A Boy with a Large Bladder Stone

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Despite the frequent association of urinary tract infection with vesicoureteral reflux and urinary calculi, since vesicoureteral reflux is induced by bladder stones, the coexistence of vesicoureteral reflux and bladder stones is rare. Because of its occurrence in children belonging to poor socioeconomic groups, it is believed to be a deficiency disorder. Most cases of bladder stones occur between the ages of 2 and 5 years. Common clinical presentations of bladder stones include urinary dribbling and enuresis, frequency of micturition, pain during micturition, pelvic pain and hematuria. We report the occurrence of a large bladder stone in a boy, who experienced intermittent lower abdominal pain and urinary incontinence, both during the day and at night. He had been diagnosed with enuresis and treated in pediatric clinics for 1 year. Delayed diagnosis resulted in bladder stone formation. The stone was larger than 2.5 cm and open vesicolithotomy was therefore selected as the best and safest treatment choice. His symptoms disappeared after surgery. Thorough metabolic and environmental evaluations of such cases are required on an individual basis. Bladder stones should be considered as a possible diagnosis in children presenting with urinary incontinence.

1. Introduction

Bladder stones are still prevalent in children living in poor or rural regions.1–3 The etiology of stone formation in pediatric populations is largely unknown, although the commonest causes are developmental anomalies, infections and metabolic risk factors.1,2 In developed countries in Europe or America, bladder stones have virtually disappeared due to improvements in diet, though they remain an endemic problem in a number of developing or underdeveloped countries in Africa and Asia. There appears to be a correlation between stone formation and malnutrition.4–6 They are more common in males than females, but the reason for this is unclear. The clinical manifestations of bladder stones are often more subtle in children, particularly younger children, when compared with the dramatic presentation in adults, which is characterized by sudden, debilitating flank pain. Among children aged 5 years and younger, symptoms such as urgency, frequency, incontinence, dysuria, pyuria and fever are noted in approximately 20–50% of patients. Microscopic or macroscopic hematuria is frequently the presenting sign, reported in 33–90% of patients.1–3 Urinary tract infection and vesicoureteral reflux may complicate stones.7 If a bladder stone is available for analysis, its composition can help to determine its underlying cause.2,4 Based on published reports, most stones are composed of calcium oxalate (45–65%), followed by calcium phosphate (14–30%).5–8 Bladder stones tend to be larger in younger children and therefore have a lower rate of spontaneous passage. Stones in children are usually bigger than 2.5 cm in diameter and are radiologically dense, and open cystolithotomy is therefore the preferred treatment for
Urinary bladder stone 151

Vesicoureteral reflux is eradicated by surgical removal of the stone. Prognosis is favorable after open surgery. The recurrence of bladder stones after removal is extremely rare.7

2. Case Report

A boy aged 3 years and 4 months was admitted with a 1-year history of intermittent lower abdominal pain and urinary incontinence, experienced both during the day and at night. During the 12-month period before this admission, he visited several pediatric clinics and was diagnosed with and treated for enuresis. His symptoms did not improve and he was transferred to St. Mary’s Hospital for further evaluation and management.

The boy’s father was a farmer and his mother was a housekeeper. The boy had two grandparents, two sisters and one brother. They lived together in a poor, rural seaside area. There was no family history of bladder stones. From birth until 1–2 years of age, he was fed cow’s milk, which is high in calcium. He usually accompanied and played with his parents when they worked on the farm. His diet consisted of starchy foods and foods with high fiber content. His water intake and total protein intake (especially animal protein) were not sufficient.

