Acute ureteric colic

Evidence check

12 September 2023

Rapid evidence checks are based on a simplified review method and may not be entirely exhaustive, but aim to provide a balanced assessment of what is already known about a specific problem or issue. This brief has not been peer-reviewed and should not be a substitute for individual clinical judgement, nor is it an endorsed position of NSW Health.

Evidence check question

What is the evidence for emergency treatment of acute ureteric colic?

Summary

- The prevalence of acute ureteric colic is estimated at between 5-15%.[1-4]
- Computed tomography (CT), ultrasound and kidney-ureter-bladder (KUB) X-ray are the most common imaging options for diagnosis and management of ureteric colic.[5]
- Generally, stones less than 5mm pass spontaneously within one to two months. Stones 9mm or larger are more likely to require emergency intervention.[5-8]
- Definitive treatment for acute ureteric colic includes extracorporeal shockwave lithotripsy or ureteroscopy.[8, 9] Indications for definitive treatment include fever, infection and unremitting pain.[6, 10, 11]

Diagnostic criteria

- Initial laboratory work for emergency presentations of acute ureteric colic may include urinary dipstick testing, urine culture and sensitivity, and haematological work-up including full blood count, renal profile, uric acid, calcium level and C-reaction protein.[1, 8, 12, 13]
- Diagnostic imaging is frequently used for the diagnosis and management of ureteric colic. Imaging options include CT, ultrasound and KUB X-ray.[5]

Computed tomography

- Traditionally, CT is the gold standard imaging modality for the diagnosis of acute ureteric colic, with high sensitivity (95-100%) and specificity (94-96%).[1, 7, 8, 12-17]
- The use of low-dose CT is recommended in the European Association of Urology guidelines and in a systematic review and multidisciplinary consensus to reduce radiation risk.[7, 18, 19] Low-dose unenhanced CT has a similar diagnostic performance to regular unenhanced CT.[20]

- A systematic review and three-step modified Delphi process on optimal imaging for acute ureteric colic suggested that CT be avoided for younger patients (≈35 years), even without a history of stones, if pain is controlled. CT is recommended for middle-aged patients (≈55 years) if there is no history of stones, and for older patients regardless of stone history.[19]
- One observational study reported that CT scans did not change management of patients when providers did not expect it would. However, CT did occasionally find important alternative diagnoses.[16]
- A quasi-experimental prospective study found that CT use could be significantly reduced using a guideline recommending emergency department point-of-care ultrasound for initial imaging with CT used for 'red flags' or patients with poor response to analgesia.[21]
- The American Urological Association and UpToDate recommend urinalysis and non-contrast CT for most adults presenting with acute ureteric colic.[22]
- The National Institute for Health and Care Excellence assessment and management guidelines for ureteric stones include urgent (within 24 hours) low-dose non-contrast CT for adults or urgent (within 24 hours) ultrasound for pregnant patients, children and young people.[23, 24]

Ultrasound

- Ultrasound is a viable alternative to CT, with the advantages of availability, lower cost and absence of radiation.[1, 12] However, sensitivity is lower than CT.[8, 25]
- Point-of-care bedside ultrasound performed by clinicians is emerging as a convenient and moderately effective option for assessing emergency department patients.[5, 15, 26]
- Ultrasound is recommended for young patients and pregnant women.[5, 8, 18, 19, 27-29] According to the Canadian Urological Association, low-dose CT or magnetic resonance imaging may also be used if the ultrasound is non-diagnostic.[30]
- One observational study reported ultrasound can safely evaluate stone size, stone location and hydronephrosis in pregnant patients.[31]
- The European Association of Urology guidelines recommend ultrasound as the primary diagnostic imaging tool for renal and ureteral stones.[7]
- The Canadian Urological Association recommends ultrasonography with KUB X-ray as initial imaging modality for acute ureteral stones. If used, CT should be low dose.[30]

Kidney-ureter-bladder X-ray

- An observational study on KUB for patients with ureteral stones found that KUB improves the ability of urologists to determine stone outcome and may reduce additional imaging.[32]
- The British Association of Urological Surgeons recommends KUB CT within 14 hours of admission for non-pregnant adult patients.[33]

Treatment

- Generally, definitive treatment for acute ureteric colic includes extracorporeal shockwave lithotripsy or ureteroscopy.[8, 9]
- The results of one observational study showed that larger stone size, higher stone density and proximal location are significantly associated with interventional rather than conservative management.[10]

- The National Institute for Health and Care Excellence, UpToDate and the British Association of Urological Surgeons recommend either ureteroscopy or shockwave lithotripsy as initial treatment for removing ureteral stones.[23, 24, 27, 33] Treatment is advised within 48 hours of diagnosis if pain is ongoing, or the stone is unlikely to pass.[23, 24, 33]

Shockwave lithotripsy

- A meta-analysis on the role of immediate shockwave lithotripsy found shockwave lithotripsy was effective in the management of ureteral stones in patients with acute ureteric colic. Shockwave lithotripsy had a low morbidity rate and a success rate of about 80%.[11]
- One observational study reported emergency shockwave lithotripsy was effective in pain control for 58.1% of patients and 44.2% of patients were stone free following treatment.[3] Early treatment (within 24 hours) increases the success rate of emergency shockwave lithotripsy.[34]
- The Canadian Urological Association recommends shockwave lithotripsy for upper ureteric stones.[30]
- According to the National Institute for Health and Care Excellence and the American Urological Association, routine stenting is not recommended for adults undergoing shockwave lithotripsy.[22, 23]
- According to the Canadian Urological Association, shockwave lithotripsy is contraindicated in pregnancy.[30]

Ureteroscopy

- An observational study on definitive treatment for ureteric stones reported that emergency ureteroscopy (within 24 hours of admission) is evolving as a standard initial treatment option.[35]
- A separate observational study found that emergency ureteroscopy has a low complications rate and is an effective treatment option for more distal stones and healthier patients in particular.[36]
- A third observational study reported ureteroscopy is a safe option for evaluation of pregnant women with unresolved renal colic.[37]
- The American Urological Association and the Canadian Urological Association recommend conservative management for pregnant patients, followed by ureteroscopy. A frequently changed ureteral stent or nephrostomy tube are alternative options.[22, 30]
- The American Urological Association, Canadian Urological Association, European Association of Urology and British Association of Urological Surgeons guidelines do not recommend routine ureteric stenting for primary uncomplicated ureteroscopy.[7, 22, 30, 33, 35]

Comparison

- According to two systematic reviews, two randomised trials and one literature review comparing ureteroscopy with shockwave lithotripsy:
  - primary ureteroscopy increases stone-free rate[12, 38, 39]
  - ureteroscopy reduces the need for further intervention[9, 39, 40]
  - ureteroscopy is associated with more complications[12, 38, 39] and longer hospital stays[38, 39]
  - shockwave lithotripsy patients required significantly higher amounts of analgesics.[41]
- The American Urological Association recommends that patients are informed that shockwave lithotripsy has lower morbidity than ureteroscopy.[22]

Indications and contraindications

- According to a meta-analysis and three observational studies, indications for emergency intervention for acute ureteric colic include:
  - fever[6, 10]
  - progressive acute kidney injury[6]
  - obstructed infected kidney[11, 12]
  - obstructed solitary kidney[11, 12]
  - bilateral obstruction[11, 12]
  - urinary tract infection or urosepsis[11]
  - resistance to standard analgesics[6]
  - uncontrolled pain[10-12]
  - nausea and vomiting not relieved by medication[10]
  - recurrent visits to emergency department.[6]
- According to one observational study, factors significantly associated with emergency intervention for acute ureteric colic include:
  - high white blood cell count
  - high C-reactive protein test
  - stone location and maximal length of ureteral calculi
  - ureteral stone volume of 0.2cm^3
  - median ureteral wall thickness of 3mm
  - multiple ureteral stones.[6]
- Generally, the probability of spontaneous stone passage decreases as stone size increases.[42] Stones 9mm or larger are more likely to require emergency intervention. Stones 5mm or less are more likely to pass spontaneously.[5-8]
- According to one observational study, upper and middle ureteral calculi are also more likely to require emergency intervention.[6] Another observational study reported proximal ureteric stones as an additional risk factor.[43]
- An observational study on early intervention suggested an interventional approach to stones larger than 5mm resulted in better patient outcomes.[2] A separate observational study reported patients with stones smaller than 5mm had more treatment failures and emergency department revisits with earlier intervention than spontaneous passage. Patients with stones 7mm or larger experienced fewer treatment failures and similar emergency department revisit rates with early intervention.[44]
- The British Association of Urological Surgeons recommends immediate imaging in patients with fever, sepsis, solitary kidney, or when diagnosis is uncertain.[33]
- The NSW Emergency Care Institute recommends admission and urology consultation for patients with evidence of associated urinary tract infection, recurrent or unremitting pain, obstruction of single kidney, or acute renal impairment.[45]

Background

Acute ureteric colic is estimated to affect between 5-15% of the population.[1-4] Patients typically present with sudden onset severe and sharp flank pain, often accompanied by nausea, vomiting and/or fever.[1, 7] Treatment may be conducted endoscopically via ureteroscopy, or via extracorporeal shockwave lithotripsy.

