Comparison of urinary sodium and potassium in children older than two with idiopathic hypercalciuria and a healthy control group in Bandar-Abbas, Iran, in 2013

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Abstract

Background: Idiopathic hypercalciuria is an important cause of symptoms related to the urinary system. The urinary excretion of high sodium and low potassium is a risk factor for hypercalciuria and urolithiasis. The aim of this study was to compare the urinary excretion of sodium and potassium by children older than two with idiopathic hypercalciuria and healthy control children in Bandar-Abbas, Iran.

Methods: This case control study was conducted during 2012 and 2013 in Bandar-Abbas, a city in southern Iran. The urinary excretion of sodium and potassium by 50 children with idiopathic hypercalciuria who were older than two was compared with that of 62 healthy children. IBM SPSS Statistics 21 software was used to analyze the data, and P < 0.05 was considered to be significant.

Results: Fifty children with idiopathic hypercalciuria (21 males and 29 females) were compared with 62 healthy children (19 males and 43 females). The results of the study indicated that there were no significant differences in the mean sodium and potassium levels in the urine of the two groups of children (P = 0.401 and P = 0.479, respectively.)

Conclusion: The study showed no significant differences in the excretion of sodium and potassium in the urine of children with idiopathic hypercalciuria and that of healthy children in Bandar-Abbas. This finding was inconsistent with the results of similar studies conducted earlier. Therefore, more studies are needed on populations in different areas with various climates and difference races.

Keywords: idiopathic hypercalciuria, urine, sodium, potassium

Additional Information for citing this article:
Title of Journal: Electronic physician; Abbreviated title of journal: Electron. Physician
doi: 10.14661/2014.872-876

Editorial information:
Type of article: Original
Received: May.20.2014
Revised: June.18.2014
Accepted: June.22.2014
Published: July.01.2014
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1.2. Statement of Problem
To determine the excretion of Ca in the urine accurately, urine output must be collected over a 24-hour period, but this is difficult to do with small children. Therefore, several studies have reported that the calcium to creatinine ratio (Ca/Cr) in urine is accurate enough to be used as an alternative to collecting urine from children over a 24-hour period (4, 5). A Ca/Cr ratio in urine of 0.21 or greater is considered to be the cut-off point for this test (1). Children with higher measures are suspected of having idiopathic hypercalciuria. Although these patients are often asymptomatic, they may present with dysuria, frequency of urination, urolithiasis, enuresis, and other symptoms related to the urinary system (6, 7). The excretion of Ca in urine is influenced by ethnicity, nutrition, water consumption, geographical area, and exposure to sunlight (6). The amount of Ca excreted in the urine is influenced by other electrolytes, such as potassium, sodium, and phosphorus and by other factors, such as the amount of protein intake. Tubular Ca absorption can be inhibited by increasing the amount of oral or intravenous sodium chloride intake. Also, it seems that an increase in the K intake may be beneficial for children with idiopathic hypercalciuria (8-10). However, the results of studies concerning the levels of urinary excretion of Na and K by children with idiopathic hypercalciuria are inconsistent. Therefore, the levels of Na and K excreted in the urine should be measured in patients with idiopathic hypercalciuria to aid in the achievement of diagnostic and therapeutic objectives.

1.3. Objectives
The general objective of this study was to compare the quantities of sodium and potassium excreted in the urine of children older than two who have idiopathic hypercalciuria in the urine of a control group of healthy children in Bandar-Abbas, Iran. The following are the specific objectives of the study:

- To compare the urinary Na excretion in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary K excretion in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary Na/K excretion ratio in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary Na/Cr excretion ratio in children with idiopathic hypercalciuria with that of healthy children
- To compare the urinary K/Cr excretion ratio in children with idiopathic hypercalciuria with that of healthy children

2. Material and Methods
2.1. Study settings
This case-control study was conducted during 2012 and 2013. Fifty children who ranged in age from two to 14 with confirmed idiopathic hypercalciuria and 62 healthy children in the same age range were enrolled in the study. The Bandar-Abbas Children’s Hospital is the main educational and referral hospital in the field of pediatric disease, and it was the nephrology clinics in this Hospital that confirmed idiopathic hypercalciuria in the case group of children.

