Renal Colic: Could Less Be More?

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Disclosure Statement

• I, Dr. Michael Patlas, have no affiliations, sponsorships, honoraria, monetary support or conflict of interest from any commercial source
Learning Objectives

1. To describe current trends and controversies in imaging of patients with renal colic

2. To highlight factors affecting selection of imaging modalities

3. To discuss the role of ultrasound in patients with suspected renal colic
• Renal colic is a common medical condition

• Renal colic accounts to 2% of all adult presentations to the Emergency Department (ED)

• Almost 50% of patients will have recurrence within 10 years

Hymans ES. J Urol. 2011; Teichman JMH. NEJM 2004
• ED visit rates for urolithiasis increased from 178 to 340 visits per 100,000 individuals from 1992 to 2009

• Total ED visit rates increased by only 16% over the same time period

Fwu CW. Kidney Int 2013; NHAMCS. National Hospital Ambulatory Medical Care Survey: 2008
The greatest increases in ED urolithiasis visit rates occurred among women and individuals aged 25 - 44 years old.

Fwu CW. Kidney Int 2013; NHAMCS. National Hospital Ambulatory Medical Care Survey: 2008
Why We See More Patients with Urolithiasis?

- Increased rate of obesity
- Increased rate of diabetes
- Use of dietary supplemental calcium
- Decreasing water intake

Taylor EN. JAMA 2005; Taylor EN. Kidney Int 2005
Wallace RB. Am J Clin Nutr 2011
Kant AK. Am J Clin Nutr 2009
• Total annual medical expenditures for urolithiasis in the US exceeded $2 billion in 2000
• An important factor in the increased cost is the use of imaging
• Potential adverse long-term sequelae of radiation, especially in patients with recurrent disease and in younger patients

The proportion of ED urolithiasis visits with any imaging used increased from 56% in 1995–1997 to 79% in 2007–2009.

The use of CT increased from 50% in 1998–2003 to 88% of visits in 2004–2009.

Fwu CW. Kidney Int 2013
• The use of CT increased from 19% in 1998-2000 to 73% in 2007-2009 in patients aged 25-44 years old

Fwu CW. Kidney Int 2013
ACR Dose Index Registry

- CT KUB was 10\textsuperscript{th} most common CT examination
- 157.936 from July 2011 through July 2014
- CT KUB had 5\textsuperscript{th} highest mean DLP (dose-length-product) between top 10 most commonly ordered CT examinations
- The mean DLP of CT KUB was 713 +/- 438 mGy-cm

Escalon JG. JACR 2015
Increased Use of CT for Urolithiasis

- CT is an excellent modality
- Physician time pressure
- Increased reliance on imaging
- Fear of malpractice
- Patient demand

Korley FK. JAMA 2010
Kenney PJ. Radiol Clin North Am 2003
• Patients with non traumatic abdominal pain
  – 547 patients
  – less than half (46%) of pre-CT diagnoses by Emergency Physicians were accurate
  – Change from pre-CT to post-CT diagnosis in patients with renal colic was 43 %

ACR Appropriateness Criteria Acute Onset Flank Pain-Suspicion of Stone Disease:

“Low dose noncontrast CT (NCCT) is the imaging study of choice for accurate evaluation of patients with acute onset of flank pain and suspicion of stone disease (sensitivity 97%, specificity 95%)”.

Coursey CA. Ultrasound Q 2012
Are We Overimage?

• 176/4562 (4%) patients with renal colic had 3 or more CT KUB during the 6-year period (Katz SI. AJR 2006)

• The mean number of CT KUB scans per patient was 2.5 during the 10-month period (Broder J. J Emerg Med 2007)
Spontaneous Passage Rate of Ureteral Stones

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Coll DM. AJR 2002
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Coll DM. AJR 2002
Lower Positive Rate of CT KUB in Female Patients

- Lower female than male positive rate:
  - 27.5% vs 57.5% (Chowdhury FU. Clin Radiol 2007)
  - 18% vs 55% (Yong AW. Scott Med J 2009)
  - 26.8% vs 61.6% (Patatas K. BJR 2012)
Alternative Causes of Symptoms on CT KUB

- Retrospective observational study
- 5383 CT KUBs
- 6.1% of “acutely important” alternative diagnoses
- *When patients with evidence of UTI or without flank or back pain were excluded, “acutely important” causes were found in only 2.8% of cases*

Moore CI. Acad Emerg Med. 2013
Alternative Causes of Symptoms on CT KUB

- Retrospective chart review
- 18-50 y.o. patients with flank pain
- 291 patients
- 115 CT KUBs
- 0 alternative emergent or urgent diagnoses

Schoenfeld EM. West J Emerg Med. 2015
• The increased use of CT was not associated with a change in the proportion of diagnosis of kidney stones among ED patients presenting with acute flank or groin pain

Hymans ES. J Urol 2011
Westphalen AC. Acad Emerg Med 2011
Dalziel PJ. Emerg Med J 2013
• The increased use of CT was not associated with a change in the proportion of alternative diagnoses or admissions to hospital among ED patients presenting with acute flank pain

Westphalen AC. Acad Emerg Med 2011
Renal Colic in 2016: What Should We Do?

• European Association of Urology 2015 Guidelines on Urolithiasis: “Ultrasound (US) should be used as the primary diagnostic imaging tool”

http://uroweb.org

Ultrasound vs CT

- 62 patients
- Prospective study
- Both SDCT and US in all patients
- US was performed by attending radiologists
- US: 93% sensitivity, 95% specificity
- CT: 91% sensitivity, 95% specificity

Patlas M. BJR 2001
US versus CT for Suspected Nephrolithiasis

- multicenter comparative effectiveness trial
- randomized study
- 2759 patients
  - 908 to point-of-care US
  - 893 to radiology US
  - 958 to CT
- 15 academic departments

Smith-Bindman R. NEJM 2014
US versus CT for Suspected Nephrolithiasis

- The incidence of high-risk diagnoses with complications in the first 30 days was low (0.4%) and did not vary according to imaging method.

