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Urolithiasis

Investigation of the Location of the Ureteral Stone and Diameter of the Ureter in Patients with Renal Colic

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Purpose: The objective of this study were to evaluate the location of ureteral stones and the diameter of the ureter in patients with renal colic.

Materials and Methods: We retrospectively reviewed the records of 95 consecutive patients who presented to the emergency department with renal colic in whom urinary stones were diagnosed by computed tomography between January 2009 and August 2009. The size and location of the stones were investigated. The length and diameter of unaffected ureters were also measured.

Results: The mean size of the stones was 4.87±3.49 mm (range, 0.9-22 mm). Stones were located at ureterovesical junction (UVJ) in 44 cases (46.3%), proximal ureter in 29 (30.5%), distal ureter in 16 (16.8%), ureteropelvic junction (UPJ) in 5 (5.2%), and the ureter crossing external iliac vessel (UEIV) in 1 case (1%). The mean length of the ureter was 226.8±20.8 mm (range, 175-286 mm). The mean diameter of the ureter was 3.40±0.61 mm (range, 1.9-5.3 mm). The mean diameter of the UEIV was 3.28±0.59 mm (range, 2.2-5.3 mm).

Conclusions: The UPJ and UEIV were not common sites of ureteral stones. The smaller the stones, the closer to the UVJ that the stones were located. Spontaneous passage of the stones was most frequently observed for stones in the UVJ. The UEIV was not significantly narrower than the other parts of the ureter.

Key Words: *Ureteral calculi; Colic*

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INTRODUCTION

Accurate diagnosis of underlying disease is essential to successfully managing patients with renal colic. Because the bowel is not empty at the time and radiolucent uric acid increases in stones, ureteral stones are often not identified on kidney ureter bladder (KUB) X-rays at the emergency department [1]. Therefore, unenhanced computed tomography (CT), which has with a high rate of accurate diagnosis is useful in clinical practice because it is feasible without any preparation of the bowel [2,3]. Ureteral stones can be treated medically with analgesics, with extracorporeal shock wave lithotripsy, ureteroscopic lithotripsy and laparoscopic ureterolithotomy. Information on the location, size, and shape of the stone is essential in the selection of a proper treatment modality. It has been reported that ureteral stone-induced pain is closely related to the anatomical structure of the ureter. Some investigators have reported that ureteral stones frequently occur the following 3 sites of the ureter: the ureteropelvic junction (UPJ), the ureter crossing external iliac vessel (UEIV) and the ureterovesical junction (UVJ), but other investigators have not [4].

This study was conducted to investigate the location of ureteral stones and the diameter of the ureter in patients with renal colic use of unenhanced CT.

MATERIALS AND METHODS

A total of 104 patients visited the emergency department of our hospital because of renal colic between January 2009 and August 2009. Of these patients, 95 patients who had no previous history of ureteral stones, and in whom ureteral stones were initially diagnosed by unenhanced abdominal CT, were enrolled in this study. The mean age of the patients was 46 years (range, 17-75 years), and the male to female ratio was 1.57:1. Ureteral stones were identified at the right ureter in 38 cases (42%) and at the left ureter

in 57 cases (58%) (Table 1). Computed tomography was performed by using a SOMATOM sensation 64 channel CT scanner (SIEMENS, Germany). After 1 mm scans were taken, 5 mm picture archiving and communication system (PACS) scans were reconstructed. From the PACS scans, the longitudinal, transverse, three-dimensional images were obtained and analyzed by a single urologist.

The size of the ureteral stone was defined as its longest diameter on CT scan. The location of the ureteral stone was classified as the UPJ, the proximal ureter between the UPJ and the UEIV, the UEIV, the distal ureter between the UEIV and UVJ, and the UVJ. The distance from the UPJ or UEIV to the stone was measured. The length of the ureter was defined as the distance between the UPJ and UVJ and the diameter of the ureter was measured at the widest portion of the ureter during ureteral peristalsis of the unaffected contralateral ureter. We used the maximal ureteral diameter of each patient to determine the mean ureteral diameter. We could not evaluate the diameter of the UEIV in 17 (17.9%) of the total 95 study participants because of ureteral peristalsis or because the UEIV could not be distinguished from surrounding structures. Statistical analyses was performed using the Student's t-test with SPSS version 17.0 (SPSS Inc, Chicago, USA). Statistical significance was considered at $p < 0.05$.

