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Demographic, Clinical and Radiological Findings among Patients with CTU Detected Urolithiasis in a Tertiary Hospital

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Computed tomography urography (CTU) is the current radiological imaging modality for the evaluation of the kidneys, ureters and urinary bladder pathologies. CTU has largely replaced intravenous urography in centers that has computed tomogram machines.
Objectives: The aim of this study is to identify the common location of urolithiasis in the urinary tract and correlate it with age, sex, stone size and Hounsfield unit (HU) using CT scan in the Radiology department of Rivers State University Teaching Hospital.
Methods: A retrospective study with descriptive study design was employed. A total of 140 patient's data were used. A *P*-value below 0.05 was considered statistically significant.

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Results: One-hundred and forty patients were studied over a 24 months period. The median age was 43.50 years. The prevalence of stones (n=47, 33.6%) and age range with the highest prevalence is 41-50 years. The male: female was 1.8:1. Renal stones are commonly found in the inferior pole. Vesicoureteric junction stones were more prevalent in females. There was significant association between age and sex. (P=0.005).
Conclusion: Urolithiasis is commonly seen in males. The location of calculi in the urinary tract is in the kidney, pelviureteric junction (PUJ), vesicoureteric junction (VUJ), ureters and the urinary bladder in a downhill order correspondingly. The inferior pole is the most prevalent site for renal stones and VUJ stones are more frequent in females while other locations are seen more in males. Interestingly, age and sex showed significant association.

Keywords: Demographic; clinical; radiological findings; computed tomography urography; urolithiasis.

1. INTRODUCTION

Urolithiasis is a broad term used in describing the existence/occurrence of calculus anywhere in the urinary system, that is the kidneys, ureters and urinary bladder [1]. Flank pain is usually the commonest presenting complaints in patients whom urolithiases are seen. Reports have it that the frequency and rate of urolithiasis is ever-increasing across the globe, involving the mechanized and the developing countries as a result of changes in socio-economic settings. Stone is commoner in the industrious age groups although the incidence is said to be rising across sex, age and race [2,3].

Previous studies documented that around 1.2million Americans are affected yearly, and it is projected that up to 14% of men and 6% of women will develop urolithiasis during their lifetime [4,5]. Also, lots of patients will be affected by multiple stones all through their lifetime , with estimated recurrence rates of 50% within 5-10 years and 75% within 20years. Earlier hospital based studies done in Nigeria, reported the incidence of 25.75 per 100,000 and 19.11 per 100,000 for North-West and South-East regions respectively [6,7].

Even if the cause of urolithiasis is not known, some investigators attribute the incidence of nephrolithiasis to dietary protein [8].

Stones can be positioned anywhere down the urinary tract. In a study done in Nepal, they reported the commonest site of calculi to be the kidneys, followed by the ureter, vesico-ureteric junction, pelvi-ureteric junction and urinary bladder in downward/descending order [8]. Twenty percent of urinary tract calculi are found in the ureters, with 75% of these at the lower one third of the ureter as documented by Cao et al [9].

Imaging is the only investigating modality to validate the occurrence of stones, to establish its size, position/site, likelihood of it to be passed, complications as well as monitoring/for follow up [10]. Varieties of imaging modalities are available for the diagnosis and localization of urinary calculi includes plain abdominal radiography of the kidneys, ureter, urinary bladder (KUB), ultrasonography (USG), intravenous urography (IVU) and computed tomography (CT) scan.

CT scan has turned out to be the investigation of choice for detection and categorization of urinary calculi due to its high sensitivity as it can readily detect calculi within the urinary tract [11]. When intravenous contrast medium is administered which is the case in computed tomography urography (CTU), function of the kidneys are also assessed. The drawbacks are non-availability especially in resource poor environment, the cost of running the test and the high radiation dose to the patient. The major advantage of ultrasonography over CT scan is its non-utilization of ionizing radiation. It is useful for stones within the kidneys, urinary bladder and gives information on possible ureteric stones from signs of obstructive changes seen. Radio-opaque materials are used to outline the urinary tract in IVU and high dose is a limit. Plain radiograph KUB is readily available and cheap, helps with the detection of radio-opaque stones in the KUB region. CT scan readily detects calculi within the urinary tract [11].

