



Original Contribution

The ability of renal ultrasound and ureteral jet evaluation to predict 30-day outcomes in patients with suspected nephrolithiasis



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ABSTRACT

Study objective: We sought to identify findings on bedside renal ultrasound that predicted need for hospitalization in patients with suspected nephrolithiasis.

Methods: A convenience sample of patients with suspected nephrolithiasis was prospectively enrolled and underwent bedside ultrasound of the kidneys and bladder to determine the presence and degree of hydronephrosis and ureteral jets. Sonologists were blinded to any other laboratory and imaging data. Patients were followed up at 30 days by phone call and review of medical records.

Results: Seventy-seven patients with suspected renal colic were included in the analysis. Thirteen patients were admitted. Reasons for admission included intractable pain, infection, or emergent urologic intervention. All 13 patients requiring admission had hydronephrosis present on initial bedside ultrasound. Patients with moderate hydronephrosis had a higher admission rate (36%) than those with mild hydronephrosis (24%), $P < .01$. Of patients without hydronephrosis, none required admission within 30 days. The sensitivity and specificity of hydronephrosis for predicting subsequent hospitalization were 100% and 44%, respectively. Loss of the ipsilateral ureteral jet was not significantly associated with subsequent hospital admission and did not improve the predictive value when used in combination with the degree of hydronephrosis.

Conclusions: No patients with suspected renal colic and absence of hydronephrosis on bedside ultrasound required admission within 30 days. Ureteral jet evaluation did not help in prediction of 30-day outcomes and may not be useful in the emergency department management of renal colic.

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1. Introduction

Renal colic caused by a ureteral stone is a frequent presentation to the emergency department (ED) accounting for approximately 5.7 million ED visits from 2005 to 2009 according to the National Hospital Ambulatory Medical Care Survey [1]. After the ED provider determines that a patient with abdominal or flank pain does not have a more immediate life-threatening diagnosis, management of patients with suspected nephrolithiasis revolves around pain control, ruling out infection, and determining the need for urologic intervention. Previous studies have shown that smaller, more distally located stones have a higher likelihood of spontaneous passage and lower incidence of complications [2,3]. Information on stone size and location is most accurately achieved with computed tomographic (CT) scan [4,5]. However, there are

disadvantages to CT including financial and human resource costs, time, logistic infrastructure, exposure to ionizing radiation, and the risk of clinically unimportant incidental findings leading to further diagnostic testing and medical interventions with their own attendant costs and risks [6,7]. As an alternative to CT, ultrasound is a frequently used imaging modality in the workup of ureteral stones. Ultrasound can readily visualize hydronephrosis secondary to ureteral obstruction (Fig. 1), is relatively inexpensive, and can be repeated without exposure to ionizing radiation: a particular advantage in a disease, which is frequently recurrent. Such considerations have led the European Association of Urology to recommend ultrasound as “the primary diagnostic imaging tool” for urolithiasis. Widespread training of emergency physicians in bedside sonography has conferred the additional advantage of potential accelerated throughput for these patients when presenting to the ED [8–10].

A limitation of ultrasound has been its inability to identify the location and size of ureteral stones, thereby restricting its ability to predict the likelihood of spontaneous stone passage and rendering it, in the view of some, as inadequate for definitive decision making in the management of these patients [9]. Despite this, a recent large

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Fig. 1. Beside ultrasound showing mild hydronephrosis (H) as a result from an obstructing ureteral pelvic junction stone (S).

multicenter, randomized controlled trial of ultrasound vs CT demonstrated that an ultrasound-first approach leads to a significant reduction in radiation exposure without affecting outcomes [11]. The findings of this study suggest that CT does not help risk stratify patients as previously believed, and ultrasound alone may be adequate. In addition, a large retrospective study by Edmonds et al [12] found that absence of hydronephrosis in patients with ureteral stones required urologic intervention in less than 1% of cases, suggesting that severity of hydronephrosis may predict the likelihood of subsequent complications or failure to pass spontaneously.

In addition to evaluating for hydronephrosis, ultrasound can also identify the ureteral jet of urine flowing into the bladder (Fig. 2). Previous study has demonstrated ureteral jet asymmetry in cases of ureterolithiasis, with an absent or weaker jet lateralizing to the side with obstruction [13]. Studies have not elucidated whether this additional sonographic bedside test could also provide prognostic information.

