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ORIGINAL PAPER

Factors associated with urinoma accompanied by ureteral calculi

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Summary ***Objective: Urinoma is a rare entity and mainly occurs due to acute obstruction such as ureteral stone. We aimed to demonstrate factors associated with urinoma accompanied by ureteral calculi.***
Material and methods: Data of 550 patients who were diagnosed with ureteral stone by computed tomography (CT) were analyzed retrospectively. In 20 patients perirenal urinoma was associated with ureteral calculi (group I), whereas in other 530 patients no urinoma was detected (group II). Gender, age, size, side and localization of the stone, hydronephrosis, fever, sepsis, urinary tract infections (UTIs), hematuria, serum creatinine, blood urea nitrogen (BUN), white blood cell (WBC), C-reactive protein (CRP), presence of diabetes mellitus (DM), hypertension (HT) and cronic kidney disease (CKD) of the two groups were compared.
Results: The average age of the patients were 46.2 (20-71) and 44.9 (10-82) years in group I and group II, respectively ($p > 0.05$). According to our results leukocytosis, microscopic and macroscopic hematuria, UTIs, increase of serum creatinine, BUN and CRP, diagnosis of DM and HT were significantly associated with urinoma ($p < 0.05$). In addition, patients with distal ureteral stones are more prone to urinoma ($p = 0.001$). An interesting finding of the study was that the stone size in group I (median 5 mm [range 3-8]) was significantly smaller than in group II (9.3 mm [4-25]; $p = 0.001$).
Conclusions: Small stone size, distal localisation of the stone in ureter, leukocytosis, hematuria, UTIs, increase of serum creatinine, BUN and CRP, presence of DM and HT are associated with perirenal urinoma.

KEY WORDS: Computerized tomography; Factors associated with urinoma; Prevalence; Ureteral calculi; Urinoma.

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INTRODUCTION

Urinoma is defined as an extravasated urine collection with surrounded fibrous capsule. Urinary stones, surgical ligation of ureters, tumors, *posterior urethral valve* (PUV) and blunt or penetrating traumas are involved in the etiology of urinoma (1). Spontaneous urinoma is rare and ureteral stones are among the most common causes of spontaneous urinoma. High hydrostatic pressure applied on the ureter wall by the impacted ureteral stone and formation of micro-tears in the mucosa during stone passage play an important role in the mechanism of urinoma (2). When the intraluminal pressure exceeds 35 cm/H_2O, rupture develops from the fornix, which is the weakest part of the collecting system, resulting in urinoma. In this case, the urine is first spread to the subcapsular area, then to the perirenal region and the retroperitoneal area (3). Urinoma leads to local irritation, inflammatory side effects, fever, malaise, sepsis, acute abdomen and deterioration of general condition (4). *Computed Tomography* (CT) is adequate for definitive diagnosis of urinoma. At CT, fluid collection around the kidney and imaging of the stone within the ureter is sufficient for the diagnosis of spontaneous urinoma. It may also document the contrast extravasation from the collecting system and determine the location of the rupture (5, 6).
Ureterorenoscopic stone surgery and ureteral stent placement are recommended in the current treatment of spontaneous urinoma (7). There is no specific finding of urinoma and this may lead to delayed diagnosis and treatment causing increased morbidity and mortality in patients who have admitted to emergency clinics with colic pain. In this study, it was aimed to identify the risk factors for urinoma, to define parameters that would facilitate the diagnosis and help in choosing appropriate treatment, and to discuss the topic under light of current literature.

MATERIAL AND METHODS

Between May 2010 and March 2018, 11,000 patients were diagnosed with ureteral stone at our center.
The diagnosis of stone was made by direct X-ray, *intravenous pyelogram* (IVP), *ultrasonography* (USG), unenhanced CT and contrast-enhanced CT. The data of 2100 patients who underwent *ureterorenoscopy* (URS) due to ureteral stone were retrospectively reviewed. Electronic and conventional medical records, including demographic information, laboratory data, electronic notes, operative reports and radiological reports, were reviewed for each patient. A total of 550 patients who were diagnosed with ureteral stone by CT and whose data were complete were included in the study.
Patients with kidney trauma and patients with a history of kidney surgery were excluded from the study. Vital findings were also queried from the medical records and

