Ureteral Stone Location at Emergency Room Presentation With Colic

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Purpose: It is thought that the 3 narrowest points of the ureter are the ureteropelvic junction, the point where the ureter crosses anterior to the iliac vessels and the ureterovesical junction. Textbooks describe these 3 sites as the most likely places for ureteral stones to lodge. We defined the stone position in the ureter when patients first present to the emergency department with colic.

Materials and Methods: We retrospectively reviewed the records of 94 consecutive patients who presented to the emergency department with a chief complaint of colic and computerized tomography showing a single unilateral ureteral calculus. Axial, coronal and 3-dimensional reformatted computerized tomography scans were evaluated, and stone position and size (maximal axial and coronal diameters) were recorded, as were the position of the ureteropelvic junction, the iliac vessels (where the ureter crosses anterior to the iliac vessels) and the ureterovesical junction. Patients with a history of nephrolithiasis, shock wave lithotripsy, ureteroscopy or percutaneous nephrolithotripsy were excluded from study. Statistical analysis was performed using Student’s t test and Pearson’s correlation coefficient.

Results: At the time of emergency department presentation for colic ureteral stone position was the ureteropelvic junction in 10.6% cases, between the ureteropelvic junction and the iliac vessels in 23.4%, where the ureter crosses anterior to the iliac vessels in 1.1%, between the iliac vessels and the ureterovesical junction in 4.3% and at the ureterovesical junction in 60.6%. Proximal calculi had a greater axial diameter than distal calculi (mean 6.1 vs 4.0 mm) and a greater coronal diameter than distal calculi (6.8 vs 4.1 mm, each p <0.001). Axial and coronal diameters moderately correlated with stone position (r = −0.47 and −0.55, respectively, each p <0.001).

Conclusions: Proximal ureteral stones were larger in axial and coronal diameter than distal ureteral stones. At emergency department presentation for colic most stones were at the ureterovesical junction and in the proximal ureter between the ureteropelvic junction and the iliac vessels. A few stones were at the ureteropelvic junction and only 1 lodged at the level where the ureter crosses anterior to the iliac vessels, despite the literature stating that these locations are 2 of the 3 most likely places for stones to become lodged.

Key Words: ureter, ureteral calculi, colic, emergencies

It has long been urological dogma that the 3 narrowest points in the ureter are the UPJ, the point where the ureter crosses anterior to the external iliac vessels, and the UVJ, and these are the 3 most likely locations for ureteral stones to lodge.1–5 With the advent of medical expulsive therapy as first line treatment for the index patient with ureteral calculi6 it is impor-
tant to understand the natural history of ureteral stone passage and the points in the ureter where stones are likely to become lodged or impacted. Recent evidence suggests that historical teachings regarding the UPJ, the level where the ureter crosses anterior to the iliac vessels and the UVJ as the most likely places to find an obstructing ureteral stone may be inaccurate. We determined the exact location of ureteral stones when patients first presented to the emergency department with colic.

MATERIALS AND METHODS
We retrospectively reviewed the records of 94 consecutive patients who presented to the emergency department with a chief complaint of colic and unenhanced CT that showed a single unilateral ureteral calculus. Axial, coronal and 3-dimensional reformatted CT images were evaluated by 2 observers. Stone position and size (axial and coronal diameters) were recorded, as were the position of the UPJ, the site where the ureter crosses anterior to the iliac vessels and the UVJ. The UPJ was defined as the convergence of the renal pelvis and the ureter. The UVJ was defined as the segment of ureter that traverses the bladder wall. Ureteral distances were calculated by subtracting CT slice numbers and multiplying by CT cut thickness. Patients with a history of nephrolithiasis, SWL, ureteroscopy or PCNL were excluded from study. Statistical analysis was performed using Student’s t test and Pearson’s correlation coefficient.

RESULTS
The records of 94 patients were analyzed. Mean age was 43.6 years (range 23 to 74). The female-to-male ratio was 17:77. CT cut thickness was 0.625 mm in 2 patients (2.1%), 1.25 mm in 81 (86.2%), 2.5 mm in 3 (3.2%) and 5 mm in 8 (8.5%). Calculi were located in the left ureter in 42 patients (45%) and in the right ureter in 52 (55%). There was no difference in mean ureteral length between females and males (21.7 vs 20.9 cm, p = 0.25).

At emergency department presentation for colic, ureteral stones were at the UPJ in 10 cases (10.6%), between the UPJ and the iliac vessels in 22 (23.4%), where the ureter crosses anterior to the iliac vessels in 1 (1.1%), between the iliac vessels and the UVJ in 4 (4.3%) and at the UVJ in 57 (60.6%) (see figure).

The 22 stones in the proximal ureter (between the UPJ and the iliac vessels) were significantly closer to the UPJ than to the iliac vessels. Mean distance below the UPJ was 4.3 cm (range 0.75 to 7.5) and mean distance above the iliac vessels was 8.9 cm (range 5.0 to 12.5) (p <0.001). The 4 stones in the distal ureter (between the iliac vessels and the UVJ) were significantly closer to the UVJ than to the iliac vessels. Mean distance below the iliac vessels was 4.9 cm (range 3.5 to 6) and mean distance above the UVJ was 1.75 cm (range 1.25 to 2.25) (p = 0.001).

