Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

FREQUENCY OF URINARY TRACT CALCULI IN PATIENTS UNDERGOING CT ABDOMEN AT RADIOLOGY DEPARTMENT OF MARDAN MEDICAL COMPLEX (A CROSS-SECTIONAL STUDY)

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DOI: https://doi.org/10.5281/zenodo.21489816

Keywords

Article History
Received: 01 February 2026
Accepted: 17 March 2026
Published: 31 March 2026

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Abstract

BACKGROUND

Urinary tract calculi are a common urological problem worldwide and are associated with significant morbidity and healthcare burden. Computed Tomography (CT) is considered the gold standard imaging modality for the detection of urinary tract stones due to its high sensitivity and specificity. This study was conducted to determine the frequency of urinary tract calculi among patients undergoing CT abdomen and to assess its association with selected demographic and clinical factors.

MATERIALS AND METHODS

A cross-sectional study was conducted among 194 patients undergoing CT scan for suspected urinary tract calculi. Data were collected regarding age, gender, history of hypertension, diabetes mellitus, water intake, and medication use through a structured questionnaire. CT scan findings were used to confirm the presence or absence of urinary tract calculi. Data were analyzed using SPSS version 25. Descriptive statistics were used to calculate frequencies, percentages, mean, and standard deviation. Fisher exact test was applied to determine the association between urinary tract calculi and selected variables, with p-value ≤0.05 considered statistically significant.

RESULTS

The mean age of participants was 40.22 ± 10.20 years, with ages ranging from 12 to 77 years. Among the total participants, 117 (60.3%) were males and 77 (39.7%) were females. Urinary tract calculi were detected in 169 (87.1%) patients on CT scan, while 25 (12.9%) had no calculi. The highest frequency of calculi was observed in the 41–60 years age group. Most participants reported adequate daily water intake (94.8%), while 7.7% had hypertension and 7.2% had diabetes mellitus. Chi-square analysis showed no statistically significant association between urinary tract calculi and diabetes

ISSN: (e) 3007-1607 (p) 3007-1593

mellitus (p=1.000), hypertension (p=0.698), daily water intake (p=1.000), or long-term medication use (p=0.225).

CONCLUSION

This study demonstrated a high frequency of urinary tract calculi among patients undergoing CT scan, with male predominance and highest occurrence in middle-aged individuals. Although diabetes mellitus, hypertension, water intake, and long-term medication use were evaluated, none showed a statistically significant association with stone formation. The findings suggest that urinary tract calculi is a multifactorial disease likely influenced by additional dietary, environmental, genetic, and metabolic factors. Further large-scale studies are recommended to explore these risk factors and support preventive strategies.

1. INTRODUCTION

1.1 BACKGROUND:

Urolithiasis is a disease that is common throughout the world, impacting all races, cultures and geographic boundaries. Urinary stone disease has been on the rise in the last few decades in developed and developing countries because of change of lifestyle, particularly obesity. A change in the composition of urolithiasis and a marked increase in the incidence of stone formation in females and young patients has been noticed in the past decade. (1)(2) The prevalence of kidney stones is 6.3% in men and 4.1% in women according to the National Health and Nutrition Examination Survey (NHANES). The rate of kidney stone disease, as well as recurrence, is on the rise worldwide and there are few effective drugs to treat the condition. The incidence of stone formation is estimated at 12% of the world's population and the reoccurrence rates are estimated to be 70-81% for males and 47-60% for females (3). Several factors such as medical conditions (urinary tract infection), metabolic disorders, diet and lifestyle contribute to the creation of stones. (4)(5). Other modifiable factors are low fluid intake and dietary calcium with high sodium and animal protein. Other metabolic features like diabetes mellitus and hypertension worsen other types of kidney stones other than obesity (6). Imaging is an important component of the diagnosis and treatment of patients with suspected renal and ureteric calculi. Selecting a proper investigation which is accurate and safe for patients should be carried out. The decision on which investigation to use is based on a few factors including the nature of presentation, the body habits of the patient, the cost of the investigation and the impact of the investigation on the patient. Multiple types of imaging are possible to assess the patient with stones, such as ultrasonography (US), X-ray, computed tomography (CT) scan and magnetic resonance imaging (MRI). Most often used are CT, US and X-rays. CT is more sensitive than ultrasound for diagnosis of renal stones. (7)(8)

1.1 OVERVIEW OF URINARY TRACT CALCULI

Urinary Tract Calculi is the solid mass of mineral constituents which get clumped in any part of urinary tract. The urinary tract is made up of the organs that filter blood and eliminate liquid waste products (urine) from the body the kidneys, ureters, bladder and urethra. Initially stones develop in the kidneys and then pass on to other parts of the urinary tract, where they can get stuck in smaller tracts, such as kidney stones, bladder stones and ureteric stones. (9) . In the urine there are normal substances that impede or limit the crystals of urine from the urinary tract. These crystals are yet small enough. These will pass through the urinary tract and the body in the urine without being noticed. Other (less common) forms of stones are due to infection in the urinary tract. This is a stone that is called a struvite stone or infection stone. A uric acid stone is a less common type of stone, and cystine stones are rare [8]. Kidney stones are inorganic and organic crystals that are mixed with proteins. There are a variety of solutes in urine that can crystallize and

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

then lactogenesis can happen. Most nephroliths are comprised of more than 80% of the stones are calcareous stones (10). The formation of stones is a multi-step phenomenon with several physicochemical processes including supersaturation, nucleation, growth, aggregation and deposition of urinary stone components in the tubules. These stages are the result of an imbalance between the promoters and inhibitors of urine crystallisation. (4)

1.2.1 Types of stones found in the urinary system:

1.2.1.1 Calcium stones:

The common kidney stone in the world is made up of calcium. The majority of calcium stones consist of calcium oxalate, or calcium phosphate or calcium urate is bound to calcium oxalate. Predisposing variables for the cause of these types of stones are low urine volume, hypocitraturia, hyperoxaluria, hypercalciuria, hyperparathyroidism, malignancy, renal tubular acidosis, sarcoidosis and excess vitamins. These are under the microscope known as 'envelopes' enclosing Calcium Oxalate. (11).

