Evaluation of Selenium and Chloride levels in both sera and saliva samples in renal stone former patients

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الخلاصة :

أجريت هذه الدراسة على 40 مريضاً، 27 ذكور و13 إناث ، وردوا وحدة تفتيت الحصى في مستشفى اليرموك التعليمي وكان معدل أعمارهم 39±14 عاما وتمت مقارنة النتائج بـ 14 من الأصحاء ظاهريا غير المصابين بحصى الكلية أو المسالك البولية معدل أعمارهم 37±12 عاما.

تهدف هذه الدراسة لتشخيص دور المعدن الأثري السيلينوم و الكلوريد في تكوين حصى الكلية والمسالك البولية.

تم قياس نسبة المعدن الأثري السيلينوم وكذلك الكلوريد في كل من مصل دم ولعاب هؤلاء المرضى ووجد أن هنالك انخفاض ملحوظ في نسبة السيلينوم في كل من مصل الدم ($p<0.0001$) واللعاب ($p<0.002$)، بينما كان الارتفاع ملحوظا في نسبة الكلوريد في مصل دم المرضى ($p<0.018$) يقابله انخفاض قليل جدا في النسبة في اللعاب ($p= 0.144$)

من نتائج هذه الدراسة تبين أن من الممكن استخدام مستوى السيلينيوم في مصل الدم أو اللعاب على حد سواء ومستوى الكلوريد في مصل الدم كعلامات حيوية عند مرضى حصى الكلية.

Abstract:

The study included 40 patients (27 males and 13 females) with renal and ureteric stones were submitted to lithotripsy unit in Al-Yarmook Hospital, Baghdad-Iraq, their mean ages were (39±14) and 14 apparently healthy controls were enrolled in this study their mean ages were (38±12) .

The study objected to evaluate the serum and saliva levels of selenium (Se) and Chloride (Cl) in patients with stones and healthy as controls to find a possible relation between these elements and stone formation.

Selenium and chloride were measured both in sera and saliva, the results showed that the mean value of serum and saliva selenium levels in stone former patients were statistically significant lower compared with healthy controls ($p<0.0001$, 0.002) respectively, while the mean value serum chloride level in stone former patients were significantly higher than healthy controls ($p< 0.018$).

This study showed that we can use serum and saliva selenium and serum chloride as a biomarker in renal stone former patients.
Keywords: Urolithiasis, Selenium, Chloride.

Introduction:

Urolithiasis is a common recurring disorder and certain intrinsic and extrinsic factors may be linked in the genesis of urinary calculi [1, 2]. Several studies have been done to determine the risk factors associated with urolithiasis so that preventive measures can be undertaken to prevent stone formation, however the exact etiology of urinary stones still remain unknown [3].

Urinary stones are similar to arteriosclerosis, the calcification that occurs in arteriosclerosis is inhibited by antioxidants [4] Oxalate and calcium concentration can be reduced and the process of crystallation can be inhibited by selenium which acts as nephroprotective antioxidant [5].

Selenium deficiency has been found to induce renal calcification, which may be primarily induced by injury of proximal tubule via oxidative stress [6]. Supplementation of selenium and vitamine E prevents hyperoxaluria in experimental urolithic rats by decreasing the level of lipid peroxidation and the activities of oxalate synthesizing enzymes like lactate dehydrogenases, xanthine oxidase [7].

Selenium is trace element that is essential in small amounts. Humans and animals require selenium for the function of a number of selenium dependent enzymes, such as glutathione peroxidase, which is antioxidant enzyme that reduces potentially damaging reactive oxygen species [8].

Recently, one of the stone formation inhibitor studied is selenium which could be stuck onto the crystal surface and would inhibit induction of new crystals, growth and aggregation [9].

Chloride is the major extracellular anion; it is significantly involved in maintenance of water distribution, osmotic pressure, and anion–cation balance in the extracellular fluid compartment [10]. Chloride has a role in nephrolithiasis, can function in both Cl^-/HCO_3^- exchange and Cl^-/oxalate exchange modes [11]. Moreover, mutations in chloride channels have been identified in the hypercalciuric nephrolithiasis disorder [12].

