کاربرد سنگ شکنی برون اندامی در سنگهای سیستم ادراری

دکتر احسان سپهران

متخصص اورولوژی

فلوشیپ اندویورولوژی

استادیار دانشگاه علوم پزشکی تبریز

HISTORY

- Beginning in 1969 and funded by the German Ministry of Defense, Dornier began a study of the effects of shock waves on tissue
- In the early 1980s SWL was developed and proved to have an excellent safety profile while achieving acceptable stone-free rates
- The production and distribution of the Dornier HM3 lithotripter began in late 1983, and SWL was approved by the US Food and Drug Administration in 1984


Dornier Relax +
Compact Delta II

Generator Type

Electrohydraulic (Spark Gap) Generator :

The clear advantage of this generator is its effectiveness in breaking kidney stones.Disadvantages are the substantial pressure fluctuations from shock to shock

Electromagnetic Generator :

More controllable and reproducible than electrohydraulic generators and eliminating the need for frequent electrode replacement and less pain but more subcapsular hematoma

Piezoelectric Generator :

The advantages of piezoelectric generators include the focusing accuracy, a long service life, and the possibility of an anesthetic-free treatment because of the relatively low-energy density at the skin entry point of the shock wave but poor stone comminution

Imaging Systems

Fluoroscopy :

The primary advantages of fluoroscopy still include its familiarity to most urologists, the ability to visualize radiopaque calculi throughout the urinary tract, the ability to use iodinated contrast agents to aid in stone localization, and the ability to display anatomic detail.

The disadvantages include the exposure of the staff and patient to ionizing radiation, the high maintenance demands of the equipment, and the inability to visualize radiolucent calculi without the use of radiographic contrast agents

Imaging System

- **Ultrasonography :**

Inexpensive to manufacture and maintain compared with fluoroscopic systems and the treatment of children and infants when concern exists about the dose of ionizing radiation and ultrasonography can localize slightly opaque or nonopaque calculi

Sonographic localization of a kidney stone requires a highly trained operator,complicating the issue of stone detection is the fact that it is almost impossible to view a kidney stone in areas such as the middle third of the ureter or when there is an indwelling ureteral catheter and once a stone is fragmented, it is difficult to identify each individual stone piece

Bioeffects

.SWL induces acute injury in a variety of extrarenal tissues

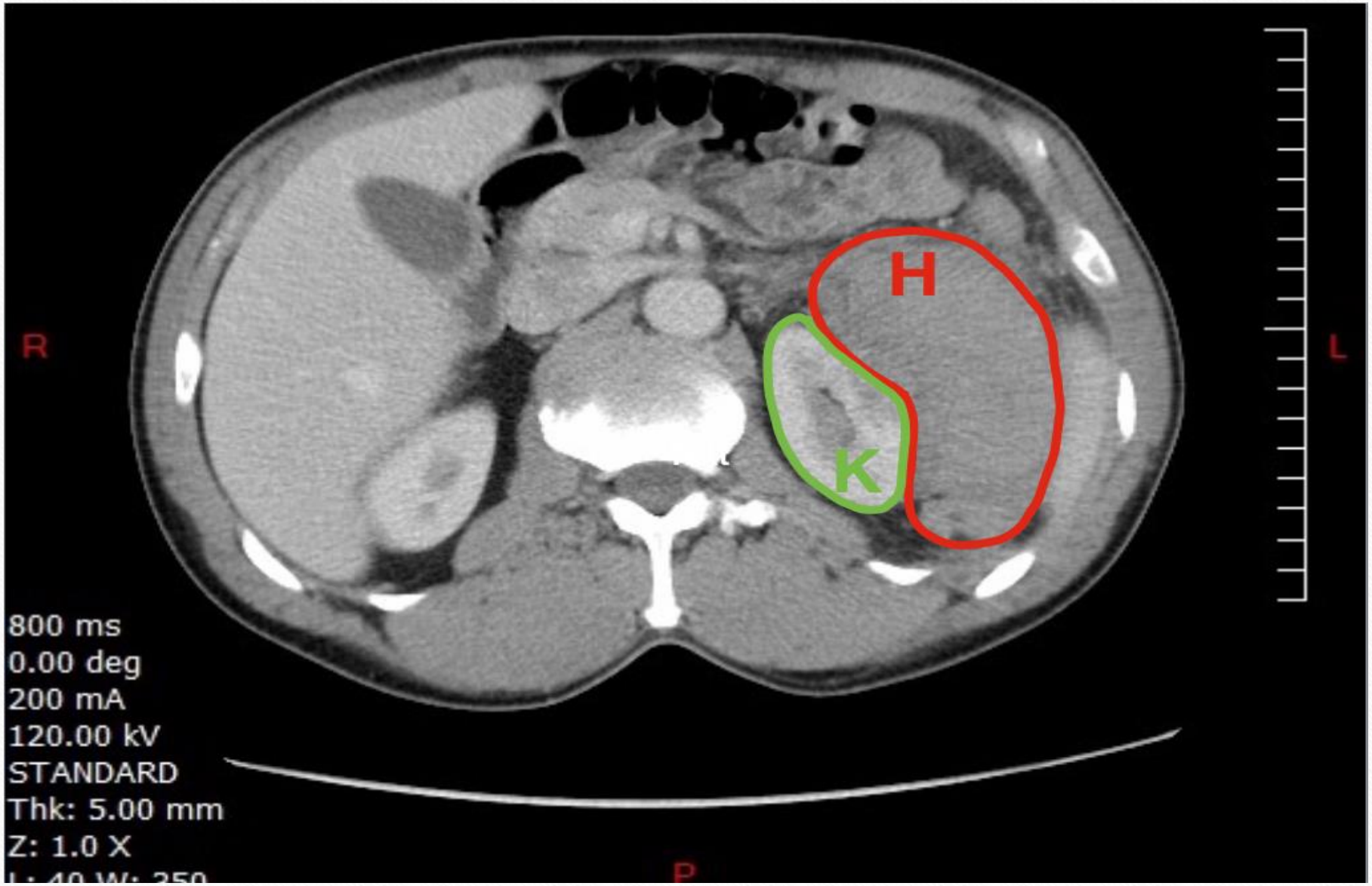
.Reports of surrounding visceral injuries after SWL, such as perforation of the colon, hepatic hematoma, splenic rupture, pancreatitis, and abdominal wall abscess

