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Washington University Emergency Medicine Journal Club
The Diagnostic Approach to Ureteral Colic In the Emergency Department

Vignette

You are a fourth-year resident working in TCC one overnight when you (not the patient) begin experiencing pain in your right flank that radiates into your right lower abdomen and groin. The pain is colicky and intermittent and increases in severity to the point that you are in tears. You go and tell your attending, Dr. Wagner, who responds "at least *I* didn't make you cry this time." He tells you to get back to work and stop complaining, but after another thirty minutes the pain is so intense that you are no longer perform your duties as a physician. The back-up person is called in and you are placed in a treatment room to be seen as a patient.

The intern enters the room and notes that you are writhing in pain and are unable to sit still. Your vitals are stable. You have mild right CVA tenderness, no abdominal tenderness, and a normal genital exam (for someone of your gender). Your lungs are clear and other than tachycardia your cardiac exam is unremarkable.

The intern clearly believed that you are suffering from renal colic and wishes to practice their "shared decision-making" skills with you and begins a discussion of the diagnostic options. The options include the following:

1. Check your labs, including a urinalysis (UA), and practice expectant management;
2. The intern can personally perform a bedside ultrasound (US) of your kidneys to evaluate for hydronephrosis;
3. The ED attending can perform a bedside US;
4. You can wait for a formal US to be performed in the morning;
5. A computed tomography (CT) scan can be ordered.

You consider your options while awaiting the IV dilaudid you requested, weighing the risks of radiation exposure, the delay in obtaining a formal US, and the potential loss of accuracy with a bedside ultrasound. You wish you could get on the computer to perform a literature search to find the best option, but choose instead to black out from the pain, welcoming the darkness that enfolds you…

PICO Question
Population: Adult patients with presumed ureteral colic
Intervention: Bedside clinician-performed US, radiology US, clinical decision rules, clinical gestalt
Comparison: CT scan
Outcome: Diagnostic accuracy, missed alternative diagnoses, need for urologic intervention

Search Strategy

Having seen published study in the New England Journal of Medicine that your institution participated in, you choose to include this article (Smith-Bindman 2014). Having such a broad topic, you ask one of your ultrasound experts for additional articles. She sends you a bevy of relevant articles, from which you select an additional three titles to include.

Article 1: Moore CL, Bomann S, Daniels B, et al. Derivation and validation of a clinical prediction rule for uncomplicated ureteral stone--the STONE score: retrospective and prospective observational cohort studies. BMJ. 2014 Mar 26;348:g2191. Answer Key.

Article 2: Herbst MK, Rosenberg G, Daniels B, et al. Effect of provider experience on clinician-performed ultrasonography for hydronephrosis in patients with suspected renal colic. Ann Emerg Med. 2014 Sep;64(3):269-76. Answer Key.

Article 3: Edmonds ML, Yan JW, Sedran RJ, McLeod SL, Theakston KD. The utility of renal ultrasonography in the diagnosis of renal colic in emergency department patients. CJEM. 2010 May;12(3):201-6. Answer Key.

Article 4: Smith-Bindman R, Aubin C, Bailitz J, et al. Ultrasonography versus computed tomography for suspected nephrolithiasis. N Engl J Med. 2014 Sep 18;371(12):1100-10. Answer Key.

Bottom Line

Ureteral colic remains a common diagnosis in emergency departments in the United States, where it accounts for over 2 million annual visits. Computed tomography (CT) as a diagnostic imaging modality has seen a dramatic increase in use for the evaluation of ureteral colic, despite growing concerns regarding exposure to ionizing radiation. Ultrasound, on the other hand, has seen very little change in its use in the US, being used in ~6.9% of cases of suspected ureteral colic in 2008. This is in stark contrast to care in Canada, where ultrasound is the preferred imaging modality, being utilized in ~70% of patients who undergo imaging.

One observational study conducted in Ontario, CA evaluated the utility of US in renal colic (Edmonds 2010). There were 817 ED-ordered renal ultrasounds for the evaluation of kidney stone. A normal ultrasound in these patients was associated with a decrease in the need to undergo a CT scan, and correctly identified a population at very low risk of requiring a urologic intervention. In patients with a normal ultrasound, 14% underwent CT scanning within the next 90 days, and one 0.6% required a urologic procedure. Among those with either a visualized stone or indirect evidence of a stone, around 30% and 18% underwent CT scanning, respectively, and around 6% in each group required a urologic procedure.

When ultrasound is used as an initial diagnostic imaging modality, it results in a significant decrease in cumulative radiation exposure without an increase in serious adverse events. In one multicenter US study (Smith-Bindman 2014), patients were randomized to an initial imaging modality of either CT scan, bedside ultrasonography performed by an emergency physician, or ultrasonography performed by a radiologist. The mean cumulative radiation dose over the next months was lower in the bedside and radiologist-performed ultrasound groups than in the CT group (10.1 mSv and 9.3 mSv, respectively, vs. 17.2 mSv). The rate of adverse events in the three groups was 12.4%, 10.8%, and 11.2%. The median ED length of stay was found to be lower in the bedside ultrasound group compared to the other two groups. These results suggest that use of ultrasound as an initial imaging modality is both safe and results in decreased radiation exposure.

Bedside ultrasound imaging use by emergency physicians has continued to increase, and its use has become a requirement for graduating emergency medicine residents. However, proficiency with ultrasound varies greatly with level of training and experience. The effect of level of training on the diagnostic accuracy of ultrasound in suspected renal colic has been evaluated in a prospective observational study (Herbst 2014). For the detection of hydronephrosis, using CT as the gold standard, diagnostic accuracy of bedside ultrasound was fair in the hands of fellowship trained emergency physicians (LR+ 4.97) but was poor in the hands of non-fellowship trained attendings, experienced residents, and inexperienced clinicians (LR+ 2.78, 2.39, and 2.07, respectively). For the detection of moderate hydronephrosis, the positive LRs were much better (22.52, 8, 4.03, and 4.15). One could argue that the detection of moderate hydronephrosis is much more likely to alter patient management than the detection of any hydronephrosis.

The diagnostic evaluation of ureteral colic has three main goals: 1) confirmation of the presence of an obstructing ureteral stone; 2) evaluation for the presence and degree of hydronephrosis; and 3) exclusion of other potentially serious alternative causes of patients' symptoms. Many would argue that for the majority of patients, this last goal is the main priority when considering a diagnostic imaging modality. The reported diagnostic accuracy of ultrasound varies widely in the literature and is typically better at detecting larger stones (Patlas 2001, Fowler 2002, Ripolles 2004). It could be argued, however, that the goal of ultrasound is not to detect the stone itself, but rather to evaluate for the degree of hydronephrosis, and hence determine the need for intervention. It therefore seems reasonable to utilize ultrasound in patients in whom the probability of an serious alternative has been deemed to be low, reserving CT for those where the concern is higher.

The STONE score is a retrospectively derived and prospectively validated clinical decision rule for evaluating the probability of a patient having renal colic. Based on five factors (sex, duration of symptoms, race, presence of nausea and/or vomiting, and

hematuria) a score of 0-13 is assigned. Patients with a score of 0-5 were found to have an 8-9% prevalence of kidney stones, compared to a prevalence of 88-89% in those with a score of 10-13. Patients in the high prevalence category had a low rate of alternative diagnoses found on CT scan (1.6%). It would be reasonable, therefore, to forego CT scanning, and potentially ultrasound as well, in patients with a high stone score, while considering CT for those with a low score. Patients with a moderate score (prevalence of ~50%) could undergo ultrasound as an initial imaging modality.