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THE ROLE OF COMPUTED TOMOGRAPHY IN EVALUATING NEPHROLITHIASIS AND ASSESSING RISK FACTORS IN PATIENTS AT LADY READING HOSPITAL

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Abstract

Nephrolithiasis or kidney stone are increasing in incidence and prevalence worldwide, which are significant clinical challenges in management. Kidney stones are solid salt and mineral deposits. The stones affect the kidney by causing hydronephrosis and may lead to kidney failure. The frequency of kidney stones was determined in Pakistan including other places. The purpose of our study is to determine the prevalence of nephrolithiasis and assess the risk factors on computed tomography. The study was conducted at Lady Reading Hospital. The cross-sectional based study was a non-probability convenient sampling technique was selected. The sample size was 216. Duration of research project was 4-6months.From the result of our study, it was examined that there is slightly rise in frequency of male individuals with the presence of kidney stones in their body as compared to females' individuals. The ratio includes 136 males and 80 females. We divided our study population into age groups in which age groups (31-45) have higher percentage of kidney stones, about 32.41%. The frequency of most observed symptoms includes flank pain (215), dysuria (159), nausea/vomiting (178) and frequency/urgency (173). The risk factors include lack of fluid intake and usage of high sodium and oxalated

diet. As the data collected from the sample population who visit to radiology department of Lady Reading Hospital for computed tomography it is concluded that the frequency of kidney stones occur higher in male as compared to female

Keywords: Nephrolithiasis, Hydronephrosis, fluid intake, stone formation, renal calculi and risk factors.

Introduction:

Nephrolithiasis, commonly known as kidney stone disease or renal calculi, is a common disorder of the urinary system characterized by the formation of crystalline stones within the kidneys or urinary tract. It represents an important global health problem because of its high occurrence, recurrent nature, associated pain, and potential complications such as urinary obstruction, hydronephrosis, urinary tract infection, and deterioration of renal function. Recent evidence indicates that the burden of kidney stone disease has increased considerably over recent decades and is influenced by demographic, environmental, metabolic, dietary, and genetic factors (Bargagli et al., 2025). Epidemiological studies have demonstrated that age, sex, body mass index, family history, metabolic disorders, dietary patterns, and lifestyle characteristics can influence the development and recurrence of nephrolithiasis (Stamatelou et al., 2023; Simmons et al., 2023). Inadequate fluid intake is particularly important because reduced urinary volume increases the concentration of stone-forming substances and promotes crystal formation, while adequate hydration is considered an important preventive measure (Gamage et al., 2020; Littlejohns et al., 2020). Dietary factors, including high sodium intake, inadequate dietary calcium, excessive animal protein, and other dietary components, have also been associated with kidney stone formation and recurrence (Chewcharat et al., 2022; Wang et al., 2022). Computed tomography (CT) has become an important imaging modality for the diagnosis and evaluation of nephrolithiasis. Non-contrast computed tomography (NCCT) of the kidney, ureter, and bladder provides rapid and detailed visualization of urinary calculi and can determine their number, size, location, and relationship with the urinary tract. CT can also demonstrate associated findings such as ureteric obstruction, hydronephrosis, perinephric changes, and alternative causes of acute flank pain (Tsili et al., 2023). Current evidence identifies non-contrast CT as the standard imaging technique for suspected acute renal colic because it can detect almost all types of urinary calculi and provide accurate information about stone burden (Dell'Aversana et al., 2025). CT-derived stone size and volume are clinically important because stone dimensions can influence treatment planning and the selection of appropriate therapeutic approaches (Reimer et al., 2020). Furthermore, advances in CT technology, including dual-energy CT, have improved the ability to characterize