. Rupture of the hepatic artery, rupture of the abdominal aorta, and iliac vein thrombosis

. Thoracic events, such as pneumothorax and urinothorax, have even been described

.Increased risk for developing diabetes mellitus

. Post-SWL hematoma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Acute Renal Side Effects: Risk Factors for Shock Wave Lithotripsy

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

Potential Long-Term Concerns Regarding Shock Wave Lithotripsy (SWL)

- Hypertension :No large-scale evidence to support an association between SWL and the development of hypertension
- Chronic kidney disease :No evidence to support an association between SWL and the development of chronic kidney disease
- Diabetes mellitus :No large-scale evidence to support an association between SWL and the development of diabetes mellitus
- Increased rate of stone recurrence :Likely an association between SWL and subsequent stone events of patient not rendered stone free
- Male fertility :Sperm quality decreases immediately post-SWL for distal ureteral stones but normalizes by 3 months postoperatively
- Female fertility :Data inconclusive and limited

Techniques to Optimize Shock Wave Lithotripsy Outcome

- Appropriate coupling
- Water-soluble lubricant applied by hand
- Decrease rate to low (60–70 shocks/min) or intermediate (80–90 shocks/min)
- Image frequently and stop shocking once fragmented
- Do not use a preset number of shocks
- Ramping protocol
- Treat with low power escalating to higher levels
- General anesthesia
- Do not use a ureteral stent
- Consider alpha-blockers for medical expulsive therapy
- Consider percussion, diuresis, inversion therapy

EVALUATION

- The total kidney stone burden, or total volume of stone(s) requiring treatment, is arguably the most important factor influencing treatment decisions
- Based on the available evidence, it is convenient to stratify stone burdens as those up to 1 cm, those between 1 cm and 2 cm, and those greater than 2 cm

UTILITY

- The majority (50% to 60%) of solitary kidney stones are 1 cm or less in diameter, and many of them are asymptomatic
- SWL has been considered first-line treatment for these smaller kidney stones without complicating clinical or renal anatomic considerations because it is the least invasive modality, achieves reasonably high stone-free rates, and requires the least technical skill
- As reflected in the most recent European Association of Urology (EAU) and AUA urolithiasis guidelines, flexible URS is now considered an alternative first-line therapy for kidney stone burden 1 cm or less in size

UTILITY

- For kidney stones 1 cm or less in diameter, SWL achieves stone-free rates of approximately 50% to 90% and effectiveness quotients of approximately 50% to 70%
- Stones with high attenuation on CT (≥900 HU) and those located in lower pole calyces represent special situations for which SWL clearance rates are poor. In these instances, URS or PCNL may be the preferred first-line treatment options or become necessary if SWL fails

SUCCESS

- Successful clearance is highest for stones in the renal pelvis and ureteropelvic junction (UPJ; 80% to 88%), favorable for stones in the upper and middle calyces (approximately 70%), and consistently less for lower pole stones (35% to 69%)