On physical examination, the patient’s weight was 12.6 kg (about 10th percentile) and height was 91.4 cm (about 10th percentile). Vital signs were within normal limits. There was no flank knocking pain, no abdominal tenderness and no palpable mass. Other physical findings were normal. On laboratory investigation, hemoglobin was 11.2 g/dL, leukocyte count was 8230/mm³, and platelet count was 492 × 10³/mm³. Urinalysis revealed pH 7.8, protein > 300 mg/dL, and 10–15 erythrocytes/high-power field (HPF) and 20–25 leukocytes/HPF on microscopic examination. Urinary calcium was 6 mg/kg/day (normal, < 4 mg/kg/day) and urinary calcium/creatinine ratio was 0.62 (normal, < 0.21). On biochemical analysis, blood urea nitrogen, creatinine, sugar, uric acid, total protein, albumin, sodium, potassium, calcium, phosphorus and liver function were all normal. Prothrombin and partial thromboplastin times were normal. The levels of 24-hour urine collections for oxalate, citrate, uric acid and cystine were all within normal ranges. An abdominal X-ray in the supine position showed a large bladder stone, which was 3 × 2.5 cm in size (Figure 1). Urogenital ultrasound showed one large urinary bladder stone (3 × 2.5 cm) and left renal pelviectasis (0.5 cm). Voiding cystourethrogram revealed bilateral grade III vesicoureteral reflux and chronic cystitis (Figure 2). Due to the large size of the bladder stone (> 2.5 cm), the boy was referred to a pediatric surgeon. He underwent open vesicolithotomy under general anesthesia for bladder stone extraction (Figure 3).

A Foley catheter was inserted and the bladder was filled with normal saline. Surgery proceeded smoothly and there were no complications such as wound infection, suprapubic urinary leakage, postoperative bleeding or catheter blockage. The Foley catheter was retained for 5 days. Biochemical analysis of the stone showed a small ammonium urate nucleus, covered with very dense calcium oxalate monohydrate. Escherichia coli > 10³ colony forming

Figure 1 Plain abdominal film revealed a large stone (3 × 2.5 cm) in the bladder.

Figure 2 Voiding cystourethrogram revealed bilateral vesicoureteral reflux, grade III.
units/mL was cultured from the urine and cefazolin and gentamicin were administered for 5 days. His intermittent lower abdominal pain and urinary incontinence disappeared after surgery. On his 7th day of hospitalization, repeat voiding cystourethrogram was performed and showed no vesicoureteral reflux on either side. In the 6 months since the operation, the patient has remained symptom free and has experienced no further stone formation.

3. Discussion

Pediatric urolithiasis, especially of the bladder, is a rare occurrence. There are marked geographic variations in the incidence of urinary tract stones in children. Although epidemiological data from some parts of the world are unclear, it is estimated that the incidence of pediatric urolithiasis may range between 1:10,000 and 1:7000 pediatric admissions. The male:female ratio for bladder stones is 15:1, and the peak age for occurrence is 2–5 years. The majority of stones are located in the upper urinary tract. In a retrospective study, 1067 (6.8%) of 15,624 urinary tract stones were bladder stones. Basaklar and Kale reported that of 196 children aged between 1 and 14 years with urinary tract stones, 96 children (49%) had renal, 52 (26.5%) had bladder, and 32 (16.3%) had ureter stones. Based on the results of stone and urine analysis, Sarkissian et al reported on the etiology of stones in 198 patients, including 18 patients with bladder stones: they were due to unknown causes in 26%, metabolic origin in 26%, infectious stones in 20%, urinary stasis secondary to a urinary tract anomaly in 4%, and endemic stones (dietary origin) in 19%. Calcium oxalate was the predominant constituent of the kidney stones in 112 patients (62%), followed by struvite in 32 (17%), calcium phosphate in 12 (7%), uric acid in 12 (7%), ammonium urate in nine (5%) and cystine in three (2%). Of the 18 bladder stones, 13 (72%) contained calcium oxalate, four (22%) contained uric acid and one (6%) contained ammonium urate. In 120 Tunisian children with urolithiasis, 22% of bladder stones were composed of struvite. Thus, pediatric urolithiasis is influenced by geographic area. Metabolic abnormalities and infectious stones prevail in most series, with metabolic stones being more frequent than infectious ones. Based on our patient’s family history, a hereditary calcium oxalate metabolic disorder was unlikely.