stone composition, particularly by differentiating uric acid stones from non-uric acid stones (McGrath et al., 2020; Jendeberg et al., 2021). Although CT provides excellent diagnostic information, radiation exposure remains an important consideration, particularly in patients who may require repeated examinations because of the recurrent nature of nephrolithiasis. Recent developments in low-dose and ultra-low-dose CT techniques have attempted to maintain diagnostic accuracy while reducing radiation exposure (Raskolnikov et al., 2022). Studies have shown that ultra-low-dose CT combined with advanced reconstruction techniques can provide high detection rates for clinically significant urinary stones while substantially reducing radiation dose (Zhang et al., 2022). Other advances, including photon-counting CT and deep-learning reconstruction, are also being investigated to improve image quality and reduce radiation exposure during urinary stone assessment (McCoombe et al., 2022). Therefore, appropriate CT protocols are important for obtaining reliable diagnostic information while minimizing unnecessary radiation exposure. The development of nephrolithiasis is multifactorial, and understanding associated risk factors is important for prevention and patient management. Studies have identified insufficient water intake, high dietary sodium intake, obesity, sedentary lifestyle, family history, hypertension, diabetes, and previous stone disease among factors associated with kidney stone formation or recurrence (Khalili et al., 2021; Mohebbi, 2021; Wang et al., 2022). Evidence from Pakistan is particularly relevant because the country lies within the traditionally recognized "stone belt," where urinary stone disease represents an important clinical problem. A study from Rawalpindi reported inadequate water intake, higher BMI, family history, and several sociodemographic and lifestyle characteristics among patients with nephrolithiasis (Khan et al., 2022). More recently, a study conducted in Khyber Pakhtunkhwa reported insufficient water intake and high sodium consumption among frequently observed factors in patients with kidney stones (Waqas et al., 2024). These findings highlight the importance of investigating local risk-factor patterns in patients undergoing radiological evaluation.

Material and Methods:

A descriptive cross-sectional study will be conducted in the Radiology Department of Lady Reading Hospital, Peshawar, over a period of six months. The sample size will consist of 216 participants, which will be calculated using the Raosoft sample size calculator at a 95% confidence level and a 5% margin of error. A non-probability convenient sampling technique will be used for participant selection. The study will include patients referred to for computed tomography (CT) kidney, ureter, and bladder (KUB) scans, patients aged above 15 and below 75 years, and those visiting the hospital

with signs and symptoms suggestive of nephrolithiasis. Patients with other significant comorbidities, pregnant patients, and those with severe cognitive impairments or mental disorders will be excluded from the study. Ethical approval will be obtained from the relevant ethical committee after approval of the research proposal by the Graduate Committee, and permission for data collection will be obtained from the Dean of Allied Health Sciences, Abasyn University, Peshawar. Data will be collected using a structured questionnaire and relevant clinical and radiological information from the participants. The collected data will be entered, processed, and analyzed using Statistical Package for the Social Sciences (SPSS), version 22. Appropriate descriptive and inferential statistical tests will be applied to summarize the findings and determine statistically significant associations among the study variables.

Results:

In this descriptive cross-sectional study, a non-probability convenient sampling technique was selected we have a sample size of 216 from the result of our study the ratio frequency of nephrolithiasis includes the respondent between age 15-30 were 69, age 31-45 were 70,46-60 were 40 and 61-75 were 37.

Table 4.1: *AGE OF PATIENTS*

Age Group	Frequency	Percent
15-30	69	31.9
31-45	70	32.4
46-60	40	18.5
61-75	37	17.1
Total	216	100.0

4.2 GENDER

we have a sample size of 216 from a result of our study the ratio frequency of the patients include male were 136 and female were 80 as shown in table 4.2.

Table 4.2: *GENDER OF PATIENTS*

	Frequency	Percent
MALE	136	63.0
female	80	37.0
Total	216	100.0

FAMILY HISTORY

We have a sample size of 216 from the result of our study this bar chart describes the ratio frequency of the patients who were involved in the study population.

Table 4.3: Family History OF PATIENTS

Family History of Flank Pain of patients	Frequency	Percent
yes	73	33.8
no	143	66.2
Total	216	100.0

FLANK PAIN

We have a sample size of 216 from the result of our study; table 4.4 describes the frequency and percentage of the patients with and without Flank pain who were involved in the study population.

Table 4.4 FLANKPAIN OF PATIENTS

Flank Pain	Frequency	Percent
yes	215	99.5
no	1	.5
Total	216	100.0

DYSURIA OF PATIENTS

We determine the frequency of the nephrolithiasis we have a sample size of 216 in which those patients who have symptoms of dysuria had 159 frequency ratio and 57 frequency ratio who were not have symptoms of dysuria.

