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Screening of parathyroid gland by high frequency ultrasound and the relationship between recurrent urinary calculi and primary hyperparathyroidism

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Abstract. – OBJECTIVE: To understand the value of high frequency ultrasound in the clinical screening of parathyroid gland, and to summarize the intrinsic relationship between primary hyperparathyroidism and recurrent urinary calculi.

PATIENTS AND METHODS: 98 cases of urinary calculi were randomly selected, and the patients were admitted to our hospital from March 2014 to August 2017. A total of 100 healthy subjects were selected as group B in the same period. High frequency color Doppler ultrasonography scan recorded the results.

RESULTS: Among the subjects in group A, 67 (68.37%) showed parathyroid gland, 14 cases (14.29%) had tumor mass in the parathyroid system, 40 cases more than those in group B (40.00%) and 2 cases (2.00%), (p <0.05). There were 10 cases (10.20%) of primary hyperparathyroidism in group A and no cases of primary hyperparathyroidism in group B (p < 0.05). The occurrence of primary hyperparathyroidism was 26.92% (7/26) in the number of cases, with 3 and more cases of urinary calculi, which was higher than that in the first recurrent cases (3/72), (p<0.005).

CONCLUSIONS: One of the key causes of recurrent episodes of urinary calculi is primary hyperparathyroidism, which can be applied to high frequency ultrasonography to develop professional screening of parathyroid gland in cases of urinary calculi.

Key Words:
Health examination personnel, Recurrent urinary calculi, Parathyroid, High frequency ultrasound, Primary hyperparathyroidism.

Introduction

Urolithiasis is characterized by a high prevalence in clinical practice. In addition to the recurrent attack, urolithiasis is also correlated with the primary hyperparathyroidism, which gives rise to the possibility to utilize the high-frequency ultrasonic technique in clinical screening, so as to clarify the function of parathyroid glands, and investigate the underlying correlation between these two conditions[1]. Therefore, to identify the value of the high-frequency ultrasonic technique in clinical practice and the correlation between urolithiasis and the primary hyperparathyroidism, we selected randomly 98 cases of urolithiasis, and simultaneously 100 cases of patients and healthy participants between March 2014 and August 2017, thereby perfecting the diagnostic technique of disease and the symptoms of disease, and guaranteeing the effectiveness and promptness of diagnosis and treatment, aiming to ameliorate the clinical outcome.

Patients and Methods

Patients

Random selection was performed among patients, and finally, 98 cases of patients who were admitted to this hospital from March 2014 to August 2017, were enrolled as Group A. In the same period, a total of 100 healthy participants were enrolled as Group B. Clinical information of patients in two groups is shown in Table I; differences had no statistical significance (p>0.05).

Diagnosis, Exclusion Criteria and Enrollment

Diagnosis: patients were conformed to the urolithiasis-specific clinical criteria of World Health

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Table I. Clinical information of subjects in two groups.

		Age (years old)			Gender (n/%)	
Group	Case (n)	Min	Max	Average	Male	Female
Group A	98	18	65	46.3±8.00	51 (52.04)	47 (47.96)
Group B	100	19	66	47.1±6.82	53 (53.00)	47 (47.00)
t-value or x^2-value	-	-0.758	0.018			
p-value	-	0.238	0.893			

Organization [2]. Exclusion criteria: patients had renal dysfunction or mental disorders. Enrollment: subjects and their families were informed of and agreed to cooperate with the screening procedures, and they signed the informed consents. This study was approved by the Ethic Committee of our hospital.

Patients and Methods

All patients received the screening procedures for their parathyroid glands: (1) GE LOGIQ 9 with specific high-frequency probes with frequency between 6.3 and 10.0 MHz; (2) during the examination, subjects were required to be in supine position to keep their anterior portion of neck being exposed; (3) the upper end of the parathyroid gland was located as the starting point of screening point, and the screening procedure ended at the supraclavicular fossa; (4) screening procedure was carried out against the surroundings of trachea, posterior portion of the thyroid gland and internal portion of the carotid arteries; the quantities of parathyroid glands and masses were recorded, and we also observed the hemodynamic features, positions of masses, internal echoes, morphology of masses and their size; (5) detailed observation was performed for the image data of subjects, and for those with definite anomalies, we measured their levels of phosphorus and calcium in serum as well as parathyroid hormone (PTH) level, so as to distinguish the cases of primary hyperparathyroidism.

