IMAGING

Distal ureteral calculi: US follow-up

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Radiology. 2011; 260: 575-80

Purpose: To assess accuracy of ultrasonographic (US) follow-up of distal ureteral calculi by using computed tomography (CT) and conventional radiography (kidneys, ureters, and bladder) as reference standards.
Materials and Methods: The study was approved by the Regional Ethics Committee, and written informed consent was obtained. One hundred fifty-eight patients with CT-diagnosed symptomatic ureteral calculi, for whom follow-up imaging was ordered, were enrolled from February 2006 to December 2008. Six were excluded, having not met study entry criteria, with 121 men (mean age, 49 years; range, 20-91 years) and 31 women (mean age, 44 years; range, 34-77 years) completing the protocol with adequate reference standard imaging. Targeted transabdominal US occurred coincidently with follow-up CT (n = 92) or radiography (n = 60), with US evaluation prospectively compared considering sensitivity and specificity. Statistical analysis was performed with a $\chi(2)$ test, t test, or paired t test, as appropriate.
Results: Results of nine US examinations were nondiagnostic because of inadequate ureteral visualization, and among these, two cases showed residual distal calculi. Of the remaining 143 patients, 33 had residual distal calculi, all visualized with US. There was a single false-positive study, giving sensitivity, including nondiagnostic US examinations, of 94.3% (95% confidence interval [CI]: 80.8%, 99.3%) and specificity of 99.1% (95% CI: 95.3%, 100%). All calculi appeared hyperechoic with posterior acoustic shadowing. Additional diagnostic features included presence of a hypoechoic rim and Doppler twinkle artifact. Mean stone length was 7.2 mm ± 2.6 (stan-

dard deviation) (range, 4-18 mm). Mean ureteral length visualized was 36.4 mm (range, 12-77 mm), with calculi positioned at a mean of 13.1 mm ± 11.2 (range, 0-40 mm) from the ureterovesical junction (UVJ). Nondiagnostic results were more likely with bladder volume of 110 mL or less (eight [16%] of 50 vs one [1%] of 102, P = .0009). Conclusion: Ureteral calculi within 35 mm of the UVJ can be accurately followed-up by using transabdominal US, which substantially reduces patient radiation burden.

Editorial Comment

Using non-contrast CT for follow-up urinary tract stone is of concern because this entity commonly occurs in a relatively young population. Recently low radiation dose CT protocol has been developed for urinary tract follow-up. The effective radiation dose to the patient range from 8-10 mSv for the standard non-contrast CT protocol, from 3-5 mSv for low dose CT-protocol and from 0.5-1.2 mSv for conventional plain film of the abdomen.

This is a retrospective study that shows that in patients with impacted ureteral stone demonstrated by previous CT, US alone can be of value for the patients' follow-up allowing the detection of residual distal ureteral stone. US showed high sensitivity and specificity when compared with non-contrast CT and conventional abdominal plain film. Calculi within 35 mm of the ureterovesical junction, larger than 4 mm (mean length of residual calculi = 7.2 mm) were better detected in non-obese patients with adequate bladder distension (150-200 mL).

Ultrasound (US) is a noninvasive, safe technique, which can detect acute urinary obstruction due to ureteral stone. Since it is an operator dependent technique and much of ureteral length is frequently obscured by bowel gas its accuracy for detecting ureteral stones varies from 4-83%. Color Doppler sonography is useful as a complimentary when the presence ureteral stone is associated with a specific artifact called "twinkle artifact". Abnormal ureteral jetting is another useful Color Doppler finding for the characterization of distal ureteral stone. In obese, dehydrated patients or in patients presenting an empty bladder, transvaginal or transrectal ultrasound could be also a useful complimentary approach for the detection of distal ureteral stone.

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