IS ESWL Becoming an ENDANGERED SPECIES?

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ESWL Machines
First Prototype (Dornier HM3)
Variable Efficacy of ESWL

• Variable efficacy relative to stone size of 60% to 90% range, after 1-3 sessions.

• Other factors influence ESWL outcome:
  – lithotripter efficacy
  – obesity
  – stone location and composition
  – Operator skill.

Treatment of Adult Patients with Ureteral Stones

• EAU Guidelines:
  “Clinicians should inform patients that SWL is the procedure with the least morbidity and lowest complication rate, but URS has a greater stone-free rate in a single procedure.”

(Index Patients 1-6) Strong Level B
Why ESWL

- Out patient procedure
- Less costly
- No Anesthesia required
- Occupy less space
- High success rate

Which Generator to choose?

- Electromagnetic most safe and efficacy.
- Electrohydraulic are much stronger, more painful, Anesthesia mostly required
- Better stone fragmentation with higher incidence of complications, namely renal hematomas and renal tissue damage.
- Piezoelectric are less effective in literature
Which Lithotriptor?

- Power in Pka
- Width of head (apparture)
- Size of Focal Area
- Rotating head Vs Prone for middle & lower 1/3 stones
- Cost and Durability

Ideal Stone

- A single stone
- Up to 2 cm in diameter in kidney
- Only lower calyceal up to 1.5 cm
- Up to 1.5 cm in upper or middle ureter
- Up to 1 cm in lower ureter
- Diameter (width) less than 8 mm in ureter
- Density up to 900 to 1000 H.U.
- Rough surface (rather than smooth)
A difficult Renal Stone

- Large renal stone >2 cm
- Stone 2cm X 2 cm
- Very dense related to last rib density
- High H.U. (> 1000)
- Very smooth contour
Calyceal Stones

Very Dense Stone
2.5 cm Renal Stone

Will result in SteinStrasse
Stone Composition

- Brushite, calcium oxalate monohydrate and cystine are resistant to ESWL fragmentation.
- Stones with greater than 900 to 1000 HU are less likely to fragment.

Lower Calyceal Stone

- Calyceal pelvic height
- infundibuloureteropelvic angle
Ideal Urinary tract

- Mild to moderate hydronephrosis
- Adequate parenchymal thickness
- Ureter not kinked or tortious

Ideal Physique

- High body mass index
- Not more than 130 Kg (Tables up to 240 kg)
- No trunkal obesity
- No major spinal deformity
Lower Calyceal Stone
Factors predicting ESWL success

- Skin-to-stone distance <10.7 cm
- <900 HU on non-contrast CT
- Rough appearance on x-ray
- Size <8 mm, solitary stone
- Non-lower pole location
- Singular minor calyx
- Favorable infundibular anatomy*
- Stone composition

Favorable infundibular anatomy

- Infundibulopelvic angle >70°
- Infundibular height <3 cm
- Infundibular width > 4 mm
- Ratio of infundibular height-to-width <7
- Singular minor calyx

- Requires Contrast
Multiple Stones

- Multiple stones means higher failure rate.
- Start with the first obstructing stone
- Usually one session is required for each stone
- But it might take more than one session

Multiple calyceal stones
A difficult Ureteric Stone

- > 1.5 cm long
- > 8 mm diameter
- Very dense, > 1200 H U
- Very smooth edge
- Abnormal axis = underneath a ridge, kinked
- “pattern of dynamic urinary transport”
- Impacted: severe dilation proximal to the stone not with the size of the stone

Impacted Stones
Nice Ureteric Stone
But Impacted

Results in the literature for Ureteric stones ESWL

- Proximal ureter is as efficient as URS (81% Vs 82%) but more costly in URS
- Urologists might offer cost-effective & only affordable procedures
- For stones > 10 mm in lower ureter, URS appears to be more cost-effective than ESWL, pain is a major issue.
- The use of Flexible URS adds to the cost with their repair and maintenance costs.
Patient Position

- Supine is the standard
- Prone for middle & Lower 1/3 stones
- Rotating head allow supine position in all cases.
- Transgluteal approach!

Transgluteal approach

- An option for Lower 1/3 Stones
- Through the greater Sciatic foramen
- Operator dependant
- Associated with pain (Sciatic N)
- Improves success from 40% to 78%
Transgluteal Approach

Transgluteal Approach
A difficult Physique

• Very big belly
• High SSD (Stone Skin Distance)
• Ideally should be < 10.7 cm
• New lithotriptors have working distance up to 21 cm (average 14-17 cm).
• SSD alone is a major factor for failure
• Only advantage: they tolerate pain much better than very thin patients

Decrease shock wave amplitude and symmetry of the wave
Stone Skin Distance (SSD)

- A major risk factor for failure
- Mejured by CT
- Limit up to 10.7 cm
- Each lithotriptor has a limit of penetration
- May reach up to 21 cm (13-17 in average)
- Problem with obese females
A difficult Physique

- a wide aperture can make focusing on the stone easier
- Medially placed ureteric stones in such patients is a challenge in focusing.
- Kyphosis and Scoliosis are not big problem with the wide aperture

Ureteric Stents

- Patients without a ureteral stent had higher stone-free rates (92.9%) compared to those with a stent (80%)
- Use it only with unresolved pyelonephritis, obstructive Anuria or intolerable pain.
Visualisation of the Stone

