Unenhanced Helical CT In Renal Colic

A Sharma

Citation

A Sharma. *Unenhanced Helical CT In Renal Colic*. The Internet Journal of Radiology. 2004 Volume 4 Number 1.

Abstract

Aim: For quite a few years now, CT has established itself as an imaging modality for renal colic. At our institution (a tertiary referral for urology) ,CT has been used for approximately 6-7 years as a diagnostic test for renal/ureteric calculi. The aim of our study was to determine the impact of CT on patient management.

Materials And Methods: Retrospective review of case notes of 100 patients who underwent CT for a clinical diagnosis of renal colic.

Results: We found that calculi greater than 5mm in size (23) were more likely to cause hydronephrosis and/or hydroureter (17,70%),and less likely to pass spontaneously, thereby requiring some form of intervention (15,65%);conversely, those less than 5mm in size (22) benefited from conservative management (14,63%).Calculi greater than 5mm in size were often visualised on plain films (20,87%);smaller calculi could only be seen on CT. The study did not reveal that there were a significant number of relevant alternative diagnoses made on the CT (8,16%). 90% (45) of patients with no calculus on CT (50 in total) were not admitted again.

Conclusion: CT is an accurate modality for the diagnosis of, and a powerful tool to rule out the presence of a urinary calculus. Size of calculus is important; calculi larger than 5mm are likely to need intervention. Radiation dose remains an issue, especially with follow-up of small, less than 5mm calculi, which are not readily visible on plain films. Urologists' awareness regarding radiation implications and the necessity of restricting additional investigations is important.

INTRODUCTION

Since it's inception as an imaging modality for renal colic in 1994,unenhanced helical CT has been increasingly used in the investigation of renal colic. The sensitivity and specificity of this examination has been found to be high (97% and 96% respectively) ([1]),while simultaneously avoiding the injection of contrast medium ([5]),a potential hazard, especially in those with impaired renal function secondary to obstruction. It is a quicker examination compared to the IVU. Previous publications have pointed out that CT can differentiate between a phlebolith and an ureteric calculus ([2,3,4]); and appearances on CT have been used to predict clinical outcome ([5,6,7]).Occasionally, CT has proved useful in making an alternative diagnosis relevant to clinical management ([8,9,10]).

On the darker side, radiation dose remains a thorny issue. Low-dose protocols have been postulated, using 7mm collimation and a 2:1 pitch, which achieved a dose of 2.8 mSv, approximately twice that of an IVU examination ([1]).This could have implications on the younger sub-group of patients, especially those who may need repeated imaging for recurrent/complicated stone disease. It is not always easy to differentiate between a small stone and a phlebolith ([11,12]),and very small stones may not be clinically relevant.

The aim of this study was to identify 100 patients who underwent unenhanced CT for renal colic and retrospectively review their notes to identify the impact of CT on clinical management.

MATERIALS AND METHODS

Case records of 100 patients who underwent unenhanced CT for a clinical diagnosis of renal colic in 2002 were reviewed in mid 2003,nearly a year post-diagnosis. Scans were performed on a single detector scanner (at the time) (Marconi Elscint) using 5mm collimation, and a pitch of 2:1,in the supine position, without oral or intravenous contrast media. Dedicated “colic” slots are available in most CT lists for emergency scanning.

A tick-box proforma was used for each patient when case notes were reviewed. At the same time, it was felt important

to canvass the opinions of the Urologists at this tertiary referral centre; a questionnaire was sent to each Urologist regarding aspects of renal colic imaging, which was returned once filled in.

RESULTS

50 patients had calculi diagnosed on unenhanced CT, while 50 patients with a clinical diagnosis of renal colic had no stone on CT. Taking 5 mm and above as the cut-off size of calculus that might be clinically relevant,22 patients had calculi less than 5mm,while 23 patients had calculi larger than 5mm.Unfortunately,size was not mentioned in 5 patients.

78% of patients with calculi had microscopic haematuria, and 17% had frank haematuria.However,42% of the patients without calculi on CT had microscopic and 6 % had frank haematuria.

Of the 23 patients with calculi larger than 5 mm,70 % had hydronephrosis /hydroureter, while 30% had no pelvicalyceal/ureteric dilatation. Of the 22 patients with calculi smaller than 5 mm,9% had hydronephrosis/hydro-ureter.

87% of calculi larger than 5mm were seen on a KUB x-ray film;36 % of smaller calculi were seen on plain film.70% of patients with larger calculi underwent some form of urologic/radiologic intervention; 18% of calculi less than 5mm underwent similar intervention.

Greater numbers of repeat admissions were seen in the group of people with calculi larger than 5 mm (26%,6) as compared to calculi less than 5mm (13 %,3) treated conservatively, requiring definitive treatment in the former group as compared to the latter.

