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Original Research

Surgical Anatomy And Histopathology In Subjects With Calcium Phosphate Stones And Hyperparathyroidism

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Abstract
Background: Primary HPT (hyperparathyroidism) with stones present a spectrum from calcium oxalate to calcium phosphate stone, it was considered that subjects with hyperparathyroidism that have calcium phosphate stones have renal histology and surgical anatomy similar to apatite and brushite stones.
Aim: The present study was aimed at assessing the surgical anatomy and histopathology in subjects with calcium phosphate stones and hyperparathyroidism.
Methods: The study included 10 subjects with confirmed diagnoses of renal stones that were indicated for surgical management and with primary hyperparathyroidism at the Institute within the defined study period.In all the subjects,Parathyroidectomy was performed on the day of, or within a few weeks after, percutaneousnephrolithotomy at which the renal biopsies reported here were obtained.The collected and extracted stones as samples/specimens were subjected to histopathological assessment in the laboratory.
Results: All subjects showed hydroxyapatite, brushite, calcium oxalate, and struvite in all the subjects. For renal surgical pathology, papillary deformity of >50% was seen in 8 subjects, and papillary deformity of <50% in 2 study subjects. White plaque percentage was 0.15%, 0.13%, 2.6%, 15.7%, 0.26%, 0.24%, 15.5%, 2.4%, 0.11%, and 0.13% were seen in study subjects numbered 1-10. Attached stones were seen in subject numbers 3, 4, 7, and 8 respectively. BD/IMCD deposits were seen as 6±1,10±1, 24±1, 25±1, 2±1, 2±1, 23±1, 22±1, 8±1, and 4±1 respectively. Cortical deposits were seen in subjects 1, 2, 5, 6, 9, and 10 respectively
Conclusion: The present study concludes that renal stones with primary hypoparathyroidism can have combined brushite kidney stones as plugging of ducts and papillary deformity – with the interstitial plaque and stone overgrowth characteristic of routine idiopathic calcium oxalate stone formers, suggesting that these two patterns can coexist in a single patient.
Keywords: calcium phosphate stones, hyperparathyroidism, kidney stones histopathology, renal calculus

Introduction

With the combined use of micro-biopsy and intraoperative digital photography, histopathological and gross cortical and renal papillary changes in subjects with dRTA (distal renal tubular acidosis), apatite stones, and brushite have been described along with subjects with CaOx (calcium oxalate) stones from obesity bypass procedure, ICSF (idiopathic Calcium oxalate stones) and cystinuria.[7] However, it has been reported that among all these stones, in ICSF, there is the presence of a mixture of BD (duct of Bellini) and IMCD (inner medullary collecting duct) plugged with apatite. In cases of cystinuria, a mixture ofduct of Bellini and IMCD apatite is seen. In both, the mixture is seen with epithelial cell loss, interstitial fibrosis, and variable papillary atrophy and flattening.[8]

However, by contrast, only interstitial apatite deposits are seen in ICSF which are also known as Randall's plaque seen in otherwise normal kidney tissues. It is of vital importance that stones start to grow on the papillary surfaces of ICSF at the sites where sub-

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urothelial plaque is present, whereas, such overgrowth is not reported in few studies.[9] Primary HPT (hyperparathyroidism) with stones present a spectrum from calcium oxalate to calcium phosphate stone, it was considered that subjects with hyperparathyroidism that have calcium phosphate stones have renal histology and surgical anatomy similar to apatite and brushite stones.[10]

However, existing literature data is scarce in assessing these predictions. Hence, the present study aimed to assess the surgical anatomy and histopathology in subjects with calcium phosphate stones and hyperparathyroidism.

Materials and methods

The present clinical assessment study was aimed at assessing the surgical anatomy and histopathology in subjects with calcium phosphate stones and hyperparathyroidism. Verbal and written informed consent were taken from all the subjects before study participation.

The study included 10 subjects with confirmed diagnoses of renal stones that were indicated for surgical management and with primary hyperparathyroidism at the Institute within the defined study period. The study excluded subjects with renal carcinoma, and any contraindication for the surgery, and were not willing to give consent for study participation.

After final inclusion, a detailed history was recorded for the study subjects including demographics. All the subjects were managed surgically and the samples obtained were transferred to the laboratory under strict aseptic and sterile conditions in 10% formalin. In all the subjects,Parathyroidectomy was performed on the day of, or within a few weeks after, percutaneousnephrolithotomy at which the renal biopsies reported here were obtained.

The collected and extracted stones as samples/specimens were subjected to histopathological assessment in the laboratory. The data gathered were statistically analyzed using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), Fisher's exact test, Mann-Whitney U test, and Chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

Results

Two females in the study had multiple stones with mainly calcium phosphate stones, however, primarily calcium oxalate stones were seen in two subjects number 1 and 10. History of hypercalcemia was known in subjects from months to yearswhich was moderate and was associated with increased serum parathormone levels. In four subjects, 24-hour urine analysis was seen and showed hypercalciuria. Parathyroid adenoma was seen in all subjects and was removed. In 8 subjects, postoperative serum calcium values were evaluated and were normal as supersaturation with urine pH, CaP, and CaOx as determinants of CaP saturation was not alkaline except for 4 subjects. Peak pH value was seen in two subjects indicating contamination as confirmed with 53mEq/day ammonia, low phosphate, and magnesium. Also, reduced eGFR and raised creatinine were seen (Tables 1 and 2).

