

# Diagnostic Imaging Pathways - Loin Pain (Renal Colic)

## Population Covered By The Guidance

This pathway provides guidance on the investigation of adult patients with renal colic, including those presenting for the first time and those with recurrent symptoms.

**Date reviewed: September 2015**

**Date of next review: 2017/2018**

**Published: February 2016**

## Quick User Guide

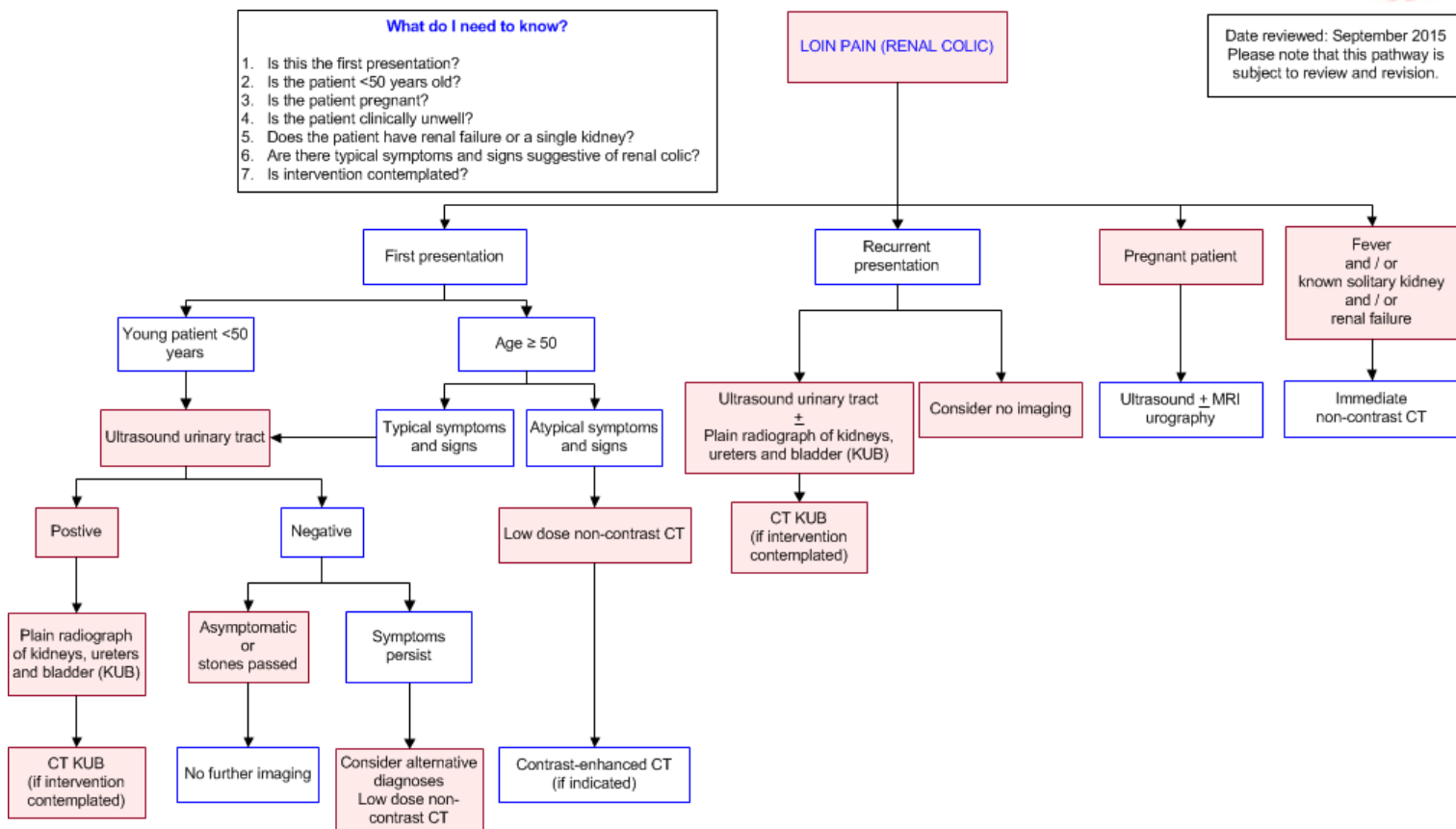
Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

## Pathway Diagram



## Image Gallery

*Note: These images open in a new page*

1



### Urolithiasis

Image 1 (Plain Radiography of Kidneys, Ureter, Bladder - KUB): An opacity is present (arrow) at the left vesico-ureteric junction.