1.2.1.2 Uric acid stones:

Uric acid stones may be more likely to occur with a diet that is high in animal protein and/or high in purine. Uric acid stones can also form in people who have certain types of metabolic problems, like obesity. Other diseases that probably play a role in uric acid stone formation include hyperuricosuria (with or without hyperuricemia) and abnormalities in acid/base metabolism.

1.2.1.3 Cysteine stone:

Cystine stones are most often the result of an inherited abnormal of the transport of the amino acid cystine, which causes a large amount of cystine in the urine and, therefore, cystine stones. Cystinuria is a disease that occurs in both men and women. Following this the cystine is less likely to remain in the urine and will start to create stones (calculi) in the urinary tract.

1.2.1.4 Silicate or drug induced stones:

Very rare one. Stones can also develop from the administration of some medicines or herbal supplements, but the buildup of the chemicals in the urine can lead to stone formation. Some of these are Loop diuretics, Acetazolamide, Topiramate, Zonisamide, Laxatives, Ciprofloxacin, Sulfa medications, Triamterene, Indinavir, Ephedrine, Guaifenesin and products that contain silica. (11)

1.2.1.5 Struvite stone:

Sometimes the stones were referred to as infection stones or triple phosphate stones because they were made of struvite. Urease producing bacteria, Proteus and Klebsiella are the cause of these infection stones. Struvite stones are formed mainly as a result of raised levels of ammonia production and raised urinary pH (alkaline urine) which reduces the solubility of phosphates. (11).

1.1 EPIDEMIOLOGY:

Epidemiological studies have suggested an increasing rate of urinary stone disorders. It is seen in different levels depending on the geology, clinical and socioeconomic factors but it is a growing problem all over the world (12). Genetic, dietary and environmental factors can influence the incidence and prevalence of kidney stones. (13)

1.3.1 Distribution in space

Urinary stones develop in most countries, but are more prevalent in Eastern Europe. Although urinary tract stones are found all over the world, they are more prevalent in the eastern part of Europe (15). Urinary calculi are found all around the world but are especially common in certain geographical areas, such as sections of the United States, South Africa, India and Southeast Asia. The prevalence and incidence of urinary stone disease (16) is higher in people with high mean temperatures. Somalia, in the eastern-most corner of Africa is a dry or semi-dry country. The country is characterized by a tropical, hot and usually dry climate where the annual mean temperature is approximately 30°C. (15) geogenic factors and

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climate change influence stone prevalence, and they presented that some countries have a greater risk of urinary stone disease (15).

1.3.2 Distribution by age

Urolithasis occurs at the most productive age of man (30-50 years) and it has been reported at all ages. It is excreted in the fetuses and neonates. However, it is uncommon in kids. The recurrence rate of renal stones is very high, about 75% over a period of 20 years. (18)

1.3.3 Gender breakdown

Every year, 1200-1400 per million people suffer urinary calculosis, and males are affected three times as frequently as females (17). It is estimated that 12% of males and 4% of females in the developed countries are affected by urinary stones. This is reflected as a double if a family history is favourable. It is more commonly seen in men because men have higher levels of endogenous production of oxalate in the liver due to the influence of testosterone, and women's urine contains more citrate on average which increases the solubility of calcium. (17)

1.2 PATHOPHYSIOLOGY OF STONE FORMATION

Urolithiasis is a multifaceted complex disease which may be associated with environmental and genetic factors. The production of urinary stones is a complicated process, involving multiple mechanisms, and the formation of CaOx stones is different from that of other stones. An important mechanism of stone formation is a deficiency in renal acidification or a change in renal excretion or an increase in digestive system absorption of stone-forming metabolites. (19)

Some health issues can increase your risk for developing kidney stones. In people with renal tubular acidosis (RTA), the kidneys cannot be able to get rid of the acid from the blood and into the urine. This causes the blood to be more acidic. Other diseases, such as hyperparathyroidism, cystinuria and frequent urinary tract infections (UTIs), can also lead to the formation of kidney stones. (19)

1.3 MECHANISM OF STONE FORMATION:

Renal stone formation is a biological phenomenon, which includes physical/chemical changes supersaturation of urine. Crystallization of solutes in the urine (supersaturation). Nucleation occurs. Concretions of crystals. Crystallization is the process of two different ions being present in solutions at concentrations above their saturation concentrations. The pH and excess chemical concentration affects the conversion of the liquid to solid phase. The risk factors are the saturation of urine, the amount of stone forming components, calcium, phosphorus, uric acid, oxalate, cystine and the low volume of urine. A series of events that lead to the formation of kidney stones is called. (11).

