

## ORIGINAL ARTICLE

## CHILDHOOD BLADDER STONES-AN ENDEMIC DISEASE OF DEVELOPING COUNTRIES

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**Background:** Bladder calculi are one of the commonest health problems in young children especially in rural and underprivileged areas. **Methods:** All children of bladder stones operated at District Headquarter Hospital Mithi from July 2009 to June 2012 were included in this cross-sectional study. Data was collected regarding age, sex, address (rural or urban), body weight, duration of breast feeding, weaning, detailed dietary history regarding milk type, volume, amount of water intake, recurrent diarrhoea, urinary tract infection (UTI), family history, and socioeconomic history. Urine analysis, complete blood count (CBC), renal function, ultra sound abdomen, X-ray kidney, ureter, and bladder (KUB) was done in all patients. All patients had cystolithotomy and were followed up till complete recovery. **Results:** A total of 113 children (97 males and 16 females) operated at District Headquarter Hospital Mithi Tharparker were included in study. All patients belonged to local desert areas of Tharparker. Age ranged from 18 months to 14 year (mean age 8.6 year). Most frequent symptom was difficulty in micturition in 76 (67.25%) patients, urinary retention in 18 (15.9%) and stone with pyuria and fever in 12 (10.6%) patients. Recurrent episodes of diarrhoea (more than 3 episodes per year) in 73(65%) patients, recurrent UTI in 51 (45.6%), family history of stone disease in 6 (5%) and associated rectal prolapse in 3(2.6%) patients. On x-ray KUB 111 (98%) patients had single stone in bladder, 2 (2%) had multiple stones and an associated renal and ureteric stone in 5 (4.5%). Mild anaemia (Hb 7–10 gm%) was seen in 35 (39.55%) patients, moderate anaemia (Hb 5–7 gm %) was seen in 21(24%) and severe anaemia (Hb less than 5 gm%) was seen in 14 (16%) patients. All patients had open cystolithotomy for removal of stones under general anaesthesia. **Conclusion:** Bladder stones are public health problem. Majority of affected patients were less than 5 years old. Low protein diet, dehydration, use of goat milk and poor socio-economic conditions were major risk factors identified for development of bladder stones.

**Keywords:** Stone disease, endemic, bladder stones

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## INTRODUCTION

Urinary stone disease is a common occurrence of modern society that has been described since antiquity. In the US the prevalence of stone disease is 10–15%.<sup>1</sup> Bladder calculi account for 5% of urinary calculi. Children remain at high risk for developing bladder stones in endemic areas.<sup>2</sup> Bladder calculi in children in the absence of obstruction, infection or neurogenic disease are considered to be endemic.<sup>3</sup> In the 19<sup>th</sup> century, bladder calculi accounted for 80% of urolithiasis in Europe. Paediatric bladder stones have been a very frequent disease worldwide; including Europe until 20<sup>th</sup> century.<sup>4</sup> Now endemic bladder stones (uric acid and ammonium acid urate) are rare in the United States.<sup>5</sup> During the last 40 years the incidence of bladder stone in childhood has decreased strikingly and they are now primarily confined to a broad belt running from North Africa to India and Indonesia.<sup>6</sup> However it continues to be a serious public health problem in resource poor setting notably in the Middle East, Africa and South East Asia the so called Afro-Asian stone belt.<sup>7,8</sup> In these

areas of endemic bladder stones, boys are affected more than girls with peak incidence at 5 year of age.<sup>9</sup>

Most vesical calculi are formed *de novo* with in bladder. In adults most common type of vesical stone is uric acid. Less frequently bladder calculi are composed of calcium oxalate, calcium phosphate, and ammonium urate or ammonium phosphate when associated with infection.<sup>10</sup> In children stones are composed mainly of ammonium acid urate, calcium oxalate, or an impure mixture of ammonium acid urate and calcium oxalate and calcium phosphate.<sup>11</sup>

The common link among endemic areas relates to feeding infants human breast milk and polished rice. These foods are low in phosphorus, ultimately leading to high ammonia excretion. These children also usually have a high intake of oxalate rich vegetables (increase oxalate crystalluria) and low animal proteins (low dietary citrate).<sup>12</sup>

Aetiology and mechanism of endemic stones are presumed to be multifactorial, but remain unclear. Higher prevalence of stone disease found in hot, arid or dry climate like mountains, desert or tropical area.

