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Surgical Management of Kidney and Ureteral Stones

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9 MARCH 2023

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Intro.

- Approximately 10 to 20 % of all kidney stones require surgical removal
- Treatment success defined as complete stone removal, or the stone-free rate (SFR):
  - Absence of residual stones or the presence of residual stone fragments ≤4 mm in size

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Intro. (cont'd)

- Procedures that offer the highest SFRs (such as URS and PNL) also have higher complication rates
- Patients should expect to experience an improvement in QoL
- However, it may be reduced by the use of postoperative ureteral stents

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Intro. (cont'd)

- Indications for emergency surgery – Urgent decompression of the collecting system
  - obstructing stones and suspected or confirmed UTI
  - bilat. obstruction and AKI
  - unilat. obstruction with AKI in a solitary kidney

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URETERAL STONES

- Indications for active removal of ureteral stones:
  - Stones with a low likelihood of spontaneous passage
    - Ureteral stones >10 mm
  - Persistent pain despite adequate analgesic medication;
  - Persistent obstruction;
    - Have not passed after four to six weeks

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Proximal ureteral stone

> 10 mm	1. URS (ante- or retrograde) 2. SWL
< 10 mm	SWL or URS

Distal ureteral stone

> 10 mm	1. URS 2. SWL
< 10 mm	SWL or URS

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URETERAL STONES (cont'd)

AUA 2016

11. **In patients with mid or distal ureteral stones who require intervention (who were not candidates for or who failed MET), clinicians should recommend URS as first-line therapy. For patients who decline URS, clinicians should offer SWL.** **(Index Patients 2,3,5,6)** ***Strong Recommendation; Evidence Level Grade B***

18. **Clinicians performing URS for proximal ureteral stones should have a flexible ureteroscope available.** **(Index Patients 1, 4)** ***Clinical Principle***

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URETERAL STONES (cont'd)

Recommendations	Strength rating
If active removal is not indicated (section 3.4.9.3) in patients with newly diagnosed small* ureteral stones, observe patient initially with periodic evaluation.	Strong
Offer α-blockers as medical expulsive therapy as one of the treatment options for (distal) ureteral stones > 5 mm.	Strong
Inform patients that ureteroscopy (URS) has a better chance of achieving stone-free status with a single procedure.	Strong
Inform patients that URS has higher complication rates when compared to shock wave lithotripsy.	Strong
Use URS as first-line therapy for ureteral (and renal) stones in cases of severe obesity.	Strong

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RENAL STONES

- Indications for the removal of renal stones, include:
  - stone growth;
  - stones in high-risk patients for stone formation;
  - obstruction caused by stones;
  - infection;
  - symptomatic stones (e.g., pain or hematuria);
  - stones > 15 mm;
  - stones < 15 mm if observation is not the option of choice;
  - patient preference;
  - comorbidity;
  - social situation of the patient (e.g., profession or travelling);
  - choice of treatment.

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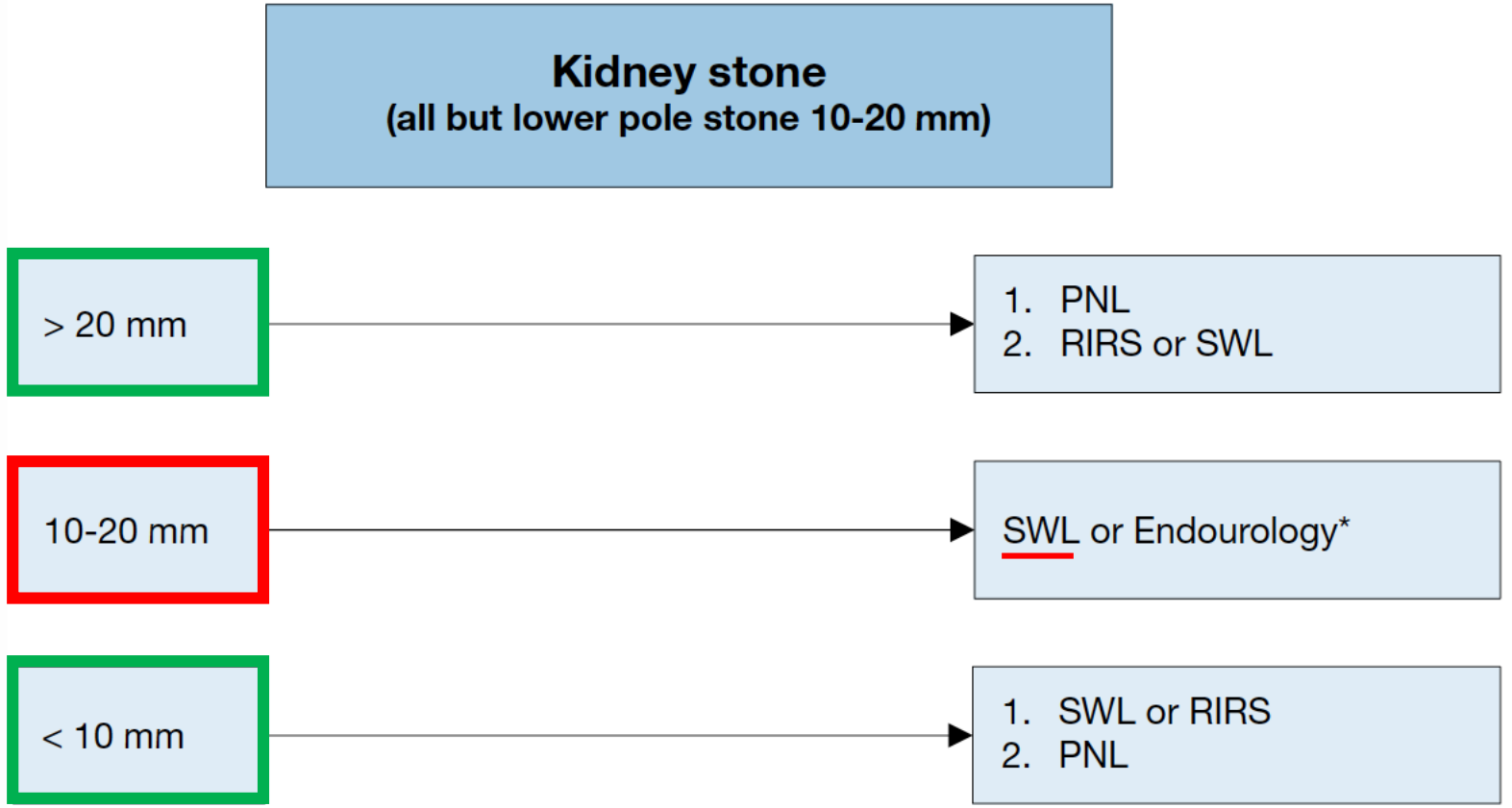