2.2. Sample size
Considering the difference of 1.1 mmol/kg/day of Na excreted in the urine of the two groups of children, the standard deviation of 1.4, and 2.3 mmol/kg/day of Na excreted by children with idiopathic hypercalciuria and children in the healthy group in previous studies (11), it was calculated that the sample size had to be at least 49 children in each group (Type 1 error = 0.05 and type II error = 0.20).

2.3. Case selection
The case group was selected among children in the age range of two to 14 who had confirmed idiopathic hypercalciuria. The ages of the children selected for the control group were in the same range as those in the case group. A written informed consent was obtained from the parents of the children. The exclusion criteria of study were thyroid and parathyroid disorders, renal tubular acidosis, chronic renal failure, chronic bone disease, and the use of drugs that alter the metabolism of bone, such as corticosteroids, diuretics, and anticonvulsants.

2.4. Laboratory tests
Urine samples were analyzed for sodium and potassium with an ion-selective electrode Easy life device. Calcium in the urine was measured with a photometric method by using the ARSENASO III, and the creatinine in the urine was measured with the JAFFE method with a wavelength of 50 nm. The reference value for Na was less than 2.3 mg/dl, the reference value for K was more than 3.91 mg/dl, and the Na/K ratio was in the range of 0.5-2.5 mmol/day.
2.5. Statistical analysis.
The data were analyzed using IBM SPSS Statistics 21 software and descriptive statistics (mean, standard deviation, and frequency), the Shapiro-Walik test (for the assessment of the normality of the distribution of Na, K, Na/K, Na/Cr, and K/Cr in the urine), independent Samples T test (to compare the Na excreted in the urine of the two groups), and the Mann-Whitney test (to compare the excretion of K, Na/K, Na/Cr, and K/Cr in the urine of the two groups). Also the chi-square test was used to compare qualitative variables between the two groups. P values < 0.05 were assumed to be significant.

3. Results
One hundred and twelve children were enrolled in this study, including 40 males (35.7%) and 72 females (64.3%). The children were divided into three separate age groups. Sixty-seven of the children (59.8%) were between two and six years old. Also, 32 of the children (28.6%) were between six and 10 years old, and 13 (11.6%) were between 10 and 14 years old.

The mean K level was 58.81 ± 46.08 mEq/L, and the K level was not normally distributed among the study’s participants (Shapiro-Wilk test P value < 0.01). Also the mean sodium excretion in urine was 132.62 ± 68.92 mEq/L, and it was normally distributed among the study’s participants (Shapiro-Wilk test P value = 0.135). Table 1 shows that the two groups were similar based on gender and age groups. The excretion of Na and K and Na/K ratio in the urine were not significantly different between the two study groups. However, the Na/Cr and K/Cr ratios were significantly greater in the children who had idiopathic hypercalciuria than they were in the control group. Details are shown in Table 2 and Table 3.

Table 1. Frequency of different genders and age groups in study groups

|                | Control | Case | Chi-Square P value |
|----------------|---------|------|--------------------|
| Gender         |         |      |                    |
| Male           | 19 (30.6%) | 21 (42%) | 0.212             |
| Female         | 43 (69.4%) | 29 (58%) |                |
| Age group      |         |      |                    |
| 2-6            | 38 (61.3%) | 29 (58%) | 0.732             |
| 6-10           | 16 (25.8%) | 16 (32%) |                |
| 10-14          | 8 (12.9%) | 5 (10%)  |                |

Table 2. Comparison of urine Na excretion between case and control group

|                | n   | Mean ± SD   | Independent Samples T test P value |
|----------------|-----|-------------|-----------------------------------|
| Urine Na excretion | Control | 62 | 137.56 ± 73.59 | 0.401 |
|                 | Case  | 50 | 126.50 ± 62.85 |

Table 3. Comparison of urine K, Na/K, Na/Cr, and K/Cr excretion between case and control group

|                | n   | Mean Rank | Sum of ranks | Mann-Whitney test P value |
|----------------|-----|-----------|--------------|--------------------------|
| Urine K excretion | Control | 62 | 54.55 | 3382 | 0.479 |
|                 | Case  | 50 | 58.92 | 2946 |            |
| Urine Na/K excretion ratio | Control | 62 | 60 | 3720 | 0.204 |
|                 | Case  | 50 | 52.16 | 2608 |            |
| Urine Na/Cr excretion ratio | Control | 62 | 48.09 | 2981.50 | 0.002 |
|                 | Case  | 50 | 66.93 | 3346.50 |            |
| Urine K/Cr excretion ratio | Control | 62 | 48.78 | 3024.50 | 0.005 |
|                 | Case  | 50 | 66.07 | 3303.50 |            |

