

Original Research Article

PROPORTION OF TYPE 2 DIABETES AMONG PATIENTS WITH UPPER TRACT UROLITHIASIS

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ABSTRACT

Background: Urinary stone disease is increasingly common alongside rising obesity, metabolic syndrome, and type 2 diabetes mellitus (T2DM) in industrialized and urban Indian populations. While diabetes is linked to a higher risk of kidney stones, the exact stone composition remains unclear. Diabetic patients tend to excrete more oxalate and uric acid, with lower urine pH, promoting stone formation. Factors such as insulin resistance and altered renal handling of calcium and ammonium contribute to this risk. However, limited data exists on the specific stone composition in diabetic patients. This study aims to explore the prevalence and composition of kidney stones in individuals with T2DM.

Materials and Methods: This 12-month cross-sectional study (Jan-Dec 2024) involved 285 patients with upper tract urolithiasis admitted for intervention. Inclusion criteria included patients with upper urinary tract stones willing to participate, while exclusions included those with conditions like coronary artery disease, chronic kidney disease, and metabolic disorders. Data collection involved structured proformas, urine pH and specific gravity meters, blood and urine analyses, imaging studies, and BMI calculations. Stone interventions included PCNL, RIRS, URS, ESWL, or open surgery. Variables analyzed included age, BMI, blood glucose, serum creatinine, urinary oxalate and uric acid, stone characteristics, and hospitalization duration. Ethical approval and informed consent were obtained.

Results: During the study period, 285 patients with upper urinary tract calculi were admitted to Rama Medical College's Urology Ward, of which 85 (29.8%) were diabetic and 200 (70.2%) were non-diabetic. Among diabetics, 42.4% were female and 57.6% were male, while in non-diabetics, 34.5% were female and 65.5% were male. Diabetic patients had higher rates of being overweight (67.1%) and obese (15.3%) compared to non-diabetic patients (34.5% overweight, 5.5% obese), with a statistically significant difference ($p < 0.001$). Symptoms like vomiting, fever, and pyuria were more common in diabetic patients. Diabetics also had significantly lower urine pH, higher urinary oxalate excretion, and higher rates of pus cells, RBCs, and radiolucent calculi. Hospital stays were longer for diabetic patients (32.9% stayed ≥ 3 days) compared to non-diabetics (9.5%). Diabetic patients had significantly higher BMI, mean age, serum uric acid, blood urea, serum creatinine, and calcium values. Urinary oxalate and uric acid values were also significantly higher in diabetics. All differences were statistically significant.

Discussion: Urolithiasis is a significant global health issue, with over \$2 billion annually spent on treatment in the U.S. Type 2 diabetes mellitus

(T2DM), characterized by insulin resistance, is a known risk factor for renal stone formation. Insulin resistance lowers renal ammonium production, reducing urinary pH, which promotes uric acid stone formation. Additionally, T2DM increases urinary calcium excretion, contributing to calcium stone formation. This study, conducted at Rama Medical College, found that 29.8% of 285 patients with upper urinary tract stones were diabetic. Diabetic patients had significantly higher fasting blood glucose, lower urine pH, and elevated urinary oxalate and uric acid levels. Obesity, common in T2DM, exacerbates stone formation. Diabetic patients also had longer hospital stays, higher infection rates, and more radiolucent stones compared to non-diabetics. These findings emphasize the need for better management of T2DM to reduce the risk and recurrence of kidney stones.

Conclusion: Obesity and type 2 diabetes mellitus (T2DM), characterized by insulin resistance, are key risk factors for nephrolithiasis. In this study, 29.8% of stone patients were diabetic, with higher rates of obesity, lower urinary pH, and abnormal solute excretion. Diabetic patients also faced longer hospital stays and more complications. These findings emphasize the need for targeted management strategies to mitigate the risk and recurrence of kidney stones in individuals with T2DM.

Keywords: Urolithiasis, Diabetes Mellitus, UTI.

INTRODUCTION

The rising incidence of urinary stone disease parallels increasing obesity, metabolic syndrome, and type 2 diabetes in industrialized nations and Indian centers.^[1] Diabetes mellitus (DM) is linked to a higher prevalence of kidney stones, though the exact stone composition remains unclear. Studies show diabetic patients excrete more oxalate and uric acid, with lower urine pH, favouring stone formation. Insulin resistance, glycemic control, and altered renal calcium and ammonium handling contribute to this association. Despite evidence linking nephrolithiasis with diabetes, obesity, and hypertension, stone composition data is limited. This study aims to explore the proportion and correlation of type 2 DM with urolithiasis.