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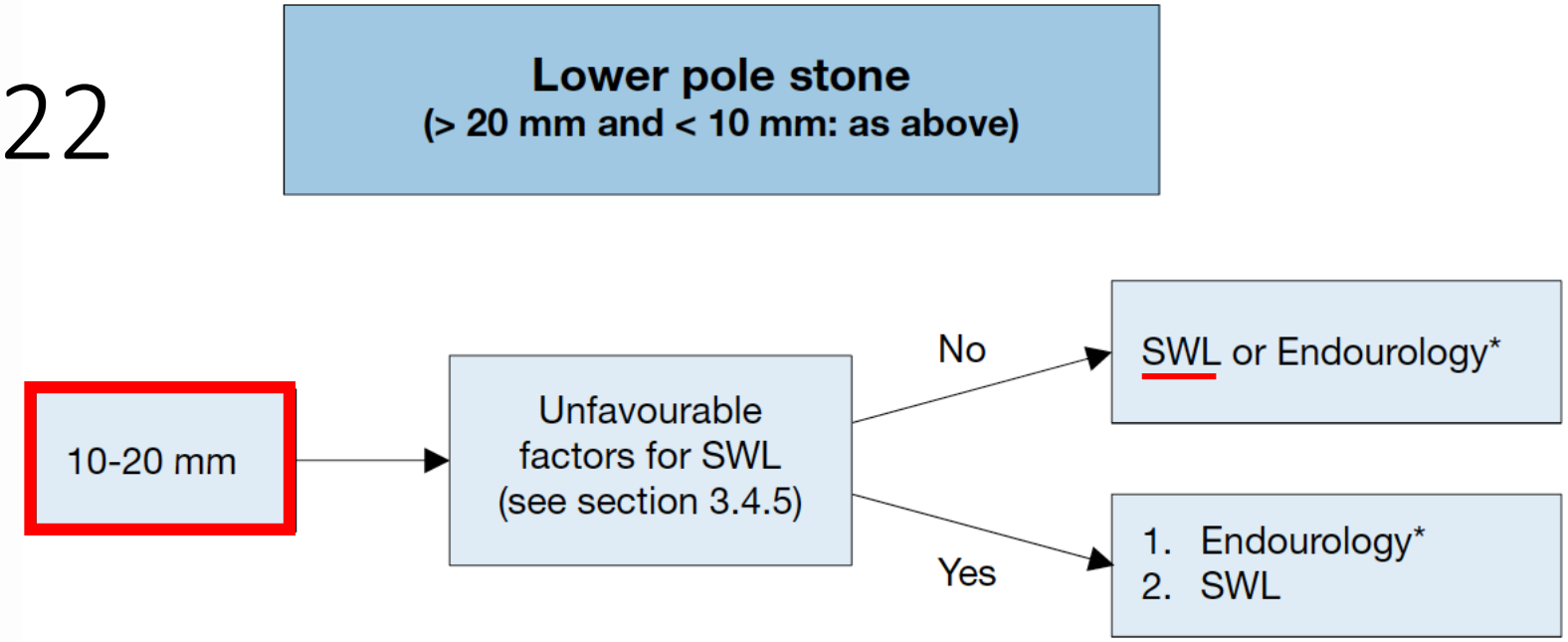

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AUA 2016

Treatment of adult patients with renal stones:

21. **In symptomatic patients with a total non-lower pole renal stone burden ≤ 20 mm, clinicians may offer SWL or URS. (Index Patient 7)** ***Strong Recommendation; Evidence Level Grade B***

22. **In symptomatic patients with a total renal stone burden >20 mm, clinicians should offer PCNL as first -line therapy. (Index Patient 8)** ***Strong Recommendation; Evidence Level Grade C***

25. **In patients with total renal stone burden >20 mm, clinicians should not offer SWL as first-line therapy. (Index Patient 8)** ***Moderate Recommendation; Evidence Level Grade C***

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30. Clinicians should offer SWL or URS to patients with symptomatic ≤ 10 mm lower pole renal stones. (Index Patient 9) *Strong Recommendation; Evidence Level Grade B*

31. Clinicians should not offer SWL as first-line therapy to patients with >10mm lower pole stones. (Index Patient 10) *Strong Recommendation; Evidence Level Grade B*

32. Clinicians should inform patients with lower pole stones >10 mm in size that PCNL has a higher stone -free rate but greater morbidity. (Index patient 10). *Strong Recommendation; Evidence Level Grade B*

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Extracorporeal Shock Wave Lithotripsy (ESWL)

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ESWL

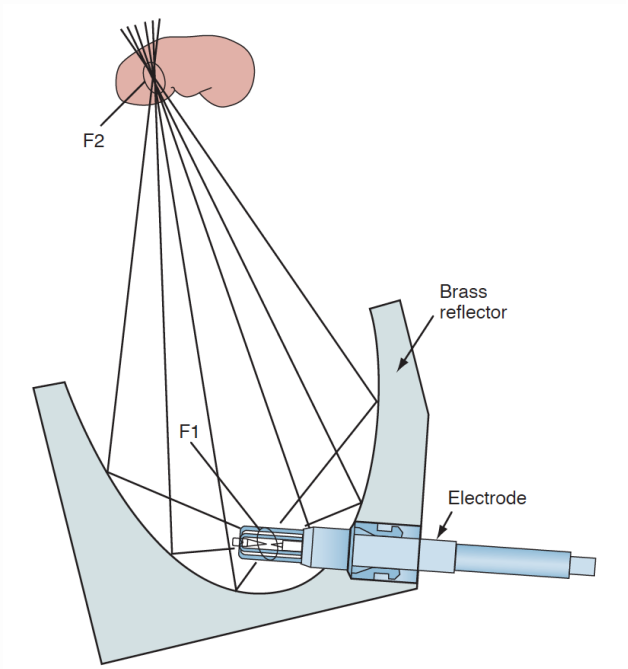

Fig. 94.1. Schematic view of an electrohydraulic shock wave generator. An electrode is used to generate a shock wave. *F1,* Focus 1; *F2,* focus 2.

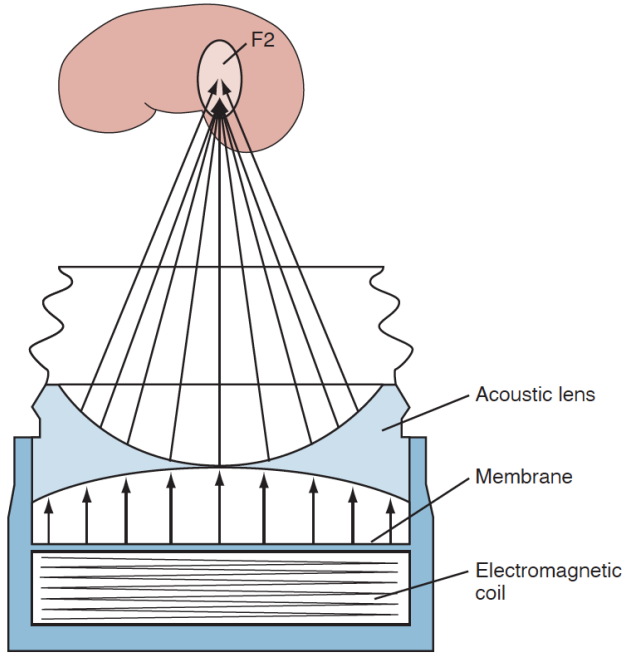

Fig. 94.2. Schematic view of an electromagnetic shock wave generator that uses an acoustic lens to focus the shock wave. An electromagnetic coil is used to generate the shock wave. *F2,* Focus 2.

