

## Vesical calculi in children

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### Abstract

Vesical calculi occur due to increased urinary concentration & are commonly seen in children belonging to low socio-economic status. They are usually formed of ammonium acid urate, calcium oxalate or calcium phosphate. Vesical calculi constitute about 70% to 85% of paediatric urolithiasis & boys are affected more than girls. Primary vesical calculi occur in sterile urine & are associated with nutritional deficiency whereas Secondary calculi occur due to infection, obstruction or inflammation. Endemic calculi are associated with oxalate-rich diet. They usually present with hematuria, dysuria, frequent urinary tract infection, urinary urgency & bedwetting. The diagnostic modalities of vesical calculi are Urinalysis, urine dipstick test, serum Creatinine level, plain x-ray abdomen & Intravenous Pyelography. Sonogram is effective in identifying both radiolucent & radiopaque stones. Spiral CT scanning is highly sensitive & specific whereas Pelvic MRI or Technetium-99m MAG-3 renal scanning yields poor resolution & are not recommended in the evaluation of bladder calculi. Treatment for vesical calculi depends on the size, composition & symptoms. The only effective medical treatment is urinary alkalization. Indications for surgery are failure of medical management, recurrent infections, acute urinary retention, suprapubic pain & significant gross hematuria. Open cystolithotomy was done earlier which is being replaced by cystolitholapaxy. With ongoing advances in instrumentation procedures like Transurethral optical litholapaxy are now applicable to children. Minimally invasive surgeries like extracorporeal lithotripsy, percutaneous nephrolithotripsy & urethroscopy have reduced open surgery to only 1- 4% of cases. Early diagnosis & appropriate management are essential for managing vesical calculi in children.

**Key words:** Vesical calculi, Children, Extracorporeal lithotripsy

### Introduction

Bladder stones form when substances in the urine concentrate & coalesce into hard, solid lumps. Urine is a stable solution & any variation in the degree of saturation, urinary pH & concentration can alter the existing equilibrium & result in urolithiasis [1].

Urinary calculi in children are categorized into 3 broad epidemiologic patterns: calculi seen in premature

infants of very low birth weight, upper urinary tract calculi seen in children and adolescents & endemic bladder calculi which are seen in healthy children without any predisposing factors [2].

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They are formed of calcium in 70% of cases, uric acid in 20%, magnesium ammonium phosphate (struvite) in

10% & cystine in < 1% of cases [3]. Pediatric bladder stones are commonly seen in children belonging to poor economic status [4] & usually consist of ammonium acid urate with/ without calcium oxalate or calcium phosphate [5].

### Incidence

The proportion of bladder stones amongst paediatric urolithiasis varies between 70% to 85% [6,7]. In India this proportion varies between 85% to 87% in Northern & Eastern regions [8].

Boys suffer more than girls with studies showing a male: female ratio of 9:1 (India), 12:1 (Turkey), 10:1 (Thailand), 12:1 (Indonesia) & 8.5:1 (Pakistan) [9]. Male predominance was explained on the basis of long tortuous urethra in males [7] or better passage of microlith in females due to the greater laxity & width of female urethra [10].

### Pathophysiology

Vesical calculi are either primary or secondary. A primary stone develops in sterile urine, usually originates in the kidney & then passes into the bladder. They may be associated with nutritional deficiency of vitamin A, magnesium, phosphate & vitamin B6 [11,12].

Secondary calculi are associated with infection, bladder outlet obstruction, prolonged duration of indwelling catheters [13] & inflammation secondary to external beam radiation/ Schistosomiasis [14].

Excessive intake of vitamins C & D, grapefruit juice, purines (gout); congenital renal abnormalities & some medications such as acetazolamide / indinavir have been associated with the development of bladder stones.

Various risk factors for bladder calculi are age, sex, race, family history of stones, long periods of dehydration, decreased water intake, urinary tract

infection, diet low in animal proteins, chronic mucus production, obesity & decreased activity level. In developed countries they occur due to urinary stasis, recurrent urinary tract infections, foreign bodies or urinary diversion.

There is a common link between endemic calculi & high intake of oxalate-rich vegetables (increased crystalluria), high animal protein diet (low dietary citrate) [15] & intake of polished rice, which is low in phosphorus & thereby leads to high ammonia excretion.

### Clinical Features

Symptoms include hematuria, pain with urination, frequent / persistent urinary tract infection, urinary urgency &/or frequency, nausea / vomiting, bedwetting, priapism & fever [16].

