Renal calculi formation and treatment: New insights

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Rabin Medical Center and Tel Aviv University School of Medicine, Israel
Where is Israel in the world...?
Mediterranean Sea

Lebanon

Syria

Tel Aviv

Jerusalem

Dead Sea

Jordan Valley

Jordan

Negev

Egypt

21,000 Km²

470 km

9hs.

110 km

90 min
JERUSALEM
Health in Israel

• Health Ministry
  - Hospitals - 14
  - Insurers (Health funds / HMO) - 4

• Clalit Health Services - biggest HMO
  - Community health
  - Hospitals - 8
Rabin Medical Center

Named in memory of Israel's late prime minister, Yitzhak Rabin.
The late P.M  Rabin
RMC: Facts and Figures

- In January 1996 Beilinson and Hasharon hospitals merged to form Rabin Medical Center. Together with Schneiders children’s medical center it is the largest and leading medical complex in Israel,

- 1300 Beds
- 4,500 Staff Members
- 8,500 Births Annually
- 37 Operating Rooms
- 167,000 Emergency Visits
- 650,000 Outpatient Clinic Visits
- 34,000 Operations Annually
- 1,600 Cardiothoracic Operations Annually-The largest number in Israel
- The largest number of patients treated for cancer in Israel
- The largest number of organ transplants in Israel
RMC: Urology department

- Divided between three campuses:
  - Urooncology (All major surgery with a special emphasis on bladder substitution, RPLND & robotic surgery and LPN)
  - Pediatric urology
  - Endourology and laparoscopy
  - 13 staff members and 8 residents rotating between the campuses
  15 operating beds per week
  About 3000 cases per year
Renal calculi formation and treatment: New insights

- Stone composition epidemiology in Israel
- The impact of the metabolic syndrome on stone disease
- Uric acid stone dissolution: how can we be more efficient?
- New insight into the formation of CaOx stones
- RIRS (retrograde intrarenal surgery) - a new standard in the treatment of renal calculi
Urinary calculi in Israel: Epidemiologic distribution of stone composition

Shay Golan¹, Tamer Abdin², Ehud Gnessin¹, Nandakishore Shapur², Pinhas M. Livne¹, Dov Pode², David Lifshitz¹,

¹ Rabin medical center, Petach Tikva, IL, ²Hadassah Hebrew University Hospital, Jerusalem, IL

Introduction
The epidemiological data regarding stone composition in Israel is based on anachronistic methods.
Unusually high percentage of uric acid component (~30%).

Purpose
To provide a contemporary description of stone composition distribution in Israel, based on modern analysis techniques.

Methods
In a bi-center study, using infrared spectroscopy and X-ray diffraction, stones from 538 patients were analyzed and demographic data was recorded.
Stone analysis techniques

• “Chemical analysis of renal calculi has been all but abandoned. Significant error may occur because qualitative and semi quantitative chemical analysis methods are not accurate (verrgauwe et al, 1994)”

• “X-ray diffraction and infrared spectroscopy are acceptable techniques for analyzing renal stones”

From Campbell’s Urology, Eighth edition (2002), p:3272
Limitation of chemical analysis: No distinction for Ca-Phosp
Limitation of chemical analysis: May miss pure cystine

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium in calculi</td>
<td>10</td>
</tr>
<tr>
<td>Oxalate in calculi</td>
<td>30</td>
</tr>
<tr>
<td>Ammonium in calculi</td>
<td>0</td>
</tr>
<tr>
<td>Phosphates in calculi</td>
<td>0</td>
</tr>
<tr>
<td>Magnesium in calculi</td>
<td>0</td>
</tr>
<tr>
<td>Uric acid in calculi</td>
<td>0</td>
</tr>
<tr>
<td>Cystine in calculi</td>
<td>80</td>
</tr>
<tr>
<td>Ca oxalate in calc</td>
<td>50</td>
</tr>
</tbody>
</table>

[Image of a crystalline deposit labeled 100% Cystine]

[Table showing the composition of the deposit]
Limitation of chemical analysis: Underestimate the uric acid %

