

Evaluation of the Stone Analysis Results of the Patients Who Underwent Ureterolithotomy

Üreterolitotomi Operasyonu Geçiren Hastaların Taş Analizi Sonuçlarının Değerlendirilmesi

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ABSTRACT Objective: We aimed to evaluate the results of stone analysis of the patients with ureter stone and to determine the role of stone analysis in treatment and prevention of recurrence. **Material and Methods:** The data of the patients who underwent ureterolithotomy for ureter stone between 2003 and 2018 were evaluated retrospectively. X-Ray Diffraction (XRD) method was used in the analysis of the stones. The examined parameters included demographic data, body mass index (BMI), operation type, operative time and stone analysis result. **Results:** A total of 31 patients (21 male and 10 female) were included in the study. The mean age of the patients was 37.2±12.6 years. The mean stone size was 20.6±6 mm. Ureterolithotomy was performed in 16 (51.6%) patients for right ureter stone and in 15 (48.4%) patients for left ureter stone. Ureterolithotomy was performed laparoscopically in 10 (32.3%) patients and open in 21 (67.7%) patients. The most common stone chemical structure was mix calcium oxalate monohydrate (COMH) and calcium oxalate dihydrate (CODH) with a rate of 32.3%. Uric acid stone was more frequent in patients with diabetes mellitus and hypertension, and the rate of struvite stones was higher in patients with a history of recurrent urinary tract infection ($p < 0.001$). The mean BMI of the patients with uric acid stone was higher than that of the patients with COMH, CODH and struvite stones, but there was no statistically significant difference, 27.8±0.9 kg/m² versus 24.3±2.4 kg/m², 22 ±1.4 kg/m² and 25.2 ±3.3 kg/m² ($p=0.102$). **Conclusion:** Uric acid stone was observed more frequently in patients with metabolic syndrome which includes obesity, diabetes mellitus and hypertension components. Stone analysis should be requested from each patient whose stone sample is obtained. In this way, metaphylaxis, which is a set of measures to prevent stone recurrence, can be meaningful.

Keywords: Urolithiasis; ureter stone; ureterolithotomy; stone analysis; x-ray diffraction

ÖZET Amaç: Üreter taşı nedeniyle üreterolitotomi operasyonu geçiren hastaların taş analizi sonuçlarını değerlendirerek tedavide ve rekürrensini önlenmesinde taş analizinin nasıl bir yeri olabileceğini ortaya koymaya çalıştık. **Gereç ve Yöntemler:** 2003-2018 yılları arasında üreter taşı nedeniyle üreterolitotomi operasyonu geçiren hastaların verileri retrospektif olarak değerlendirildi. Taşların analizinde X-Ray Difraksiyon (XRD) yöntemi kullanıldı. İncelenen parametreler; hastaların demografik verileri, beden kitle indeksleri (BKİ), operasyon türü, süresi ve taş analizi sonuçlarından oluşmakta idi. **Bulgular:** Çalışmaya 21 'i erkek, 10'u kadın olmak üzere toplam 31 hasta dahil edildi. Hastaların ortalama yaşı 37,2±12,6 yıl idi. Ortalama taş boyutu 20,6±6 mm idi. On altı (%51,6) hastaya sağ üreter taşı, 15 (%48,4) hastaya ise sol üreter taşı sebebiyle üreterolitotomi operasyonu uygulandı. Üreterolitotomi operasyonları 10 (%32,3) hastada laparoskopik, 21 (%67,7) hastada ise açık olarak gerçekleştirildi. En sık saptanan taş kimyasal yapısı %32,3 ile kalsiyum oksalat monohidrat (KOMH) ve kalsiyum oksalat dihidrat (KODH) bileşimi idi. Ürik asit taşı, diabetes mellitus ve hipertansiyonu olan hastalarda daha sık gözlenirken tekrarlayan idrar yolu enfeksiyonu (İYE) hikayesi olan hastalarda strüvit taşı oranı daha fazla idi ($p < 0,001$). Ürik asit taşıma sahip olan hastaların ortalama VKİ değeri KOMH, KODH ve strüvit taşı olan hastalardan yüksek olmakla birlikte istatistiksel olarak anlamlı farklılık saptanmamıştır, 27,8±0,9 kg/m²'ye karşı sırasıyla 24,3±2,4 kg/m², 22 ±1,4 kg/m² ve 25,2 ±3,3 kg/m² ($p=0,102$). **Sonuç:** Obezite, diyabet ve hipertansiyon bileşenlerinden oluşan metabolik sendromu olan hastalarda ürik asit taşı daha sık gözlenmiştir. Taş numunesi elde edilen her hastadan taş analizi istenmelidir. Bu sayede taş rekürrensini önleyecek önlemler bütünü olan metafleksis anlam kazanabilir.