50 patients had no demonstrable calculus on CT;of these,90 % were not admitted again.8% were rea-admitted and 10 % underwent further urologic examination ,inc cystoscopy, all of which proved negative.

In the patients without calculi,12 % had other relevant findings on CT that helped to make a diagnosis other than renal colic.

Questionnaires regarding investigation for renal colic were circulated to 7 practising Urologists at registrar grade and above.5 urologists believed that CT was most appropriate for investigating renal colic, while 2 were of the opinion that a 15-minute IVU was probably better. All 7 agreed that CT showed up more calculi; while 5 felt that calculi were clinically relevant more than 50 % of the time,2 urologists disagreed.3 urologists felt that a KUB would still be necessary following a CT, and 4 wanted IVU's in addition if intervention was planned.

While the urologists appeared to be divided in their opinion about whether they would follow up patients with incidentally detected renal stones on CT, all of them agreed that they would follow-up with plain films rather than CT. On the controversial topic of dose,3 urologists felt that IVU carried a higher radiation burden than CT.

In conclusion, 5 felt that CT would never replace IVU as imaging modality of choice in the future.

DISCUSSION

When Helical CT was first conceptualised as an imaging modality for renal colic in 1995 ([13,14]), uroradiology was revolutionized. A new technique had been developed that had an unprecedented high sensitivity ,specificity and diagnostic accuracy(above 90%).The dangers of contrast media administration were effectively eliminated, at the same time enabling an objective assessment of stone size and secondary effects of ureteric stone impaction ([15]).

But were the clinicians and patients really benefiting from this new technique? The object of our study was to assess impact of CT on patient management and to determine imaging details that might be of relevance.

Firstly, the clinical test of haematuria proved to be a poor discriminator. While the sensitivity was high (95% of patients with calculi had haematuria), specificity was low (48% of patients without proven calculi had haematuria). Thus, it proves to be an unpredictable screening test, and imaging remains the mainstay of diagnosis.

In a study of 850 patients with CT diagnosis of ureteric calculi in 172 patients, Dierdre M Coll et al ([6]) deduced that the incidence of spontaneous stone passage was 76% for stones 2-4mm in diameter; dropping to 60% for 5-7mm diameter and 48% for 7-9mm diameter. Based on this,5mm was taken as the cut-off size, and patients with calculi were divided into 2 groups-those with calculi up to 4mm in size and those with calculi 5mm and above.

The majority of patients with calculi 5mm ([23]) and above had evidence of urinary obstruction (70%,17),in the form of hydronephrosis and/or hydroureter.65% (15) of this group required some form of treatment (Nephrostomy,

Percutaneous lithotripsy, cystoscopic retrieval) in order to alleviate symptoms- of the treated group,87 % (13) had evidence of obstruction, and 14% (2) had no signs of obstruction..35 % (8) of patients with calculi >5mm,once treated definitively were not re-admitted.However,26% (6) of the >5mm group were initially treated conservatively-and did not do too well, requiring re-admission till some form of intervention was instituted. Ultimately, only a small proportion of the initial group (17%,4)were treated conservatively, with successful passage of the stone-2 of these had evidence of hydro-ureter on CT. One patient was treated with lithotripsy and stone retrieval, but continued to have pain, which was investigated by an IVU (negative).One patient had disciitis and was transferred to the orthopaedic surgeons; 3 patients with renal/staghorn calculi and medical problems were deemed unfit for surgical intervention.

The majority of patients with calculus 4mm in size and smaller ([22]) had no evidence of hydronephrosis/hydroureter (91%,20).Most of these patients were treated conservatively (82%,18) and did well in the majority (63%,14).A small but significant proportion (13%,3) were re-admitted with similar symptoms and were treated conservatively.A small (18%,4) number of patients with calculus 4mm and smaller in size required intervention, of whom 1 had evidence of hydronephrosis/hydroureter.

Thus, from our study, size of the calculus appears to play an important role in prognosis and should be mentioned in the report. Calculi 5mm and more in diameter are unlikely to pass spontaneously ,and more likely to need definitive treatment.

Hydronephrosis and hydro-ureter, when present, should be commented on, and is likely to influence management. This is in accordance with previous studies ([14,15,23,24]).

