Video-based tips A to Z for NO complication after basic endourological procedures for beginners

Seoul Metropolitan Government Seoul National University Boramae Medical Center

Min Soo Choo, M.D., Ph.D.

Contants

Basic principles

- Prevention of sepsis in urologic endoscopic surgery
- Radiation safety during diagnosis and treatment

Minimizing complications in URSL

Minimizing complications in PCNL

General measures of sepsis prevention in genitourinary surgical patients

- **Isolation** of all patients infected with multiresistant organisms to avoid cross-infection.
- Prudent use of **antimicrobial agents**, both in prophylaxis and in treatment of established infections, to avoid selection of resistant strains. Antibiotic agents should be chosen according to the predominant pathogens at a given site of infection in the hospital environment.
- Reduction in **hospital stay**. It is well known that long inpatient stays prior to surgery lead to a greater incidence of nosocomial infections.
- **Early removal** of indwelling urethral catheters, as soon as allowed by the patient's condition.
- Nosocomial UTIs are promoted by bladder catheterization as well as by ureteral stenting.
- Antibiotic prophylaxis does not prevent stent colonization, which appears in 100% of patients with a permanent ureteral stent and in 70% of those temporarily stented.
- Use of closed catheter drainage and minimization of breaks in the integrity of the system.
- Use of the **least-invasive** method to release urinary tract obstruction until the patient is stabilized.
- Attention to simple everyday techniques to ensure **asepsis**, including the routine use of protective, disposable gloves, frequent hand disinfection, and infectious disease control measures to prevent cross-infections.

Prevention of sepsis in urologic endoscopic surgery

- Ensure sterile urine preoperatively.
- Treat preoperative positive urine cultures:
  - ✓ never perform stone manipulation or incision therapy when there is active UTI!
- Antimicrobial prophylaxis in all cases.
- **Stop** procedure if purulent fluid is obtained at puncture, leave a nephrostomy tube, and stage treatment.

Recommended antimicrobial prophylaxis in genitourinary surgery and procedures

Procedure	Indication		Antibiotic scheme		Duration	Remarks
	AUA	EAU	First choice	Alternative		
Diagnostic procedures						
Cystography, cystoscopy, ureteroscopy, urodynamics	If risk factors	If risk factors	Fluoroquinolone or 2nd-generation cephalosporin or TMP–SMX	Aminoglycoside ± ampicillin or amoxicillin/clavulanate	≤24 hours	If urine culture is negative, antimicrobial prophylaxis is not necessary
Prostate biopsy	All	All	Fluoroquinolone or TMP–SMX	Aminoglycoside + metronidazole or clindamycin	≤72 hours	
Endourologic surgery and shock-wave lithotripsy						
Shock-wave lithotripsy	All	If risk factors	Fluoroquinolone or TMP–SMX or 2nd/3rd-generation cephalosporin	Aminoglycoside ± ampicillin or amoxicillin/clavulanate	≤24 hours	Patients with ureteral stent, nephrostomy obstruction and infection stone
TURP/TURBT	All	If risk factors	Fluoroquinolone or TMP–SMX or 2nd/3rd-generation cephalosporin or aminopenicillin/BLI	Aminoglycoside + ampicillin or 1st-generation cephalosporin or amoxicillin/clavulanate	≤24 hours	Consider in large necrotic tumors
Ureteroscopy	All	If risk factors	2nd/3rd-generation cephalosporin or TMP–SMX or aminopenicillin/BLI or fluoroquinolone	Aminoglycoside ± ampicillin or 1st-generation cephalosporin or amoxicillin/clavulanate	≤24 hours	
Percutaneous renal surgery	All	All	2nd/3rd-generation cephalosporin or TMP–SMX or aminopenicillin/BLI	Ampicillin/sulbactam or fluoroquinolone or 1st-generation cephalosporin	≤24 hours	Length of short course to be determined, intravenous route suggested
Open or laparoscopic surgery						
Clean operations	If risk factor	All	1st-generation cephalosporin	Clindamycin	Single dose	Consider in high-risk and short postoperative catheter treatment
Clean–contaminated opening of urinary tract	All	All	2nd/3rd-generation cephalosporin or aminoglycoside + metronidazole or aminopenicillin/BLI	Ampicillin/sulbactam Fluoroquinolone	Single perioperative dose	
Contaminated (involving bowel)	All	All	2nd/3rd-generation cephalosporin or aminoglycoside + metronidazole or clindamycin	Ampicillin/sulbactam Ticarcillin/clavulanate Pipercillin/tazobactam Fluoroquinolone	≤24 hours	For surgery involving the colon, bowel preparation with oral neomycin plus either erythromycin base or metronidazole can be added
Implanted prosthetic devices	All	All	Aminoglycoside + 1st/2nd-generation cephalosporin or vancomycin	Ampicillin/sulbactam Ticarcillin/clavulanate Pipercillin/tazobactam	≤24 hours	

TURP, transurethral resection of prostate; TURBT, transurethral resection of bladder tumor; TMP–SMX, trimethoprim–sulfamethoxazole; BLI, β-lactamase inhibitor.

Modifiable intraoperative factors in urologic endoscopic surgery

Low-pressure irrigation system

- bacterial and **endotoxin** translocation into the systemic circulation (systemic inflammatory response syndrome (SIRS))
- Only enough **irrigation** to maintain adequate visibility
- **ureteral access sheath**
  - ✓ With the ureteroscope positioned in the distal ureter, the mean intrarenal pressure without the UAS was 60 compared with **15mmHg** with the UAS; with the ureteroscope in the renal pelvis the pressures were 94.4 and **40.6mmHg**, respectively
- periodic **drainage** of the collecting system through the ureteroscope
- continuous or intermittent **bladder drainage**

Effective dose associated with different imaging and image-guided interventions

- patient undergoing PCNL
  - ✓ preoperative CT scan, intraoperative fluoroscopy equaling another CT scan, and a postoperative follow-up CT scan
  - ✓ **50th percentile** of the dose received by the victims of the Hiroshima and Nagasaki **nuclear bombs** in World War 2