Total stones number in each subject CaOx and hydroxyapatite/brushite (HA/BR), and struvite percentage in all subjects were assessed. Further breakdown of stones number per subject and composition of stones is also described in Table 1. All subjects showed hydroxyapatite, brushite, calcium oxalate, and struvite in all the subjects.

For renal surgical pathology, papillary deformity of >50% was seen in 8 subjects, and papillary deformity of <50% in 2 study subjects. White plaque percentage was 0.15%, 0.13%, 2.6%, 15.7%, 0.26%, 0.24%, 15.5%, 2.4%, 0.11%, and 0.13% were seen in study subjects numbered 1-10. Attached stones were seen in subject numbers 3, 4, 7, and 8 respectively. BD/IMCD deposits were seen as6±1,10±1, 24±1, 25±1, 2±1, 2±1, 23±1, 22±1, 8±1, and 4±1 respectively. Cortical deposits were seen in subjects 1, 2, 5, 6, 9, and 10 respectively (Table 3).

S. No	Gender	First stone age	Stones	ESWL	PNL	Total	Age at biopsy	Age at PTX	Known Ca increase the duration			
										Struvite	HA/BR	CaOx
1.	**Female**	31	3/1	0	1/1	3/1	32	32	3 months	14	65/0	21
2.	**Female**	28	3/2	1/1	1/1	4/2	35	35	2 years	0	43/50	7
3.	**Female**	27	11/7	0	3/1	13/5	32	32	5 years	0	34/38	28
4.	**Male**	50	5/-	1/-	2/1	5/-	51	51	<12 months	0	0/100	0
5.	**Female**	46	4/2	0	2/1	2/1	47	47	>4	0	33/0	67

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									months			
6.	**Female**	44	4/2	0	2/1	2/1	45	45	>4 months	0	33/0	67
7.	**Male**	48	5/1	1/1	2/1	5/1	49	49	<12 months	0	0/100	0
8.	**Female**	25	10/5	0	3/1	12/3	30	30	4 years	0	34/38	28
9.	**Female**	26	3/1	1/1	1/1	3/1	33	33	2 years	0	43/50	7
10.	**Female**	29	3/2	0	1/1	4/1	30	30	3 months	14	65/0	21

Table 1: Clinical data of subjects that underwent biopsies

Case no.	**Collection time**	**Serum**				**24 hours urine**				
		EDGAR	**Creatinine**	**PTH**	**calcium**	SSCap	SSCaOx	Ca/Creat	Volume	pH
1.	Post-PTX	35	1.5	ND	7.9	0.4	5.2	86	1.51	5.91
	Pre-PTX	40	1.3	141	11.1	ND	ND	ND	ND	ND
2.	Post-PTX	ND	ND	23	9.2	0.6	6.9	73	1.26	5.95
	Pre-PTX	73	0.7	186	10.6	0.9	11.7	259	1.90	5.63
3.	Post-PTX	ND	ND	ND	ND	0.1	1.0	9	0.92	8.52
	Pre-PTX	53	1.0	147	11	ND	ND	ND	ND	ND
4.	Post-PTX	81	1	ND	9.6	1.9	5.5	116	2.10	6.87
	Pre-PTX	105	0.6	231	12.0	2.2	7.3	172	2.39	6.88
5.	Post-PTX	49	1.0	74	9.1	0.012	4.2	105	1.30	5.56
	Pre-PTX	54	0.9	170	10.8	ND	ND	ND	ND	ND
6.	Post-PTX	47	1.0	72	8.9	0.010	4.0	103	1.28	5.54
	Pre-PTX	52	0.7	168	10.6	ND	ND	ND	ND	ND
7.	Post-PTX	479	1	ND	9.4	1.7	5.3	114	2.08	6.85
	Pre-PTX	103	0.4	229	12	2.0	7.1	170	2.37	6.86
8.	Post-PTX	ND	ND	ND	ND	0.1	1.0	7	0.90	8.50
	Pre-PTX	51	1.0	145	10.8	ND	ND	ND	ND	ND
9.	Post-PTX	ND	ND	23	9	0.4	6.7	71	1.24	5.92
	Pre-PTX	71	0.5	184	10.4	0.7	11.5	257	1.88	5.61
10.	Post-PTX	33	1.3	ND	7.7	0.2	5.0	84	1.49	5.89
	Pre-PTX	38	1.1	139	10.9	ND	ND	ND	ND	ND

