Is Point-of-Care Ultrasonography Effective for the Diagnosis of Urolithiasis?

TAKE-HOME MESSAGE

Moderate or severe hydronephrosis is highly specific for the presence of a stone in patients presenting with renal colic, whereas the absence of hydronephrosis cannot exclude the diagnosis.

METHODS

DATA SOURCES

Two reviewers independently searched MEDLINE, EMBASE, Scopus, Web of Science, and PubMed on April 15, 2016, for literature evaluating adult emergency department (ED) patients with urolithiasis or renal colic symptoms, using a combination of key words and Medical Subject Headings terms. Bibliographies of included studies, narrative reviews, and conference abstracts were also manually examined.

STUDY SELECTION

Studies were considered eligible if they included patients older than 18 years and presenting to an ED with signs or symptoms suggestive of urolithiasis and point-of-care ultrasonography was performed by an attending or resident emergency physician. Acceptable criterion standards included computed tomography (CT) evidence of renal stone or hydronephrosis, direct stone visualization, or surgical findings. Studies including intravenous pyelogram and radiology-performed ultrasonography as the reference standard were excluded because they have been demonstrated to

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Editor's Note: This is a clinical synopsis, a regular feature of the *Annals'* Systematic Review Snapshot (SRS) series. The source for this systematic review snapshot is: **Wong C, Teitge B, Ross M, et al. The accuracy and prognostic value of point-of-care ultrasound for nephrolithiasis in the emergency department: a systematic review and meta-analysis. *Acad Emerg Med.* 2018;25:684-698.**

Results

Diagnostic accuracy of ultrasonography for urolithiasis.

Outcome	No. of Studies (No. of Participants)	Sensitivity (95% CI), %	Specificity (95% CI), %	LR+ (95% CI)	LR− (95% CI)	Heterogeneity (I^2), %
POCUS for urolithiasis (overall)	5 (1,773)	70.2 (67.1–73.2)	75.4 (72.5–78.2)	2.85 (2.50–3.20)	0.39 (0.36–0.44)	76
POCUS for urolithiasis with moderate to severe hydronephrosis	2 (1,505)	29 (25–32)	94.4 (92.7–95.8)	5.22 (3.85–7.08)	0.76 (0.72–0.80)	Not available

CI, Confidence interval; *LR+*, positive likelihood ratio; *LR−*, negative likelihood ratio; *POCUS*, point-of-care ultrasonography.

The search strategy identified 627 unique abstracts, of which 26 were selected for full-text review. Nine studies were determined to meet the inclusion criteria (3 addressing accuracy only, 3 addressing prognostic value only, and 3 addressing both). One large study by Smith-Bindman et al[2] was excluded from diagnostic accuracy assessment because of concern about risk of bias from a weak reference standard (ie, direct stone visualization or surgical removal determined by follow-up telephone call) and a large proportion of patients lost to follow-up (14.4%). The remaining 5 studies (n=1,773 participants) were all deemed to be at low risk of

have reduced accuracy compared with CT.[1] The primary outcome was the accuracy of point-of-care ultrasonography for identifying nephrolithiasis, whereas the secondary outcome was the prognostic value of point-of-care ultrasonography for the management of nephrolithiasis. Studies were independently screened for inclusion by 2 reviewers, with discrepancies resolved by consensus with a third reviewer. Articles were assessed for quality with the Quality Assessment of Diagnostic Accuracy Studies–2 instrument.

DATA EXTRACTION AND SYNTHESIS

Data were extracted by one author and reviewed for accuracy by a second one. Any degree of hydronephrosis was considered a positive point-of-care ultrasonographic finding. Heterogeneity was evaluated with the χ^2 test and I^2 statistic. Sensitivity, specificity, positive likelihood ratios, and negative likelihood ratios with 95% confidence intervals were calculated using a random-effects model. A subgroup analysis was performed of studies that independently assessed the accuracy of the specific degree of hydronephrosis on point-of-care ultrasonographic examination.

bias and were subsequently assessed for the primary outcome of accuracy of point-of-care ultrasonography in the diagnosis of urolithiasis. The prevalence of urolithiasis in the 5 studies that were evaluated for diagnostic accuracy ranged from 35.5% to 84.2%. All 5 studies used noncontrast CT as the criterion standard. The overall sensitivity and specificity of point-of-care ultrasonography for diagnosing urolithiasis was 70.2% and 75.4%, respectively (Table). When the 2 studies assessing the degree of hydronephrosis were evaluated, moderate to severe was found to be 94.4% specific, but only 29% sensitive.[3,4]

The authors also provided a narrative summary of the 6 studies assessing prognostic value. Although the exact outcomes differed between studies, there were several significant themes noted. First, if moderate to severe hydronephrosis was present, there was an increased rate of hospitalization and likelihood of receiving a urologic intervention. Second, the sensitivity of point-of-care ultrasonography improved with increasing stone size. Third, patients who were allocated to point-of-care ultrasonography received less total radiation exposure.