1.5.1 Urinary saturation

Kidney stones develop in 3 stages with the first stage being "supersaturation of urine." This is due to high levels of some substances in the urine, which are not soluble, such as calcium, oxalate or phosphate. This results in a higher concentration of urine which make the ease of formation of crystals. In such circumstances the solutes added to the water no longer stay in solution but start to crystallise into small particles (20). The particles can then aggregate and grow into larger crystals which can build up stones in the kidneys. The degree of supersaturation, as well as other factors including urine pH and inhibitors or promoters of crystal growth can play a significant role in the formation and growth of crystals and ultimately in the development of kidney stones. Understanding the underlying processes that lead to urinary hyper-saturation, and hence crystal formation is crucial in the process of kidney stone prevention and treatment. (20) (5)

1.5.2 Crystallisation:

Crystallization is the process of urine becoming over-saturated and solid crystals forming. The type and characteristics of the crystals will vary with the composition of the urine and the conditions under which the crystals are formed. When crystals are concentrated, they can develop and

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ISSN: (e) 3007-1607 (p) 3007-1593

form urinary casts that can clog up urine flow and contribute to further stone formation (5).

1.5.3 Nucleation of crystals

Nucleation is the change from the liquid to solid phase of a supersaturated solution. When the bulk free energy of the cluster is less than that in the liquid, unbound atoms, ions or molecules start forming microscopic clusters that precipitate to form supersaturated liquid. In supersaturated fluids nucleation occurs if there are more promoters than inhibitors. Other nucleators such as epithelial cells, urinary casts, RBCs and other crystals may also be found in the urine and serve as nucleators in the nuclei production process (called heterogeneous nucleation). On the other hand, renal tubular cell injury may be associated with an increase in the crystallization of CaOx crystals that provide ingredients for the heterogeneous nucleation of the crystals. (21)

1.5.4 Crystal growth: a crystal. The growth rate is influenced by many factors such as the salt concentration in the urine that forms the stones, the pH of urine, and inhibitors or promoters of crystal growth. (22)

1.5.5 Crystal aggregation

When crystals get together over time, they can become bigger, which can be a cause for the development of stones. The aggregation of crystals can be influenced by many factors such as concentration and composition of the salts which are building up the crystals, the pH of the urine and the presence of organic and inorganic substances which act as 'bridging agents' or inhibitors of crystal aggregation (22).

1.5.6 Crystal cell interactions

The Crystal-cell contact leads to the transfer of the crystals to the basement membrane from the basolateral side of the cells. Most of the crystals deposited on the epithelial cells will be broken down by macrophages or cell lysosomes and be excreted in the urine. Cellular breakdown during renal tubular cell injury leads to the formation of many membrane vesicles which act as nucleators of calcium crystals (21) (4).

1.4 RISK FACTORS OF URINARY TRACT STONES:

Risk factors alone do not cause the disease, but are somehow linked to it. Risk factors are age, sex, climate, season, stress, fluid intake, work, wealth, food, metabolic and genetic alterations [19]. Other risk factors that were near to renal calculus in the study population were Diabetes and Hypertension.23

1.6.1 Obesity: It is well known that obesity is a risk factor for insulin resistance and diabetes. Kidney stones were more common in obese than in normal weight people (11.3% vs 6.1%). Those who were obese were at 55% higher risk of developing a kidney stone than those who were normal weight. Metabolic conditions - like diabetes mellitus - associated with obesity may result in the development of kidney stones. Furthermore, higher weight is a risk factor for uric acid and oxalate urinary excretion, which are both risk factors for calcium oxalate stones(24).

1.6.2 Diet: Diets would appear to have much to do with the incidence of stones among a community. The general rule is that districts where people are principally engaged in the cultivation of maize will have a high incidence of stones, whilst those raising cattle and having a diet predominantly based on milk and milk products or other mixed diets, a low incidence. (25)

1.6.3 Dehydration: Urolithiasis is a result of dehydration (warm environment or otherwise). Low urinary volume and high urine osmolality leads to increased urinary calcium and oxalate. For water, it was thought that if the drinking water is high in calcium then the conditions conducive for the urinary stone formation should be present among the population. (25)

1.6.4 Climate: This region (16) has a high incidence and prevalence of urinary stones and high temperature throughout the year. Somalia is a very dry country, located on the easternmost tip of Africa, called the Horn of Africa. The climate of the country is a tropical climate hot and mostly dry with annual mean of about 30°C. (15)

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1.6.5 Age and gender: Nephrolithiasis is well known to be more prevalent in males than in females. However, urinary stone disease increases with age, peaking at 60-69 years old. (2)

1.6.6 Genetics: Urolithiasis is known to have a genetic association and individuals with a family history of urolithiasis may be at increased risk of developing urinary stones (27).

1.6.7 Urinary tract infection: The altered urine and the aggravated dehydration may increase the risk of the formation of urinary stones or urinary calculi for UTI patients. UTIs may change the composition of the urine (including the pH and the number of bacteria, white blood cells and other substances present in the urine). (28) This is because these changes can create the right environment for formation of crystals and aggregates of certain minerals (such as calcium or struvite) in the urinary tract.

1.6.8 Medical problems: Kidney stones may be a risk factor for certain medical problems. Renal tubular acidosis is a condition in which the kidneys do not get rid of acids from the blood through the urine and too much acid builds up in the blood. Other conditions that can contribute to the number of kidney stones include hyperparathyroidism, cystinuria and recurrent urinary tract infections. (19)

1.6.9 Medications: This is important to note because some medications, like diuretics, calcium containing antacids and protease inhibitors, may alter the composition of urine and increase the risk of forming urinary stones. It is wise to be aware of the side effects of these drugs and take steps to reduce any possible risks of using them. (11)

1.6.10 Hypertension and diabetes: Other risk variables that had strong association with renal calculi in the study population were Diabetes and Hypertension. Overweight people are at risk of kidney stones; hypertension is believed to be a risk factor. (29)

1.5 **Clinical features:** The narrower parts of the ureter are at the pelviureteric junction, mid-ureter where it crosses the iliac arteries and the vesicoureteral junction (VUJ). The most common place for obstruction is VUJ. Kidney failure may be caused by stones that block the passage of urine.