RESULTS

Of the 95 patients with ureteral stones, 55 (57.8%) were definitely diagnosed by KUB X-rays, but the remaining 40 (42.2%) were not. The ureteral stones were located at the UPJ in 5 patients (5.2%), at the proximal ureter in 29 patients (30.5%), at the UEIV in 1 patient (1%), at the distal ureter in 16 patients (16.8%) and at the UVJ in 44 patients (46.3%). The mean size of the stones was 10.2±8.9 mm (range, 1-20 mm) at the UPJ, 5.3±2.93 mm (range, 2-18 mm) at the proximal ureter, 9.0 mm at the UEIV, 4.4±1.87 mm (range, 1-8 mm) and 3.77±1.71 mm (range, 1-11 mm) at the UVJ. In 29 patients located at the proximal ureter, the distance between UPJ and the UEIV was 138±23.4 mm (range, 85-180 mm), and the distance between the UPJ and the stone was 50.3±23.1 mm (range, 19-109 mm). The proximal ureter stones were closer to the UPJ than to the UEIV, but this was not statistically significant (p=0.64). In 16 patients with ureteral stones located at the distal ureter, the distance between the UEIV and the UVJ was 73±15 mm (range, 56-83 mm), and the distance between the UEIV and the stone was 43.1±15.4 mm (range, 17-79 mm). The stones were located significantly closer to the UVJ (p=0.03).

Smaller the stones were located closer to the distal ureter (Table 2, Fig. 1). Sixty-two patients were followed up after 3.4 days (range, 1-7 days). Of the 62 patients, spontaneous passage of the stones was noted in 24 patients; in the remaining patients, ureteroscopic lithotripsy was need in 10 patients, extracorporeal shock wave lithotripsy in 25 patients, and medical treatment in 3 patients. In 24 patients with spontaneous passage, the mean stone size was 3.8±1.5 mm (range, 1-8 mm). Spontaneous passage was most frequently observed in those with UVJ stones (14/26, 53%), followed by proximal ureter stones (7/19, 36%), and distal ureter stones (3/9, 33.3%).

Mean diameter of the normal ureter was 3.38±0.6 mm (range, 1.9-4.9 mm), and that of the UEIV was 3.28±0.59 mm (range, 2.2-5.3 mm), but the difference was not statistically significant (p=0.27).

TABLE 1. Demographic and clinical characteristics of the patients

No. of patients	95
Age (years)	46.1±13.9 (17-75)
No. of men/no. of women	58/37
Location of ureter stones	
Right ureter	38
Left ureter	57
No. of stones detected on CT and KUB, both (%)	40 (44)

CT: computed tomography, KUB: kidney ureter bladder

TABLE 2. Location, number and size of ureteral stones

Location	Number (%)	Mean size (mm)
UPJ	5 (5.2)	10.2±8.9 (1-20)
Proximal ureter	29 (30.5)	5.3±2.93 (2-18)
UEIV	1 (1)	9
Distal ureter	16 (16.8)	4.4±1.87 (1-8)
UVJ	44 (46.3)	3.77±1.71 (1-11)
Total	95	

r=−0.321, p=0.002, UPJ: ureteropelvic junction, UEIV: ureter crossing external iliac vessel, UVJ: ureterovesical junction

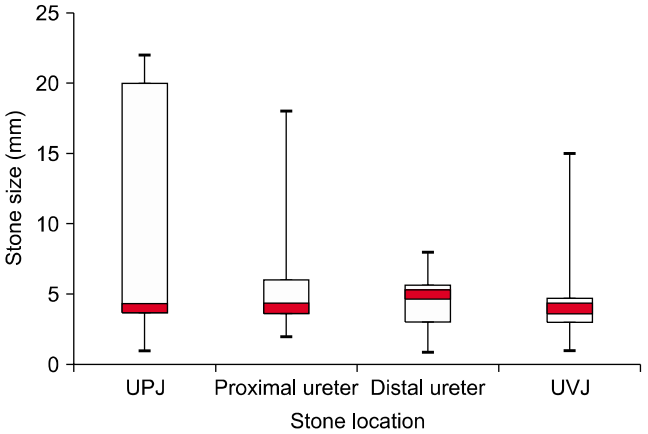

FIG. 1. Stone size and location. Because of low number of case, ureter crossing external iliac vessel (UEIV) was omitted from the figure. UPJ: ureteropelvic junction, UVJ: ureterovesical junction.