Table 2: Laboratory data of specimens that underwent biopsy

Case No	**Papillary deformity (%)**	**White plaque (%)**	**Attached stones**	**BD/IMCD deposits**	**Cortical deposits**
1.	**>50**	0.15	No	6±1	Yes
2.	**>50**	0.13	No	10±1	Yes
3.	**>50**	2.6	Yes	24±1	No
4.	**>50**	15.7	Yes	25±1	No
5.	**<50**	0.26	No	2±1	Yes
6.	**<50**	0.24	No	2±1	Yes
7.	**>50**	15.5	Yes	23±1	No
8.	**>50**	2.4	Yes	22±1	No
9.	**>50**	0.11	No	8±1	Yes
10.	**>50**	0.13	No	4±1	Yes

Table 3: Pathological changes in study subjects

Discussion

The study assessed 10 subjects with renal calculi and primary hypoparathyroidism. Two females in the study had multiple stones with mainly calcium phosphate stones, however, primarily calcium oxalate stones were seen in two subjects number 1 and 10. History of hypercalcemia was known in subjects from months to years which was moderate and was associated with increased serum parathormone levels. In four subjects, 24-hour urine analysis was seen and showed hypercalciuria. Parathyroid adenoma was seen in all subjects and was removed. In 8 subjects, postoperative serum calcium values were evaluated and were normal as supersaturation with urine pH,

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CaP, and CaOx as determinants of CaP saturation was not alkaline except for 4 subjects. Peak pH value was seen in two subjects indicating contamination as confirmed with 53mEq/day ammonia, low phosphate, and magnesium. Also, reduced eGFR and raised creatinine were seen. These results were consistent with the findings of Henegar JR et al[5] in 2003 and Parks JH et al[6] in 2004 where authors reported results similar to the present study in their respective studies.

The study results showed that the total stones number in each subject CaOx and hydroxyapatite/brushite (HA/BR), and struvite percentage in all subjects were assessed. Further breakdown of stones number per subject and composition of stones is also described in Table 1. All subjects showed hydroxyapatite, brushite, calcium oxalate, and struvite in all the subjects. These findings were in agreement with the results of Kuo RL et al[7] in 2003 and Pak CY et al[8] in 2003 where stone numbers and composition reported by authors in their subjects with hyperparathyroidism reported by the authors in their studies were also similar to the present study.

It was seen that for renal surgical pathology, papillary deformity of >50% was seen in 8 subjects and papillary deformity of <50% in 2 study subjects. White plaque percentage was 0.15%, 0.13%, 2.6%, 15.7%, 0.26%, 0.24%, 15.5%, 2.4%, 0.11%, and 0.13% were seen in study subjects numbered 1-10. Attached stones were seen in subject numbers 3, 4, 7, and 8 respectively. BD/IMCD deposits were seen as 6±1,10±1, 24±1, 25±1, 2±1, 2±1, 23±1, 22±1, 8±1, and 4±1 respectively. Cortical deposits were seen in subjects 1, 2, 5, 6, 9, and 10 respectively. These results were in line with the findings ofOdvina CV et al[9] in 2007 and Evan AP et al[10] in 2007 where renal surgical pathology comparable to the present study was also reported by the authors in their respective studies.

Conclusion

The present study, within its limitations, concludes that renal stones with primary hypoparathyroidism can have combined brushite kidney stones as plugging of ducts and papillary deformity – with the interstitial plaque and stone overgrowth characteristic of routine idiopathic calcium oxalate stone formers, suggesting that these two patterns can coexist in a single patient.

References

1. Evan AP, Coe FL, Lingeman JE et al. Renal crystal deposits and histopathology in patients with cystine stones. Kidney Int. 2006;69:2227–35.
2. Evan AP, Lingeman JE, Coe FL et al. Randall's plaque of patients with nephrolithiasis begins in basement membranes of thin loops of Henle. J Clin Invest 2003;111:607–16.
3. Evan AP, Lingeman J, Coe F et al. Renal histopathology of stone-forming patients with distal renal tubular acidosis. Kidney Int 2007;71:795–801.
4. Evan AP, Lingeman JE, Coe FL et al. Crystal-associated nephropathy in patients with brushite nephrolithiasis. Kidney Int 2005;67:576–91.
5. Henegar JR, Coleman JP, Cespedes J et al. Glomerular calcification in hypercalcemic nephropathy. Arch Pathol Lab Med 2003;127:E80–E85.
6. Parks JH, Worcester EM, Coe FL, et al. Clinical implications of abundant calcium phosphate in routinely analyzed kidney stones. Kidney Int 2004;66:777–85.
7. Kuo RL, Lingeman JE, Evan AP et al. Urine calcium and volume predict coverage of renal papilla by Randall's plaque. Kidney Int 2003;64:2150–4.
8. Pak CY, Poindexter JR, ms-Huet B et al. Predictive value of kidney stone composition in the detection of metabolic abnormalities. Am J Med 2003;115:26–32.
9. Odvina CV, Sakhaee K, Heller HJ et al. Biochemical characterization of primary hyperparathyroidism with and without kidney stones. Urol Res 2007;35:123–8.
10. Evan AP, Coe FL, Lingeman JE et al. Mechanism of formation of human calcium oxalate renal stones on Randall's plaque. Anat Rec (Hoboken) 2007;290:1315-23.