1.7.1 Pain on one side: A rapid onset of intense sharp pain at the flanks, waxing and waning, and increasing over 15-45 minutes is the presenting symptom that may be renal colic. The pain caused by the stone as it travels from the ureter to the bladder is felt along the side (flank) down to the groin. If the stone is hit at the VUJ, urinary frequency and dysuria can ensue. The passage of the stone into the bladder or from the calyceal system out to the ureter may provide relief from the pain. (30)

1.7.2 Nausea and vomiting: Soon after it becomes regular and painful, and accompanied by frequent vomiting and nausea. (30)

1.7.3 Urinary symptoms: If the stone is present at the VUJ, urinary frequency and dysuria can be presented (30).

1.7.4 Haematuria: In renal colic, there may be little or no blood in the urine; if there is, then the ureter must be either totally or partially blocked (unless the blood is from the other side's ureter). A careful lookout for it will certainly reveal a very small amount of blood in the urine after the attack is over, either because of the passage, or because of the displacement of the calculus. (31)

1.8 COMPUTED TOMOGRAPHY

Due to its high sensitivity and specificity, and ability to show other causes of symptoms, non-enhanced CT (NECT) is becoming the imaging modality of first choice for evaluation of suspected renal colic (32)(33). Typically the NECTs done for suspected renal colic are from the upper pole of the kidneys to the urinary bladder and may pick up findings unrelated to stone disease or the presenting symptoms. (34). In the management of

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ISSN: (e) 3007-1607 (p) 3007-1593

patients with urinary lithiasis, the size and the location of the stones are the two most relevant factors to be taken into consideration and both are well determined by a CT scan. If urinary lithiasis is not found, CT will be able to detect (or exclude) the majority of the other disorders which can present with flank pain and mimic ureteric colic. Besides these advantages, unenhanced CT is not associated with the risks of intravenous contrast material and is generally performed in <5 min (35).

1.8.1 CT KUB:

European Association of Urology and American Urological Association recommend imaging modality of choice for the patient with suspected urolithiasis is the Non-contrast computed tomography of the kidney, ureter and bladder (CT KUB). CT KUB provides information regarding the presence of stone/s, its size, location, hydronephrosis and its density, for the appropriate therapy. Images should be taken from the top of the kidneys to the base of the bladder, but should not include oral or intravenous contrast (37). Some take the whole of the abdomen. Whether or not contraindicated, patients should be scanned in the prone position to differentiate stones in the Vescio-ureteric junction (VUJ) from stones that have gone into the bladder. Bladder should be distended to better visualize the ureters as they enter the bladder which can help in the identification of phleboliths from distal ureteric stones. For females, distending the bladder displaces the uterus to give a better view of the distal end of the ureters. (35)

1.8.2 CT detection of urolithiasis:

The MDCT evaluation of urolithiasis should include both axial and multiplanar reformatted images in order to make the diagnosis more accurate. Unenhanced CT is capable of detecting all urinary stones including uric acid stones, xanthine stones and the rest of radiolucent cystine stones. The only exception is pure matrix stones which are encountered in indinavir-treated patients, and which are typically not seen on MDCT owing to their soft tissue attenuation (15-30 HU) (39). In such cases, intravenous administration of contrast and delayed imaging may help in their diagnosis (39).

2 MATERIAL AND METHODS

This study received ethical approval from the Clinical Research Ethics Committee of the College of Medical Technology (BKMC), Mardan, and data collection permission was obtained from the tertiary care hospital, Mardan Medical Complex (MTI-MMC). A descriptive cross-sectional study design was employed and conducted in the Radiology Department of MTI-MMC Mardan over a period of four months. The calculated sample size for the study was 194 participants, selected using a non-probability convenient sampling technique. The study included patients aged 18–60 years undergoing CT abdomen, irrespective of the presence or absence of urinary tract infection symptoms. However, pregnant women, patients with congenital urinary tract anomalies, those who had recently undergone urinary tract surgery, and patients on dialysis were excluded to avoid confounding factors and ensure patient safety.

Data collection was initiated after approval of the research proposal by the Institutional Research Committee and ethical clearance from AS&RB BKMC Mardan. Informed consent was obtained from all participants prior to inclusion. Eligible patients undergoing CT abdomen for suspected urinary tract calculi were evaluated using a 64-slice CT scanner with a standard protocol, including axial images with a slice thickness of 3–5 mm from the diaphragm to the pubic symphysis. All scans were interpreted by an expert radiologist. Relevant data, including patient demographics and CT findings (presence or absence of urinary tract calculi), were recorded on a structured, self-designed questionnaire while maintaining strict confidentiality. Statistical analysis was performed using SPSS version 25.0. Descriptive statistics such as mean and standard deviation were calculated for continuous variables (e.g., age), while categorical variables (e.g., gender, calculi status, hypertension, diabetes, hydration, and medication use) were presented as frequencies and percentages. Associations between urinary tract calculi and clinical variables were assessed using

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ISSN: (e) 3007-1607 (p) 3007-1593

the Chi-square test, with a p-value of <0.05 considered statistically significant.

3 RESULTS
3.1 DEMOGRAPHIC CHARACTERISTICS
In total, 194 patients were included in this study. The demographic characteristics of the study participants are shown in table 3.1. The age range of the participants. The mean age of the respondents was 40.22 years and a standard deviation of 10.209 years. The youngest and oldest weavers were 12 and 77 years, respectively, and there was a wide age span among the weavers. In 194, 100 of those (51.5% of those surveyed) were in the age group of 41-60 years. There were 75 (38.7%) in the age group 26-40 years and 15 (7.7%) below 25 years. Only 4 people (2.1%) were aged 61 and above. Most participants were male (117; 60.3%) and 77 (39.7%) were female. This means that the population studied is mostly male.