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presence of UTIs, fever and urosepsis were recorded. Patients' age, gender, stone localization, presence of hydronephrosis, fever, sepsis, UTIs, microscopic and macroscopic hematuria, serum creatinine, BUN, WBC and CRP values were evaluated. Chronic diseases such as *diabetes mellitus* (DM), *hypertension* (HT) and *chronic kidney disease* (CKD) were recorded. Urine cultures were obtained from patients with asymptomatic bacteriuria and appropriate empirical treatment was initiated. Symptomatic UTIs criteria included fever, costovertebral angle sensitivity, pyuria (≥ 10 white blood cells per high-power field), and positive urine culture [≥ 105 *colony-forming units* (CFU) of uropathogen/mL]. Findings of urosepsis included at least 2 signs of SIRS (Systemic Inflammatory Response Syndrome) in the presence of infection (Fever > 38°C or < 36°C, heart rate > 90 beats/min, respiratory rate > 20/min or PaCO2 < 32 mm/Hg, WBC > 12,000/mm^3 or < 4.000/mm^3). Appropriate antibiotic therapy was started according to results of antibiotic susceptibility testing in patients who were diagnosed with urosepsis.

Patients were classified as group I (n = 20; 3,6%) if were diagnosed with spontaneous urinoma secondary to ureteral stone and group II (n = 530; 96,4%), if without urinoma (Figure 1).

Patients diagnosed with urinoma and ureteral stone were treated with *ureteroscopy* (URS) and lithotripsy and ureteral double J stent placement. The stents were removed after 4 weeks as treatment was completed. Both groups were compared in terms of gender, age, stone size and stone localization, fever, sepsis, UTIs, hematuria, serum cratinine, BUN, WBC, CKD values as well as presence of DM, HT and CKD.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statistical Analysis

The data obtained in this study were analyzed with the SPSS 20 (*IBM SPSS Statistics; Armonk, NY, USA*) package program. Results are presented as frequency and percentage (%). The abnormal distribution of data from each group was confirmed with the Kolmogorov-Smirnov test, thus statistical comparisons were performed using Mann Whitney-U Test. Chi-square test was used to examine the dependency between the groups. A P value less than 0.05 was considered statistically significant.

Results

In this study, we found urinoma in 20 (0.2%) of 11000 patients diagnosed with ureteral stones in our clinic.

The mean age of the patients was 46.2 (20-71) years in group I and 44.91 (10-82) years in group II (p > 0.005). Gender distributions of the patients were 16 (80%) male, 4 (20%) female in group I and 339 (63.96%) male and 191 (36.04%) women in group II (p > 0.005). Gender distributions of the patients were similar in both groups. Upper ureter was considered as the segment from renal pelvis to the upper border of the sacrum, middle ureter is as the segment from the upper to the lower border of the sacrum, and lower ureter as the segment which extends from lower border of the sacrum to the bladder. Proximal ureteral stones were not observed in group I, while they were present in 345 (65.1%) patients in group II. Middle ureteral stones were found in 5 (25%) patients in group I and 126 (23.8%) patients in group II. Distal ureteral stone distributions in group I and group II were 15 (75%) and 59 (11.1%), respectively (p = 0.001).

The difference of distribution of stone localizations between the groups was statistically significant. Pyuria was found in 5 (25%) patients in group I and in 47 (8.9%) patients in group II (p = 0.032). Microscopic hematuria was detected in 16 patients (80%) in group I and in 42 (7.9%) patients in group II (p = 0.001). Macroscopic hematuria was positive in 9 (45%) and 42 (7.9%) patients, respectively (p = 0.001). Fever was found in 12 (60%) patients in group I and in 30 (5.7%) patients in group II (p = 0.001) and UTIs were detected in

Figure 1.
The image of spontaneous urinoma. ***A:*** *Perirenal urinary leak;* ***B:*** *Retroperitoneal urinary leakage;* ***C:*** *Stones of millimetric size in the distal ureter;* ***D:*** *Sagittal section view of urinoma and distal ureteral stone.*