87% (20) of calculi greater than 5mm in size were seen on X-Ray KUB, while 36 % (8) of calculi 4mm and smaller were visualised. This has implications for follow-up – ironically, the smaller calculus with the greater likelihood of conservative management is less likely to be seen on the plain film. Ronald J Zagoria et al ([17]) assessed the conspicuity of calculi on Abdominal radiography following CT and established that most calculi greater than 5mm in size were well seen on Plain films, as were calculi with an attenuation value greater than 300 HU on CT. An interesting study by Cynthia H McCullough et al ([18]) comparing dose and quality of screen-film, computed radiography and CT generated projection revealed that while doses were comparable, CT scannogram was inferior to both screen-film and CR in spatial resolution. Contrast resolution ,especially of low-contrast calculi, was superior on CT scannogram and CR.A further study by Creed M Zackaria Assi et al revealed that while abdominal radiography was superior to CT scannogram, there were still some small calculi seen only on axial CT,and not visible by other modalities ([19]).Thus the follow-up of small, less radio-opaque calculi by modalities other than CT is less feasible.

The most significant finding in our study was the fact that ,in the 50 patients without calculi,following a CT scan,90% (45) were not re-admitted.10 % (5) underwent further urology examinations (cystoscopy) owing to symptomatology and /or presence of haematuria, all of which were negative. Thus,CT has emerged as the gold standard indeed-a definitive test to rule out a urinary calculus.

On the front of an alternative diagnosis for flank pain other than renal colic,the results of our study were less encouraging.16 % (8) of the patients without calculi had relevant findings, including diffuse liver parenchymal change, scarred kidney, extrarenal pelves(three patients),infected kidney, large cyst in a kidney and an aortic-stentgraft. Compared to previous reports of unsuspected diagnoses varying from 16% to 45% ([5,8,9,10,20]), in our experience, the incidence of other significant findings leading to an alternative diagnosis is not as common as one would hope.

Also of note is the clinical perception amongst Urologists, based on the results of the questionairre.While there is no doubt that Helical CT shows up more calculi, they seem to be at a loss to deal with this excessive amount of new information. They were divided in their opinion regarding other investigations-most seemed to think that a further KUB and/or an IVU would additionally be needed. They were similarly divided about the dose from a CT or an IVU, some considering an IVU to give a higher dose. The majority did not feel that CT would replace IVU.

Education is important. Even the so-called low-dose protocols used for single-row detector CT have come up with an Effective dose equivalent of 2.8 mSv, nearly twice that of an IVU. The newer Multi-detector row CT scanners hold out a promise that needs to be investigated further; one of the published reports suggests that a low dose protocol using 4x2.5mm collimation,120 kVp and 30 mAs ([21]) gives an effective dose equivalent of 1.2 mSv in men and 1.9mSv

in women, with no loss of additional information that would help to make an alternative diagnosis. Even allowing for this reduction in dose, this is a radiation burden to the patient-pregnant patients, children and young adults ([16]) being particularly vulnerable. Once CT has been used to make a diagnosis of urinary calculus, additional radiological investigations should only be used at follow-up, f deemed necessary.

In conclusion, CT is a powerful tool in the diagnosis of urinary calculus. A calculus greater than 5mm in size is more likely to need intervention, especially with accompanying hydronephrosis/hydrouereter.These calculi are easier to follow-up on KUB.A negative CT scan effectively rules out a urinary calculus. However,it is a weapon to to be wielded with caution, the radiologist being aware of the radiation burden it imposes on the patient, and the possible implications in the long term([16,22]).