Table 3.1: Demographic Characteristics of Study Participants (N=194)

Demographics		
Age in Years Mean (± SD)		40.2 ± 10.2
Age Category n(%)	Up to 25 years	15(7.7)
	26–40 years	75(38.7)
	41–60 years	100(51.5)
	61+ years	4(2.1)
Gender n(%)	Male	117(60.3)
	Female	77(39.7)
Total n(%)		194 (100.0)

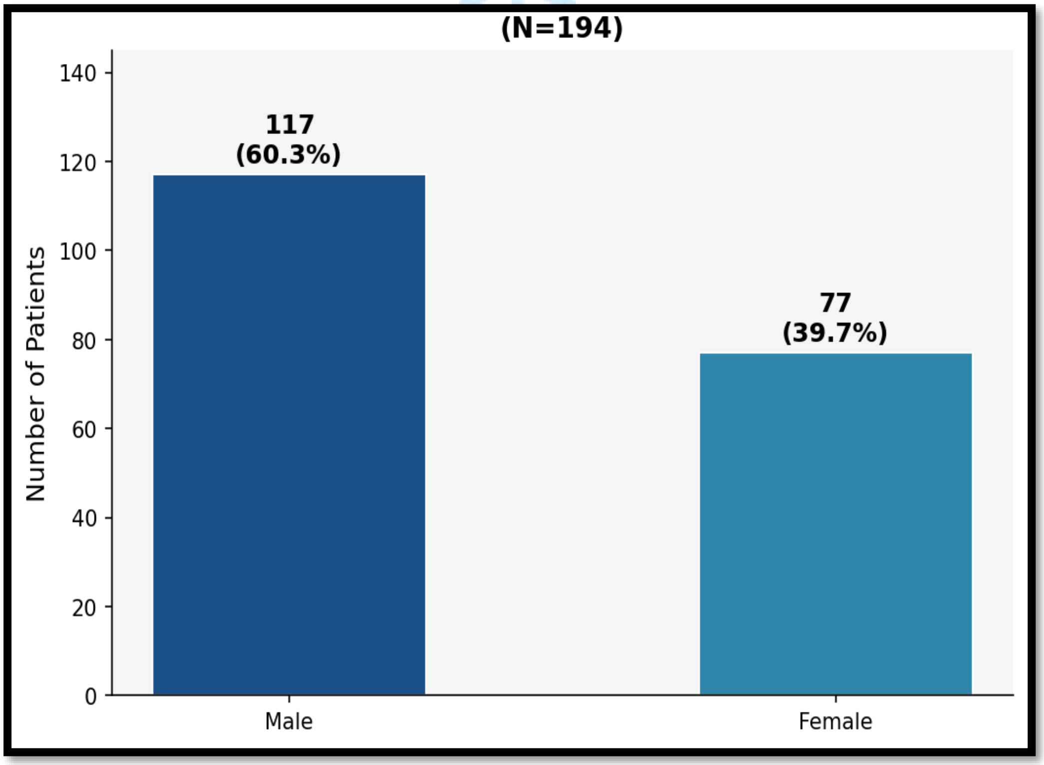

Figure 3.1: Gender Distribution of Study Participants (N=194)

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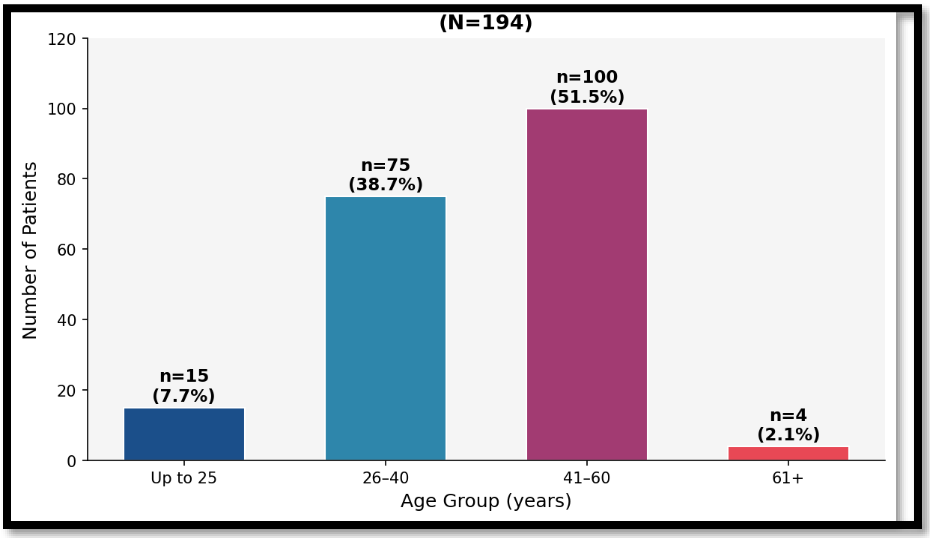

Figure 3.2: Age Category Distribution of Study Participants (N=194)

3.2 CLINICAL PRESENTATION

Most of the CT abdomen was done for flank pain (167 patients, 86.1%). Most patients (48.5%, n=94) experienced symptoms for 4–6 months, followed by 1–3 months (29.9%, n=58). The pain intensity most frequently reported was moderate (49.0%, n=95) and the back was the most frequent sight of pain (64.4%, n=125). As far as urinary symptoms are concerned, 64.9% (n=126) none of the patients had any burning midstream, and 34.0% (n=66) had increased urinary frequency.

