ejpmr, 2024, 11(7), 14-17

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

ESTIMATION OF SOME MINERALS IN PATIENTS WITH RENAL STONES

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Article Received on 03/05/2024 **Article Revised on 22/05/2024** **Article Accepted on 12/06/2024**

ABSTRACT

This study aims to determine the serum levels of some minerals ions in patients with kidney stones. One hundred and ten adult individuals participated in this study, thirty of them healthy control versus eighty patients with kidney stones, who attended private laboratories in Kirkuk, northern Iraq, in the period from February to April 2023.The results demonstrated that the levels of calcium and magnesium in the serum of kidney stone patients were remarkably lower compared to control group, while phosphate levels decreased notably in the serum of kidney stone patients. It has been concluded that kidney stones increase the concentration of phosphate, which may negatively affect vital signs.

KEYWORDS: Biochemical variables, Kidney stones, Renal function.

INTRODUCTION

The kidneys are complex organs that play a crucial role in the maintenance of normal physiological functions, as important functions and processes carried out by the kidneys are crucial to body survival.[1,2] The renal system affects every part of the body by keeping physiological fluids in balance and other organ systems functioning normally,[3] and any age or period can be affected by renal and urologic illnesses.[4] The evolution of the kidney has clinical implications.[5] In renal failure, one must deal not only with issues of insufficient excretion due to diminished glomerular filtration, but also with issues of excess losses due to changes in the function of the tubular system recovering filtrate.[6] The kidney purpose is to keep the body water, mineral, and salt balance in check. Most kidney stones exist on the inner surface, where urine withdrawal renal tissue entering urinary collecting system. They can be as little as a pebble or grain of sand, but they are frequently much bigger.[7] Many stones in the kidneys contain calcium oxalate, and individuals who develop stones have hypercalciuria, a disorder marked by an excess of calcium in the urine.[8] Much of the calcium is absorbed from the intestines along with absorb an abnormally large quantity of calcium from bones.

The majority of patients are diagnosed with kidney stones after experiencing acute and lasting agony.[9] Acute pain accompanies the release of a kidney stone from its site of formation, the renal papilla, and enters the urine collecting system. The stone obstructs the flow of urine from the kidney, leading to renal colic.[10] Hematuria, persistent urinary tract infections, urinary urgency, and nausea or vomiting are all possible symptoms. Kidney stones don't always create symptoms. The painless stones can be identified on X-rays when your doctor is checking for other things.[11]

A stone may not hurt, yet it still could result in other problems, including recurring blood in urinary tract infections.[12] In addition to environmental and lifestyle factors including insufficient fluid consumption, a diet high in refined sugar, protein, oxalate, cola and salt beverages, the majority of kidney stones are brought on by a hereditary predisposition.[13] Kidney stones are associated with type 2 diabetes, obesity, dyslipidemia, and hypertension. Primary hyperparathyroidism, hypercalciuria and hypercalcemia, and urinary tract infection are all risk factors.[14] Increased oxalate absorption in the stomach is caused by inflammatory bowel disease as well as gastric bypass surgery for the treatment of morbid obesity, and prolonged immobility results in bone calcium loss into the urine.[15] According to the idea of stone production, crystals initially precipitate in supersaturated urine. It is unclear how these crystals adhere to the urothelial to allow stones to develop. According to one explanation, Randall's plaques (Calcium phosphate deposits) occur under the epithelium in locations with high ionic concentrations.[16] A more recent theory proposes that crystals bind to and are taken up through endocytosis, where they are either destroyed or carried into the interstitial, perhaps producing Plaques by Randall, as a result of chemicals on the mucosal surfaceof the cells that line the ducts that collect

water.[17] The calcium oxalate crystals in the lumen of the plaques, which expand in size as they eat their way through the epithelium, join together to form stones.[18] This study was designed to evaluate the relationship between serum levels of some minerals ions in individuals with kidney stones.

MATERIALS AND METHODS

One hundred twenty subjects were participated in the study (30 normal healthy subjects and 80 renal stone patients). Blood samples were collected from 80 patients with kidney stone, in private laboratories and hospitals in Kirkuk city (Iraq) from February 2023 to April 2023. Male and female patients in this research ranged in age from 25 to 65 years old, respectively. Collect 10 ml venous blood from patients, clot at 25°C, and centrifuge for 15 minutes, extract serum, divide into aliquots, and store in refrigerator.

Determination of calcium: The basic principles of this method are metallic chromogen arsenazo III interacts with calcium at a somewhat acidic pH to generate a colorful compound whose absorbance at 650 nm correlates with the material's calcium content. In the test tube, mix well the reagent 1000 µl and the specimen 20 µl. After waiting for 1 min at room temperature, absorbance was measured at 650 nm against the reagent blank.

Determination of phosphate: In an acidic medium, phosphate ions combine with ammonium molybdate to generate a phosphomolybdic combination. The absorbance at 340 nm is proportional to the concentration of phosphate ions in the sample. 1 mL of reagent solution was mixed well with 20 µL of sample. Incubate at room temperature for 2 minutes. Using a 1 cm path length cuvette, compare the absorbance of the Standard and tests at 340 nm (334–366) to that of the reagent blank, the specimen was Read against a saline solution.

Determination of magnesium: A metallochromic indicator discovered by Gindler, Heth, and Khayam-Bashi, forms a colorful complex with magnesium in a basic buffered solution. The absorbance between 510 and 550 nm related to the magnesium content in the samples. 1 mL of reagent solution was mixed well with 10 µL of sample, then Let stand for 5 min at constant temperature. Read the standard and assay absorbance at 530 nm (510–550) against the reagent blank.