2



### Pelvicalyceal Dilatation

Image 2 (Intravenous Pyelography): No stone is visualised, but there is dilatation of the ureter and pelvicalyceal system on the left side.

3

### Staghorn Calculus

Image 3 (KUB): A staghorn calculus is present in the collecting system of the right kidney.



4a



### Urolithiasis

Image 4a and b (Computed Tomography): A 10mm calculus is present at the left pelviureteric junction responsible for mild left hydronephrosis and perinephric stranding.

4b



## Teaching Points

- Non-enhanced CT is the 'gold-standard' for diagnosis of ureteric colic
- Low-dose CT protocols can be effectively used in acute renal colic
- Immediate imaging is required when patients do not improve after treatment and / or when there is fever and / or leukocytosis and / or the patient has renal failure or a single kidney
- However, because of concerns about ionising radiation and because the vast majority of ureteric stones pass without the need for intervention, ultrasound (US) has been increasingly recommended and used as the initial imaging modality, with no sacrifice in patient outcome, thus avoiding the need for CT in about 70% of cases
- Ultrasound is also capable of identifying most of the alternative diagnoses listed as mimickers of renal colic
- US in combination with plain x-ray KUB misses very few clinically important stones
- In pregnant patients, it should be borne in mind that unless a calculus is visualized it may be difficult to differentiate obstructive hydronephrosis due to a calculus from 'physiological' hydronephrosis of pregnancy. In selected cases, MRI urography may be then required
- Conventional IVP can now be considered almost obsolete for the diagnosis of renal colic

## Loin Pain (Renal Colic)

- Non-enhanced CT is the 'gold-standard' for diagnosis of ureteric colic and is used in many institutions. However, despite the introduction of low-dose CT protocols, because many patients are young and have recurrent episodes of renal colic, there is concern about cumulative radiation dose. Therefore, ultrasound (US) has been increasingly recommended and used as the initial imaging modality, with no sacrifice in patient outcome, thus avoiding the need for CT in about 70% of cases. [1](#) Despite the superior sensitivity of CT versus US, the outcome is the same whether CT or US is used for imaging [2](#)
- Recent European Association of Urology Guidelines on urolithiasis recommend US as the primary imaging modality, [3](#) quoting a sensitivity of 45% and specificity of 94% for ureteric stones [4](#)
- Because young patients with typical symptoms of renal colic have a low incidence of adverse

outcomes, there is a valid argument for avoiding acute imaging altogether, and deferring investigating only if symptoms persist or the stone has not been known to pass

- Immediate imaging is required when patients do not improve after treatment and / or when there is fever and / or leukocytosis and / or the patient has renal failure or a single kidney
- Predictors for spontaneous passage of ureteric stones include
  - Stone size - the large majority of stones

## Computed Tomography of the Kidneys, Ureters and Urinary Bladder (CT KUB)

- Unenhanced (i.e. no IV contrast) CT scan - so called CT KUB or NCCT is the most accurate and widely used imaging investigation for diagnosis of ureteric stones. However, despite the superior sensitivity of CT versus ultrasound (US), the outcome is the same whether CT or US is used for imaging [2](#)
- CT can identify the presence of stones with very high accuracy (>95%), [16](#) allows accurate measurement of stones ( the major factor in determining whether stones will pass without intervention) and, to some extent, stone composition. CT is also able to identify alternative diagnoses that can mimic renal colic in up to 10% of cases, [17](#) e.g.
  - Pyelonephritis
  - Acute adnexal pathology in women
  - Appendicitis
  - Diverticulitis
  - Abdominal aortic aneurysm rupture or aortic dissection
  - Colonic diverticulitis
- However, it should be noted that US is also capable of identifying most of the alternative diagnoses listed as mimickers of renal colic
- Studies using "low-dose" protocols have shown sensitivities of 93-97% and specificities of 86-97%, when compared to standard dose CT, [18](#) and radiation doses equal to or lower than that of intravenous pyelogram (IVP). [18,19,20](#) More recent studies confirm the accuracy of low dose protocols in patients with a BMI30, discretionary increase in CT exposure parameters may be needed
- Earlier studies using "low-dose" multidetector CT (MDCT) protocols reported increased rates of false positive and false negative results in obese patients. [18,20](#) More recent studies have not reported similar difficulties [19,25](#)
- Despite the above, the adoption of low-dose protocols has not been universal [27](#)
- However, there is concern regarding cumulative dose from repeated studies required for follow-up of calculi, or in patients with recurrent stones [28,29](#) although this is much less of an issue if low-dose protocols are employed
- There is a trend towards a more discriminate use of CT KUB in patients with clinical uncomplicated acute renal colic, particularly in young female patients, in whom there is a relatively high incidence of negative CT examinations, and in whom radiation is more of an issue [8,9](#)
  - Of the issue of ionising radiation
  - The vast majority of ureteric stones pass without the need for intervention
  - CT in the emergency department rarely alters immediate management [6,7](#)
  - Adverse events are rare among patients

