

Clinical Scenario:

26 y/o M with no significant pmhx presents with acute right-sided flank pain radiating to the groin, nausea, and microscopic hematuria. He is afebrile with stable vital signs. A non-contrast CT scan is obtained and shows a 4 mm ureteral stone, and he is managed conservatively with hydration and pain control.

Later, a 35 y/o M with a similar presentation (flank pain, nausea, hematuria, no fever) undergoes point-of-care ultrasound (POCUS) instead, which shows mild hydronephrosis. He is treated conservatively without CT and passes the stone within hours.

Clinical Question:

In adults presenting to emergency department with suspected renal colic, does POCUS as the initial imaging modality, compared to non-contrast CT, provide comparable diagnostic accuracy?

PICO Elements:

Population	Intervention	Comparison	Outcome
Adult(s)	Point-of-care ultrasound	Non-contrast CT scan	Diagnostic accuracy
Emergency department	POCUS	Computed tomography	Sensitivity/specificity
Renal colic	Ultrasonography		Rate of missed diagnosis
Kidney stones			
Urolithiasis			

Search Strategy:PubMed

(renal colic OR kidney stones OR urolithiasis) AND (POCUS OR point-of-care ultrasound OR ultrasonography) AND (non-contrast CT OR computed tomography) AND (diagnostic accuracy OR sensitivity OR specificity OR missed diagnosis) → 1042 results

Filters applied: English language, Human, Last 15 years, Systemic review/meta-analysis/RCT, Age 19-44 → 15 results

Google Scholar

Renal colic POCUS vs CT diagnostic accuracy ultrasound kidney stone sensitivity specificity → 277 results

Filters applied: Last 5 years → 50 results

Cochrane

Renal colic OR urolithiasis AND ultrasound OR POCUS AND CT scan → 10 results

After running the searches in each database, I narrowed down the articles in a few steps. First, I focused on studies that actually compared POCUS with non-contrast CT in patients coming in with suspected renal colic. I also tried to limit the results to English language human studies in adults aged 19–44 and mostly kept the timeframe to the last 5–15 years to make sure the evidence was still relevant to current ED practice. I prioritized higher-level evidence like systematic reviews, meta-analyses, and randomized trials, and only kept observational studies if they directly compared the two imaging methods. From there, I looked through titles and abstracts and removed anything that didn't report outcomes like diagnostic accuracy, sensitivity, specificity, or missed diagnoses. I also excluded studies that didn't focus on uncomplicated renal colic. After going through this process, I was left with a small group of studies that were most relevant and useful for answering my clinical question.

1. Imaging in Suspected Renal Colic: Systematic Review of the Literature and Multispecialty Consensus

Citation: Moore CL, Carpenter CR, Heilbrun ML, Klauer K, Krambeck AC, Moreno C, Remer EM, Scales C, Shaw MM, Sternberg KM. Imaging in Suspected Renal Colic: Systematic Review of the Literature and Multispecialty Consensus. J Urol. 2019 Sep;202(3):475-483.

Purpose: Renal colic is common and CT (computerized tomography) is frequently utilized when the diagnosis of kidney stone is suspected. CT is accurate, but exposes patients to ionizing radiation and has not been shown to alter either interventional approaches or hospital admission rates. This multi-organizational transdisciplinary collaboration sought evidence-based, multispecialty consensus on optimal imaging across different clinical scenarios in patients with suspected renal colic in the acute setting.

Materials and Methods: In conjunction with the ACEP (American College of Emergency Physicians®) E-QUAL (Emergency Quality Network) we formed a nine-member panel with three physician representatives each from the ACEP, the ACR® (American College of Radiology) and the AUA (American Urological Association). A systematic literature review was used as the basis for a 3-step modified Delphi process to seek consensus on optimal imaging in 29 specific clinical scenarios.

