Block 3 Journal Club

September 6, 2016

Clinical Question: In the adult ED patient with suspect renal colic, does ultrasound identify clinically important renal pathology as well as abdominal CT?

Scenario: You are working in a busy community emergency department and managing multiple patients. As always, there is pressure to decrease door to disposition times. You have just evaluated a 50 year-old Caucasian female with a chief complaint of left flank pain. She has a history of ureteral stones, UTI, and HTN. Pain began two hours ago and is associated with nausea and vomiting. She is hypertensive with an initial blood pressure of 165/90 mmHg. Heart rate, respiratory rate, temperature, oxygen saturation are all within normal limits. On exam the pt is standing next to the bed and appears uncomfortable. She has no abdominal tenderness or obvious masses. Pulses are symmetric bilaterally. There are no signs of trauma. What are your differential diagnoses? What is your plan? Do you want to obtain imaging, and if so, what kind of imaging?

Bottom Line:

In ED patients with suspected renal colic, the decision of type of imaging to obtain must be carefully considered.

The down sides of obtaining a CT scan include radiation exposure and cost. However, if a CT scan is not obtained, one risks missing significant ureteral stones (for example in the mid ureter) and possibly, more importantly, missing serious alternative diagnoses.

An ultrasound is a great test in that it causes no ionizing radiation and may be done at the bedside (in an appropriately trained ED physician's hands), though again, what can actually be evaluated on renal ultrasound is more limited when compared to CT.

During our journal club discussion, many suggested performing bedside aortic ultrasound in addition to renal ultrasound when considering a patient with suspected renal colic. We agree that this is a smart, and likely feasible, idea.

Article Summaries:

Ultrasound versus computed tomography for suspected nephrolithiasis. Smith-Bindman R, Aubin C, Bailitz J, Bengiamin RN, Camargo CA Jr, Corbo J, Dean AJ, Goldstein RB, Griffey RT, Jay GD, Kang TL, Kriesel DR, Ma OJ, Mallin M, Manson W, Melnikow J, Miglioretti DL, Miller SK, Mills LD, Miner JR, Moghadassi M, Noble VE, Press GM, Stoller ML, Valencia VE, Wang J, Wang RC, Cummings SR. N Engl J Med. 2014 Sep 18; 371(12):1100-10. Doi:10.1056/NEJMoa1404446.

Background:
CT has become the most common initial imaging modality used to evaluate and diagnose nephrolithiasis, but there is no evidence that it improves outcomes. Alternatively, the increased use of CT has increased healthcare costs, increased exposure to ionizing radiation, and increased incidental findings leading to inappropriate referrals and follow ups.

Clinical question:
To assess the effect of diagnostic imaging techniques on patient outcomes.

Methods:
A total of 2759 patients ages 18-76 were recruited from 15 "geographically diverse" hospitals. These patients were randomly assigned into one of three imaging groups: POCUS by an emergency physician, US performed by a radiologist, or abdominal CT. Patients were included if they presented with abdominal or flank pain and the ED physician ordered imaging to rule out a kidney stone. Patients in whom the physician considered high risk for other diagnoses such as cholecystitis, appendicitis, aortic aneurysm, or bowel disorders, were excluded. Men weighing more than 129 kg (285 lb) and women weighing more than 113 kg (250 lb) were excluded.

Three primary outcomes were considered:

1) high risk diagnoses with complications related to missed/delayed diagnosis defined as any of the following diagnoses within 30 days after the department visit: abdominal aortic aneurysm with rupture, pneumonia with sepsis, appendicitis with rupture, diverticulitis with abscess or sepsis, bowel ischemia or perforation, renal infarction, renal stone with abscess, pyelonephritis with urosepsis or bacteremia, ovarian torsion with necrosis, or aortic dissection with ischemia.
2) Cumulative radiation exposure within 6 months of enrollment.
3) Total costs (which were not reported in the paper).

Numerous secondary outcomes were assessed as outlined below in the table. Diagnostic accuracy was assessed by comparing to the standard of confirmed passage or surgical removal of a stone. Accuracy of initial imaging also assessed based on initial interpretation and whether exam was consistent with nephrolithiasis.

Results
908 patients were randomly assigned to point-of-care ultrasonography, 893 to radiology ultrasonography, and 958 to CT.

Ultimately, they found no statistically significant difference in high risk diagnoses with adverse events or serious adverse events between groups. The US groups did show a statistically significant difference in radiation exposure in the ED. Accuracy based on diagnosis at the end of the ED visit when considering eventual passage or removal of a stone, all three groups had similar specificity and sensitivity. Based on the initial diagnostic test in the ED, CT had a much higher sensitivity but lower specificity than US. It is important to point out that 34.5% in the point-of-care ultrasonography group, 31.2% in the radiology ultrasonography group,

and 32.7% in the CT group had eventual confirmed passage or surgical removal of a stone.

