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Original article

Association of Dental Calculus among Sudanese Patients with Renal calculi

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ABSTRACT

Introduction: Dental calculus is a form of calcification process that occurs in the oral cavity and due to its similar structural composition with renal stones; dental calculus formation may increase in patients with calcium renal stones.**Objectives:** Toevaluate the possible association between dental and renal calculus formation, assess the gender and age relation, and compare the prevalence of supra gingival and subgingival calculus formation among renal calculi patients.**Methods:** The study group included 200 patients diagnosed with renal calculi.Calculus Index component of Simplified Oral Hygiene Index of Green and Vermillion was used to record oral cleanliness. **Results**: 67% of the patients with renal stones had dental calculus, 70.8% had supragingivalcalculus, 26.1% had sub/supra gingival calculus and 3% had subgingival calculus only. 64.7% of them were males and 35.3 % werefemales. Patients less than 20 years old were the least group with dental calculus, and those above 60 years were the highest group with dental calculus. The mean of dental calculus index according to gender, males were 1.28±0.89 and females were 1.20±0.99. The mean of dental calculus index according agegroups, among less than 20 years were 0.60±0.22, among 20-39years were 0.96±0.69, among 40-59 years 1.50±1.22 and among 60years and above were 1.69±0.89. **Conclusion:** There is a high prevalence of dental calculus among patients with renal stones. There is tendency for dental calculus to increase withage, with older group showing more calculus. The difference is statistically significant.

KEYWORDS: Dental Calculus, renal calculi, Sudanese.

INTRODUCTION

Dental calculus is defined as calcified or calcifying bacterial dental plaque that forms on the surface of natural teeth and dental prostheses. Dental Plaque can be defined as the soft deposits that form the biofilm adhering to the tooth surface or other hard surface in the oral cavity, including removable and fixed restorations. [1].Dental calculus is generally calcified into two clinical types according to its position on the tooth; supragingival calculus which is located coronal to the gingival margin and visible in the oral cavityand sub gingival calculus which is located below the crest of the marginal gingival and is not visible on routine clinical examination and can be detected by careful tactile perception with explorer instrument.[2]

The most frequent accumulation of supragingival calculus deposits are found in the areas of thebuccal surfaces of the upper molars and the lingual surfaces of the lower anterior teeth, These areas are located near the orifices of the salivary glands. Calculus formation enhances further precipitation of calcium and phosphates from thesaliva (supragingival calculus) [3]. The source of mineralization ofsubgingival calculus is mainly from the gingival Crevicular fluid. [4]. Mineralized dental plaque is permeated with crystals of various calciumphosphate, brushite, octa calcium phosphate, hydroxyapatite and whitlockite [5]. kidney calculi is a hard, crystalline mineral material formed within the kidney or urinary tract .[6] It forms as a result of physicochemical or genetic derangements leading to super-saturation of the urine with calculi-forming salts or, less commonly, from recurrent urinary tract infection with urease-producing bacteria.[7].

Kidney calculi are composed of different types of crystals; mostlyare Calcium stones calcium oxalate (CaOx), calcium phosphate which is a combination of CaOxand calcium phosphate crystals, uric acid stones(uric acid crystals), struvite or infection stones (magnesium ammonium phosphate), cystine stones and miscellaneous types such as those which occur with drug metabolites [8].

There are three general pathways for kidney calculi formation; stones or calculi fixed to the surface of a renal papilla at sites of interstitial apatite plaque (termed Randall's plaque) as seen in idiopathic calcium oxalate stone formers, calculi attached to plugs protruding from the openings of ducts of Bellini(as seen in hyperoxaluria and distal tubular acidosis). Thirdly, and lastly, calculi forming in free solution in the renal collection system, as in cystinuria. [9].

Dental andRenal Calculus Compositions: Dental and renal calculus has similar structural composition, and mainly consists of different forms of calcium phosphate (CaP).Calcium phosphate is present in one of three forms; hydroxyapatite, carbonate apatite, and Brushite. Theseinclude Hydroxyapatite $Ca10\ (PO4)^6\ (OH)^2$, also known as basic calcium hydrogen phosphate, and is detected most frequently (97%-100% of all supra gingival calculus), and in renal calculi related to a urinary pH > 6.0, hypocitraturia, hypercalciuria, hyperphosphaturia and hypomagnesiuria..

Risk factor: Renalcalculi formation is usually due to genetic and environmental factors. Genetic factors have been postulated to play an important role in the risk of renal calculi as demonstrated by the evidence that positive family history is a well known risk factor for renal calculi. Stone formation seems to be inherited with a polygenic mechanism[10]genetic forms of urolithiasis are mainly based on mutations in the nuclear DNA and are transferred from generation to generation.

