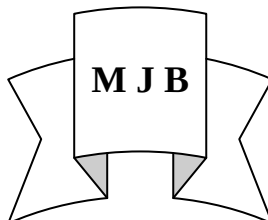


The Measurement of Intact Parathyroid Hormone and Serum Electrolytes and Their Relation with Renal Stones in Hilla City

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Abstract

The study was conducted on seventy patients with renal stones and fifty apparently healthy were taken as control group. Blood collected from clinic of urology in AL-Hilla Teaching Hospital .The sera obtained from the blood were used to measure intact PTH and electrolytes (calcium, phosphorus) and its relation with renal stones.

The results of the present study showed a significant increase in intact PTH and calcium concentration and a significant decrease in phosphorus concentration in sera of the renal stones group compared to the control group, significant increase in intact PTH concentration in the sera of male with renal stones than their counterparts females.

قياس هرمون جار الدرقية وبعض العناصر (الكالسيوم و الفسفور) وعلاقتها بتكوين حصى الكلية في مدينة الحلة

الخلاصة

أجريت الدراسة على سبعين مريض بحصى الكلى وخمسون شخص سوي أخذت كمجموعة سيطرة. عينات الدم تم الحصول عليها من مرضى بحصى الكلى ومجموعة السيطرة في مستشفى الحلة التعليمي في مدينة الحلة. المصول تم الحصول عليها من الدم لقياس تأثير هرمون جار الدرقية وبعض العناصر (الكالسيوم و الفسفور). أظهرت نتائج هذه الدراسة (زيادة ملحوظة في تركيز هرمون جار الدرقية والكالسيوم) و نقصان ملحوظ في الفسفور ومقارنتها بمجموعة السيطرة. كذلك هذه الدراسة أظهرت زيادة ملحوظة في تركيز هرمون جار الدرقية في مصول الرجال المصابين بحصى الكلى مقارنة بالنساء.

Introduction

The kidneys are two bean-shaped organs that are located in the back part of the abdomen [1]. The Kidney Regulate plasma ionic composition. Ions such as sodium, potassium, calcium, magnesium, chloride, bicarbonate, and phosphates are regulated by the amount that the kidney excretes[2].

Kidney stones (called renal calculi) are solid concretions or crystal aggregations formed in the kidneys from dietary minerals in the urine[3].

Urinary calculi are the third most common affliction of the urinary tract, exceeded only by urinary tract infections and pathologic conditions of the prostate [4] , in Iraq, environmental or occupational factors, as well as the presence of any bowel disease associated with diarrhea and/or malabsorption can each predispose to stone disease[5]. About three males are afflicted for every female [6]. For both sexes, the peak age at first episode is between twenty and forty years [7].

There are four Types of renal stones: Calcium stones (account for 75% of renal calculi), struvite stones (account for 15% of renal calculi) [8], uric acid stones (account for 6% of renal calculi) and cystine stones (account for 2% of renal calculi) [9].

The risk Factors for Recurrent Stone Formation are onset of disease early in life, i.e., below 25 years of age, stones containing brushite (calcium hydrogen phosphate; $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$) [10], strong family history of stone formation [11], diseases associated with stone formation: hyperparathyroidism, renal tubular acidosis (partial/complete), cystinuria, primary hyperoxaluria, jejunoileal bypass, Crohn's disease, intestinal resection, malabsorptive conditions, sarcoidosis and hyperthyroidism [12], medication associated with stone formation: calcium supplements, vitamin D supplements, acetazolamide, ascorbic acid in megadoses (>4 g/day), triamterene and indinavir [13], and the anatomy of the upper and lower tracts may also influence the likelihood of stone formation by predisposing to urinary tract infection or stasis [14].

The parathyroid glands are four or more small glands, about the size of a grain of rice, located on the posterior surface (back side) of the thyroid gland [15]. Parathyroid glands produce parathyroid hormone, which plays a role in the regulation of calcium levels in the blood.

Parathyroid hormone (PTH), parathormone or parathyrin, is secreted by the chief cells of the parathyroid glands as a polypeptide containing 84 amino acids [16]. It acts to increase the concentration of calcium (Ca^{2+}) in the blood. PTH acts to increase the concentration of calcium in the blood by acting upon parathyroid hormone receptor in three parts of the body [17]

PTH half-life is approximately 4 minutes. It has a molecular mass of 9.4 kDa [18]. Also it takes part in the control of phosphate homeostasis in the body.

