

Prevalence of carotid artery calcification on panoramic radiographs in patients with renal stones

Ihsan ÜSTÜN^{1*}, Mehmet İNCİ², Abdullah DEMİRTAŞ³, Yıldray ŞİŞMAN⁴, Cumali GÖKÇE¹, Elif TARIM ERTAŞ⁵

¹Department of Internal Medicine/Endocrinology, Faculty of Medicine, Mustafa Kemal University, Hatay, Turkey

²Department of Urology, Faculty of Medicine, Mustafa Kemal University, Hatay, Turkey

³Department of Urology, Faculty of Medicine, Erciyes University, Kayseri, Turkey

⁴Department of Oral Diagnosis and Radiology, Faculty of Dentistry, Erciyes University, Kayseri, Turkey

⁵Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Katip Çelebi University, İzmir, Turkey

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Aim: To determine the prevalence of carotid artery calcification (CAC) detected in routine dental radiography (PRs) in patients with kidney stones (KSS) and to investigate the relationship between CAC-atherosclerosis and KSS.

Materials and methods: A total of 108 patients with renal stones were included in the present study. A history of renal colic, with confirmed hematuria and voiding of the calculus, radiographic evidence of KSS, or previous surgical and endoscopic removal of KSS, was used to define the nephrolithiasis. KS patients were evaluated by PR in terms of the presence of CAC. Subjects with either unilateral or bilateral CAC on these radiographs were identified.

Results: Of the 108 patients included in the data analysis, 18 (16.6%) were detected as having CAC upon PR; of these, there were 8 males (11.5% of all males) and 10 females (25.6% of all females) ($P > 0.05$). There was no significant difference between the patients with CAC and the patients without CAC in any aspect of biochemical parameters, and also in the history of predisposing factors ($P > 0.05$). The CAC prevalence (16.6%) was significantly higher in patients with KSS when compared to the normal population (5.06%) in our previous study ($P > 0.05$).

Conclusion: Our study shows that CAC is significantly higher in patients with KSS when compared to the normal population. This study may draw the attention of clinicians to the fact that patients with KSS should be evaluated further for atherosclerosis and treated for vascular risk factors.

Key words: Carotid artery calcification, renal stones, atherosclerosis, panoramic radiography

1. Introduction

Nephrolithiasis is a relatively common disorder in western countries. The lifetime prevalence is between 5% and 10% in the United States (1) and the prevalence is increasing all over the world (2). As a consequence of the polygenic etiology and multifactorial character of lithiasis, calculus formation is a complex process. Although important advances were made during the last decades in defining kidney stone formation, many problems regarding calculus pathogenesis still remain unexplained. It is becoming apparent that renal stone disorder is generally associated with type 2 diabetes, hypertension, dyslipidemia, obesity, and cardiovascular diseases (3,4). There is some evidence that subjects who have kidney stones are at elevated risk for myocardial infarction, and this risk is found to be independent of chronic renal failure and other risk factors (5).

Atherosclerosis is a progressive disorder associated with vascular inflammation, endothelial dysfunction, and deposition of lipids, cholesterol, cellular debris, and calcium within the intima of the vessel, and it is responsible for coronary and peripheral artery disease and stroke (6,7). Hyperlipidemia, diabetes, hypertension, obesity, cigarette smoking, age, and sex are important risk factors for atherosclerosis (6). Recently, the relation has been determined between a history of kidney stones (KSS) and subclinical carotid atherosclerosis in young adults, and this also adds more support to the theory that atherosclerosis and nephrolithiasis have common systemic risk factors and/or pathophysiology (8).

It has been shown in the literature that panoramic radiography (PR) used during routine dental examination

* Correspondence: iustun@yahoo.com

is a useful tool for identifying atheromatous plaques or wall calcification in the carotid arteries (CAC) (9).

As far as we know, the presence of CAC detected by dental PR in individuals with KSs has not been reported. Therefore, the aim of this present study was to determine the prevalence of CAC detected upon PR, and to investigate a correlation between the blood test values thought to be at the origin of KS formation and the presence of CAC.

2. Materials and methods

Between 2008 and 2009, KS patients who were treated at the Urology Department of Erciyes University and the Kayseri Research and Training Hospital and who had recent medical records with KSs were referred for participation in order to look for the existence of CAC by PR. A history of renal colic, with confirmed hematuria and voiding of the calculus, radiographic evidence of KSs, or previous surgical and endoscopic removal of KSs, was used to define the nephrolithiasis. There were 116 patients enrolled in the study; all patients were informed about the study and a signed consent form was obtained. The study was approved by the Ethics Committee on Human Rights Related to Research Involving Human Subjects, Faculty of Dentistry, Erciyes University, Kayseri, Turkey (28.11.2008, Decision no: 1).

