# Alternate and Incidental Diagnoses on Noncontrast-Enhanced Spiral Computed Tomography for Acute Flank Pain

M Hammad Ather, Kulsoom Faizullah, Ilyas Achakzai, Rizwan Siwani, Fariah Irani

**Introduction:** Our aim was to determine the incidence and spectrum of significant alternate or incidental diagnoses established or suggested on spiral computed tomography (CT) in a large series of patients with suspected renal colic.

**Materials and Methods:** Records of all patients that had undergone spiral CT (5-mm to 7-mm slice thickness) for acute flank pain during a 5-year period were reviewed. The radiological diagnoses of urinary calculi and obstruction as well as clinical entities not suspected otherwise were analyzed.

**Results:** A total of 4000 CTs had been performed in the evaluation of acute flank pain. Urinary calculi had been identified in 3120 patients (78.0%). There were 398 patients (9.9%) who had an alternate cause of flank pain or an incidentally detected condition on CT. Of these patients, 102 (25.6%) had more than one additional finding. A total of 153 clinical conditions had been identified mimicking flank pain secondary to calculus and obstruction. In 47 patients (1.2%), incidental solid masses had been detected.

**Conclusion:** Spiral CT is a valuable technique in the evaluation of acute flank pain with uncertain clinical diagnosis. A wide spectrum of alternate and additional diagnoses including abdominal solid organ tumors and other significant abdominal conditions such as pancreatitis can be established or suggested on spiral CT performed for suspected acute urinary colic.

*Keywords: urinary calculi, colic, spiral computed tomography, incidental findings, differential diagnosis, urologic neoplasms*

*Urol J. 2009;6:14-8.*
*www.uj.unrc.ir*

## INTRODUCTION

Acute flank pain is a common presentation in emergency room, particularly in young men. In 2000, there were 108 000 000 emergency room visits in the United States, of which a total of 1 139 257 included a primary diagnosis of urinary calculus or renal colic.[1] In recent years, noncontrast-enhanced computed tomography (CT) has become the first choice in the evaluation of acute flank pain.[2,3] Advantages over other diagnostic modalities include being available and less time consuming, independent of the operator, high sensitive even for small or radiolucent calculi, no need for contrast medium injection, good calculus localization, fair size estimation, and ability to detect lesions mimicking calculi that cause acute flank pain.[2-5] Spiral CT has also become an accepted modality prior to treatment of urolithiasis by lithotripsy.[4,5] However, patients presenting with signs and symptoms suggestive of renal colic may have alternate conditions

*Department of Surgery, Aga Khan University, Karachi, Pakistan*

*Corresponding Author:*
*M Hammad Ather, MD*
*Aga Khan University, P O Box 3500, Stadium Rd, Karachi 74800, Pakistan*
*Tel: +92 21 486 4778*
*Fax: +92 21 493 4294*
*E-mail: hammad.ather@aku.edu*

*Received June 2008*
*Accepted December 2008*

which may not be apparent from history and examination and can change the management.[6-8] Thus, an early diagnosis and appropriate treatment of acute flank pain is important.

The use of spiral CT has popularized significantly; however, this has not resulted in increased number of negative scans for calculus. Kirpalani and colleagues[6] noted that there was no significant decrease in positive results in favor of renal colic or alternate diagnoses despite a definite trend of increased use of CT during a period between 1998 and 2002. Katz and colleagues noted a wide spectrum of significant alternate diagnoses including genitourinary (GU) and non-GU conditions that could be reliably established or suggested on spiral CTs performed for suspected renal colic cases.[7] This study was conducted to determine the incidence and spectrum of significant alternate or incidental diagnoses established or suggested on spiral CT in a large series of patients with suspected renal colic.

## MATERIALS AND METHODS

We reviewed spiral CT examinations of the kidneys, ureters, and bladder performed at the department of radiology of Aga Khan University, during a 5-year period between 2001 and 2005. We selected spiral CTs of patients with acute flank pain in whom urinary calculi were suspected according to the clinical data or a preceded ultrasonography indicating calculus or obstruction. Spiral CTs officially reported by the consultant radiologists with significant experience were reviewed and radiological findings other than urinary calculi were analyzed. Repeated CT scans of the patients for re-evaluation of the status of the calculus were excluded. Computed tomography scans in which alternate and/or incidental diagnoses had been identified were retrospectively reviewed by 2 radiologists. For these cases, a detailed chart and imaging review was performed, supplemented by phone calls to the selected patients and/or referring physicians, when necessary.