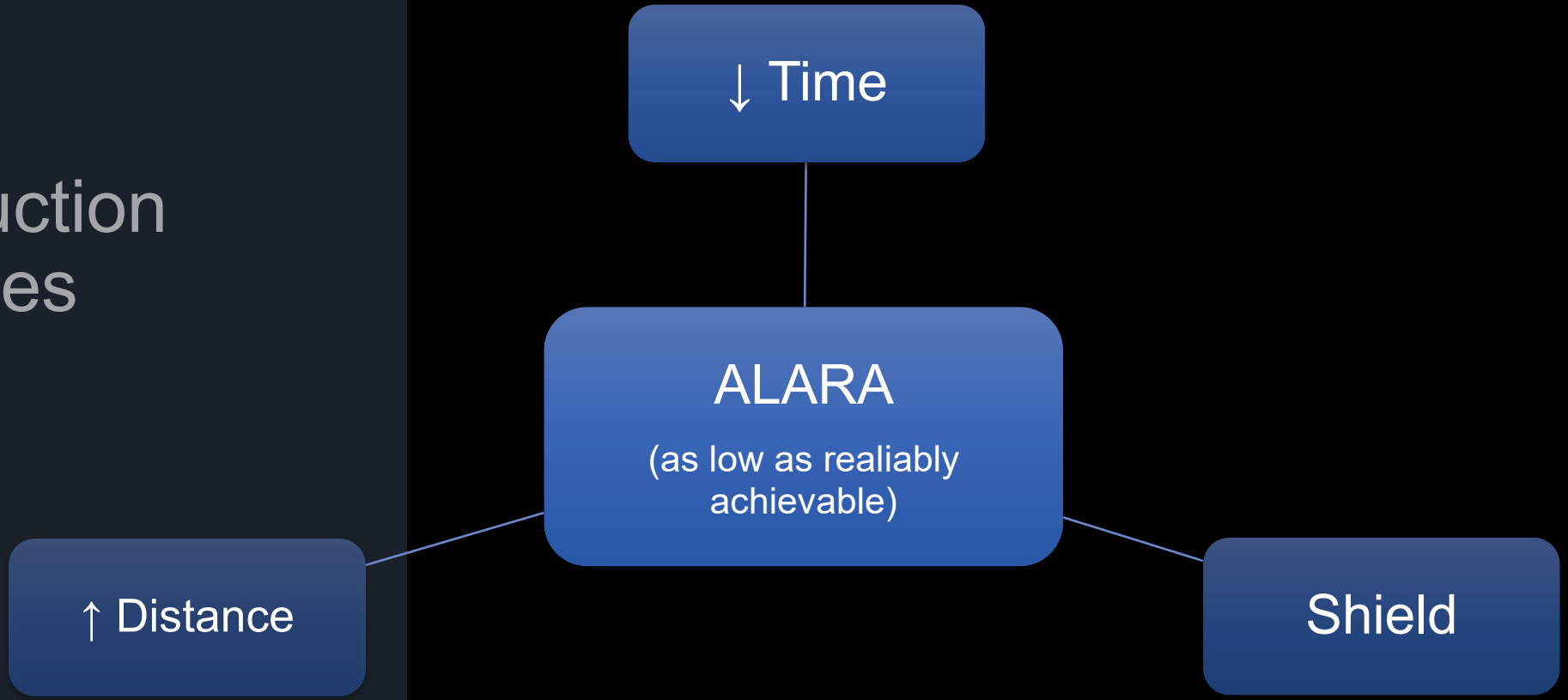
- The International Commission on Radioloical Protection (ICRP)
  - ✓ 50mSv per a single year
  - ✓ 20mSv/year for 5-year period

Procedure	Mean effective dose (mSv)
KUB [24, 55, 94, 111]	0.7–1.1
IVU [24, 55, 94, 111]	1.5–3.5
Standard-dose CT, abdomen [24, 55, 95]	5–10
Standard-dose CT, pelvis [55, 95]	5–10
Standard-dose CT, urogram [22, 24]	10–31
Low-dose CT, abdomen/pelvis [94, 102]	2.0–3.5
Ultra low-dose CT, abdomen/pelvis [109]	0.5–1.5
PET CT scan [24]	14.1
Diuretic renal scan [24]	2.6
Bone scan [24]	6.3
Cystography [24]	1.8
Nephrostomy tube placement [24]	3.4
SWL [127, 128]	1–8
Ureteroscopy [128, 159]	1–7
PCNL [59, 62]	3–18

Radiation safety measures

- Practice ALARA principles (minimize time, maximize distance, and always use shields).
- Use modern equipment with digital fluoroscopy with **last-image hold technology**.
- Stand as **far** as possible from the patient to avoid scattered radiation.
- Place the image intensifier as close as possible to the patient to minimize scatter radiation.
- Minimize the area of radiation exposure by using collimators to narrow the field.
- Use **pulsed fluoroscopy** with **4 frames** per second.
- Control the **foot pedal** and movement of the C-arm.
- Limit the time of fluoroscopic exposure to a minimum during absolute key points rather than continuous stretches.
- Track and document the amount of radiation used for each procedure.
- Check each fluoroscopy unit annually.
- Invest in custom-made lightweight **aprons** and examine each apron annually for defects.
- Whenever possible, order imaging studies associated with lower radiation exposure such as ultrasound/KUB or low-dose CT.

