THE ROLE OF RADIOLOGICAL IMAGING (CT SCAN) IN THE DIAGNOSIS AND TREATMENT OF UROLITHIASIS: A CLINICAL STUDY

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ABSTRACT

Background: Urolithiasis (urinary tract stones) is a prevalent urological disorder causing significant morbidity. Timely and accurate diagnosis is crucial for effective treatment. Non-contrast computed tomography (NCCT) has emerged as the gold standard in imaging for urolithiasis. **Objective**: To assess the diagnostic efficacy of CT scans in detecting urolithiasis and its impact on treatment decision-making. **Methods**: This observational study included 36 patients clinically suspected of having urolithiasis. All underwent NCCT for diagnosis, and findings were correlated with clinical outcomes. Demographic and risk factor data were also analyzed. **Results**: CT scans detected stones in 32 (88.9%) patients. Stone location, size, and number were accurately identified. The most common site was the ureter (53.1%), and the most frequent risk factors were low fluid intake and high salt consumption. CT findings guided decisions such as conservative management, lithotripsy, or surgery in 94.4% of cases. **Conclusion**: CT scan is highly effective in diagnosing urolithiasis and plays a vital role in guiding appropriate treatment strategies.

KEYWORDS: Urolithiasis, CT scan.

INTRODUCTION

Urolithiasis is the formation of stones in the urinary tract, affecting up to 10–15% of the global population at some point in life. Risk factors include dehydration, dietary habits, metabolic conditions, and genetic predisposition[1]. Accurate localization and characterization of urinary stones are essential for appropriate treatment planning.

Traditionally, ultrasound and X-rays have been used for evaluation, but these may miss smaller or radiolucent stones. Non-contrast computed tomography (NCCT) has revolutionized the diagnostic process due to its high sensitivity and specificity. This study evaluates the role of NCCT in diagnosing urolithiasis and its contribution to guiding clinical management. [2-5]

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Kidney stones affect a significant portion of the global population, with prevalence rates varying by region and demographic factors. In India, about 12% of the population is estimated to have urinary stones, and some studies suggest that this number may be as high as 15% in certain areas like northern India. Globally, prevalence rates range from 1% to 15%, with variations across continents[6-9].

Regional Variations: India: While the overall prevalence is estimated at 12%, some regions, particularly northern India, experience higher rates, reaching 15%. Asia: Kidney stone prevalence varies significantly across Asia, with rates ranging from 1-5% in some areas to 5-19.1% in West, Southeast, and South Asia. United States: Kidney stones affect approximately 1 in 11 people in the US, with higher rates among certain ethnic groups and those who are obese, according to research from the National Institutes of Health. Saudi Arabia: A substantial 20% of individuals in Saudi Arabia are reported to suffer from kidney stones. China: In China, the adjusted prevalence rate was 5.8% in 2013. Factors Influencing Prevalence: Age: Kidney stone prevalence tends to increase with age. Gender: Kidney stones are more common in men than women, though women may be more susceptible in certain contexts (e.g., post-menopause)[10-16]. Ethnicity: Some studies suggest variations in prevalence based on ethnicity, with certain groups like Black, non-Hispanic and Hispanic individuals in the US being less likely to report kidney stones compared to white, non-Hispanic individuals, according to research from the National Institutes of Health. Obesity: Obesity is strongly associated with a higher risk of kidney stones. Diet: Dietary factors, such as high intake of sodium, animal protein, and certain types of supplements (e.g., vitamin C supplements) can increase the risk, while increased fluid, fruit, and vegetable intake may be protective. Other comorbidities: Conditions like diabetes, gout, and hypertension are also linked to increased risk. Family history: A family history of kidney stones can increase an individual's risk[17].

Important Considerations: Recurrence: Once a kidney stone is formed, the risk of recurrence is high, with some individuals experiencing recurrence within a few years. Complications:

Kidney stones can be associated with complications such as chronic kidney disease, end-stage renal disease, and cardiovascular disease. Geographic location: he prevalence of kidney stones can vary significantly based on geographic location, with certain regions known as "stone belts" due to higher rates of stone formation

METHODS

This study was conducted in a tertiary hospital. After obtaining institutional ethical committee approval. It was Cross-sectional observational study conducted on 36 patients in the department of Radiology and General Surgery, at a tertiary care centre, from September / 2021 to March/2022

Total 36 participant were approached to project among them No one were excluded in this study and Total 36 Confirmed cases were included on the basis of fulfilling of the eligibility criteria.