Anahtar Kelimeler: Ürolitiyazis; üreter taşı; üreterolitotomi; taş analizi; x ışını difraksiyon

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Urinary system stone disease has been an important public health problem across the world for centuries and its prevalence gradually increased globally in recent years.^{1,2} Even if the complete stone-free status is provided after urinary system stone disease treatment, urinary system stone disease has a tendency to recur and a recurrence ratio reaching 50% in a period of 10 years has been reported.³

Extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and ureterorenoscopic lithotripsy (URS) are the minimally invasive techniques commonly used for effective treatment of urinary system stones. Ureterolithotomy, especially laparoscopic ureterolithotomy in recent years, is a minimally invasive technique which can be applied with the high success rate in individuals with the high stone burden or individuals who had failed treatment with other treatment modalities.⁴

Since a stone sample cannot be acquired in each patient who was diagnosed with urinary system stone disease, it is not possible to make a stone analysis. Determining the stone type in patients whose stone analysis was acquired plays an important role in determining the protective approaches which would prevent stone formation and recurrence. In this study, we aimed to present the importance of stone analysis in treatment and recurrence prevention by evaluating the stone analysis results of the patients who underwent ureterolithotomy at our clinic.

MATERIAL AND METHODS

Data of the patients who underwent ureterolithotomy between 2003 and 2018 at our clinic were examined retrospectively. Examined parameters included the demographic characteristic, stone dimension and location, operative time, hospitalization time, and stone analysis result. Patients under 18 years of age, whose missing clinical data and whose stone samples were not examined with the stone analysis method suggested by the European Association of Urology guidelines were excluded from the study. Ureterolithotomy was performed open or laparoscopic. The removed stone samples were sent for analysis as a whole.

This study was approved by the Scientific Ethics Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital (04.03.2019 Approval Number: 2019/119). The study conforms to the provisions of the Declaration of Helsinki. Informed consent could not be obtained from the participants since this study had a retrospective design.

STONE ANALYSIS

Analysis of all stones was made with X-Ray Diffraction (XRD) method in İstanbul University Technology Transfer Application and Research Center, Central Laboratory (MERLAB). Stones brought to the laboratory were powdered and taken in sample glasses. Then the samples were located in X-ray diffractometer and the mineral designation was made using diffraction patterns.

STATISTICAL ANALYSIS

IBM SPSS statistics for Mac version 21 (Chicago, IL, USA) was used for data analysis. Descriptive statistics of the data were presented as n (%) and mean±standard deviation. Student's T-test was used for the analysis of continuous variables with normal distribution and data were presented as mean±standard deviation. Mann-Whitney U test was used for the analysis of continuous and sequential variables that did not show normal distribution, and the data presented as median (25-75% quarters) or median (minimum- maximum). Categorical data were compared with Pearson chi-square test and the data were given as n (%). Statistical significance was accepted as $p < 0.001$.