References

1. Weldon Liu, Stephen J. Esler, Bryan J. Kenny, Raymond H. Goh, Andrew J. Rainbow, and Giles W. Stevenson. Low-Dose Nonenhanced Helical CT of Renal Colic: Assessment of Ureteric Stone Detection and Measurement of Effective Dose Equivalent. Radiology 2000; 215: 51-54.
2. Nizar A. Al-Nakshabandi The Soft-Tissue Rim Sign Radiology 2003; 229: 239-240.
3. Kawashima A, Sandler C, Boridy IC, Takahashi N, Benson GS, Goldman SM. Unenhanced helical CT of ureterolithiasis: value of the tissue rim sign. AJR Am J Roentgenol 1997; 168:997-1000.[Abstract]
4. Heneghan JP, Dalrymple NC, Verga M, Rosenfield AT, Smith RC. Soft-tissue rim sign in the diagnosis of ureteral calculi with use of unenhanced helical CT. Radiology 1997; 202:709-711.[Abstract]
5. Eric P. Tamm, Paul M. Silverman, and William P. Shuman
Evaluation of the Patient with Flank Pain and Possible Ureteral Calculus
Radiology 2003 228: 319-329
6. Deirdre M. Coll, Michael J. Varanelli, and Robert C. Smith
Relationship of Spontaneous Passage of Ureteral Calculi to Stone Size and Location as Revealed by Unenhanced Helical CT. Am. J. Roentgenol., Jan 2002; 178: 101 - 103.
7. I Boulay, P Holtz, WD Foley, B White, and FP Begun Ureteral calculi: diagnostic efficacy of helical CT and implications for treatment of patients. Am. J. Roentgenol., Jun 1999; 172: 1485 - 1490.
8. Chen MY, Zagoria RJ, Saunders HS, Dyer RB. Trends in the use of unenhanced helical CT for acute rinary colic. AJR Am J Roentgenol 1999; 173:1447-1450.[Abstract]
9. Smith RC, Verga M, McCarthy S, Rosenfield AT. Diagnosis of acute flank pain: value of unenhanced elical CT. AJR Am J Roentgenol 1996; 166:97-101.[Abstract]
10. Chen MY, Scharling ES, Zagoria RJ, Bechtold RE, Dixon RL, Dyer RB. CT diagnosis of acute flank pain from urolithiasis. Semin Ultrasound CT MR 2000; 21:2-19.[Medline]
11. Illya C. Boridy, Paul Nikolaidis, Akira Kawashima, Stanford M. Goldman, and Carl M. Sandler. Ureterolithiasis: Value of the Tail Sign in Differentiating Phleboliths from Ureteral Calculi at Nonenhanced Helical CT Radiology 1999; 211: 619-621.
12. Amy Rochester Guest, Richard H. Cohan, Melvyn Korobkin, Joel F. Platt, Claudia C. Bundschu, Isaac R. Francis, Achamyeleh Gebramarium, and Uwada M. Murray. Assessment of the Clinical Utility of the Rim and Comet-Tail Signs in Differentiating Ureteral Stones from Phleboliths
Am. J. Roentgenol., Dec 2001; 177: 1285 - 1291.
13. Smith RC, Essenmacher KR, Rosenfield AT, Choe KA, Glickman M. Acute flank pain: comparison of non-contrast CT and IVU. Radiology 1995;194:789 -794[Abstract]
14. Robert C. Smith and Michael Varanelli. Diagnosis and Management of Acute Ureterolithiasis: CT Is Truth. Am. J. Roentgenol., Jul 2000; 175: 3 - 6.
15. DS Katz, MJ Lane, and FG Sommer. Unenhanced helical CT of ureteral stones: incidence of associated urinary tract findings. Am. J. Roentgenol., Jun 1996; 166: 1319 - 1322.
16. Michael J. Morin, Stavroula Sourtzis, W. Dennis Foley, Donald R. Jacobsun, and Frank P. Begun Helical CT and Renal Calculi. Am. J. Roentgenol., Feb 2000; 174: 568 - 569.
17. Ronald J. Zagoria, Elaine G. Khatod, and Michael Y. M. Chen
Abdominal Radiography After CT Reveals Urinary Calculi: A Method to Predict Usefulness of Abdominal Radiography on the Basis of Size and CT Attenuation of Calculi. Am. J. Roentgenol., May 2001; 176: 1117 - 1122.
18. Cynthia H. McCollough, Michael R. Bruesewitz, Terri J. Vrtiska, Bernard F. King, Andrew J. LeRoy, Jeffrey P. Quam, and Robert R. Hattery
Image Quality and Dose Comparison among Screen-Film, Computed, and CT Scanned Projection Radiography: Applications to CT Urography
Radiology 2001 221: 395-403.
19. Creed M. Zakaria Assi, Joel F. Platt, Isaac R. Francis, Richard H. Cohan, and Melvyn Korobkin Sensitivity of CT Scout Radiography and Abdominal Radiography for Revealing Ureteral Calculi on Helical CT: Implications for Radiologic Follow-Up.Am. J. Roentgenol., Aug 2000; 175: 333 - 337.
20. Creed M. Rucker, Christine O. Menias, and Sanjeev Bhalla
Mimics of Renal Colic: Alternative Diagnoses at Unenhanced Helical CT RadioGraphics 2004; 24: 11-28.
21. Denis Tack, Stavroula Sourtzis, Isabelle Delpierre, Viviane de Maertelaer, and Pierre Alain Gevenois Low-Dose Unenhanced Multidetector CT of Patients with Suspected Renal Colic Am. J. Roentgenol., Feb 2003; 180: 305 - 311.22. Everett Marc Lautin. CT As a Cause of Cancer: What's Old Is New Again Am. J. Roentgenol., Sep 2001; 177: 717.
22. S Sourtzis, JF Thibeau, N Damry, A Raslan, M Vandendris, and M Bellemans
Radiologic investigation of renal colic: unenhanced helical CT compared with excretory urography. Am. J. Roentgenol., Jun 1999; 172: 1491 - 1494.
23. Fielding JR, Fox LA, Heller H, et al. Spiral CT in the evaluation of flank pain: overall accuracy and feature analysis. J Comput Assist Tomogr 1997; 21:635-638.[Medline]

Author Information

A. Sharma
Newton Mearns