Incidence, prevalence and risk of stone disease are directly related with weight and body mass index in both sexes. Malnourished children with low body mass index (BMI) are more prone to develop bladder stones. In many countries like Thailand, India, and Pakistan an association between childhood bladder stone and famine, drought and vegetarian diet has been documented, a link supported by a dramatic decline in prevalence with improvement in child nutritional status.

Stone formation results from dietary and nutritional deficiencies. Children in endemic areas are dependent on cereal based diet that is lacking in animal proteins; especially goat and cow's milk.<sup>8</sup> Cereals commonly used are whole wheat, flour, millet and rice. Less than 25% of total protein intake is of animal origin. Human breast milk and foods such as polished rice and cereals are low in phosphorus. Chronic dehydration, excessive protein or oxalate consumption, vitamin A, B, B6 and magnesium have been associated with stone formation.

Common symptoms are vague abdominal pain, hypogastric discomfort, interruption of urinary stream, pulling and rubbing of penis. Some children present with dysuria, frequency and dribbling or retention of urine. Rectal prolapse may be associated. Endemic calculi are mostly solitary and rarely reoccur once removed. In our study we are looking at the associated risk factors related with development of bladder stones in paediatric population which seems like an endemic disease. This will help us to take preventive measures.

## MATERIAL AND METHODS

All children of bladder stones operated at District Headquarter Hospital Mithi from July 2009 to June 2012 were included in this cross-sectional study.

Data was collected regarding age, sex, address (rural or urban), body weight, duration of breast feeding, weaning, detailed dietary history includes type of food (cereals, proteins, vegetables, fruits) and milk type (cow, goat, buffalo), amount of glasses of milk per day, amount of water intake (assessed by number of glasses taken in a day), type of water hard or soft, dehydration, recurrent diarrhoea, UTI, family history and socioeconomic history.

Urine analysis, CBC, renal function, ultrasound abdomen, X-ray KUB was done in all patients. Patients presented with fever, UTI, and anaemia was optimized before surgery. All patients had open cystolithotomy under general anaesthesia. Bladder was closed in two layers without drain. Catheter removed on 3<sup>rd</sup> or 4<sup>th</sup> post-

operative day depending upon the recovery; and discharged the same day. Increase fluid intake was advised to all patients at the time of discharge.

## RESULTS

A total of 113 children with bladder stones were operated at District Headquarter Hospital Mithi Tharparker were included in study. Males were 97 (85.8%) and females were 16 (14.15%) with M: F ratio of (6:1). All patients belonged to Tharparker. Age ranged from 18 months to 14 year (mean age  $8.6 \pm 4.9$  years). Affected children age distribution was 1–5 year 66 (58.4%) patients, 6–10 year 28 (29.2%) and 11–14 year 19 (16.8%) patients.

Most frequent symptom was difficulty in micturition (crying during micturition/rubbing and pulling of penis) in 76 (67.25%) patients, urinary retention in 18 (15.9%) and stone with pyuria and fever in 12 (10.6%) patients. Haematuria was noted in 3 and rectal prolapse in 4 patients. (Table-1) Six patients presented with retention of urine due to impacted urethral stone which pushed back and subsequently removed.

Ninety one (80.53%) children were malnourished as their weight was below required range as per age. Parental interview disclosed breast feeding in all for 1–2 year, weaning started at 6–8 months but not properly because of cultural pattern with wrong food fed and poverty. They added mostly wheat or *bajra* (millet) roti with tea or *Lassi*, *Khichri* and *Sagu Dana*. With increase in age wheat, pulses and vegetables were added. Only 5% parents added meat, fish, and eggs in diet. Milk commonly used was taken from goat followed by cow. Recurrent episodes of diarrhea (more than 3 episodes per year) was recorded in 73 (65%) patients, recurrent UTI in 51 (45.6%), family history of stone disease in 6 (5%) and associated rectal prolapse in 3 (2.6%) patients.