Methods (Appendix 1)

PubMed and Google were searched on 16 November 2022 and 6 December 2022. The search terms used are outlined in Appendix 1. A grey literature search was conducted using Google.

Limitations

Articles included in this review vary in type and quality. There were differences in terminology used across the literature.

Results

Note: The information contained in these tables has been copied directly from the source material.

Table 1

Source	Summary
Peer reviewed sources	
Clinical and Radiological Predictors of Early Intervention in Acute Ureteral Colic Abushamma, et al. 2021[6]	**Study type:** Observational, retrospective cohort study **Method:** Patients (n=161) presenting to emergency with acute ureteric colic diagnosed based on non-contrast computerised tomography between 2019 and 2020. **Results:** • Patients with who had emergency intervention (group 1) included 87 (54%) patients, while 74 (46%) managed to pass the stone spontaneously (group 2). • The mean time of emergency intervention was 3.6 (1–37 days). • Indications of emergency intervention were: developing fever (n=7; 8.04%); progressive acute kidney injury (eGFR <60) (n=26; 29.88%); and acute ureteric colic refractory to standard analgesics, in addition to recurrent visits to emergency department (n=54; 62.06%). • High white blood cell count and high C-reactive protein levels are significantly associated with emergency intervention. • Stone location and maximal length of ureteral calculi were significantly associated with emergency intervention. • Ureteral stone volume of 0.2 [0.14–0.5] cm3 was significantly associated with efficiency improvement (EI) and ureteral stone volume of 0.096 (0.04–0.2) was associated with spontaneous passage of stone (p <0.001). • Multiple ureteral stones were associated with EI in 22 patients (25%). • Hounsfield unit density of 800 [500–1100] was statistically correlated to EI, while Hounsfield unit density of 565 (397.5–850) was more likely to have spontaneous passage of stone (p <0.001). • Median ureteral wall thickness of 3 (2–3mm) was significantly associated with EI, and ureteral wall thickness of 2 (2–3mm) was associated with spontaneous passage of stone (*p*=0.010). **Discussion:** • There is no consensus regarding the optimal period of observation before surgical intervention. Nevertheless, it is estimated that most stones less than 5mm will pass spontaneously within 40 days. • Emergency intervention may be required during this period of expectant management because of either failure of medical treatment or the development of complications such as sepsis or progressive kidney injury. Limited studies indicate criteria for the identification of those patients. • Stone size and a maximum length of ureteral calculi of 9mm is more likely to require emergency intervention while stones with a maximum

Source	Summary
Peer reviewed sources	
	length of ureteral calculi of 5mm or less are more likely to pass spontaneously. • Upper and middle ureteral calculi are also more likely to need emergency intervention. **Conclusions:** • Stone size is an independent and robust predictor of EI in acute ureteric colic, with a noticeable increase in EI with each 1mm increase in length.
Barriers in Managing Acute Ureteric Colic Clinical Review and Commentary Chislett, et al. 2022[42]	**Study type:** Review of barriers to management of acute ureteric colic. • Management strategies encompass medical expulsion therapy and various interventional modalities aimed at urinary diversion or definitive stone management. • Percutaneous nephrostomies and ureteral stents are forms of urinary diversion, with definitive ureteral stone management being either extracorporeal shockwave therapy or ureteroscopy (URS) and laser lithotripsy. • Successful conservative management is dependent on multiple variables, though notably, the probability of spontaneous passage diminishes as the stone size increases. • Refractory ureteric colic, in patients who are febrile or possess a solitary kidney, are absolute indications of ureteral stone intervention via diversion or definitive stone management.
Which Patients Should Have Early Surgical Intervention for Acute Ureteral Colic? Innes, et al. 2021[44]	**Study type:** Observational study comparing treatment failure rates in patients receiving early intervention and patients offered spontaneous passage to identify subgroups that benefit from early intervention. **Methods:** Consecutive patients (n=3,081) attending nine emergency departments in two Canadian provinces with confirmed 2.0-9.9mm ureteral stones. **Results:** • Patients who underwent early intervention included 1,168 of 3,081. • Intervention patients were older, more often female, and had larger more proximal stones with more prominent hydronephrosis. • Among 1,913 patients who underwent trial of spontaneous passage, stone width, stone location, hydronephrosis, length of stay and Vancouver region were associated with treatment failure. • Those with stones smaller than 5mm experienced more treatment failures (31.5% vs 9.9%, difference 21.6%, 95% confidence interval (CI) 16.9-21.2) and emergency department revisits (38.5% vs 19.7%, difference 18.8%, 95% CI 13.8-23.8) with early intervention than with spontaneous passage. • Patients with stones 7.0mm or larger experienced fewer treatment failures (34.7% vs 58.6%, risk difference 23.9%, 95% CI 11.3 to 36.6) and similar emergency department revisit rates with early intervention.

Source	Summary
Peer reviewed sources	
	• Patients with 5.0-6.9mm stones had fewer treatment failures with intervention (37.4% vs 55.5%, risk difference 18.1%, 95% CI 7.1-28.9) if stones were in the proximal or middle ureter. **Conclusions:** Early intervention improves outcomes for patients with large (greater than 7mm) ureteral stones or 5-7mm proximal or mid ureteral stones. Early intervention may increase morbidity for patients with stones smaller than 5mm. Based on these findings we propose that patients with stones less than 5mm generally be offered spontaneous passage as initial treatment, while those with proximal or middle ureteral stones larger than 5mm, or any stone larger than 7mm, be offered early intervention.
A renal colic fast track pathway to improve waiting times and outcomes for patients presenting to the emergency department Al Kadhi, et al. 2017[14]	**Study type:** Single-centre observational study on a fast-track renal colic initiative. **Method:** Investigations, diagnosis and patient demographics were recorded for 1,157 consecutive patients coded as renal colic. The pathway was designed to direct patients with single kidney, dehydration, signs of shock or sepsis to immediate assessment by an emergency department clinician, while others with typical features of renal colic were directed to analgesia, fast track non-contrast CT and review by a urology clinician. **Discussion:** • Non-contrast CT used to confirm the presence and position of the calculus is the current gold standard imaging modality for patients presenting with acute-onset flank pain and is 96.6% sensitive and 94.9% specific.
Renal colic: current protocols for emergency presentations Leveridge, et al. 2016[1]	**Study type:** Review on emergency department presentations of flank pain caused by renal colic. **Method:** Review of studies from 1970 to 2016. **Discussion:** • The prevalence of urolithiasis has been estimated to be 5–13% of the population in Europe and North America, with an incidence of 1.5–2 per 1,000 population, and recurrence rates of up to 60% after a first episode. • Renal colic from an obstructing calculus presents classically with sudden-onset, severe and sharp pain localised to the flank, with radiation to the lower abdomen, groin or genitals. It is often accompanied by nausea and vomiting. Urinary symptoms, most commonly frequency and urgency with low voided volumes, are common with distal ureteric stones. • For emergency presentations of acute ureteric colic, initial lab work in the form of urinary dipstick testing (assessing the presence of red blood cells, white blood cells, nitrites and pH) and a urine culture and sensitivity, as well as haematological work-up including a full blood

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	count, renal profile, uric acid, calcium level and C-reactive protein test (if intervention is anticipated) is appropriate. • Imaging is the cornerstone of the diagnosis of ureteric obstruction and of urolithiasis. This may include a combination of flat-plate abdominal radiography, ultrasound or CT. • Abdominal plain films [colloquially called KUB (kidney-ureters-bladder) radiographs] may identify an opacity representative of a stone. • Ultrasound imaging has the advantages of avoiding radiation exposure to the patient as well as providing a more directed and comprehensive anatomic assessment compared with KUB. • CT has been cemented as the imaging modality of choice in the diagnosis of ureteric calculi and the investigation of renal colic. It should be considered the definitive imaging test to establish the diagnosis of urolithiasis. **Conclusion:** Unenhanced CT is the optimal initial imaging study to confirm the presence of the stone, although selected patients can be spared the cost and radiation dose upon subsequent presentation by plain radiography or ultrasound.
Bedside ultrasound and the assessment of renal colic: a review Dalziel, et al. 2013[5]	**Study type:** Literature review. • Imaging is frequently used to direct the diagnosis and management of renal colic. Choices for assessing the urinary tract include KUB X-ray films, intravenous pyelourethrography, ultrasound and CT. • CT is now the most common imaging modality. However, ultrasound remains an important diagnostic tool and is the imaging modality of choice in young patients and pregnant women. • More recently, point-of-care clinician-performed bedside ultrasound has emerged as a diagnostic imaging option when assessing emergency department patients, including those presenting with flank pain. • At least eight published studies have shown how bedside ultrasound might be used to inform renal colic management and to assess its accuracy. **Conclusion:** It is generally thought that most stones <5mm will ultimately pass, stones 5–9mm will likely pass (and may be candidates for expectant medical therapy) and stones ≥10mm will likely require extraction.
The Accuracy and Prognostic Value of Point-of-care Ultrasound for Nephrolithiasis in the Emergency Department: A Systematic Review and Meta-analysis Wong, et al. 2018[15]	**Study type:** Systematic review and meta-analysis (n=9) on point-of-care ultrasound as an initial investigation in the management of renal colic. **Discussion:** • CT has become the modality of choice due to its high sensitivity and perceived usefulness for ruling out other pathologies in patients with suspected renal colic.