DISCUSSION

Patients with urinary stones presenting to the emergency department complain of severe renal colic caused by sudden obstruction of the ureter by the stones. In such cases, on simple X-rays and intravenous pyelograms stones are frequently found at the three anatomically narrow sites: the UPJ, the UEIV and the UVJ [5]. With remarkable advances in CT technologies, its diagnostic accuracy of the stones including radiolucent and small stones has increased, and the locations of the UPJ, UEIV and UVJ in relationship with the stones could be identified [2,3]. In recent days, multidetector CT has become widely used in clinical practice. Forrest et al have reported low-dose radiation CT protocols to reduce adverse reactions due to CT [6].

In the present study, of 95 patients with ureteral stones confirmed by CT, the stones were identifiable on KUB in 55 (57.8%). The stones were most frequently located at the UVJ (46.3%), followed by the proximal ureter (30.5%), distal ureter (16.8%), UPJ (5.2%) and UEIV (1.1%). This result was inconsistent with the previous assertion that ureteral stones are mainly located at the anatomically narrow sites. Eisner et al have also advocated that the predilection sites for ureteral stones are not the three aforementioned sites [4]. The mean diameter of the ureter was 3.38±0.6 mm (range, 1.0-4.9 mm), which was larger than a previous report of 1.8±0.9 mm (range, 1.0-6.0 mm) [7]. The difference might have resulted from the variations in measuring the exact diameter of the ureter in its course of peristalsis. In addition, the mean diameter of the UEIV was 3.28±0.59 mm (range, 2.2-5.3 mm), and the stone was found at this location in one of the 95 patients. These were in contrast with those of previous studies showing that the UEIV is an anatomically narrow segment. The stones at the distal ureter were located significantly closer to the UVJ, whereas those at the proximal ureter were closer to the UPJ. In our study, the smaller the stones, the closer to the distal ureter it was located, which was similar to the result of a study by Coll et al [8]. In addition, they reported that spontaneous passage of ureteral stones occurred in 76% of the patients with ureteral stones of <5 mm, in 60% of the patients with stones of 5-7 mm and in 48% of the patients with stones of 7-9 mm. In our study, we showed that spontaneous passage of ureteral stones occurred in 39% (24/62) of the patients with a mean stone size of 3.8±1.5 mm. The discrepancy between the results of the study by Coll et al and ours may be due to the short follow-up; average follow-up was three days and 18 (44%) of the patients with ureteral stones at the UVJ were lost to follow-up [8]. Song et al have reported that spontaneous passage of ureteral stones is affected by the size and location as well as two other secondary signs including hydronephrosis and perinephric edema [9]. Previous studies have suggested that ureteral stones are mainly located at the proximal and distal ureters, and mid-ureteral stones are found in 15 to 30% of the patients [10-12]. Since the incidence of stone at the UEIV is unreported, it is difficult of compare the results between the study results.

The present study results are subjected to several limitations. First, the study subjects were limited to the patients who visited the emergency department of our hospital. Second, since only 65% of the patients were followed up, it is possible that the information of the remaining 35% of the patients may influence the study results otherwise. Third, the accuracy of the method for measuring ureteral diameter needs to be validated because simple visual estimation on unenhanced CT image was used. Also, possible variations from ureteral peristalsis need to be considered as mean peristaltic frequency is reported to be 3.5 waves per minute (range, 2.5-6.5 waves/minute) in normal ureters [13]. Finally, relatively short duration of follow-up before treatment decision was made may limit the effective comparison between spontaneous passage and the treatment effect of the ureter stones. Although our results cannot be applied to clinical practice, the difference between the results of previous studies and ours may have some implications in the management of ureteral stones as well as understanding of ureteral anatomy. Further studies with a larger sample size are needed to confirm our results.

CONCLUSIONS

Taken together, our results showed that ureteral stones were located at the UVJ, proximal ureter and distal ureter in an increasing order of frequency. Smaller stones were located closer to the distal ureter. Stones were found relatively infrequently at the UPJ and UEIV and no significant difference in ureteral diameter between the UEIV and the other sites were noted. The results of this study may provide useful information on patients with ureteral stones in terms of their radiological diagnosis and successful treatment.

Conflicts of Interest

The authors have nothing to disclose.

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