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Serum zinc levels in children with and without nephrolithiasis.

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Abstract

Introduction: Nephrolithiasis, as a major health issue, have significant contribution to wide surgical procedures and loss of kidney. In addition, serum electrolytes level specially Zinc level, affect renal function. This paper is intended to get to the relationship between serum Zinc level and development of nephrolithiasis in children.

Material and methods: In this as a case-control study, with a random sampling method, 2-18 years old children who reffered to Amir-Kabir Hospital, we selected 208 children with nephrolithiasis as case and 208 children without nephrolithiatic as control groups. Ultrasonography was performed for both groups. Urine and blood were analyzed and based on this serum and urinary metabolic problems were evaluated. Also demographic information was being taken from patients. Data were analyzed by independent T-test and regression logistic test in the SPSS21 statistical software.

Results: Although the serum Zinc level in case group were higher than control group, but this difference is not statistically significant (p=0).

Conclusion: Relationship between nephrolithiasis and serum Zinc level has not been approved but with urinary Zinc level has been approved.

Keywords: Nephrolithiasis, Zinc, Children.

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Introduction

Kidney stones are a common disease in general population who has an estimated prevalence of 10-15% in males and 3-5% in females. These result from obstructive abnormalities or underlying metabolic predisposition. In industrialized societies, more cases (>90%) in children arise in the urinary tract (UT) and become symptomatic. Metabolic causes consist of hyperoxaluria, cystinuria, idiopathic familial hypercalciuria (IHC), distal renal tubular acidosis, and primary hyperparathyroidism. Urinary tract stones may be composed from calcium, cystine or uric acid stones also it can appear in any grade of urinary tract from kidney to bladder, each has its own special cause as well as special diet is advised for any type of stones. A flank renal colic pain that is sharp, severe and intermittent radiating to the groin with vomiting, distress and inability to positional pain, included as clinical manifestations. Younger children may not be having these classic manifestations; vomiting and fussiness as only symptoms [1,2].

Different combinations and composition of nephrolithiasis, depends on causative agent included high doses vitamin C, Sodium Bicarbonate, Calcium Carbonate, Aluminum Hydroxide and Acetazolamide [3]. These combinations including uric acid, Calcium (Calcium Oxalate, Calcium Phosphate), xanthine, steroids, triple phosphate (infected) and cysteine [1]. These can be formed in different parts of the urinary tract including calyces, Renal pelvis, ureter and bladder [4]. Nephrolithiasis inhibitor factors included, Glycosaminoglycan's, Citrate, Magnesium, Zinc and Pyrophosphate [5,6]. Associated anatomical abnormalities

with nephrolithiasis included calyceal diverticulum, ureteropelvic junction (UPJ) obstruction, urinary tract obstruction, vesicoureteral reflux (VUR), benign prostatic hypertrophy (BPH) and Medullary sponge disease (tubular ectasia). In addition, nephrolithiasis metabolically associated included metabolic syndrome, hypovolemia, Hypercalcuria and hypocitraturia.

Renal ultrasound as nephrolithiasis diagnostic approach easily misses UT stones. Another test, included Computed Tomography (CT), particularly a helical CT, can identify urolithiasis [7]. By urine electrolyte analysis, etiologic diagnosis is facilitated [8].

Proper nutrition is a good way to control nephrolithiasis. Treatment of nephrolithiasis involved hydration and analgesia as acute treatment and vigorous fluid intake, usually twice maintenance rates as chronic treatment for all types of metabolic stones [9]. On the other hand, specific metabolic conditions require specific treatments [10].

Variety of body processes are based on Zinc as second most distributed trace element in the body after iron, including metabolism, immune regulation, appetite stimulation and wound healing. Also urinarry and serum electrolites is a strong causes of nephrolithiasis, it has suggested evaluation of urinarry and serum Zinc levels, as a important inhibitors of crystal growth and crystallisation and prognostic indicator, in vitro and in vivo studies supported and suggests correction of urinarry and serum Zinc levels and urolithiasis, but in some recent studies contradictory results have been seen. So, in our study, we have been evaluated the urinary and serum Zinc levels in nephrolithiasis in children, as a widespread study.