Dose-reduction strategies



ALARA principles: Time (minimize time)

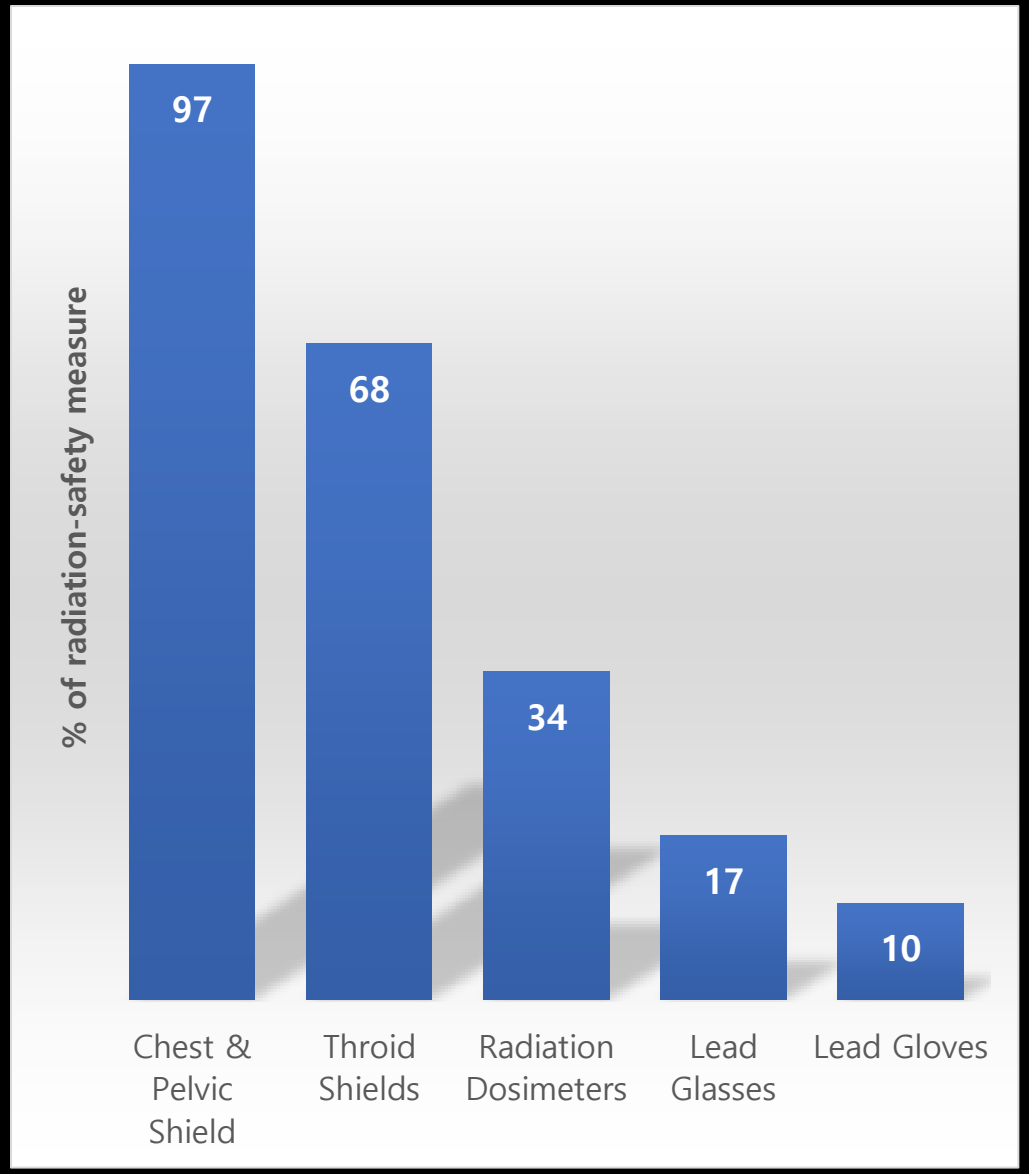
- Substitute fluoroscopy with other imaging modalities such as **ultrasound**-guided PCA during PCNL or totally ultrasound- guided PCNL.
- Use "**last-image-hold**" technology which has been shown to reduce radiation exposure dose by almost 10-fold (from 3000 to 400mGy).
- Use pulsed fluoroscopy with **fewer frames** per second (such as 1 or 4 frames per second) rather than standard fluoroscopy at 30 frames per second.
- Fluoroscopy should be turned on/off **by the surgeon** only during absolute key points rather than continuous stretches.
- Use digital fluoroscopy.
- Keep tracking the FT.
- Document the FT after each procedure

ALARA principles: Distance (maximize distance)

- the cheapest and most effective way
- As radiation exposure has an **inverse** relationship with the **square** of the distance, doubling the distance reduces radiation to one-quarter and at a distance of 3m the radiation dose becomes similar to background levels.

ALARA principles: Shielding (always use shields)

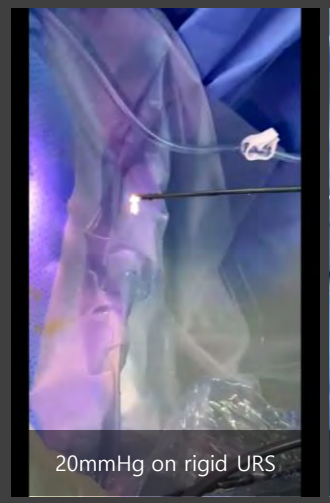
- the **third line** of defense, especially for personnel who have to be in the radiation field
- 0.5mm lead equivalent that attenuate radiation by 96.5–99.5%
- thyroid shields were found to decrease radiation exposure 23 times (from 46 to 0.02mSv), thereby reducing radiation exposure to background levels