The CT examinations with 5-mm to 7-mm slices had been obtained on a Cti/pro single slice helical CT scanner (General Electrical medical systems, Milwaukee, Wisconsin, USA). Setting of the exposure factors had been 130 KVp and 200 mAS to 250 mAS. All scans had been obtained from the upper border of the T12 vertebral body to the lower border of the symphysis pubis using 5-mm collimation until 2003, and thereafter, it had increased to 7-mm in order to decrease radiation, without the use of oral or intravenous contrast medium. Patients had been placed in the supine position with a full bladder at the time of the CT. Additional prone films would have been taken whenever the radiologist had needed a better description of the suspected distal ureteral calculi.

All other radiological, biochemical, and serological investigations and findings during the operation were also noted. The patients' medical charts were reviewed to exclude CT-based diagnoses already known. Incidental conditions identified were further classified into significant and insignificant. The significant conditions were defined as those requiring further evaluation and management.

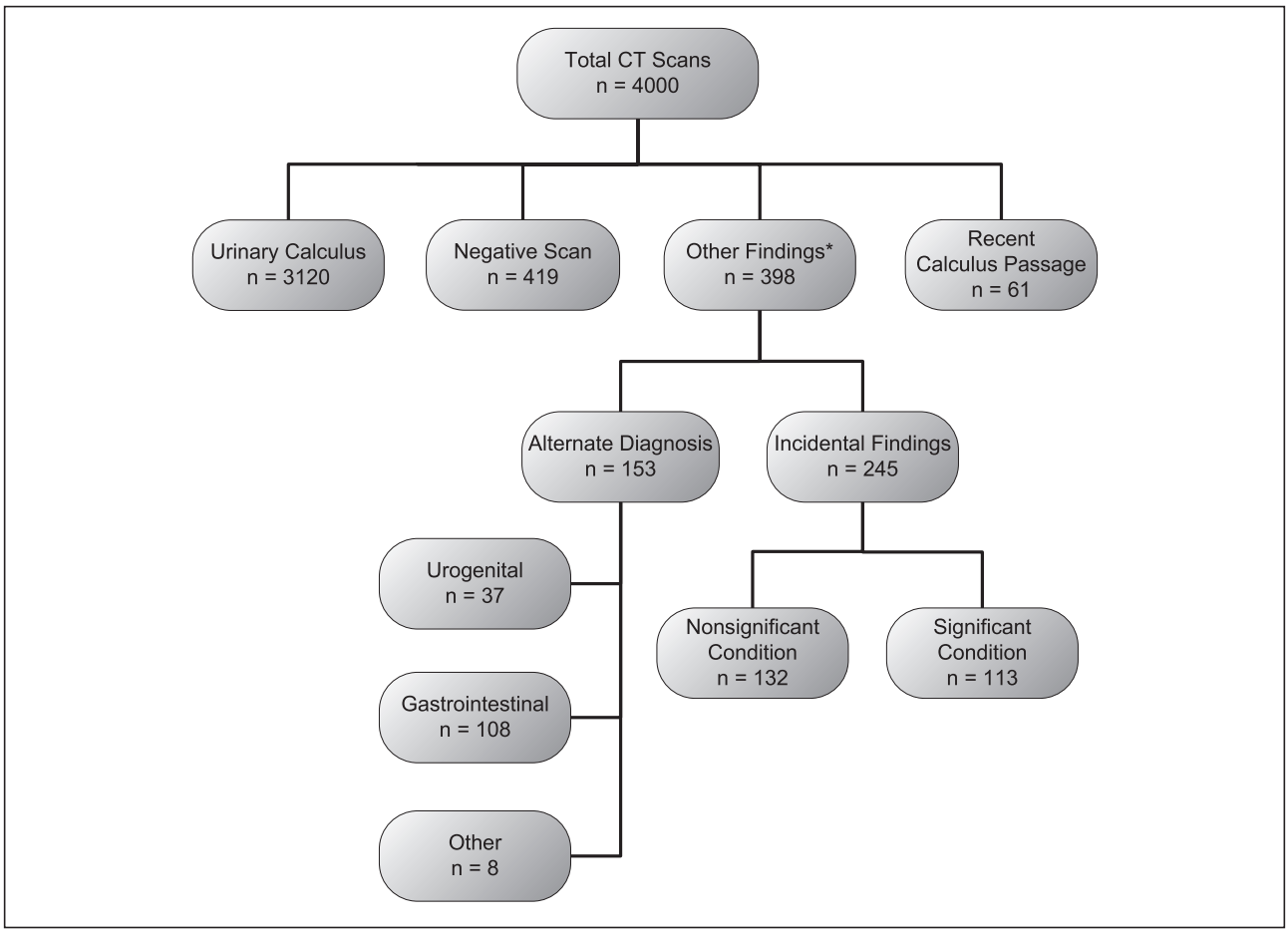
## RESULTS

Spiral CTs of 4000 patients were reviewed. The mean age of the patients was 45.0 ± 16.6 years, and 2360 of them (59.0%) were men. The spiral CTs had been ordered in the emergency room for 2920 patients (73.0%), while in 1080 (27.0%), they had been ordered either in clinics or in inpatient settings. Urinary calculus was the only diagnosis on 3120 examinations (78.0%). An alternate or incidental diagnosis was established or suggested on 398 examinations (9.9%). Of 245 patients (6.1%) with incidental findings, 180 (4.5%) also had urinary calculi (Table 1). Of the remaining 12.0%, 10.5% had normal scans and 1.5% had evidence of recent passage of a calculus. Patients' distribution based on the diagnoses is depicted in the Figure.

**Table 1.** Urinary Calculi Identified on Spiral Computed Tomography Scans in 180 of 398 Patients With Findings Unrelated to Calculi

| Calculi Location | Frequency (%) |
|---|---|
| Both Kidneys | 1 (0.6) |