## Pregnant Patients

- Ultrasound (US) is the first investigation of choice as it does not involve exposure to ionising radiation. However, it should be borne in mind that unless a calculus is visualized it may be difficult to differentiate obstructive hydronephrosis due to a calculus from 'physiological' hydronephrosis of pregnancy. In selected cases, MRI urography may be required [37](#)

## References

Date of literature search: September 2015

The search methodology is available on request. [Email](#)

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. [Download the document](#)

1. Nicolau C, Claudon M, Derchi LE, Adam EJ, Nielsen MB, Mostbeck G, et al. **Imaging patients with renal colic-consider ultrasound first.** Insights Imaging. 2015;6(4):441-7. (Review article). [View the reference](#)
2. Smith-Bindman R, Aubin C, Bailitz J, Bengiamin RN, Camargo CA, Jr., Corbo J, et al. **Ultrasonography versus computed tomography for suspected nephrolithiasis.** N Engl J Med. 2014;371(12):1100-10. (Level II evidence). [View the reference](#)
3. Turk C, Petrik A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. **EAU guidelines on diagnosis and conservative management of urolithiasis.** Eur Urol. 2015;pii: S0302-2838(15)00699-5. [Epub ahead of print]. (Guidelines). [View the reference](#)
4. Ray AA, Ghiculete D, Pace KT, Honey RJ. **Limitations to ultrasound in the detection and measurement of urinary tract calculi.** Urology. 2010;76(2):295-300. (Level III evidence). [View the reference](#)
5. Sfoungaristos S, Kavouras A, Katafigiotis I, Perimenis P. **Role of white blood cell and neutrophil counts in predicting spontaneous stone passage in patients with renal colic.** BJU Int. 2012;110(8 Pt B):E339-45. (Level III evidence). [View the reference](#)
6. Lindqvist K, Hellstrom M, Holmberg G, Peeker R, Grenabo L. **Immediate versus deferred radiological investigation after acute renal colic: a prospective randomized study.** Scand J Urol Nephrol. 2006;40(2):119-24. (Level II evidence). [View the reference](#)
7. Zwank MD, Ho BM, Gresback D, Stuck LH, Salzman JG, Woster WR. **Does computed tomographic scan affect diagnosis and management of patients with suspected renal colic?** Am J Emerg Med. 2014;32(4):367-70. (Level III evidence). [View the reference](#)
8. Patatas K, Panditaratne N, Wah TM, Weston MJ, Irving HC. **Emergency department imaging protocol for suspected acute renal colic: re-evaluating our service.** Br J Radiol.