Endemic bladder stones present with abdominal pain, interrupted urine flow, dysuria, alguria or frequency whereas secondary bladder stones present with recurrent urinary tract infections or urinary retention. Bacteria grow on bladder stones & causes recurrent bladder infections. Antibiotics kill the bacteria in the bladder but not in the stones.

Large urinary bladder calculi are commonly seen in association with recurrent urinary tract infection, azotemia, & urinary retention. Vesical calculus can be associated with congenital anomalies of urinary tract [17] like posterior urethral valve which leads to stasis of urine & bladder dysfunction [18].

Ideally the diagnosis of posterior urethral valves should be suspected in children with vesical calculi who have persistence of symptoms even after removal of the calculi [19].

### Diagnosis

Urinalysis is an inexpensive, rapid investigation which provides useful information. Urine dipstick is positive for nitrite, leukocyte esterase & blood. Creatinine level

may be elevated in outlet obstruction. Bladder stones are commonly diagnosed on plain x-ray abdomen but 10% of calculi are radiolucent which are missed on radiology.

Intravenous Pyelography may be done to identify associated abnormalities like upper urinary tract calculi, ureterocele, cystocele or bladder diverticula[20]. Sonogram shows a classic hyperechoic object with posterior shadowing & differentiates a calculus from tumor/ clot. They are also effective in identifying both radiolucent & radiopaque stones [21].

An excretory urography is useful to demonstrate anatomical & functional alterations [22]. Unenhanced spiral CT scanning is highly sensitive & specific in diagnosing calculi along the urinary tract.

Even pure urate calculi can be detected with this method. Cystoscopy allows the examiner to visualize the stones and assess their number, size & position. Pelvic magnetic resonance imaging & technetium-99m MAG-3 renal scanning yields poor resolution of calculi & are not recommended in the evaluation of bladder calculi.

## Treatment

The treatment for kidney stones depends on the size, composition & symptoms. Small stones will pass on their own & require only analgesics whereas large stones or those blocking urinary flow require surgery/ hospitalization.

The only effective medical treatment for bladder calculi is urinary alkalization ( pH>6.5) with agents like potassium citrate, Suby G or M solution for the dissolution of uric acid stones. However aggressive alkalization causes calcium phosphate deposits on the stone surface.

Renacidinin conjunction with indwelling irrigating catheters dissolves phosphate / struvite calculi, but treatment is slow and invasive with risk of sepsis & hypermagnesemia. Indications for surgery are failure of medical management, recurrent infections, acute urinary retention, suprapubic pain & significant gross hematuria.

Open cystolithotomy which was described by Hippocrates as early as the 3rd century B C remained the only method till Bigelow perfected the use of blind lithotrites [23]. Open cystolithotomy is associated with problems of postoperative pain, long scars, prolonged catheterization, extended hospitalization, risk of wound infection & increased over all cost of treatment [24]. Nowadays the most common procedure is cystolitholapaxy, where a thin tube (cystoscope) with a camera at the end is used to find the bladder stones.

Transurethral Optical litholapaxy is the procedure of choice for vesical calculi in adults. The cystoscope uses energy sources like a mechanical device/ a lithoclast (pneumatic jack hammer), ultrasonic device, electrohydraulic device, a manual lithotrite, or a laser to break up the stones before they're removed.

The pulsed-dye & other wavelength-specific light sources like holmium laser fracture the stone through direct absorption, vaporization, water absorption & pressure-wave generation [25]. Common complications include urinary infection (11%), fever (9%), bladder perforation (2%), hyponatremia (2%) & haemorrhage (1%) [15].

However it is dangerous in children, especially in boys due to disparity between the size of instrument & urethral calibre with a risk of urethral trauma leading to urethral stricture [24]. With ongoing advances in instrumentation, smaller caliber of the pediatric urethra

can be accommodated & these approaches are now applicable to selected children [26].

Minimally invasive surgeries like extracorporeal lithotripsy, percutaneous nephrolithotripsy & urethroscopy have reduced open surgery to only 1 to 4% of cases [27].

Percutaneous removal of bladder calculi in children is relatively simple, cheap, effective, safe & easy to master [28] with significantly lesser morbidity of than open cystolithotomy [2].

Sometimes combined transurethral & percutaneous approach may be necessary for stone stabilization and irrigation of the stone debris [29]. Procedures like Electrohydraulic shockwave lithotripsy which has been associated with higher incidence of bladder mucosal injury should be avoided in large, hard vesical calculi & stones in the diverticulum [30].

## Conclusion

Educating health personnel & mothers on proper infant feeding & weaning at appropriate age can reduce the risk factors for endemic bladder calculi & their recurrence. Early diagnosis & prompt appropriate management is essential in the management of vesical calculi in children.

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