| One Kidney | 88 (48.9) |
| Ureters | 58 (32.2) |
| Ureterovesical Junction | 31 (17.2) |
| Bladder* | 2 (11.1) |

*Two patients had small bladder calculi with a dilated ureter and other secondary signs of obstruction such as perinephric stranding that indicated a recent passage.




Distribution of patients based on their diagnoses according to spiral computed tomography findings.
*Of patients with incidental diagnoses, 180 had also a urinary calculus.

A total of 500 additional and alternate findings were found in the 398 patients; 2, 3, 4, and 5 additional findings were noted in 74, 20, 7, and 1 patients, respectively. There were 310 patients (77.9%) who had abnormalities outside the urogenital tract and 190 (44.7%) who had urogenital abnormalities. Inflammatory conditions, masses, and miscellaneous conditions were the findings outside the urogenital tract observed in 96, 12, and 202, respectively. Of the 190 urogenital findings, 5, 95, and 90 were inflammatory conditions, masses, and miscellaneous conditions, respectively.

Overall, spiral CT revealed solid masses in 47 patients (1.2%) which were in the urogenital tract in 36 patients and outside the urogenital tract in 11 patients. Masses in the urogenital tract were renal masses in 12, bladder tumors in 6, and angiomyolipomas in 2 patients (Table 2). Cystic lesions were detected in 58 patients (1.5%), of which 34 were in the kidneys (58.6%), 17 in the ovaries (29.3%), and 7 in the liver (12.1%).

Acute flank pain was secondary to other abdominal conditions in 153 cases. Clinical findings outside the urogenital tract were noted

**Table 2.** Incidental Diagnoses of Solid Mass Lesions on Spiral Computed Tomography in Patients With Acute Flank Pain

| Mass | Frequency (%) |
|---|---|
| Urogenital tumors | 36 (76.6) |
| Renal masses | 12 (25.5) |
| Ovarian masses | 8 (22.2) |
| Bladder tumors | 6 (17.0) |
| Uterine fibroids | 5 (10.6) |
| Renal angiomyolipoma | 2 (4.3) |
| Adnexal masses | 2 (4.3) |
| Prostatic nodule | 1 (2.1) |
| Nonurogenital tumors | 11 (23.4) |
| Adrenal mass | 5 (10.6) |
| Peri-ampullary tumors | 2 (4.3) |
| Caecal mass | 2 (4.3) |
| Hepatoma | 2 (4.3) |

