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Stone Disease/Endourology

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Imaging/Diagnosis of Ureteral Calculi

- Non-contrast CT preferred method for **initial** diagnosis
- Renal US plus KUB acceptable in **known opaque** stone formers
- **Low dose** CT (< 4mSv) preferred *if* BMI < 30
- If stone **not** seen on CT scout, KUB recommended to determine opacity of stone
- Visible, opaque stones: repeat KUBs can monitor stone progression
  – helps reduce overall radiation exposure

Imaging/Diagnosis of Ureteral Calculi

- Pediatrics:
  - renal US initially
  - low-dose CT if needed
- Pregnancy:
  - 1st line: renal ultrasound
  - 2nd line: MRI **without** contrast
  - low dose CT an option in 2nd/3rd trimesters only
  - up to 5 rads not associated with fetal anomalies or fetal loss

Based on AUA Clinical Guidelines on Imaging for Ureteral Stones

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Important Prognostic Factors on CT

- Hydronephrosis: not by itself a determinant of need to intervene
  - Lowers success rate of ESWL; less impact on URS
- Stone size and location: predictive of stone passage
- Peri-ureteral/renal stranding, ureteral edema (tissue rim sign) and peri-renal fluid: do **NOT** consistently influence likelihood passage
- Skin to stone distance: impacts success of ESWL of **renal** stones, not necessarily ureteral stones

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Important Prognostic Factors on CT

- Hounsfield units: can be used to diagnose stone composition; impacts success of **ESWL**:
  - Uric acid: 200-500
  - Struvite: 500-700
  - Cystine: 900-1200
  - Calcium phosphate: 1250-1650
  - Calcium oxalate dihydrate: 1800-2200
  - Calcium oxalate monohydrate: >2000

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Radiation Doses (mSv)

Type of Exam	Effective dose (mSv)	Reference
Ultrasound (US)		
Abdomen and pelvis US	0	
Magnetic Resonance Imaging (MRI)		
Abdomen and pelvis MRI	0	
Conventional Radiography (CR)		
KUB	0.7	A
KUB with tomograms	3.9	B
IVU	3.0	A, C
Computed Tomography (CT)		
Non-contrast CT, abdomen and pelvis	10.0	D,E
Without and with contrast CT, abdomen and pelvis (2-phase)	15.0	F
Without and with contrast CT, abdomen and pelvis (3-phase)	20.0	A
Non-contrast CT, abdomen and pelvis (low-dose protocol)	3.0	G

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Ureteral Stones—AUA Guidelines 2016

- Uncomplicated ureteral stones <10 mm
  - should be offered observation
  - if distal, MET with α-blockers should be offered.
  - *Strong Recommendation; Evidence Level Grade B*
- SWL has least morbidity and lowest complication rate, but URS has greater stone-free rate in a single procedure
  - *Strong Recommendation; Evidence Level Grade B*
- Mid/distal stones requiring intervention should be offered URS as first-line therapy or SWL if URS is refused
  - *Strong Recommendation; Evidence Level Grade B*

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Ureteral Stones—AUA Guidelines 2016

- Routine stenting should not be performed in pts undergoing SWL or prior to URS.
  - *Strong Recommendation; Evidence Level Grade B*
- Obstructing stones and suspected infection: must urgently drain collecting system with a stent or nephrostomy tube and delay stone treatment.
  - *Strong Recommendation; Evidence Level Grade C*

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Follow up

- Spontaneous passage: no further imaging needed in most pts.
- ESWL: imaging **recommended** to rule out residual fragments and/or hydro
- URS: imaging **recommended** to rule out silent hydronephrosis

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Renal Stones—2016 AUA Guidelines

- Symptomatic patients with total non-lower pole stone burden < 10 mm:
  - can offer SWL or URS
  - *Strong Recommendation; Evidence Level Grade B*
- Symptomatic patients with total stone burden > 20 mm:
  - should be offered **PCNL** as first-line therapy and ***not*** ESWL
  - *Strong Recommendation & Moderate Recommendation; Evidence Level Grade C*

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Lower Pole Renal Stones—2016 AUA Guidelines

- Less than 10 mm:
  - URS *or* SWL should be offered to symptomatic patients
    - *Strong Recommendation; Evidence Level Grade B*
- Greater than 10 mm:
  - SWL should not be offered as first-line
    - *Strong Recommendation; Evidence Level Grade B*
  - Pts should be informed that PCNL has a higher stone-free rate but greater morbidity
    - *Strong Recommendation; Evidence Level Grade B*

