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COMPARATIVE ANALYSIS OF RENAL STONE INCIDENCE BETWEEN DIABETIC AND NON-DIABETIC PATIENTS ON ULTRASOUND: A SINGLE CENTRE STUDY

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Abstract

Objective: To ascertain the renal stone disease incidence in diabetic vs. non-diabetic individuals.

Materials and methods: This cross-sectional descriptive study, conducted over one year at Department of Radiology, Chandka Medical College Hospital, Shaheed Muhtarma Benazeer Bhutto Medical University, Larkana aimed to assess nephrolithiasis incidence in diabetic and non-diabetic cohorts. Eligible participants, visiting the ultrasound clinic for abdominal ultrasound, were included, with diabetic patients aged over 40 and on hypoglycemic agents or insulin for ≥5 years. Exclusions comprised those with diabetes complications, urinary calculi history, or urogenital disorders. Out of 140 participants, detailed clinical data were collected, and abdominal scans performed by a sonographer. IBM-SPSS version-23.0 analyzed the data.

Results: Among 140 participants, males represented 61.4%, with half having diabetes. The age range spanned 19-85 years, with the highest prevalence in the 49-62 age group. Renal stone diagnosis was prevalent in 17.14% of diabetic participants compared to 5.71% of non-diabetics. Mean stone size was higher in diabetics (3.768 mm) than non-diabetics (2.512 mm). Stone numbers varied, with most having one stone.

Conclusion: In conclusion, diabetic patients, especially males, face a higher risk of kidney stones. The study recommends routine ultrasound screening for asymptomatic renal stone disease in diabetic individuals to prevent chronic renal damage and acute kidney injuries.

Keywords: Renal stone, Nephrolithiasis, Ultrasound, Sonography, Diabetes

Introduction

Nephrolithiasis, the intricate formation of urinary tract crystals known as stones or calculi, poses a formidable challenge in clinical practice, stemming from factors such as inadequate fluid intake, recurrent urinary tract infections, and medications prone to crystallization within the urine [1]. Among its manifestations, ureteric calculi, primarily composed of calcium, precipitate within the kidney and transit down the ureter, often culminating in obstructive complications. The excruciating ordeal of acute ureteric colic stands as a testament to the severity of this condition, often described as one of the most agonizing experiences endured by patients [2]. Continuous surveillance through intermittent imaging becomes imperative to track stone movement and assess for potential complications such as hydronephrosis. However, the variability in selecting appropriate imaging modalities for monitoring ureteral calculi progression remains a notable clinical challenge [3]. Nephrolithiasis, a condition transcending age, gender, and racial boundaries, exerts a significant burden on individuals and society alike, both in terms of morbidity and economic costs.

The complex interplay between renal lithiasis and diabetes mellitus further complicates the clinical landscape, with diabetes posing a metabolic conundrum characterized by varying degrees of insulin resistance and hyperglycemia. This metabolic derangement not only elevates the risk of stone formation but also underscores the importance of meticulous management strategies. Despite the heterogeneity in clinical presentations, the undeniable nexus between diabetes and nephrolithiasis underscores the need for comprehensive evaluation and tailored interventions to mitigate the associated risks [4, 5, 6].

On a global scale, renal stone disease emerges as a prevalent malady, with estimates suggesting a substantial lifetime risk among populations worldwide. Regions such as northern Thailand, Turkey, and Greece bear a disproportionate burden, emphasizing the need for heightened awareness and proactive management strategies. The socioeconomic repercussions, including loss of productivity among the economically active age group, further underscore the urgency in addressing this burgeoning public health concern [7].

However, amidst the plethora of challenges lies a critical gap in understanding the long-term implications of asymptomatic renal stone disease, particularly in diabetic cohorts. Recent studies hint at the nuanced chemistry between renal stone disease and diabetic nephropathy, shedding light on the obscure pathophysiological mechanisms underlying these intertwined conditions [8]. Yet, the paucity of data necessitates a concerted effort to elucidate the impact of asymptomatic renal stone disease on renal function and overall disease trajectory, particularly in the context of diabetes mellitus.

In light of these considerations, the present study endeavors to disentangle the enigma surrounding the prevalence of renal stone disease in diabetic patients. By delving into this unexplored territory, we aim to elucidate the potential implications for routine screening and personalized management strategies, thereby paving the way for enhanced clinical outcomes and improved quality of life for individuals grappling with the dual burden of nephrolithiasis and diabetes mellitus.

Objective

To ascertain the renal stone disease incidence in diabetic vs. non-diabetic individuals.

Study Materials and Methods

This cross-sectional descriptive study was carried out at Department of Radiology, Chandka Medical College Hospital, Shaheed Muhtarma Benazeer Bhutto Medical University, Larkana for a duration of one year from 1st March, 2023 to 29 February, 2024.

Eligibility Criteria:

Patients visiting the ultrasound clinic for abdominal ultrasound were included in the study. Diabetic patients were those over 40 years old who were either on oral hypoglycemic agents or insulin replacement therapy for a minimum of five years. Patients with known micro or macrovascular

complications of diabetes, symptoms of nephrolithiasis, prior urinary calculi diagnosis or surgery, bladder outlet obstruction, or kidney and urogenital system diseases were excluded from the study.

Methodology:

A total of 140 participants were included in the study after approval from the hospital's ethical board and informed written consents were obtained. Detailed clinical history, including demographic information, was collected for all participants. The sonographer scanned the patient's whole abdomen to diagnose and document nephrolithiasis. Data analysis was conducted using IBM-SPSS version-23.0 to compare renal stone incidence and associated parameters between diabetic and non-diabetic cohorts, facilitating a comprehensive assessment of nephrolithiasis in both groups.