Discussion:
Ultimately, the patients in the US group had a statistically significant reduction in radiation exposure without any increase in high risk diagnoses or serious adverse events. Ultrasound is a good first pass imaging modality in patients with reasonable suspicion for nephrolithiasis. It is important to point out that approximately one third of the patients involved in this study were confirmed to have a stone based on their gold standard of passage/surgical removal. More patients in the POCUS group underwent further imaging, likely due to ED physician hesitance/lack of confidence in hedging all their bets on their bedside US. Remember that significantly obese patients and those with high suspicion for high risk diagnoses were excluded completely from this study.

A Prospective Comparative Study of Color Doppler Ultrasound with Twinkling and Noncontrast Computerized Tomography for the Evaluation of Acute Renal Colic. Abdel-Gawad M, Kadasne RD, Elsobky E, Ali-El-Dein B, Monga M. J Urol. 2016 Apr 8. pii: S0022-5347(16)30130-6. doi: 10.1016/j.juro.2016.03.175.

Clinical Question: Comparison of the use of CDU with twinkling to NCCT in the dx of renal colic in ER patients

Background: With growing awareness of overuse of CT in the evaluation of patients with acute flank pain (radiation effects, potential long term health hazards), alternative imaging modalities are being considered. One such consideration is color Doppler ultrasound (CDU).

Methods:

-Prospective study, compared CDU and NCCT (done simultaneously) in the dx of suspected acute renal colic in adult patients presenting to the ER from Jan 2012 to June 2014.

-Exclusion criteria: hx of urolithiasis in last 3 years, suspected UTI, recent urologic procedures, bilateral flank pain, pregnancy

-Gold standard for stone dx: ureteroscopic ID of the stone or confirmed passage and stone retrieval by the patient

Results:

-723 of 815 patients enrolled had ureteral stones (88.72%), 60 (7%) had kidney stones, and 32 (4%) had other causes of pain including nonspecific abd pain, appendicitis, ureteritis, diverticulitis (each dx by ultrasound findings)

-NCCT showed some findings which were not detected by US, though none of these findings required emergent intervention

-24% of stones were < 5 mm diameter, 71% were between 5 and 10 mm, 5.5% were > 10 mm

-Twinkling Sn 97%, Sp 99%

-NCCT confirmed presence of stones in 99.6% of pt and was negative in 0.4%

-Sites, diameter of stones significantly affected results of US

Bottom Line: In this population, CDU results were comparable to those of NCCT. However, interpretation of CDU requires experience. Additionally, this may not be generalizable, given inclusion and exclusion criteria, average BMI of population, incidence of important alternative diagnoses.

Limitations: Location, pt BMI, pt age, lack of serious alternative dx, how renal ultrasound actually performed locally

STONE PLUS: Evaluation of Emergency Department Patients With Suspected Renal Colic Using a Clinical Prediction Tool Combined With Point-of-Care Limited Ultrasonography. Daniels B, Gross CP, Molinaro A, Singh D, Luty S, Jessey R, Moore CL. Ann Emerg Med. 2016 Apr;67(4): 439-48. doi: 10.1016/j.annemergmed.2015.10.020.

BACKGROUND:

CT imaging is now performed in more than 70% of ED patients receiving a diagnosis of ureterolithiasis. CT use for renal colic has increased without any significant change in patient-centered outcomes, such as hospital admissions or identification of alternate diagnoses. Ultrasonography use for suspected renal colic is more common outside the United States and could potentially help avoid CT imaging.

CLINICAL QUESTION:

This Annals of Emergency Medicine article looks at the question of whether the addition of point-of-care limited ultrasonography (PLUS) to look for hydronephrosis improves the performance of the STONE clinical score in predicting the presence of renal stones in uncomplicated ED patients, with a potential ultimate goal of reducing unnecessary CT-related radiation by categorizing patients into low- and high-risk groups for kidney stone or alternative diagnoses.

PATIENTS ENROLLED:

The prospective observational study enrolled 835 adult patients between May 2011 and February 2013 at two sites in Connecticut, an urban, academic, Level I trauma center with over 80,000 annual visits, and a freestanding, suburban ED with about 20,000 annual visits. A proportion of patients included in this analysis were enrolled during the validation trial of the original STONE score. Of 2091 patients undergoing a CT stone protocol, 835 were enrolled in this study. Patients were excluded due to a number of reasons, to include no research staff being available, patients not giving consent, renal colic not being suspected, CT scan being cancelled, renal PLUS not being done, or patient being lost to follow-up. The study did not include patients with symptomatic stones who may have been discharged without CT imaging.