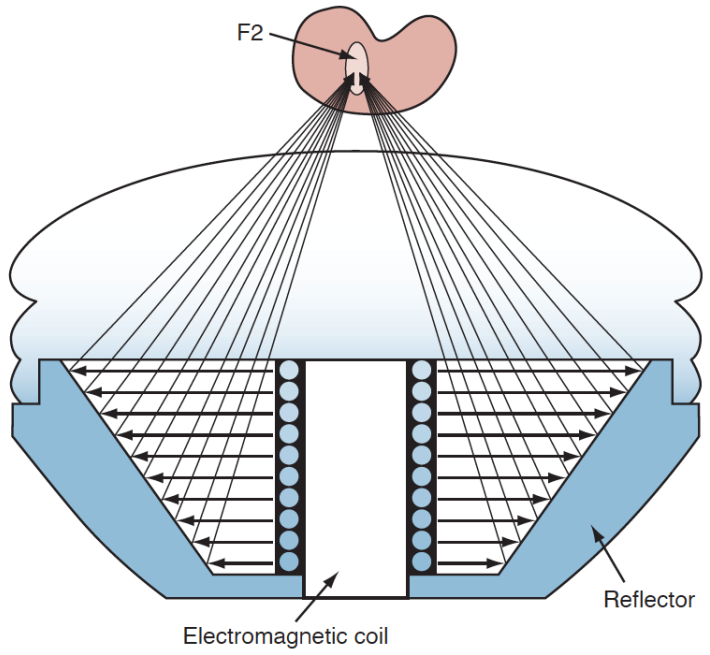

Fig. 94.3. Schematic view of an electromagnetic shock wave generator that uses a parabolic reflector to focus the shock wave. An electromagnetic coil is used to generate the shock wave. *F2,* Focus 2.

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ESWL (cont'd)

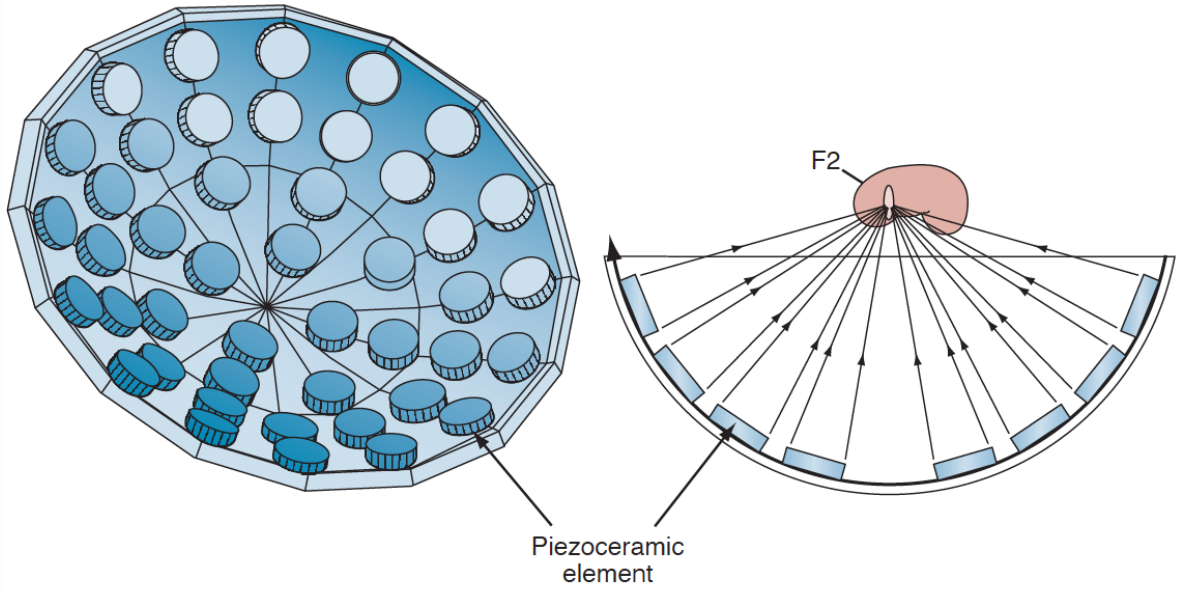

Fig. 94.4. Schematic view of a piezoelectric shock wave generator. Numerous polarized polycrystalline ceramic elements are positioned on the inside of a spherical dish. *F2*, Focus 2. The focal plane at the focus *(circles)*.

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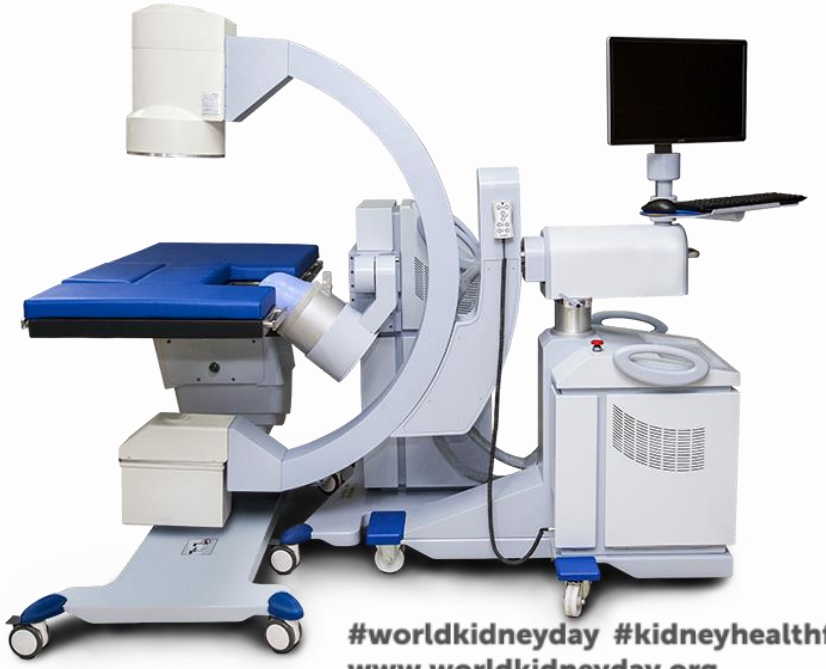
ESWL (cont'd)

- An outpatient basis with the patient under conscious sedation, general anesthesia, or regional anesthesia
- Contraindications:
  - Pregnancy
  - Untreated UTI/urosepsis
  - Decompensated coagulopathy
  - Uncontrolled arrhythmia
  - Abdominal aortic aneurysm >4.0 cm



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ESWL (cont'd)

- The success of SWL depends on the efficacy of the lithotripter and the following factors:
  - size, location (ureteral, pelvic or calyceal), and composition (hardness) of the stones
  - patient's habitus
  - performance of SWL

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ESWL (cont'd)

- Factors that impair successful stone treatment by SWL
  - steep infundibular-pelvic angle;
  - long calyx;
  - long skin-to-stone distance;
  - narrow infundibulum;
  - shock wave-resistant stones (calcium oxalate monohydrate, brushite, or cystine).