Source	Summary
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	• Point-of-care ultrasound has received increasing attention for the diagnosis and management of nephrolithiasis. In patients presenting with renal colic, point-of-care ultrasound is used to detect hydronephrosis, which can be quantified as mild, moderate, or severe, depending on a subjective assessment of the degree of pelvicalyceal dilatation. Occasionally, stones can be directly visualised, and visualisation of ureteral jets can be utilised as a surrogate for ureteral flow. The utilisation of point-of-care ultrasound holds promise in its potential to decrease radiation exposure and costs. Evidence has shown that radiology-performed ultrasonography and point-of-care ultrasound perform comparably, with a reported inter-rater reliability of 87.5%. **Conclusion:** Overall accuracy of point-of-care ultrasound for the diagnosis of nephrolithiasis is modest. The finding of moderate or greater hydronephrosis is highly specific for the presence of any stone, and the presence of any hydronephrosis is suggestive of a larger (>5mm) stone in those presenting with renal colic.
Diagnostic management of renal colic Nicolau, et al. 2014[18]	**Study type:** Review on the utility of imaging diagnostic techniques for the clinical diagnosis and management of renal colic. **Discussion:** • Renal colic is a common reason for presentation to emergency departments, and imaging has become fundamental for the diagnosis and clinical management of this condition. • Ultrasonography and particularly non-contrast CT have good diagnostic performance in diagnosing renal colic. • It is essential to use CT techniques that minimise radiation and to use alternatives like ultrasonography in pregnant patients and children. • CT is the modality with the best diagnostic yield and in many centres it has become the initial test to assess the index renal colic. Its use should be limited to patients who do not show any clinical improvement after treatment, in cases of fever or leukocytosis, in patients with a single kidney or with renal failure, or in high-risk populations. • If CT without contrast is performed, low-dose techniques should be used. • Although the ultrasound is inferior to the CT for the detection of lithiasis, it would be reasonable to use it as an initial method especially in younger patients where the probability of an alternative serious diagnosis is lower. **Conclusion:** Although in all the cases the first step can be to resort to ultrasound, its use is compulsory in children and young people as well as in pregnant and fertile women.

Source	Summary
Peer reviewed sources	
Ultrasound at the patient's bedside for the diagnosis and prognostication of a renal colic Bourcier, et al. 2021[26]	**Study type:** Single-centre, prospective observational study in an emergency unit on the performance of point-of-care ultrasound in the diagnosis of renal colic. **Method:** Patients (n=103) underwent point-of-care ultrasound to conclude whether a diagnosis of renal colic should be made. CT was subsequently performed to determine whether ureteral or bladder lithiasis was present to diagnose a ureteral colic. **Results:** • Accuracy of point-of-care ultrasound was 91% for detecting urinary tract dilatation, 83% for detecting perinephric fluid, and 54% for detecting lithiasis. • Only high urinary tract stones with ≥6mm diameter were surgically managed (p <0.01). • Conversely, distal ureteral stones with a diameter of <6mm were managed with medical ambulatory treatment (p <0.05). **Conclusion:** Point-of-care ultrasound is a good diagnostic tool, for renal colic, and could help reduce the requirement for CT examinations and, hence, reduce induced radiation exposure.
Hydronephrosis severity clarifies prognosis and guides management for emergency department patients with acute ureteral colic Innes, et al. 2021[46]	**Study type:** Observational cohort study on the prognostic value of hydronephrosis in emergency department patients with ureteral colic. **Method:** Patients (n=3251) underwent CT imaging to assess hydronephrosis and stone size. **Results:** • Absent and mild hydronephrosis carry a favourable prognosis, while severe hydronephrosis predicts a high risk of passage failure justifying CT imaging and expedited urology referral. • Moderate hydronephrosis, which increased the likelihood of passage failure from 23% (pre-test) to 28%, does not mandate CT imaging. **Discussion:** • Renal colic can be diagnosed with relative confidence based on clinical presentation and decision tools like the STONE (size, topography, obstruction, number of stones present and evaluation of Hounsfield units) score. • Hydronephrosis on ultrasound increases certainty but seldom confirms stone size and location, which are key predictors of passage success and management approach. • Up to 83% of patients now undergo CT imaging during an acute episode. **Conclusion:** Severe hydronephrosis should trigger definitive imaging and referral.
Variability of renal colic management and outcomes in two Canadian cities Innes, et al. 2018[2]	**Study type:** Observational study comparing 60-day outcomes for emergency department patients with ureteral colic in Calgary and Vancouver. **Method:** Administrative data and structure chart review of patients with CT-defined stones (n=3283).

Source	Summary
Peer reviewed sources	
	Results: • An early interventional approach was associated with a 50% higher cumulative probability of an emergency department revisit and double the rates of readmission and intervention. • Emergency department revisit and hospitalisation rates of 22.6% and 6.5%, respectively, in Vancouver (a system in which early intervention rarely occurs). • Rates of 29.7% for emergency department revisits and 14.3% for readmission at 60 days in Calgary (a system that provides early definitive intervention for most patients with significant stones). **Discussion:** • Renal colic is a high prevalence disorder that affects 10% of the population. • Our data suggest that current processes for identifying patients who would likely benefit from early intervention are highly variable and imperfect in terms of sensitivity and specificity. • Our findings suggest that an interventional approach leads to better outcomes for stones >5mm. **Conclusion:** A less interventional approach to small stones and earlier definitive management of large stones may reduce health system utilisation and improve outcomes for patients presenting with an index emergency department visit for acute ureteral colic.
Predictors of successful emergency shock wave lithotripsy for acute renal colic Kurkar, et al. 2022[3]	**Study type:** Prospective observational study on the role of emergency shockwave lithotripsy in persistent pain control in patients with ureteral stones. **Method:** Shockwave lithotripsy was performed on patients (n=86) with a persistent renal colic secondary to a single ureteral stone (6-12mm) within 24 hours of onset of flank pain. **Results:** • Pain control and stone-free rate after an emergency shockwave lithotripsy session were 58.1% and 44.2%, respectively. • Seven patients required post-shockwave lithotripsy ureteroscopy and ureteral stent placement for uncontrolled pain. • The overall 3-month stone-free rate after shockwave lithotripsy monotherapy was 83.7%. • Predictors for pain relief after emergency shockwave lithotripsy were lower Hounsfield unit stone density, mild hydronephrosis at presentation and presentation during the first colic episode. • Emergency shockwave lithotripsy was effective in pain control in 58.1% of patients. In addition, 44.2% of patients were stone-free after an emergency shockwave lithotripsy session.

