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The Relationship between Salivary Gland Stones and Renal Stones in an Indian Population

Running Title: Salivary gland stones and renal stones

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Abstract

Background: Sialolithiasis is the most common salivary gland disease. The aim of the present study was to determine the prevalence of salivary stones in patients with renal stones and to determine the relationship between the salivary stones and renal stones.

Study design: A total of 248 patients participated in the study. Group A consisted of 120 patients who had renal calculi and Group B had 128 randomly selected controls for the study. The intra oral occlusal radiographs for all patients were evaluated to determine the presence or absence of salivary stones. The results were compared and analyzed using the Chi-square test and the statistical significance was set at 5% level ($p<0.05$).

Results: Salivary gland calcifications were detected in a total of 9 patients (3.6%), which included 6 renal calculi patients and 3 controls. There was no statistical correlation between renal stones and salivary gland stones ($p>0.05$).

Conclusion: There was no significant correlation between the presence of renal stones and salivary gland stones.

Keywords: Renal stone; salivary gland stone; occlusal radiograph.

Introduction

Sialolithiasis is the most common disorder involving the major salivary glands. As per one of the proposed theories for its etiopathogenesis, a deposition of calcium salts around a core made of desquamated epithelial cells, bacteria, mucus or foreign bodies results in the formation of stones. These stones are of laminal structure. Their main inorganic components are phosphates and calcium carbonates.[1,2] The submandibular salivary gland is the most common site for stone formation (60-90%), followed by parotid gland (10-20%) and in the sublingual gland (1-5%).[1.3] The size may vary from 0.1 to 30 mm. However, Drage et al. have reported a mean size of up to 3.4 mm (range from 1.5 to 9 mm) for the parotid and submandibular stones, and a mean number of 1.67 stones (range from 1 to 5) per patient.[4]

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Renal stone disease is common and is reported to be increasing across the globe and in areas of the hot climate like Saudi Arabia. .[5] Kidney stone formation results mainly due to genetic and environmental factors. Genetic factors are less likely to be the driving force to influence stone risk, as these changes in the gene pool occur at a slow pace. The varied and complex environmental factors, particularly diet and climate are more apparent to influence the stone formation as changes occur over a shorter time interval.[6,7]

No studies have been done till date to establish any correlation between the presence of salivary gland stones and any systemic conditions. The present study is the first study to determine the prevalence of salivary gland stones in patients with renal calculi and to determine the relationship between the salivary stones and renal stones.

Methods

The present study included a total of 248 patients to study the prevalence of salivary gland stones in patients with renal stones and to determine if any relationship exists between the salivary stones and renal stones. All the patients were divided in 2 groups. Group A consisted of 120 randomly selected renal calculi patients from the Nephrology Department and Group B had 128 randomly selected controls from the patients visiting the out patient department of Jodhpur Dental College General Hospital for the study. Ethical clearance was obtained from the Institutional Ethical Committee. A detailed medical and dental history of all the patients was recorded. Patients with any history of cardiovascular diseases, gout, gall stones or any other systemic diseases were excluded from the study. The mandibular occlusal radiographs were evaluated for the presence or absence of stones in the submandibular and sublingual glands and ducts. Since majority of the salivary stones are present in the submandibular and sublingual

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glands, radiographs of only these glands were examined. Standard equipment (65 kVp, 15 Ma, 2.7 mm Al filt., Trophy Irix, Trophy Radiologie, Paris, France) and films (Ektaspeed, Kodak, Chalon-sur-Saone, France) were used and automatic processing (Velopex, London, UK) followed standard routines. The radiographs with poor angulations, improper exposures or faulty processing and which could lead to scoring difficulties were excluded from the study. All the radiographs were interpreted by oral radiologists in a dark room by using a standard viewing box under the 2X magnification and with the peripheral light being blocked out, to ensure the accuracy of the diagnosis. The definite radiopaque masses inside the salivary glands were identified as salivary stones. They were scored as present or absent. The data was entered using computer software SPSS 12.0 (SPSS Inc., Chicago, USA) and analyzed using the Chi-square test. P-value<0.05 was considered to be statistically significant.

Results

The renal calculi patients had 68 (56.67%) males and 52 (43.33%) females, with a mean age of 33.9±10.6 years. The controls comprised of 70 (54.68%) males and 58 (45.32%) females with a mean age of 34.8±10.1 years. On examination of the mandibular occlusal radiographs salivary gland calcifications were detected in a total of 9 patients, with a prevalence of 3.6% (Table 1). 6 patients (4 males and 2 females) with renal calculi presented with salivary gland calcifications and only 3 controls (2 males and 1 female) showed calcifications in the submandibular gland. The mean age of the patients with salivary gland stones was 38.1±8.2 years. Males were commonly affected for renal as well as salivary stones, however, this was not statistically significant (p>0.05). All the calcifications detected were located in the submandibular gland. There was no statistically significant (p>0.05) correlation between the presence of renal stones and salivary gland stones.