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca Oxalate in Calculi</td>
<td>CaOx</td>
<td>100%</td>
</tr>
<tr>
<td>Cystine in Calculi</td>
<td>Cys</td>
<td>0%</td>
</tr>
<tr>
<td>Phosphates in Calculi</td>
<td>P</td>
<td>4%</td>
</tr>
<tr>
<td>Magnesium in Calculi</td>
<td>Mg</td>
<td>1%</td>
</tr>
<tr>
<td>Uric Acid in Calculi</td>
<td>UA</td>
<td>5%</td>
</tr>
<tr>
<td>Calcium in Calculi</td>
<td>CaO</td>
<td>85%</td>
</tr>
<tr>
<td>Ammonium in Calculi</td>
<td>NH₄⁺</td>
<td>0%</td>
</tr>
<tr>
<td>Oxalate in Calculi</td>
<td>Oxalate</td>
<td>70%</td>
</tr>
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</table>
Table 1: Occurrence frequency of stone components according to homogeneity.

<table>
<thead>
<tr>
<th>Stone component</th>
<th>Total Number (%)</th>
<th>Mixed (%)</th>
<th>Pure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium oxalate monohydrate</td>
<td>399 (74.2)</td>
<td>309 (57.4)</td>
<td>90 (16.7)</td>
</tr>
<tr>
<td>Calcium oxalate dihydrate</td>
<td>183 (34)</td>
<td>165 (30.6)</td>
<td>18 (3.3)</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>197 (36.6)</td>
<td>188 (34.9)</td>
<td>9 (1.6)</td>
</tr>
<tr>
<td>Uric acid</td>
<td>78 (14.5)</td>
<td>30 (5.5)</td>
<td>48 (8.9)</td>
</tr>
<tr>
<td>Carbonite-apatite</td>
<td>67 (12)</td>
<td>64 (11.9)</td>
<td>3 (0.5)</td>
</tr>
<tr>
<td>Magnesium ammonium phosphate (Struvite)</td>
<td>23 (4.1)</td>
<td>22 (4)</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Calcium hydrogen phosphate dihydrate (Brushite)</td>
<td>13 (2.3)</td>
<td>11 (2)</td>
<td>2 (0.3)</td>
</tr>
<tr>
<td>Cystine</td>
<td>12 (2.2)</td>
<td>0</td>
<td>12 (2.2)</td>
</tr>
</tbody>
</table>
Table 1: Occurrence frequency of stone components according to gender and age.

<table>
<thead>
<tr>
<th>Stone component</th>
<th>Total Number (%)</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>0-20 y (%) N=21 (4%)</th>
<th>20-40 y (%) N=142 (26%)</th>
<th>40-60 y (%) N=272 (51%)</th>
<th>&gt;60 y (%) N=103 (19%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium oxalate monohydrate</td>
<td>399 (74.2)</td>
<td>77.3</td>
<td>65.0</td>
<td>47.6</td>
<td>71.1</td>
<td>78.7</td>
<td>71.8</td>
</tr>
<tr>
<td>Calcium oxalate dihydrate</td>
<td>183 (34)</td>
<td>38.2</td>
<td>21.9</td>
<td>47.6</td>
<td>48.6</td>
<td>28.3</td>
<td>26.2</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>197 (36.6)</td>
<td>37.4</td>
<td>34.3</td>
<td>23.8</td>
<td>43.7</td>
<td>36.4</td>
<td>30.1</td>
</tr>
<tr>
<td>Uric acid</td>
<td>78 (14.5)</td>
<td>14.5</td>
<td>14.6</td>
<td>0.0</td>
<td>9.2</td>
<td>15.8</td>
<td>21.4</td>
</tr>
<tr>
<td>Carbonate-apatite</td>
<td>67 (12)</td>
<td>8.2</td>
<td>24.8</td>
<td>14.3</td>
<td>8.5</td>
<td>12.5</td>
<td>17.5</td>
</tr>
<tr>
<td>Magnesium ammonium phosphate</td>
<td>23 (4.1)</td>
<td>2.0</td>
<td>10.9</td>
<td>9.5</td>
<td>0.7</td>
<td>4.0</td>
<td>8.7</td>
</tr>
<tr>
<td>Calcium hydrogen phosphate dehydrate</td>
<td>13 (2.3)</td>
<td>3.0</td>
<td>0.7</td>
<td>4.8</td>
<td>1.4</td>
<td>2.2</td>
<td>3.9</td>
</tr>
<tr>
<td>Cystine</td>
<td>12 (2.2)</td>
<td>1.7</td>
<td>3.6</td>
<td>14.3</td>
<td>3.5</td>
<td>1.5</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Conclusions