RESULTS

Data of 329 patients who underwent ureterolithotomy were evaluated retrospectively. A total of 31 patients including 21 males (67.7%) and 10 females (32.3%) were included in the study. The mean age of the patients was 37.2 ± 12.6 years. The mean stone dimension was 20.6 ± 6 mm. Twelve patients had a history of failed ESWL. Ureterolithotomy was performed for 16 patients due to right ureter stone (51.6%) and for 15 patients due to left ureter stone (48.4%). Ureterolithotomy was laparoscopic in 10 patients (32.3%) and open in 21 patients (67.7%). The mean

body mass index (BMI) of the patients was 25.2 ± 2.8 kg/m². The mean operative time was 67.5 ± 11.4 minutes and the mean hospitalization time was 2.7 ± 0.8 days. Diabetes mellitus (DM) and hypertension (HT) were the most common comorbidities of the patients.

Six different chemical structures were detected based on stone analysis results. Of these stones, 21 (67.7%) had single and 10 had multiple stone composition (32.3%). The most commonly detected stone type was the combination of calcium oxalate monohydrate (COMH) and calcium oxalate dihydrate (CODH) with 32.3%. Uric acid stone was detected in 6 (19.4%) patients and struvite (magnesium ammonium phosphate) stone in 4 (12.9%) patients. A summary of stone analysis data was provided in Table 1.

According to chi-square analysis, while uric acid stone was more commonly observed in patients with DM and HT, struvite stone ratio was higher in patients who had recurrent urinary tract infection (UTI) history ($p < 0.001$). Although the mean BMI of uric acid stone patients was higher than the patients with

COMH, CODH and struvite stone, no statistically significant difference was detected, 27.8 ± 0.9 vs 24.3 ± 2.4 , 22 ± 1.4 and 25.2 ± 3.3 kg/m², respectively ($p = 0.102$). According to student t test, operative time and hospitalization time were similar in open and laparoscopic ureterolithotomy patients, 66.9 ± 12.1 vs 68.7 ± 10.3 min ($p = 0.69$), 2.9 ± 0.8 vs 2.5 ± 0.5 days, respectively ($p = 0.12$).

DISCUSSION

Due to its long term problems, urinary system stone disease may become a burden both in medical and socioeconomic terms.⁵ Turkey has a high urinary system stone disease incidence with a ratio of 14.8%.^{6,7} The importance of stone analysis in preventing the recurrence of urinary system stone disease and thus in lowering health expenditures and improvement of general health conditions is obvious. A risk-related strategy should be applied in the treatment and follow-up of urinary system stone disease and stone analysis is quite important for determining this risk. Thus the stone type should be determined in every patient who passed a kidney stone and had it or removed with surgical intervention. Stone analysis results of the patients who had open or laparoscopic ureterolithotomy due to ureter stone were evaluated in our study.

In urinary system stone disease, metabolic and radiological evaluations are used to acquire information on the chemical structure of the stone before treatment. Twenty-four-hour urine test is preferred more than spot urine as it provides more comprehensive and reliable results. Apart from these tests and examinations, certain diagnosis is made with stone analysis. Considering current treatment alternatives, the stone analysis provides some advantages. For deciding the treatment method to be selected or predicting the treatment efficiency, stone analysis result provides a contribution. In ESWL resistant cases, such as COMH or cystine stones, methods such as URS or ureterolithotomy can be performed without losing time. It may also lead to the initiation of appropriate medical treatment, such as oral chemolysis, in patients (uric acid and infection- stones) who may benefit from medical treatments.^{8,9} Cystine stone was detected in one patient and uric acid stone in six pa-

TABLE 1: Patient, stone and operation characteristics.

| Variables | Mean±sd/n-% |
|--------------------------------------|-------------|
| Age (years) | 37.2±12.6 |
| Body Mass Index (kg/m ²) | 25.2±2.8 |
| Gender | |
| Male | 21-67.7% |
| Female | 10-32.3% |
| Side | |
| Right | 16-51.6% |
| Left | 15-48.4% |
| Operative Time (min) | 67.5±11.4 |
| Stone Type | |
| COMH | 8-25.8% |
| CODH | 2-6.5% |
| COMH + CODH | 10-32.3% |
| Uric Acid | 6-19.4% |
| Struvite | 4-12.9% |
| Cystine | 1-3.2% |
| Hospitalization Time (days) | 2.7±0.8 |
| Operation Type | |
| Open | 21-67.7% |
| Laparoscopic | 10-32.3% |

COMH: Calcium Oxalate Monohydrate, CODH: Calcium Oxalate Dihydrate

tients in our current study. The benefiting ratio of these patients from metaphylaxis can be high.