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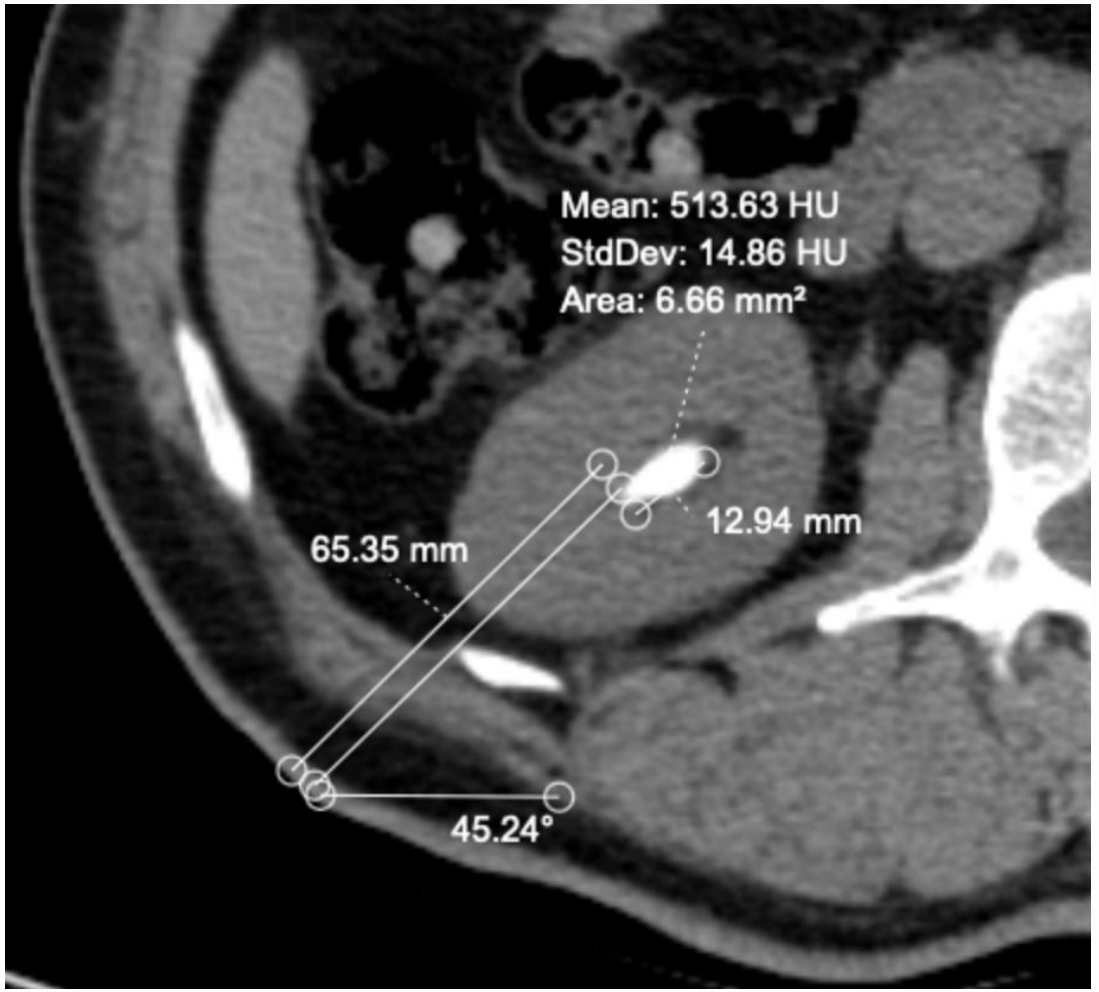
SSD & HU



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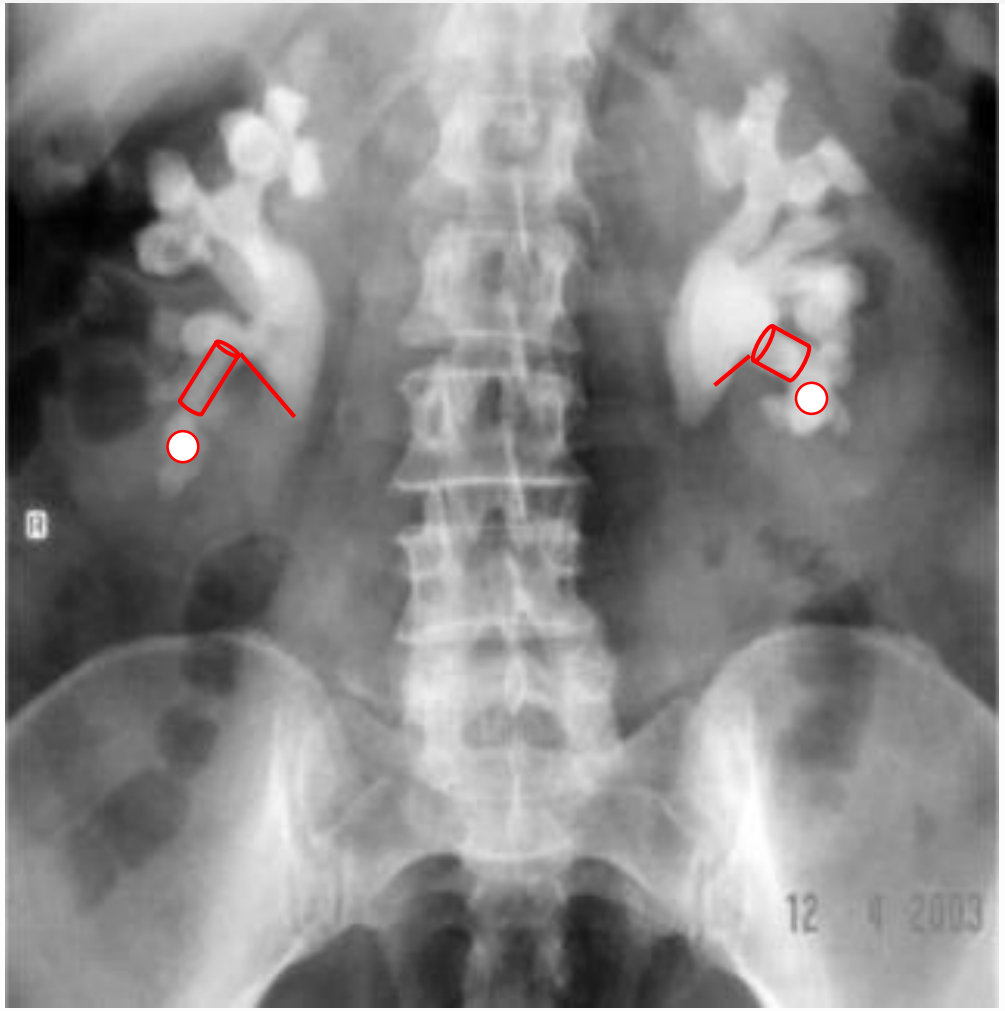
Anatomical indices



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ESWL complications

Complications			%
Related to stone fragments	Steinstrasse		4 – 7
	Regrowth of residual fragments		21 – 59
	Renal colic		2 – 4
Infections	Bacteriuria in non-infection stones		7.7 – 23
	Sepsis		1 – 2.7
Tissue effect	Renal	Haematoma, symptomatic	< 1
		Haematoma, asymptomatic	4 – 19
	Cardiovascular	Dysrhythmia	11 – 59
		Morbid cardiac events	Case reports
	Gastrointestinal	Bowel perforation	Case reports
		Liver, spleen haematoma	Case reports

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BOX 94.1 Acute Renal Side Effects: Risk Factors for Shock Wave Lithotripsy

Age	Diabetes mellitus
Obesity	Coronary heart disease
Coagulopathies	Preexisting hypertension
Thrombocytopenia	Body mass index >30 or <21.5

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ESWL (cont'd)