Table 3.2: Clinical Presentation of Study Participants (N=194)

Variable	Category	Frequency (n)	Percentage (%)
Reason for CT Abdomen	Flank Pain	167	86.1
	Abdominal Pain (Non-specific)	22	11.3
	Recurrent UTI	2	1.0
	Hematuria	2	1.0
	Other	1	0.5
Duration of Symptoms	< 1 Month	18	9.3
	1–3 Months	58	29.9
	4–6 Months	94	48.5
	> 6 Months	24	12.4
Severity of Pain	Mild	25	12.9
	Moderate	95	49.0
	Severe	74	38.1
Pain Radiation	Groin	28	14.4
	Lower Abdomen	34	17.5
	Back	125	64.4
	No Radiation	7	3.6
Burning Sensation	Yes, Frequently	31	16.0
	Yes, Occasionally	37	19.1
	No, Never	126	64.9

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Increased Urinary Frequency	Yes	66	34.0
	No	128	66.0

3.3 ASSOCIATED COMORBIDITIES AND RISK FACTORS

Table 3.3: Associated Comorbidities and Risk Factors (N=194)

Variable	Category	Frequency (n)	Percentage (%)
Diabetes Mellitus	Yes	14	7.2
	No	180	92.8
Hypertension	Yes	15	7.7
	No	179	92.3
Adequate Water Intake	Yes	184	94.8
	No	10	5.2
Use of Stone-forming Medications	Yes	22	11.3
	No	172	88.7
Use of Long-term Medications	Yes	13	6.7
	No	181	93.3

7.7 % of the participants had hypertension (n=15) and 7.2 % had diabetes mellitus (n=14). Most patients (94.8%, n=184) had "symptomatic" drinking. 11.3% (n=22) were prescribed with stone forming drugs, 6.7% (n=13) were taking long-term medication.

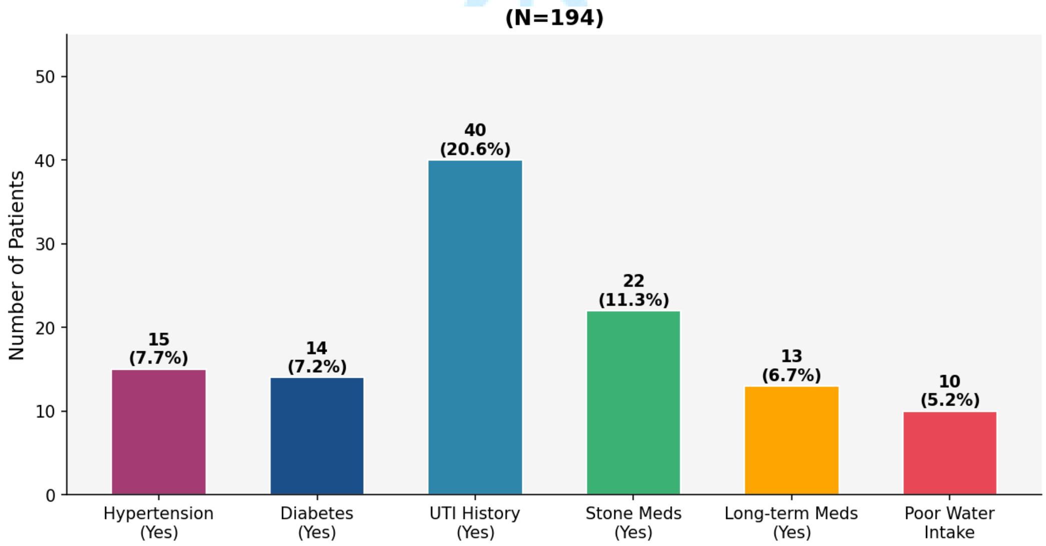

Figure3.3: Distribution of associated comorbidities and risk factors

3.4 FREQUENCY OF URINARY TRACT CALCULI (PRIMARY OUTCOME)

The main aim of this study was to find the incidence of urinary tract calculi among patients who had CT abdomen. Out of 194 enrolled patients, urinary tract calculi were detected in 169 patients (87.1%) and in 25 patients (12.9%) no urinary tract calculi were found on CT examination. The high frequency in the study population of the patients visiting Radiology Department at Mardan Medical Complex highlights burden of urolithiasis in the study

Volume 4, Issue 3, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

population.

Table 3.4: Frequency of Urinary Tract Calculi on CT Abdomen (N=194)

Diagnosis	Frequency (n)	Percentage (%)
Present	169	87.1
Absent	25	12.9
Total	194	100.0

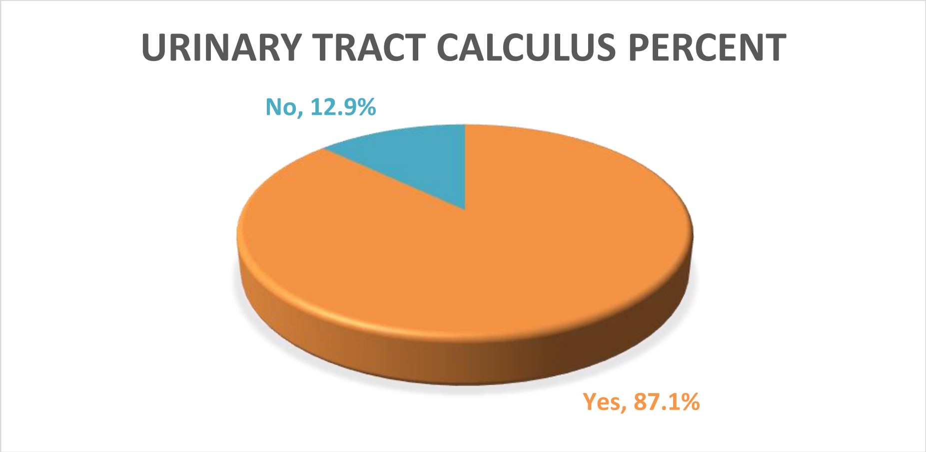

Figure3.4: Frequency of urinary tract calculi on ct abdomen(N=194)

