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Research Article

Effect of Immobilization on Emerging of Hypercalciuria in Patients Admitted to Pediatric Intensive Care Unit

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Abstract

Purpose: Hypercalciuria as a common phenomenon in the normal population is associated with several complications such as urinary tract infections, colic pains and stone formation. In this study, our aim was to investigate association of immobilization and the incidence of hypercalciuria among children.

Methods: Forty seven children who were active before the study over 2 years were hospitalized and immobilized in intensive care unit of hospital based on type or severity of illness. Calcium/ creatinine ratio was evaluated, the rate of over 0.21 was considered as hypercalciuria. In 40 healthy children, this value was determined and compared by statistical methods of Paired t-test and independent t –test. P values less than 0.05 was considered as statistically significant.

Results: The prevalence of hypercalciuria in immobilized patients was significantly higher than that of the control group after 7 days, which was 37% versus 10% respectively. The rate rose from 37% to 53%, which was not statistically significant .Immobilization alone in the inception of hospitalization (first 48 hours) was associated with impaired calcium excretion in the urine. Urinary tract infection as a complication of hypercalciuria in patients and controls group such as hypercalciuria and uncommon calcium excretion was not normal, but microscopic hematuria was observed in patients with hypercalciuria in about 2.1 items.

Conclusion: The hypercalciuria in the immobilized children was significantly more than in the normal children. One of the most common causes of microscopic hematuria in the immobilized patients was hypercalciuria.

Introduction

Hypercaciuria is urinary excretion of calcium. Its rate is above 4 mg per kilogram of bodyweight in 24 hours or a calcium to urine creatinine ratio of more than 0.21 [1-2]. It may cause hematuria, impaired elimination, flank or abdominal pain, kidney stones, urinary tract infection and loss of bone density. [3] Hypercalciuria prevalence varies in different studies, although according to published studies, 2.9 to 6% of children are healthy, which can cause hematuria dysuria and urgent need to urinate (urgency), and urinary tract infections and kidney stones. Although hypercalciuria may be sporadic or inherited , idiopathic hypercalciuria is the most common form. In our country its prevalence varies in different regions [4-6]. Secondary causes of hypercalciuria include a high intake of sodium, prolonged use of corticosteroids or diuretics, calcium and vitamin D intake, chronic metabolic acidosis and phosphate deficiency, which can cause hypercalciuria by stimulating the production of vitamin D [4]. Although some studies showed nutritional risk factors [7] and immobile lifestyle [8] as causes of hypercalyuria, these are seen rarely in children, especially in children admitted to intensive care, that are in special catabolic state and are not able to bear his or her weight due to the disease. Calcium is the most abundant electrolyte in the body and about 99% of it exists in bones and the rest in organs and soft tissues and Extracellular fluid. In growing people, due to an ever need of body to clacium , the pneumatic calcium balance must be positive to be in accordance with the requirements of skeletal growth. In adults, calcium balance is zero and with aging the balance will increase negatively [9]. Prolonged immobility can lead to hypercalcemia and hypercalciuria and osteoporosis. Although the exact mechanism is not clear, this problem is associated with suppressing parathyroid and 1-25 Hydroxy vitamin D, that is, a form of hypercalcemia of bone dissolution (resorptive hypercalciuria). The immobilization through dissolution of bone that causes hypercalcemia and hypercalciuria in children can be a rapid process. It was reported that 2 stones were formed in the left kidney of a child aged 10 after 8 days of immobilization [10].

presence of stasis in immobilization is a cause of kidney stones and it is said that patients taking potassium citrate and magnesium are at risk [11]. Korkes et al. conducted a 16-weekly period of study on motionless patients with hip dysplasia and Legg-Calve-Perthes disease. within 7 days, urinary calcium excretion in patients days increased to 2/3 times of the normal level, but the serum parameters such as calcium, phosphorus, alkaline phosphatase, and parathormone did not change during the study and no stone was found in the patients' sonography [8-12].

In another study, Moreno assessed 4 ill and immobile children. The authors observed hypercalcemia in that the total calcium serum of these patients was between 12.2 to 13.4 mg/ deciliter who answered only to the administration of calcitonin [13].Ralf.S. Goldsmith conducted a study on 6 patients with fractures and immobility and

administered phosphate oral compositions and compared the results with the control group. The authors demonstrated that the amount of calcium in the urine decreased, calcium was balanced and none of them passed crystal in urine [14] .