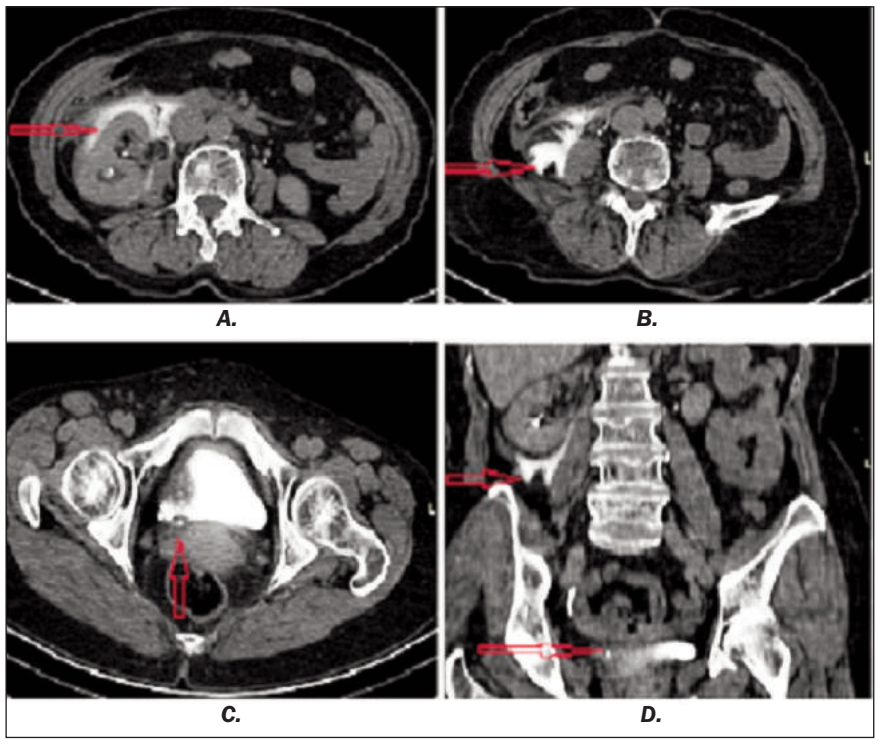

Table 1.
Factors associated with urinoma accompanied by ureteral calculi.

		Group I		Group II		Total		Chi Square Test	
		n	%	n	%	n	%	Chi Square	p
Gender	Male	16	80	339	64.0	355	64.6	1.522	0.217
	Female	4	20	191	36.0	195	35.4		
	Total	20	100	530	100	550	100		
Localization	Proximal	0	0	345	65.1	345	62.7	*	**0.001**
	Middle	5	25	126	23.8	131	23.8		
	Distal	15	75	59	11.1	74	13.5		
	Total	20	100	530	100	550	100		
Pyuria	Absent	15	75	483	91.1	498	90.5	Fisher's exact	**0.032**
	Exist	5	25	47	8.9	52	9.5		
	Total	20	100	530	100	550	100		
Microscopik hematuria	Absent	4	20	488	92.1	492	89.5	Fisher's exact	**0.001**
	Exist	16	80	42	7.9	58	10.5		
	Total	20	100	530	100	550	100		
Gross hematuria	Absent	11	55	488	92.1	499	90.7	Fisher's exact	**0.001**
	Exist	9	45	42	7.9	51	9.3		
	Total	20	100	530	100	550	100		
Fever	Absent	8	40	500	94.3	508	92.4	Fisher's exact	**0.001**
	Exist	12	60	30	5.7	42	7.6		
	Total	20	100	530	100	550	100		
UTI	Absent	15	75	506	95.5	521	94.7	Fisher's exact	**0.003**
	Exist	5	25	24	4.5	29	5.3		
	Total	20	100	530	100	550	100		
Urosepsis	Absent	18	90	520	98.1	538	97.8	Fisher's exact	0.067
	Exist	2	10	10	1.9	12	2.2		
	Total	20	100	530	100	550	100		
CRP	Normal	6	30	508	95.9	514	93.5	Fisher's exact	**0.001**
	High	14	70	22	4.1	36	6.5		
WBC	Normal	10	50	506	95.5	516	93.8	Fisher's exact	**0.001**
	High	10	50	24	4.5	34	6.2		
	Total	20	100	530	100	550	100		
BUN	Normal	13	65	492	92.8	505	91.8	Fisher's exact	**0.001**
	High	7	35	38	7.2	45	8.2		
	Total	20	100	530	100	550	100		
Creatinin	Normal	10	50	505	95.3	515	93.6	Fisher's exact	**0.001**
	High	10	50	25	4.7	35	6.5		
	Total	20	100	530	100	550	100		
DM	Absent	13	65	507	95.7	520	94.6	Fisher's exact	**0.001**
	Exist	7	35	23	4.3	30	5.5		
	Total	20	100	530	100	550	100		
CKD	Absent	20	100	523	98.7	543	98.7	Fisher's exact	1
	Exist	0	0	7	1.3	7	1.3		
	Total	20	100	530	100	550	100		
HT	Absent	10	50	506	95.5	516	93.8	Fisher's exact	**0.001**
	Exist	10	50	24	4.5	34	6.2		
	Total	20	100	530	100	550	100		

