

MANAGEMENT OF CHILDREN AND ADOLESCENTS WITH KIDNEY AND URETERAL STONES

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Medical Expulsion Therapy

Management options in pediatric patients with a ureteral stone:

1. **observation** with pain control
2. medical expulsion therapy (**MET**)
3. **surgery**

MET:

α -blockers

less commonly, calcium-channel blockers

Mechanism for MET: type **1a and 1d** α -receptors (distal one-third of the ureter and UVJ)

Spontaneous stone passage without MET is higher among **older patients** and **<5 mm** and distal ureteral stones.

Medical Expulsion Therapy

- Tamsulosin was safe in children despite its off-label use
- **AUA: ureteral stones ≤ 10 mm should be offered “observation with or without MET using alpha-blockers”.**
- The use of α -blockers is off-label and that the maximum duration of MET is unknown but should not exceed 6 weeks.

Surgical Management

- **Up to 60% of children with kidney or ureteral stones require surgery.**
- **As for adults: ureteroscopy (URS), ESWL, and PCNL**
- Open stone surgery such as nephrolithotomy is rarely used in the contemporary era.

Surgical Management

- AUA and Endourological Society Recommendations for the Surgical Management of Urinary Stones for Pediatric Patients

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients with <u>uncomplicated ureteral stones <10 mm</u> , clinicians should offer observation with or without medical expulsive therapy using α-blockers .	Moderate: Net benefit or harm moderate	B: Moderate certainty

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
Clinicians should offer URS or SWL for pediatric patients with ureteral stones who are <u>unlikely to pass the stones or who failed observation</u> and/or <u>MET</u> , based on patients-specific anatomy and body habitus.	Strong: Net benefit or harm substantial	B: Moderate certainty

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
Clinicians should obtain a low-dose CT scan on pediatric patients before performing <u>PCNL</u> .	Strong: Net benefit or harm substantial	C: Low certainty

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients with <u>ureteral stones</u> , clinicians should not routinely place a stent before URS.	Panel consensus	Expert opinion

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients with a total renal <u>stone burden</u> ≤ 20 mm, clinicians may offer SWL or URS as first-line therapy .	Moderate: Net benefit or harm moderate	C: Low certainty

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients with a total renal stone <u>burden >20 mm</u> , both PCNL and SWL are acceptable treatment options. If SWL is utilized, clinicians should place DJ or nephrostomy tube	Panel consensus	Expert opinion

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients, except in cases of <u>coexisting anatomic abnormalities</u> , clinicians should not routinely perform open/laparoscopic/robotic surgery for upper tract stones .	Panel consensus	Expert opinion

Surgical Management

RECOMMENDATION	STRENGTH OF RECOMMENDATION	LEVEL OF EVIDENCE
In pediatric patients with <u>asymptomatic</u> and <u>nonobstructing</u> renal stones, clinicians may utilize active surveillance with periodic ultrasonography.	Panel consensus	Expert opinion

Goals of Therapy

- **The choice of intervention:**
 - **Size**
 - **location of the stone**
 - **patient anatomy**
 - **patient (and provider) preference.**
 - **patient comorbidities**
 - **composition of stone (if known)**
 - **equipment availability**

Radiation

- Each patient received a median of one CT scan and three abdominal radiographs for the associated stone episode.
- A CT scan, PCNL, and 3 radiographs: 32 mSv.
- Current guidelines recommend a maximum dose of 50 mSv in a 12-month period, and an average of <20 mSv/year over a 5-year period.

Ancillary Procedures/Anesthesia

- **Children often need multiple anesthetics.**
- For URS, the smaller size of children's ureters often precludes direct access with a ureteroscope.
- **Active dilation** is not recommended in children, a **ureteral stent** may need to be placed.
- However, a “pre-stent” increases the number of anesthetics needed to remove the stone.
- Similarly, SWL often requires retreatment to clear the stone.

Surgical Antimicrobial Prophylaxis

- Antibiotic prophylaxis is indicated in **all patients undergoing URS or PCNL** and is indicated for patients undergoing SWL who are at increased risk for infection.
- For uncomplicated SWL and URS: cefazolin
- All children undergoing a **percutaneous** procedure or who have a **preexisting ureteral stent** or **nephrostomy** tube receive a fluoroquinolone or ampicillin/gentamicin.
- Antibiotics **should not be continued for greater than 24 hours**

Ureteroscopic Management of Upper Urinary Tract Calculi

- URS was not considered primary therapy for **upper tract stones** in children
 - ureteral ischemia
 - Perforation
 - Stricture
 - potential for development of VUR as a result of dilation of small-caliber ureteric orifices.
- Children **<6 years** of age had **lower success** and **higher complications**

