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Review

Paediatric urolithiasis in emerging economies

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HIGHLIGHTS

- Paediatric stone disease remains endemic in emerging economies.
- Hot climate, poor nutrition and diarrheal disease are the main causative factors.
- Ammonium hydrogen urate and calcium oxalate stones remain highly prevalent.
- Hypocitraturia is a major risk factor.
- MIS is now the mainstay of management of paediatric urolithiasis.

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ABSTRACT

Background: Paediatric urolithiasis remains endemic in low resource countries. This review highlights the epidemiology, causation and management of urolithiasis in an Asian country in the context of emerging economies.

Methods: A literature review of recent articles with key words paediatric urolithiasis, developing countries, endemic stone disease, stone composition, metabolic risk factors, management of paediatric urolithiasis was undertaken and 51 relevant articles were selected with the main focus on experience of this center in managing stone disease in the last two decades.

Results: Prevalence of paediatric urolithiasis is high upto 15% affecting children under 15 years with male predominance. Bladder stones still constitutes 10–70% of the burden. Etiology remains unknown where 55% are considered idiopathic, 25% metabolic, 7% infection and 12% due to anatomical abnormalities. Hot climate, poor nutrition, diarrheal diseases are the major causative factors. Chemical composition of stones showed CaOX in 30–63%, AAU in 17–55%, struvite in 8–9%, uric acid in 3–6% and cystine in 1%. Important metabolic risk factors are hypocitraturia in 63–87%, hyperoxaluria in 40–43%, hypocalciuria in 20%, hyperuricosuria in 27%, hyperammonuria in 11–51% and hypovolemia in 31%.

Minimally invasive surgery is the mainstay of surgical management. ESWL provides excellent free rates of 84% for smaller stones. PCNL is the option for majority of renal stones with success rates of 89% for simple and 71.5% for complex stones. For bladder stones PUCL and PCCL success rates were 100%. URS for ureteric stones showed clearance rate of 90%. Open surgery is required in 12% of patients with large stone burden.

Conclusion: Paediatric urolithiasis remains a devastating health problem in low resource settings. MIS offers relief to majority of patients with excellent stone free rates and short hospital stay. Preventable strategies have to be put in place by improving nutrition and eliminating risk factors by diet and medical intervention.

1. Introduction

Paediatric urolithiasis remains endemic in low resource countries, mostly situated in the geographical region of the world, dubbed “The Afro-Asian Stone Belt” [1]. The prevalence rates are

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high, with up to 15% of children under 15 years of age being affected, as compared to the 1–5% affected in developed countries [2–4]. Endemic bladder calculi continue to contribute a major proportion of stones in the developing world from 10% in Nepal [5], and 21% in Tunisia [6], to 18% in Pakistan [7] and 70% in Cameroon [8]. However, in recent years a number of countries (namely Afghanistan, Iraq, Iran, Turkey and Egypt) have reported reductions in bladder stones ranging between 2 and 10% [9–13]. In contrast to this bladder stones are rarely reported from the developed countries [14]. Paediatric urolithiasis remains a significant urological problem in this region contributing upto 60% of the urological work load in our center [2]. Furthermore, due to neglect 4–8% of cases present with end stage renal disease [7]. Most of the studies report male predominance [2,7,15–17]. The spectrum of paediatric urological workload from 1998 to 2015 recorded 21,390 patients where urolithiasis workload increased to 62% (Fig. 1).

This review presents the epidemiology of paediatric stones in emerging economies and focuses on the experience of our unit over the last 2 decades which indicates the spectrum of the disease, its devastating effects and the special issues in management of paediatric patients with stones in the context of a poor resource Asian country where the capita income is US$2535, expenditure on health is 1.3% of GNP and 60% of the people live below the poverty line on less than a dollar a day [18].

2. Epidemiology

The overall risk of forming a stone depends upon several factors-geographical region, race, gender, climate and dietary habits [1]. Etiologies remains largely unknown in emerging economies where 55% are considered idiopathic, 25% metabolic, 7% infection and 12% associated with anatomical abnormalities [2]. In Korea, urinary tract abnormalities were identified in 9.5% and infection in 10% [17], and in Turkey infection was reported in 20% [16].

