Renal Study Day Feb 2019
Journal Club

Aled Williams
ST5
Kidney stones and kidney function loss: a cohort study

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Basis of the Study

• Kidney stones are infrequently implicated as the primary cause of ESRD (0.2–3.2% of all ESRD cases).

• Limited evidence suggests an association between kidney stones and the development of CKD.

• Stones are common and preventable – Accurate assessment of Long-term consequences is important to inform health interventions.
Objective

• Unclear whether kidney stones are a risk factor for the development of ESRD

• Hypothesis – An single episode of kidney stones would be associated with excess risk of adverse renal outcomes including ESRD or development of clinically relevant CKD (Stage 3b – 5)
Study Design

Adults Aged >18
Residing in Alberta
April 1997 – March 2009

Population – 4 million
>99% residents have insurance coverage by Alberta Health and Wellness

Exclusions:
ESRD
Tx recipients,
Any pyelonephritis episode

3,089 194
Eligible Patients

1,954 836
Included

1,134 358
Excluded

No Serial Serum Cr Measurements
eGFR <45 ml/min at baseline

ICD-9 Codes
Physician Claims
Hosp Data
Kidney Stone Episodes

Absolute rates were calculated by totalling the number of events and dividing by the total follow-up time. These are presented as events per 1,000,000 person days.
Censored follow-up when a participant died, moved out of the province, or reached the end of the study.
## Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Registry dataset*</th>
<th>Laboratory dataset†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stone(s) (n=23 706)</td>
<td>No stone (n=3 065 488)</td>
</tr>
<tr>
<td>Median (IQR) age (years)</td>
<td>46 (35.1–60.1)</td>
<td>35.4 (23.2–48.6)</td>
</tr>
<tr>
<td>Male</td>
<td>15 686 (66.2)</td>
<td>1 537 388 (50.2)</td>
</tr>
<tr>
<td>Aboriginal</td>
<td>450 (1.9)</td>
<td>84 244 (2.7)</td>
</tr>
<tr>
<td>Receiving social assistance</td>
<td>819 (3.5)</td>
<td>81 852 (2.7)</td>
</tr>
<tr>
<td>Rural residence</td>
<td>3357 (14.3)</td>
<td>389 597 (12.8)</td>
</tr>
<tr>
<td>Comorbidities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median (IQR) Charlson score</td>
<td>0 (0–1)</td>
<td>0 (0–0)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3766 (15.9)</td>
<td>252 467 (8.2)</td>
</tr>
<tr>
<td>Prior nephrolithiasis§</td>
<td>4056 (17.1)</td>
<td>4150 (.1)</td>
</tr>
</tbody>
</table>

IQR=Interquartile range. CKD chronic kidney disease

*Full set of 3 089 194 eligible patients without end stage renal disease at baseline.
†Subset of 1 954 836 patients with serum creatinine measurements available.
‡Charison score includes AIDS/HIV, metastatic cancer, non-metastatic cancer, cerebral vascular disease, chronic obstructive pulmonary disease, dementia, diabetes, heart failure, mild liver disease, moderate/severe liver disease, myocardial infarction, paraplegia, peptic ulcer, peripheral vascular disease, and rheumatological disease.
§Nephrolithiasis occurring within 3 years or 8 years before follow-up period in the registry and laboratory dataset respectively.
# Adverse Event Outcomes

## Table 2: Presence of kidney stones* and risk of adverse renal outcomes (end stage renal disease, chronic kidney disease (stage 3b–5), and doubling of serum creatinine concentration). Values are multivariable adjusted hazard ratios† (95% confidence intervals) unless stated otherwise

<table>
<thead>
<tr>
<th></th>
<th>End stage renal disease</th>
<th>Chronic kidney disease</th>
<th>Doubled serum creatinine</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of events/No of patients (%)</td>
<td>5306/3 068 816 (0.2)</td>
<td>68 453/1 952 198 (3.5)</td>
<td>6574/1 952 198 (0.3)</td>
</tr>
<tr>
<td>First kidney stone episode during follow-up (v no stone)</td>
<td>2.16 (1.79 to 2.62)</td>
<td>1.74 (1.61 to 1.88)</td>
<td>1.94 (1.56 to 2.43)</td>
</tr>
<tr>
<td>No stones</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Single kidney stone episode during follow-up (v no stone)</td>
<td>2.11 (1.69 to 2.63)</td>
<td>1.73 (1.58 to 1.88)</td>
<td>1.84 (1.43 to 2.36)</td>
</tr>
<tr>
<td>≥2 kidney stone episodes during follow-up (v no stone)</td>
<td>2.31 (1.66 to 3.21)</td>
<td>1.63 (1.37 to 1.95)</td>
<td>2.22 (1.49 to 3.33)</td>
</tr>
<tr>
<td>P value for trend (No of stone episodes)</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*Kidney stones were treated as a time-varying exposure: all participants were classified as “unexposed” at the start of follow-up, but, once a kidney stone occurred, participants were classified as “exposed” for the remainder of the study.

†Results were adjusted for age (18–49.9, 50–69.9, ≥70 years), sex, Aboriginal, receipt of social assistance, rural residence, comorbidities (Charlson score and hypertension), and prior nephrolithiasis. New stage 3b–5 chronic kidney disease and doubling of serum creatinine were evaluated in a subset of 1 954 836 patients and also adjusted for baseline estimated glomerular filtration rate. The referent group for all analyses was those who had no stone during follow-up.