- The most prevalent stone component in Israel is Calcium oxalate Monohydrate.
- The overall occurrence of uric acid is 14.5%.
- The occurrence of uric acid increases with age, reaching 21% in people > 60 years old.
- A significant gender difference was noted in the distribution of CaOx stones and infection stones.
The results of metabolic evaluation in CaOx stone formers in Israel

- Ca-Ox-monohydrate: 58%
- Ca-Ox-dihydrate: 33%
- Ca-Phos: 9%
|                          |                                                              |
|--------------------------|                                                              |
| **The results of metabolic evaluation in CaOx stone formers in israel** |                                                              |
| Female/male              | 22/76                                                         |
| Average age              | (17-73) 48                                                   |
| % Abnormality            |                                                              |
| 1                        | 24%                                                          |
| 2                        | 37%                                                          |
| 3+                       | 31%                                                          |
The results of metabolic evaluation

- hypercalciuria: 54%
- hyperuricosuria: 69%
- hypocytraturia: 29%
- hyperparathyroidism: 2%
- low urine volume: 35%
- high salt intake: 31%
Stone disease in the 21 century

- The prevalence of stone disease went up in the US from 3% to 5% between the years 1970-2000 and still on the rise - diet related?
- The life time risk for a stone event is up to 10%
- Recurrence rate of 50% in 5-10 years, also true for a stone to become symptomatic
- The standard male/female ratio of 3:1 now is changing toward a smaller difference
The metabolic syndrome and renal diseases

- An NIH study has shown that patients with BMI >27 and stone history have lower GFR
- High BMI stone formers have more HTN
- INSULIN RESISTANCE diminishes amonia production in the kidney resulting in more acidic urine
Diabetes Mellitus and the Risk of Urinary Tract Stones: A Population-Based Case-Control Study

John C. Lieske, MD, Lourdes S. Peña de la Vega, MD, Matthew T. Gittman, MD, Jeffrey M. Slezak, BS, Eric J. Bergstralh, MS, L. Joseph Melton III, MD, and Cynthia L. Leibson, PhD

Background: Because nephrolithiasis has been associated with obesity, an important risk factor for type 2 diabetes mellitus (DM), we tested the hypothesis that DM prevalence is increased in individuals who develop renal stones. Methods: in an initial electronic analysis, prior diagnoses of DM, hypertension, and obesity were compared between all Olmsted County, MN residents with a diagnosis code for nephrolithiasis between 1980 and 1999 and matched residents of similar age and sex (N = 3,561 case-control pairs). A random sample of 260 cases and corresponding controls was selected for detailed medical record review to confirm and characterize the stone event and obtain heights, weights, blood pressures, and glucose and cholesterol values. Results: In the electronic analysis, unadjusted odds ratios (ORs) for DM (OR, 1.29; 95% confidence interval [CI], 1.09 to 1.53), obesity (OR, 1.15; 95% CI, 1.02 to 1.31), and hypertension (OR, 1.19; 95% CI, 1.04 to 1.35) were increased significantly for nephrolithiasis cases versus controls; DM remained significant after adjustment for age, sex, calendar year, hypertension, and obesity (OR, 1.22; 95% CI, 1.03 to 1.46). Detailed record review of a subset showed significant increases for cases versus controls for body mass index (OR, 1.05; 95% CI, 1.01 to 1.09) and hypertension (OR, 1.71; 95% CI, 1.17 to 2.59). Odds for DM were increased, but not significantly, in the subsample (OR, 1.44; 95% CI, 0.75 to 2.72). Among cases with stone analyses, those with uric acid stones (n = 10) had a greater percentage of DM compared with those with all other stone types (n = 112; 40% versus 9%; P = 0.02). Conclusion: Findings from this population-based study suggest that DM, obesity, and hypertension are associated with nephrolithiasis, and DM may be a factor in the development of uric acid stones. Am J Kidney Dis 48:897-904.
The metabolic syndrome and stone disease