2.1. Panoramic radiography processing and evaluation

All PR was performed at the Erciyes University Dentistry Faculty's Department of Oral Diagnosis and Radiology, Kayseri, Turkey, with a Orthopantomograph OP200D device (Instrumentarium Corp. Imaging Division, Tuusula, Finland). The radiographs were printed by a printer with a magnification factor of 1:1.3, and they were all assessed by the same author (YS). Any PRs that displayed questionable CACs were excluded. They were also excluded if they either did not have vertebrae C3 and C4 or if the patient had moved during the radiography. The PR images were viewed in subdued ambient light using transmitted light from a standard view box. Single or multiple discrete radiopaque nodular mass or masses within the neck, 1.5 cm inferior and 2.5 cm posterior to the cortical rim of the midpoint of the mandibular angle, were defined as cases of CAC (Figure).

The PR images were evaluated by 2 experienced radiologists separately. Subjects with either unilateral or bilateral CAC in these radiographs were determined. To investigate intra- and interobserver variation, 2 experienced dentists interpreted all PR images and evaluated the existence and localization of the CAC twice with a time lapse of 14 days. The radiologists were blinded to both the patient identity and diagnosis. During the evaluation, each examiner was able to manipulate the controls of brightness and contrast for the PR to increase the visualization of the atherosclerosis. CACs were scored as present or absent.

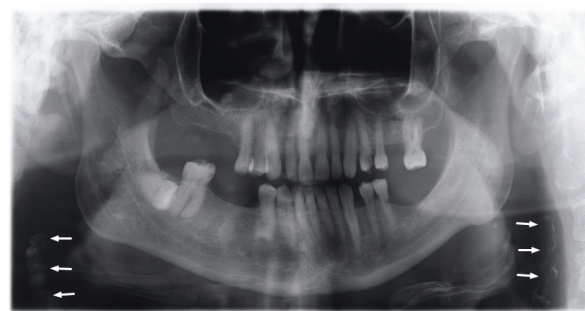


Figure. Panoramic radiograph of carotid artery calcifications visible on the neck, adjacent to the intervertebral space between C3 and C4 (arrows).

For the differential diagnosis, other cervical calcifications including calcified triticeous and thyroid cartilage, hyoid bone, and submandibular salivary gland sialoliths were excluded according to Carter's study (10).

2.2. Statistical analysis

The prevalence of CAC was analyzed in relation to the percentage of the total number of subjects. A Mann-Whitney U test was done to evaluate the significance of the risk factors, as defined in the medical history. The significance level (α) was set to a P-value of less than 0.05. Variables were coded to permit a qualitative investigation of the data, and a chi-square test was performed to evaluate the relation between CAC and cofactors found in the medical history (hypertension, hyperlipidemia, diabetes, and smoking). Statistical evaluation was performed with SPSS 15.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 116 patients with renal stones were included in the study. The PR results of 8 patients who had questionable CAC were excluded; hence, the PR results of 108 patients were included in the data analysis. This population consisted of 69 males and 39 females, with an overall mean age of 44.5 ± 12.4 years. There was no significant difference in mean age between males (43.6 ± 12.1 years) and females (46.0 ± 13.0 years) ($P > 0.05$).

Of the 108 patients included in the data analysis, 18 (16.6%) were detected as having CAC upon PR; of these, there were 8 males (11.5% of all males) and 10 females (25.6% of all females). The mean age of patients with CAC was 50.5 ± 9.9 years and, in this group, the mean age was not statistically different for males (54.2 ± 10.5 years) versus females (47.5 ± 8.7 years) ($P > 0.05$). There was a significant difference in mean age between patients with CAC (50.5 ± 9.9 years) and those without CAC (43.2 ± 12.5 years) ($P < 0.001$). CAC was unilateral in 11 (10%) patients and bilateral in 8 (7.4%) patients. A total of 25 cases of CAC were detected in the 108 patients and, of these, 11

(44%) were located on the right side and 14 (56%) were located on the left side.

The mean history of the KS period for all patients was 6.4 ± 7.8 years (range: 0–30 years). No significant difference in KS period was detected between males (7.2 ± 8.8 years) and females (4.9 ± 5.4 years) ($P > 0.05$). There was no significant difference in KS period between patients with CAC and those without CAC ($P > 0.05$).

There was no significant difference between the patients with CAC and the patients without CAC in terms of blood glucose, creatinine, calcium, phosphorus, total protein, albumin, total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), and triglyceride levels (Table) ($P > 0.05$), and also the history of hypertension, hyperlipidemia, and smoking.

4. Discussion

To our knowledge, the present study is the first report that shows CAC prevalence in patients with KSs on PR imaging being 16.6%, a relatively high value when compared to the general population. There are reports that show a prevalence of CAC of between 3% and 5% in the population, being higher in the risk-group population (11,12). The CAC prevalence changes from 2.1% to 5.06% in some studies performed in Turkey (9,13). The current study does not have a control group, but in our previous report, it was shown that the CAC prevalence was 5.06% in the same region (14).