Results: From an initial search yielding 6,337 records there were 232 relevant articles of acceptable evidence quality to guide the literature summary. At the completion of the Delphi process consensus, agreement was rated as perfect in 15 (52%), excellent in 8 (28%), good in 3 (10%) and moderate in 3 (10%) of the 29 scenarios. There were no scenarios where at least moderate consensus was not reached. CT was recommended in 7 scenarios (24%) with ultrasound in 9 (31%) and no further imaging needed in 13 (45%).

Conclusions: Evidence and multispecialty consensus support ultrasound or no further imaging in specific clinical scenarios, with reduced-radiation dose CT to be employed when CT is needed in patients with suspected renal colic.

2. Point-of-care ultrasound associated with shorter length of stay than computed tomography for renal colic

Citation: Orosco E, Terai H, Lotterman S, Baker R, Friedman C, Watt A, Beaubian D, Grady J, Delgado J, Herbst MK. Point-of-care ultrasound associated with shorter length of stay than computed tomography for renal colic. Am J Emerg Med. 2024 May;79:167-171.

Abstract

Background: Despite similar diagnostic effectiveness for renal colic, computed tomography (CT) is more resource intensive than point-of-care ultrasound (PoCUS). We sought to compare Emergency Department (ED) length of stay (LOS) among patients with renal colic according to imaging modality utilized. We secondarily compared rates of infection, return ED visits, missed significant pathology, and urologic intervention.

Methods: This was a 12-month (1/1/22-12/31/22) multi-site retrospective cohort study of all patients diagnosed with renal colic who presented to the ED on days when at least one patient had a billable renal PoCUS examination performed. Patients with a history of genitourinary malignancy, pregnancy, renal transplant, hemodialysis, single kidney, prior visit for renal colic in the previous 30 days, or an incomplete workup were excluded. Median ED LOS was compared using a Wilcoxon rank sum test, and the 95% confidence limits for the difference between medians was calculated. Secondary outcomes were compared using a Fisher's Exact test.

Results: Of 415 patients screened, 325 were included for analysis: 150 had CT alone, 80 had PoCUS alone, 54 had PoCUS plus CT, and 41 had neither. Median LOS for PoCUS alone was 75.0 (95% CI 39.3-110.7) minutes shorter than CT alone (231.5 vs. 307.0 min, $p < 0.0001$). Similar rates of infection, return visits, and missed pathology occurred across all groups ($p > 0.10$). Urologic interventions were higher in the PoCUS plus CT (25.9%) group compared to CT alone (7.3%), PoCUS alone (2.5%), and neither (7.3%), $p < 0.0001$.

Conclusion: Among patients with renal colic, PoCUS was associated with shorter ED LOS compared to CT, without differences in infection rates, return visits, or missed pathology. Patients with PoCUS plus CT had a higher rate of urologic interventions, suggesting PoCUS may have a role in identifying patients who would most benefit from CT.

3. Ultrasonography versus computed tomography for suspected nephrolithiasis

Citation: 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. Ultrasonography versus computed tomography for suspected nephrolithiasis. *N Engl J Med.* 2014 Sep 18;371(12):1100-10.

Abstract

Background: There is a lack of consensus about whether the initial imaging method for patients with suspected nephrolithiasis should be computed tomography (CT) or ultrasonography.

Methods: In this multicenter, pragmatic, comparative effectiveness trial, we randomly assigned patients 18 to 76 years of age who presented to the emergency department with suspected nephrolithiasis to undergo initial diagnostic ultrasonography performed by an emergency physician (point-of-care ultrasonography), ultrasonography performed by a radiologist (radiology ultrasonography), or abdominal CT. Subsequent management, including additional imaging, was at the discretion of the physician. We compared the three groups with respect to the 30-day incidence of high-risk diagnoses with complications that could be related to missed or delayed diagnosis and the 6-month cumulative radiation exposure. Secondary outcomes were serious adverse events, related serious adverse events (deemed attributable to study participation), pain (assessed on an 11-point visual-analogue scale, with higher scores indicating more severe pain), return emergency department visits, hospitalizations, and diagnostic accuracy.