4. Discussion
4.1. Level of Na excreted in urine
The finding in our study showed no significant difference in the amount of Na excreted in the urine of the children with and without idiopathic hypercalciuria. This finding was in disagreement with the findings of Rodriguez et al. (12), Kovacevic (13, 14), Polito (11), and Honarpisheh (15), all of whom reported increased levels of sodium excreted in the urine of hypercalciuric children. These findings do not support our hypothesis about the difference between urinary excretions of Na and K in children with and without idiopathic hypercalciuria. Several factors may

have affected our results. Nutritional and climate factors are important variables that could account for the differences between our results and the results of similar studies.

4.2. Excretion level of K in urine
We found no significant difference in the levels of excreted K in the urine of children with and without idiopathic hypercalciuria. This finding was in disagreement with the finding of Rodriguez et al. (12). In the Polito study in 2002 (11), there was no difference in the excretion of potassium in the urine of hypercalciuric and healthy children; our findings were in agreement with these results. The results of various studies on the excretion of K in urine are inconsistent. In addition to climate and nutritional variations, body mass index is also an important factor that potentially could alter the amount of K excreted. Also, the male to female ratio have a significant effect on the amount of K excreted in urine due to the greater body mass index and muscular mass among the males.

4.3. Excretion levels of Na/K in urine
Based on our findings, there was no significant difference in the Na/K excretion ratio between children with idiopathic hypercalciuria and the healthy children in the control group. Although most studies have reported higher levels in children with idiopathic hypercalciuria, some studies have reported lower levels in such children (16). As discussed above, there are some controversies about the levels of the Na/K ratio in normal children and children with idiopathic hypercalciuria. Therefore, studies with larger sample sizes are needed in different areas and for different races.

4.4. Excretion levels of Na/Cr and K/Cr in urine
In our study, the Na/Cr excretion ratio in urine was greater in children with idiopathic hypercalciuria than in the children in the control group. The results of our study showing that there was a direct relation between the Ca/Cr ratio and the Na/Cr ratio in urine were compatible with the results of a study conducted by Erol et al. in 2001-2002 in Turkey (17). Our results showed that patients with idiopathic hypercalciuria had greater K/Cr ratios in their urine than the children in the healthy control group, but this finding was not compatible with the findings by other researchers who have reported lower K excretion in children with idiopathic hypercalciuria (12). Various studies have shown that the Na/Cr ratio is greater in the urine of children with idiopathic hypercalciuria. However, our results are not compatible with this, and we recommend more studies to confirm these results.

5. Conclusions
The study showed no significant difference in the excretion of sodium and potassium in the urine of idiopathic hypercalciuria and the urine of the healthy children in the control group in Bandar-Abbas. The results of our study could have been affected by nutrition and geographical variations in the different areas. Therefore, more studies are needed in this field in different areas in Iran.

Acknowledgments:
This article was extracted from a thesis prepared by Dr. Elham Ajdadi to fulfill the requirements of his residency course for earning his degree in Pediatric Diseases. This study was conducted with financial support provided by the Hormozgan University of Medical Sciences.

Conflict of Interest:
There is no conflict of interest to be declared.

Authors' contributions:
All of authors contributed to this project and article equally. All authors read and approved the final manuscript.

References:
1. Safaei Asl A, Heidarzadeh A, Maleknejad S, Moradi B. Hypercalciuria in school-aged children of Rasht: a single-center study. Iranian journal of kidney diseases. 2013;7(4):265-7. Epub 2013/07/25. PMID: 23880802.
2. Manz F, Kehrt R, Lausen B, Merkel A. Urinary calcium excretion in healthy children and adolescents. Pediatr Nephrol. 1999;13(9):894-9. Epub 1999/12/22. http://dx.doi.org/10.1007/s004670050723. PMID: 10603144.
3. Akl K, Ghawanmeh R. The clinical spectrum of idiopathic hyperuricosuria in children: isolated and associated with hypercalciuria/hyperoxaluria. Saudi Journal of Kidney Diseases and Transplantation: An official publication of the Saudi Center for Organ Transplantation, Saudi Arabia. 2012;23(5):979-84. Epub 2012/09/18. http://dx.doi.org/10.4103/1319-2442.100879. PMID: 22982910.