- 2012;85(1016):1118-22. (Level III evidence). [View the reference](#)
9. Aubrey-Bassler FK, Lee SD, Barter RB, Asghari S, Cullen R, Godwin M. **Utility of computed tomography and derivation and validation of a score to identify an emergent outcome in 2,315 patients with suspected urinary tract stone.** CJEM. 2013;15(5):261-9. (Level III evidence). [View the reference](#)
10. Epstein N, Rosenberg P, Samuel M, Lee J. **Adverse events are rare among adults 50 years of age and younger with flank pain when abdominal computed tomography is not clinically indicated according to the emergency physician.** CJEM. 2013;15(3):167-74. (Level III/IV evidence). [View the reference](#)
11. Ripolles T, Martinez-Perez MJ, Vizuete J, Miralles S, Delgado F, Pastor-Navarro T. **Sonographic diagnosis of symptomatic ureteral calculi: usefulness of the twinkling artifact.** Abdom Imaging. 2013;38(4):863-9. (Level III evidence). [View the reference](#)
12. Patlas M, Farkas A, Fisher D, Zaghal I, Hadas-Halpern I. **Ultrasound vs CT for the detection of ureteric stones in patients with renal colic.** Br J Radiol. 2001;74(886):901-4. (Level III evidence). [View the reference](#)
13. Sheafor DH, Hertzberg BS, Freed KS, Carroll BA, Keogan MT, Paulson EK, et al. **Nonenhanced helical CT and US in the emergency evaluation of patients with renal colic: prospective comparison.** Radiology. 2000;217(3):792-7. (Level III evidence). [View the reference](#)
14. Ripolles T, Agramunt M, Errando J, Martinez MJ, Coronel B, Morales M. **Suspected ureteral colic: plain film and sonography vs unenhanced helical CT. A prospective study in 66 patients.** Eur Radiol. 2004;14(1):129-36. (Level III evidence). [View the reference](#)
15. Catalano O, Nunziata A, Altei F, Siani A. **Suspected ureteral colic: primary helical CT versus selective helical CT after unenhanced radiography and sonography.** AJR Am J Roentgenol. 2002;178(2):379-87. (Level II evidence). [View the reference](#)
16. Smith RC, Verga M, McCarthy S, Rosenfield AT. **Diagnosis of acute flank pain: value of unenhanced helical CT.** Am J Roentgenol. 1996;166:97-101. (Level II/III evidence). [View the reference](#)
17. Pernet J, Abergel S, Parra J, Ayed A, Bokobza J, Renard-Penna R, et al. **Prevalence of alternative diagnoses in patients with suspected uncomplicated renal colic undergoing computed tomography: a prospective study.** CJEM. 2015;17(1):67-73. (Level III evidence). [View the reference](#)
18. Tack D, Sourtzis S, Delpierre I, de Maertelaer V, Gevenois PA. **Low-dose unenhanced multidetector CT of patients with suspected renal colic.** AJR Am J Roentgenol. 2003;180(2):305-11. (Level II/III evidence). [View the reference](#)
19. Kluner C, Hein PA, Gralla O, Hein E, Hamm B, Romano V, et al. **Does ultra-low-dose CT with a radiation dose equivalent to that of KUB suffice to detect renal and ureteral calculi?** J Comput Assist Tomogr. 2006;30(1):44-50. (Level II/III evidence). [View the reference](#)
20. Hamm M, Knopfle E, Wartenberg S, Wawroschek F, Weckermann D,



- Harzmann R. **Low dose unenhanced helical computerized tomography for the evaluation of acute flank pain.** J Urol. 2002;167(4):1687-91. (Level II/III evidence). [View the reference](#)
21. Poletti PA, Platon A, Rutschmann OT, Schmidlin FR, Iselin CE, Becker CD. **Low-dose versus standard-dose CT protocol in patients with clinically suspected renal colic.** AJR Am J Roentgenol. 2007;188(4):927-33. (Level III evidence). [View the reference](#)
22. Jain N, Robinson S. **Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. BET 4: Investigating flank pain: can the CT stay low?** Emerg Med J. 2012;29(8):687-8. (Review article). [View the reference](#)
23. Fulgham PF, Assimos DG, Pearle MS, Preminger GM. **A clinical effectiveness protocols for imaging in the management of ureteral calculous disease: AUA technology assessment.** J Urol. 2013;189(4):1203-13. (Review article). [View the reference](#)
24. Moore CL, Daniels B, Singh D, Luty S, Molinaro A. **Prevalence and clinical importance of alternative causes of symptoms using a renal colic computed tomography protocol in patients with flank or back pain and absence of pyuria.** Acad Emerg Med. 2013;20(5):470-8. (Level III evidence). [View the reference](#)
25. Kim BS, Hwang IK, Choi YW, Namkung S, Kim HC, Hwang WC, et al. **Low-dose and standard-dose unenhanced helical computed tomography for the assessment of acute renal colic: prospective comparative study.** Acta Radiol. 2005;46(7):756-63. (Level III evidence). [View the reference](#)
26. McLaughlin PD, Murphy KP, Hayes SA, Carey K, Sammon J, Crush L, et al. **Non-contrast CT at comparable dose to an abdominal radiograph in patients with acute renal colic; impact of iterative reconstruction on image quality and diagnostic performance.** Insights Imaging. 2014;5(2):217-30. (Level III evidence). [View the reference](#)
27. Lukasiewicz A, Bhargavan-Chatfield M, Coombs L, Ghita M, Weinreb J, Gunabushanam G, et al. **Radiation dose index of renal colic protocol CT studies in the United States: a report from the American College of Radiology National Radiology Data Registry.** Radiology. 2014;271(2):445-51. (Level III evidence). [View the reference](#)
28. Manohar P, McCahy P. **Repeated radiological radiation exposure in patients undergoing surgery for urinary tract stone disease in Victoria, Australia.** BJU Int. 2011;108 Suppl 2:34-7. (Level III evidence). [View the reference](#)
29. Katz SI, Saluja S, Brink JA, Forman HP. **Radiation dose associated with unenhanced CT for suspected renal colic: impact of repetitive studies.** AJR Am J Roentgenol. 2006;186(4):1120-4. (Level III evidence). [View the reference](#)
30. Ascenti G, Siragusa C, Racchiusa S, Ielo I, Privitera G, Midili F, et al. **Stone-targeted dual-energy CT: a new diagnostic approach to urinary calculosis.** AJR Am J Roentgenol. 2010;195(4):953-8. (Level III evidence). [View the reference](#)
31. Boll DT, Patil NA, Paulson EK, Merkle EM, Simmons WN, Pierre SA,