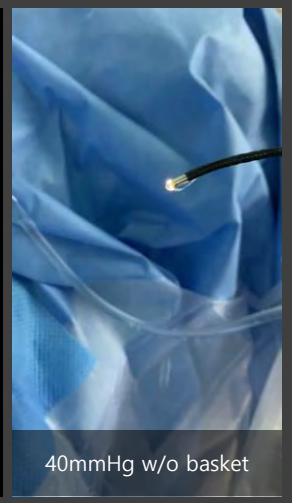


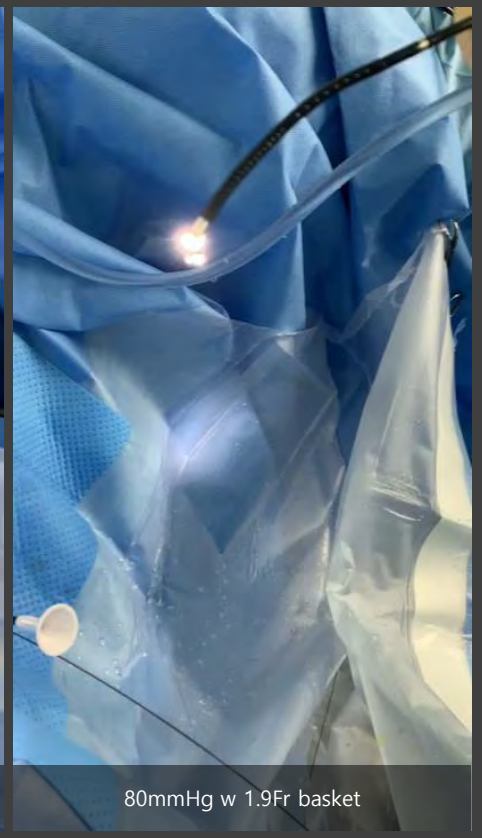
Minimizing complications in URSL

General tips for a simpler and safer ureteroscopy

- Always work with a **safety wire** in place
- Keep the **irrigation** as slow as possible
- white balanced and the focus performed prior
- Always remember to **empty the bladder** afterwards! if the bladder is full, the ureteric orifices are displaced laterally, making access into the lower ureter more difficult.
- always consider whether it would be possible to **reposition** a lower pole stone into an upper (preferably) or midpole calyx prior to laser fragmentation.
- Always ensure that the flexible ureteroscope is as '**straight**' as possible when passing a laser fibre.
- Always start laser stone fragmentation with a **low setting**, typically 5 Hz and 0.5 W, only increasing the power if the stone is particularly hard
- Try to have 2–4 favoured guidewires and baskets rather than having a very large selection as the latter often proves restrictive, particularly with an unfamiliar theatre team.







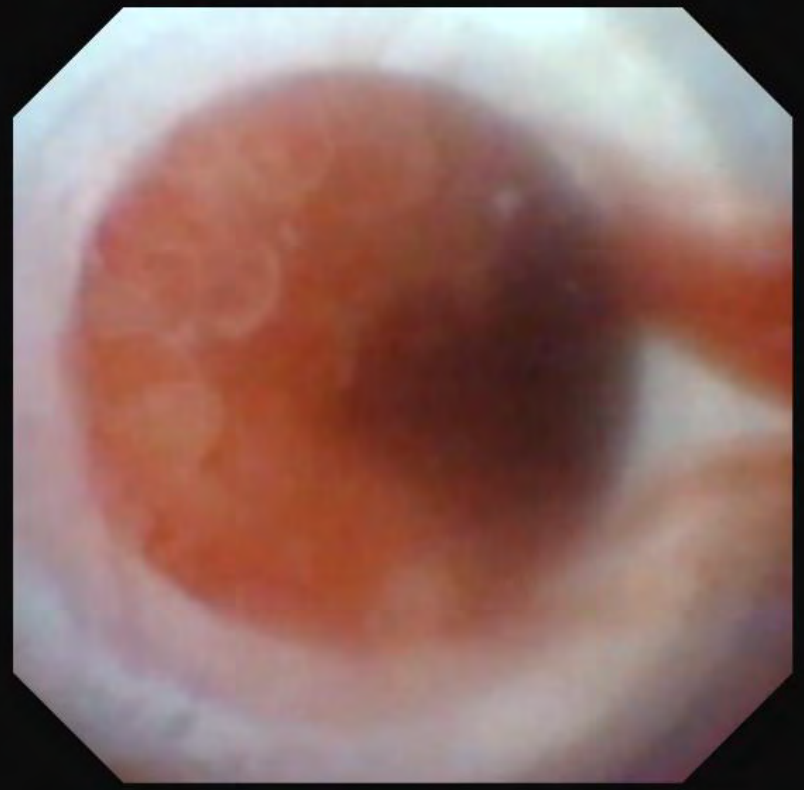
Keep the irrigation as slow as possible

Always remember to empty the bladder afterwards!

Always

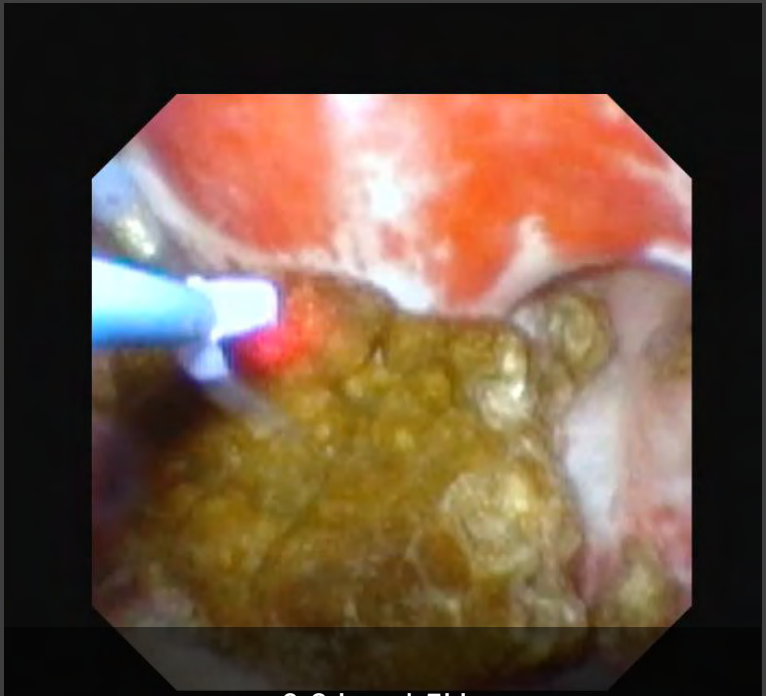
- ensure that the flexible ureteroscope is as '**straight**' as possible when passing a laser fibre.

- consider whether it would be possible to **reposition** a lower pole stone into an upper to laser fragmentation.