UTI: Urinary tract infection; CRP: C-reactive protein; WBC: White blood cell; BUN: Blood urea nitrogen, DM: Diyabetes Mellitus; CKD: Chronic kidney disease; HT: Hypertension.

Table 2.
The differences between groups with/without urinoma in terms of age and stone size.

								Mann Whitney U Test		
		n	Mean	Median	Min	Max	SD	Rank Avarage	z	p
Age	Group I	20	46.2	45	20	71	13.88	274.89	-0.465	0.642
	Group II	530	44.9	44	10	82	13.95	291.73		
	Total	550	45	44	10	82	13.94			
Stone size/mm	Group I	20	5	4	3	8	1.78	283.07	-5.785	0.001
	Group II	530	9.3	9	4	25	3.56	74.9		
	Total	550	9.1	8	3	25	3.6			

5 (25%) and 24 (4.5%), respectively (p = 0.003).

The difference between the two groups was statistically significant in terms of pyuria, hematuria, fever and UTIs.

Urosepsis was observed in 2 (10%) patients in group I and in 10 (1.9%) patients group II, however the difference was not statistically significant (p > 0.05).

CRP was higher in 14 (70%) patients in group I and in 22 (4.1%) patients in group II (p = 0.001). WBC was high in 10 (50%) patients in group I and in 24 patients (4.53%) in group II (p = 0.001). BUN was high in 7 (35%) patients in group I and in 38 (7.2%) patients in group II (p = 0.001). Creatinine was high in 10 (50%) patients in group I than and in 25 (4.7%) patients in group II (p = 0.001). DM was detected in 7 (35%) and 23 (4.3%) patients in group I and group II, respectively (p = 0.001). CKD was not seen in any patients in group I, whereas 7 (1.3%) patients had CKD in group II (p > 0.05).

However, this difference was not statistically significant. HT was found in 10 (50%) patients in group I and in 24 (4.5%) patients in group II (p = 0.001). The difference between the two groups in terms of CRP, WBC, BUN and high serum creatinine values and presence of chronic diseases such as DM and HT was statistically significant. There was no statistically significant difference between the patient groups in term of presence of CKD (Table 1).

The mean stone size was 5 (3-8) mm in group I and 9.3 (4-25) mm in group II (p = 0.001). The difference in stone size between the two groups was statistically significant (Table 2).

According to logistic regression analysis results, 1 mm increase in stone length reduced the risk for urinoma 2.022-fold. The presence of microscopic hematuria and high serum CRP

level were both detected high in patients with urinoma. Logistic regression analysis revealed that distal localization of the stones also increased the risk for urinoma 3.806-fold.