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Pregnancy and Stones

- **No** increased incidence
  - Hypercalciuria occurs due to placental vitamin D production
  - This is ameliorated by increased citrate excretion
- Observation is first line therapy (AUA guideline 2016)
- Avoid NSAIDs
  - Cause pulmonary HTN and premature closure of the fetal ductus arteriosus
- Alpha blockers: pregnancy category B
- 2nd trimester safest time to intervene—shield pelvis or use only US guidance
- 3rd trimester
  - elevate right flank to prevent IVC compression
  - Consider intraop fetal monitoring
- PCN or stents require frequent changing
  - consider URSLL with Holmium laser if unable to tolerate stent or fails observation
  - shown to be safe--***not*** EHL or US or ESWL (fetal hearing loss)

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ARS-Q1

A 24-year-old man has acute severe left flank pain. Urinalysis is normal. He denies a history of urinary stone disease or recent trauma. The next step is:

A. Reassurance
B. Non-contrast helical CT scan
C. Abdominal ultrasonography
D. IVP
E. MRI scan

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ARS- Q2

For patients with a 1-cm proximal ureteral stone, placement of an internal stent at the time of the SWL will result in:

A. A higher stone free rate
B. A lower complication rate
C. Less hematuria
D. Increased irritative voiding symptoms
E. Reduced analgesic requirements

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ARS-Q3

A 38-year-old woman has severe right flank pain. She is afebrile, and urinalysis demonstrates pyuria and microhematuria. A helical CT scan demonstrates right perinephric fluid and right hydroureteronephrosis down to a 3 mm distal ureteral stone. The best treatment is:

A. Ureteral stent
B. Percutaneous nephrostomy drainage
C. Percutaneous drainage of the perinephric fluid
D. Ureteroscopic stone removal
E. Analgesic therapy

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ARS-Q4

The increased risk for calculus disease during pregnancy is associated with:

A. Increased parathyroid hormone levels
B. Absorptive hypercalcuria
C. Placental suppression of 1, 25-dihydroxycholecalciferol
D. Decreased urinary glycosaminoglycans
E. Decreased urinary citrate levels

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ARS- Q5

The physiologic change during the third trimester pregnancy that offers protection against kidney stone formation is:

A. Increased ureteral peristalsis
B. Increased ureteral dilation
C. Increased urinary citrate
D. Decreased urinary calcium
E. Decreased urinary uric acid

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Renal Calculi

- Stone size most important; location #2
- Large stones > 2cm: PCNL
- Lower pole stones:
  - Less than 1 cm: ESWL
  - Greater than 1 cm: ESWL success only 21%; esp. poor with hydronephrosis, abnormal anatomy (e.g. horseshoe kidney; ileal conduit)
  - 1-2 cm: PCNL or URSLL acceptable
- Calyceal tics: PCNL generally preferable; URS good for small stones in anterior upper pole calyces

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Complications

- ESWL:
  - Hematoma: 1-2%; HTN, anticoagulants are risk factors
    - Transfusion, hydration, observation, bedrest; no long term damage
  - Steinstrasse: drainage; PCN may be better than stent
    - Spontaneous resolution common once PCN placed
  - HTN: esp. in elderly and with prior CRI; DM ?; interstitial fibrosis has been demonstrated
  - Slow rate and pre-treating with 100 shocks and doing 3-4 min pause can decrease injury
- URS :
  - Stricture (1-2%); silent hydronephrosis—follow up imaging can detect
  - Ureteral tear/perforation: majority heal with a stent; consider foley
  - Avulsion: immediate repair if possible; if not, percutaneous nephrostomy
- PCNL:
  - Bleeding: immediate-place large NT and clamp; delayed--AVF or pseudoaneurysm—embolize
  - Perforation of pelvis: if large, abort, place NT; return when nephrostogram shows resolution
  - Colon injury: pull back NT into colon, place ureteral stent (separate wind and water)
  - Duodenal injury: bowel rest/NG suction, TPN; pull NT back into renal pelvis
  - Hemo/hydro/pneumothorax: recognize intraop and place pigtail catheter into pleural space
  - Sepsis: do stone cultures in patients at risk; most predictive of causative organism

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AUA Guidelines for Staghorn Calculi

- Standards:
  - Newly diagnosed pts should be actively treated; observation not acceptable in most cases (10 yr. mortality 28%)
  - Pt must be informed about relative benefits and risks associated with all active treatment modalities; must offer regardless of available equipment or expertise
- Recommendations:
  - PCNL should be first treatment utilized for most pts
  - With combination therapy (ESWL and PCNL), percutaneous nephroscopy should be the last procedure for most pts
  - ESWL monotherapy should not be used for most pts; if it is undertaken adequate drainage of the treated renal unit should be established *before* treatment
  - Open surgery should not be used for most pts
  - ESWL monotherapy should not be used for pts with staghorn or partial staghorn **cystine** stones