- et al. **Renal stone assessment with dual-energy multidetector CT and advanced postprocessing techniques: improved characterization of renal stone composition--pilot study.** *Radiology.* 2009;250(3):813-20. (Level III evidence). [View the reference](#)
32. Grosjean R, Sauer B, Guerra RM, Daudon M, Blum A, Felblinger J, et al. **Characterization of human renal stones with MDCT: advantage of dual energy and limitations due to respiratory motion.** *AJR Am J Roentgenol.* 2008;190(3):720-8. (Level III evidence). [View the reference](#)
33. Thomas C, Heuschmid M, Schilling D, Ketelsen D, Tsiflikas I, Stenzl A, et al. **Urinary calculi composed of uric acid, cystine, and mineral salts: differentiation with dual-energy CT at a radiation dose comparable to that of intravenous pyelography.** *Radiology.* 2010;257(2):402-9. (Level IV evidence). [View the reference](#)
34. Ekici S, Sinanoglu O. **Comparison of conventional radiography combined with ultrasonography versus nonenhanced helical computed tomography in evaluation of patients with renal colic.** *Urol Res.* 2012;40(5):543-7. (Level III evidence). [View the reference](#)
35. Foell K, Ordon M, Ghiculete D, Lee JY, Honey RJ, Pace KT. **Does baseline radiography of the kidneys, ureters, and bladder help facilitate stone management in patients presenting to the emergency department with renal colic?** *Endourol.* 2013;27(12):1425-30. (Level III evidence). [View the reference](#)
36. Teichman JM. **Clinical practice. Acute renal colic from ureteral calculus.** *N Engl J Med.* 2004;350(7):684-93. (Review article). [View the reference](#)
37. Masselli G, Derme M, Laghi F, Poletini E, Brunelli R, Framarino ML, et al. **Imaging of stone disease in pregnancy.** *Abdom Imaging.* 2013;38(6):1409-14. (Review article). [View the reference](#)

## Information for Consumers

Information from this website	Information from the Royal Australian and New Zealand College of Radiologists' website
<a href="#">Radiation Risks of X-rays and Scans</a> <a href="#">Computed Tomography (CT)</a> <a href="#">Intravenous Pyelogram (IVP)</a> <a href="#">Ultrasound</a>	<a href="#">Computed Tomography (CT)</a> <a href="#">Iodine-Containing Contrast Medium</a> <a href="#">Radiation Risk of Medical Imaging During Pregnancy</a>



<a href="#">Plain Radiography (X-ray)</a>	<a href="#">Radiation Risk of Medical Imaging for Adults and Children</a>  <a href="#">Ultrasound</a>
---	---

## Copyright

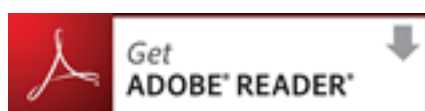
© Copyright 2015, Department of Health Western Australia. All Rights Reserved. This web site and its content has been prepared by The Department of Health, Western Australia. The information contained on this web site is protected by copyright.

## Legal Notice

Please remember that this leaflet is intended as general information only. It is not definitive and The Department of Health, Western Australia can not accept any legal liability arising from its use. The information is kept as up to date and accurate as possible, but please be warned that it is always subject to change

## File Formats

Some documents for download on this website are in a Portable Document Format (PDF). To read these files you might need to download Adobe Acrobat Reader.



## [Legal Matters](#)