**Table 3.** Incidental Diagnoses of Significant Inflammatory Causes of Acute Flank Pain on Spiral Computed Tomography

| Condition | Frequency (%) |
|---|---|
| Appendicitis | 20 (38.5) |
| Hepatic granuloma | 15 (28.8) |
| Splenic granuloma | 4 (7.7) |
| Retroperitoneal fibrosis | 3 (5.8) |
| Pancreatitis | 3 (5.8) |
| Soft tissue emphysema | 2 (3.8) |
| Paracolic abscess | 1 (1.9) |
| Adnexal inflammation | 1 (1.9) |
| Renal abscess | 1 (1.9) |
| Diverticulitis | 1 (1.9) |
| Emphysematous pyelonephritis | 1 (1.9) |

in 75.8% including 108 cases of gastrointestinal disorders and 8 other conditions. Inflammatory conditions identified on the spiral CT which required appropriate institution of therapy are detailed in Table 3.

## DISCUSSION

The value of spiral CT for investigating acute flank pain suggestive of urinary calculi was first established by Smith and colleagues.[3] Many studies have shown its high sensitivity and specificity in diagnosis of calculi and urinary obstruction.[2,3,8-13] In the current work, spiral CT showed calculi in 80% of the patients in the group without additional diagnoses and in 45% of those in the group with additional findings. One of the disadvantages of CT, however, is the radiation dose per study. This is significantly higher than that of intravenous urography and a combination of plain abdominal radiography and ultrasonography. Recently, Kluner and associates evaluated the diagnostic yield of multislice CT using a radiation dose equivalent to that of conventional abdominal radiography. They noted that the sensitivity and specificity of detecting patients with calculi was 97% and 95% for CT and 67% and 90% for ultrasonography, respectively.[14] Urinary obstruction was similarly assessed, and CT identified more alternate diagnoses than ultrasonography ($P < .001$). On the contrary, Catalano and coworkers observed that noncontrast-enhanced helical CT and ultrasonography had comparable accuracy in diagnosing causes other than calculi.[15]
The present CT protocol is comparable in diagnostic yield and radiation dose to that of plain radiography of the kidneys, ureters, and bladder.

Usually, noncontrast-enhanced CT is performed with 5-mm collimation for the evaluation of ureteral calculi, while many ureteral calculi are 5 mm in diameter or smaller; therefore, size measurements made at CT with 5-mm collimation may not be accurate. However, size measurement by CT does not significantly vary with slice thickness.[16] Many patients presenting to the emergency rooms have nonobstructing urinary calculi on noncontrast-enhanced CT. Furlan and colleagues noted that these calculi were usually not recognized as the cause of pain by physicians and may be responsible for multiple clinical and radiological evaluations.[17] In the absence of other clinical or CT evidence, these calculi are likely to be the cause of the patient's acute pain.

Gynecologic, gastrointestinal, and urogenital disorders can also present as abdominal pain mimicking ureteral colic.[8-11,13] Additional advantages of spiral CT in recognizing alternate findings within or outside the urinary tract have also been mentioned in some recent studies.[8-13] In the present study, various significant inflammatory conditions of the abdomen helped in triaging these patients. In-time identification of the potentially morbid conditions not only helps to reduce the time of stay in the emergency room, but also significantly reduces morbidity.

In a recent study, Lazarus and colleagues determined the sensitivity and specificity of CT for the diagnosis of appendicitis in pregnant women with nontraumatic abdominal pain.[18] They found a sensitivity rate of 92%, a specificity of 99%, and a negative predictive value of 99%. They noted that CT findings were normal in 51 cases (64%) and abnormal in 29 (36%). Abnormal findings were appendicitis (16%), urinary tract calculi (7%), small bowel obstruction (2%), cholelithiasis (2%), pyelonephritis (2%), diaphragmatic hernia (1%), caecal bascule (1%), ileus (1), and metastatic lymphadenopathy (1%). Up to one-third of CTs performed because of flank pain may reveal findings unrelated to urolithiasis.[9] Alternate diagnoses are gynecologic conditions (especially adnexal masses) and urogenital diseases (such as pyelonephritis and

kidney neoplasms), followed by gastrointestinal (especially appendicitis and diverticulitis), hepatobiliary, vascular, and musculoskeletal conditions. Radiologists should know alternate diagnoses as well as the typical findings in favor of urolithiasis detected on CT. Early diagnosis and appropriate treatment of these causes are important. Computed tomography potentially gives more information and may detect alternate or additional pathologies which would be missed on intravenous urography. Many abdominal cancers related to or out of the urogenital tract could be incidentally found by CT of the kidneys, ureters, and bladder.

