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Metabolic stone composition in Egyptian children

Ashraf Aggour, Ali M. Ziada*, Ahmad Z. AbdelHamid, Sherif AbdelRahman, Ahmad Morsi

Department of Urology and Aboul-Riche Children's Hospital, Cairo University, Cairo, Egypt

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Abstract *Objective:* The composition of urinary stones in children depends on socioeconomic conditions, geography and dietary habits. Pediatric urolithiasis remains endemic in developing countries. The aim of this study was to analyze stone composition in an Egyptian patient population.
Patients and methods: We analyzed prospectively urinary stones from 100 consecutive children (73 males, 27 females), aged 14 months to 12 years. The stones were located in the upper urinary tract in 78%, lower urinary tract in 19% and both in 3%. Male patients had more lower urinary tract stones. On presentation 67% had flank pain and 37% had hematuria. Stones were treated by open surgery in 69% of patients, shockwave lithotripsy in 20% and endoscopic extraction in 13%.
Results: The components of the upper urinary tract calculi were calcium oxalate (47%), ammonium acid urate (26%) and calcium carbonate (21%), whereas the main components of the lower urinary tract calculi were ammonium acid urate (27.2%), struvite (27.2%) and calcium carbonate (22.7%). Urinary tract infection was involved in the development of one third of the stones. Endemic stones were present in 17% of patients, and stones of metabolic origin in 15%. The etiology of stone formation remained unknown in one third of patients.
Conclusion: The epidemiological profile of urinary stones in Egyptian children can now be considered intermediate between developing countries where dietary deficiencies are the main causes and developed countries where infectious and metabolic calculi are observed.

Introduction

In children, urolithiasis remains a significant problem with serious consequences. The types of stone formed depend mainly on the urine composition, which, in turn, reflects the type of diet consumed. In the pediatric population, nutritional and metabolic causes of tubular reabsorption can contribute to stone formation. In developing countries, nutritional factors can be a major factor in the formation of bladder stones in poor children. This is caused by a nutritionally poor acidogenic diet, high in cereal and low in animal protein, calcium and phosphate, which leads to the formation of urine with a relatively high content of

* Corresponding author. Tel.: +20 10 1001136; fax: +20 1 619 996 8026.
E-mail address: aziada@kasralainyurology.net (A.M. Ziada).

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ammonium and urate ions, and consequently to the formation of ammonium acid urate crystals and stones. In countries where there is also a high intake of oxalate from leaves and vegetables, urinary oxalate is increased and, as a result, the ammonium acid urate stones often contain calcium oxalate as well. The stone problem is compounded by low urine volumes resulting in some areas from poor drinking water, and chronic diarrhea, and in others from the hot climate and fluid losses through the skin. Calcium oxalate and uric acid stones are more frequent in males than in females whereas calcium phosphate and struvite stones are more prevalent in females [1,2].

Urolithiasis in the pediatric age group, although occurring less often than in adults, causes considerable morbidity [3,4]. In certain areas of the Near and Far East stones may affect more than 1 in 1000 children at risk [5]. The estimated population of the greater Cairo area <13 years is 4.5 million. However, it is hard to estimate the population served by the hospital because, as a tertiary care center, patients are referred from all over the country. Stone disease represents 12.6% of cases undergoing surgery at our pediatric urology unit. The aim of this study was to analyze stone composition in our patient population.

Patients and methods

This study involved 100 consecutive patients, aged between 14 months and 12 years, evaluated and treated between September 2005 and December 2006. Each patient was subjected to full clinical history, complete examination, and laboratory investigations (urine analysis, blood picture, blood urea and serum creatinine, urine culture and sensitivity whenever the urine is infected). Abdominal and pelvic ultrasonography were performed in uremic patients, patients presenting with acute retention of urine, and those complaining of abdominal pain or hematuria. IVU was used for patients who had stones in the upper urinary tract, evidence of hydronephrosis or hydroureter by ultrasound, and hematuria either gross or microscopic in the urine analysis. Our standard practice for children presenting with UTI includes urinalysis, urine culture and abdomino-pelvic ultrasound. In this series, 2% of patients were discovered incidentally on ultrasound done for other reasons. Patients with bilateral stones (14 patients) also underwent kidney function evaluation with either IVU or abdomino-pelvic ultrasound.

Stone analysis included gross picture of the stone, chemical analysis and character of the stone (unilateral or bilateral, single or multiple). Metabolic work up was done for patients suffering from multiple or bilateral renal stones. Metabolic work up included assessment of serum levels of blood urea nitrogen, creatinine, calcium and uric acid. Urinary 24-h collections were done for volume, pH, calcium, oxalate, citrate and uric acid. Ratio measurements were taken of calcium:creatinine, oxalate:creatinine and citrate:creatinine.

Management was determined depending on the site and size of the stone as well as age of the child. Patients with lower urinary stones underwent cystolithotomy in 22% of cases and urethral stone extraction was done in 1%. The choice of management of ureteric stones depended on the sex of the patient, the size of the stone and the laterality of the stone. Open ureterolithotomy was done in 9% of patients and 4% underwent ureteroscopy. The choice of management of renal stones depended on the age of the patient, site and size of the stone, intrarenal anatomy, stone distribution and presence of associated abnormality. Open procedures for kidney stones were done in 39% of patients, while 23% underwent ESWL (with an overall stone-free rate of 91.3%), and PCNL was used in 8%. Overall, surgery was required in 69%, ESWL in 20%, and endoscopy in 13% either through ureteroscopy or PCNL.

Results

The mean age of the patients was 5.8 years: 22% were less than 4 years, 61% aged from 4 to 8 years, and 17% more than 8 years. The main presenting symptoms were flank pain (67%), hematuria (27%) and dysuria (23%). Minor symptoms like vague abdominal pain, nausea and vomiting were present in 6% of patients. The location of the stone was in the upper urinary tract in 78 patients (78%) and lower urinary tract in 19 patients (19%).

Urolithiasis was more common in boys with a male:female ratio of 2.7:1. Patients with lower urinary tract stones included 16 boys and three girls. Fifty-five boys and 23 girls had upper urinary tract stones, and three patients had stones in both the upper and lower urinary tract (two males and one female). Table 1 shows the main components of urinary stones distributed according to patient gender. Fourteen patients presented with bilateral renal stones: 12 had stones of metabolic origin and the remaining two had

Table 1 Stone composition and location according to patient gender.

	Upper tract		Lower tract		Overall %
	Boys	Girls	Boys	Girls	
Calcium oxalate	21	8	2	0	30
Ammonium acid urate	10	3	4	1	17.5
Calcium oxalate + carbonate	4	5	2	0	10.7
Ammonium acid urate + calcium	6	3	1	0	9.8
Calcium carbonate	5	3	2	1	10.7
Magnesium ammonium phosphate	2	1	5	1	8.7
Calcium phosphate	6	1	1	1	8.7
Uric acid	2	0	1	0	2.9
Ammonium acid urate + protein	1	0	0	0	1