- The recent literature suggests that URS in experienced hands has an excellent safety profile, with stone-free rates and treatment efficiency superior to SWL for small renal stones

Factors Negatively Affecting Shock Wave Lithotripsy Success

- Stone composition (cystine, brushite, calcium oxalate monohydrate, matrix)
- Stone attenuation ≥1000 HU
- Skin-to-stone distance >10 cm (morbid obesity)
- Renal anatomic anomalies (horseshoe kidney, calyceal diverticulum)
- Unfavorable lower pole anatomy (narrow infundibulopelvic angle, narrow infundibulum, long lower pole calyx)
- Relative or complete patient immobility

Contraindications to Shock Wave Lithotripsy

- Pregnancy
- Uncorrected coagulopathy or bleeding diathesis
- Untreated urinary tract infection
- Arterial aneurysm near stone (renal or abdominal aortic aneurysms)
- Obstruction of urinary tract distal to stone
- Inability to target stone (skeletal malformation)

STONE SIZE

- For stones between 1 cm and 2 cm that are *not* located in the lower pole, SWL had traditionally been recommended as first-line therapy
- The most current AUA and EAU stone guidelines recommend URS and SWL as alternative first-line therapeutic options
- PCNL accomplishes higher stone-free rates and requires fewer auxiliary procedures than SWL or URS for renal stones between 1 cm and 2 cm

ANOMALY

- For kidney stones in ectopic and horseshoe kidneys, SWL is a reasonable treatment option when stones are smaller than 1.5 cm and there is no UPJO or demonstration of poor renal drainage

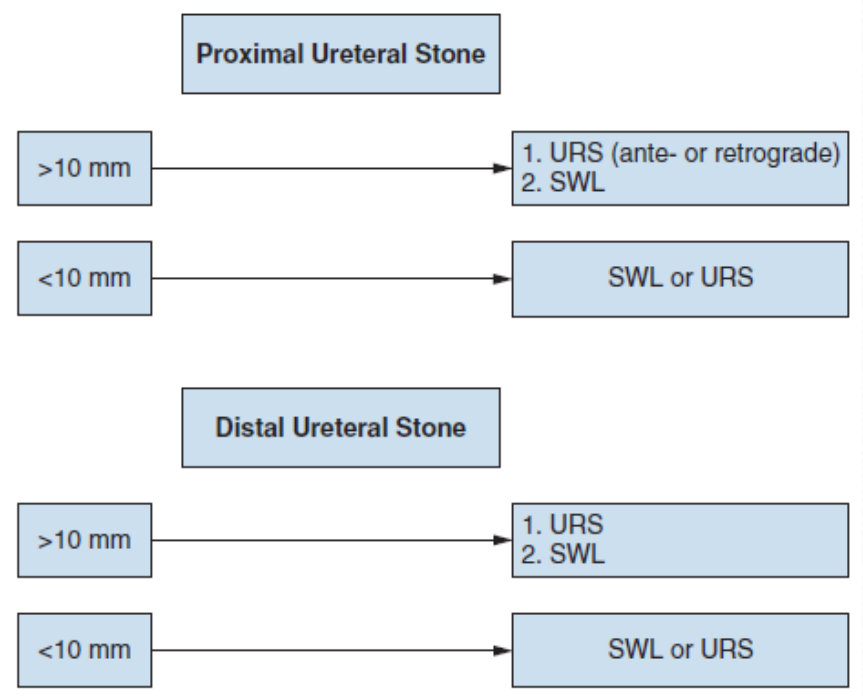
- SWL has been described for stones in transplant kidneys and is an option for stones smaller than 1.5 cm; however, high re-treatment rates and auxiliary procedure rates should be expected

- Success rates were highest for PCNL (91% to 98%), respectable for URS (87% to 91%), and significantly lower for SWL (66% to 86%)
- The PCNL groups experienced more overall and serious complications, but they also had the lowest need for additional procedures
- **PCNL should be considered first-line therapy for kidney stone burdens 2 cm and greater**

LOWER POLE STONES

- Stones situated in the lower pole prove more difficult to clear with URS or SWL, and therefore stones 1 cm or larger within the lower pole may be most efficiently treated with PCNL
- Stones in a non–lower pole location tend to respond more readily to SWL and URS, making those techniques more competitive with PCNL

URETERAL CALCULI



PCNL AND SWL

- Prior SWL therapy can make salvage PCNL more difficult, as evidenced by longer operative times and lower stone-free rates (Yuruk et al., 2009; Zhong et al., 2013)

THANK YOU