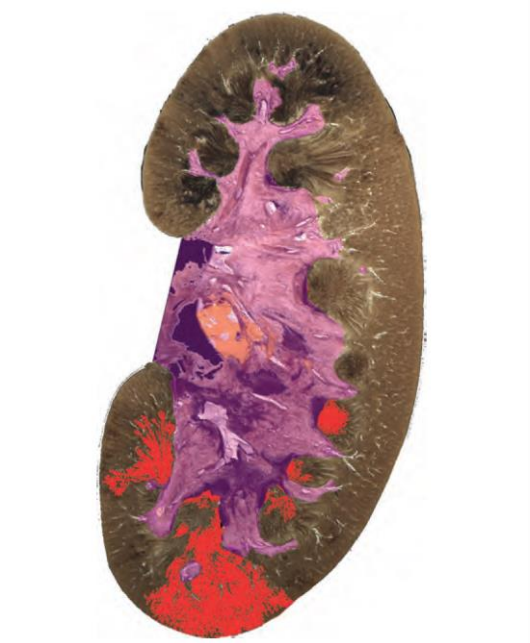

Fig. 94.8. Macroscopic photomicrograph of a coronal section through the kidney of a juvenile pig (~6 weeks old) treated with 2000 shocks at 24 kV by an unmodified Dornier HM3 lithotripter and examined 4 hours after treatment. The region of intraparenchymal hemorrhage has been colored red by an automated computer color recognition program. Note that the lesion involves multiple papillae and in some regions extends through the cortex to the renal capsule, where a subcapsular hematoma may develop.

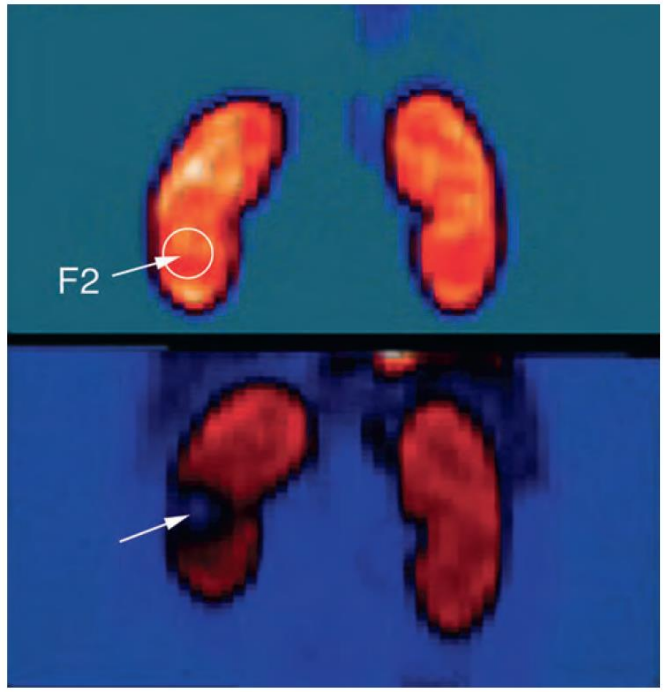

Fig. 94.10. Shock wave lithotripsy–treated and control kidneys imaged by positron emission tomographic scanning before and immediately after treatment with 3500 shock waves to the lower pole, at level six, with a DoLi 50 device. The site of focus 2 (F2) (lower pole) on the shocked kidney shows a 50% reduction of renal blood flow *(arrow)*.

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Journal of Endourology, Vol. 32, No. 3 | Extracorporeal Shockwave Lithotripsy

Extracorporeal Shockwave Lithotripsy Could Lead to a Prolonged Increase in the Renal Fibrotic Process of Up to 2 Years

Chi-fai Ng ✉, Sylvia Luke, Chi-hang Yee, Steven C.H. Leung, Jeremy Y.C. Teoh, and John Yuen

Published Online: 1 Mar 2018 | https://doi.org/10.1089/end.2017.0684

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ESWL (cont'd)

- Previously some concern that SWL could cause long-term complications such as hypertension, diabetes mellitus, kidney injury, and infertility
- A systematic review found NO strong evidence to support an association between SWL and these adverse effects

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ESWL: future direction

- Visio-Track (VT) locking system
- Ultrasonic propulsion of renal and ureteral calculi
- Burst wave lithotripsy
  - potential to revolutionize the future of SWL

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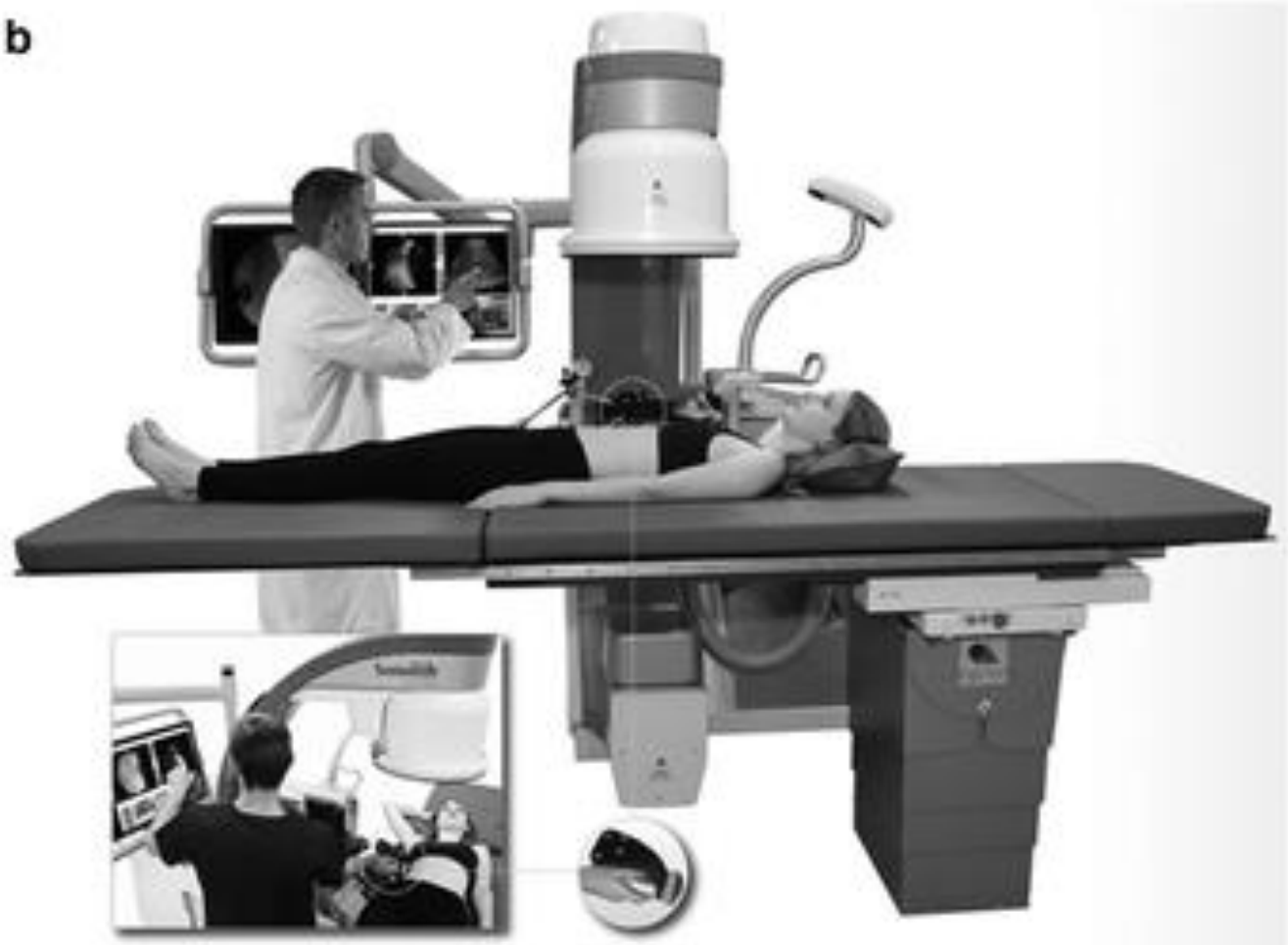