Discussion

As a result of the collecting system disruption at any level from calyces to urethra, the urine that extravasates the urinary system is called urinoma. Urinomas may sometimes, although rare, occur spontaneously. The most common etiological cause of spontaneous urinomas is the ureteral stones (8). Hydronephrosis, UTIs, and increased pressure due to obstruction, provide a basis for rupture. The intraluminal pressure increases on the collecting system as a result of obstruction elsewhere in the system due to a stone and extravasation occurs at the calyceal fornix, the weakest part of the collecting system. The kidneys have mechanisms to protect themselves against increasing pressure in the collecting system. These mechanisms include pyelo-sinus, pyelo-venous, and pyelo-lymphatic backflow. An increase of more than 35 cmH_2O in intrapelvic pressure results in the failure of these mechanisms and leads to forniceal rupture (9). Furthermore, small-sized ureteral stones cause micro-tears during spontaneous passage; this in turn plays a facilitating role in the rupture of collecting system mucosa, resulting in extravasation of urine (10, 11).

In their latest study, *Gershman et al.* (12) reported that 75.7% of distal ureteral stones cause primary urinoma. In the same study, the mean stone size was 4.09 mm with stone size decreasing significantly from proximal ureteral to distal ureteral locations, and urinoma incidence was found to be more frequent in distal ureteral stones. In our present study, 75% of the patients with urinoma had distal ureteral stones and this finding was consistent with the literature. We found that the mean stone size was 5 mm and a 1 mm increase in stone length reduced the urinoma risk of 2.022 fold, whereas the distal localization of stones increased the urinoma risk of 3.806 fold.

Apart from obstruction and stasis caused by the stone in the ureteral lumen, in addition UTIs constitute a facilitating factor for development of the urinoma.

Spontaneous urinomas that develop due to an ureteral stone may cause side-pain, reno-ureteral pain, reno-abdominal pain, as well as vasovagal nausea and vomiting. *Ureterovesical junction* (UVJ) stones and UTIs can cause urinary urgency, fever, abdominal pain and pain in genital organs. Besides these symptoms, urinomas can result in serious complications. Possible complications include hydronephrosis, paralytic ileus and acute abdomen, electrolyte imbalances, abscess formation, sepsis, and chronic renal failure in delayed cases (11). *Gershman et al.* (12) reported a UTIs ratio of 5.2% in a retrospective study. The rate of UTIs in our study was 5.3% in accordance with previous reports. UTIs trigger the collecting system rupture and result in the accumulation of infected urine in the retroperitoneal space.

This picture sets a ground for urosepsis and retroperitoneal abscess formation in delayed cases (13). In our study, we found that the rate of patients diagnosed with urosepsis was 2.2%, a rate not statistically different from that observed in absence of urinoma. Furthermore, retroperitoneal abscess was not observed in any of the patients who were diagnosed with urosepsis. We think that early diagnosis of urinoma along with early surgical and medical treatment were effective in this respect.

Sterile urine in contact with the retroperitoneum can trigger an inflammatory response, whereas infected urine may lead to acute abdomen, retroperitoneal abscess formation and retroperitoneal fibrosis in later stages.

In patients with urinary infection and pyuria, these complications may be more aggressive and may result in a clinical picture with progression to sepsis by disturbing the general condition in the patients. In many case reports published to this time, it has been reported that urinary infection, pyuria, hematuria and sepsis were present in patients who had diagnosis of urinoma in the emergency room. Blood tests of these cases revealed high WBC, BUN and elevated serum creatinine levels (14).

In our study pyuria, hematuria, fever, UTIs and urosepsis were significantly common in the patients with urinoma and CRP and WBC values were also high in these patients.

Although urinoma has been reported to play a protective role in renal function, it has been shown an impaired kidney function in several recent case reports. *Heikkila et al.* (15) demonstrated that urinoma affects renal function and leads to progressive renal damage in 25% of patients. In our study, BUN and plasma creatinine values were significantly higher in the cases with urinoma but CKD did not develop in our patients, probably because of early treatment and early surgical intervention.

HT, DM and CKD are common comorbid diseases. Comorbidities are important for the patient in terms of bearing an additional disease to the existing disease and facing an increased morbidity. Especially, the suppression of the current clinical picture by these comorbid diseases may delay the diagnosis and increase the complication rates. Many case reports published in the literature have reported that diagnosis of urinoma might be delayed with accompanied CKD and DM and as a result, the complication rates were increased (11, 15). In our present study, the DM rate was 35% *vs* 4.3% and the HT rate was 50% *vs* 4.5% in patients with and without urinoma ($p < 0.05$). CKD was not seen in any of the patients who had been diagnosed with urinoma.