3.5 CT FINDINGS AND STONE CHARACTERISTICS

Table 3.5: CT Scan Findings and Stone Characteristics (N=194)

CT Finding	Category	Frequency (n)	Percentage (%)
Calculus Detected on CT	Yes	169	87.1
	No	25	12.9
Anatomical Location	Renal Pelvis	113	58.2
	Ureter	50	25.8
	Urinary Bladder	8	4.1
	Not Detected	23	11.9
Stone Laterality	One Side	104	53.6
	Both Sides	67	34.5
	None	23	11.9
Obstructive Changes	None	155	79.9
	Mild	33	17.0
	Moderate to Severe	6	3.1
Hydronephrosis	Yes	118	60.8
	No	66	34.0
	Not Sure	10	5.2

87.1% of the CT results (n=169) showed presence of calculus on CT. The renal pelvis was most found (58.2%, n=113), followed by the ureter (25.8%, n=50) and the urinary bladder (4.1%, n=8). As far as stone laterality was concerned, 53.6% (n=104) had unilateral stones and 34.5% (n=67) had bilateral stones. Obstructive changes were absent in 79.9% (n=155), mild in 17.0% (n=33), and moderate to severe in 3.1% (n=6). 60.8% (n=118) had hydronephrosis.

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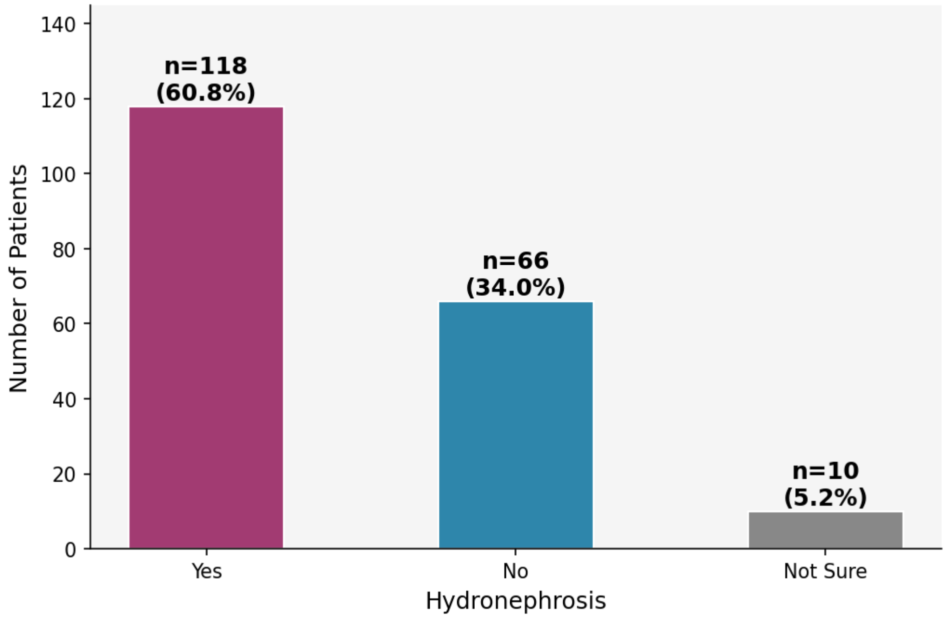

Figure 3.5: Hydronephrosis Among Study Participants (N=194)

3.6 CHI-SQUARE TABLE (ASSOCIATION WITH URINARY TRACT CALCULUS)

Chi-square test was done to analyze the association between different parameters and presence of urinary calculus. Among diabetics, 92.9% had calculus compared to 86.7% among non-diabetics (p = 1.000). For daily water consumption, calculus was found in 87.0% of the adequate water consumers and 90.0% of the inadequate water consumers (p = 1.000). In participants with high blood pressure, 93,3% had calculus while in normotensive individuals 86,6% had calculus (p = 0,698). If you compare them with those who did not use long-term medication, the prevalence of calculus among them was 100.0% and for non-users, it was 86.2% (p = 0.225). Though different prevalence exists, none of the associations were statically significant (all p>0.05) concluding that diabetes mellitus, daily water intake, high blood pressure and long-term medication usage were not significantly associated with the presence of urinary tract calculus in this study population

Table 3.6: Association of risk factors with urinary tract calculi (N= 194)

Variable		Calculi status		Total	p-value
		Calculi Presentn(%)	Calculi Absentn(%)		
Diabetes Mellitus	Yes	13 (92.9%)	1 (7.1%)	14 (100.0%)	1.000
	No	156 (86.7%)	24 (13.3%)	180 (100.0%)	
Hypertension	Yes	14 93.3%)	1 (6.7%)	15 (100.0%)	0.698
	No	155 (86.6%)	24 (13.4%)	179 (100.0%)	
Poor Water Intake	Yes	160 (87.0%)	24 (13.0%)	184 (100.0%)	1.000

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	No	9 (90.0%)	1 (10.0%)	10 (100.0%)	
Long-term Medications	Yes	20 (90.9%)	2 (9.1%)	22 (100.0%)	0.745
	No	149 (86.6%)	23 (13.4%)	172 (100.0%)	

4 DISCUSSION AND RECOMMENDATIONS

In this study, the prevalence of urinary tract calculi and its relationship to the clinical and demographic features were evaluated in patients undergoing CT scan. The study revealed 87.1% with renal tract calculi, thus proving that there was a high burden of the disease in the community studied. This is not the first report of such a high prevalence as it has been shown that urolithiasis is a widespread problem around the world, especially in the underdeveloped world, in which certain factors such as diet and weather are of importance (45,46).