The aim of this study is to identify the common location of urolithiasis in the urinary tract and correlate it with age, sex, size of stone and Hounsfield unit (HU) using CT scan in the Radiology department of Rivers State University Teaching Hospital.

2. MATERIALS AND METHODS

The study was conducted at the Radiology Department of RSUTH, South-South Nigeria. The records of patients, who presented for computed tomography urography (CTU) between 1st January, 2021 and 31st December, 2022 were studied. The socio-demographic/Biodata and the findings were obtained and documented.

Patients were examined using a 64-slice CT scanner GE medical system (USA). Images were obtained from the xiphisternum to the upper thigh with the following techniques, by using a collimator of 5mm, a pitch of 6, and 200mAs. Post intravenous (IV) contrast images were also acquired to determine function. Reformation of previously obtained images was done at a thickness of 2.5mm with intervals of 1.25mm. Three-dimensional (3D) reconstructions were generated for proper evaluation.

Ethical approval was not considered necessary since it's a secondary data.

Sample size calculation: Sample size calculation employed the formula for cross-sectional studies [12] based on the 95% confidence level, power of 80%, minimum difference of 12%, 65.6% frequency of renal stones from a similar study in south-eastern Nigeria, [13] and 10% non-response rate. Consequently, the study comprised of 140 patients.

Data analysis: IBM Statistical Package for Social Sciences (SPSS) version 21 was employed for statistical analysis. Means, standard deviation, median and ranges were used to summarize numerical data, and absolute frequencies and percentages for categorical data. Fisher's Exact and Chi-square tests were employed for comparison between proportions. One-way Analysis of Variance (ANOVA) was employed in comparison of means across categories. Statistical significance was set at 0.05.

3. RESULTS

Median age = 43.50 years
Minimum = 4.00 years
Maximum = 93.00 years
Male: Female ratio for the entire study=1.5:1
Male: Female ratio for stones=1.8:1

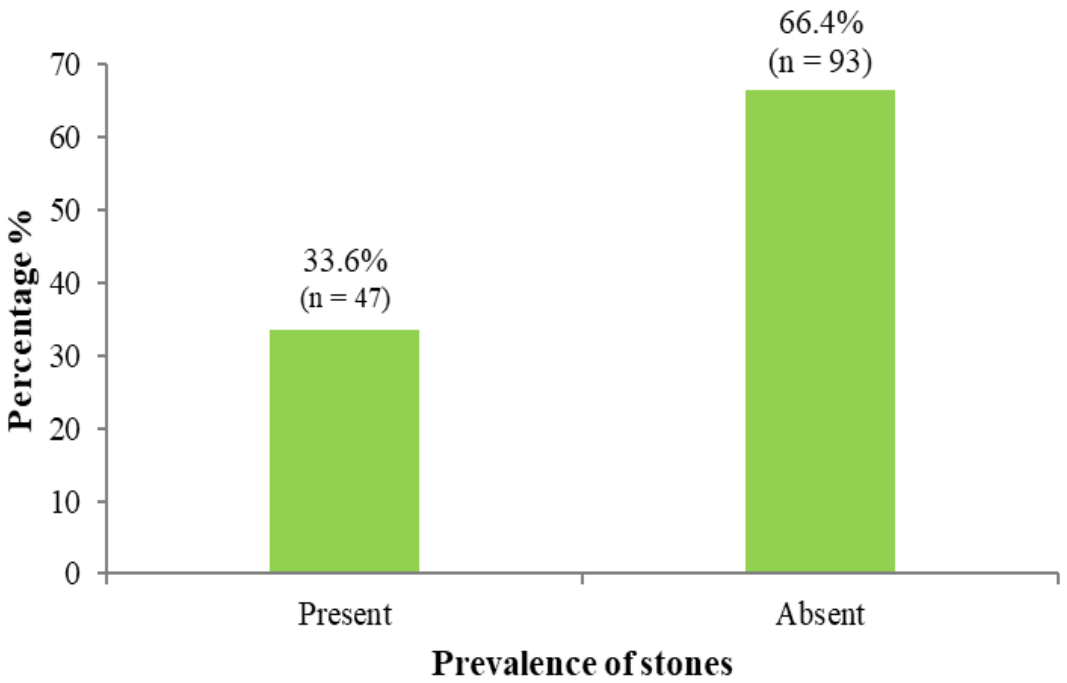

Fig. 1. Prevalence of stones among patients presenting for CTU in the study population

