Predictive factors for spontaneous stone passage in diabetic patients with acute ureteric colic

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To the Editor: According to the data from the National Health and Nutrition Examination Survey (2007–2010), the prevalence of kidney stones in the United States (US) population is 8.8%\textsuperscript{1}. A prior US population study has found that the prevalence of kidney stones increases with obesity, diabetes, and metabolic syndrome; for individuals with type 2 diabetes, the severity of disease is associated with a greater risk of kidney stones.\textsuperscript{1,2} Choi \textit{et al}\textsuperscript{3} reported that a diagnosis of diabetes was a significant predictive risk factor for failure of spontaneous stone passage (SSP) possibly secondary to ureteral edema and those diabetic patients should be considered for candidates for more invasive treatment. However, this study included only 26 diabetic patients, and only 31 of 366 patients failed to spontaneously pass their stones both of which may limit the power to predict SSP of diabetes.\textsuperscript{3} This is an important question to answer given the volume of stones in the US and the consequences of changes in SSP rates between patient groups. Therefore, through a retrospective analysis of the database of emergency renal colic visits in Cleveland Clinic Foundation, we evaluate the association of diabetes on SSP and investigated the predictive factors of SSP in diabetic patients.

Those patients who were presented at Emergency Department with urolithiasis between December 2010 and May 2013 were identified in the prospective institutional review board of Cleveland Clinic Foundation approved Kidney Stone Registry (No. 11-266) and were entered into the study. We excluded patients with stones located only in the kidney, multiple ureteral stones, solitary kidney, pregnancy, fever, or signs of infection. Totally 660 ureteral stone patients with acute ureteric colic were enrolled in the study, and diabetic patients were 100 cases (15.2%). The stone site was measured by an experienced endourologist in the axial diameter from computed tomography (CT) scan, and location as well as the degree of hydronephrosis was also measured by CT scan. Patients’ characteristics, including age, gender, and comorbidities, as well as laboratory test results, were obtained from the electronic medical records. The level of hemoglobin A1c (HbA1c) was obtained in diabetic patients. Ureteral wall thickness (UWT) at the stone site was also measured from axial CT scan in diabetic patients. According to Yoshida \textit{et al}\textsuperscript{4} the UWT was measured as the point of greatest soft-tissue thickness around the circumference of the stone. We evaluated the association of diabetes on SSP within the 90-day follow-up period. Patients were followed at 2 to 4 weeks intervals to a maximum of 90 days and monitored for worsening in symptoms or renal function. SSP was defined as the stone passage from the ureter without any invasive interventions, which was confirmed by clinical manifestations and follow-up imaging or reported by telephone follow-up. The potential predictive factors for SSP in diabetic patients with acute ureteric colic were obtained with univariate and multivariate analyses. Statistical analysis was performed on the SPSS 25.0 platform (IBM Corp, Armonk, NY, USA), and \( P < 0.05 \) (two-tailed) was considered as statistically significant. Data with normal distribution were recorded as the mean \( \pm \) standard deviations. The \( \chi^2 \)-test was used to check the differences in proportions for categorical data, whereas continuous variables were processed using independent sample \( t \)-tests. For the variables that are significant in univariable tests, the logistic regression was performed to identify the independent risk factors.

Among the patients enrolled in the study, 418 (63.3%) were male with an average age of 48.6 \( \pm \) 15.0 years old and 418 (63.3%) patients passed their stones spontaneously. Diabetes diagnosis as well as the level of HbA1c was not associated with changes in SSP. As for the stone location, we found out that stones located more distally in the ureter had the highest rates of spontaneous passage (\( P < 0.001 \)). The SSP rates were 75.6%, 58.3%, and 38.7% for distal,

\begin{table}
\centering
\begin{tabular}{|c|c|}
\hline
Stone Site & SSP Rate (\%) \\
\hline
Distal & 75.6 \\
Near & 63.5 \\
Proximal & 38.7 \\
\hline
\end{tabular}
\end{table}
Table 1: Demographics of diabetic patients' characteristics and univariate and multivariate analyses.