The parathyroid hormone stimulates the following functions: release of calcium by bones into the bloodstream, absorption of food by the intestines, and conservation of calcium by the kidneys [19].

The stimulators of PTH are: Decreased serum $[\text{Ca}^{2+}]$, mild decreases in serum $[\text{Mg}^{2+}]$, and an increase in serum phosphate (increased phosphate causes it to complex with serum calcium, forming calcium phosphate, which reduces stimulation of Ca-sensitive receptors (CaSr) that do not sense Calcium phosphate, triggering an increase in PTH [20].

The Inhibitors of PTH are: Increased serum $[\text{Ca}^{2+}]$ and severe decreases in serum $[\text{Mg}^{2+}]$, which also produces symptoms of hypoparathyroidism (such as hypocalcemia). [21]

Calcium is the most abundant mineral in the human body. The average adult body contains in total approximately 1 kg, 99% in the skeleton in the form of calcium phosphate salts. The serum level of calcium is closely regulated with a normal total calcium of 2.2-2.6 mmol/L (9-10.5 mg/dL) and a normal ionized calcium of 1.1-1.4 mmol/L (4.5-5.6 mg/dL). The amount of total calcium varies with the level of serum albumin, a protein to which calcium is bound.

Bone serves as an important storage point for calcium, as it contains 99% of the total body calcium. Calcium release from bone is regulated by parathyroid hormone [22].

A phosphate, in inorganic chemistry, is a salt of phosphoric acid. In organic chemistry, a phosphate, or organophosphate, is an ester of

phosphoric acid. The physiologic concentration of serum phosphorus (phosphate) in normal adults ranges from 2.5 to 4.5 mg/dL (0.80–1.44 mmol/L). A diurnal variation occurs in serum phosphorus of 0.6 to 1.0 mg/dl .

PTH takes part in the control of phosphate homeostasis in the body [23].

Materials and Methods

Materials:

Subjects:

The study was conducted over the period from 1st of December 2010 till 30th of June 2011. Samples collected from clinic of urology in AL-Hilla Teaching Hospital. The practical side of the study was performed at the laboratory of biochemistry department at College of Medicine, Babylon University.

This study included seventy patients with renal stones and fifty healthy subjects were taken as control group. All patients underwent full history and physical examination including: age, gender, smoking, family history of urolithiasis, past history of recurrent stone and any current medical diseases. The patients underwent general urine examination (GUE), random blood sugar (RBS), with ultrasonography (US), plain abdominal X ray film of kidney, ureter and bladder (KUB), and intravenous urography (IVU).

The general criteria for all subjects in this study included not those suffering from any disease (e.g. hypertension, diabetes mellitus, asthma etc.), not given any medication (e.g. methotrexate diuretics, steroid, etc.) for at least one month, not drinking alcohol, not smoking and not pregnant women. Subjects that had these criteria were excluded from this study.

The renal stones group comprised seventy adults (42 male and 28 female), aged 9-66 years with mean $\pm$

SD of 44.19 ± 13.7 years. The control group includes fifty apparently healthy individuals aged 11-65 years with mean $\pm$ SD 39.87 ± 15.03 .

Blood Sampling:

Venous blood samples were drawn from patients with renal stones and control subjects by using disposable syringes (5mL) in the sitting position without tourniquet. Five mls of blood were obtained from each subject by vein puncture and pushed slowly into plain disposable tubes. Blood was allowed to clot at 37°C for 10-15 minutes, and then centrifuged at 1800 rpm for approximately 10-15 minutes then the sera were obtained and stored at -20°C until analysis (measurement of intact PTH, calcium, phosphorus, total protein and albumin).

Methods:

Serum intact PTH concentration was determined by ELISA technique using a kit provided by DRG (Germany). Serum total calcium concentration was determined spectrophotometrically by Spinreact (Spain) kit. Phosphorus concentration was determined spectrophotometrically by Linear Chemicals (Spain). Total protein was determined spectrophotometrically by Spinreact (Spain) kit and albumin was determined colorimetrically by Biolabo SA (France) kit. Free calcium was calculated : Corrected calcium (mg/dL) = measured total Ca (mg/dL) + 0.8 (4.0 - serum albumin [g/dL]), where 4.0 represents the average albumin level in g/dL [24]

Results

Intact PTH concentration were measured in sera of seventy patients with renal stones and fifty healthy (control group) as shown in table (1).