DISCUSSION
We examined the veracity of what has long been taught in urology, that the UPJ, the site where the ureter crosses anterior to the iliac vessels and the UVJ are the 3 narrowest points in the ureter and the likeliest places for stones to lodge. Despite historical teachings there is a paucity of corroborating evidence. Older data relied on traditional excretory urography and plain abdominal x-ray to determine stone location. These studies cannot definitively identify the site of the iliac vessels and may not be able to identify the site of the UPJ and UVJ as accurately as CT. Recent data suggest that the most common places where stones become impacted in the ureter may not be at those 3 sites.
Our findings contradict what has been taught to residents in urology, surgery, medicine, emergency medicine and medical students for decades. We found that the 2 most common places for stones to lodge at emergency department presentation with colic were the UVJ (60.6% of cases) and the proximal ureter between the UPJ and the iliac vessels (23.4%). A few stones were located at the UPJ (10.6%) and the distal ureter (4.3%), and only 1 (1.1%) was at the iliac vessel level. While textbooks are correct about the UVJ, our findings do not agree with the statement that stones often lodge at the UPJ or where the ureter crosses anterior to the iliac vessels. Our analysis included patients upon initial presentation to the emergency room and excluded those with a history of nephrolithiasis, or any surgical or minimally invasive treatment for nephrolithiasis to ascertain the location of stones when colic first becomes severe enough to bring patients to the emergency department.

We also found that axial and coronal diameters moderately correlated with ureteral stone position. The smaller the stone, the more likely it is to pass down to the distal ureter. This is consistent with previously published data.11

Schuler et al recently examined the site of ureteral stones in a patient referred to a urological clinic for extracorporeal shock wave lithotripsy.7 Histogram analysis showed 2 peaks of calculous distribution, that is the first adjacent to the proximal border of the third lumbar vertebra and the second in the pelvic ureter near the UVJ. There was no histogram peak at the point where the ureter crosses anterior to the iliac vessels. However, there are several important distinctions between that study and ours. That group examined patients referred for SWL, not at the time of emergency department presentation with renal colic. In some if not all of their patients presumably several weeks would have passed between the initial presentation with colic and the time of imaging for SWL. Their study does not reflect the position in patients when they first present with colic. In contrast, we examined patients upon the initial presentation to the emergency department. In addition, they did not distinguish patients who had previously passed stones or had been previously treated with ureteroscopy or PCNL from those who had not.7 In our study patients with a history of previous stone passage, ureteroscopy, SWL or PCNL were excluded to avoid the possible confounding effects of previous stone passage or surgery. Thus, we believe that we addressed the natural history of ureteral stone passage in ureters that have not been previously instrumented or altered by inflammation due to prior stone passage.

To our knowledge no studies have truly examined variations in ureteral diameter with respect to ureteral site. However, 2 groups have radiographically examined ureteral width. Zelenko et al examined 212 patients with a single obstructing ureteral stone.12 The obstructed ureter and the ureter without a stone were measured. Findings showed that the mean axial diameter of the ureter that did not contain a stone was 1.8 mm (range 1 to 6) and 96% of ureters were 3 mm or less in diameter. Eisner et al looked at the 2 ureters in 50 patients who presented for ureteroscopy with a single obstructing ureteral calculus.13 Ureteral diameter was measured and stratified by location. For unobstructed ureters there was no statistically significant difference between proximal and distal ureteral diameters (4.3 vs 3.8 mm, p not significant).

There are several inherent weaknesses of our study. It is a retrospective study and, thus, subject to the shortcomings of retrospective review. In addition, although we report the site where stones lodged at the time of emergency department presentation with colic, we did not measure ureteral diameter to confirm whether stone site corresponded with ureteral diameter. It is possible that the UPJ and the level where the ureter crosses anterior to the iliac vessels may be 2 of the 3 narrowest points of the ureter but they are not among the most common places for stones to lodge when patients present with colic. Also, there were significantly more men than women in our study (77 vs 17). This occurred by chance, ie this was the gender ratio after excluding patients ineligible for study. While it is known that nephrolithiasis occurs with greater frequency in men than in women,6 theoretically this could confound our results if differences exist between male and female ureters. Finally, we did not examine outcomes, which would be interesting with respect to our findings. A future study of the rate of spontaneous passage relative to initial obstruction site would yield interesting information for clinicians.

CONCLUSIONS

This study shows that a few stones lodge at the UPJ and the point where the ureter crosses anterior to the iliac vessels. Most stones lodge at the UVJ and the proximal ureter (60.6% and 23.4%, respectively). Based on our findings we have certain recommendations for clinicians who evaluate patients with colic.

1) When interpreting plain x-ray of the kidneys, ureters and bladder, the points of focus should be the UVJ and the upper ureter, which accounted for 84% of stones in our study. 2) When evaluating colic on abdominal ultrasound, the study should be performed in a patient with a full bladder (to serve as an acoustic window) to best visualize the UVJ.
REFERENCES