Table 4.5 DYSURIA OF PATIENTS

Dysuria		Frequency	Percent
Valid	yes	159	73.6
	no	57	26.4
	Total	216	100.0

NAUSEA/VOMITTING OF PATIENTS

Those patients who experienced nausea/vomiting had frequency was 178 and those who did not experience nausea/vomiting had frequency was 38.

Table 4.6 NAUSEA/VOMITTING OF PATIENTS

Nausea and vomiting	Frequency	Percent
yes	178	82.4
no	38	17.6
Total	216	100.0

OXALATE/SODIUM DIET OF PATIENTS

We determined the frequency of high oxalate/sodium diet was yes (74) and No were 142 in patients.

TABLE 4.7: *OXALATE AND SODIUM CONTAINING DIET OF PATIENTS*

Oxalate And Sodium Diet Consumed by The Patients	Frequency	Percent
yes	74	34.3
no	142	65.7
Total	216	100.0

FLUID INTAKE OF PATIENTS

From the results of our study the people having fluid intake frequency ratio is 83 and those people having less fluid intake frequency ratio is 133.

Table 4.8; *FLUID INTAKE OF PATIENTS*

Fluid Intake	Frequency	Percent
yes	83	38.4
no	133	61.6
Total	216	100.0

STONE LOCATION OF PATIENTS

We have a sample size of 216 from the result of our study the ratio percentage of nephrolithiasis includes the respondent between upper zone kidney were 29.17%, mid zone were 11.11%, lower zone kidney were 16.20%, proximal ureter were 24.07%, mid ureter were 3.241%, distal ureter 12.5% and bladder were 3.704% as shown in table 4.9.

Table 4.9: *STONELOCATION OF PATIENTS*

Stone location in patients	Frequency	Percent
upper zone of kidney	63	29.2
mid zone of kidney	24	11.1
lower zone of kidney	35	16.2
proximal ureter	52	24.1
mid ureter	7	3.2
distal ureter	27	12.5
bladder	8	3.7
Total	216	100.0

NUMBER OF STONES OF PATIENTS

Table 4.10 shows a skewed distribution, with most observations concentrated in the ONE category and this category has the highest frequency (176) indicating the most

observations have only one stone. The TWO category has a significantly lower frequency (23) and the multiple categories have the lowest frequency.

Table 4.10: *NUMBER STONES OF PATIENTS*

Stones of patients	Frequency	Percent
one	176	81.5
two	23	10.6
multiple	17	7.9
Total	216	100.0

STONE DIMENSION OF PATIENTS

The chart displays the distribution of stone dimensions across three categories: 2-15mm, 16-25mm, and 26-35mm. The majority (191) of stones were within 2-15mm, while 20 are in 16-25mm, and 5 are in 26-35mm. The data shows a skewed distribution with a decreasing trend as dimension increases. Most stones are within 2-15mm.

Table 4.11: *STONE DIMENSION OF PATIENTS*

Stone Dimension of Patients	Frequency	Percent
2-15mm	191	88.4
16-25mm	20	9.3
26-35mm	5	2.3
Total	216	100.0

STONE DENSITY OF PATIENTS

The bar chart compares the frequency of "average" and "peak" stone density categories. The "average" category has a frequency of 104, while the "peak" category has a frequency of 102. Both categories have nearly equal frequencies.

Table 4.12: *STONE DENSITY OF PATIENTS*

Stone Density	Frequency	Percent
average	104	48.1
peak	112	51.9
Total	216	100.0

Statistical Analysis:

The combined distribution showed that 61.6% of participants reported inadequate fluid intake, while 38.4% reported adequate intake. A high oxalate/sodium diet was reported by 34.3%, whereas 65.7% did not report this dietary pattern. Flank pain was reported by 99.5% of participants, with only 0.5% reporting no flank pain. The chi-square tests showed statistically significant differences between the observed and expected

frequencies for adequate fluid intake (χ^2 = 11.574, p = 0.001), high oxalate/sodium diet (χ^2 = 21.407, p < 0.001), and flank pain (χ^2 = 212.963, p < 0.001).