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Peer reviewed sources	
	Discussion: • The prevalence of nephrolithiasis is reported to be 13%. • Traditionally, after control of pain, the definitive treatment of stones was delayed with options including medical expulsive therapy, shockwave lithotripsy, and ureteroscopy. • For ureteral stones > 6mm, both URS and shockwave lithotripsy have higher stone-free rate compared to medical expulsive therapy. **Conclusion:** Emergency shockwave lithotripsy is feasible and effective in management of ureteral stones presented by renal colic with low Hounsfield unit density.
Evolving Guidance on Ureteric Calculi Management in the Acute Setting Makanjuola, et al. 2016[12]	**Study type:** Review on the evidence on management of ureteric colic. **Discussion:** • The indications for hospital admission in patients with ureteric colic are as follows: diagnostic uncertainty; uncontrolled pain; presence of significant fever (>37.5); solitary or transplanted kidney; bilateral obstructing stones; and impending acute renal failure. • Assessment of patients presenting with acute ureteric colic must include routine observations with blood pressure, heart rate and temperature. All patients should have urinalysis to look for haematuria, pyuria and nitrites. Blood testing should include full blood count and renal function. • It has also been suggested that measurement of C-reactive protein maybe useful and could be a determinant of patients who may require a stent. • All patients with urolithiasis should have a basic metabolic evaluation with serum creatinine and urate. • The gold standard test for the diagnosis of acute ureteric colic is non-contrast CT of the kidneys ureters and bladder (CT KUB). • Despite CT KUB offering near 100% sensitivity for diagnosis of stones, ultrasound offers an alternative, especially as an initial screening tool. The advantages of ultrasound are the availability, lower cost and absence of radiation. Ultrasound has a sensitivity of 57% and specificity of 97% in detecting calculi. • Emergency surgical intervention for ureteric colic is recommended in the presence of an obstructed infected kidney, obstruction of a solitary kidney, bilateral obstruction or uncontrolled pain. • In the cases of non-infected ureteric colic, there is growing evidence that the use of primary URS is a feasible and safe option with the right surgical experience, equipment and theatre support. **Conclusion:** The use of extracorporeal shockwave lithotripsy is an option for ureteric stones. Overall stone-free rates after URS or extracorporeal shockwave lithotripsy for ureteric stones are comparable. However, larger stones achieve earlier stone-free rates with URS. URS has a better chance of achieving stone-free rate with a single procedure, though the complication rates are higher.

Source	Summary
Peer reviewed sources	

The management of acute renal colic
Gandhi, et al. 2019[8]
	Study type: Review article.
	Discussion:
	• The British Association of Urological Surgeons and European Association of Urology recommend that all patients undergoing investigation for renal colic should have urine dipstick testing.
	• The British Association of Urological Surgeons and European Association of Urology recommend that measurement of the full blood count, serum electrolytes, creatinine, C-reactive protein, uric acid and calcium levels should be undertaken.
	• The gold standard radiological investigation for diagnosing urolithiasis is non-contrast enhanced CT.
	• Renal ultrasound can be used to diagnose renal stones, particularly in pregnancy or other situations where avoiding radiation exposure is advised but is not routinely recommended because of its low sensitivity.
	• Emergency surgical intervention is indicated in four situations:
	  ○ The presence of an obstructed infected kidney.
	  ○ Obstruction of a solitary kidney.
	  ○ Bilateral obstruction.
	  ○ Uncontrolled pain.
	• The National Institute for Health and Care Excellence (2015) guidelines state that small stones (of <5 mm) are likely to pass spontaneously within 1–2 months of the onset of symptoms.
	• The decision to actively treat a stone depends on its size, location, pain intensity, treatment availability and patient preference.
	Conclusion: Definitive removal of a stone can be achieved in three ways: extracorporeal shockwave lithotripsy, fragmentation with URS or percutaneous nephrolithotomy.

The use of computed tomography as the first imaging modality in patients with renal colic and microscopic haematuria Sen, et al. 2021[13]	**Study type:** Retrospective observational study on the use of CT as the first imaging modality for renal colic. **Method:** Review of patients (n=834) presenting to the emergency department for whom non-contrast CT was used as the first imaging modality. **Discussion:** • In the United States of America, more than 1 million patients are admitted to emergency clinics per year because of renal colic. • In Europe, 7-9% of emergency ambulance service calls because of the pain caused by renal colic. • Renal colic is the most common symptom of urinary system stone disease and is also the most common urological cause of admission to the emergency department. The possibility of a person experiencing renal colic in their lifetime is reported to be between 1% and 10%.

Source	Summary
Peer reviewed sources	
	• One of the first examinations to be performed in renal colic assessment is a complete urinalysis, which should also involve the evaluation of the presence of infection and microscopic haematuria. • Compared with other imaging modalities, CT is the gold standard method for the diagnosis of stone disease. **Conclusion:** Because of its high sensitivity and specificity values in the diagnosis of stone disease, easy applicability and fast results, CT can be safely used as the first imaging modality for the diagnosis of renal colic and microscopic haematuria.
Introduction of a new imaging guideline for suspected renal colic in the ED reduces CT urography utilisation Blecher, et al. 2017[21]	**Study type:** Quasi-experimental prospective study on a new imaging and management guideline for suspected renal colic in an emergency department. **Method:** A consecutive series of patients (n=324) with suspected renal colic were prospectively enrolled and outcomes compared between two sites. **Results:** • Use of a simple assessment guideline for suspected renal colic was associated with a 21% lower CT urogram rate at the study site, compared against the control site. **Discussion:** • CT use has become widespread in suspected renal colic without associated improvement in patient-centred outcomes. • Associated harms include overdiagnosis, radiation harm and resource waste. • Ultrasound has been demonstrated to be non-inferior to CT in a randomised trial. • In non-contrast CT urogram, the diagnostic sensitivity and specificity both exceed 90%; details of size and site of the stone, the two best predictors of spontaneous stone passage, are provided. **Conclusion:** This study found that CT urogram use could be significantly reduced by introduction of a simple guideline, with emergency department point-of-care ultrasound as the initial imaging and CT urogram reserved for those with ‘red flags’ or poor analgesic response.
Can Unenhanced CT Findings Predict Interventional Versus Conservative Treatment in Acute Renal Colic? Lotan, et al. 2016[10]	**Study type:** Single-centre retrospective comparative study on the value of clinical parameters and radiologic findings on unenhanced CT to the choice between interventional and conservative management for patients with acute renal colic. **Method:** The records of 183 consecutive patients who underwent unenhanced CT in the emergency department for acute renal colic over a 6-month period (November 2011 through April 2012) were reviewed. **Results:** • Patients with symptoms and signs of an infection, such as shivering, fever, or leukocytosis, were highly likely to undergo interventional treatment.

Source	Summary
Peer reviewed sources	
	• Patients with stones presenting in the proximal ureter at the time of the unenhanced CT were statistically significantly more likely to be treated interventionally regardless of stone size. • Other stone locations were not shown to significantly predict the type of recommended treatment. • Patients treated conservatively were more likely to have a stone in the distal ureter and the ureterovesical junction, rather than in the proximal and mid ureter. **Discussion:** • The accepted criteria for determining the need for an immediate intervention are intractable pain, nausea and vomiting not relieved by medications, fever higher than 38.3°C, and radiologic evidence of obstruction (hydronephrosis or delayed contrast material excretion). **Conclusion:** Our results showed that larger stone size, higher density, and proximal location are significantly associated with the selection of interventional over conservative management for patients with acute renal colic. Complaints of shivering, fever and leukocytosis also strongly correlate with the selection for interventional treatment.
The identification of pregnant women with renal colic who may need surgical intervention He, et al. 2022[31]	**Study type:** Observational study on the predictive factors of pregnant women with renal colic in need of surgical intervention. **Method:** Retrospective review of 212 pregnant women presenting with renal colic between 1 January 2009 and 31 December 2020. **Results:** • Duration of pain, ureteral stone size, hydronephrosis and fever were independent predictors for surgical intervention. **Discussion:** • Ultrasound can safely evaluate stone size, stone location, and hydronephrosis in pregnancy. • Data from CT imaging techniques are likely to improve the estimation of calculus size and location, particularly when very small calculi are present. **Conclusion:** A duration of pain ≥4 days, a stone size ≥8mm, fever, and hydronephrosis, all play significant roles in the prediction of surgical intervention.
Does computed tomographic scan affect diagnosis and management of patients with suspected renal colic? Zwank, et al. 2014[16]	**Study type:** Observational study comparing diagnosis and treatment plans before and after CT in patients with suspected renal colic. **Method:** A convenience sample of clinically-stable emergency department patients (n=93) older than 17 with suspected renal colic for whom CT was planned. **Results:** • Discharge diagnosis was renal colic in 62 of 93 enrolled patients (67%). • Urinalysis showed blood in 52 of these patients (84%). • CT confirmed obstructing kidney or bladder stone in 50 patients.