Stone analysis entered routine use with the studies made by Heller in 1847 and Ultzmann in 1882.¹⁰ With the technological developments, many methods were determined for stone analysis and these are used in different centers today. Infrared spectroscopy (IRS) and XRD methods suggested in the European Association of Urology Guidelines were the methods most commonly preferred and applied in routine practice.^{8,10-15} All stone analyses in our series were made by an experienced center using XRD method.

Urinary system stone disease prevalence changes according to age, gender, race, and geography. In a prevalence study made by Karabacak et al. in our country, 6453 kidney stones were analyzed with XRD method. Based on the results of this study, it was reported that 80.4% of the stones were calcium oxalate and 4.8% were uric acid stones.⁶ In the study by Kendi et al. analyzing the urinary system stones of a total of 50 patients with XRD method, 16 ureter stones were examined and it was stated that the stones had a mixed structure rather than containing a single substance.¹⁶ Based on the qualitative analysis made with XRD method on 34 kidney, 8 ureter and 3 bladder stones taken from 45 patients, the most common stone content was detected as calcium.¹⁷ Chemical method was used in a study made by Kara et al. on 198 patients and calcium oxalate (22%) and calcium phosphate stones (11.6%) were detected most commonly.¹⁸ In another study, Yapanoglu et al. reported that 218 stones (72.7%) were calcium oxalate stones according to stone analysis results made with XRD method on 300 patients. Among calcium oxalate stones, 170 (56.7%) were COMH, 12 (4%) were CODH and 36 (12%) were COMH and CODH combination. In this study, 128 of 300 urinary system stones were ureter stones and based on upper urinary system stone analysis results evaluating ureter and kidney stones together, the most common stone type was similarly found as calcium oxalate (78.63%). Mixed stone type formed by COMH and uric acid components was detected as the second most common stone type among upper urinary system stones.¹⁹ In our series, calcium oxalate stones were the most common stone type while uric acid stones were the

second and it was in line with the literature of the world and our country.

Based on the gender distribution of stone patients in an epidemiological study made in our country in 1991, the male/female rate was calculated as 1.5/1.⁷ Similarly, 4411 of the patients were male (68.3%) and 2042 (31.7%) were female based on the stone analysis made in the study by Karabacak et al.⁶ In the epidemiological study on 2.468 individuals which was published by Muslumanoglu et al. in 2011, the number of female participants with urinary system stone disease was found to be a little higher than the male participants.²⁰ In our series, most of the cases that had stone analysis were male (21/31-67.7%).

It is considered that metabolic syndrome constituents such as obesity, HT and DM are related to urinary system stone disease. In the study by Binbay et al. examining the connection between metabolic syndrome components and urinary system stone disease, important influences of HT and obesity on urinary system stone disease occurrence were presented. It was also reported that individuals with a BMI of over 30 had nearly 2.2 times higher urinary system stone disease risk.²¹ In our current study, the uric acid stone prevalence was found higher in patients with DM, HT and increased BMI.

Our study also had some limitations. The study was made retrospectively and the number of patients was relatively lower. The fact that the operations were made by different surgeons may have affected the results. On the other hand, not being able to make comparisons with stones in different locations like kidney and bladder may be a limitation.

CONCLUSION

In line with the literature, oxalate stones were the most common stone type in our study. Uric acid stone was observed more commonly in patients with metabolic syndrome formed by the components of obesity, DM and HT. Stone analysis should be demanded from each patient whose stone sample was acquired. Thus, metaphylaxis which is the sum of the precautions to prevent stone recurrence may be meaningful.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

All authors contributed equally while preparing this study.

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