Visio-track configuration

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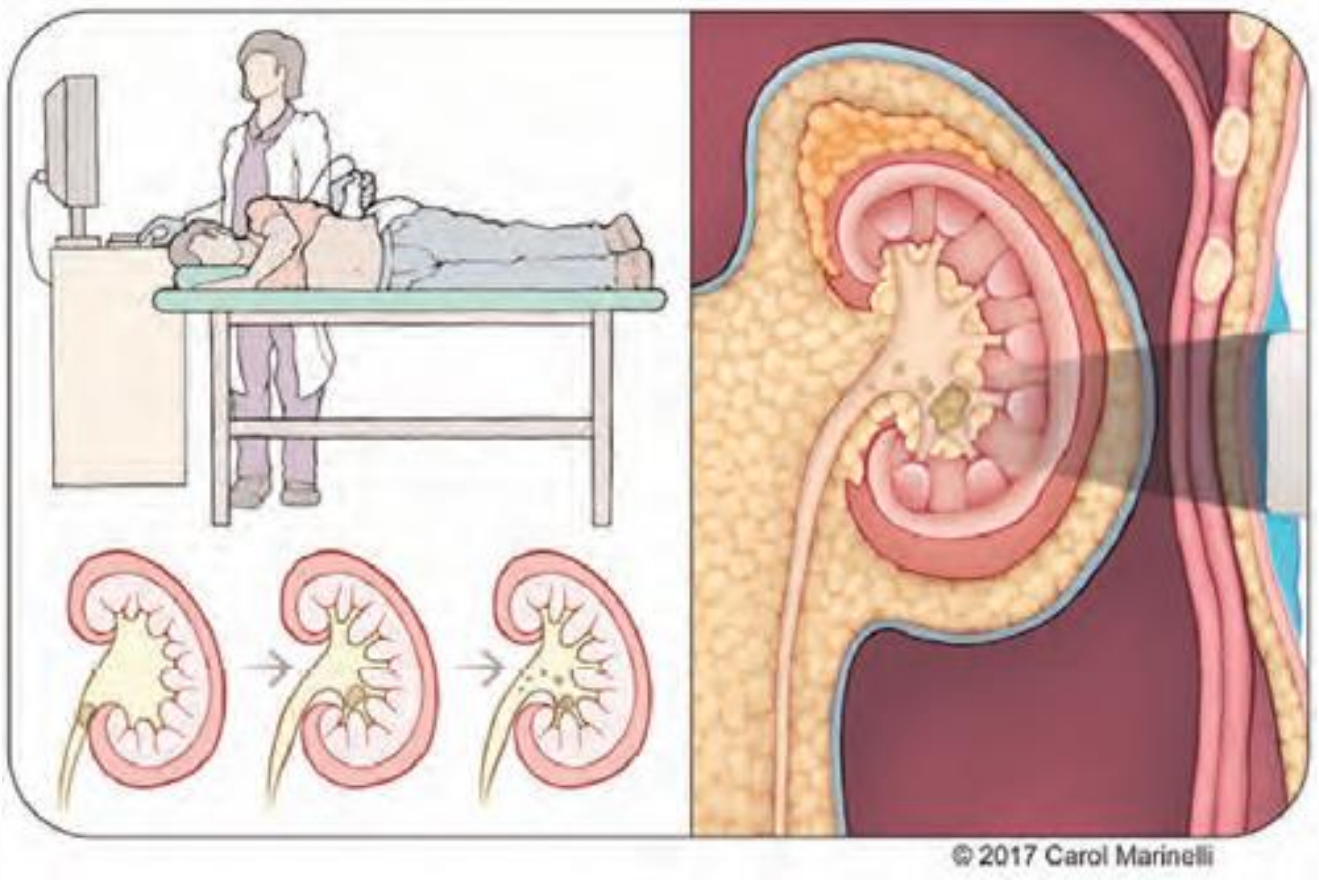
Ultrasonic propulsion



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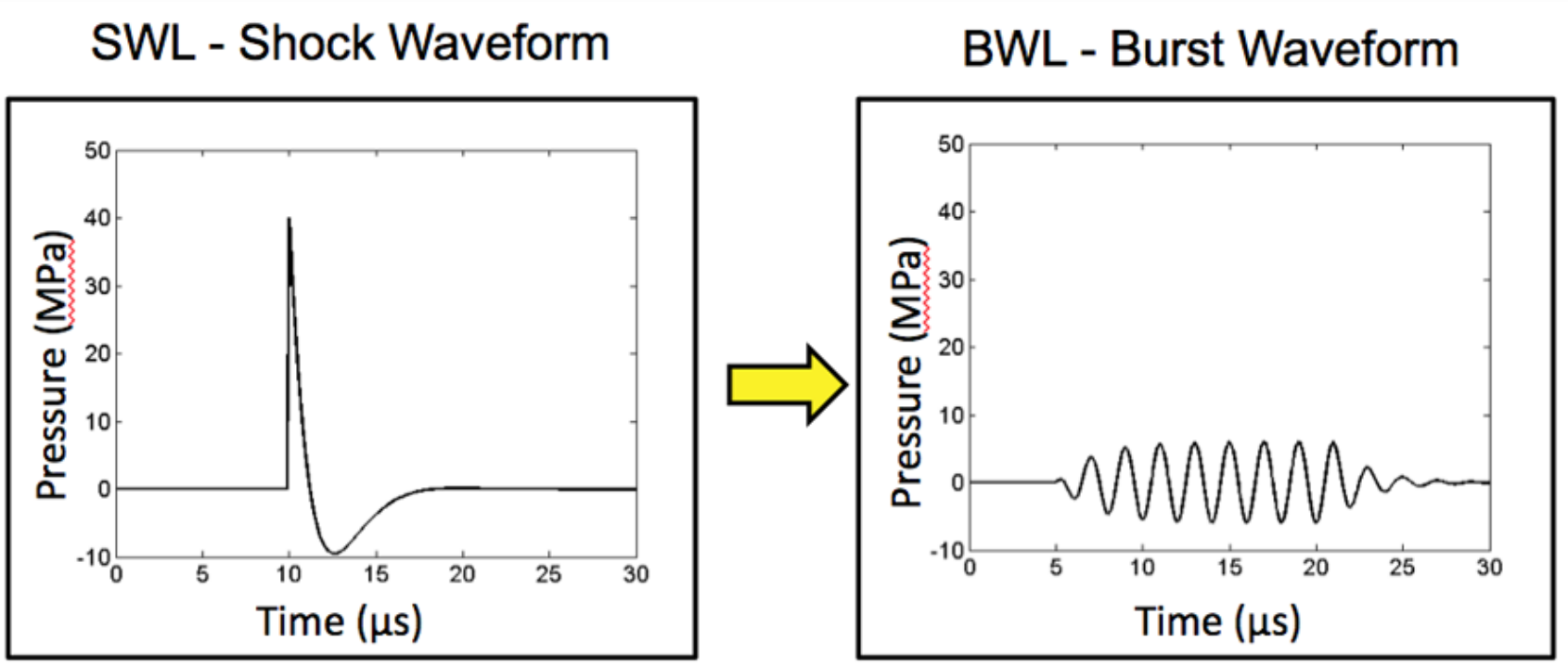
SWL vs. BWL