A number of studies have reported a high prevalence of CAC in particular groups of patients, such as

hemodialyzed patients (17.6%) (15), renal transplant recipients (15.7%) (15), patients with peritoneal dialysis (27.4%) (16), postmenopausal women (11%, 31%) (17,18), and patients with diabetes mellitus (24% not treated with insulin, 36% insulin-treated) (19), obstructive sleep apnea syndrome (22%), metabolic syndrome (22.4%) (20), and radiation treatment within the 10 years of having received irradiation (40%) (21).

The lifetime prevalence of KS is increasing in the United States (22) and the prevalence is found to be 11.1% in Turkey (23); it varies between 2% and 20% worldwide (3). KS has been associated with obesity, hypertension, and diabetes mellitus (24–26). When compared to the general population, patients with KSs have a higher prevalence of chronic diseases and are associated with cardiovascular disorders (4,5,25). Recently, a significant association between KSs and carotid atherosclerosis has been found (8).

Atherosclerosis is a major health problem, causing complications that result in the primary cause of death in the world. There are many risk factors that may be preventable, including hypertension, hypercholesterolemia, cigarette smoking, diabetes mellitus, and obesity (27–29), but there is a need for a marker that proposes atherosclerosis in the absence of classical risk factors.

CAC is identified as a radiopaque nodular mass, or masses, adjacent to the cervical vertebrae at or below the intervertebral space between C3 and C4. During the investigation of the individuals with dental problems, PR images are routinely used and may be useful in defining

Table. Laboratory values of subjects with and without carotid artery calcification (CAC). M, male; F, female; LDL, low density lipoprotein; HDL, high density lipoprotein; FBG, fasting blood glucose.

	Patients with CACs (n = 18)	Patients without CACs (n = 90)	P
Age (years)	50.5 ± 9.9	43.2 ± 12.5	P < 0.05
Sex	8 M, 10 F	61 M, 29 F	P > 0.05
Kidney stone period (years)	9.7 ± 10.7	5.5 ± 6.7	P > 0.05
Body mass index (kg/m ²)	28.5 ± 4.7	26.4 ± 4.6	P > 0.05
Total cholesterol (mg/dL)	185.9 ± 30.1	189.6 ± 39.7	P > 0.05
LDL (mg/dL)	114.3 ± 27.2	116.9 ± 32.2	P > 0.05
HDL (mg/dL)	50.9 ± 25.1	47.1 ± 15.5	P > 0.05
Triglyceride(mg/dL)	177.3 ± 93.3	154.0 ± 76.9	P > 0.05
FBG (mg/dL)	93.3 ± 21.4	90.2 ± 13.3	P > 0.05
Creatinine (mg/dL)	0.9 ± 0.1	1.0 ± 0.4	P > 0.05
Calcium (mg/dL)	9.4 ± 0.4	9.6 ± 0.6	P > 0.05
Phosphate(mg/dL)	3.1 ± 0.5	3.6 ± 2.1	P > 0.05
Albumin (mg/dL)	4.4 ± 0.3	4.3 ± 0.3	P > 0.05

CAC. When compared to the other imaging methods, it is cheap and noninvasive, but it should be assessed by an experienced dentist. One should keep in mind that some disorders presenting with submandibular sialolithiasis, phleboliths, calcified lymph nodes, hyoid bones, thyroid cartilage, and stylohyoid and stylomandibular ligament calcification could mimic CAC (30).

When used as a marker for atherosclerosis, CAC may be a significant indicator for future coronary artery disease, strokes, and death (10). In one report, patients with a history of ischemic stroke were evaluated for CAC by standard PR, and this research confirmed the high prevalence in patients with ischemic cerebrovascular accidents (31). In some studies, the patients with CAC had a history of hyperlipidemia, diabetes mellitus, hypertension, and smoking, which are risk factors for atherosclerosis (8,32,33). In the current study, we found no significant difference between the patients with CAC and without CAC in terms of blood glucose, creatinine, calcium, phosphorus, albumin, total protein, total cholesterol, LDL, HDL, and triglyceride levels, and also

a history of hypertension, hyperlipidemia, and smoking. This may be due to the low number of patients enrolled in the study.

KS is gradually being related to atherosclerosis and recognized as an indicator of systemic disease (4,5,24–26). The current study highlights the association of KSs with CAC. The formation of KSs and vascular calcification may share same pathophysiology. Proteins that have crystal binding affinity could play an important role in mediating the earliest events in both atherosclerosis and KS formation (34). There are also studies that investigated nanobacteria, which are supposed to be an etiological factor for both KSs and calcified human arteries (35–37).

In conclusion, our study suggests that CAC is significantly higher in patients with KSs when compared with the normal population. Therefore, because of the significant relationships between CAC and some of the atherosclerotic risk factors, this study should draw the attention of clinicians to the fact that patients with KSs should be evaluated further for atherosclerosis and treated for vascular risk factors.

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