Currently, unless a CT is obtained, the management of renal colic is based on clinical data (eg, pain control, ability to tolerate oral intake, concomitant urinary infection, etc). Identification of sonographic findings that predict complications of ureteral colic such as need for hospitalization or urologic intervention would be of value in the management of these patients. Conversely, identifying patients with a high rate of spontaneous passage and low rate of complications could decrease utilization of CT.

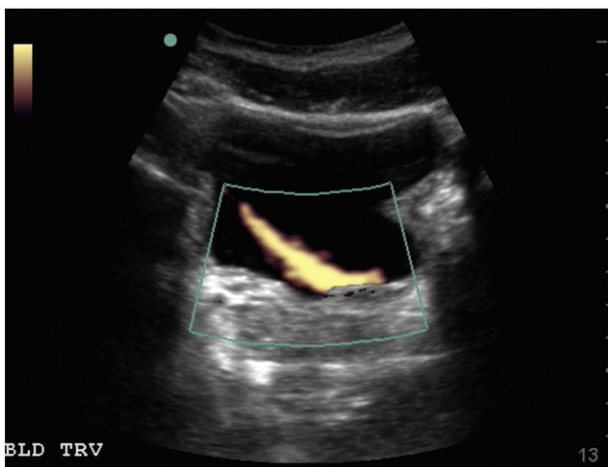


Fig. 2. Power Doppler of a bladder demonstrating a normal left ureteral jet.

We hypothesized that severity of hydronephrosis and a decreased or absent ureteral jet on the side of the patient's symptoms would be associated with an increased need for hospitalization for pain, infection, or urologic intervention within 30 days in patients with suspected nephrolithiasis.

2. Methods

2.1. Study design

This prospective, observational study enrolled a convenience sample of ED patients presenting with symptoms of renal colic during 2008 to 2011. The facility's institutional review board approved the study, and all patients provided informed consent.

2.2. Setting and population

The study was performed at a single-center urban teaching ED with an annual census of 55 000. Adult patients with symptoms consistent with renal colic (eg, flank or abdominal pain, hematuria, etc) were included. Exclusion criteria included presence of ureteral stent or percutaneous nephrostomy, history of end-stage renal disease or renal transplant, and pregnancy. In addition, patients who had a diagnosis other than nephrolithiasis as the most likely cause of their symptoms (as determined by the caring ED attending physician) were excluded from analysis. Study personnel consisted of seven emergency physicians who all met the 2008 American College of Emergency Physician's Emergency Ultrasound Guidelines with at least 25 renal studies [14]. In addition, sonographers were given a standard didactic and hands-on training for assessment of ureteral jets. Study personnel were blinded to laboratory and radiology data of enrolled patients and were not involved in the clinical care of the patient.

2.3. Methods and measurements

Ultrasound examination of both kidneys and the bladder was performed in longitudinal and transverse planes. The sonologist graded the presence of hydronephrosis for each kidney as none, mild (any non-vascular and noncystic fluid collection in the renal sinus), moderate (renal sinus dilatation resulting in confluence of calices), or severe (grossly dilated renal sinus with cortical effacement). At the discretion of the sonologist, color or power Doppler ultrasound was used to confirm or exclude hydronephrosis in equivocal cases. Bilateral simultaneous ureteral jet evaluation was performed in the transverse plane at the level of the ureterovesical junctions using color or power Doppler with a pulse repetition frequency set to detect low flow. The power Doppler field size was set to include the entire posterior wall of the bladder and was visualized for 3 minutes. Ureteral jets were considered normal if present at least once on each side. Ureteral jets were considered nondiagnostic when neither side was visualized during the 3 minutes. A ureteral jet was considered abnormal when visualized on the contralateral side but was either absent or comparatively diminished on the ipsilateral side. Patients with an empty bladder were excluded from ureteral jet analysis. All ultrasounds were obtained with either a Sonosite M-Turbo or a Siemens Accuson X-300 using a curvilinear 2- to 5-MHz probe depending on sonologist preference and machine availability. The time spent performing each study was determined by machine timestamps of study start and finish.

All patients received a follow-up phone-call 30 days after the ED visit for information regarding repeat ED visits, need for admission, or urologic intervention. The primary outcome was any subsequent urologic intervention or hospitalization related to the diagnosis of ureterolithiasis at the time of presentation or within 30 days after initial ED presentation.

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