Materials and Methods

This as a case-control study conducted on 416 children referred to the pediatric clinic of Amirkabir hospital.

Study Setting

In this as a hospital-based study, representative sample was taken from children 1 to 18 years old with nephrolithiasis who referred to Amir Kabir Hospital.

Study Population

Populations for study were male and female children in 1 to 18 years old with nephrolithiasis. The sample size, based on previous studies, was 416 children: 208 in control and 208 in case groups, children with nephrolithiasis was taken as case group and without it was taken as control group. The samples are randomly chosen and enrolled to study, which was a double blind randomized clinical trial.

Measurements

Total study population with respect to demographic and socio-economic issues was at the same level. Ultrasonography for nephrolithiasis detection was conducted in two groups. In addition, serum and urinary Zinc level have evaluated based on 5–Br–PAPS/ COLORIMETRIC approach, who is able to measure Zinc, directly in biological fluids. Masking materials were used for masking intruder metals such as copper, cobalt, nickel, and iron. The Zinc with specific chromogenic complex have been forms Br-PAPS permanent color. Moreover, wavelength based on color intensity determines the Zinc amounts (normal range of wavelength: 542-578). In addition, Zinc urinary assay was based on colorimeter and guidelines of diagnostic kits (bio-pharmaceutical company of Tehran) that was based on mg/dl; normal range was 15-150 mg/dl. Then data has been concluded by SPSS program.

Ethical Considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors. In addition, the ethical committee of Arak University of Medical Sciences approved the study protocol.

Statistical Analysis

Data analysis was conducted by T-test for quantitative and x^2 for qualitative data tests in SPSS program and significance level ($p<0.05$) have been considered.

Inclusion and Exclusion Criteria

1-18 year old patient referred to Amir Kabir Hospital with a diagnosis of kidney stones by taking informed consent and after a full explanation to the parents about the importance of Zinc in serum and urine, were enrolled to study. All cases that have not provided necessary cooperation, patients with zinc deficiency, recent Zinc use, infected, chronic diarrhea and vomiting, severe obesity (BMI>35) and nephrolithiasis history were excluded.

Results

In total, 416 children with and without nephrolithiasis as case and control groups were 224 males (53.8%) and 192 females (46.2%), 208 patients as control group were 108 males (26%) and 100 females (24%), 208 patients as case group were 116 males (27.5%) and 92 females (22.5%) that it is show that were not significant differences in groups (p=0.23). The mean age of children in the case group was 10 ± 4.6 and in the control group was 9.7 ± 2.8 years (P=0.112). The youngest children were 1 years old and the oldest one was 18 years old as shown in Table 1. As a result, two nodes are homogeneous in terms of age and gender. In addition other demographic information including father education (P=0.08), mother education (P=0.09), economical status (USD) (P=0.1), living area (P=0.616), number of brothers (P=0.756), number of sisters (P=0.394), father age (years) (P=0.06) and mother age (years) (P=0.185) were equal in two groups and mentioned in Table 1.

Also as shown in Table 2, in urinary Zinc level there are a significant statistically differences in two groups (P=0.023), also about serum Zinc level, although were

Table 1. *Age and gender and other demographic information of children with (n=208) and without (n=208) nephrolithiasis*