Spontaneous urinoma is a rare disease and most commonly caused by ureteral stones. Until recently, literature about urinoma mainly consisted of case reports only and there was no study on prevalence of urinoma. However, the development of imaging modalities, availability of spiral CT and the widespread use of contrast agents in the clinical settings have led to a relative increase in the number of diagnosed spontaneous urinomas (16, 17).

In fact, in the present study, we found urinoma in 0.2% of patients diagnosed with ureteral stones.

Conclusions

Infection related parameters such as CRP and WBC elevation, pyuria, hematuria, fever, and high creatinine levels were found to be higher in patients with ureteral stones and urinoma. Interestingly, urinomas were more

common in the smaller-sized and distally ureter-located stones. In addition, chronic diseases such as HT and DM have attracted attention as factors that increase urinoma risk in patients with ureteral stones.

References

1. Nouira Y, Ben Younes A, Rekik H, et al. Spontaneous perirenal urinoma during nephritic colic. Ann Urol (Paris) 2000; 34:156-7.

2. Ay D, Yencilek E, Celikmen MF, et al. Spontaneous rupture of ureter: an unusual cause of acute abdominal pain. Am J Emerg Med. 2012, 30:1-2.

3. Miller NL, Lingeman JE. Management of kidney stones. BMJ. 2007; 334: 468-72.

4. Patil KK, Wilcox DT, Samuel M, et al. Management of urinary extravasation in 18 boys with posterior urethral valves. J Urol. 2003; 169:1508-11.

5. Chen GH, Hsiao PJ, Chang YH, et al. Spontaneous ureteral rupture and review of the literature. Am J Emerg Med. 2014; 32:772-4.

6. Pampana E, Altobelli S, Morini M, et al. Spontaneous ureteral rupture diagnosis and treatment. Case Rep Radiol. 2013; 2013:851859.

7. Stravodimos K, Adamakis I, Koutalellis G, et al. Spontaneous perforation of the ureter: clinical presentation and endourologic management. J Endourol. 2008; 22:479-84.

8. Jeon CH, Kang JH, Min JH, et al. Spontaneous Ureteropelvic Junction Rupture Caused by a Small Distal Ureteral Calculus. Chin Med J (Engl) 2015; 128:3118-19.

9. Georgieva M, Thieme M, Pernice W, et al. Urinary ascites and perirenal urinoma-a renoprotective "Complication" of posterior urethral valves. Aktuelle Urol. 2003; 34:410-12.

10. Ferri E, Casoni GL, Morabito G, et al. Rupture of the renal pelvis complicating a renal colic: report of a case. Am J Emerg Med. 2006; 24:383-5.

11. Gayer G, Zissin R, Apter S, et al. Urinomas caused by ureteral injuries: CT appearance. Abdom Imaging. 2002; 27:88-92.

12. Gershman B, Kulkarni N, Sahani DV, et al. Causes of renal forniceal rupture. BJU Int. 2011; 108:1909-12.

13. Titton RL, Gervais DA, Hahn PF, et al. Urine leaks and urinomas: diagnosis and imaging-guided intervention. Radiographics. 2003; 23:1133-47.

14. Pace K, Spiteri K, German K. Spontaneous proximal ureteric rupture secondary to ureterolithiasis. J Surg Case Rep. 2017, 2016.

15. Heikkilä J, Taskinen S, Rintala R. Urinomas associated with posterior urethral valves. J Urol. 2008; 180:1476-78.

16. Murawski M, Gołebiewski A, Komasara L, et al. Rupture of the normal renal pelvis after blunt abdominal trauma. J Pediatr Surg. 2008; 43:e31-33.

17. Ashebu SD, Elshebiny YH, Dahniya MH. Spontaneous rupture of the renal pelvis. Australas Radiol. 2000; 44:125-27.

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