Statistical Analysis

Examination results of two groups were recorded and input in the Excel charts for statistical analysis using SPSS 22.0 software (SPSS Inc., Armonk, NY, USA). Measurement data were reported as n (%). Tukey's HSD (honestly significant difference) test was used in conjunction with an ANOVA to find means that were significantly different from each other.

Results

Screening Results of Subjects in Two Groups

In Group A, there were 67 patients (68.37%) manifesting parathyroid glands, in which 14 patients (14.29%) exhibited masses in parathyroid glands, more than 40 (40.00%) and 2 (2.00%) in Group B ($p<0.05$; Table II). The volume of masses in Group A was within 91.0 and 1660.2 mm^3 with an average of (590.15±14.26) mm^3, while the volume in Group B ranged from 49.1 mm^3 to 290.5 mm^3 with an average of (83.33±11.26) mm^3 (t=277.855; p=0.000).

Table II. Screening results of subjects in two groups [n (%)].

		Parathyroid glands			Masses		
Group	Case (n)	Left	Right	Total	Left	Right	Total
Group A	98	37 (37.76)	30 (30.61)	67 (68.37)	6 (6.12)	8 (8.16)	14 (14.29)
Group B	100	21 (21.00)	19 (19.00)	40 (40.00)	1 (1.00)	1 (1.00)	2 (2.00)
x^2-value	-	16.036			10.058		
p-value	-	0.000			0.001		

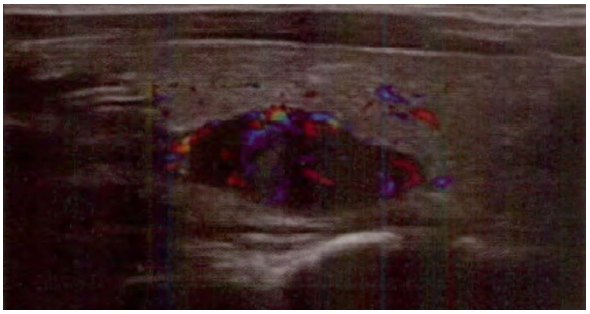

Figure 1. Image data of Case 1.

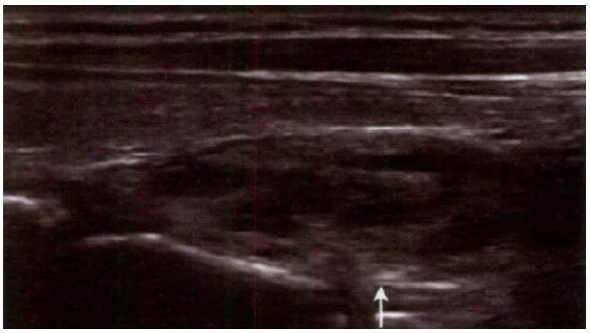

Figure 2. Image data of Case 2.

Clinical Examinations of the Primary Hyperparathyroidism in Subjects of Two Groups

In Group A, among patients with masses in parathyroid glands that were screened, there were 10 patients with primary hyperparathyroidism, while none was identified in Group B (x^2=10.747; p=0.001). In addition, the correlation between the times of attack of urolithiasis and the primary hyperparathyroidism in Group A is shown in Table III.

As shown in Table III, among patients with attack exceeding three times or more, the occurrence rate of primary hyperparathyroidism was 26.92% (7/26), significantly higher than 4.17% (3/72) in those with attack fewer than three times of attack (χ^2=7.630; p=0.005).

Typical Cases

Case 1

Patients that experienced four attacks of the urolithiasis, and after high-frequency ultrasonic probing, the upper dorsal portion, right to the thyroid tissues, exhibited low echoes, with a measurement of 17 mm*8 mm*13 mm, indicating even and standard internal echoes and abundant blood flow (Figure 1).

Case 2

Patients that experienced three attacks of urolithiasis, and high-frequency ultrasonic probing indicated low echoes in the dorsal, upper portion of the right thyroid tissues, with a measurement of 23 mm*9 mm*18 mm, manifesting the uneven internal echoes, and the presentations of echo-less region mainly in irregular shape (Figure 2).

Discussion

As the lesion type in the urinary system, urolithiasis, also regarded as a kind of the multi-onset disease in clinical practice, is induced by various factors including gout, bacterial infection, urine concentration or diet, with recurrence as its major features, but the onset-specific pathogenesis is quite complicated[3]. Genovese et al[5] have suggested that primary hyperparathyroidism, with a relatively low occurrence rate, has been identified as

Table III. Correlation between the times of attack of urolithiasis and the primary hyperparathyroidism [n (%)].

