. In a specialty thesis study conducted in Ankara University Faculty of Medicine in 2005, the frequency of AAA in hemodialysis patients was investigated. The rate of AAA was 8.2% and 3.8% in hemodialysis patients and the control group, respectively [16]. The reason why the AAA prevalence in our study was lower than the reference studies may be because our research was done in a population aged 55 years and over. The frequency of AAA increases with age. However, the majority of studies worldwide have been conducted in the population aged 65 years and over.

When patients in the study group were evaluated concerning the CKD stages, the frequency of AAA was found to be 6% and 14.9% in stage 3 and 4 patients, respectively. The difference was statistically significant ($p = 0.038$). This difference can be explained by the higher cardiovascular risk factors in patients with a higher degree of renal dysfunction. The risk of cardiovascular disease begins to increase from the early stages of CKD [2, 17]. Furthermore, the incidence of cardiovascular disease increases with CKD progression [3]. The relationship between CKD and cardiovascular event risk was evaluated in a study of more than 1 million participants. Patients without dialysis and renal transplantation were included in the study, and the GFR was calculated by the MDRD formula. Among the patients, 17.5% had a GFR of $<60\text{ mL/min per }1.73\text{ m}^2$. The mean follow-up was 2.8 years, and 138000 cardiovascular events occurred. Compared to those with GFR of $>60\text{ mL/min per }1.73\text{ m}^2$, the risk of having any cardiovascular event is 1.4 times in those with GFR 45-59, 2.0 in those with GFR 30-44, 2.8 in those with GFR 15-29, and 3.4 times in patients with GFR $<15\text{ mL/min per }1.73\text{ m}^2$ [18].

Besides, it is known that AAA develops 4-5 times more frequently in men than in women [13, 19]. In a population survey among 65-80 years-old persons in the USA, the prevalence of AAA was 1.3% in women and 7.6% in men [20]. In our study, although AAA was

detected more frequently in males, the difference was not statistically significant ($p = 0.107$). Of 22 patients with AAA, 18 (81.8%) were male, and 4 (18.2%) were female.

The correlations between the variables and abdominal aortic diameter were evaluated in the whole group. There was a significant negative correlation between abdominal aortic diameter and creatinine clearance, hemoglobin and hematocrit levels. The positive correlation was observed between abdominal aortic diameter and creatinine value, protein/creatinine ratio, PTH, CRP levels, and the amount of cigarette consumption. When multiple logistic regression analysis was performed, only PTH and CRP levels were found to be independent predictors of AAA risk increase.

In recent years, CRP has emerged as a strong and independent risk factor for atherosclerosis and complications associated with atherosclerosis. In a study based on the hypothesis that CRP was produced from aneurysmal tissue, CRP was associated with the size of the aneurysm [21]. Thirty-nine patients with AAA were included in the study. Aneurysmal tissue of 16 patients was evaluated for the presence of CRP mRNA, and CRP mRNA was detected in 25% of these cases. In this study, it was emphasized that CRP production from vascular tissue may contribute to aneurysm formation. In a study conducted by H. Domanovits et al., 225 patients with AAA (111 asymptomatic, 52 symptomatic but not ruptured, 62 ruptured AAA) were evaluated [22]. CRP and white blood cell levels were significantly higher in symptomatic AAA and ruptured AAA than asymptomatic patients. In a study by M. Vega de Ceniga et al. in Spain, 35 patients with AAA and 35 without AAA were compared. Patients with FMF were followed up for 12 months [23]. There was a significant positive correlation between CRP and AAA diameters as well as alpha-1 antitrypsin levels and AAA expansion rate.

Although there is no direct study on the relationship between AAA and PTH in the literature, many studies are evaluating the relationship between PTH and cardiovascular diseases. In a community-based study in Norway, individuals with normal serum creatinine levels were included, where serum PTH levels were measured in 3570 patients having serum Ca levels within the reference range [24]. The coronary heart disease rate was significantly higher in patients with high serum PTH levels. Thus, it was concluded that a high PTH level may be an indicator of coronary heart disease. Considering the etiology of AAA, it may be easier to understand the relationship between AAA and PTH levels. Part of the middle layer in the infrarenal aorta close to the lumen receives oxygen and nutrients through diffusion via the aortic lumen. Atherosclerosis leads to hypoxemia by causing thickening of the intima and decreasing nutrient diffusion into the middle layer. On the other hand, hypoxemia causes ischemia and degeneration of the elastic components in this layer. This degeneration weakens the aortic wall and makes it susceptible to aneurysm development [25].

In our study, the frequency of AAA was 9% in CKD stage 3-4 patients and 3.6% in the control group with a GFR of >60 mL/min per 1.73 m². The difference did not reach a statistical significance ($p = 0.07$). We think that this difference can be revealed more clearly by other studies conducted with a higher number of participants. Previous studies have shown that the incidence of cardiovascular disease increases with CKD progression. In line of these results, we showed that the rate of AAA increased with an increase in the stage of CKD. We found that PTH and CRP levels were the most critical factors in the surge of this risk. Our findings suggest that screening programs in CKD patients with these risk factors may detect early AAA and contribute to prolonging their survival by performing necessary interventions.

Conclusion. In this study, we found that compared to a control group, AAA is seen slightly more frequent-

ly in patients with CKD, without reaching statistical significance. The prevalence of AAA rose with the increasing stage of CKD. PTH and CRP levels were the most essential risk factors in AAA. Our findings suggest that in CKD patients, aortic aneurysms can be detected earlier with screening programs, which can contribute to their survival by enabling timely interventions.

Conflict of interest. The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the paper.

Contribution. All ultrasonographic examinations in the study were performed by Özlem Karaarslan Cengiz, one of the authors of the study, using the ultrasonography device of the nephrology discipline. The other parameters used in the study were obtained from the data already available in the patient files. Therefore, no budget was required for the study. We thank all the patients who volunteered to participate in this study.

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