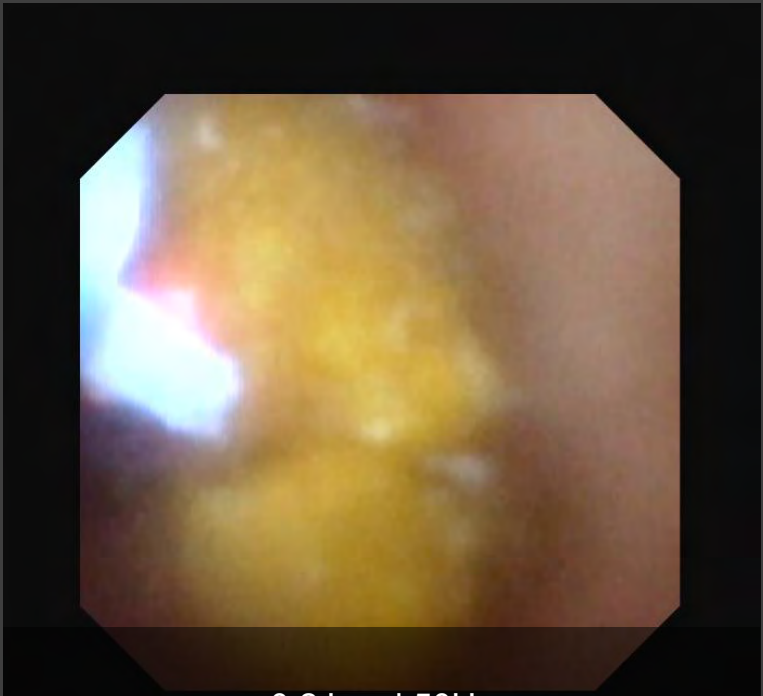


General tips for a simpler and safer ureteroscopy

- **Warm** fluid is preferred
- The use of apnea during laser lithotripsy
  - ✓ A recent report described a protocol to perform apnea during fURS, allowing its maintenance for approximately 5minutes. This illustrates the role of the collaboration between anesthesiologists and surgeons in order to achieve optimum treatment
- **Basketing** vs. dusting (vs. pop-dusting)
- After complete stone fragmentation, the entire collecting system is again **inspect**ed to ensure that no large stone fragments remain. The access sheath is whithdrawn with the ureteroscope down the entire length of the ureter to facilitate inspection of the entire ureter.



0.8J and 5Hz



0.2J and 50Hz

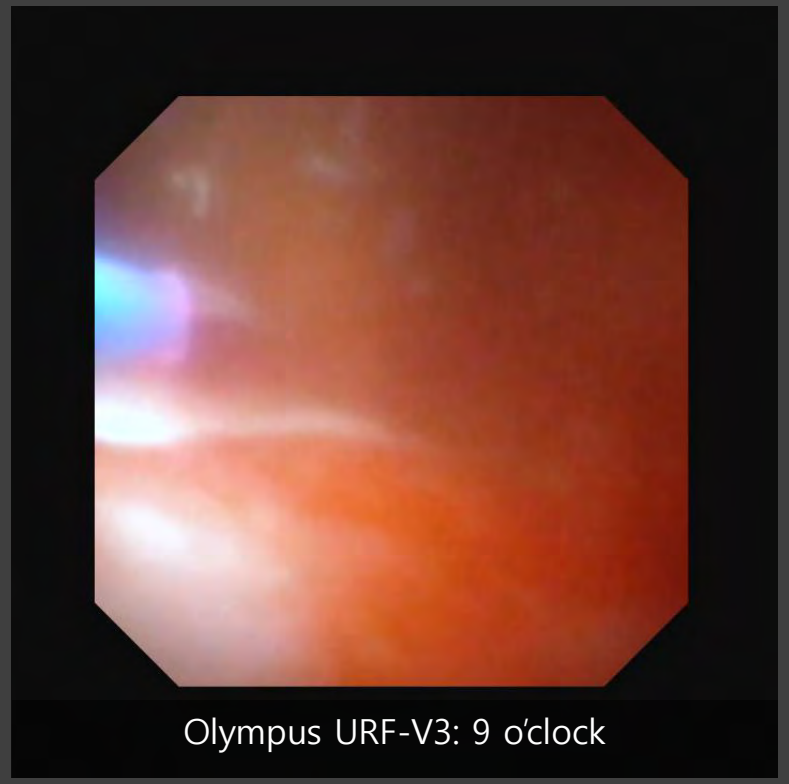
Basketing vs. Dusting

Inspection of entire collecting system and ureter

General tips for a simpler and safer ureteroscopy

- Most flexible ureteroscopes have a 3 or 9 o'clock **working channel position**. When performing laser lithotripsy in a **right kidney**, a **3 o'clock** position is better to ablate stones. However, to better fragment stones located in right anterior calyces, a 9 o'clock working channel position is advised. Conversely, a **9 o'clock** working channel is advised for **left renal stones** except for posterior calyces where a 3 o'clock working channel is preferable
- The **laser console** should be positioned **as close as possible** to the surgeon and patient, preventing any long lines of laser fiber that could be inadvertently **pulled on** by operating room (OR) staff walking through the room. This is also dangerous to the ureteroscope if the laser is being activated and a staff member becomes entangled in the fiber and pulls it back into the working channel, thus damaging the ureteroscope.
- The **aiming beam** produced by the console, which allows visualization of the distal tip of the laser fiber, should always be clearly visible. If the tip of the laser fiber is activated too close to the end or within the ureteroscope, it will cause catastrophic and irreversible scope damage. **Loss of visualization of the aiming beam** is also a sign that there is a break somewhere along the laser fiber, which could result in harm to the ureteroscope or those present in the OR