	Disease type		
Attack	Non-primary hyperparathyroidism	Primary hyperparathyroidism	Total
First attack	42 (97.67)	1 (2.33)	43 (43.88)
Second attack	27 (93.10)	2 (6.90)	29 (29.59)
Three times of attack or more	19 (73.08)	7 (26.92)	26 (26.53)
Total	88 (89.80)	10 (10.20)	98 (100.00)
x^2-value	7.630		
p-value	0.005		

As shown in Table III, among patients with attack exceeding three times or more, the occurrence rate of primary hyperparathyroidism was 26.92% (7/26), significantly higher than 4.17% (3/72) in those with attack fewer than three times of attack (x^2 = 7630; p=0.005).

a critical factor contributing to the recurrence of urolithiasis; in clinical practice, this disease usually has a long disease course with hidden onset, and at the early stage, patients show no specific or typical symptoms, which defers the diagnosis to the time of complication development, including the urolithiasis. Since the importance of clinical diagnosis of the primary disease is usually ignored, plus the aggravation in diseases, we need to emphasize the professional screening of this disease and require a better understanding on the correlation between these two diseases, so as to efficiently guiding the clinical diagnosis and treatment. The excellent performance of high-frequency ultrasonic technique makes it the preferred choice in solving this problem. Clinical pathogens of primary hyperthyroidism mainly involve the adenocarcinoma, hyperplasia of parathyroid tissues and adenoma, which can increase the secretion of PTH, thereby leading to the disease[6]. In all participants of this study, after the ultrasonic examination, there were 67 patients (68.37%) in Group A with the signs of parathyroid glands, among which there were 14 patients (14.29%) with mass in parathyroid tissues, more than 40 (40.00%) and 2 (2.00%) in Group B ($p<0.05$), indicating higher detection rates of parathyroid glands in the urolithiasis cases and masses in parathyroid tissues than their healthy counterparts. This is because after the development of primary hyperparathyroidism, the abnormally increased PTH affects the functions of organs or tissues, with the manifestations of urolithiasis, or signs of parathyroid glands or masses in parathyroid tissues. In clinical screening of the parathyroid glands, high-frequency ultrasonic technique, with the advantages of radiation-free, convenience and non-invasion, can measure the hemodynamic index and morphological features of patients, clearly exhibiting the parathyroid glands in the urolithiasis cases, thus guaranteeing the prompt detection of masses in parathyroid tissues[7,8]. Meanwhile, after the application of high-frequency ultrasonic examination, there were 10 patients (10.20%) in Group A with primary hyperparathyroidism, but none was found in Group B ($p<0.05$). Patients with three or more attacks of urolithiasis had a total occurrence rate of 26.92% (7/26) as for primary hyperparathyroidism, significantly higher than 4.17% (3/72) in patients with twice or fewer attacks ($p<0.005$), suggesting that the occurrence rate of the complication of primary hyperparathyroidism in the urolithiasis cases was much higher, and was increasing against the times of attacks of urolithiasis. We infer that the total secretion and synthesis of PTH in primary hyperparathyroidism patients are increased aberrantly, and under the direct stimuli posed by PTH, renal system increases the generation and output of 1,25-dihydroxyvitamin D3, which results in the re-absorbance of the calcium in gut and kidney, thereby accelerating the growth of osteoclast tissues with an acute increase of calcium level in serum [9]. Researches[10] have revealed that a sustained increase in serum calcium can augment the glomerular filtration rate, which arises urolithiasis in addition to the calcium deposit. Nevertheless, it can enhance the excretion of calcium through the renal system, leading to aberrant increase in urine calcium, which, thus, increases not only the risk of urolithiasis, but also the probability of recurrence[11]. Through high-frequency ultrasonic examination, we could clearly understand the hemodynamic features through the morphological structures of lesion tissues, so as to identify the information of disease. In addition, screening the primary hyperparathyroidism can guarantee the implementation of diagnosis and treatment while enhance the understanding on the correlation between these two diseases[12,13].

Conclusions

Primary hyperparathyroidism is the critical pathogen contributing to the recurrent urolithiasis, and high-frequency ultrasonic examination and professional screening of the parathyroid glands in cases of urolithiasis can better guide the diagnosis and treatment through providing us the precise condition of pathogens and disease progression, so as to improve the outcome.

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Conflict of Interest

The Authors declare that they have no conflict of interest.

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