Variable	Response	Observed (n)	Expected (n)	Percentage (%)	χ^2	df	p-value
Adequate Fluid Intake	Yes	83	108	38.4	**11.574**	1	**0.001**
	No	133	108	61.6			
High Oxalate/Sodium Diet	Yes	74	108	34.3	**21.407**	1	**<0.001**
	No	142	108	65.7			
Flank Pain	Yes	215	108	99.5	**212.963**	1	**<0.001**
	No	1	108	0.5			

Discussion:

The renal system consists of the kidney, ureters, and the urethra. The kidney regulating plasma osmolarity by modulating the amount of water, solutes, and electrolytes in to the blood Nephrolithiasis are commonly encountered renal pathology in routine practice The types of kidney stones include calcium oxalate, calcium phosphate, uric acid, struvite, and mixed stones In Asian populations, a 60% increase in risk was related with a family history of nephrolithiasis (Ali et al., 2024a) In Pakistan, kidney stone prevalence ranges from 1% to 5%, with a recent study finding that 2.8% of individuals undergoing routine CT scans had asymptomatic stones (Almusafer et al., 2024). A descriptive cross-sectional study was conducted at Benazir Bhutto Hospital, Rawalpindi. Patients in the 15–30 age range (47.55%), male (56.65%), low socioeconomic status (66.43%), poor water consumption (61.53%), tap water (56.64%), daily vegetable consumption habit (65.04%), sedentary lifestyle (51.74%), family history of renal stones (57.34%) (Khan et al., 2022) The findings of our study was indicate the patients attending Lady Reading Hospital (LRH) Peshawar frequently experience of CT KUB scan. There were 216 Participants in this study, A noticeable gender males demonstrating a higher percentage of the sample (62.96%) compared to females (37.04%), based on frequencies of 136 and 80 respectively. Age wise, participants are categorized into various groups such as 15-30, 31-45, 46-60 and 61-75. The most affected nephrolithiasis age group is 31-45 which frequency is 70 or percentage is 32.41% or as well as 15-30 age group is also affected with nephrolithiasis which frequency is 69 and percentage is 91.94%. Our present study found that currently nephrolithiasis affects about 62.96% male and 37.04% female which concludes that male ratio is higher than female ratio. The

symptoms in our research study are used such as Flank pain, dysuria, fever, nausea, vomiting, frequency and urgency. The most frequently observed symptoms are Flank pain, frequency/urgency and dysuria. The rarely observed symptoms are fever. The most observed risk factors associated with nephrolithiasis from our study population are fluid intake or high sodium/oxalate diet. A noticeable fluid intake percentage is 38.43% which indicates that nephrolithiasis can be caused also by the high oxalate/sodium diet percentage (65.74%) indicated nephrolithiasis occurrence. CT scan is the diagnostic imaging modality for nephrolithiasis, which yields additional information or findings such as hydronephrosis, perinephric collection, fat stranding, and other causes of pain. Based on the calyx in which the calculus is situated, renal calculi locations were classified as upper, inter, and lower poles, and renal pelvis. The location of renal stones showed across the upper pole of kidney, mid pole of kidney, lower pole of kidney, proximal ureter, mid ureter, distal ureter and bladder. The most common location of kidney stones is upper pole of kidney with the higher frequency ratio is 63 compared to others in study population. The number of stones and sizes vary per patient ranging from single to multiple occurrences. The CT scan findings further revealed stone dimension and stone density. The stone dimension is categorized into ranges such as 2-15mm, 16-25mm and 26-35mm. Stone density is either average or peak, and it depends on type of stones e.g. calcium stones have peak density. The value with the highest Hounsfield unit (HU) was determined as the density of the stone. From our results the peak density of stone percentage is 51.85% compared to average density of stone percentage 48.15%. The laterality from our study population referred to as site of stone. The ratio frequency and percentage of right site 106(49.07%), Left site 80(37.04%), Bilateral 20 (9.259%) and bladder 10 (4.630%).

Conclusion

It was concluded that the risk factors include lack of fluid intake and usage of high sodium and oxalated diet. As the data collected from the sample population who visit to radiology department of Lady Reading Hospital for computed tomography it is concluded that the frequency of kidney stones occur higher in male as compared to female.

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