MATERIALS AND METHODS

This cross-sectional study was conducted over 12 months (Jan 2024– Dec 2024), involving 285 patients with upper tract urolithiasis admitted for intervention. Inclusion criteria encompassed all patients with upper urinary tract calculi admitted to the Urology Ward who were willing to participate, while exclusion criteria included those unwilling to participate or with conditions such as coronary artery disease, chronic kidney disease, Uricosuric medication use, metabolic disorders, recurrent stone formation, gastrointestinal diseases, hyperparathyroidism, elevated serum creatinine levels, or chronic urinary tract infections. Data collection involved a structured proforma, urine pH and specific gravity meters, the AGD-2020 Clinical Chemistry Analyzer, and SPSS software. Patient history was detailed, including blood and

urine analyses, imaging studies (USG, X-rays, or CT), and BMI calculation. Stone interventions comprised PCNL, RIRS, URS, ESWL, or open surgery. Variables analyzed included age, BMI, symptoms, fasting blood glucose, serum creatinine, urine pH, specific gravity, 24-hour urinary oxalate and uric acid levels, radiological stone characteristics, and duration of hospitalization. Ethical clearance for the study was obtained, and informed consent was secured from all participants.

RESULTS

A total of 285 patients with upper urinary tract calculi were admitted to Urology Ward of Rama Medical College, Hapur for intervention during the study period. Out of 285 patients, 85 (29.8%) were Diabetic and 200 (70.2%) were Non-Diabetic. Out of 85 Diabetic patients, 42.4% (i.e, 36) were females and 57.6% (i.e.,49) were males. Whereas, in Non-diabetic patients, 34.5% (69) were females and 65.5% (131) were males. In diabetic patients 67.1% (i.e.,57) subjects were overweight and 15.3% (i.e.,13) subjects were obese, whereas in Non-Diabetic subjects, 34.5% (i.e.,69) subjects were overweight and only 5.5% (i.e.,24) were obese. This difference was statistically significant ($p < 0.001$). All the study subjects presented with pain, while vomiting was predominant in Diabetic subjects i.e., 25.9 % and was statistically significant ($p=0.008$). fever and pyuria were more common in Diabetic subjects i.e., 10.6% and 14.1% respectively. Dysuria and hematuria were also common in Diabetic patients but the difference was not statistically significant. Out of 85 Diabetic patients, 43.5% (i.e., 37) had urine pH value

<5.5 whereas only 8% (i.e. 16) of non-diabetic patients had urine pH <5.5. In our study among the diabetic group 65.9% (i.e., 56) of Diabetic patients had abnormal 24 hr urinary oxalate values whereas only 12% of Non- Diabetic patients showed abnormality in these values. This difference was statistically significant ($p < 0.001$). 20% (i.e., 17) of Diabetic patients had significant pus cells in urine routine whereas only 9% (i.e., 18) Non- Diabetic patients had significant pus cells in urine. This was statistically significant data. Among Diabetic subjects 15.3% presented with significant RBCs in urine routine, whereas only 6.5% of Non-Diabetic subjects had significant RBCs in urine and this was statistically significant. In diabetic group 34.1% had radiolucent calculi whereas 22.5% of Non- Diabetic patients had radiolucent calculi. This showed statistical significant difference. In Diabetic patients 32.9% stayed in hospital for ≥ 3 days owing to the complications whereas only 9.5% of Non- Diabetic subjects stayed for ≥ 3 days. This difference was statistically significant. The mean age in diabetic group was significantly higher than non- diabetic group i.e., 53 ± 8.2 yrs vs. 46.4 ± 12.1 yrs. The mean BMI value was strikingly higher in patients with Type 2 Diabetes than in patients without Diabetes (27.1 ± 2.3 versus 25.2 ± 1.9 kg/m²). Diabetic patients had statistically significant higher mean serum uric acid values than non – diabetic patients. Urine pH was also significantly lower in Diabetics as compared to non-diabetics. Diabetic patients had significantly higher blood urea, S. creatinine and S. Calcium values than non-diabetic subjects. 24 hr urinary oxalate and uric acid values were also significantly higher in diabetic subjects.