In low resources countries, hot climate (with average temperature > 28 °C) [19] and poor nutrition are the major causes of urolithiasis. Acidogenic diets high in cereal, low in protein, calcium and phosphate; with high urinary ammonium and urate ions result in ammonium acid urate (AAU) stones. In other situations high intake of oxalate from leaves and vegetable increases oxalate excretion, resulting in a mixture of (AAU) and calcium oxalate (CaOX) stones [5,8,10–13,20,21].

3. Stone composition

Recent reports of stone analysis show continuing presence of AAU and CaOX in both renal and bladder stones [2,16,22]. In our study where core and surface of stones were analyzed. AAU was found in the core of 43% of renal and 38% of bladder stones [2]. These findings suggest a common cause of malnutrition, dehydration and recurrent diarrhea episodes for both renal and bladder stones. Of the different components CaOX was present in 30–63%, AAU in 17–58%, Calcium Phosphate (CaP) in 11–12%, Struvite in 8–9%, Uric Acid in 3–6% and Cystine in 1% [7,22]. This contrasts from developed countries where calcium oxalate constitute 63% and the rest CaOX + CaP in 30%, struvite in 4% and cystine in 2% [23]. In our study of 2039 stones, 726 (36%) were composed purely of a single compound and the rest 64% were mixtures. Composition of pure 570 renal stones showed variation in different age groups. In age group <5 years AAU was found in 65% and CaOX in 18%, in age group 6–10 years, AAU in 19% and CaOX in 61% while in >10 years CaOX was found in 70%, AAU in 10% [7].

4. Metabolic risk factors

Evaluation of urinary risk factors are important in the treatment and prevention of urolithiasis, especially in children where risk factors are identified in majority and can be corrected by dietary and medical intervention [7]. In our center, two separate studies evaluating urinary risk factors in stone formers hypocitraturia was found in 63–87%, hyperoxaluria in 40–43%, hypercalciuria in 11–26%, hypocalciuria in 20%, hyperuricosuria in 26–27%, hyperammonuria in 11–51% and low urinary volume in 9–31% of the children [2,7]. A study from Turkey showed hypercalcuria in 41%, hypocitraturia in 40%, hyperoxaluria in 22% and hyperuricosuria in 9% and cystinuria in 4% [16]. A recent study identified risk factors in genders and different age groups showed similar risk factors in males and females except higher rates of hyponatriuria, hypophosphaturia and hypocalciuria in

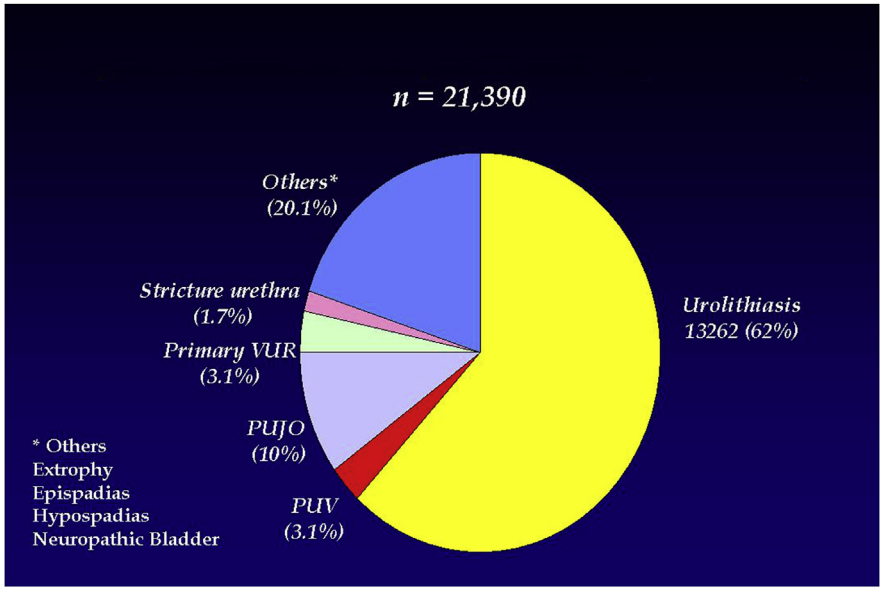

Fig. 1. Paediatric Urological Workload (1998–2015) n = 21,390.