Microbiology: Studies described the factors involved in renal stone formation as an alteration in the excretion of the enzymes urokinase and sialidaseby decreased urokinase and increased sialidase in urine that leads to the formation of mineralizable stone matrix. *Proteus Mirabilis* and *Escherichia Coli (E. coli)* decrease urokinase and increase sialidase activity. According to these findings, *E. coli* may cause urolithiasis by producing matrix substances that in turn increase crystal adherence to the epithelium[11].

The role of ureolytic gram-negative bacteria, e.g.*Prov. Rettgeri*, is production of the struvite and carbonate-apatite mineral components of the Struvite stones. Ammonia, produced by the bacterial hydrolysis of urea, raises urine pH and causes precipitation of Mg2 +, Ca2 +, C03 - , and Po43 - as struvite and carbonate-apatite [12].The dental calculus flora is complex; with up to 22 species found in a single sample. There was qualitative similarity with the flora of dental plaque formed at the margin of the gingivae. The chief difference being the absence of *Streptococcus mutans* and the increased prevalence of *Str. Sanguisserotype I/I I. A. naeslundii, A. viscous and V. alcalescens* were more prevalent in subgingival samples and *N. pharyngis, B. melaninogenicus* in supragingival[13].

Aims: The aim of the present study is to assess if any association exists between renal stones and dental calculus among a group of Sudanese patients. This may help to diagnose patients with renal stones from the presence of dental calculus at an early stage.

Specific objectives*:*

1. To evaluate the prevalence of dental calculus in patients who experienced renal stones.

2. To compare the prevalence of supra and sub gingival calculus formation among renal stone patients.

3.To examine the presence of dental calculus among patients with renal stone according to age.

4.To assess any gender and age association between renal stones and dental calculus.

MATERIALS AND METHODS

Study Design: Cross sectional-hospital based study. Studyarea is Khartoum State; Military Hospital, Police Hospital and ShargElnileHospital. All patients attended the department of urology center in the selected hospitals and diagnosed as renal stone patients during the study period from December 2015 to March 2016, were included in the study. Convenient sample size technique was used in this study, the sample size was 200. Patient's age range was 6-87 years.

Exclusion Criteria:

1.Patientswith chronic medical problems including diabetes mellitus, hypertension, kidney failure or liver disease.

2.Patients taking calcium or vitamin D supplements.

3.Patients wearing fixed or removable dental prosthesis or orthodontic appliances.

4. Patients who received periodontal treatment during the last six months.

5.Pregnant women.

Tools of data collection: Personal data, dental and medical history were takenursing data sheet .Oral examination was performed using dental mirror and explorer. All patients were examined in day light while seated on an ordinary chair. Calculus index (CI-S) component of the Simplified Oral Hygiene Index[14].

Statistical Analysis: Data was entered in a computer and analyzed using Statistical Package for Social Sciences (version 22). Difference in study parameter was compared using students T test and Chi square test. P value below 0.05 was considered statistically significant. Results were presented in the form of frequencies, cross tabulation and graphs.

Ethical Consideration: The participants were informed about the objectives and the methodology of the study. Those who accepted to participate were asked to sign a consent form in Arabic. The acceptance of the ethical committee was obtained from the concerned bodies at the urology centers in Military Hospital, Sudan Medical Specialization Board and the Federal Ministry of Health.

RESULTS

A total of 200 patients in all age groups having renal stones were examined in the present study. Males constituted 61% of the sample while female were 39%. (Table 1). Patients were classified into four groups according to age. The group with the highest prevalence of renal stone were theage group 20-39 years; 89 patient from the total number of patients which accounts for (44.5%), followed by the age group 40-59 years; 53 patients which accounts for (26.5%), then the less than 60years old in which there is30 patients which

accounts for (15%) and lastly the less than 20 years old were there are 28 patients (14%).

Table 1: Distribution of calculus according to agegroup

Age (year)	No Calculus	Calculus	Total
≤ 20	15(55.6%)	12(44.4%)	27(100%)
(20 – 39)	35(40.2%)	52(59.8%)	87(100%)
(40 – 59)	11(20.8%)	42(79.2%)	53(100%)
≥ 60 years	2(6.7%)	28(93.3%)	30(100%)
Total	**63(32%)**	**134(68%)**	**197(100%)**

Chi squire test performed, p value= 0.001, p value is statistically significant

After oral examination of the patients usingthe CI-S part from theSimplifiedOral Hygiene index, 67% of the patients with renal stones had dental calculus (134 patients).The mean variable of CI-S is 1.25±0.93(SD), the minimum variable is 0.16 and the maximum is 6. It is found that47.5% of the patients have supragingival calculus (95 patients), 17.5% have both supra and sub gingival calculus (35 patients) and 2% have subgingival calculus only(Table2).