Boston LithoVue: 3 o'clock

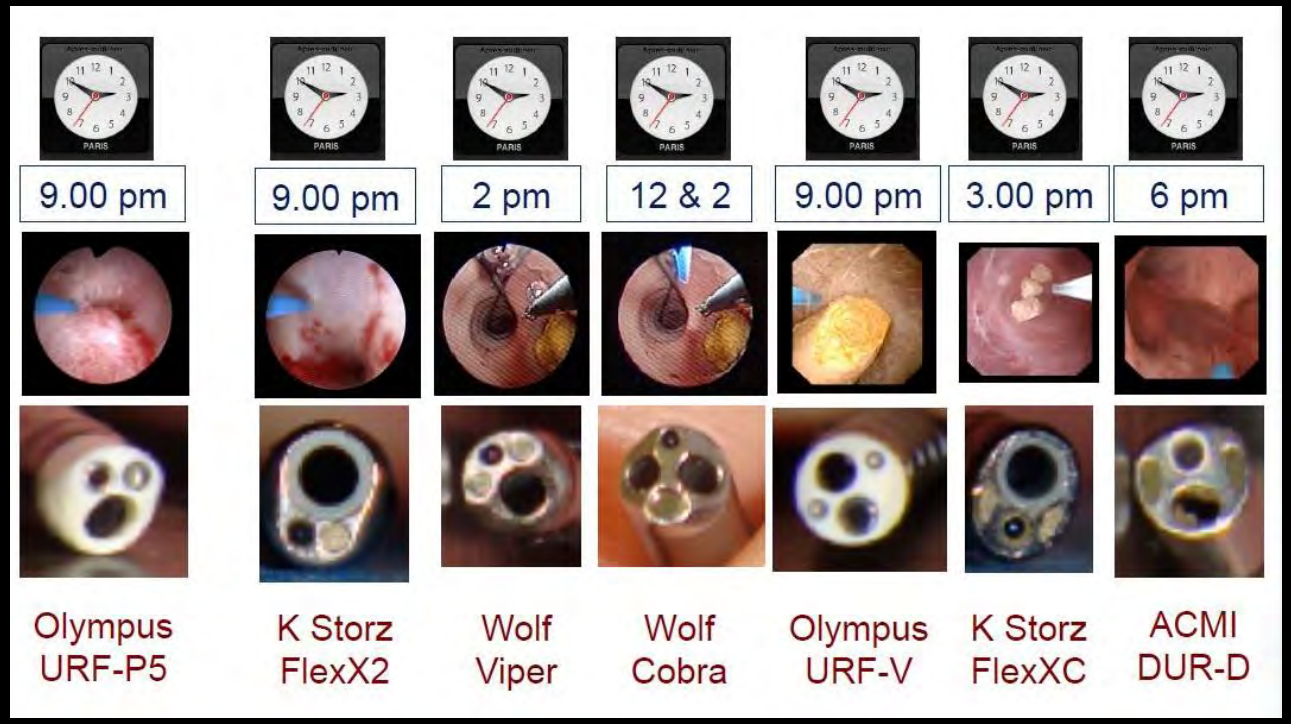


Olympus URF-V3: 9 o'clock

Storz Flex-X2S: 9 o'clock

Working channel position

Different location of working channel



RIGHT Kidney

Calices are at 9’00

Gravity is at 3’00

RIGHT Kidney : better to use a F-URS with Working Channel positioned at **3’00**

LEFT Kidney

Gravity is at 9’00

Calices are at 3’00

LEFT Kidney : better to use a F-URS with Working Channel positioned at **9’00**

Benefit on Different location of working channel

Intussusception and ureteral avulsion

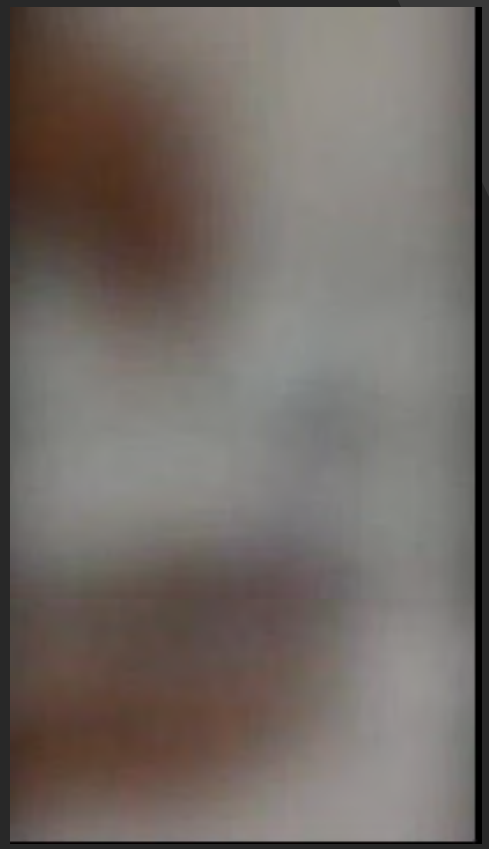
- Use a '**soft hands**' approach to upper tract endoscopy; if passage of the ureteroscope during primary ureteroscopy is not possible due to resistance, then avoid using force. A **stent placement** in such a situation is **not a ' failure'**, allowing safe return at a later date. Ureteric trauma, on the other hand, with forced passage of a ureteroscope may prove to be a **career regret!**
- **No force** should be generated when extracting fragments, and basketing should always be done **under direct vision**; blind basketing is never acceptable
- When the ureteroscope is being withdrawn, you should be able to see the **ureteric walls moving away from you**, similar to sitting in a train with the landscape moving away; **if the landscape is coming with you then you are in trouble**.
- It is important to remember to keep gentle pressure on the scope when the ureter is tight rather than using active force. Usually the tip of the ureteroscope is narrow and the **diameter increases** towards the shaft and the proximal end, therefore negotiating the narrow area may not necessarily mean that the rest of the procedure will be easy. The narrow area in the distal ureter may continue to be tight and make it really difficult to pass the ureteroscope.
- When removing the stone, do not pull the basket right to the tip of the ureteroscope, thus blocking the endoscopic view. The surgeon should be able to **see the endoscope, stone, and ureter** during stone extraction. The ureter must be seen, and if the surgeon **sees the same window of ureter during extraction**, it could signal that the ureter is being avulsed.
- The best position for the UAS is with its **tip in the proximal ureter** or just below the ureteropelvic junction but not through it, since this is the portion of the ureter at greatest risk of avulsion because it has the least muscular tissue support.