Materials and Methods:

Patient selection:

A total of 40 stone former patients (renal and ureteric) were candidate for shock wave lithotripsy and 14 healthy controls were enrolled in this study between February 2009 and January 2010.

The patients and controls characteristics are summarized in table-1.

Variable	Patients	Controls
Age (range)	15-68	14-58
Sex (no.) **male** **female**	 27 13	 12 2
Renal / ureter stones	34/6	
Right/left renal stones	25/14	
Bilateral renal stones	1	

Table-1: Demographic and baseline characteristics of patients & controls

Patient assessment:

At initial presentation, blood and saliva samples for selenium and chloride were determined by atomic absorption method In Ibn Sina Labs.

Patient history: all patients were free from associated morbidities apart from urinary stone, diagnosis of renal stone was depend on X-rays and Ultrasound imaging, the patients have no other diseases and take no drugs, duration of renal stone cannot be detected, all the patients have normal renal function (normal serum creatinine). Blood and saliva were collected from the patients in the lithotripsy unit in AL-Yarmouk Teaching Hospital, these samples initially were collected in plane tubes, and sera were separated and stored in deep freeze (-20˚C) in the labs of the hospital.

Serum and saliva selenium were measured by using atomic absorption spectrophotometer 680AA model (Shimadzu) , whereas serum and saliva chloride were measured by tittering process using silver nitrate as titrate. All these measurements were performed in Ibn Sina Labs, Ministry of Industry & minerals.

Statistical analysis:

All statistical measurements were done by using student t-test; ($p < 0.05$) were used as significant value.

Results:

In this study, the ages of patients and controls were nearly comparable, just one patient had bilateral renal stone were included in our study (table-1).

Serum and saliva selenium concentrations in stone former patients were significantly lower as compared to control subjects ($p<0.0001$, 0.002 respectively), (table-2).

	Control	Patients	p-value
Serum	0.520±0.181	0.286±0.194	0.0001
Saliva	0.482±0.305	0.145±0.179	0.002
p-value		0.0005	

Table-2: Selenium measurements in stone former patients & control subjects

The figure-1 revealed the ability of detecting the deficiency of selenium in both serum and saliva of stone former patients as compared to control subjects.

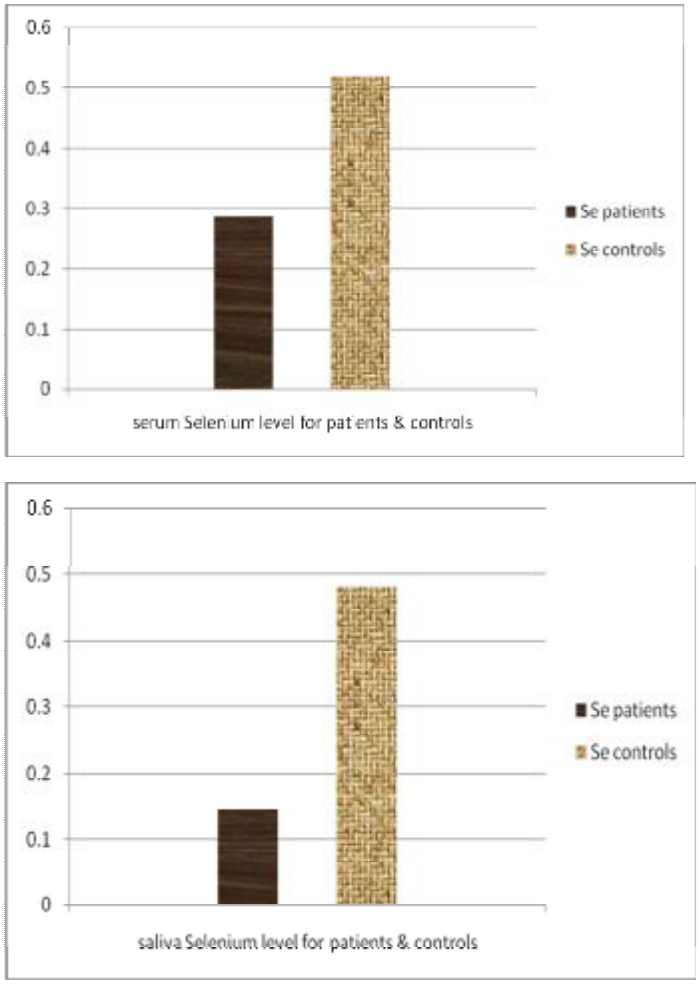

Figure-1: Selenium level (ppm) in the serum & saliva of patients compared to those of controls

We found in this study that serum chloride level in stone former patients was significantly higher than in controls (p-value 0.018), whereas the levels in saliva were not significant (p-value 0.144) as shown in table-3.