Ureteroscopic Management of Upper Urinary Tract Calculi

- Pediatric ureters may require a period of **stenting** before definitive **URS** treatment.
- **Approximately 25% of children undergoing URS required staged procedures.**
- **AUA do not recommend routine “prestenting” before URS**

Ureteroscopic Technique in Children

- Irrigating fluid should be isotonic and body temperature
- **The decision to place a ureteral stent postoperatively:**
 - duration of the procedure
 - the number of passes with the ureteroscope
 - the degree of visible ureteral trauma or edema
- The stent is removed under brief anesthesia after 7 days.

Limitations and Complications

- **The complications of URS:**
 - **ureteral injury**
 - **UTI**
 - **bleeding.**
- Serious complications (greater than Clavien3) are uncommon.
 - mucosal flaps and tears
 - Perforation
 - false passage
 - partial to complete ureteral avulsion

SHOCK WAVE LITHOTRIPSY

- SWL may be more effective in children
- **Along with URS, SWL is a treatment option for upper tract calculi 15 mm or smaller in children.**
- **For upper tract calculi, SWL efficacy ranges from 68% to 84%**
- stone clearance of 80% at 3 months.
- 91% stone clearance for mean stone diameter less than 10 mm versus 75% stone clearance for stone size greater than 10 mm.

SHOCK WAVE LITHOTRIPSY

- For renal stones > 20 mm, clearance is lower for SWL than PCNL and requires multiple treatments.
- AUA: Ureteral stent to decrease the risk for major complications for pediatric patients who undergo SWL for stones > 20 mm
- It is the authors' practice not to perform SWL for stones greater than 15 mm in pediatric patients.

SHOCK WAVE LITHOTRIPSY

- SWL failure:
 - increased mean stone burden
 - increased infundibular length
 - Infundibulo-pelvic angle greater than 45 degrees.
- CT is not necessary before SWL
- Stone attenuation less than 1000 HU was associated with treatment success in children.

Shock Wave Lithotripsy Technique in Children

- SWL is typically performed **under general anesthesia**
- Bowel preparation is seldom used to avoid dehydration and electrolyte imbalance
- The AUA recommended placement of a ureteral stent or nephrostomy for SWL for stones greater than 20 mm.
- **additional relative indications include:**
 - **Solitary kidneys**
 - **Obstruction**
 - **Abnormal anatomy.**

Limitations and Concerns

- Stone clearance after single SWL treatment is low.
- Children are subjected to multiple treatments requiring general anesthesia.
- **SWL was associated with 40% increased risk for incident hypertension in adults.**

PERCUTANEOUS NEPHROLITHOTOMY

- **PCNL is considered first-line therapy for renal stones greater than 20 mm in children**
- **stone clearances: 90%.**
- PCNL has replaced open surgery as the treatment of choice for large stone burdens in all children.

PERCUTANEOUS NEPHROLITHOTOMY

- **Adult-sized PCNL** for pediatric patients reported **high stone clearance** demonstrated that the risk for **bleeding** increases with access tract size. (relative size 72 Fr).
- Mini- and micro-PCNL have become increasingly common for large renal stones for both children and adults.
- Mini-PCNL < 20 to 24 Fr
- micro-PCNL < 10 Fr.
- The indications for PCNL in children are expected to continue to increase
- For children with renal stones greater than 20 mm, we recommend PCNL

Percutaneous Nephrolithotomy Planning for Pediatric Patients

- **The risks associated with PCNL:**
 - **bleeding requiring transfusion**
 - **delayed renal hemorrhage requiring angioembolization**
 - **Sepsis**
 - **Pneumothorax**
 - **Hemothorax**
 - **Urothorax**
 - **incomplete stone clearance**
 - **injuries to adjacent organs.**

Percutaneous Nephrolithotomy Complications

- Complication: 15% to 39%.
- most of them are minor
- Blood transfusion is consistently <10%.
- Complications:
 - postoperative fever (30%)
 - need for transfusion (24%).
- **Transfusion was associated with operative time, sheath size, and stone burden**
- PCNL has not been shown to cause loss of kidney function or scarring.

PERCUTANEOUS NEPHROLITHOTOMY

- Significant bleeding
 - insert a Foley catheter or re-entry in the collecting system through the nephrostomy tract
- Renal pelvis injury
 - the operation should be stopped and an antegrade ureteral stent should be placed, if feasible.
- **Treatment of known complications of PCNL in children is similar to adults.**