Stone basket entrapment

- approximately 0.5% of cases
- Fragment too large for removal through the ureter

- The first maneuver is to **gently advance** the stone more proximal and disengage the stone using the basket mechanism
- The next maneuver should be to **cut the basket** wiring with scissors just beyond the handle or basket **disassembly** if basket preservation is necessary

- Nitinol baskets are easily withdrawn after being lasered because of their soft nature.



Technique for Tight ureteral orifice and difficult ureter

- telescoping the wire through a ureteral catheter to improve direction and stability
- converting to a straight or curved hydrophilic wire
- **emptying/filling** the bladder
- manually reducing a cystocele or vaginal prolapse (e.g. vaginal packing)
- flexible cystoscope
- Albarran bridge with 70° lens
- Methylene blue or Fluorescein to endoscopically visualize the effluxing ureteral orifice
- Incision

- Staged approach
- tapered dilators or dilating balloons
- **Railroad technique**
- Antegrade approach

Minimizing complications in PCNL

Dilation of the Nephrostomy Tract

Complications include

- vascular lesions of intra- or extraparenchymal vessels,
- collecting system lesions by a nontranspapillary access,
- rupture of the collecting system in the case of a mismatch between dilation size and collecting system, and
- frontal forward perforations.

Guidewire kinking

- Any **discrepancy** between **forward pushing forces** and the **rigidity** of the guidewire carries the risk of permanent guidewire kinking or passive guidewire retraction. This can jeopardize the access and make a new puncture necessary.

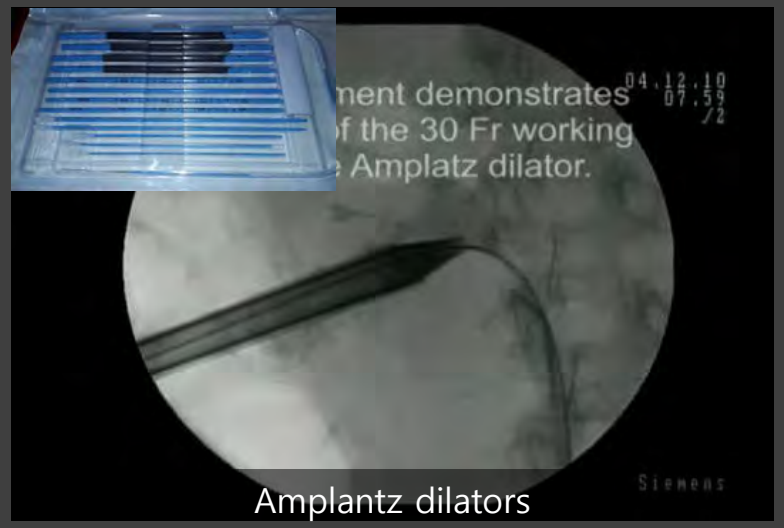
Dilation of the nephrostomy tract

- All forward-advancing movements with any dilator or sheath should principally be done with one hand, in a **twisting bidirectional rotation** with approximately **70–80%** of the force turning the dilator and 20–30% pushing it forward.
  - ✓ This is surprisingly easier than a predominant forward movement. The force should primarily come from the **fingers** and the **wrist**.
  - ✓ To prevent forward perforation the pushing hand should always be **ready to stop** the forward movement immediately;
  - ✓ The other hand **controls** the guidewire or guide rod.
  - ✓ To prevent a sudden jerky forward movement and perforation the surgeon's arms should be bent at the elbows and drawn to the surgeon's flank. The force does not come from the surgeon's body leant against the dilators but from the arms.

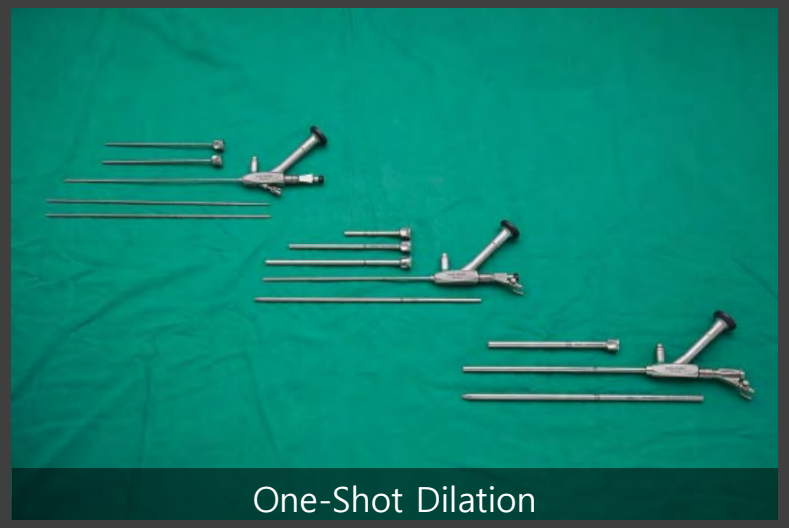
- Frequent short **imaging** controls with fluoroscopy or sonography are advisable.