	Controls	Patients	p-value
Serum	3.752±0.975	4.096±0.198	0.018
Saliva	0.599±0.157	0.469±0.197	0.144
p-value		0.0001	

Table-3: Chloride measurements in stone former patients & control subjects

In tables 2 and 3, revealed significant values in selenium and chloride measured in serum and saliva among the same patients ($p < 0.0005$, 0.0001 respectively).

According to figure-2, the evaluation of chloride in serum is more reliable than in saliva of stone former patients.

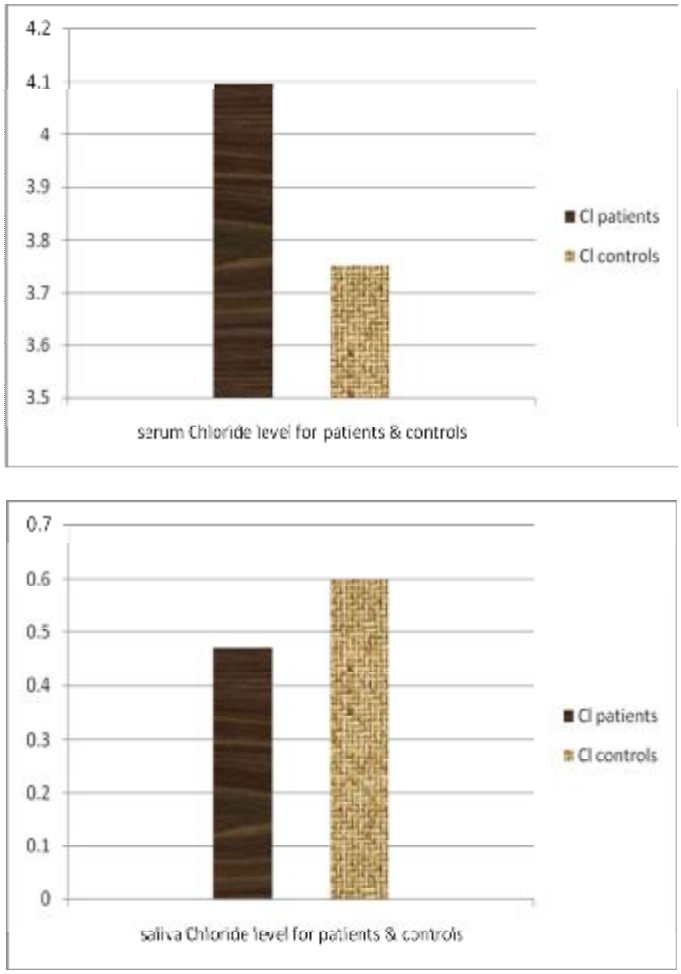

Figure-2: Chloride level (ppm) in the serum & saliva of patients compared to those of controls.

Discussion:

The role of trace elements in lithogenesis is still unclear [1]. The long list of stone inhibitors includes ionic and macromolecular moieties, some being produced within the nephron in response to lithogenic insults, and some affecting not only crystallization but also crystal cell adherence. Crystal trapping is believed to anticipate a renal stone [13].

It is considered that many factors may play a role in urolithiasis. Experimental and clinical studies have shown that Selenium has an inhibitory effect on urolithiasis [7,8].

In this study the concentrations of selenium in serum and saliva in stone former were statistically significantly lower than healthy control individuals ($p<0.0001$, 0.002). This finding might indicate that selenium has a role in urolithiasis.

Selenium is one of stone formation inhibitor studied which could be stuck onto the crystal surface and would inhibit induction of new crystals, growth and aggregation [9].

It was found that urinary excretion of oxalate and calcium were normalized with selenium supplement [7,8]. Selenium administration cause a reduction in serum calcium level may be in part due to changes in calcium filtered load, changes in glomerular filteration rate or interference with calcium absorption from the gut [14].