Absolute Risk -
Conclusions

- Assoc between episodes of kidney stones and the risk of adverse renal outcomes including ESRD
- Absolute increase in the rate of adverse renal outcomes associated with stones was small
  - Unadjusted rate of ESRD was 2.48 per million person days in people with one or more episodes of stones
  - 0.52 per million person days in people without stones.
Limitations

• Findings based on symptomatic kidney stones
• Not applicable for asymptomatic stones who didn’t seek medical advice
• Assumptions made about 1st episode stones and recurrent presentations with same stone
• Patients with stones may be more likely to have serum creatinine concentration measured – Event more likely!!
UK Comparisons

Prospective cohort study of about 1.5 million people
Kidney stones were a significant risk for ESRD in women but **not** men
Much Smaller Study!
Validation of a Functional Pyelocalyceal Renal Model for the Evaluation of Renal Calculi Passage While Riding a Roller Coaster

Marc A. Mitchell, DO
David D. Wartinger, DO, JD

Context: The identification and evaluation of activities capable of dislodging calyceal renal calculi require a patient surrogate or validated functional pyelocalyceal renal model.

Objective: To evaluate roller coaster facilitation of calyceal renal calculi passage using a functional pyelocalyceal renal model.

Methods: A previously described adult ureteroscopy and renoscopy simulator (Ideal

Science & Environment

Ig Nobel win for kidney stone removing roller-coaster

By Pallab Ghosh
Science correspondent, BBC News

© 14 September 2018

Riding on some types of roller-coaster is an effective way of removing kidney stones.
Could riding roller coasters help you pass kidney stones?

Tuesday September 27 2016

"Got kidney stones? Ride a roller coaster! Study shows it is the most pain-free cost-efficient way to pass them," says the Mail Online of a study carried out in the US which tested riding roller coasters as a way of passing kidney stones.

The study came about after a number of people with kidney stones claimed riding on Walt Disney World's Big Thunder Mountain Railroad ride had helped them pass their stones. In particular, one person with kidney stones reported passing a stone after each of three consecutive rides. This prompted a research team from Michigan State University, led by Dr David Wartinger, to investigate further.
Stones and Roller Coasters??

• Stones in the US – Lifetime prevalence of 11% in Men and 6% Women
• A renal calculus greater than 6 mm in diameter has about a 1% chance of spontaneous passage without intervention.
• Stone recurrence rate approaches 50% at 10 years
• Patient reports of renal calculi passage with activities that exert force on the body

• **Objective** - Evaluate roller coaster facilitation on the passage of renal calculi
Methods

- Modified high-fidelity adult ureteroscopy and renoscopy simulator
- Functional model (silicone) to permit direct inspection calculi
- This model containing 3 calculi was taken for 20 rides on the roller coaster
- Seat position was random
- Stones were evenly distributed in each calyx
## Results

### Front

<table>
<thead>
<tr>
<th>Location of Calculi in Calyx</th>
<th>Calculi Volume</th>
<th>Overall Passage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.5 mm³</td>
<td>13.5 mm³</td>
</tr>
<tr>
<td>Upper</td>
<td>0/1 (0)</td>
<td>0/1 (0)</td>
</tr>
<tr>
<td>Middle</td>
<td>0/4 (0)</td>
<td>1/2 (50.0)</td>
</tr>
<tr>
<td>Lower</td>
<td>1/3 (33.3)</td>
<td>0/5 (0)</td>
</tr>
<tr>
<td>Total</td>
<td>1/8 (12.5)</td>
<td>1/8 (12.5)</td>
</tr>
</tbody>
</table>

### Back

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<tr>
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</tr>
<tr>
<td>Upper</td>
<td>4/4 (100)</td>
<td>4/4 (100)</td>
</tr>
<tr>
<td>Middle</td>
<td>3/3 (100)</td>
<td>1/4 (25.0)</td>
</tr>
<tr>
<td>Lower</td>
<td>1/5 (20.0)</td>
<td>2/4 (50.0)</td>
</tr>
<tr>
<td>Total</td>
<td>8/12 (66.7)</td>
<td>7/12 (58.3)</td>
</tr>
</tbody>
</table>
Discussion

• This model appeared to be sensitive to changes in force and direction on a roller coaster
• May be some evidence for assisting passage of a small stone lodged in the lower calyx
• Advocate using a roller coaster as an adjunct to ESWL
• Most people in the US live within 1 hour of an amusement park
Limitations

• No more likely to pass a stone going on a roller coaster than you are bungee jumping or experiencing turbulence on a plane
• Most stones in the upper calyxes pass easily with gravity anyway
• No idea if this is actually what happens in patients
• Originally wanted porcine or bovine models – Disney weren’t impressed!!


Conclusions

• 2 very different ‘scientific’ approaches to kidney stones

• 1\textsuperscript{st} Journal – Attempting to answer a relevant question! Outcome – No Change

• 2\textsuperscript{nd} Journal – Attempting to combine work and playtime and in the process answer a useless question! Outcome – Global recognition