Table 2: Distribution the calculus types

	Calculus status	Frequency (%)	Total
No calculus	No calculus	66 (33)	66
calculus	Supra gingival	95 (70.9)	134
	sub gingival	4 (3)	
	Both supra and sub gingival	35 (26.1)	
	Total	**200 (100)**	**200**

64.7% of males with renal stones have dental calculus (79patients). Table 3shows the distribution of study subjects according to age. In the age groupless than 20 years,(42.8%) of patients had dental calculus; 75% have supra gingival calculus, 25% have both supra and sub gingival calculus and none had sub gingival calculus (Table 3).

Dental calculus and age were showing an association, using the chi squire test P=0.001, statistically significant; but the distribution of calculus type according to age was not statistically significant, (p value = 0.717).The mean value of calculus index score CS-I among those who had calculus showed an increase with increasedage (Table3).

Table (3) Distribution of calculus according to gender

Gender	No Calculus	Calculus	Total
Male	40(33.6%)	79 (66.4%)	**119(100%)**
Female	23(29.5%)	55(70.5%)	**78**
Total	**63(32%)**	**134(68%)**	**197(100%)**

Chi squire test performed, p value= 0.652, statistically not significant

DISCUSSION

In the present study males/females ratio is 1.6: 1.This finding is similar to the results of Fatima et al. which was also conducted in Sudanese patients, this may be due to increase of body mass index for men, life style and diet intake by men compared to women[10].The age of the patients in the present study showed that there is higher prevalence of renal stones at the age (20-39) years although there is an international variation of age prevalence of renal stones according to global studies which confirm that there is decrease in renal stone prevalence among older age groups [11].

In the current study, 67% of the investigated renal stone patients had dental calculus; this may be due to the risk factors responsible of renal stones formation which is the hyper saturation. The most common causes of calcium containing renal stones arehypercalciuria, hypocalcaemia, hyperoxaluria, andincrease. In these cases the levels of serum parameters like calcium, sodium and intact parathyroid hormone (IPTH) is higher than normal whereas potassium and magnesium are lower than normal. The decreased potassium is a cause of hypocitraturia. The citrate complex limits calcium super saturation and prevents nucleation of both calcium oxalate and calcium phosphate stones [15].

Dental calculus formation depends on the saliva and gingival Crevicularfluid (GCF). Various components of saliva and GCF are either passively diffused or actively transported directly from the serum into the saliva through the oral mucosa and/or gingiva. The composition of such components in saliva may or may not reflect their serum composition. The watery component and the electrolytes in saliva are derived from serum; thishypothesis is supported byShimaa et al [16] study which concluded that the higher values of salivary pH and

Buffer capacity among renal stones patients permits the saliva to be more supersaturated with calcium phosphates which might promote dental calculus formation. The study also reported statistically significant relation between urinary calcium/creatinine ratios which is also one of calcium renal stone promoters with dental calculus accumulation. In the current study the mean value of dental calculus index scores (DCI-S) in males is higher than

females with renal stones (Table 3); this may be attributed to the fact that females are more proactive to maintain good oral hygiene than males.

The study observed that the most common type of dental calculus in patients with renal stones is Supragingival calculus but its percentage decreases with age. The Sub gingival calculus in renal stones patients is rare (3%). These results agree with the national survey of oral health which was conducted by U.S.Mandel et al [17] on school children less than 20 years old; in which the supra gingival calculus was noted in 34% and sub gingival calculus in 23%.

The results are also comparable with the results of the same age group from the present study where the supra gingival calculus in renal stones patients is 75% (Table 2), this explains the role of hyper saturation of urine and saliva in renal and dental stones formation. In the present study,41% of adult had no dental calculus; the results of both studies for these age groups are the same but in the senior population above 60 years with renal stone 67.9%,had sup gingival calculus while in the Mandel survey [18] is 20%. This could be because uric acid stone is associated with older age and the excretion of uric acid in saliva facilitates dental plaque calcification and calculus formation when regular mouth cleaning was not performed [19], [20].

CONCLUSION

From result of the present study the following isconcluded; there is a high prevalence of dental calculus among patients with renal stones. The prevalence of dental calculus among patients with renal stones is higher among males compared to females, but the difference is not statistically significant. There is tendency for dental calculus to increase with age; older group showing more calculus. The difference is statistically significant. There is always more supragingival calculus compared tosubgingival calculus.

Competing interest: The authors declare that they have no competing interests.

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