On X-ray KUB, 111 (98.23%) patients had single stone in bladder, 2 (1.77%) had multiple stones and associated renal and ureteric stone in 5 (4.5%) patients. All stones were radiopaque Stone size ranged from 1 to 4 cm with mean of 2.5 cm. Majority of stones were round or oval in shape. Ultrasound KUB with post void volume was done in all children that did not reveal any urinary tract anatomical abnormality or bladder outflow obstruction like posterior urethral valves. Neurogenic bladder element was ruled out by history and examination. Urinary, faecal incontinence, lower limb weakness were not seen in any patient of our study. Urine analysis showed red cells in 107 (95%) patients, pus cells in 55 (48%) and albumin in 6 (5%).

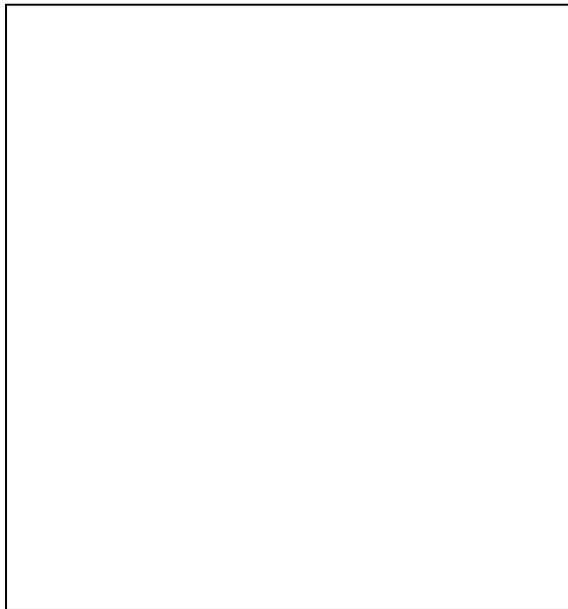
Mild anaemia (Hb 7–10 gm %) was seen in 35 (39.55%) patients, moderate anaemia (Hb 5–7Gm

%) was seen in 21(18.58%) and severe anaemia (Hb less than 5 gm %) was seen in 14 (12.38%) patients.

All patients had open cystolithotomy with standard technique of Pfannenstiel incision for removal of stones under general anaesthesia. Bladder was thick walled in 36.5% patients mostly in older children with history of long standing large size stone. Bladder was closed in two layers without putting drain as surgery was meticulous. Patients discharged on the day-4 after removal of Foley’s catheter. Patients were followed up initially on weekly basis for 1st month to look for any complication and then three monthly up to three years for recurrence of disease. Postoperative complications like haematuria occurred in 3, supra-pubic leakage in 1, urinary retention after catheter removal in 4, and wound infection in 10 patients.

**Table-1: Clinical Presentations**

Symptoms	n	%age
Dysuria, Pulling and rubbing of penis	76	67.25%
Retention of urine	18	15.9%
Pyuria, fever	12	10.6%
Hematuria	3	2.6%
Associated rectal prolapse, RTI, Chronic diarrhea	4	3.5%



**Figure-1: The size and number of stone**



**Figure-2: Shape of removed stone**

**DISCUSSION**

In Pakistan no efforts have been made so far to localize the high and low stone forming areas, nor are detailed studies available on the clinical and aetiological aspect of disease.<sup>13</sup> Bladder calculi in children are common problems encountered in clinical practice at District Headquarter Hospital Mithi Tharparker which is a desert and remote area of Sindh province. More than 90% from rural population of Tharparker live in poor socioeconomic conditions. Joseph *et al*<sup>14</sup> stated that the incidence of bladder stone in children is slowly declining, even in endemic areas. This is mostly due to improved nutrition, better pre-natal and post-natal care and improved awareness of the problem in the endemic areas.

In the 21<sup>st</sup> century, the incidence of this disease in children probably continues to decline and the disease will largely become a disease of adults. Our study of 21<sup>st</sup> century in remote and rural area of developing country still shows the scenario of 19<sup>th</sup> century, because one century ago bladder stones were common in the West, especially among children<sup>15</sup>, but now this is almost unknown in such countries today<sup>16</sup>. With improved nutrition, hydration, public awareness and socioeconomic condition now endemic bladder stones are rare in Europe.