DISCUSSION

Urolithiasis, a significant global health issue, incurs over \$2 billion annually in treatment costs in the U.S. Type 2 diabetes mellitus (T2DM), characterized by insulin resistance, is a known risk factor for renal stone formation.^[2] Insulin resistance leads to reduced renal ammonium production, resulting in lower urinary pH, a critical factor in uric acid (UA) stone formation. Additionally, hyperinsulinemia in T2DM increases urinary calcium excretion, contributing to calcium stone formation.^[3] Hypocitraturia, caused by defects in renal acid excretion, further raises the risk of calcium stones.^[4]

This study conducted at Rama medical college and hospital Hapur, evaluated 285 patients undergoing treatment for upper urinary tract stones, finding that 29.8% were diabetic, aligning with similar studies. Most patients (60.7%) were aged 41-60, consistent with age-related insulin resistance and mitochondrial decline affecting tubular function.

Males constituted 63.2% of participants, though gender differences in stone prevalence are narrowing.

Prevalence of stones increases with age, with peak incidence in fourth to sixth decade of life as shown in separate studies conducted by Marshall et al,^[5] and Johnson et al.^[6] This observation is consistent with our study, as maximum number of study patients i.e., 173 out of 285, were in 41-60 years of age group.

Poor glycemic control was an independent risk factor for kidney stones, as diabetic patients in this study exhibited significantly higher fasting blood sugar levels (137 ± 42 vs. 94 ± 11 mg/dL; $p < 0.001$). Urine pH was notably lower in diabetics (5.6 ± 0.4 vs. 6.0 ± 0.3 ; $p < 0.001$), with 43.5% of diabetic patients having a pH below 5.5, favouring UA stone formation. Hartman et al,^[7] found that urine pH was significantly lower in the urolithiasis patients with DM as compared to patients without DM.

Obesity, often associated with T2DM, exacerbates insulin resistance through pro- inflammatory cytokines and reduced adiponectin. In this study, diabetic patients had a significantly higher mean BMI (27.1 ± 2.3 vs. 25.2 ± 1.9 kg/m²; $p < 0.001$). Higher BMI correlated with increased urinary excretion of lithogenic solutes (oxalate, UA, calcium) and lower urine pH, supporting previous findings that obesity promotes stone formation via urinary changes.

Several studies have suggested that poor glycemic control could be an independent

risk factor for kidney stones. Kebaya et al,^[8] in a cross-sectional study with 2171 patients reported that patients with fasting plasma glucose concentrations ≥ 7.0 mmol/L had an odds ratio of 1.83 for forming kidney stones as compared to patients with fasting plasma glucose concentrations < 5.52 mmol/L. Their results were similar to those reported by Weinberg et al,^[9] in the cross-sectional study of 12,110 participants in the National Health and Nutrition Examination Survey. Weinberg et al.^[9] reported that HbA1c and a history of insulin use were strongly associated with self- reported stone disease. In our study, patients with type 2 diabetes had significantly higher fasting blood sugar as compared to non- diabetic patients (137 ± 42 versus 94 ± 11 mg/dl; $p < 0.001$), signifying insulin resistance in the former group. This finding was also consistent with the work of Cameron et al.^[10] Clinical symptoms like flank pain were common in all patients. However, vomiting, fever, and pyuria were more prevalent among diabetics due to gastroparesis, severe pain, and higher infection risk. Diabetic patients had elevated blood urea, serum creatinine, and calcium levels, indicating possible diabetic nephropathy.

Urinary oxalate and UA excretion were significantly elevated in diabetics. Mean urinary oxalate levels

were 45.8 ± 15.4 mg/day, with 65.9% of diabetics exceeding 40 mg/day compared to 12% of non-diabetics. Similarly, urinary UA excretion was higher in diabetics (682.9 ± 222.5 mg/day vs. 560.7 ± 79.2 mg/day; $p < 0.001$). Pus cells and RBC counts were also raised due to higher infection rates in diabetics. Radiology revealed that 34.1% of diabetic patients had radiolucent stones versus 22.5% of non-diabetics ($p < 0.001$). Hospital stays were longer for diabetics (≥ 3 days in 32.9% vs. 9.5% of non-diabetics; $p < 0.001$), largely due to preoperative complications like uncontrolled blood sugar and infections.

In brief, T2DM significantly impacts urolithiasis through mechanisms like insulin resistance, low urinary pH, and higher excretion of lithogenic solutes, emphasizing the need for targeted management to reduce stone risk and recurrence

CONCLUSION

Obesity and T2DM, marked by insulin resistance, are major nephrolithiasis risk factors. This study found 29.8% of stone patients were diabetic, with higher obesity rates, lower urinary pH, and abnormal solute excretion. Diabetics experienced longer hospital stays and complications, highlighting the need for targeted management to reduce kidney stone burden.

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