Source	Summary
Peer reviewed sources	
	• There were five cases of alternative diagnoses noted on CT scan. • After CT scan, seven patients had changes in disposition. • Sixteen providers felt that CT would not change management. In these cases, CT offered no alternative diagnosis and didn't change disposition. **Discussion:** • The gold standard for the diagnosis of urolithiasis is CT scan of the abdomen/pelvis without intravenous or oral contrast. The high sensitivity (95-100%) and specificity (94-96%) of CT scans for renal stones makes it a good choice to diagnose urolithiasis. • There is increasing concern about the radiation risk that accompanies the CT scans for these patients with a condition that often does not require immediate intervention. • The European Association of Urology published guidelines in 2011 supporting ultrasound in place of CT as initial imaging. • However, in the United States, both the American Urological Association and the American College of Radiology recommend CT scan as initial imaging for patients with suspected renal colic. Both societies do note an option for reduced-dose CT with similar test performance characteristics. **Conclusion:** CT scan didn't change management when providers did not expect it would. This indicates that providers who are confident with the diagnosis of renal colic should consider forgoing a CT scan. CT scan did occasionally find important alternative diagnoses and should be utilised when providers are considering other concerning pathology.
Ureteroscopy in pregnant women with complicated colic pain: Is there any risk of premature labor? Buttice, et al. 2017[37]	**Study type:** Observational study on the management of renal colic during pregnancy in emergency settings. **Method:** Observation of 208 pregnant patients who presented to emergency department with renal colic pain and underwent URS. **Discussion:** • The first diagnostic step is an ultrasonographic examination. Real-time ultrasonography demonstrates the renal parenchyma, calyceal system, dilated ureter and occasionally the offending calculus, without radiation exposure. • European Association of Urology guidelines permit the use of a low-dose CT as a last resort in selected cases. Magnetic resonance imaging can also be used as it may define the level of urinary tract obstruction and visualise stones as filling defects. • In patients with complicated hydronephrosis with colic pain, ureteroscopy can be used as a diagnostic procedure. • The first step in active treatment is the placement of a ureteral double J stent or percutaneous nephrostomy. **Conclusion:** Ureteroscopy is a safe option for evaluation of pregnant patients with unresolved renal colic.

Source	Summary
Peer reviewed sources	
Emergency versus elective ureteroscopic treatment of ureteral stones Matani, et al. 2013[35]	**Study type:** Retrospective study on the role of emergency URS in the definitive treatment of ureteric stones. **Method:** Patients (n=903) admitted for ureteric stones from May 2003 to December 2010 who underwent URS stone treatment. **Discussion:** • When drug therapy fails to resolve symptoms, the next step is to place a ureteric catheter, double J stent or nephrostomy tube. • These simple procedures can provide prompt symptom relief, and they are usually followed by URS or shockwave lithotripsy, which are currently the main options for symptomatic ureteral stones. • The emergency URS approach, within 24 to 48 hours of presentation to the emergency room, is both attractive and cost-effective. It is still being explored in the American Urological Association and European Association of Urology stone treatment guidelines, which have emphasised the value of elective retrograde laser treatment of stones and discouraged the routine use of double J stents in uncomplicated URS. **Conclusion:** Emergency URS treatment (within 24 hours of admission to emergency department) of ureteric stones is evolving as a standard initial management option.
Risk Factors Associated with Urologic Intervention in Emergency Department Patients with Suspected Renal Colic Yan, et al. 2015[43]	**Study type:** Prospective cohort study on predictors of urologic intervention for emergency department patients with suspected renal colic. **Method:** Adult patients (n=565) presenting to one of two emergency departments with suspected renal colic over a 20-month period. **Discussion:** • The results of this study confirm two previously reported risk factors (stone size ≥5mm on either CT scan or ultrasound and proximal ureteric stone). • Furthermore, six additional predictors were identified (presence of nitrites on Chemstrip urinalysis, presence of leukocyte esterase on Chemstrip urinalysis, age >50 years, tachycardia at triage, abnormal serum white blood cells, and a history of renal colic) independently associated with urologic intervention within 90 days for suspected renal colic patients presenting to the emergency department. **Conclusion:** Patients with these risk factors have a higher likelihood of urologic intervention and should be considered for early urologic follow-up.
Role of emergency ureteroscopy in the management of ureteric stones: analysis of 394 cases Zargar-Shoshtari, et al. 2014[36]	**Study type:** Observational study on outcomes of emergency URS cases. **Method:** Retrospective review of all emergency URS procedures performed at Auckland City Hospital between 1 January 2010 and 31 December 2011 (n=499). **Conclusion:** Emergency URS is a feasible approach for the routine management of acute ureteric colic with a low complications rate. This approach is effective, particularly for more distal stones and for healthier patients.

Source	Summary
Peer reviewed sources	
Appropriate use of CT for patients presenting with suspected renal colic: a quality improvement study Himelfarb, et al. 2019[25]	**Study type:** Observational study on the utilisation of CT imaging for renal colic. **Method:** Retrospective chart review was performed for all patients (n=63) younger than 50 years who visited Sunnybrook Health Sciences Centre emergency department between December 2015 and May 2016 with a discharge diagnosis of renal colic. **Discussion:** • CT is often used as an initial diagnostic modality for suspected recurrent renal colic despite current guidelines. • CT exposes patients to high levels of ionising radiation with consequent long-term cancer risk. • There is no evidence to show that increased CT use, despite its higher sensitivity, is associated with improved patient outcomes. • Ultrasound has lower sensitivities to visualise urinary stones, however it is an alternative imaging modality which may be used to investigate renal colic without exposing patients to ionising radiation. • Furthermore, ultrasound can accurately detect hydronephrosis, perinephric fluid and abnormal ureteric jets, which increases the sensitivity for detecting kidney stones when they are too small to be visualised directly. • The American College of Emergency Physicians released 10 recommendations specifically targeting emergency department interventions. One of these recommendations was to 'avoid ordering CT of the abdomen and pelvis in young, otherwise healthy emergency department patients (age <50) with known histories of kidney stones, or ureterolithiasis, presenting with symptoms consistent with uncomplicated renal colic'. **Conclusion:** As a result of this project, there is a newly implemented low-dose CT order for renal colic patients.
Prevalence of alternative diagnoses in patients with suspected uncomplicated renal colic undergoing computed tomography: a prospective study Pernet, et al. 2015[20]	**Study type:** Observational study on the prevalence of alternative diagnosis identified with low-dose unenhanced CT in the emergency department in patients with suspected uncomplicated renal colic. **Method:** Prospective single-centre study carried out in a large university hospital emergency department (n=178). **Discussion:** • Renal colic is a painful condition that accounts for some 1 million emergency department visits annually and has an incidence exceeding one per 1,000 persons per year in the United States. • The American College of Radiology recommends unenhanced CT as the technique of choice for renal stone imaging, as do the American Urological Association and the European Association of Urology. • In France, ultrasonography is considered an acceptable first-line imaging modality according to both the French Society of Urology and the French Society of Emergency Medicine.

Source	Summary
Peer reviewed sources	
	• Low-dose CT has a radiation exposure that is slightly higher than that of KUB radiography and significantly less than that of intravenous pyelourethrography or regular-dose CT. Its diagnostic performance has been found to be similar to regular unenhanced CT. • Low-dose unenhanced CT in the emergency department detects alternative diagnoses in 6% (95% CI 3-10) of patients with suspected uncomplicated renal colic, half of whom are subsequently hospitalised. **Conclusion:** Our prospective findings, which were similar to those reported in retrospective studies, are a potential argument for a systematic approach to emergency department imaging in suspected renal colic.
Does baseline radiography of the kidneys, ureters, and bladder help facilitate stone management in patients presenting to the emergency department with renal colic? Foell, et al. 2013[32]	**Study type:** Retrospective observational study on the diagnostic utility of baseline KUB for patients with ureteral stones. **Conclusion:** The addition of a baseline KUB to the CT scout film improves the ability of urologists to determine stone outcome when following patients with KUB imaging and might reduce the subsequent need for additional imaging.
Urgent shock wave lithotripsy as first-line treatment for ureteral stones: a meta-analysis of 570 patients Picozzi, et al. 2012[11]	**Study type:** Meta-analysis on the role of immediate shockwave lithotripsy in the emergency setting as first-line treatment for renal colic. **Method:** Analysis of seven studies (n=570). **Discussion:** • Passage of ureteral stent or positioning a nephrostomy tube, extracorporeal shockwave lithotripsy or ureteroscopy with intracorporeal lithotripsy are reserved for uncontrolled pain, inadequate renal function, and clinical evidence of sepsis or perinephric urine extravasation. • The rationale for use of immediate shockwave lithotripsy after a renal colic episode is to attain maximum stone clearance rate in the shortest possible time. • International guidelines today recommend active removal of all stones exceeding 5–7mm, when proven that they have resisted medical therapy. • Active removal is also strongly indicated in patients with persistent pain despite adequate medical treatment, acute obstruction with impaired renal function or solitary functional kidney, urinary tract infection and risk or suspicion of urosepsis. • The efficacy of shockwave lithotripsy and its low morbidity rate make it a desirable option in the management of ureteral stones, even during acute renal colic secondary to ureteral stone obstruction. The