INTERVENTION:

All enrolled patients underwent renal PLUS before CT scanning to assess for the presence of hydronephrosis. Stones and ureteral jets were also documented if noted, but neither were required. The patients also underwent point-of-care urine testing, and were classified based on the STONE clinical scoring system into risk categories for symptomatic stone (see table above).

COMPARISON:

The addition of PLUS was compared to use of the STONE clinical score, with universal follow-up CT scanning as the gold standard.

OUTCOME:

The primary outcome was symptomatic ureteral stone or acutely important alternative finding identified on CT scan. Acute important alternative finding was defined as such findings determined to be the cause of the presenting flank pain and requiring intervention in the ED, such as antibiotics, admission other than for pain control, or transfer to the OR. The secondary outcome, urologic intervention, was assessed by 90-day follow-up interview and record review.

INTERNAL VALIDITY:

Trained assistants were available to enroll patients during predefined periods, including overnight, weekends, and holidays. However, there were still a significant percentage (33%) of patients not enrolled due to lack of research assistant availability. There were a sizeable number of exclusions due to renal PLUS not being done (8.5%) and due to loss to follow-up (7.9%). Both clinicians and research assistants were blinded to the elements of the prediction score at data collection, and to the data at the time of the PLUS procedure. Research assistants extracting CT results were blinded to all clinical data, including STONE score and PLUS results.

RESULTS:

Only about half (52.9%) of patients enrolled had a symptomatic stone diagnosed on CT. Using presence of any degree of hydronephrosis on PLUS alone had poor sensitivity (65%), but those with moderate or greater hydronephrosis on PLUS had a specificity of 93% for symptomatic stone. Similarly, when combining hydronephrosis on PLUS with STONE scoring, sensitivity was improved but remained poor in the low and moderate risk groups. Adding PLUS to STONE scoring significantly improved specificity in the low and moderate risk groups, from 67% to 98%, and from 42% to 92%. On the other hand, use of PLUS did not make any significant difference in sensitivity or specificity in the high risk STONE group. There was a more consistent association between presence of hydronephrosis when looking at larger stones. Those with any hydronephrosis were about 4 times more likely to have a large stone (5 mm or greater). However, even still, only 86% of those with large stones requiring urologic intervention within 90 days had hydronephrosis on renal PLUS.

Finally, and perhaps most importantly, about 6.5% of patients were found to have an acutely important alternate finding identified on CT scan. Most of these patients did not have hydronephrosis, and most of the patients were in the low- and moderate- risk STONE groups.

However, there were 4 patients of 386 (1%) with hydronephrosis on PLUS who were found on CT to have appendicitis. There were 2 of 54 patients (4%, 1 with pyelonephritis, and 1 with appendicitis) who were found to have significant alternative diagnosis requiring intervention despite presence of hydronephrosis within the high-risk STONE group.

APPLICABILITY:

Besides the validity issues raised above (i.e. exclusions), there is at least one limitation that may affect generalizability. This study was performed at an academic institution with an active bedside ultrasonography training program, and it has been shown previously that those with fellowship training in ultrasound are better at discerning hydronephrosis. It is also unclear whether this approach brings enough sensitivity to alter clinical practice. Overall, sensitivity remained poor except in the high-risk STONE group. While PLUS did improve the sensitivity in the low- and moderate-risk groups, it is unlikely to be enough to be able to defend not getting a CT scan in many of these patients. The best value of the STONE-PLUS approach seems to be in the high specificity obtained with ultrasound. Put simply, if a patient demonstrates hydronephrosis on ultrasound or falls in the high-risk STONE group, it is less likely that the patient has an alternative diagnosis. However, the miss rate is still pretty high… 4% in this study. One of those diagnoses, the pyelonephritis, would arguably have been picked up from the urine study. The appendicitis, however, apparently required CT scan to make the diagnosis.

The bottom line is that larger studies are likely needed for further validation of the STONE-PLUS approach before the use of CT scans can be reduced in this patient population.

Specifically, one of the approaches suggested by this study that should probably be looked at more closely is the role of reduced dose CT of the abdomen/pelvis in cases of moderate probability of renal stone. Reduced dose CT can reduce ionizing radiation by more than 80% and is recommended by the American College of Radiologists when symptomatic stone is suspected. However, less than 2% of CT scans for renal colic in the United States are done with reduced dose protocol.