Urinary calcium excretion is slightly higher in Taiwanese children relative to children in other regions. In our case, urinalysis detected more calcium crystals than normal, and higher levels of calcium/creatinine. Hypercalciuria could therefore be the main risk factor in this patient. Specific infections are strongly associated with stones, including those caused by E. coli, Proteus sp., Providencia sp., and some strains of Klebsiella sp., Pseudomonas sp., and Enterococci. These organisms contain urease, an enzyme that catalyzes the hydrolysis of urea. This initiates a complex biochemical cascade that creates a unique urinary milieu, which is highly favorable to struvite stone formation. In the present case, urine culture grew E. coli. The presence of vesicoureteric reflux is well known to produce stasis, so predisposing to recurrent and persistent urinary tract infections and stone formation. The urinary tract changes caused by a bladder stone result from a combination of inflammatory edema of the bladder, detrusor spasm, and intermittent bladder obstruction. Stone formation, especially in the presence of metabolic abnormalities, is initiated by frequent urinary tract infection secondary to high-grade vesicoureteral reflux. The incidence of calculi in patients with vesicoureteral reflux is 0.5%. Primary bladder stones (endemic stones) have almost disappeared in developed countries, probably as a result of a more balanced diet. In some underdeveloped or developing countries, however, primary bladder stones still constitute a significant problem. Taiwan is a developed country and children of school age have a balanced diet. However, poor nutrition leading to the development of large bladder stones can still be a problem for some children, such as our patient who lived in a poor, rural seaside area.

Symptoms of bladder stones in children vary with age. Renal colic and flank pain associated with stone
Urinary bladder stone passage is uncommon in children.\textsuperscript{1,3,8,12} Hematuria, either microscopic or macroscopic, has been reported in 33–90\% of children with stones, while lower abdominal pain or pelvic pain occurs in approximately 50\% of childhood cases. Urinary incontinence and urinary frequency, caused either by the stone itself or by associated urinary infections, are also common manifestations of bladder stones. Urinary tract infections are most commonly associated with stones in preschool children. In infants, pain from stones can mimic colic.\textsuperscript{1,2} Our patient suffered from lower abdominal pain, urinary frequency, urinary incontinence and microscopic hematuria, as reported in the literature.

Abdominal radiography, ultrasonography, intravenous pyelography (IVP) and computed tomography (CT) are the most useful tools for the evaluation of children with stones.\textsuperscript{1,2,6} Many clinicians use plain abdominal radiography and ultrasonography for initial studies. Ultrasonography reveals many types of stones, including some radiolucent stones, and may yield other clinically important findings such as urinary obstruction or nephrocalcinosis. IVP is associated with higher radiation exposure and risks due to the use of contrast agents. More recently, studies have suggested that non-enhanced helical CT is superior to IVP for the evaluation of urolithiasis. The advantages of CT include shorter examination times, higher sensitivity and specificity for calculi, no need for intravenous contrast agents, and a greater potential for making alternative diagnoses. Many pediatric nephrologists use an abdominal flat plate and ultrasound for routine surveillance in asymptomatic children, reserving the non-enhanced thin-cut helical CT for patients who are symptomatic.\textsuperscript{2,5–7} Open surgery is the preferred treatment of choice for removing bladder stones\textsuperscript{9–11} because the stones in children are usually >2.5 cm in diameter and are radiologically dense.

Based on a literature survey,\textsuperscript{9–11} cases of bladder stones were managed by open vesicolithotomy in 307 cases (68.7\%), by extracorporeal short wave lithotripsy in 63 (14.1\%), and by transurethral pneumatic cystolithotripsy in 77 (17.2\%). In the present case, the bladder stone was 3 cm in diameter and open vesicolithotomy was chosen by the pediatric surgeon.

The prognosis of bladder stones depends on the primary diagnosis and adherence to therapy.\textsuperscript{1–3} Recurrence after surgical removal of the stone is unusual.\textsuperscript{10} The reflux was eradicated in our patient by surgical removal of the stone. The boy had normal renal function and no further symptoms of lower abdominal pain, urinary frequency or incontinence, and no recurrence of calculi, after follow-up in the outpatient department.

References