Hemorrhagic complication associated with PCNL

- 7.8% rate of significant bleeding and a blood transfusion rate of 5.7%
- needle puncture, dilation of the percutaneous tract, **excessive torqueing** of the renal parenchyma through an established access sheath, aggressive **stone manipulation** and extraction
- Patient-related factors: obesity, certain comorbidities such as hypertension, arteriosclerosis and diabetes, older age, patient frailty, higher American Society of Anesthesiology (ASA) classification, renal insufficiency, lack of preoperative hydronephrosis, history of prior renal surgery, renal anomalies, underlying or prior urinary tract **infections**, and the use of anticoagulants
- Operative-related factors: **longer** operative duration, **larger** access tract size, less surgeon experience, use of **multiple** access tracts, upper pole calyceal access, longer intraoperative time to successful renal puncture and larger bore nephroscopes



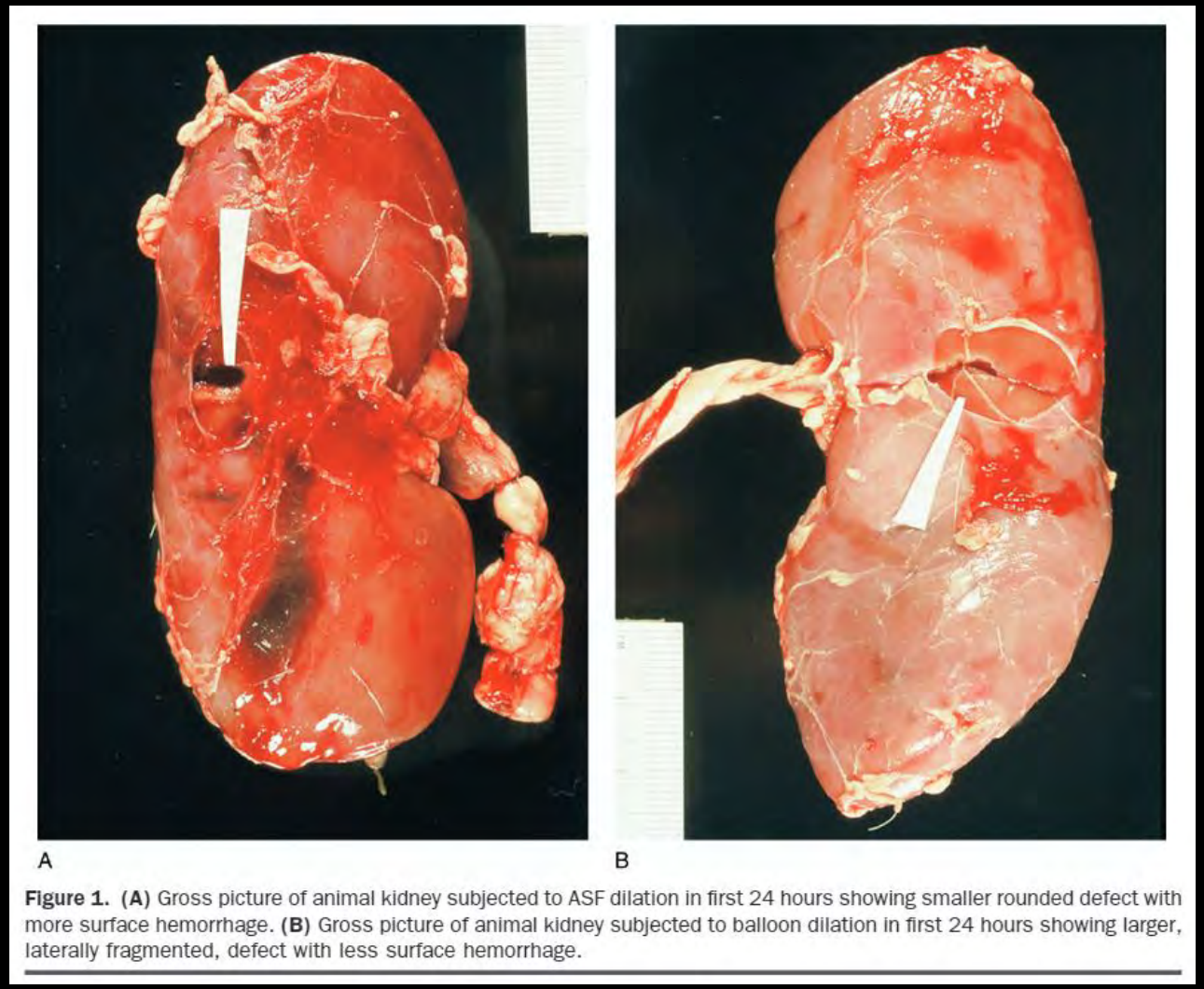
Amplantz dilators


One-Shot Dilation

Balloon dilators

Dilators

Amplantz vs. Balloon Dilation



A B

Figure 1. **(A)** Gross picture of animal kidney subjected to ASF dilation in first 24 hours showing smaller rounded defect with more surface hemorrhage. **(B)** Gross picture of animal kidney subjected to balloon dilation in first 24 hours showing larger, laterally fragmented, defect with less surface hemorrhage.

Tract dilation: Ideal situation

In the **ideal situation** all dilation techniques are equally effective and safe:

- the puncture is **transpapillary**;
- its **direction** exactly matches the long axis of the access calyx;
- the tract leads through a wide calyx straight into a capacious renal pelvis;
- the **tip** of whatever dilator used is well within the renal pelvis;
- and the collecting system is a significant part of the tract, adding safety space for movements.
- Only the parenchyma is dilated in an **avascular** area.

Optimization

- In the operating room, immediately preceding PCNL, maintaining adequate **patient temperature** is imperative as efficient **clot formation** depends on body temperature, and lower core body temperatures are associated with inefficient clot formation
- During patient positioning alone, core body temperatures can fall by approximately 1°C. Furthermore, it is important to use **warmed irrigation** fluid when available.

My experiences with PCNL

- **Miniaturized** instrument
- Torqueing
  - ECIRS
- **Low energy** setting (maximal 0.8J)
- Vacuum cleaner effect
- Renal access: radiologist vs. urologist
  - Lower pole puncture
- Hemostatic agent

Summary

- Sepsis: sterile urine, low-pressure
- Radiation: ALARA principle
  - ✓Last-image hold, pulsed with 4 frame, foot pedal by surgeon, shielding
- URSL: empty bladder, slow irrigation, low power setting, basketing, inspection
  - ✓Avulsion: soft hands, direct vision
- PCNL: twisting rotation, miniaturized, low energy

Thank you for your attention

mschoo@snu.ac.kr