RESULTS

Determination of minerals (Calcium, Phosphate and Magnesium)

As shown in table (3.1), results demonstrated significant increase in phosphate concentration (5.381±0.9224) versus control group (3.897±0.4255), calcium level (8.828±0.3489) versus control group (9.393±0.4719), and magnesium concentration (1.566±0.3225) versus control group (2.140±0.2568).

Table 1: Minerals level in both control Groups and The patients' sera.

Minerals (mg/dl)	Control (n=30)	Patient (n=80)	P-Value
Calcium	9.393 ±0.4719a	8.828 ±0.3489a	0.0370
Phosphate	3.897±0.4255aa	5.381±0.9224aa	<0.0001
Magnesium	2.140±0.2568ns	1.566±0.3225ns	0.1689

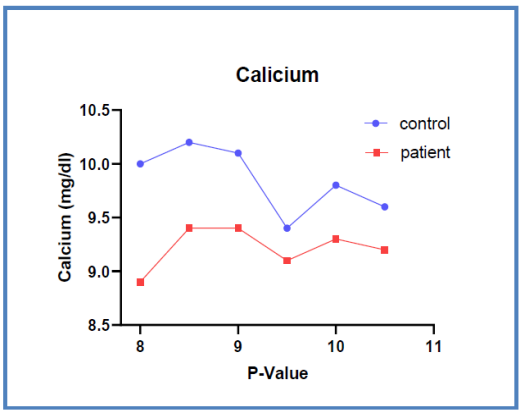

Figure 1: Compared in calcium levels between Patients and Control groups.

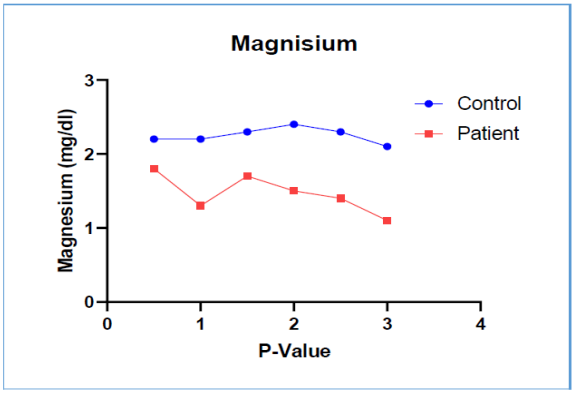

Figure 2: Compared in magnesium levels between Patients and Control groups.

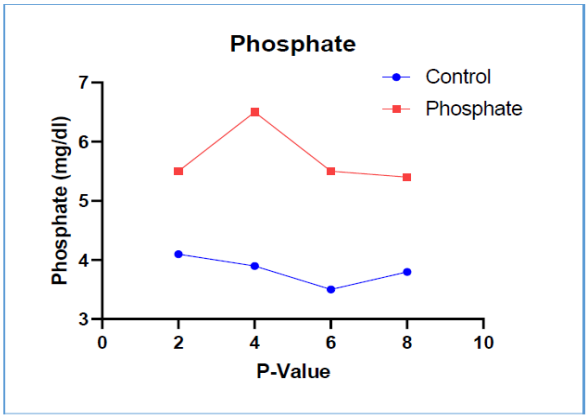

Figure 3: Compared in phosphate levels between Patients and Control groups.

DISCUSSION

In the current study, three of Biolabo's manufactured kit tests were used (Calcium, phosphate, and magnesium). Some patients with autosomal dominant hypocalcemia have high calcium levels in their urine (Hypercalciuria), which can lead to calcium deposits in the kidneys (Nephrocalcinosis) or kidney stone development (Nephrolithiasis). These disorders can cause kidney injury and impede their function.[19] Inadequate calcium consumption causes parathyroid gland hyperactivity, which causes the movement of a very large amount of calcium from the bones into the blood to maintain a constant level of calcium ion in the blood, causing its weakening and the occurrence of osteoporosis, so the amount of calcium bound in the blood increases. It promotes the production of calcium phosphate stones.[20] The kidney stone may form in alkaline conditions, as an increase in phosphoric acid leads to an increase in the acidity index, and this rise is a suitable environment for the formation of stones. The presence of phosphate in abundance tends to be transformed in the urine into phosphoric acid, and this acid combines with excess calcium to precipitate calcium phosphate constituting the nucleus of gravel, and hypercalciuria is a contributing factor in the increase.[21] The low magnesium concentration may be attributed to a variety of circumstances, including malnutrition or the occurrence of certain chronic conditions, which resulted in a drop in magnesium levels in patients and, as a result, an increase in this element's permeability to urine, resulting in an excess of urinary magnesium Additionally a lengthier low level of magnesium is one of the most essential variables that contribute to the formation of kidney stones since high magnesium inhibits the formation of kidney stones and when it falls.[22] The current study's findings involving phosphate and magnesium were consistent with those of Liu, et al. (2020), however those findings about calcium there was no agreement, because there was no discernible change in calcium ion concentration between the sick group and the control group.[23] Also the current study not conflict with other studies, Wijst, et al (2019) and William, et al (2018) who found The low concentration of magnesium may be due to some factors of malnutrition or some diseases that led to a decrease in the level of magnesium in patients. As for the increase in phosphate, it led to association with the free calcium ion and the formation of calcium phosphate stones.[24,25]

CONCLUSION

Kidney stones cause a rise in the concentrations of phosphorus, which affects most of the vital signs evaluated. As a result, they can be utilized to detect the existence of kidney stones.

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