Body Size and 24-Hour Urine Composition

Eric N. Taylor, MD, and Gary C. Curhan, MD, ScD

Background: Greater body mass index (BMI) is a risk factor for kidney stones. However, the relation between BMI and the urinary excretion of many lithogenic factors remains unclear. Methods: We studied urine pH, urine volume, and 24-hour urinary excretion of calcium, oxalate, citrate, uric acid, sodium, magnesium, potassium, phosphate, and creatinine in stone-forming and non–stone-forming participants in the Health Professionals Follow-Up Study (599 stone-forming and 404 non–stone-forming men), Nurses’ Health Study (638 stone-forming and 398 non–stone-forming older women), and Nurses’ Health Study II (689 stone-forming and 295 non–stone-forming younger women). Each cohort was divided into quintiles of BMI. Tests of linear trend were conducted by 1-way analysis of variance. Linear regression models were adjusted for age, history of stone disease, dietary intake, and urinary factors. Results: Participants with greater BMIs excreted more urinary oxalate (P for trend = 0.04), uric acid (P < 0.001), sodium (P < 0.001), and phosphate (P < 0.001) than participants with lower BMIs. There was an inverse relation between BMI and urine pH (P = 0.02). Positive associations between BMI and urinary calcium excretion in men and stone-forming younger women (P ≤ 0.02) did not persist after adjustment for urinary sodium and phosphate excretion. Because of differences in urinary volume and excretion of inhibitors such as citrate, we observed no relation between BMI and urinary supersaturation of calcium oxalate. Urinary supersaturation of uric acid increased with BMI (P ≤ 0.01). Conclusion: Positive associations between BMI and urinary calcium excretion likely are due to differences in animal protein and sodium intake. The greater incidence of kidney stones in the obese may be due to an increase in uric acid nephrolithiasis. Am J Kidney Dis 48:905-915.
Take home message

• If you see a western obese, diabetic patient with renal calculi consider the option of uric acid stone and treat accordingly
The kinetics of uric acid stones dissolution

Bezalel Sivan¹, Yizhak Mastai², Ruth Fried², Pinhas. M. Livne¹, David A Lifshitz¹
Rabin Medical Center – Departement of Urology ¹, Bar Ilan University – Departement of Chemistry²

Background
Dissolution by oral medication is often the treatment of choice for patients diagnosed with non obstructing renal uric acid (UA) stones. Urine alkalization is the major goal. There is little data in recent years as to the optimal pH required for efficient chemolysis of UA stones.

Objective
To evaluate, in vitro using modern techniques, the dissolution kinetics of pure UA stones from patients and various parameters which may enhance chemolysis.

Methods

a. Whole UA stone
Fragmented stone

• Whole (Figure a) and fragmented stones (figure b) were obtained from patients who underwent percutaneous nephrolithotomy.

• The UA crystalline structure of the stones was verified with the use of X-ray diffraction (XRD).

• The kinetics of the solubility of UA stones was studied using Time Resolved UV-vis spectroscopy, which measures the changes of ultraviolet light absorbance due to soluble UA, at a wave length of 290nm. Measurements were performed at different increments of solution pH.

Results

• A significant difference in the rate of dissolution was found for higher pH values.

• Between a pH of 6.5 and 6.9 the rate of dissolution doubled

• Dissolution of fragmented stone was significantly more efficient.

• The rate of dissolution of fragments of UA stones is up to 52% faster than whole UA stones

Conclusion
In vitro, there is a major difference in the efficacy of UA stone dissolution between the low and high range of the acceptable therapeutic goal. Further more, fragmented stones respond better than whole stones. The clinical implication of these findings may be that for a better response to oral chemolysis a combination of shock wave lithotripsy followed by alkalization of the urine close to pH 7 is needed.
Do we need to reduce uric acid levels within the normal range to enhance dissolution?

pH = 6.8
Zero saturation Uric acid $k = 31$ mgr/sec
A = 50 mg/dL saturated UA $k = 11$ mgr/sec
B = 80 mg/dL saturated UA $k = 9.8$ mgr/sec
C = 130 mg/dL saturated UA $k = 7.2$ mgr/sec
## Pathogenesis of CaOx stones

<table>
<thead>
<tr>
<th>Metastable Zone:</th>
<th>Spontaneous nucleation does not occur</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaOx:</td>
<td>Crystal growth can occur</td>
</tr>
<tr>
<td>SS&lt;8</td>
<td>Inhibitors can impede or prevent crystallization</td>
</tr>
<tr>
<td>Brushite:</td>
<td></td>
</tr>
<tr>
<td>SS&lt;2.5</td>
<td></td>
</tr>
<tr>
<td>Uric Acid:</td>
<td></td>
</tr>
<tr>
<td>SS&lt;2</td>
<td></td>
</tr>
<tr>
<td>Equilibrium Point: Solubility Product</td>
<td>Crystals neither grow nor dissolve</td>
</tr>
<tr>
<td>SS = 1</td>
<td></td>
</tr>
<tr>
<td>Undersaturation Zone:</td>
<td>Nuclei may dissolve (uric acid)</td>
</tr>
<tr>
<td>SS &lt; 1</td>
<td></td>
</tr>
</tbody>
</table>
Pathogenesis of CaOx stones
Pathogenesis of CaOx calculi