Creatinine clearance increase significantly after Selenium supplementation this suggests appositive influence of selenium on glomerular filteration rate and selenium might be involved in the vascular regulatory mechanism of the kidney [15].

One of hypothesis of stone formation found that oxalate-induced membrane injury was mediated by lipid peroxidation reaction through the generation of oxygen free radicals. Membrane injury facilitated the fixation of calcium oxalate crystals and subsequent growth into kidney stones [16].
Moreover, the presence of selenium in supplement increases the antioxidant activity[17].

References:

1- Słojewski, M. and Czerny, B *et al.* (2009). Microelements in Stones, Urine, and Hair of Stone Formers: A New Key to the Puzzle of Lithogenesis? Biol Trace Elem Res.
2- Kanchana, G. and Sundaramoorthi, P. *et al.* (2009). Biochemical analysis and FTIR Spectral studies of artificially removed renal stone mineral constituents Journal of minerals and materials characterization and Engineering. Vol. 8, No. 2: pp161-170.
3- Sinha, Karan, S.C. *et al.* (2010). Increased urinary uric acid excretion: a finding in Indian stone formers. Journal of Urology. Vol. 38, No.1, pp17-20.
4- Itoh, Y. and Yasui, T. *et al.* (2005). Preventive effects of green tea on renal stone formation and the role of oxidative stress in nephrolithiasis. Journal of Urology. Vol. 173: pp271-275.
5- Lahme, S. and Feil G. *et al.* (2004). Renal tubular alteration by crystalluria in stone disease an experimental study by means of MDCK cells. Journal of Urologia Internationalis. Vol. 72, No. 3: pp244-251.
6- Mikiya Fujieda and Keishi Naruse *et al.* (2007). Effect of selenium-deficient diet on tubular epithelium in normal rats. Journal of Pediatric Nephrology. Vol. 22, No. 2: pp192-201.
7- Manisanthosh Kumar and Ramasmy Selvam (2003). Supplementation of vitamine E and selenium prevents hyperoxaluria in experimental urolithic rats. Journal of Nutritional Biochemistry. Vol. 14, No. 6: pp306-313.
8- Rayman, M.P. (2000). The importance of selenium to human health. Lancet. 356 (9225):233-241.
9- Sakly, R.; Chaouch, A.; El Hani, A. and Najjar, M.F. (2003) Effects of intra peritoneally administered vitamine E and selenium on calcium oxalate

renal stone formation: experimental study in rat. Annals of Urology. Vol. 37, No. 2: pp 47-50.

10- Carl A. Burtis and Edward R. Ashwood, M.D. (1999). Electrolytes, Tietz Textbook of Clinical Chemistry. Third edition.

11- Soleimani, M. (2008). The role of SLC26A6-mediated chloride/oxalate exchange in causing susceptibility to nephrolithiasis. J physiol. Mar 1; 586(5):1205-6

12- Thakker, R.V. (1998). The role of renal chloride channel mutations in kidney stone disease and nephrocalcinosis. Curr. Opin Nephrol Hypertens. Jul; 7(4):385-8.

13- Carl, A. Burtis (1993). Tietz textbook of clinical chemistry. 3rd edition.

14- Marangella, M.; Bagnis, C.; Bruno, M.; Vitale, C.; Petrarulo, M. and Ramello, A. (2004). Crystallization inhibitors in the pathophysiology and treatment of nephrolithiasis. Urol Int. 72 Suppl 1:6-10.

15- Clark, Hulda Regehr Clark and Santhose *et al.* (2004). The effect of supraphysiological levels of cortisol with selenomethonine on kidney. Journal of the Missippi Academy of Sciences, July 01.

16- Selvam, R. (2002). Calcium oxalate stone disease: role of lipid peroxidation and antioxidants. Urol. Res. 30 (1): 35-47.

17- Turło, J.; Gutkowska, B. and Herold, F. (2010). Effect of selenium enrichment on antioxidant activities and chemical composition of Lentinula edodes (Berk.) Pegl. mycelial extracts. Food Chem Toxicol. Apr; 48(4):1085-91.