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Abstract  Background. Secondary signs of urinary obstruction associated with ureteral calculi are useful adjuncts to diagnosis in adults with renal colic evaluated by unenhanced helical CT.  
Objective. Our purpose was to evaluate the frequency of secondary signs of obstruction in children with renal colic undergoing unenhanced helical CT.  
Materials and methods. Ureteral calculi were identified in 20 of 61 children with acute flank pain examined by unenhanced helical CT. Each imaging study was evaluated for the presence of secondary signs of urinary obstruction. The frequencies of individual signs were compared with each other by means of the McNemar test.  
Results. Six children had no secondary sign identified. In the remaining 14 children, proximal ureteral dilation was seen in 10, renal enlargement in 10, hydronephrosis in 9, tissue rim sign in 6, decreased kidney attenuation in 5, and perinephric stranding in 1. Comparison of the frequencies strongly suggested that perinephric stranding occurs less frequently than proximal ureteral dilatation (P = 0.004), hydronephrosis (P = 0.008), or renal enlargement (P = 0.012).  
Conclusion. Perinephric stranding, a common secondary sign in adults with ureteral calculi, occurs less frequently in children than other reported secondary signs.

Introduction  
The diagnostic modality of choice for patients with acute renal colic is unenhanced helical computed tomography (UHCT). [1, 2, 3] UHCT is more sensitive and specific for the detection of ureteral calculi than all other imaging modalities. Secondary signs of urinary tract obstruction are useful in adults in the diagnosis of ureteral calculi. [4, 5, 6]  
Our purpose is to describe the relative frequency of selected secondary signs in children with renal colic undergoing UHCT.

Materials and methods  
UHCT was performed to rule out urinary tract calculi in 61 patients with acute flank pain at a tertiary pediatric hospital between June, 1997 and December, 1998. The patients ranged in age from 6 months to 19 years (mean age 11.6 years) and included 30 boys and 31 girls. Helical computed tomography was performed using 5 mm collimation at 2.5 mm reconstruction intervals and a pitch of 1.0. No oral or intravenous contrast was used. The area of coverage included the kidneys, ureters, and urinary bladder. Cooperative patients suspended respiration during the examination. Younger children were studied during quiet respiration.

Two pediatric radiologists independently reviewed each case retrospectively for presence of ureteral calculi and for secondary signs of ureteral obstruction: proximal ureteral dilation (PUD), renal enlargement (RE), hydronephrosis (HN), decreased renal attenuation (DRA), tissue rim sign (TRS), and perinephric stranding (PNS). Proximal ureteral dilatation was identified if ureteral dilatation was seen on sequential images from the level of the renal hilum to the level of the calculus, with normal caliber ureter inferior to the level of the calculus. [5] Renal enlargement was identified if scans through the level of the central portions of the two kidneys showed subjective asymmetry of renal cortical thickness and asymmetry in transverse renal diameter. [7] Decreased renal attenuation was identified as visual asymmetry of renal parenchymal attenuation.
Table 1. Secondary signs of urinary obstruction in 20 patients with ureteral calculus (PUD proximal ureteral dilatation, RE renal enlargement, HN hydronephrosis, TRS tissue rim sign, DRA decreased renal attenuation, PNS perinephric stranding)

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Fig. 1 UHCT at level inferior to kidneys shows proximal ureteral dilatation (arrow) in a 13-year-old girl with left distal ureteral calculus.

Fig. 2 Renal enlargement and decreased renal attenuation demonstrated by UHCT in a 17-year-old girl with obstructing right ureteral calculus.

Results

Forty of the 61 patients had no stones and no secondary signs of urinary obstruction at UHCT. One patient with known history of stone disease had hydronephrosis, renal enlargement, and decreased renal attenuation on the same side as the flank pain, but no calculus detected. Twenty patients had ureteral calculi detected at UHCT. Nineteen children had unilateral calculi identified, and 1 child had bilateral calculi. Six children with calculi had no secondary signs of obstruction. Secondary signs of ureteral obstruction were present in 13 children with unilateral calculi and present on one side in the child with bilateral calculi. Abdominal radiograph was per-