| Variables          | SSP + (n=60) | SSP – (n=40) | P value | OR (95% CI) | P value |
|--------------------|--------------|--------------|---------|-------------|---------|
| Gender             |              |              | 0.669   |             | –       |
| Male               | 38 (63.3)    | 27 (67.5)    |         |             | –       |
| Female             | 22 (36.7)    | 13 (32.5)    |         |             | –       |
| Age (years)        | 58.0 ± 11.2  | 60.8 ± 10.2  | 0.207   |             | –       |
| Degree of hydronephrosis |           |              | 0.275   |             | –       |
| None               | 45 (75.0)    | 25 (62.5)    |         |             | –       |
| Mild               | 9 (15.0)     | 8 (20.0)     |         |             | –       |
| Moderate           | 6 (10.0)     | 5 (12.5)     |         |             | –       |
| Severe             | 0            | 2 (5.0)      |         |             | –       |
| Blood WBC (× 10^9/L) | 10.34 ± 3.17 | 9.57 ± 2.99  | 0.240   |             | –       |
| Serum creatinine (mg/dL) | 1.03 ± 0.36 | 1.04 ± 0.29  | 0.897   |             | –       |
| UWT (mm)           | 1.78 ± 1.04  | 3.67 ± 1.58  | <0.001  | 4.163       | <0.001  |
| Stone size         |              |              |         | (2.232–7.766) |         |
| <5 mm              | 41 (68.3)    | 11 (27.5)    |         | 1.000       | 0.004   |
| 5–7 mm             | 15 (25.0)    | 23 (57.5)    |         | 11.113      | 0.001   |
| >7 mm              | 4 (6.7)      | 6 (13.0)     |         | 5.768       | 0.001   |
| Stone location     |              |              |         |             |         |
| Distal             | 36 (60.0)    | 19 (47.5)    | 0.035   | 1.000       | 0.021   |
| Middle             | 11 (18.3)    | 3 (7.5)      |         | 0.071       | 0.001   |
| Proximal           | 13 (21.7)    | 18 (45.0)    |         | 0.146       | 0.001   |
| HBA1c (%)          | 6.64 ± 1.02  | 6.98 ± 1.67  | 0.268   |             | –       |
| HBA1c <5.7%        | 3 (6.5)      | 2 (6.5)      |         |             | –       |
| 5.7–6.4%           | 24 (52.2)    | 12 (38.7)    |         |             | –       |
| ≥6.5%              | 19 (41.3)    | 17 (54.8)    |         |             | –       |

Values are presented as median ± standard deviations (SDs) or number (%). *Indicates P < 0.05. HBA1c: Hemoglobin A1c; SSP: Spontaneous stone passage; UWT: Ureteral wall thickness; WBC: White blood cells.

middle, and proximal ureteral stones, respectively. With regards to stone size, we observed that larger stones had lower rates of successful SSP (P < 0.001). We then divided the stone size into three groups, <5 mm (SSP rate 80.6%), 5 to 7 mm (SSP rate 44.5%), and >7 mm (SSP rate 16.3%).

When we focused on diabetic patients with acute ureteric colic, we found out that smaller stone size (P < 0.001), more distal stone location (P = 0.035) were statistically significantly associated with increased rates of SSP. Furthermore, smaller UWT (P < 0.001) was statistically significantly associated with increased rates of SSP in diabetic patients; hydronephrosis and white blood cells were not statistically significant predictors of stone passage in diabetic patients with acute ureteric colic in univariate analysis. When we evaluated the factors that were statistically significant into multivariable analysis in diabetic patients, smaller UWT (P < 0.001), smaller stone size (P = 0.004), and more distal stone location (P = 0.021) were recognized as independent risk factors for SSP (Table 1).