Results: A total of 2759 patients underwent randomization: 908 to point-of-care ultrasonography, 893 to radiology ultrasonography, and 958 to CT. The incidence of high-risk diagnoses with complications in the first 30 days was low (0.4%) and did not vary according to imaging method. The mean 6-month cumulative radiation exposure was significantly lower in the ultrasonography groups than in the CT group ($P<0.001$). Serious adverse events occurred in 12.4% of the patients assigned to point-of-care ultrasonography, 10.8% of those assigned to radiology ultrasonography, and 11.2% of those assigned to CT ($P=0.50$). Related adverse events were infrequent (incidence, 0.4%) and similar across groups. By 7 days, the average pain score was 2.0 in each group ($P=0.84$). Return emergency department visits, hospitalizations, and diagnostic accuracy did not differ significantly among the groups.

Conclusions: Initial ultrasonography was associated with lower cumulative radiation exposure than initial CT, without significant differences in high-risk diagnoses with complications, serious adverse events, pain scores, return emergency department visits, or hospitalizations. (Funded by the Agency for Healthcare Research and Quality.).

4. The Accuracy and Prognostic Value of Point-of-care Ultrasound for Nephrolithiasis in the Emergency Department: A Systematic Review and Meta-analysis

Citation: Wong C, Teitge B, Ross M, Young P, Robertson HL, Lang E. 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 Jun;25(6):684-698.

Abstract

Introduction: Point-of-care ultrasound (POCUS) has been suggested as an initial investigation in the management of renal colic. Our objectives were: 1) to determine the accuracy of POCUS for the diagnosis of nephrolithiasis and 2) to assess its prognostic value in the management of renal colic.

Methods: The review protocol was registered to the PROSPERO database (CRD42016035331). An electronic database search of MEDLINE, Embase, and PubMed was conducted utilizing subject headings, keywords, and synonyms that address our research question. Bibliographies of included studies and narrative reviews were manually examined. Studies of adult emergency department patients with renal colic symptoms were included. Any degree of hydronephrosis was considered a positive POCUS finding. Accepted criterion standards were computed tomography evidence of renal stone or hydronephrosis, direct stone visualization, or surgical findings. Screening of abstracts, quality assessment with the QUADAS-2 instrument, and data extraction were performed by two reviewers, with discrepancies resolved by consensus with a third reviewer. Test performance was assessed by pooled sensitivity and specificity, calculated likelihood ratios, and a summary receiver operator curve (SROC). The secondary objective of prognostic value was reported as a narrative summary.

Results: The electronic search yielded 627 unique titles. After relevance screening, 26 papers underwent full-text review, and nine articles met all inclusion criteria. Of these, five high-quality studies ($N = 1,773$) were included in the meta-analysis for diagnostic accuracy and the remaining yielded data on prognostic value. The pooled results for sensitivity and specificity were 70.2% (95% confidence interval [CI] = 67.1%-73.2%) and 75.4% (95% CI = 72.5%-78.2%), respectively. The calculated positive and negative likelihood ratios were 2.85 and 0.39. The SROC generated did not show evidence of a threshold effect. Two of the studies in the meta-analysis found that the finding of moderate or greater hydronephrosis yielded a specificity of 94.4% (95% CI = 92.7%-95.8%). Four studies examining prognostic value noted a higher likelihood of a large stone when positive POCUS findings were present. The largest randomized trial showed lower cumulative radiation exposure and no increase in adverse events in those who received POCUS investigation as the initial renal colic investigation.

Conclusion: Point-of-care ultrasound has modest diagnostic accuracy for diagnosing nephrolithiasis. The finding of moderate or severe hydronephrosis is highly specific for the presence of any stone, and the presence of any hydronephrosis is suggestive of a larger (>5 mm) stone in those presenting with renal colic.