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Table

	Salivary stone present (%)	Salivary stone absent (%)	Total (%)	Z-value	P value
Renal calculi patients	6 (5%)	114 (95%)	120 (100%)	**-13.9427**	**0.00001***
Controls	3 (2.3%)	125 (97.7%)	128 (100%)	**-11.9053**	**0.00001***
Total	9 (3.6%)	239 (96.4%)	248 (100%)	**-14.2187**	**0.00001***
Chi-square with Yates's correction = 0.6053 P = 0.4371					

Table 1: Distribution of patients with and without salivary stones

Discussion

Sialolithiasis is the most common disease of salivary glands, which accounts for more than 50% of diseases of the large salivary glands and is thus the most common cause of acute and chronic infections.[8} The prevalence of salivary stones in the general population according to post mortem studies is about 1.2%, but the prevalence of salivary stones which cause symptoms is about 0.45% in the general population.[8] Around one-fourth of the cases, multiple stones have been reported. The prevalence of salivary gland stones in the present study was 3.6%, which is quite higher than as mentioned in the literature.

Submandibular gland is the most common site for stone formation. This is because the gland produces viscous, mucous and more alkaline saliva, with a relatively high concentration of hydroxyapatites and phosphates, which predisposes to the precipitation of salts.[1],[9] Also the opening of the Wharton's duct is narrower than the diameter of the whole duct and the duct ascends towards its opening, leading to retention of the saliva.[9],[11 The present study also reported all the salivary stones to be located in the submandibular gland. 85% of submandibular gland stones are located in Wharton's duct and 15% in gland parenchyma, which do not tend to cause significant clinical symptoms, unlike the stones in the Wharton's duct which produce symptoms of inflammation or pain.[10] The proximal segment of the Wharton's duct, where the duct wraps around the posterior edge of the mylohyoid muscle, at a steep angle is the most common site for calculi formation. Sjögren's syndrome and sarcoidosis also promote the formation of sialoliths.[12] Salivary gland stones commonly occurs in the 3rd-6th decade, and are uncommon in children with only 3% of the paediatric population being affected by the disease.[13] These stones have a predilection for male patients, particularly in the case of parotid gland stones.[14] The present study also reported similar findings with 6 of the 9 salivary gland calculi detected in the males. However, all these stones were present in the submandibular gland.

Renal stone disease affects approximately 1.2 million people every year, accounting for approximately 1% of all hospital admissions. In certain parts of the world, as in the Middle East, the lifetime risk appears to be even higher. It poses a significant health care burden in a working-age population.[15] The 16th century reported the first documented increase in stone disease when European stone cutters found an increased demand in their services. Improvements in food production and corn becoming a popular staple food occurred during the same time.[16] This promoted obesity, which is currently a known risk factor for stone formation, due to increased consumption of corn derived starchy foods. Other dietary risk factors such as high fructose consumption, increased oxalate, diminished fluid and calcium consumption is also considered to be a risk factor for renal stone formation.[6,17] Epidemiologic studies have demonstrated increased sodium and animal protein intake to have an equivocal impact on stone risk. However, reduction of sodium and animal protein and maintenance of normal dietary calcium intake,

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demonstrated attenuated stone activity in recurrent hypercalciuric stone formers.[6] While certain studies have demonstrated a decrease in stone prevalence among older age groups with increased intake of sodium and sodium-rich foods.[18] These differences could be attributed to differences in sampling methods, study design or renal calculi patients dying at a younger age. While the increase is present across all age groups, it is interesting to note that the majority of the attributable rise in prevalence of stone disease stems from the 60–74 years age, so the present study was carried among patients aged 60 years and above.[6] Renal stone formation has been associated with a number of medical co-morbidities such as obesity, hypertension, cardiovascular ailments, diabetes mellitus and chronic kidney disease.[19] No studies have been done till date to find if any association exists between the presence of renal stones and salivary gland stones. However, a number of studies have suggested pulp stones to be a manifestation of systemic illnesses leading to pathological biomineralization in many parts of the body.[20[,[21]

Immunohistochemical studies have revealed the unexpected finding that osteopontin is deposited as a prominent layer at the luminal surfaces of specific populations of epithelial cells of various organs other then kidney including the salivary glands.[22] Recently expression of osteopontin has been studied by immunohistochemistry using a well characterized monoclonal antibody in mice. Osteopontin secreted from granular duct cells may influence the composition of the saliva, thereby modulating pathways affecting sialolithiasis. Its expression in striated duct cells may also hint to roles such as cell-cell attachment or cell differentiation. The cell-specific expression detected in the rat major salivary glands differs in part from that reported in mice, human and monkey.[23] Kohri K et al.[24] found similar occurrence of osteopontin in their immunohistochemical study on atherosclerotic plaques and urinary stones. These findings suggest that a relationship may occur between the incidence of salivary stones and kidney stones contrary to the findings of the present study.

Conclusion

In the present study, no significant association was reported between salivary gland stones and renal stones. Further large scale, multi-institutional studies are encouraged to establish any positive association between salivary gland and renal calcifications along with other systemic diseases. It is thus suggested that routine dental radiographs could serve as a significant prognostic tool for early identification of potential renal stones. This screening method could easily be employed as a tool in public health programs for early identification of possible renal calculi symptoms, since it requires minimal radiation, with the advanced imaging techniques.

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