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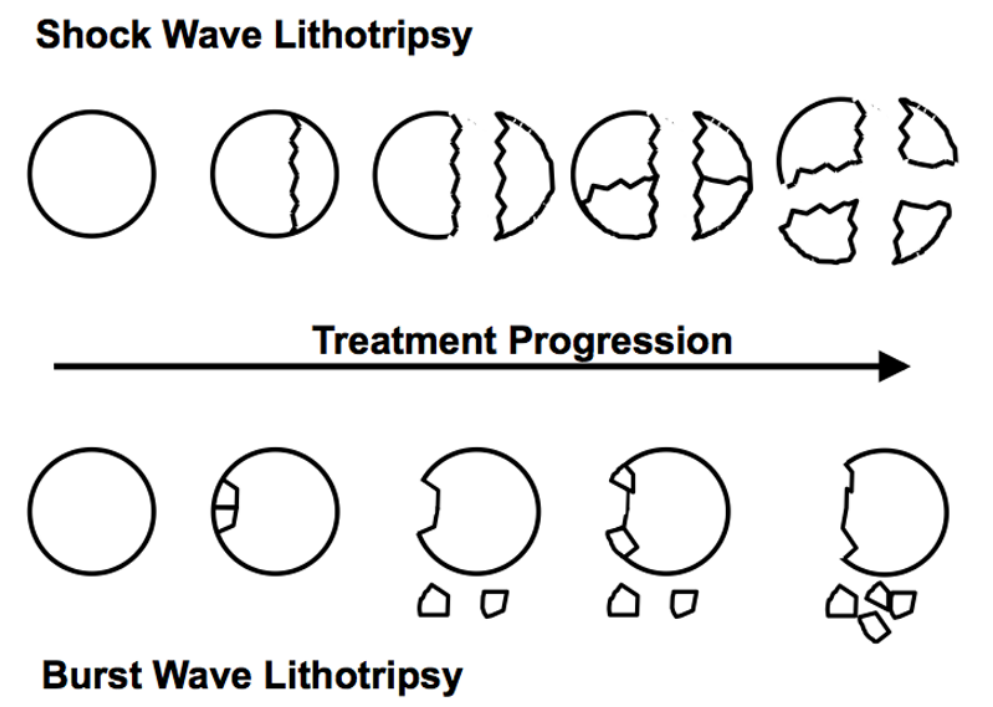
SWL vs. BWL



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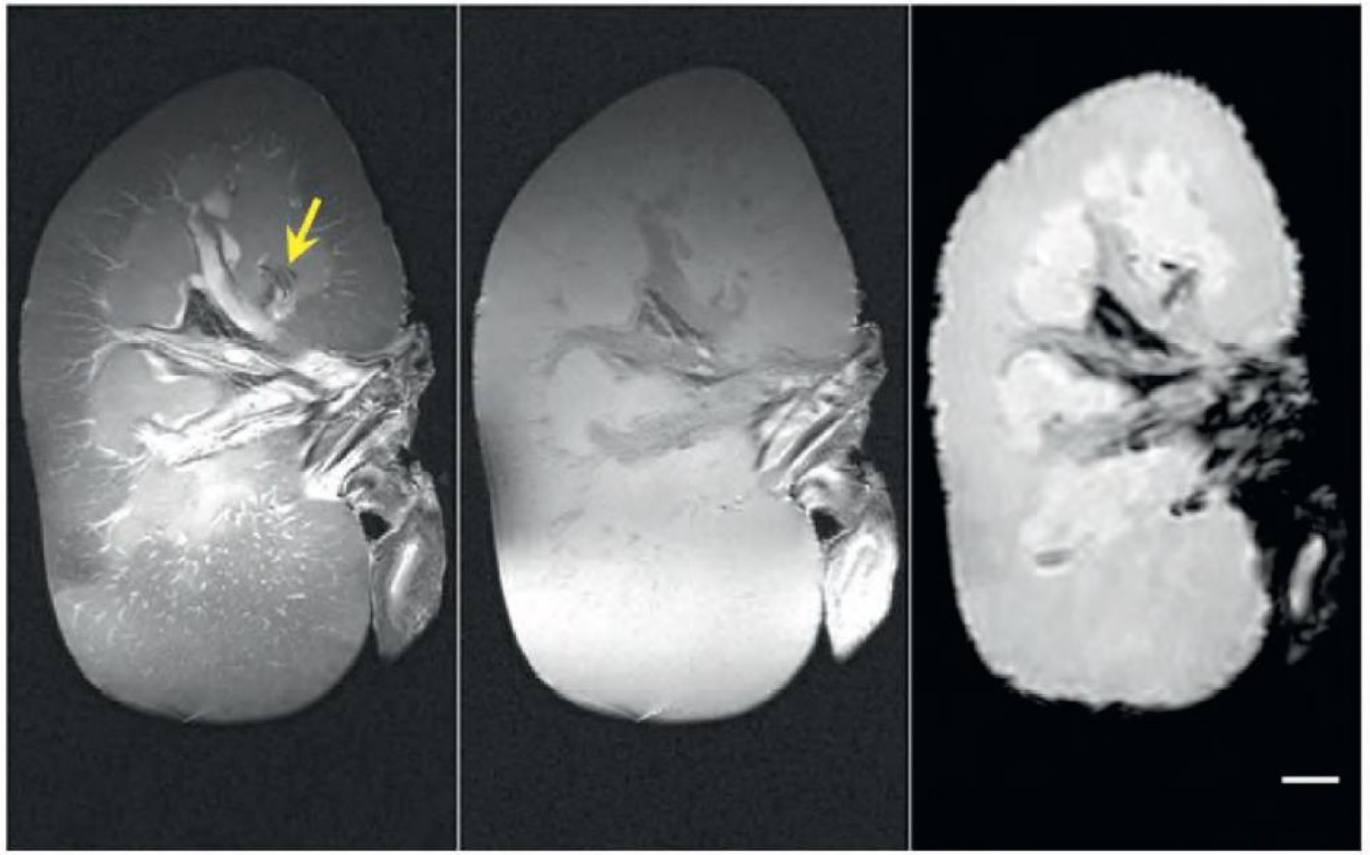
BWL



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Ureteroscopy (URS)