Author (Date)	Level of Evidence	Sample/Setting	Outcome(s) studied	Key findings	Limitations & Biases
Moore CL, et al. (2019)	Systemic review	A synthesis of 232 relevant articles from an initial 6,337 records. A nine-member expert panel (3 each from ACEP, ACR, and AUA) evaluated 29 specific clinical vignettes representing typical Emergency Department (ED) presentations.	Primary: Identification of an "optimal diagnostic imaging strategy" for renal colic while assessing patient-centered outcomes (hospital admission rates, return ED visits), safety and harms, diagnostic accuracy, and efficiency of care	No significant difference in return ED visits, hospitalizations, or diagnostic accuracy for high-risk diagnoses between POCUS and CT groups Although CT is the gold standard for stone detection, the dramatic increase in its use over the last two decades has not been shown to alter interventional approaches or hospital admission rates For younger patients (around 35), CT can be avoided, even if it is their first suspected stone For middle-aged patients (around 55), CT can be avoided if the patient has prior history of kidney stones and presents with typical symptoms For older patients (around 75), CT should generally be obtained	Only 29 clinical vignettes were accounted for, meaning there are nearly unlimited permutations of clinical presentations that could not all be captured POCUS skill sets between individual providers Lack of gender variation

Smith-Bindman, R., et al. (2014)	Randomized controlled trial	2,759 patients (ages 18–76) with suspected nephrolithiasis across 15 academic emergency departments in the U.S	Primary: 30-day incidence of high-risk diagnoses with complications, 6-month cumulative radiation exposure, and total costs Secondary: Serious adverse events, pain scores, return ED visits, hospitalizations, and diagnostic accuracy	Overall diagnostic accuracy for nephrolithiasis between POCUS and CT was similar POCUS use resulted in lower overall total costs for the initial ED visit POCUS was associated with a shorter median length of stay in the ED compared to CT No significant differences in the occurrence of serious adverse events Average pain scores were identical across both groups CT often led to a higher rate of incidental findings unrelated to the kidney stone, which can trigger unnecessary follow-up referrals and increased healthcare costs	Lack of blinding Loss of follow-up by participants Study relied on patient-reported passage of the stone which is subjective (can sometimes be missed) Study was conducted in an ED where physicians were well trained with POCUS, which may not translate well in other settings
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Wong C, et al. (2018)	Systemic review and Meta-analysis	1,773 subjects across five high-quality studies (total of nine articles reviewed) consisting of adult emergency department patients with symptoms of renal colic	Primary: Accuracy of POCUS for diagnosing nephrolithiasis Secondary: Prognostic value (urologic intervention, hospitalization, stone size, radiation exposure)	Diagnostic accuracy for POCUS is modest, with a pooled sensitivity of 70.2% and specificity of 75.4% Sensitivity/specificity for CT ranges from 84-92% POCUS is more sensitive when detecting larger stones. When stones $\geq$ 5 mm or 6 mm, the sensitivity of POCUS improves to approximately 90% No significant difference in the 30-day incidence of missed high-risk diagnoses or serious adverse events between patients who received POCUS as their initial investigation vs those who received CT Using POCUS as the initial modality significantly reduces cumulative radiation exposure for patients over time	Some studies had a large proportion of missing data, where patients lost follow-up Providers were more likely to document POCUS findings only when they were clearly positive, which can potentially skew results toward higher accuracy
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Orosco E, Terai H, Lotterman S, et al. (2024)	Retrospective cohort study	325 patients (from 415 screened) across two Emergency Departments (one being a Level III suburban trauma center) over a 12-month period in 2022	Primary: ED Length of Stay (LOS) Secondary: Rates of infection, return ED visits, missed significant pathology, and urologic interventions	Patients who received POCUS alone had a median ED LOS 75 minutes shorter than those who received CT alone (231.5 minutes vs. 307.0 minutes) No significant differences observed between POCUS and CT groups regarding secondary safety outcomes	Retrospective studies only show associations and cannot prove cause and effect Study was not randomized Study does not account for the varying skill levels of providers performing POCUS
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Conclusions:

Moore et al. (2019) found that in patients presenting with a “straightforward” renal colic (flank pain, stable vitals, no red flags), POCUS is a reasonable first step. The review did not show an increase in missed serious diagnoses, return visits, or hospital admissions when US was used instead of CT. Although CT remains the most accurate test for directly identifying stones, the authors noted that increased CT use has not clearly improved patient outcomes. Overall, in low-risk patients, starting with bedside US rather than immediately ordering CT appears to be a safe and practical approach.

Smith-Bindman et al. (2014) essentially echoes what was already said; starting patients with suspected renal colic with POCUS does not increase the risk of missing serious or high-risk diagnoses compared to CT. One of the most important findings is that patients who had US first were exposed to significantly less radiation and had slightly lower overall costs. On top of that, key outcomes like pain control, return visits to the ED, and adverse events were essentially the same between the two imaging groups.

Wong et al. (2018) found that POCUS has moderate sensitivity and specificity for diagnosing kidney stones, meaning it is not as accurate as CT when it comes to directly identifying stones. CT still remains the more reliable test for picking up even small stones. That being said, the review points out an important clinical point: POCUS performs better when identifying hydronephrosis or larger stones, which are actually the ones more likely to cause clinically significant obstruction. So even if it misses some small stones, it still tends to pick up the cases that matter most clinically.

Orosco et al. (2024) builds on what was said above and adds more real-world evidence from the ED setting. It suggests that starting with POCUS instead of CT can meaningfully reduce emergency department length of stay, which is a big deal in a busy clinical environment. Patients were evaluated and discharged faster when US was used first, and importantly, this quicker workflow did not come with an increase in missed diagnoses, return visits, or other safety concerns. But because this is a retrospective study, the findings need to be interpreted with some caution.

Overall, across all four studies, CT remains the most sensitive test for detecting kidney stones, but POCUS consistently performs well enough in low-risk patients to be used as an initial imaging tool without increasing harm or missed serious diagnoses. The main trade-off is reduced sensitivity for small stones in exchange for faster imaging, lower radiation exposure, and shorter ED length of stay.

Clinical Bottom Line:

The evidence consistently points in the same direction: in low-risk patients with suspected renal colic, starting with POCUS instead of jumping straight to CT is safe and comes with real practical benefits. The strongest piece is the large randomized trial by Smith-Bindman (2014), which showed no increase in serious missed diagnoses, return visits, or adverse events with a POCUS-first approach, while meaningfully cutting radiation exposure. That finding is backed up by the Wong (2018) meta-analysis showing that even though POCUS misses some small stones, it catches the larger ones that actually matter clinically, and by Orosco (2024), who found POCUS shaved a median of 75 minutes off ED length of stay without a jump in missed pathology. The clinical significance is that you can spare a young patient a dose of radiation and save the system money without making them less safe.

Clinically, the takeaway isn't that POCUS replaces CT, but that it's an excellent first step in the right patients. The key safety outcomes (missed high-risk diagnoses, hospital admissions, urologic interventions) were not worse with US, so the trade-off for lower radiation and faster disposition is usually worth it. That said, this whole strategy lives or dies on operator skill, and we still don't have robust data from community hospitals or less resourced settings where bedside ultrasound proficiency varies widely. Future studies should focus on exactly that - whether the same safety and efficiency hold up outside of big centers/hospitals, and whether formal decision rules or quality standards can make the approach more reproducible. For now, the evidence supports POCUS-first in well-selected, straightforward cases, with CT held in reserve for high-risk presentations, older patients without a clear stone history, or when the ultrasound is negative but pain is uncontrolled.