The results in table (1) show significant increase in intact PTH concentration in sera of males in renal

stones group compared with those of the control group, significant increase in intact PTH concentration in sera of females in renal stones group compared with those of the control group.

While there is no significant difference in intact PTH concentration

found in sera of females in renal stones group compared to males of the same group, also no significant difference in intact PTH concentration found in sera of females in control group compared to males of the same group.

Table 1 Serum intactPTH concentration in renal stones and control group. (P-value of < 0.05 was considered to be statistically significant)

	Subjects	No.	Mean $\pm$ SD	P-value
Intact PTH(pg/mL)	Male renal stones group	42	58.35 $\pm$ 30.91	0.001<P
	Female renal stones group	28	60.32 $\pm$ 28.57	
	Male control group	29	38.75 $\pm$ 15.31	
	Female control group	21	37.60 $\pm$ 15.02	

Calcium ,phosphorus, total protein ,albumin and free calcium concentration were measured in sera of

seventy patients with renal stones and fifty healthy (control group) as shown in table (2).

Table 2 Serum Calcium, phosphorus, total protein, albumin and free calcium concentration in renal stones and control group. (P-value of < 0.05 was considered to be statistically significant)

Parameter	Subjects	No.	Mean $\pm$ SD	P-value
Calcium (mg/dL)	Renal stones group	70	9.30 $\pm$ 1.31	0.001<P
	Control group	50	8.52 $\pm$ 0.91	
Phosphorus (mg dL)	Renal stones group	70	2.10 $\pm$ 0.86	0.001<P
	Control group	50	3.39 $\pm$ 0.75	
Totalprotein(g/dL)	Renal stones group	70	5.85 $\pm$ 1.18	0.001<P
	Control group	50	7.43 $\pm$ 0.75	
Albumin (g/dL)	Renal stones group	70	3.65 $\pm$ 0.90	0.001<P
	Control group	50	3.74 $\pm$ 0.75	
Free calcium (mg/dL)	Renal stones group	70	5.64 $\pm$ 0.36	0.001<P
	Control group	50	4.67 $\pm$ 0.43	

The results in table (2) show significant increase in (total calcium and free calcium concentration), significant decrease in phosphorus concentration in sera renal stones group compared with those of the control group.

Discussion

Renal stones:

Amongst 70 patient with renal stones included in this study, there were 42 males and 28 females, and this represents 60% and 40% of patients respectively. There was an increment in the rate of males compared to females. And this is consistent with some studies that consider males have slightly higher renal stones rates than females [25].

In our study, patients with renal stones were divided into two groups:

1. Patients with radiopaque stones: this group consists of 45 patients.
2. Patients with radiolucent stones: this group consists of 25 patients.

This goes with the fact that the major type of renal stones is radiopaque which accounts for 60% of all renal stones cases, while radiolucent stones represents 40% of these cases [26].

The current study has revealed a higher percentage of renal stones patients have had one stone, also The current study has revealed that higher percentage of renal stones patients have had recurrent stones. And no family history of renal stones has presented in higher percentage among patients with renal stones.

Intact PTH:

One of the major findings of the present study was the significant increase in serum intact PTH concentration observed in renal stones group compared to those control group. The results of the present study were in agreement with Michael Cotant [27], Ronald Olson [28]. they found people with renal stones have higher levels of the intact PTH than those without renal stones.

The excess PTH triggers the release of too much calcium into the bloodstream. The bones may lose calcium, and too much calcium may be absorbed from food. The levels of calcium may increase in the urine, causing kidney stones [29].

Serum electrolytes (calcium and phosphorus):

The results of present study show significant increase in (total and free calcium concentration) in sera of renal stones group compared to those control group and significant decrease in phosphorus concentration in sera of renal stones group compared to control group.

The results of the present study were in agreement with other studies David S. [30], Kathleen Deska [31], Hory B [32] and Coburn JW [33]. they showed that serum electrolytes in renal stones patients undergoes some considerable changes in which the levels of total calcium and free calcium were significantly increased and decreased phosphorus concentration.

Conclusions

The study concluded that increase intact PTH cause increase in calcium level and lead to renal stones formation.

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