- Fluroscopy and/or Ultrasound
- Fluro: Limit exposure time.
- U/S to avoid excessive exposure of patients and health providers to radiation
- Not for ureteric lucent stones
- Costs in average 1 Million LE extra cost
- Difficult to use with ease, specially in obese
- IVU: Tedious and time consuming (1-2 hours)

Investigations Required

- KUB is essential, even with a CT.
- KUB can detect problems:
  - Stone close to the rib, very close to the body of Vert.
  - Middle 1/3 stone
  - Horse-shoe and Ectopic pelvic kidney.
- CT Density may be inaccurate, size depends on the cut
CT abdomen and pelvis

- The gold standard may be falacious
- Size depends on the cuts
- Size relation to bone needs reconstruction
- Density a big problem
- It is only a hint for density and radioopacity

ESWL in Children

- Infants and children are best treated by ESWL
- Same indications as adults applies, although their kidneys are much smaller
- Excellent ability to pass fragments
- Avoid invasive, more traumatic scopes.
ESWL in Children

- Anasthesia a must for pain and immobilization
- Require special carrier to prevent slipping through the table apparatus
- Age 12-17 years: depend on physic, personality and pain tolerance.
Elderly patients

• Most suitable line of treatment due to minimal intervention and co-morbidities
• Require less analgesics
• Make sure to stop oral Anti-coagulant before session.

Patient Weight

• Limited by table ability
• Now available up to 180/240 kg
• MBI: related more to short obese patients
• Mostly females with huge waist and short stature.
Consent your Patient

• Success rate should be discussed
• No 100% success rate is present in literature
• Discuss limitations and risks
• Define time-frame of management
• Explain post-session course

Cost of ESWL Vs URS

“SWL is more cost-effective than ureteroscopy and Holmium:YAG laser lithotripsy for ureteric stones: A comparative analysis for a tertiary referral centre”

A.N. Argyropoulos, D.A. Tolley

• The Scottish Lithotriptor Centre, Scotland, UK

British Journal of Medical and Surgical Urology (2010) 3, 65—71
Cost of ESWL Vs URS

a. Cost SWL = cost(initial SWL session) + [cost(SWL session) × retreatment rate] + [cost(URS) × SWL failure rate] + [cost(stent insertion and removal) × rate] + [cost(KUB film) × 4]

b. Cost URS = cost(URS) + [cost(stent removal) × 50%] + [cost(KUB film) × 2]

Cost ESWL VS URS

Scottish Lithotriptor Centre
- ESWL = 1491 €
- URS = 2195 €

If applied same equation to Egypt:
- ESWL = 3500 LE
- URS = 11000 LE

Average cost of ESWL 4800$

Cost varies significantly between countries and continents.
Outcome in literature

• Kidney
  – Pelvis  86–89%
  – Upper calyx  71–83%
  – Middle calyx  73–84%
  – Lower calyx  37–68%

• Ureter
  – Upper 1/3  85.4%
  – Middle 1/3  78.9%
  – Lower 1/3  75.9%

TECHNICAL ASPECTS
How many Shocks

• 3000-5000 shocks/session, varies according to manufacturer
• Less for parenchyma and more for ureter
• Relate number with power (less power require more number of shocks)
• Stop if the stone not seen anymore
• Paediatric: limit no. and power, variable
  • < 6 years  Max. 2000 shocks  Max 2.0 (Scale 4.0)
  • 6-12 years Max 2500 shocks  Max 2.5

Rate of Shocks

• Varies from 30/mn to 240 /mn
• 60 shocks/mn gives the best result.
• Significantly better then 120/mn
• No significant difference to 90/mn
• My own experience, no sign.difference between 60 and 90/mn
Rate of Shocks

• If no difference proof, time is money
• It would take 80 mns to finish one session at 60 shocks /mn Vs only 40 mns for 120/mns
• Limits number of patients served /day
• ECG gated: Rate of shocks synchronised with heart rate through an attached ECG monitor to the lithotriptor.
• Required in patients prone to Arrhythmia.
• Cardiac Pace-Maker should be deactivated before the session by special cardiac technician.

Pain Tolerance

• 1.6% abandon treatment due to intolerable pain.
• Pain is intense but tolerable (40- 65%)
• Anesthesia Vs No Anesthesia

• But, Good pain tolerance could result in more post-session complications.
What to expect after the session

- Pain
- Hematuria
- Vomiting
- Fever
- Hematoma

“Let your patient be prepared”

Complications

- Colick and hematuria
- Renal Hematoma
- Steinstrasse: only with large stone burden with very good fragmentation
- Give it more time if no large fragment is seen
- If big leading stone, ESWL to the leading stone
- Renal tissue damage depends on power used
- Visceral damage: Colon, Pancreas (case reports)
- Hypertension and D.M.: Studies proved no relation to late development of both diseases
Renal Hematoma

• Up to 20% asymptomatic peri-renal or subcapsular hematomas occur
• Detected only if U/S or CT done post-session
• Symptomatic in 4-7%
• Requires blood transfusion or surgical intervention in < 1%.

Radiologic Follow up

• KUB is a must
• CT & U/S falacious, adjacent gravels would be interpreted as a single “larger” stone.
• Residual fragments not seen in KUB will not be further managed by ESWL
• 14 days is required before the next session for the tissue edema and microhematoma to resolve, so don’t order KUB any earlier.
ESWL is not endangered in EGYPT

Thank You