Importance of immobility was determined through a case study conducted by Stiller. The condition associated with recurrent urinary tract infections that generally has been with Proteus causes formation of stag horn stones [10]. so the vicious cycle of infection and immobilization hypercalciuria and new large stones cause more problem in emotionalized patients [12].The aim of this study was to determine the rate of hypercalciuria in patients admitted to pediatric intensive care unit.

Methods

The target population was selected from patients admitted to pediatric intensive care unit, with age of more than 2 years old. The laboratory standards of hypercalciuria were defined these children. According to previous studies, an investigation period of one week was determined. The study was initiated in February, 2010 and completed by the end of March, 2011.The first study was done on arrival by carrying out tests of serology of calcium, phosphorus, alkaline phosphatase and blood urea and venous or arterial blood gas analysis and urine test of calcium and creatinine. Since the samples were known by calcium random to creatinine in children as a very useful and reliable method to assess daily hypercalciuria, these tests were repeated again on the seventh day. Calcium to creatinine ratio of urinary random over 0.21, which is known as hypercalciuria. in this case, the calcium of urine of 24 hours was checked after 24 hours.

Exclusion Criteria

patients taking medications that might interfere with calcium excretion like steroids, and diuretics (prior to or during hospitalization), calcium and vitamin D; (36-35) and cases with a history of chronic diseases that are motionless or malabsorption that can cause hypercalciuria and kidney stone formation, such as fibrocystic patients were excluded from this study. Regular sampling was done from patients who were admitted to the Intensive care unit and did not have previous history of renal diseases (congenital lesions or glomerulonephritis or previous surgery such as nephrectomy) and kidney stones and were not motionless before the admission. Sampling conditions were the same for all the patients in the first and seventh days.

Control group consisted of healthy and active children older than 2 years who did not have a history of renal disease and outpatient children who were admitted to the hospital for checking their health status. A sample of urinary Random was controlled with calcium creatinine indices. In the case of patients intake steroids, diuretics, vitamin D and calcium and also patients with exclusion criteria were excluded.The results of the tests based on the chart and percentage were determined and recorded in the beginning (0) and after 7 days (1). These percentages were compared with each other and those of the control group, separately. Where the calcium urinary random was above 0.21 and daily urinary calcium of over 4 mg per kg of body weight was considered as hypercalciuria. Sampling conditions were similar in all groups. The categorical variables were analyzed using chi square. Quantitative variables were analyzed by Paired T test and Independent T test and in the linear relationship between time variables and hypercalciuria by Pearson method. The Data were analyzed by the SPSS Package (version 16). P values less than 0.05 was considered significant. The control group consisted of 40 healthy children were randomly selected. The mean age was 82± 37 months. (A Minimum age of 24 months and a maximum age of 15 months).

Results

Thirty seven children were enrolled in this study including 16 girls and 21 boys with a mean age of 66 ±43 months at the entry (a minimum age of 24 months and maximum age of 156 months). The patients were hospitalized due to different causes on arrival including 15 cases of burns, 7 cases of pulmonary disease, 14 cases of acute central nervous system disease and 1 case due to caustic ingestion; and none of the patients had symptoms of renal diseases in his/her history.

Among the 37 patients on admission to the intensive care unit, 14 patients (equivalent to 37%) had hypercalciuria significantly. the prevalence increased after 7 days and was as much as 53% that was not statistically significant (p=0.29). the total number of cases of hypercalciuria was 34 according to calcium to creatinine ratio on urinary random and the 24-hour urinary calcium.

Hypercalciuria prevalence was 10% in the control group. Difference in the prevalence of hypercalciuria in the patients in intensive care units and the control group was statistically significant (P = 0.04). The total number of hypercalciuric patients were 4 in the control group based on urinary random calcium to creatinine.

The mean calcium excretion in the patients on arrival was 0.3 according to the ratio of calcium to creatinine in random and after 7 days was 0.37, (SE-0.08); the difference was not statistically significant. This ratio in the control group was 0.15, as compared with the patients; the difference was statistically significant (P = 0.001).

In the initial experiments on the first day and the seventh day, there was not any case of hypercalcemia although the mean serum calcium levels on Day 7 was slightly higher than the initial; however, this difference was not significant (P = 0.22), the values of serum urea, creatinine on the first day and seventh day had no significant differences and there was no case of renal failure.

The severity of hypercalciuria based on the disease was different, the highest number in status epileptics and encephalopathy (0.42) and then burn (0.33) and finally pulmonary disease (0.2) was observed. On Days 1,7 and 12, patients had normal calcium excretion. Hypercalciuria was found in 14 cases in the first. two cases improved and 12 cases were still hypercalciuric. Eight patients who initially had normal excretion of calcium were hypercalciuric.