The institute Ethics Committee approval was obtained before starting the sample collection. A written and informed consent was taken from the patient regarding the study in his/her vernacular language and English. In this study Patients were subjected to: A detailed history of sign & symptoms and its duration. Detailed history of systemic diseases and its duration, medication were noted. Patients were subjected to General physical examination

Study Design:
- Cross-sectional observational study
- Duration: 6 months
- Sample size: 36 patients
- Setting: Radiology and Urology departments in a tertiary care hospital

Inclusion Criteria:
- Age 18 years and above
- Clinically suspected urolithiasis (e.g., flank pain, hematuria)
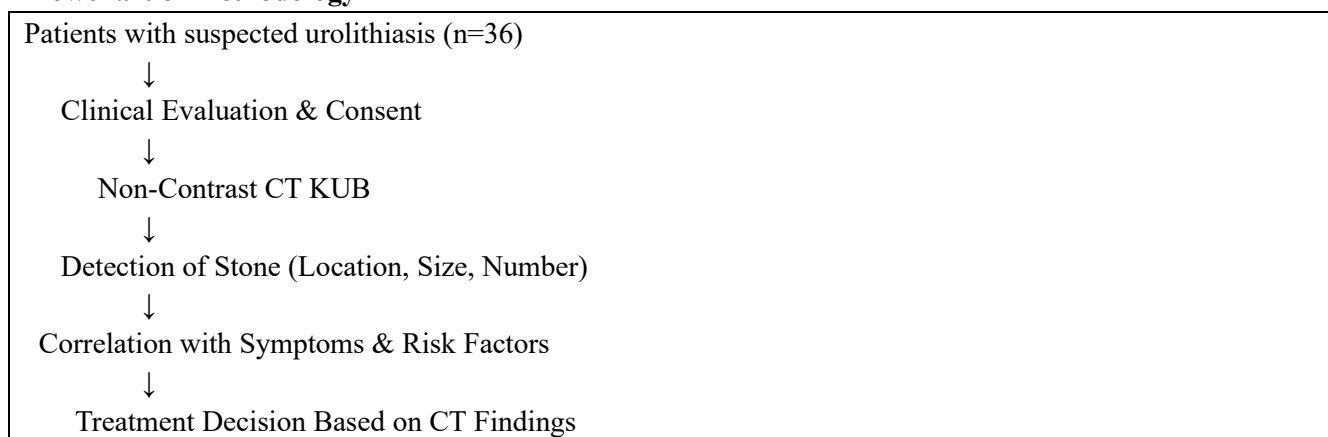- Willing to undergo CT scan

Exclusion Criteria:

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- Pregnant women
- Known renal malignancy or infections mimicking stones
- Patients with previous urological surgery in last 6 months

Procedure:
- Detailed clinical examination and history
- Non-contrast CT KUB (Kidney, Ureter, Bladder) imaging performed
- Evaluation for number, size, location, and density of stones
- Treatment decisions recorded post-imaging

Flowchart of Methodology

Patients with suspected urolithiasis (n=36)

↓

Clinical Evaluation & Consent

↓

Non-Contrast CT KUB

↓

Detection of Stone (Location, Size, Number)

↓

Correlation with Symptoms & Risk Factors

↓

Treatment Decision Based on CT Findings

RESULTS

In this study we found that Urolithiasis (urinary tract stones) is associated with demographic profile of patient. Male were more prone to suffered of Urolithiasis (urinary tract stones) as compared to Female, its prevalence is 63.9%. Urolithiasis (urinary tract stones). were more dominance among urban residence, its prevalence is 58.3%. (Table 1).

Age is also associated factors for Urolithiasis (urinary tract stones). Average mean age for Urolithiasis is 41.6 ± 12.2. Its prevalence is 63.9%. (Table 1).

Table 1: Demographic Characteristics (n=36)

Variable	Value
Mean Age (years)	41.6 ± 12.2
Age Group	18–30: 8 (22.2%)
	31–50.: 20 (55.6%)
	>50: 8 (22.2%)
Gender	Male: 23 (63.9%)
	Female: 13 (36.1%)
Residence	Urban: 21 (58.3%)
	Rural: 15 (41.7%)

Risk Factors for Urolithiasis is Low Fluid Intake (<2L/day). High Salt Intake, Family History, Sedentary Lifestyle, Recurrent UTI, High Animal Protein Diet and Obesity (BMI > 25). Among them low fluid intake is most important, its prevalence is 66.7%(Table 2)

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Table 2: Risk Factors for Urolithiasis

Risk Factor	Frequency (%)
Low Fluid Intake (<2L/day)	66.7%
High Salt Intake	52.8%
Family History	33.3%
Sedentary Lifestyle	44.4%
Recurrent UTI	22.2%
High Animal Protein Diet	36.1%
Obesity (BMI > 25)	30.6%