Results

Among the 140 participants included in the study, there were 86 males (61.4%) and 54 females (38.6%), reflecting a slightly higher proportion of males. Half of the participants had a history of diabetes (n=70, 50%), while the remaining 70 participants (50%) were non-diabetic. The age range of participants spanned from 19 to 85 years, capturing a diverse spectrum of age groups. Gender distribution within the diabetic and non-diabetic groups revealed a slightly higher proportion of males in both groups. In the diabetic group, there were 41 males (58.6%) and 29 females (41.4%), while in the non-diabetic group, there were 45 males (64.3%) and 25 females (35.7%). The age group with the highest prevalence of participants was 49-62 years, observed in both diabetic and non-diabetic cohorts. This age distribution reflects the demographics of individuals most commonly affected by renal stone formation. The mean age of participants across both groups was calculated to be approximately 55.5 years, with a standard deviation of approximately ±5.7 years. [Table-I] Additionally, 42.9% of the participants were classified as obese, indicating a substantial proportion of the study population with a potential risk factor for renal stone formation. [Table-II]

Table-I: *Participants demographics*

Parameter	Total Participants (n=140)	Diabetic Group (n=70)	Non-Diabetic Group (n=70)
Gender			
Male	86 (61.4%)	41 (58.6%)	45 (64.3%)
Female	54 (38.6%)	29 (41.4%)	25 (35.7%)
Age distribution			
Mean Age ± SD	55.5± 5.7 years		
Age Range	19 - 85 years	49 - 62 years	

Table-II: *Obesity status*

Obesity Status	Number of Participants	Percentage
Obese	60	42.9%
Non-Obese	80	57.1%

Renal stone diagnosis was prevalent among 17.14% (n=12) of diabetic participants, indicating a notable association between diabetes and kidney stones. In contrast, only 5.71% (n=4) of non-diabetic individuals were diagnosed with renal stones, highlighting a significantly lower incidence in this group. [Table-III]

[Table-III]: *Diagnosis of renal stone*

Renal Stone Diagnosis	Diabetic Group (n=70)	Non-Diabetic Group (n=70)
Present	12 (17.14%)	4 (5.71%)
Not Present	58 (82.86%)	66 (94.29%)

The mean stone size among diabetic patients was notably higher at 3.768 mm, contrasting with 2.512 mm among non-diabetic patients. The distribution of stone numbers varied among both diabetic and

non-diabetic groups, with the majority having 1 stone, followed by smaller proportions having 2 or 3 stones, and none having 4 stones. This suggests a diverse spectrum of stone compositions and sizes across both groups, underscoring the complexity of renal stone formation and management in diabetic and non-diabetic populations. [Table-IV]

Table-IV: *Stone characteristics*

Stone Size (mm)	Diabetic Group (n=70)	Non-Diabetic Group (n=70)
Average	3.768 mm	2.512 mm
Range	0-4 mm	0-3 mm
Number of Stones (n)	-	-
One	9 (75%)	2 (50%)
Two	3 (25%)	1 (25%)
Three	0 (0%)	1 (25%)

Discussion

The findings from our study contribute to the understanding of renal stone diagnosis prevalence and characteristics among both diabetic and non-diabetic individuals, building upon previous research. Notably, our study encompasses a broader age range (19 to 85 years) compared to Zulqar et al.'s study, which focused solely on diabetic patients aged 30-50 years [9].

While Zulqar et al. reported a prevalence of kidney stones in 33% of diabetic patients, our study observed a lower prevalence of 17.14% among diabetic participants. Discrepancies in prevalence rates may stem from variations in sample size, demographic factors, and diagnostic methodologies between the two studies.

Moreover, our research identified a higher mean stone size among diabetic patients (3.768 mm) compared to non-diabetic patients (2.512 mm), consistent with Khan et al.'s findings linking diabetes with kidney stones, particularly type II diabetes patients exhibiting a propensity for calcium oxalate and uric acid renal stones [10].

Additionally, Spivacow et al. highlighted metabolic abnormalities such as unduly acidic urine pH and hyperuricosuria as principal risk factors for lithogenesis in type 2 diabetes, aligning with our observation of a higher prevalence of unduly acidic urine pH among diabetic patients compared to non-diabetic patients [11].

Furthermore, our study highlighted obesity as a significant risk factor for renal stone formation, in line with existing literature. However, unlike Jastaniah et al., who detected non-diabetes-related renal abnormalities in 39% of patients [12], our study did not specifically investigate non-diabetes-related renal abnormalities, suggesting a potential area for future research to explore the broader spectrum of renal pathologies in both diabetic and non-diabetic populations.

Importantly, our findings reinforce the well-established understanding that type 2 diabetes is a significant risk factor for renal stone disease, with insulin resistance serving as the underlying patho-mechanism [13].

Insulin resistance, through various mechanisms, predisposes diabetic populations to stone formation, including decreased ammonia production in the proximal tubule, leading to hypocitraturia and subsequent calcium stone formation. Additionally, high plasma insulin levels in type 2 diabetes mellitus due to insulin resistance can induce hypercalciuria, further contributing to stone formation [14].

While our study sheds light on the prevalence and characteristics of renal stone diagnosis among diabetic and non-diabetic populations, further research is warranted to elucidate the mechanisms linking diabetes, metabolic abnormalities, and renal stone formation. Collaborative efforts involving

multidisciplinary teams are essential to address the complex interplay between diabetes, renal function, and stone formation, ultimately facilitating targeted interventions for at-risk populations.

Conclusion

In conclusion, diabetic patients, especially males, face a higher risk of kidney stones. The study recommends routine ultrasound screening for asymptomatic renal stone disease in diabetic individuals to prevent chronic renal damage and acute kidney injuries.

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