An interesting finding from this study is the higher prevalence of males (60.3%) as compared to patients with urological tract stones. This specific discovery is confirmed by previous studies which showed that men have a higher risk for urolithiasis as compared to women. Hormonal differences, diet differences, and job-related factors are some of the factors that contribute to gender differences in urolithiasis(47,48). Estrogen appears to be protective as it raises urine citrate levels and testosterone urolithogenic(49).

In terms of age distribution, 51.5% respondents had age range of 41-60 years followed by age range 26-40 years. The result is in line with that of several studies that have reported that the middle aged people are at high risk of urinary tract stone, when exposed to different risk factors(50).The relative low proportion of elderly (≥61 years) patients in this study might have been the result of different illness patterns in older patients or a lower number of referrals for diagnosis.

The prevalence of diabetes mellitus was only 7.2% in the patients of the current study and no statistically significant association was found between diabetes mellitus and ureteral calculus formation ($p = 1.000$). The low number of patients with diabetes mellitus may explain the lack of any correlation, but other studies have indicated that diabetes mellitus is a risk factor for uric acid stones due to insulin resistance and aciduria (51).

Also, hypertension was reported in 7.7 % of the subjects but no correlation was found ($p=0.698$) between the two. The results obtained in this study differ from those of previous studies that showed a possible association between hypertension and kidney stone disease because of the similarities in their metabolic processes(40). Again, this difference could probably be attributed to the low prevalence of hypertension in this sample.

On the other hand, when it came to how much water people consume on a daily basis, one of the interesting findings of the study was that 94.8% of the respondents reported being sufficiently hydrated. But there was no association between stone formation and water intake ($p = 1.000$). This is in contradiction to the evidence that inadequate fluid intake is an important risk factor for urolithiasis(46). This difference may be explained by the use of a self-reported bias, where individuals estimate their usage of water. Other factors such as ambient temperature, genetic predisposition and nutrition composition could also have influenced stone formation.

The study also looked at the impact of long-term drug usage and drugs linked to the development of stones. All of the long term users of medicines had calculi (100%), but it was not statistically significant ($p = 0.225$). This may have been due to the small proportion of people (6.7%) who were taking long-term drugs. While some pharmaceuticals, such as diuretics and calcium based therapies, may be associated with stone development as indicated by previous studies, larger studies are needed to validate this association.

In general, the absence of statistically significant correlation between most of the factors and

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urinary system calculi suggests the polyfaceted characteristics of the process of stone formation. The characteristics evaluated in this study are probably not as important as characteristics like heredity, food (e.g., excessive oxalate or salt intake), environment, and metabolic disorders.

Study Strengths and Weaknesses

By using CT scanning, which is the gold standard method of diagnosis, this study presents very useful data concerning the incidence of urinary stones. It should be noted that there are some weaknesses in the study, such as:

- The cross-sectional design creates challenges in establishing causality.
- Some variables, like diabetes and high blood pressure, have extremely low sample size.
- There was no information on eating practices, BMI, or biochemical markers.
- Bias may be introduced by self-reported factors like water intake.

Despite these limitations, the study contributes important local data on urolithiasis and highlights areas for future research.

5 CONCLUSIONS

This cross sectional study was conducted for 4-6 months in Radiology department Mardan medical complex (MMC) Mardan with non-probability convenient sampling of 194 patients referred for CT abdomen to determine the frequency of urinary tract calcinate among these patients. In total, the urinary stones were prevalent with 86.1% (n=167) patients having urinary stones on CT. Demographically, the mean age of the participants was 40.2 ± 10.2 years with the age group of 41–60 years being the most affected (51.5%) and males affected more than females (60.3% to 39.7%) and this is in accord with the well established male predominance for urolithiasis. The most common presenting complaint was flank pain (86.1%) and the most common features were moderate pain (49.0%) and back radiation (64.4%). The most common site of calculi was renal pelvis (58.2%) followed by ureter (25.8%) and urinary bladder (4.1%) and unilateral stones were seen in 53.6% and bilateral stones in 34.5% of the patients, hydronephrosis was also seen in 60.8% which showed the obstructive effect of urinary tract calculi on this group of patients. As far as the associated comorbidities are concerned, 20.6% of the cases had a history of urinary tract infection, 7.7% hypertension, 7.2% diabetes mellitus (DM) and 11.3% were on stone forming medications. The lack of significant association with urinary tract calculi and any single risk factor evaluated (gender, diabetes mellitus, hypertension, water intake, history of UTI, and medication use) was likely due to the high incidence of the presence of urinary tract calculi in this clinically selected symptomatic population that reduced the statistical power to detect differences between groups. All the above data highlighted the importance of CT abdomen as the modality of preference for diagnosis and characterization of urinary stones, the importance of early diagnosis of urinary stones and prompt referral to urologist in cases of obstructive uropathy, and the need to develop urinary stone prevention in high risk group of urinary stones such as people in this region. Hopefully the study will help in providing good baseline epidemiological information about urolithiasis for better clinical practice as well as for research for prevention and treatment of urolithiasis in Khyber Pakhtunkhwa and Pakistan.

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