CT Findings
- **Stones detected**: 32 patients (88.9%)
- **Common sites**:
o Ureter: 17 cases (53.1%)
o Kidney (pelvis/calyces): 12 cases (37.5%)
o Bladder: 3 cases (9.4%)
- **Average Stone Size**: 6.2 mm (range: 3–14 mm)
- **Hydronephrosis**: Noted in 10 cases (27.8%)
- **Multiple stones**: 8 cases (22.2%)

Treatment Plan Based on CT Findings

Treatment Type	Number of Patients	%
Conservative (hydration, pain relief)	15	41.7
ESWL (Shock wave lithotripsy)	8	22.2
Ureteroscopy/PCNL	10	27.8
Referral for surgical management	3	8.3

DISCUSSION

Our study confirms the pivotal role of CT scanning in the diagnosis and treatment planning of urolithiasis. With a detection rate of 88.9%, NCCT remains superior to other imaging techniques, particularly in identifying radiolucent and small stones. Most stones were found in the ureter, aligning with the typical pain pattern of flank to groin radiation. High salt intake, dehydration, and sedentary behaviour were prominent risk factors—lifestyle modifications are therefore crucial alongside medical or surgical intervention[18-20].

Kidney stones can form due to a variety of factors, including dehydration, diet, and certain medical conditions. Dehydration, especially in warm climates, is a significant risk factor, as is a diet high in sodium, protein, or oxalate-rich foods. Medical conditions like obesity, diabetes, gout, and some digestive or urinary tract issues can also increase the likelihood of developing kidney stones[21].

In this study we found that Urolithiasis (urinary tract stones) is associated with demographic profile of patient. Male were more prone to suffered of Urolithiasis (urinary tract stones) as compared to Female, its prevalence is 63.9%. Urolithiasis (urinary tract stones). were more dominance among urban residence, its prevalence is 58.3%. (Table 1).

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Risk Factors for Urolithiasis is Low Fluid Intake (<2L/day). High Salt Intake, Family History, Sedentary Lifestyle, Recurrent UTI, High Animal Protein Diet and Obesity (BMI > 25). Among them low fluid intake is most important, its prevalence is 66.7%(Table 2)

Lifestyle Factors: Dehydration: Inadequate fluid intake leads to concentrated urine, making it easier for minerals and salts to crystallize and form stones. Diet: High Sodium: Excess sodium can increase calcium levels in the urine, promoting stone formation. High Protein: High protein intake, particularly from animal sources, can increase uric acid levels and the risk of uric acid stones[22].

High Oxalate: Oxalates are naturally occurring substances found in many foods. High oxalate levels in the urine can lead to calcium oxalate stones. Obesity: Obesity is linked to metabolic changes that can increase the risk of calcium-containing stones. Medical Conditions: Urinary Tract Infections: Recurrent or chronic UTIs can increase the risk of struvite stones, especially in individuals with long-term urinary catheters. Digestive Diseases: Conditions like inflammatory bowel disease or gastric bypass surgery can affect nutrient absorption and increase the risk of kidney stones. Hyperparathyroidism: This condition causes the overproduction of parathyroid hormone, which can lead to high calcium levels in the blood and urine[23].

Gout: Gout is a type of arthritis caused by a buildup of uric acid. High uric acid levels in the urine can contribute to uric acid stones. Diabetes: Diabetes is associated with metabolic changes that can increase the risk of kidney stones, particularly calcium oxalate stones. Renal Tubular Acidosis: This condition affects the kidneys' ability to regulate acid-base balance, potentially leading to kidney stones. Cystinuria: This is a rare, inherited disorder where the kidneys don't reabsorb the amino acid cystine, leading to its buildup in the urine and the formation of cystine stones[24-29]. Other Factors: Family History: A family history of kidney stones increases the risk of developing them. Age and Sex: Kidney stones are more common in men and tend to occur more frequently with age. Certain Medications: Some medications, like diuretics, calcium-based antacids, and some anti-seizure medications, can increase the risk of stone formation CT[30] scan findings directly influenced treatment decisions in the majority of cases, demonstrating its clinical value in not only diagnosis but also patient management strategy formulation. Comparison with other studies: Our results align with international studies showing CT sensitivity above 90% in urolithiasis diagnosis.

CONCLUSION

Non-contrast CT is a highly sensitive and specific tool in diagnosing urolithiasis. It provides critical details for effective treatment planning and should be considered the imaging modality of choice in most adult patients with suspected urinary stones. Early diagnosis through CT, combined with risk factor management, can greatly reduce morbidity associated with urolithiasis

SUBMISSION DECLARATION
This submission has not been published anywhere previously and that it is not simultaneously being considered for any other journal.

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