Commentary

Urolithiasis is a common presentation to the ED, with an incidence of 116 cases per 100,000 person-years in the United States and a 5-year recurrence rate approaching 50%.[5,6] Additionally, the incidence of urolithiasis has been increasing, resulting in 2.7 million annual visits to an ED or primary care provider and health care costs exceeding $2.1 billion per year.[5] In recent years, CT has been increasingly used for the evaluation of urolithiasis because of its high diagnostic accuracy and ability to identify alternate causes for a patient's symptoms.[7] This has led to a 10-fold increase in use between 1996 and 2007, resulting in significantly increased radiation exposure for patients.[8] Consequently, there has been increasing interest in identifying noninvasive methods for diagnosing urolithiasis without exposing patients to significant radiation.

The current review found that point-of-care ultrasonography was moderately sensitive and specific for the diagnosis of urolithiasis when hydronephrosis was present but was much more specific with moderate to severe hydronephrosis. Unfortunately, the pooled likelihood ratios for the overall assessment with either all patients or those with moderate to severe hydronephrosis were relatively small and unlikely to significantly influence the posttest probability in isolation. However, it is possible that combining point-of-care ultrasonography with historical features, physical examination findings, and laboratory testing will increase the diagnostic accuracy, especially when limited to patients with moderate to severe hydronephrosis.[3] Clinicians could use the STONE score or another risk-stratification tool to identify the pretest probability of nephrolithiasis and then use the above likelihood ratios to determine the posttest probability.[3]

It is important to consider limitations in regard to the current review. First, there were large variations in the experience and point-of-care ultrasonographic training of providers between studies, which may have altered the diagnostic accuracy because point-of-care ultrasonography is a user-dependent skill. Additionally, although all studies used noncontrast CT as the criterion standard, there were variations in the definitions of a positive CT finding. Moreover, it may be

difficult for less experienced sonographers to differentiate mild from moderate hydronephrosis, which may have altered the test characteristics for this subgroup. Furthermore, there were only 2 studies assessing the diagnostic accuracy of moderate to severe hydronephrosis, thereby precluding the ability to calculate the statistical heterogeneity. However, both studies were of relatively equivalent size and demonstrated similar diagnostic accuracies. Finally, there was significant heterogeneity in the outcomes for the prognostic assessment, thereby limiting the ability to perform a meta-analysis, and most of the individual prognostic studies were limited by small sample sizes.

1. Brisbane W, Bailey MR, Sorensen MD. An overview of kidney stone imaging techniques. *Nat Rev Urol*. 2016;13:654-662.
2. Smith-Bindman R, Aubin C, Bailitz J, et al. Ultrasonography versus computed tomography for suspected nephrolithiasis. *N Engl J Med*. 2014;371:1100-1110.
3. Daniels B, Gross CP, Molinaro A, et al. STONE PLUS: evaluation of emergency department patients with suspected renal colic, using a clinical prediction tool combined with point-of-care limited ultrasonography. *Ann Emerg Med*. 2016;67:439-448.
4. 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;64:269-276.
5. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. *Rev Urol*. 2010;12:e86-e96.
6. Pearle MS, Calhoun EA, Curhan GC. Urologic Diseases of America Project. Urologic Diseases in America Project: urolithiasis. *J Urol*. 2005;173:848-857.
7. Gottlieb M, Long B, Koyfman A. The evaluation and management of urolithiasis in the ED: a review of the literature. *Am J Emerg Med*. 2018;36:699-706.
8. Westphalen AC, Hsia RY, Maselli JH, et al. Radiological imaging of patients with suspected urinary tract stones: national trends, diagnoses, and predictors. *Acad Emerg Med*. 2011;18:699-707.

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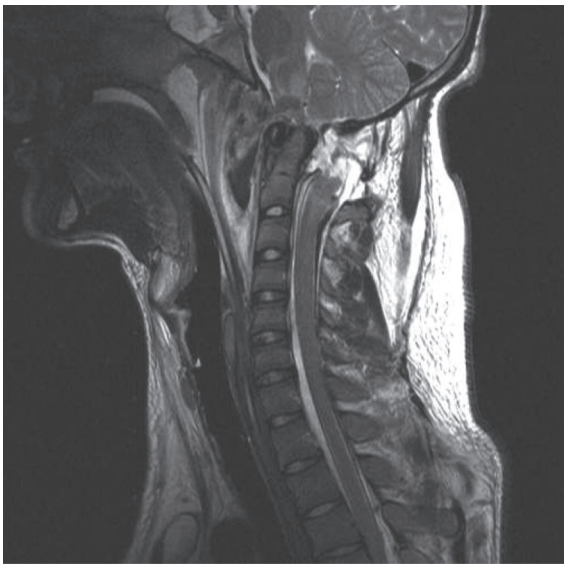

"Long-Term Survival Following Complete Medulla/Cervical Spinal Cord Transection" by Gautschi and Zellweger, April 2007, Volume 49, #1, pp. 540, 545.