Source	Summary
Peer reviewed sources	
	success rate of shockwave lithotripsy in the treatment of ureteral stones is about 80%. **Conclusion:** According to our meta-analysis, immediate treatment for ureteral stone seems to be a safe treatment with good success rate.
Factors predicting success of emergency extracorporeal shockwave lithotripsy (eESWL) in ureteric calculi—a single centre experience from the United Kingdom (UK) Panah, et al. 2013[34]	**Study type:** Observational study on the success of emergency extracorporeal shockwave lithotripsy in patients with ureteric calculi. **Method:** Retrospective study of patients (n=97) presenting with their first episode of ureteric colic undergoing emergency extracorporeal shockwave lithotripsy (within 72 hours of presentation) over a five-year period. **Conclusion:** Emergency extracorporeal shockwave lithotripsy is safe and effective in patients with ureteric colic. Stone size and Hounsfield units are important factors in predicting success. Early treatment (≤24 hours) minimises stone impaction and increases the success rate of extracorporeal shockwave lithotripsy.
Shockwave Lithotripsy Versus Ureteroscopic Treatment as Therapeutic Interventions for Stones of the Ureter (TISU): A Multicentre Randomised Controlled Non-inferiority Trial Dasgupta, et al. 2021[40]	**Study type:** A pragmatic multicentre non-inferiority randomised control trial comparing shockwave lithotripsy with URS. **Method:** This trial tested for non-inferiority of up to two sessions of shockwave lithotripsy compared with URS as initial treatment for ureteric stones requiring intervention (n=613). **Discussion:** • In the emergency setting, a kidney obstructed by a stone can be drained with a temporary nephrostomy or ureteric stent, while the definitive surgical management to fragment the stone involves either shockwave lithotripsy or laser fragmentation with URS. **Conclusion:** Our primary analysis found that shockwave lithotripsy can be considered non-inferior to URS. The broader picture over a range of sensitivity analyses is that URS is consistently better than shockwave lithotripsy in terms of the need for further intervention.
Shockwave lithotripsy compared with ureteroscopic stone treatment for adults with ureteric stones: the TISU non-inferiority RCT Dasgupta, et al. 2022[9]	**Study type:** A pragmatic, multicentre, non-inferiority, randomised controlled trial of shockwave lithotripsy as a first-line treatment option compared with primary ureteroscopic stone treatment for ureteric stones. **Method:** Eligible participants (n=302) were randomised 1:1 to shockwave lithotripsy (up to two sessions) or ureteroscopic stone treatment. **Discussion:** • Urinary stone disease affects 2-3% of the general population. • Most ureteric stones are expected to pass spontaneously with supportive care; however, between one-fifth and one-third of patients require an active intervention. • The two standard interventions are shockwave lithotripsy and ureteroscopic stone treatment. • The treatment pathway for a patient with a stone that is judged clinically to be unlikely to pass spontaneously, will generally start with either shockwave lithotripsy or URS.

Source	Summary
Peer reviewed sources	
	• Some patients presenting with ureteric stones as an emergency may have continuing severe pain or evidence of infection or obstruction, and these patients may require urgent drainage of their renal collecting system either through insertion of a ureteric stent or through a nephrostomy (rather than having primary shockwave lithotripsy or URS), with definitive treatment postponed to a later date. • At the time of funding, a Cochrane review suggested that URS was associated with better stone clearance rates but higher complication rates than shockwave lithotripsy. A more recent systematic review supports these findings. A joint European Association of Urology – American Urological Association guideline for ureteric stones, current at the time of funding, had similar findings, but the evidence at that time was deemed insufficient to recommend either shockwave lithotripsy or URS as the first-line treatment. **Conclusion:** Patients receiving shockwave lithotripsy needed more further interventions than those receiving primary ureteroscopic retrieval, although the overall costs for those receiving the shockwave treatment were lower.
Extracorporeal shock wave lithotripsy (ESWL) versus ureteroscopic management for ureteric calculi Aboumarzouk, et al. 2012[38]	**Study type:** Cochrane systematic review. **Method:** Seven randomised control trials (n=1205) that compared extracorporeal shockwave lithotripsy with ureteroscopic retrieval of ureteric stones were included in this review. **Discussion:** • The accepted management of ureteric stones ranges from observation (watchful waiting with or without expulsive treatment using different drugs) to surgical exposure of ureter and stone removal (ureterolithotomy). • Various factors such as stone size, symptom severity, degree of obstruction, kidney function, stone location and urinary tract infection status influence the choice of intervention. **Conclusion:** Ureteroscopic retrieval of ureteric calculi increases stone-free rate but is associated with more complications and longer hospital stays.
What are the Benefits and Harms of Ureteroscopy Compared with Shock-wave Lithotripsy in the Treatment of Upper Ureteral Stones? A Systematic Review Drake, et al. 2017[39]	**Study type:** Systematic review of literature reporting benefits and harms of shockwave lithotripsy and URS in the management of upper ureteric stones. **Method:** Forty-seven studies met inclusion criteria; URS and shockwave lithotripsy were compared in 22 studies. **Results:** • Compared with shockwave lithotripsy, URS was associated with a significantly greater stone-free rate up to four weeks but the difference was not significant at three months in the included studies. • URS was associated with fewer retreatments and need for secondary procedures, but with a higher need for adjunctive procedures, greater complication rates and longer hospital stay.

Source	Summary
Peer reviewed sources	
	Discussion: • The current 2016 American Urological Association Guidelines state that URS for proximal ureteral stones has a greater stone-free rate in a single procedure compared with shockwave lithotripsy, regardless of stone size. • URS can be recommended as the first treatment option for proximal ureteral stones >10mm, but for stones 10mm the European Association of Urology Urolithiasis Guidelines panel consensus is that either treatment option is viable as first choice and should be presented to patients. • Counterbalancing for URS's higher stone-free rates, shockwave lithotripsy is associated with the least morbidity and lower complication rates. **Conclusion:** Both treatments are safe and effective options that should be offered based on individual patient circumstances and preferences.
Emergency management of ureteral stones: Evaluation of two different approaches with an emphasis on patients' life quality Sarica, et al. 2016[41]	**Study type:** Randomised study to evaluate the emergency management of obstructing ureteral calculi with two different techniques (shockwave lithotripsy and URS). **Method:** All cases (n=80) were treated within 24 hours following the onset of pain with two different approaches (shockwave lithotripsy and URS) in a randomised manner. **Results:** • Of all the 31 cases treated with URS: 26 cases (83.9%) became completely stone free, residual fragments were present in five cases (16.1%). • Of the 34 cases undergoing shockwave lithotripsy: 24 cases were completely stone free (70.6%), one case (2.9%) had residual fragments (<4mm), the procedure was unsuccessful in the remaining nine cases (26.5%). • Cases undergoing shockwave lithotripsy required statistically significant higher amounts of analgesics. **Conclusion:** Emergency ureteroscopic management of obstructive ureteral stones appears to be an effective treatment modality with comparable success as well as complication rates with shockwave lithotripsy performed in the same manner.
Retrospective Review of Acute Renal Colic Management in the Emergency Department and Review of Guidelines Jackson, et al. 2018	**Study type:** Review on practice patterns in an emergency department among patients presenting with acute renal colic. **Method:** Retrospective chart review of 469 patients from 2013 to 2015. **Results:** • There was a slight preference toward non-contrast CT (29%) as a single modality imaging study compared to renal ultrasound (26%). • Only 34% of the total cohort received a urology consultation in the emergency department or subsequent outpatient referral.

Source	Summary
Peer reviewed sources	
	Discussion: • Non-contrast CT remains the gold standard for acute renal colic in guidelines. • Our practice patterns indicate that renal ultrasound and non-contrast CT are used relatively equally. Without uniform recommendations across guidelines, quantifying the appropriate use of ultrasound remains difficult. **Conclusion:** There is a lack of consensus on the imaging modality of choice for renal colic with practice patterns showing use of renal ultrasound at relative equivalency with the guideline recommended gold standard of non-contrast CT.
Imaging in Suspected Renal Colic: Systematic Review of the Literature and Multispecialty Consensus Moore, et al. 2019	**Study type:** Systematic review on optimal imaging in patients with suspected renal colic in the acute setting. **Method:** Systematic literature review and three-step modified Delphi process on optimal imaging in 29 specific clinical scenarios. **Discussion:** • When CT is needed, a reduced-radiation approach should be used. • As the presentation becomes less typical, CT is favoured. • It is recommended that for younger patients (≈35 years), even without a history of stones, CT may be avoided if pain is controlled (perfect consensus). • For middle-aged patients (≈55 years), CT is recommended if there is no history of kidney stones. • For older patients, CT is recommended regardless of history. • Pregnant and paediatric patients with a typical presentation should undergo ultrasonography and do not require initial CT if symptoms are relieved. **Conclusion:** CT is not necessary in the emergency department evaluation of many patients with suspected renal colic, and the decision should be influenced by factors including age, clinical suspicion, history of kidney stone, pregnancy and relief of pain.