The incidence of hematuria in the patients with high calcium excretion on the first day was 14 patients who had hematuria in 5 patients (35.7%) and on the seventh day of the 20 patients with hypercalciuria (Microscopic hematuria is called equal or greater than 5 red blood cells per microliter of urine and hematuria Gross is called, the number of red blood cells per microliter of urine is above 50.

There were 4 cases of hematuria (45%). On the first day, of the 23 patients who had hypercalciuria, 6 patients had hematuria (26%); however, on the seventh day, there was 3 cases of hematuria among 17 cases of hypercalcyuria (17.6%). In the control group, there were no cases of hematuria. There was no platelet dysfunction in the patients with hematuria.

during the investigation In patients with Hypercalciuria there was no case of urinary infection

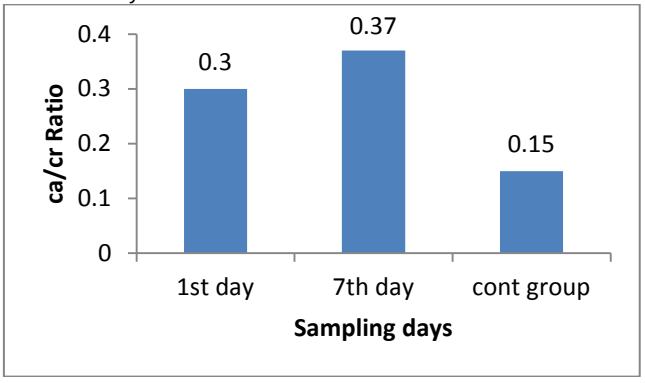

Figure 1. Average urine ca/cr in 1st day and 7 th day and control group.

Discussion

Urinary stones are generally found in youth (especially males) [15-17], although in some studies, sex does not affect its rate [18]. This complication in children varies in different studies, and the incidence has also been reported to vary between 2-7% and up to 10% [16]. Its prevalence is related to age, diet, lifestyle, genetic and geographical attribute as their prevalence is high in Japan and in the Aral mountains (42 to 44). In Iran, the prevalence varies in different regions. Its prevalence in Urmia is 11% and in Kashan is 5.3% [5-6], although these studies have been done on general active population and specific risk factors were not considered, as one of the most important factors is immobilization in chronic and immobilized patients

especially in sanatoriums. The immobilization is in fact a common complication in intensive care units. It means that the lack of activities that lead to weight bearing such as standing or sitting on the edge of a chair or bed. A study on healthy volunteers reported that the minimum period of immobilization that can be associated with complications was 48 hours, leading to hemodynamic abnormalities such and electrolytes excretion as calcium [22].

In another study published in 2004 by Kevin & Meyer, hypercalciuria was considered as an important factor in painless hematuria and in a study conducted on children visiting outpatient because of hematuria. Among the 325 patients studied by, 11% of them were hypercalciuric [23].Shane Roye at first did not find result in the investigatin of the cause of hematuria in 5 children, until 14-20 months after the first examination, each of these children eliminated stones or it was seen stone in the graph that this time after urine investigation of calcium all patients had hypercalciuria and after treatment with thiazide hypercalciuria and hematuria resolved in them [24].In this study, the hypercalciuria in the patients on admission to the pediatric intensive care unit was significantly higher than in the control group (44% vs. 10%). This difference was statistically significant (P = 0.0001). There was no significant difference in the mean calcium excretion at entry and at seventh day (0.3 vs 0.37), although the values were higher than the mean calcium excretion of the control group (0.15 vs 0.03). This difference was not significant (P> 0.05).Urinary tract infections were rare in both groups (controls and patients); no stone and urinary tract infection were found.

Although the incidence of hematuria in the patients with hypercalciuria was higher than in the patients with normal calcium excretion, all of these were microscopic hematuria forms. Gross hematuria was not seen in our patients; blood levels of calcium in our patients did not change during 7 days; and no hypercalcemia was observed in these patients. Indices of renal function including urea and creatinine during 7 days were not different and no case of renal failure was observed in this group. In our study there was no case of serum phosphorus impairment. (P = 0.14).

Conclusion

Intensive care unit admission alone is associated with a higher prevalence of hypercalciuria, The hypercalciuria in the immobilized children was significantly more than in the normal children. One of the most common causes of microscopic hematuria in the immobilized patients was hypercalciuria.

Limitations of the study: This study performed on the limited number of patients admitted to pediatric intensive care unit and thus cannot be generalized to the entire population.

Conflict of interests: The authors declare no conflict of interest.

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