## CONCLUSION

Spiral CT is now the imaging method of choice for evaluation of acute flank pain, because it is not only highly sensitive and specific in identifying calculi and obstruction, but also can reveal alternate causes of flank pain and identify many significant incidental conditions such as solid organ tumors.

## ACKNOWLEDGEMENT

We would like to thank Professor Jeffrey Rees and Dr Wasim Memon for their help and kind cooperation.

## CONFLICT OF INTEREST

None declared.

## REFERENCES

1. Brown J. Diagnostic and treatment patterns for renal colic in US emergency departments. Int Urol Nephrol. 2006;38:87-92.
2. Ahmad NA, Ather MH, Rees J. Unenhanced helical computed tomography in the evaluation of acute flank pain. Int J Urol. 2003;10:287-92.
3. Smith RC, Verga M, McCarthy S, Rosenfield AT. Diagnosis of acute flank pain: value of unenhanced helical CT. AJR Am J Roentgenol. 1996;166:97-101.
4. Ather MH, Faruqui N, Akhtar S, Sulaiman MN. Is an excretory urogram mandatory in patients with small to medium-sized renal and ureteric stones treated by extra corporeal shock wave lithotripsy? BMC Med. 2004;2:15.
5. Greenstein A, Beri A, Sofer M, Matzkin H. Is intravenous urography a prerequisite for renal shockwave lithotripsy? J Endourol. 2003;17:835-9.
6. Kirpalani A, Khalili K, Lee S, Haider MA. Renal colic: comparison of use and outcomes of unenhanced helical CT for emergency investigation in 1998 and 2002. Radiology. 2005;236:554-8.
7. Katz DS, Scheer M, Lumerman JH, Mellinger BC, Stillman CA, Lane MJ. Alternative or additional diagnoses on unenhanced helical computed tomography for suspected renal colic: experience with 1000 consecutive examinations. Urology. 2000;56:53-7.
8. Ather MH, Memon W, Rees J. Clinical impact of incidental diagnosis of disease on non-contrast-enhanced helical CT for acute ureteral colic. Semin Ultrasound CT MR. 2005;26:20-3.
9. Eshed I, Kornecki A, Rabin A, Elias S, Katz R. Unenhanced spiral CT for the assessment of renal colic. How does limiting the referral base affect the discovery of additional findings not related to urinary tract calculi? Eur J Radiol. 2002;41:60-4.
10. Ahmad NA, Ather MH, Rees J. Incidental diagnosis of diseases on un-enhanced helical computed tomography performed for ureteric colic. BMC Urol. 2003;3:2.
11. Hoppe H, Studer R, Kessler TM, Vock P, Studer UE, Thoeny HC. Alternate or additional findings to stone disease on unenhanced computerized tomography for acute flank pain can impact management. J Urol. 2006;175:1725-30.
12. Dalrymple NC, Verga M, Anderson KR, et al. The value of unenhanced helical computerized tomography in the management of acute flank pain. J Urol. 1998;159:735-40.
13. Katz DS, Lane MJ, Sommer FG. Unenhanced helical CT of ureteral stones: incidence of associated urinary tract findings. AJR Am J Roentgenol. 1996;166:1319-22.
14. Kluner C, Hein PA, Gralla O, 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;30:44-50.
15. Catalano O, Nunziata A, Sandomenico F, Siani A. Acute flank pain: comparison of unenhanced helical CT and ultrasonography in detecting causes other than ureterolithiasis. Emerg Radiol. 2002;9:146-54.
16. Dobbins JM, Novelline RA, Rhea JT, Rao PM, Prien EL, Dretler SP. Helical computed tomography of urinary tract stones: Accuracy and diagnostic value of stone size and density measurements. Emergency Radiology. 1997;4:303-8
17. Furlan A, Federle MP, Yealy DM, Averch TD, Pealer K. Nonobstructing renal stones on unenhanced CT: a real cause for renal colic? AJR Am J Roentgenol. 2008;190:W125-7.
18. Lazarus E, Mayo-Smith WW, Mainiero MB, Spencer PK. CT in the evaluation of nontraumatic abdominal pain in pregnant women. Radiology. 2007;244:784-90.