4. Esfahani ST, Madani A, Siadati AA, Nabavi M. Prevalence and symptoms of idiopathic hypercalciuria in primary school children of Tehran. Iranian Journal of Pediatrics. 2007;17(4):353-8.

5. Heiliczer JD, Canonigo BB, Bishop NA, Moore ES. Noncalciu urinary tract disorders secondary to idiopathic hypercalciuria in children. Pediatric clinics of North America. 1987;34(3):711-8. Epub 1987/06/01. PMID: 3295723.

6. Ahmadzadeh A, Hakimzadeh M, Safa-Abadi A. Idiopathic hypercalciuria in Iranian children. Iranian Journal of Pediatrics. 2008;18(2):163-6.

7. Alon US, Berenbom A. Idiopathic hypercalciuria of childhood: 4- to 11-year outcome. Pediatr Nephrol. 2000;14(10-11):1011-5. Epub 2000/09/07. http://dx.doi.org/10.1007/s004670050064. PMID: 10975318.

8. Nordin BE, Need AG, Morris HA, Horowitz M. The nature and significance of the relationship between urinary sodium and urinary calcium in women. The Journal of Nutrition. 1993;123(9):1615-22. Epub 1993/09/01. PMID: 8360790.

9. Osorio AV, Alon US. The relationship between urinary calcium, sodium, and potassium excretion and the role of potassium in treating idiopathic hypercalciuria. Pediatrics. 1997;100(4):675-81. Epub 1997/10/02. http://dx.doi.org/10.1542/peds.100.4.675. PMID: 9310524.

10. Srivastava T, Alon US. Pathophysiology of hypercalciuria in children. Pediatric Nephrology. 2007;22(10):1659-73. http://dx.doi.org/10.1007/s00467-007-0482-6. PMID: 17464515.

11. Politó C, La Manna A, Maiello R, Nappi B, Siciliano MC, Di Domenico MR, et al. Urinary sodium and potassium excretion in idiopathic hypercalciuria of children. Nephron. 2002;91(1):7-12. Epub 2002/05/22. http://dx.doi.org/10.1159/000057598. PMID: 12021513.

12. Rodriguez-Soriano J, Ubetagoyena M, Vallo A. Renal potassium excretion is reduced in children with idiopathic hypercalciuria. Miner Electrolyte Metab. 1991;17(6):357-61. Epub 1991/01/01. PMID: 1823384.

13. Kovacevic L, Kovacevic S, Smoljancic Z, Kostic M, Peco-Antic A, Gajic M, et al. [Renal tubular function in children with hypercalciuria]. Srpski arhiv za celokupno lekarstvo. 1998;126(7-8):223-7. Epub 1998/12/24. Funkcije tubula bubrega kod dece s hiperkalciurijom. PMID: 9863386.

14. Kovacević L, Kovacević S, Smoljanić Z, Peco-Antić A, Kostić N, Gajić M, et al. Sodium excretion in children with lithogenic disorders. Srpski arhiv za celokupno lekarstvo. 1998;126(9-10):321. PMID: 9863402.

15. Honarpisheh A, Hooman N, Taghavi A. Urinary calcium excretion in healthy children living in Kashan/Iran. Iranian Journal of Pediatrics. 2009;19(2):154-8.

16. Nikibakhsh A, Seyedzadeh A, Mahmooodzadeh H, Yekta Z, Zadieh M, Karamyar M, et al. Normal values for random urinary calcium to creatinine ratio in Iranian children. Iranian Journal of Pediatrics (Persian edition). 2008;18(3):263.

17. Erol İ, Buyan N, Özkaya O, Şahin F, Beyazova U, Söylemezoğlu O, et al. Reference values for urinary calcium, sodium and potassium in healthy newborns, infants and children. Turkish Journal of Pediatrics. 2009;51(1). PMID: 19378884.