- The mean 6-month cumulative radiation exposure was significantly lower in the US groups than in the CT group (P<0.001).

Smith-Bindman R. NEJM 2014
US versus CT for Suspected Nephrolithiasis

• The median ED length of stay:
  – point-of-care US - 6.3 hours
  – radiology US - 7 hours
  – CT - 6.4 hours

• The median ED length of stay for patients who underwent single examination:
  – point-of-care US - 5.1 hours
  – radiology US - 6.4 hours
  – CT - 6.2 hours
US versus CT for Suspected Nephrolithiasis

- No significant differences were observed among the groups with respect to:
  - return visit to the ED within 7 or 30 days
  - hospital admission within 7, 30 or 180 days
  - self-reported pain scores

Smith-Bindman R. NEJM 2014
US versus CT for Suspected Nephrolithiasis

• The proportion of patients with a confirmed stone diagnosis within 6 months after randomization was similar in the three study groups (34.5% in the point-of-care US group, 31.2% in the radiology US group and 32.7% in the CT group)

Smith-Bindman R. NEJM 2014
US versus CT for Suspected Nephrolithiasis

• Additional diagnostic testing:
  - 40.7% of the patients in the point-of-care US group underwent CT
  - 27.0% of the patients in the radiology US group underwent CT
  - 5.1% of the patients in the CT group underwent US

Smith-Bindman R. NEJM 2014
US versus CT for Suspected Nephrolithiasis

- Mean total costs for the ED visit were slightly lower among patients assigned to US than among those assigned to CT (a difference of $25 between CT and radiology US, \( P<0.001 \))

Smith-Bindman R. NEJM 2014
US for the prediction of urological surgical intervention

- Retrospective cohort study
- Single center
- 483 patients
- Radiology US
- Main outcome was *urological surgical intervention* within 16 weeks of initial ED presentation

US for the prediction of urological surgical intervention

- US was 97% sensitive and 28.1% specific in prediction of surgery
- The presence of either stone or hydronephrosis was seen in 97% of patients requiring surgery
- Renal or ureteric stone
- Moderate or severe hydronephrosis
- Only 2/67 surgical patients had no stone or hydronephrosis

US for the prediction of admission

- Prospective study
- 77 patients with suspected renal colic
- Bedside US of kidneys and bladder to determine the presence of hydronephrosis and ureteral jets

- *Of patients without hydronephrosis, none required admission within 30 days*

- Loss of the ipsilateral ureteral jet was not significantly associated with subsequent hospital admission

Normal US identifies Patients at Low Risk for Intervention

- Prospective cohort study
- Single center
- 610 enrolled patients
- 341 patients had US
- Radiology US
- Main outcome was urological intervention within 90 days of ED visit

Yan JW. CJEM 2015
Normal US identifies Patients at Low Risk for Intervention

- Four categories of US results
  - Normal
  - Ureteric stone seen
  - Suggestive of ureteric stone (hydronephrosis, perinephric fluid, renal stones, abnormal or absent ureteric jet)
  - Other disease unrelated to urolithiasis

Yan JW. CJEM 2015
Normal US identifies Patients at Low Risk for Intervention

• **Outcome**
  
  – *Normal US* - 0/105 urological interventions
  
  – *Ureteric stone* - 34/139 urological interventions
  
  – *Suggestion of ureteric stone* - 9/90 urological interventions
  
  – *Other disease* - 0/7 urological interventions

Yan JW. CJEM 2015
McMaster Protocol

- Level 1 academic trauma center
- 45,000 ED visits per year
- US is ordered at discretion of ED physician
  (Teaching point: Trust...and educate your ED docs)
- 1291 ED abdominal USs per year (2015)
- 661/1291 are performed for renal colic
McMaster Protocol

- The standard of care at our ED is to get US from 8:00 to 18:00 seven days a week.
- Patient seen outside of this timeline are either kept in the ED or return next morning.
- Blocked ED US spots each morning.
McMaster Protocol

• US department staffed by technologists and fellowship trained radiologists

• Specific renal protocol:
  – kidneys
  – ureters
  – bladder
  – ureteric jets
  – postvoid residual
McMaster Protocol

- RIs are not routinely obtained

- Based on ED physician differential diagnosis, imaging of other intra-abdominal and pelvic structures may have been included (liver, pancreas, biliary tree, aorta, uterus and ovaries)

McMaster Protocol

• Ingestion of 400 ml of water:
  – distended bladder provides a good acoustic window to the terminal ureter
  – visibility of the ureteral jet

• Compression

• Change of patient’s position
Why Use US First?

- Reduced cost
- *Avoid radiation exposure in 70% of cases*
- Available
- Patient with normal US are unlikely to require urological intervention
- No increased rate of complications
- No increased rate of admissions

Nicolau C. Insights Imaging 2015
Disadvantages of US

- Length of examination
- Limited ability to detect small stones (<5mm) - significance?
- Experience of examiner
- Challenging in obese patients
- Difficult identification of mid ureter
- Lower sensitivity for alternative diagnoses?
Conclusions

• US should be considered the first imaging modality in patients with renal colic

• CT should be reserved for patients with negative US and unresolving symptoms, and/or high clinical suspicion for the alternative diagnosis
Thank you!