Table 2

Source	Summary
Grey literature	
European Association of Urology Guidelines on Diagnosis and Conservative Management of Urolithiasis Turk, et al. 2016[7]	**Study type:** Guidelines on current recommendations for imaging, pain management, conservative treatment, and medical expulsive therapy for renal and ureteral stones. **Discussion:** • Evaluation includes a detailed medical history, physical examination, appropriate imaging, and basic evaluation.

Source	Summary
Grey literature	
	• Patients with ureteral stones usually present with loin pain, vomiting, and sometimes fever, whereas renal stones maybe asymptomatic. • Ultrasound should be used as the primary diagnostic imaging tool. For all stones, ultrasound has sensitivity of 19-93% and specificity of 84-100%. • The sensitivity and specificity of KUB radiography for stone identification are 44-77% and 80-87%, respectively. • Non-contrast CT has become the standard for diagnosing acute flank pain and has replaced intravenous urography. • Radiation risk can be reduced by low-dose CT. In patients with body mass index (BMI) <30kg/m2, low-dose CT has sensitivity of 86% for detecting ureteric stones <3mm and 100% for calculi >3mm. • Imaging in pregnant women is limited owing to the possible risk of foetal radiation exposure and potential induction of later malignancies in the child. The risk depends on gestational age and the amount of radiation delivered. **Conclusion:** Routine evaluation includes imaging with US as the first-line modality. Low-dose CT has become the method of choice in the acute setting and when intervention is planned. Ureteral stones <6mm can pass spontaneously in well-controlled patients.
Kidney stones in adults: Diagnosis and acute management of suspected nephrolithiasis UpToDate, 2022[27]	**Diagnosis**: • The diagnosis of nephrolithiasis should be suspected in any patient presenting with renal colic or flank pain, with or without haematuria, particularly if the patient has a prior history of stone disease. • Patients should undergo laboratory testing and imaging of the kidneys, ureters, and bladder to confirm the presence of a stone and assess for signs of urinary obstruction. **Laboratory testing**: All patients presenting with suspected nephrolithiasis should undergo basic laboratory testing. We obtain a basic metabolic panel to assess kidney function and a urinalysis to evaluate for haematuria and signs of urinary tract infection. **Diagnostic imaging**: CT of the abdomen and pelvis without contrast performed using low-radiation-dose protocols is the preferred examination for most adults with suspected nephrolithiasis. • If the patient has a body mass index (BMI) >30kg/m or weighs more than 130kg (male) or 115kg (female), then a standard-dose CT is performed. • If CT technology is not available, ultrasound of the kidneys and bladder, sometimes in combination with abdominopelvic radiography, is the second-line option for initial imaging. Ultrasound is preferred for pregnant patients. • Other options included intravenous pyelography and magnetic resonance imaging if CT and ultrasound are not available.

Source	Summary
Grey literature	
	Acute management: Many patients with acute renal colic can be managed conservatively with pain medication and hydration until the stone passes. • Urgent urologic consultation is warranted in patients with urinary tract infection, acute kidney injury, anuria, and/or unyielding pain, nausea, or vomiting. • Both URS and shockwave lithotripsy may be considered first-line management options for ureteral stones that require removal. **Conclusion:** Studies suggest that URS offers higher stone-free rates but slightly increased complications compared to shockwave lithotripsy.
British Association of Urological Surgeons standards for management of acute ureteric colic Tsiotras, et al. 2018[33]	**Recommendation**: Patients should be given non-steroidal anti-inflammatory drugs for analgesia, immediately after initial assessment, unless there are specific contraindications. • Immediate pain relief is the primary treatment requirement in patients with suspected acute ureteric colic and should not be deferred by imaging assessment. **Recommendation**: Investigations in all patients should include: • Urine dipstick and culture dependent on dipstick findings • Serum creatinine and electrolytes (including estimated glomerular filtration rate), calcium, urate, full blood count and C-reactive protein • A clotting screen if percutaneous intervention is likely or planned • Blood cultures if the patient is pyrexial >38°C or has signs of systemic inflammatory response syndrome or sepsis. **Recommendation**: A CT scan of the kidneys, ureter and bladder should be performed within 14 hours of admission for the standard (non-pregnant adult) patient to make the diagnosis and help plan treatment. • In patients with fever and/or other evidence of sepsis, patients with a solitary kidney, or when diagnosis is uncertain, immediate imaging is indicated. • Non-contrast enhanced CT has become the standard for the diagnosis of acute ureteric colic with a high sensitivity of 97% for ureteric stones and a specificity of 95%. • CT KUB can determine stone characteristics, such as Hounsfield unit density, size and skin-to-stone distance, all of which may affect the choice of treatment modality. • If the patient is a known stone former, particularly if a CT KUB has been performed within the last three months, a KUB ultrasound and/or an X-ray KUB may suffice. **Recommendation**: For symptomatic ureteric stones, primary treatment of the stone should be the goal and should be undertaken within 48 hours of the decision to intervene. • Primary treatment may be with shockwave lithotripsy or ureteroscopy and will be determined by the stone characteristics and location, patient, surgical and local factors.

Source	Summary
Grey literature	
	• Compared to shockwave lithotripsy, ureteroscopy for proximal ureteric stones is associated with higher stone-free rates and lower re-treatment rates, at the cost of a higher complication rate and longer hospital stay. • Larger stones have higher stone-free rates and are stone-free sooner with ureteroscopy compared to shockwave lithotripsy. **Recommendation**: Where primary treatment of the stone is not immediately feasible, a stent may be inserted. Subsequent ureteroscopy should be undertaken within four weeks, to minimise patient morbidity. Shockwave lithotripsy should not be routinely undertaken with a stent in situ. • Ureteric stenting should not be routinely performed before primary ureteroscopy. • Pre-stenting facilitates subsequent ureteroscopic management of stones, improves stone-free rates and reduces complications. Stenting may be associated with higher morbidity, pre- and post-ureteroscopy. • Routine use of stents before shockwave lithotripsy does not improve stone-free rates and does not reduce the incidence of complications and is therefore not recommended. **Recommendation**: A patient with sepsis and an obstructing stone should undergo urgent decompression of the collecting system, with a nephrostomy tube or a stent.
Renal and ureteric stones: assessment and management National Institute for Health and Care Excellence, 2019[23]	**Diagnostic imaging** • Offer urgent (within 24 hours of presentation) low-dose non-contrast CT to adults with suspected renal colic. If a woman is pregnant, offer ultrasound instead of CT. • Offer urgent (within 24 hours of presentation) ultrasound as first-line imaging for children and young people with suspected renal colic. • If there is still uncertainty about the diagnosis of renal colic after ultrasound for children and young people, consider low-dose non-contrast CT. **Stenting before shockwave lithotripsy** • Do not offer pre-treatment stenting to adults having shockwave lithotripsy for ureteric or renal stones. • Consider pre-treatment stenting for children and young people having shockwave lithotripsy for renal staghorn stones.

Surgical treatments

Table 1 Surgical treatment (including SWL) of renal stones in adults, children and young people

Stone type and size	Treatment for adults (16 years and over)	Treatment for children and young people (under 16 years)
Renal stone less than 10 mm	Offer SWL Consider URS: • if there are contraindications for SWL **or** • if a previous course of SWL has failed **or** • because of anatomical reasons, SWL is not indicated Consider PCNL if SWL and URS have failed to treat the current stone or they are not an option	Consider URS or SWL Consider PCNL if: • URS or SWL have failed **or** • for anatomical reasons, PCNL is the more favourable option
Renal stone 10 to 20 mm	Consider URS or SWL Consider PCNL if URS or SWL have failed	Consider URS, SWL or PCNL
Renal stone larger than 20 mm, including staghorn stones	Offer PCNL Consider URS if PCNL is not an option	Consider URS, SWL or PCNL

Table 2 Surgical treatment (including SWL) of ureteric stones in adults, children and young people

Stone type and size	Treatment for adults (16 years and over)	Treatment for children and young people (under 16 years)
Ureteric stone less than 10 mm	Offer SWL Consider URS if: • stone clearance is not possible within 4 weeks with SWL **or** • there are contraindications for SWL **or** • the stone is not targetable with SWL **or**	Consider URS or SWL

Source	Summary
Grey literature	

	<table><tr><td></td><td>• a previous course of SWL has failed</td><td></td></tr><tr><td>Ureteric stone 10 to 20 mm</td><td>Offer URS
	
	Consider SWL if local facilities allow stone clearance within 4 weeks
	
	Consider PCNL for impacted proximal stones when URS has failed</td><td>Consider URS or SWL</td></tr></table>
	• Offer surgical treatment (including shockwave lithotripsy) to adults with ureteric stones and renal colic within 48 hours of diagnosis or readmission, if:
	  ○ pain is ongoing and not tolerated or
	  ○ the stone is unlikely to pass.
	• Stenting after ureteroscopy for adults with ureteric stones <20mm
	  ○ Do not routinely offer post-treatment stenting to adults who have had ureteroscopy for ureteric stones less than 20mm.