When we sought to delineate the factors associated with the SSP with a focus on diabetes, a common comorbidity in the US yet also a relationship that has not yet been fully characterized in the literature. We did not find any association between diabetes and changes in SSP rates. This is of interest to the current literature since it is contradictory to the findings reported by Choi et al., one of the only other published studies that looked specifically at both diabetes and stone passage rates.

The stone passage trends for our study population appeared to be consistent with those reported in previous studies, including stone location, stone size. We observed an overall SSP rate within 90 days was 63.3% which increased to 75.6% for distal stones. This trend is consistent with the SSP rates of distal stones reported in recent randomized controlled trials in this field. We also observed that stone size was a major predictor of SSP. A multicenter study (Multi-center cohort study evaluating the role of Inflammatory Markers In patients presenting with acute ureteric Colic) demonstrated that the SSP rate of ureteral stones <5 mm was 89% compared to 49% for ureteral stones ≥5 to 7 mm, and 29% for ureteral stones >7 mm. We observed a similar trend in our study.

When we focused on diabetic patients with acute ureteric colic, we still found that smaller stone size and more distal stone location were independent risk factors for SSP. Recent studies showed that UWT, measured at the stone site by non-contrast CT scan could predict SSP. Yoshida et al first reported the clinical significance of UWT in terms of predicting SSP, low UWT had a significantly higher 4-week SSP rate than high UWT (76.4% vs. 14.7%, respectively; P < 0.001). Ureretal obstruction by stones can cause deteriorated renal function, and febrile UTI (fever of ≥38°C), even urosepsis. Urosepsis is of particular
Concern for diabetics, who may be more predisposed to developing pyelonephritis. And diabetes is the major leading cause of chronic kidney disease that causes deteriorated renal function, so it is especially important to identify the predictive factors for SSP in diabetic patients. The previous finding suggests that UWT might improve our clinical decision-making at the initial visit regarding whether patients with ureteral stones can be conservatively treated or must undergo immediate interventions.\footnote{4} In the present study, we also confirmed that UWT was a superior predictor for SSP in diabetic patients.

In conclusion, successful identification of diabetic patients with acute ureteric colic suitable for conservative management is an important decision point, with both medical and financial benefits to the healthcare system by reducing unnecessary surgeries and complications. We found that diabetes was not associated with changes in SSP. UWT and stone size are the most important factors in diabetic patients when considering interventions such as extracorporeal shock wave lithotripsy or ureteroscopy.

**Conflicts of interest**

None.

**References**

1. Scales CD Jr, Smith AC, Hanley JM, Saigal CS. Urologic Diseases in America Project. Prevalence of kidney stones in the United States. Eur Urol 2012;62:160–165. doi: 10.1016/j.eururo.2012.03.052.
2. Weinberg AE, Patel CJ, Chertow GM, Leppert JT. Diabetic severity and risk of kidney stone disease. Eur Urol 2014;65:242–247. doi: 10.1016/j.eururo.2013.03.026.
3. Choi T, Yoo KH, Choi SK, Kim DS, Lee DG, Min GE, et al. Analysis of factors affecting spontaneous expulsion of ureteral stones that may predict unfavorable outcomes during watchful waiting periods: what is the influence of diabetes mellitus on the ureter? Korean J Urol 2015;56:455–460. doi: 10.4111/kju.2015.56.6.455.
4. Yoshida T, Inoue T, Taguchi M, Omura N, Kinoshita H, Matsuda T. Ureteral wall thickness as a significant factor in predicting spontaneous passage of ureteral stones of ≤ 10 mm: a preliminary report. World J Urol 2019;37:913–919. doi: 10.1007/s00345-018-2461-x.
5. Shah TT, Gao C, Peters M, Manning T, Cashman S, Nambiar A, et al. Factors associated with spontaneous stone passage in a contemporary cohort of patients presenting with acute ureteric colic: results from the multi-centre cohort study evaluating the role of inflammatory markers in patients presenting with acute ureteric Colic (MIMIC) study. BJU Int 2019;12:504–513. doi: 10.1111/bju.14777.

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