Husain M *et al* (2001)<sup>17</sup> have reported in their study that the geographical distribution of paediatric bladder stone is in transition phase in this country. The children from affluent areas of the city have decreased incidence but disease continues to be endemic in rural areas of the country and poor localities of big cities. In our study 98% children from rural population of poor socioeconomic group and 2% from urban cities/town’s population of Tharparker. These findings support the argument of Husain M *et al*. Improved socioeconomic condition, availability of soft drinking water, education

(awareness), health facilities and improved nutrition in cities of Tharparker may be the reason of decreased endemic bladder stones in cities as compared to rural areas.

Our study revealed that, like in some other developing countries of Afro-Asian stone belt<sup>6,7</sup> in our country endemic bladder is a serious public health problem and no definite data is available especially of remote and rural areas. Bladder stone surgery accounted for 85% of all surgical procedures performed on children.

Malnutrition, non-availability of drinking water, dehydration (recurrent diarrhoea), respiratory tract infection (RTI), poverty, poor public health services and unawareness are main health concern all over the country. This is the 1<sup>st</sup> study conducted at rural setting with very close observation of children and their parent's routine life and their problems.

Routh JC<sup>18</sup> *et al* reported that frequency of urolithiasis in children has not been done through a population based study. Institutional case reports indicate regional variation. Husain M *et al*<sup>19</sup> reported a high prevalence of urinary stones both in the adults and paediatric populations. However in recent years a change of pattern has been observed from predominantly bladder calculi in the 1980s constituting 76% of all stones to predominantly renal calculi in 85% of the patients in the present decade.

We agree with Van Reen and Routh that still in 21<sup>st</sup> century studies regarding childhood bladder calculi indicates institutional and regional variations. In our study 67% children were less than 5 year of age. In literature this fact is supported by Rizvi *et al*<sup>20</sup> on the backdrop of malnutrition, chronic dehydration, and a diet poor in proteins and rich in oxalates lead to formation of ammonium hydrogen urate stones which constitute up to 64% of stones in children less than 5 years of age.

There has been little research into the relationship between hardness of drinking water and stone disease. Waheed *et al* and most authors suggest that habitual low level of intake of fluids and water and subsequent low urine output has a definite role in the pathogenesis of stone disease.<sup>21</sup> In our study more than 90% children were from areas of hard water and areas where water is scarce. Bush NC *et al*<sup>5</sup> report that children with stones now accounts for 1 in 685 paediatric hospitalizations in the United States. In our series it is probably 3 for 685. Poorly balanced diet, deficient in proteins, vitamins and phosphates favours child lithogenesis.<sup>7,22</sup> In our study dietary data findings were that more than 95% children were using cereals, vegetables and only 5% children were taking animal proteins. About 98% used either cow or goat milk, and 2% used buffalo milk. About 70% children drank less water than required. Risk factors

of endemic bladder stones observed in our study correlates with the risk factors described by Rizvi SA<sup>20</sup> and several authors in literature.<sup>8,11,12</sup> In Thar, 50% population is below poverty line and not able to provide three times meal to their children. Huffman *et al*<sup>23</sup> report that childhood bladder stones are more common in boys than girls. In our study of 113 patient's 97(85.8%) were males and 19(14.15%) females. These findings correlate well with Huffman *et al*<sup>23</sup> and Banner MP<sup>6</sup> that in areas of endemic bladder stones boys are affected more than girls. In our study common clinical presentation was difficulty in micturition (67.25%) and retention of urine (15.9%).

Suprapubic open cystolithotomy was done in all children, because majority of the stones were of large size with good stone clearance rate. Mortality was zero and no concern of possible damage of male urethra. We agree with argument of Kemal Sarica<sup>24</sup> Papatsoris<sup>2</sup> and Lam *et al*<sup>25</sup>, that open cystolithotomy has evolved as a safe and effective alternative technique in cases of large size and hard bladder stones. In our observations open cystolithotomy is best option where there is non-availability of instruments or skills. Complication rate was less than 5% and no major complication like bladder perforation. All complications were noted in malnourished children, large long standing bladder stone, pre-operative pyuria and fever and intraoperative thick walled urinary bladder Stone. Recurrence rate was zero at 1–2 year follow up in our study. In children over all stone recurrence rates range widely from 3.6 to 67%.<sup>24</sup>

## CONCLUSION

This study indicates that paediatric endemic bladder stonosis a public health problem in developing countries. Majority of affected patients are less than 5 years old with history of low protein diet, dehydration, use of goat milk and poor socio-economic conditions as major risk factors for development of bladder stones.

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