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ARS-Q6

A 40-year-old woman has a large staghorn stone (surface area 3500 mm2) in her right kidney. The collecting system is grossly dilated with infundibular stenosis. Nuclear renography demonstrates that this kidney provides 30% of global renal function. Serum creatinine is 1.2 mg/dL. The best treatment is:

A. Serial SWL with ureteral stent
B. Percutaneous nephrolithotomy
C. Percutaneous nephrolithotomy combined with SWL
D. Ureteroscopy and holmium laser lithotripsy
E. Nephrectomy

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ARS-Q7

A decrease in renal injury w/ SWL can be accomplished by:

A. Starting at a low energy setting
B. Starting at a low energy setting and pausing for 3-4 min before increasing the energy setting
C. Starting at a slow shockwave firing rate and pausing for 3-4 minutes before increasing the shockwave firing rate
D. Decreasing the total number of shocks delivered
E. Starting at a slow rate and gradually increasing

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ARS- Q8

During PCNL, a collecting system perforation is noted. The first sign of significant extravasation of irrigant into the peritoneal cavity is:

A. Abdominal distension
B. Narrowed pulse pressures
C. Increasing ventilatory pressures
D. Hypertension
E. Bradycardia

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ARS-Q9

Three days s/p a right PCNL, green fluid begins to drain through the nephrostomy tube. The patient is afebrile and there is no abdominal tenderness. Contrast instilled into the tube immediately outlines the second part of the duodenum. The tube is repositioned into the renal pelvis. The next step is:

A. Upper GI Series
B. Surgical exploration
C. Nasogastric suction and parenteral nutrition
D. Duodenoscopy and attempted closure
E. Placement of a peri-duodenal drain

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ARS- Q10

A 10 Fr nephrostomy tube was placed uneventfully to drain a pyonephrotic kidney. Follow-up nephrostogram reveals a 6 cm staghorn calculus. The percutaneous nephrostomy tube enters directly into the renal pelvis. At time of PCNL, optimal access is obtained via:

A. Dilating the established nephrostomy tract
B. A new percutaneous tract- inferior anterior calyx
C. A new percutaneous tract- inferior posterior calyx
D. Getting as much stone out as possible through established tract then getting a new access
E. Getting as much stone out through established tract then bringing the patient back for ESWL

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ARS-Q11

When performing percutaneous access to the upper collecting system:

A. It is best to secure a safety guidewire down the ureter
B. Dilation of the tract should be performed over the floppy portion of the working guidewire
C. The final diameter of the tract should be 10F greater than the largest instrument to be inserted
D. Dilation of the tract should include the calyx and infundibulum into the renal pelvis
E. Arterial bleeding is most likely with a superior pole puncture

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ARS-Q12

The following true statement regarding ureteral obstruction in pregnancy is:

A. This phenomenon is related to the progesterone-mediated relaxation of urinary tract smooth muscle
B. Dilation of the ureters occurs commonly in pregnancy at the fourth week of gestation
C. Dilation of the ureters progresses such that 90% of women will demonstrate ureteral dilation by the 10th week of gestation
D. This phenomenon is related to the estrogen-mediated relaxation of urinary tract smooth muscle
E. This phenomenon is not related to compression of the ureters by the gravida uterus

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ARS-Q13

The following situation when arterial bleeding is most likely is:

A. Direct posterolateral puncture of the kidney.
B. Direct posteromedial puncture of the kidney.
C. Superior pole puncture of the kidney.
D. Mid zone puncture of the kidney.
E. Inferior pole puncture of the kidney.

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ARS-Q14

A 33-year-old woman develops gross hematuria requiring multiple transfusions four weeks after a percutaneous nephrolithotomy. The next step is:

A. Observation
B. Renal arteriogram
C. CT scan
D. Exploration and repair
E. Nephrectomy

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ARS-Q15

30 hours after a successful left PCNL, a 35 year-old man has a fever of 100.2°F, ileus, urine mixed with feces from the nephrostomy tube, and bloody stools. His WBC is 18,000/cu mm. Nephrostogram demonstrates the tube is transcolonic. The best next steps are to administer parenteral antibiotics, prohibit food by mouth and:

A. Observe the patient.
B. Withdraw the nephrostomy tube into the colon.
C. Place a second nephrostomy tube.
D. Perform a colostomy.
E. Close the bowel perforation.

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