Variables	Case Group	Control Group	Total	P Value[c]
Age[a]	10 ± 4.6	9.7 ± 2.8	9.8 ± 3.7	0.112
Gender[b]				0.23
Male	108 (26)	116 (27.5)	224 (26.7)	
Female	100 (24)	92 (22.5)	192 (23.2)	
Father Education				0.08
Ph.D.	6 (3)	4 (2)	10 (2.5)	
Master	15 (7)	15 (7)	30 (7)	
Bachelor	37 (18)	15 (7)	52 (12.5)	
Associate	13 (6)	37 (18)	50 (12)	
Diploma	120 (58)	96 (46)	216 (26)	
Under Diploma	17 (8)	41 (20)	58 (14)	
Mother Education				0.09
Ph.D.	17 (8)	13 (6)	30 (7)	
Master	17 (8)	17 (8)	34 (8)	
Bachelor	41 (20)	17 (8)	58 (14)	
Associate	17 (8)	41 (20)	58 (14)	
Diploma	100 (48)	82 (40)	182 (44)	
Under Diploma	17 (8)	37 (18)	54 (13)	
Economical Status (USD)				0.1
<150	2 (1)	0 (0)	2 (0.5)	
150-300	35 (17)	62 (30)	97 (23.5)	
300-450	60 (29)	100 (48)	160 (38.5)	
450-600	78 (37)	35 (17)	113 (27)	
>600	33 (16)	11 (5)	44 (10.5)	
Living Area				0.616
Downtown	48 (23)	37 (18)	85 (20.5)	
Fringe	145 (70)	148 (71)	293 (70.5)	
Rural	15 (7)	23 (11)	38 (9)	
Brothers Number				0.756
0	121 (58)	131 (63)	252 (60.5)	
1	79 (38)	69 (33)	148 (35.5)	
≥ 2	8 (4)	8 (4)	16 (4)	
Sisters Number				0.394
0	146 (70)	133 (64)	279 (67)	
1	54 (26)	71 (34)	125 (30)	
≥ 2	8 (4)	4 (2)	12 (3)	
Father Age (years)				0.06
<25	10 (5)	2 (1)	12 (3)	
26-30	65 (31)	35 (17)	100 (24)	
31-35	79 (38)	92 (44)	171 (41)	
36-40	54 (26)	60 (29)	114 (27.5)	
>40	0 (0)	19 (9)	19 (4.5)	
Mother Age (years)				0.185
<25	25 (12)	20 (10)	45 (11)	
26-30	92 (44)	71 (34)	163 (39)	
31-35	79 (38)	92 (44)	171 (41)	
36-40	12 (6)	17 (8)	29 (7)	
>40	0 (0)	8 (4)	8 (2)	

[a]Presented as mean ± SD
[b]Presented as No. (%)
[c]P values <0.5 were considered statistically significant

Table 2. *Urinary and serum zinc levels in children with (n=208) and without (n=208) nephrolithiasis*

Variables	Zinc Levels in Children		P Value[b]
	Case Group	Control Group	
Urinary	172.3 ± 6.1	103.2 ± 8.1	0.021
Serum	123.4 ± 40.9	118.2 ± 38.1	0.3

[a]The values are presented as Mean ± SD

[b]P values <0.5 were considered statistically significant

higher in case group but we could not saw statistically significant difference in two groups (P=0.3) .

Discussion

Our results showed correction between urinary Zinc level and nephrolithiasis but about serum Zinc levels in two groups, we have not statistically significant differences. Rangnekar et al. [11] in a study entitled, Serum and Urinary Zinc Levels in Urolithiasis they were measured blood serum and urinary zinc levels in 30 normal healthy controls and 42 stone forming patients (renal, ureteric and vesical) and have be found Statistically significant levels in all groups, varying according to the number of calculi also they observed increased urinary zinc levels and decreased serum zinc levels, secondary to the process of stone formation [11]. In another study by Habibian et al. [12] efficacy of Zinc Sulphate Syrup on respiratory tract infections have evaluated, they observed a beneficial efficacy of Zinc supplementation in fever duration, but about cough, bed rest duration and respiratory rate they cannot observe this efficacy. In a study by Tang et al. [13], they have reviewed dietary Zinc intake (DZI) and its effects on nephrolithiasis; they concluded that higher DZI can increase risk of kidney stone formation [13]. Mahyar et al. [14] in a study about acute pyelonephritis and Zinc have been reached to relation between Zinc and pyelonephritis and potential role of Zinc in acute pyelonephritis pathogenesis. In a study entitled "Oral Zinc Sulfate as Adjuvant Treatment in Children with Nephrolithiasis: a Randomized, Double-Blind, Placebo-Controlled Clinical Trial" who have been conducted by Yousefichaijan et al. [15], they concluded, zinc adjuvant than consecutive approach have not more efficacy in nephrolithiasis. However, because of few clinical studies have been carried out regarding, impact of serum and urine Zinc level in nephrolithiasis, further studies will be needed.

Conclusion

Our results showed that the urinary Zinc level were higher in case rather than control group, as a significant statistically difference in two groups, but, although serum Zinc level in case group were higher, there is not significant statistically differences; therefore, other studies with larger sample size are required.

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