- Urinary supersaturation vs. urine inhibitors
- Inhibitors: citracts, Mg, complex mucopolysaccharides.
- Promoters: stasis, nucleation, urinary pH
- Transit time from the kidney to the bladder is about 10 minutes, therefore, for a stone to be formed a fixed point (nidus) is required
STONE FORMATION IS PROPORTIONAL TO PAPILLARY SURFACE COVERAGE BY RANDALL’S PLAQUE

SAMUEL C. KIM, FREDRIC L. COE, WILLIAM W. TINMOUTH, RAMSAY L. KUO,* RYAN F. PATERSON, JOAN H. PARKS, LARRY C. MUNCH, ANDREW P. EVAN† AND JAMES E. LINGEMAN‡§
Fig. 1. a, number of stones vs log transformed mean plaque surface area. Nonparametric ellipse of containment includes 2 SD. b, number of stones vs multivariate regression equation from general linear model, including stone disease duration and plaque surface. Plaque time score $\times 1.788 + 1.386 \times \log 10$ mean plaque surface area $+ 0.082 \times$ time.
Randall’s plaque of patients with nephrolithiasis begins in basement membranes of thin loops of Henle

Andrew P. Evan,1 James E. Lingeman,2 Fredric L. Coe,3 Joan H. Parks,3 Sharon B. Bledsoe,1 Youzhi Shao,4 Andre J. Sommer,5 Ryan F. Paterson,2 Ramsay L. Kuo,2 and Marc Grynpas6

1Department of Anatomy and Cell Biology, Indiana University School of Medicine, Indianapolis, Indiana, USA
2Methodist Hospital Institute for Kidney Stone Disease, Indianapolis, Indiana, USA
3Nephrology Section, University of Chicago, Chicago, Illinois, USA
4Department of Histology, Jinhua Medical College, Jinhua, Zhejiang, People’s Republic of China
5Department of Chemistry and Biochemistry, Miami University, Oxford, Ohio
6Samuel Lunenfeld Research Institute, Mount Sinai Hospital, Toronto, Canada

Our purpose here is to test the hypothesis that Randall’s plaques, calcium phosphate deposits in kidneys of patients with calcium renal stones, arise in unique anatomical regions of the kidney, their formation conditioned by specific stone-forming pathophysiologicals. To test this hypothesis, we performed intraoperative biopsies of plaques in kidneys of idiopathic-calcium-stone formers and patients with stones due to obesity-related bypass procedures and obtained papillary specimens from non-stone formers after nephrectomy. Plaques originate in the basement membranes of the thin loops of Henle and spread from the through the interstitium to the urothelium. Patients who have undergone bypass surgery do not produce such plaque but instead form intratubular hydroxyapatite crystals in collecting ducts. Non-stone formers also do not form plaque. Plaque is specific to certain kinds of stone-forming patients and is initiated specifically in thin-limb basement membranes by mechanisms that remain to be elucidated.

Pathogenesis: CaOx stones

- IH- Idiopathic hypercalciuria, normocalcemia
- Hyperclaciuric conditions (PTH, malignancy, hyperthyrodisim, sarcoidosis, immobilization, etc)
- Low urinary citrate
- Hyperoxaluria
- Hyperuricosuria
Pathogenesis: CaOx stones

• IH can be found in 30-60% of normocalcemic hyperchloricuric patients
Traditional classification of IH - relevant?

