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ULTRASOUND FOR THE DIAGNOSIS AND MANAGEMENT OF SUSPECTED UROLITHIASIS IN THE EMERGENCY DEPARTMENT

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☐ **Abstract—Background: This review provides practicing emergency physicians updated information regarding point-of-care ultrasound (POCUS) imaging of patients with suspected urolithiasis. Methods: A PubMed literature search was conducted for articles published between January 1, 1996 and May 31, 2017 and limited to human clinical trials written in English with relevant keywords. High-quality studies identified then underwent a structured review. Recommendations herein are made based on the literature review. Results: Two hundred seventy-two abstracts fulfilling the search criteria were screened and 10 appropriate articles were rigorously reviewed in detail. There were 8 prospective studies and 2 retrospective studies. Only 1 of them was a multi-institutional randomized trial. POCUS performed in the emergency department (ED) is moderately sensitive and specific in making the diagnosis of urolithiasis in symptomatic patients. Suspected urolithiasis patients evaluated initially with ED POCUS have complication rates compatible with those evaluated initially with computed tomography. Conclusions: POCUS has moderate accuracy in making the diagnosis of urolithiasis. Nevertheless, it may be safely used as a first line of imaging in ED patients with suspected symptomatic urolithiaisis.** © 2017 Elsevier Inc. All rights reserved.

☐ **Keywords—emergency department; kidney calculi; systemic review; ultrasonography**

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INTRODUCTION

Kidney stone disease (urolithiasis) is a common complaint in the emergency department (ED), accounting for an estimated 2.1 million annual visits in the United States alone (1). The lifetime prevalence is estimated to be 13% for men and 7% for women, and appears to be rising (2). The majority of affected patients are young males <50 years of age (2,3).

Over the last 2 decades, noncontrast computed tomography (CT) of the abdomen and pelvis has been used increasingly to determine the size and location of a suspected urolithiasis and to determine the extent of obstruction (4–6). One study estimated that CT was used in 71% of urolithiasis-related ED visits (5). Nevertheless, medical radiation increases the risk for long-term cancer, which is cumulative over the course of one's life (7,8).

In contrast, bedside point-of-care ultrasound (POCUS) performed by emergency physicians permits faster image acquisition than CT scanning without the

risks associated with ionizing radiation. In addition, POCUS is a procedural skill that is part of the core curriculum of emergency medicine residency training (9). The objective of this article is to review the evidence for using ultrasound to evaluate patients with suspected urolithiasis.

METHODS

A structured review of the medical literature using PubMed was performed and limited to studies published between January 1, 1996 and May 31, 2017. Inclusion criteria were all clinical trials involving human subjects and written in English and containing the following keywords: "nephrolithiasis" OR "kidney calculi" OR "kidney stone" OR "urolithiasis" AND ("ultrasonography" OR "ultrasound") AND "emergency department." For this review, only studies that focused on ED patients who received POCUS by an attending emergency physician or an emergency medicine resident for urolithiasis were included. Studies using a variety of different operators and clinical settings were closely reviewed but ultimately were deemed dissimilar to current emergency medicine POCUS practices and were therefore excluded. References of the selected articles were also screened to search for potential additional relevant studies. The abstracts of the articles found in this search were assessed independently by 2 of the authors to determine which papers should be pulled for more detailed review based on their suspected relevance to the clinical question. Studies included for the final detailed review were limited to randomized controlled trials, prospective cohort trials, or retrospective case-control or case cohort studies. Case series, case reports, and opinion pieces were excluded. General review articles and abstracts presented at conferences were not included for formal review.

Each of the selected articles was subjected to detailed review by at least 2 of the authors. The level of the evidence was assigned a grade of evidence using the definitions in Table 1 and were based on reference focus, specific research design, and methodology. Each of the selected articles was also subjected to detailed review and assigned a quality ranking based on a critical assessment with regard to quality of the design and methodology. This includes design consideration (focus, model structure, presence of controls, etc.) and methodology consideration (the actual methodology used). The definitions of the quality ranking scores are included in Table 2.

Independent review of the articles and discussion and joint review by the authors was undertaken to answer the clinical questions. The references were sorted into 3 categories: supportive, neutral, and opposed. A table was constructed to assign the supportive references to the appropriate location using both the grade of evidence and quality ranking.

Finally, recommendations were made based on the review of the literature and assigned a level of recommendation defined in Table 3.

RESULTS

The PubMed search using the method outlined above resulted in 272 unique articles of human studies that were written in English. Two emergency physicians independently assessed the abstracts of the articles. A total of 10 articles were deemed appropriate to be included in this summary. These articles include 7 prospective cohort studies, 2 retrospective cohort studies, and 1 randomized study.

Tables 4 and 5 list the selected references along with the appropriate classifications using both grade and quality of evidence. In total, 9 of the trials were supportive of POCUS use, 1 was neutral, and no trial demonstrated harm on the primary outcome (10–19).

Question 1: What Are the Test Characteristics of POCUS in Making the Diagnosis of Urolithiasis in the ED?

There have been 6 prospective and 1 retrospective published studies addressing the test characteristics of POCUS in the diagnosis of urolithiasis (10–16). Henderson et al. used intravenous pyelography as a criterion standard, and found that a combination of POCUS and plain radiography of the kidneys, ureters, and bladder was 97% sensitive and 59% specific for detecting urolithiasis (10). Rosen et al. used a combination of intravenous pyelography and CT as criterion standards and found that POCUS was 72% sensitive and 73% specific for detecting hydronephrosis (11). Kartel et al. also used a combination of measures at follow-up and found that hydronephrosis on POCUS

Table 1. Definitions of the Grades of Evidence of the Articles

Grade A	Randomized clinical trials or meta-analyses (multiple clinical trials) or randomized clinical trials (smaller trials), directly addressing the review issue
Grade B	Randomized clinical trials or meta-analyses (multiple clinical trials) or randomized clinical trials (smaller trials), indirectly addressing the review issue
Grade C	Prospective, controlled, nonrandomized, cohort studies
Grade D	Retrospective, nonrandomized, cohort or case-control studies
Grade E	Case series, animal/model scientific investigations, theoretical analyses, or case reports
Grade F	Rational conjecture, extrapolations, unreferenced opinion in literature, or common practice