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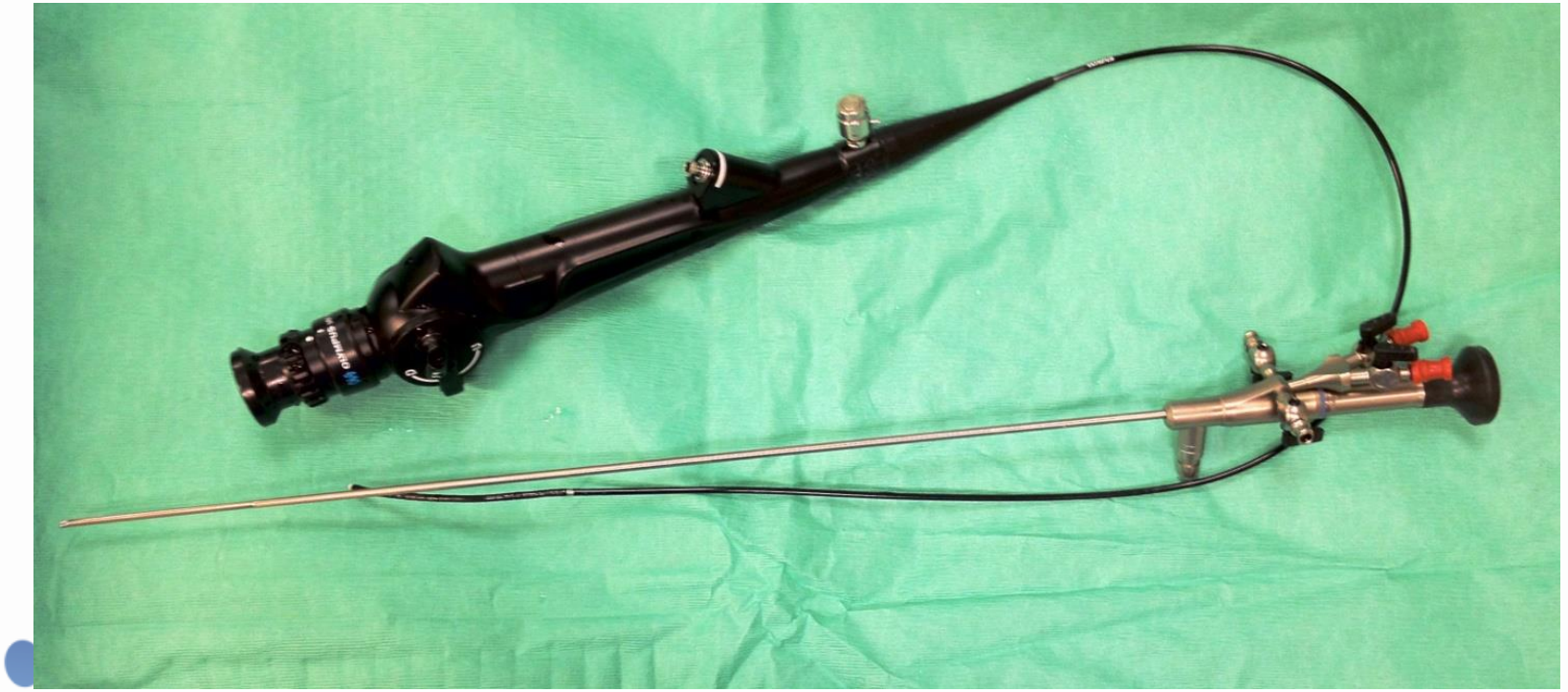
URS (cont'd)

- Generally performed on an outpatient basis with the patient under GA
- By a small endoscope
  - Rigid, semirigid: mid and distal ureteral stones
  - Flexible: proximal and intrarenal

URS (cont'd)



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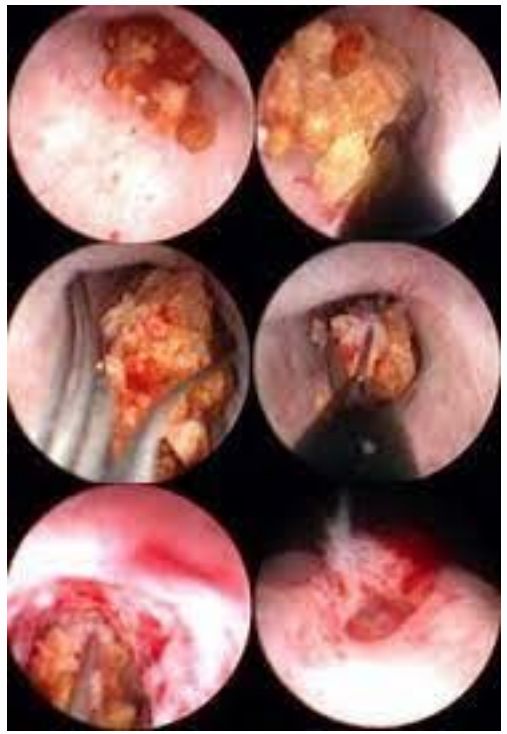
URS (cont'd)

- URS is the modality of choice for patients with
  - Obesity
  - Hard stones
  - Pregnant
  - Have a bleeding diathesis



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URS (cont'd)

- Generally considered a safe procedure
- Higher complication rate compared with SWL
  - Ureteral stent discomfort (>25 %)
  - UTI (5 %)
  - Ureteral wall injury (5 %)
- Major complications such as sepsis or ureteral avulsion occur in less than 1 percent

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Percutaneous Nephrolithotomy (PNL or PCNL)

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PCNL (cont'd)

- Usually under GA
- In the prone or supine position
- typically requires an inpatient hospital stay of one to three days.

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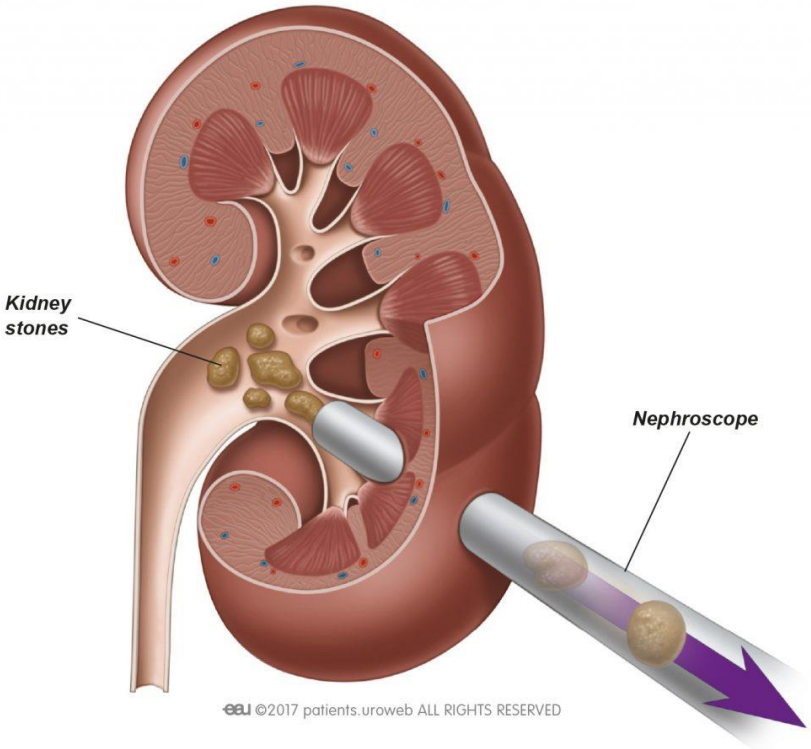
PCNL (cont'd)



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PCNL

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PCNL (cont'd)

- Contraindications
  - Patients receiving anti-coagulant therapy
  - Untreated UTI;
  - Tumor in the presumptive access tract area;
  - Potential malignant kidney tumor;
  - Pregnancy

PCNL (cont'd)

- higher complication rate compared with URS and SWL
  - Fever 10.8%
  - Transfusion 7%
  - Thoracic complication 1.5%
  - Sepsis 0.5%
  - Organ injury 0.4%
  - Embolization 0.4%
  - Urinoma 0.2%
  - Death 0.05%

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Other procedures

- Open surgeries
- Laparoscopy
- Robotic

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World Kidney Day

#worldkidneyday #kidneyhealthforall
www.worldkidneyday.org

World Kidney Day is a joint ISN IFKF-WKA