• (1) absorptive hypercalciuria, in which the primary abnormality was an increased intestinal absorption of calcium (vit D mediated)
• (2) renal hypercalciuria, characterized by a primary renal leak of calcium
• (3) resorptive hypercalciuria, characterized by increased bone demineralization
• IH- is a spectrum of syndromes rather than different subgroups
• Effective treatment is the same in most patients (Thaizides + salt restriction)
RIRS (Retrograde Intrarenal Surgery)- a new standard in the treatment of renal stones
RIRS - Retrograde Intra Renal Surgery

Indications:
• Radiolucent stones
• Ureteral and renal stones
• Failed SWL
• Cougulopathy
• Ureteral/renal stones indwelling D-J stent
• Special body habitus
Between 2001-2011: 2500 ureteroscopic procedures

RIRS 430 (19%)
Indications for primary RIRS

- Renal + Ureteral Stone: 55%
- Push Back: 22%
- Radiolucent Stone: 15%
- Habitus Coagulopathy: 8%
## Comparison of RIRS early and late groups

<table>
<thead>
<tr>
<th>P</th>
<th>Late group</th>
<th>Early group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>21</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>P &gt; 0.05</td>
<td>(4-17) 12</td>
<td>(4-15) 8.6</td>
</tr>
<tr>
<td>Mean stone size (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P &gt; 0.05</td>
<td>51%</td>
<td>69%</td>
</tr>
<tr>
<td>Lower pole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P &gt; 0.05</td>
<td>(1-3) 1.3</td>
<td>(1-3) 1.4</td>
</tr>
<tr>
<td>Mean stone number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P &gt; 0.05</td>
<td>33%</td>
<td>30%</td>
</tr>
<tr>
<td>Primary procedure</td>
<td></td>
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</table>
## Comparison of RIRS early and late groups

<table>
<thead>
<tr>
<th>P Value</th>
<th>Late group</th>
<th>Early group</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>NS</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P&lt;0.05</td>
<td>(28-93) 58</td>
<td>(48-187) 92</td>
</tr>
<tr>
<td>NS</td>
<td>87</td>
<td>70</td>
</tr>
</tbody>
</table>

- complications
- Median hospital stay
- Surgery time (min)
- (%) Stone Free
Comparison of RIRS early and late groups

late group

early group
Comparison of RIRS early and late groups

Number of procedures per repair:

Early group – 19
Late group - 26

Price per repair about 130 Euro
Renal Stones

• MP 1378 Lower pole renal stone management using flexible ureterorenoscopy with holmium laser (multi-centeric study).
  
  S. Alqahtani et al. Paris, France

  – A retrospective, multicenter study, N=199 pt.
  – Patients were divided according to stone size: group 1 (1-10mm), 2 (10-20mm), 3 (>20mm)
  – Stone free rate was 95%, 78% and 40% in group 1, 2 and 3 respectively.
  – When allowing 2 sessions success rate improved in groups 2 and 3 to 86% and 82%, respectively.
  – Predictors for failure were infundibular length and width

• fURS offers excellent, single session, stone free rate for lower pole stones up to 1 cm in size. For larger stones good results can be achieved with two sessions.
Renal Stones

- MP 926 The equivalency of treatment modalities for intermediate-sized renal calculi. J.D. Wiesenthal et al. St. Michael’s Hospital, Canada
  - 137 patients treated for renal stones 100-300mm² (10-20mm)
  - SWL- 53 (39%), URS- 41 (30%), PCNL- 43 (31%)
  - Mean stone area was higher for PCNL (p<0.001)
  - Single treatment success was: 95.3%, 87.8% and 60.4% for PCNL, URS and SWL, respectively (p<0.001)
  - When allowing for 2 SWL treatments success rate improved to 79.2%, equalizing success rate between the groups.
  - Auxiliary treatments were more common after SWL- 42%!

- A patient with a renal stone 1-2 cm in size should be aware that PCNL followed by URS are significantly better options than SWL for a single session treatment
The results of RIRS for stones > 15 mm

<table>
<thead>
<tr>
<th></th>
<th>RIRS ( \geq 15 )</th>
<th>RIRS ( &lt; 15 )</th>
<th>Mean size (mm)</th>
<th>Surgery time (min)</th>
<th>Hospital stay (days)</th>
<th>Complications</th>
<th>Stone free rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean size</strong></td>
<td>10.6 (3-14)</td>
<td>19.6 (15-28)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surgery time</strong></td>
<td>67</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hospital stay</strong></td>
<td>1.1</td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td>5%</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stone free rate</strong></td>
<td>78%</td>
<td>74%</td>
<td></td>
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</tr>
</tbody>
</table>

\( p < 0.05 \) N.S
Take home message

RIRS should be considered and discussed with the patient as one of the first line options for treating renal stone.

Pros and cons in comparison to SWL are now part of a routine dialog with the patient.

RIRS should be performed in a proper set up with enough back up equipment.