Renal and ureteric stones: Quality standard National Institute for Health and Care Excellence, July 2020[24]	• **Quality statement 1: Diagnostic imaging** – Adults with suspected renal colic have low-dose non-contrast CT within 24 hours of presentation. • CT should be performed as soon as possible, unless it is contraindicated, to prevent pain and delays the can cause renal function to decline. • **Quality statement 2: Pain management** – Adults, children and young people with suspected renal colic receive a non-steroidal anti-inflammatory drug as first-line treatment. • **Quality statement 3: Timing of surgical treatment** – Adults with ureteric stones and renal colic have surgical treatment within 48 hours of diagnosis or readmission, if pain is ongoing and not tolerated, or the stone is unlikely to pass. • **Quality statement 4: Metabolic testing** – Adults with renal or ureteric stones have their serum calcium measured. • **Quality statement 5: Dietary advice** – Adults, children and young people with renal or ureteric stones are given advice on diet and fluid intake.

Renal colic in the ED – Disposition
Emergency Care Institute, 2022[45]
	• The following patients will require admission and should be discussed with the urology team on-call as soon as analgesia and initial investigations are complete:
	  • Evidence of associated urinary tract infection (infected obstruction)
	  • Recurrent or unremitting pain

Source	Summary
Grey literature	
	• Obstruction of single kidney • Acute renal impairment. • In addition, calculi >7mm are less likely to pass and should be discussed with urology regarding management. • Patients can be discharged from the emergency department if pain is controlled, diagnosis is reasonably secure, and they do not fit any of the categories above. • All patients discharged prior to CT KUB should have one arranged within 48 hours either via referral from emergency department or via their general practitioner.
Nephrolithiasis BMJ Best Practice, 2021[28]	• Arrange urgent (within 24 hours of presentation) low-dose non-contrast CT for adults with suspected renal colic. • If the patient is pregnant or aged under 16 years, arrange an urgent ultrasound instead of CT. • Manage the patient based on stone size, location, and composition, in addition to anatomical and clinical features. Treatment consists of both medical and surgical therapies. • Refer the patient for immediate urological consultation if they have a stone in the kidney or ureter together with signs and symptoms of infection, or obstruction alone.
Renal colic – assessment Safer Care Victoria, 2021[29]	• Ultrasound should be considered if patients are: o under 50 years of age (first presentation) o pregnant o or when investigation is required in patients who re-present with renal colic.
Surgical Management of Stones: AUA/Endourology Society Guideline (2016) American Urological Association, 2016[22]	• Clinicians should obtain a non-contrast CT scan on patients prior to performing percutaneous nephrolithotomy. • Clinicians may obtain a non-contrast CT scan to help select the best candidate for shockwave lithotripsy versus URS. • Clinicians are required to obtain a urinalysis prior to intervention. In patients with clinical or laboratory signs of infection, urine culture should be obtained. • Patients with uncomplicated ureteral stones ≤10mm should be offered observation, and those with distal stones of similar size should be offered medical expulsive therapy with α-blockers. • Clinicians should inform patients that shockwave lithotripsy is the procedure with the least morbidity and lowest complication rate, but URS has a greater stone-free rate in a single procedure. • In patients with mid or distal ureteral stones who require intervention (who were not candidates for or who failed medical expulsive therapy), clinicians should recommend URS as first-line therapy. • URS is recommended for patients with suspected cystine or uric acid ureteral stones who fail medical expulsive therapy or desire intervention.

Source	Summary
Grey literature	
	• Routine stenting should not be performed in patients undergoing shockwave lithotripsy. • Following URS, clinicians may omit ureteral stenting in patients meeting all of the following criteria: those without suspected ureteric injury during URS, those without evidence of ureteral stricture or other anatomical impediments to stone fragment clearance, those with a normal contralateral kidney, those without renal functional impairment, and those in whom a secondary URS procedure is not planned. • Placement of a ureteral stent prior to URS should not be performed routinely. • In symptomatic patients with a total non-lower pole renal stone burden ≤20mm, clinicians may offer shockwave lithotripsy or URS. • In symptomatic patients with a total renal stone burden >20mm, clinicians should offer percutaneous nephrolithotomy as first-line therapy. • In patients with total renal stone burden >20mm, clinicians should not offer shockwave lithotripsy as first-line therapy. • Clinicians should offer shockwave lithotripsy or URS to patients with symptomatic ≤10mm lower pole renal stones. • Clinicians should not offer shockwave lithotripsy as first-line therapy to patients with >10mm lower pole stones. • Clinicians should inform patients with lower pole stones >10mm in size that percutaneous nephrolithotomy has a higher stone-free rate but greater morbidity. • In pregnant patients with ureteral stones and well controlled symptoms, clinicians should offer observation as first-line therapy. In pregnant patients with ureteral stones, clinicians may offer URS to patients who fail observation. Ureteral stent and nephrostomy tube are alternative options with frequent stent or tube changes usually being necessary.
Canadian Urological Association guideline: Management of ureteral calculi Canadian Urological Association, 2021	• **Recommendation**: Ultrasonography with KUB X-ray should be considered the initial modality of choice for acute ureteral stones. Judicious use of CT scans, preferably low-dose, provides valuable information for management decisions. • **Recommendation**: Stone location, composition, density and skin-to-stone distance can help counsel patients regarding the success rates of shockwave lithotripsy treatment. Known uric acid, cystine and brushite stones are likely best treated with URS. • Patients with ureteral stones with a density >1,000 HU or SSD >10cm have lower stone-free rates with shockwave lithotripsy. • **Recommendation**: Patients with upper ureteric stones should initially receive low-energy shocks, with gradual voltage escalation up to maximum energy.

Source	Summary
Grey literature	
	• If unsuccessful, repeat shockwave lithotripsy can be considered but more than two treatments to the same ureteric stone has little incremental benefit and URS should then be considered. • **Recommendation**: Routine pre-URS stenting is not necessary but may facilitate ureteral access sheath insertion and improve stone free rates in patients with larger stones. • Routine stenting after uncomplicated URS is likely unnecessary but stent placement after ureteral access sheath use is warranted. • **Recommendation**: Shockwave lithotripsy produces similar stone free rate to URS for ureteral stones, albeit with a higher retreatment rate and lower complication rate. • First-line diagnostic testing for stones in pregnancy is ultrasound, but low-dose non-contrast CT or magnetic resonance imaging (without gadolinium in the first trimester) can also be used. Obstructing ureteral stones in pregnancy can be managed conservatively in the absence of suspected or confirmed urinary infection. URS with laser lithotripsy is safe in pregnancy; however, shockwave lithotripsy is contraindicated in pregnancy.

Appendix

PubMed search terms

(("Renal Colic"[MeSH Terms] OR "acute ureteric colic"[Title/Abstract] OR "acute ureteral colic"[Title/Abstract] OR "acute renal colic"[Title/Abstract] OR "ureteric colic"[Title/Abstract] OR "ureteral colic"[Title/Abstract]) AND ("treat*"[Title/Abstract] OR "guideline*"[Title/Abstract] OR "manage*"[Title/Abstract]) AND ("emergenc*"[Title/Abstract] OR "hospital*"[Title/Abstract] OR "emergency medical services"[MeSH Terms] OR "emergency service, hospital"[MeSH Terms]) AND ("english"[Language] AND 2012/01/01:2022/12/31[Date - Publication]))

Google search terms

acute ureteric colic AND guidelines

Inclusion and exclusion criteria

Inclusion	Exclusion

• Published in English
• Studies reporting empirical data, including modelling studies, and systematic review articles
• Published between 2012 and present
	• Letters, comments, editorials, study protocols, case reports or conference abstracts
	• Abstract only
	• Studies or results related to:
	  ○ Pain management for acute ureteric colic
	  ○ Medical expulsive therapy
	  ○ COVID-19
	  ○ Non-emergency intervention
	  ○ Paediatric patients
	• Studies from non-OECD countries

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