Table 1. Age and stone characteristics of patients

	Age	Stone size	Hounsfield Unit
N	140	47	28
Mean	44.71	4.20mm	1092.52
Minimum	4	0.34mm	80.00
Maximum	93	10.00mm	9698.71

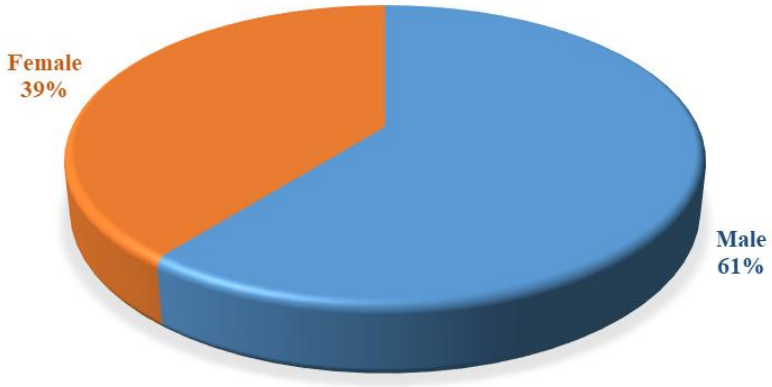

Fig. 2. Pie chart showing the sex distribution of the study population

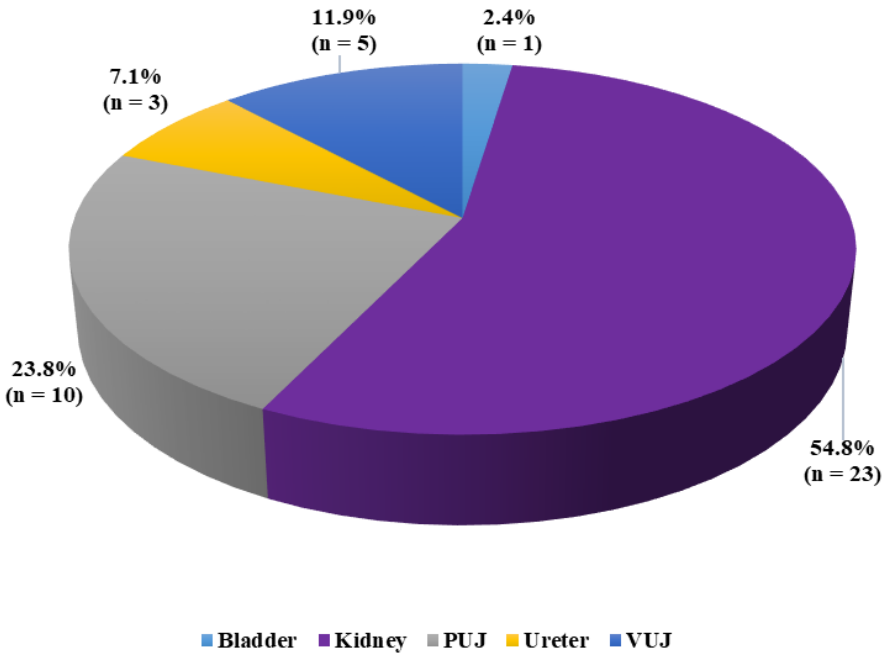

Fig. 3. Anatomical location of stones irrespective of age group and sex

Table 2. Comparison of the mean age, stone size and stone Hounsfield unit by location

	Stone location						
	Bladder	**Renal**	**Ureter**	**Pelvicalyceal Junctions**	**Vesicoureteric Junctions**	**ANOVA**	**p-value**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**		
Age	68.00 ± Nil	47.65 ±15.98	59.00 ±8.66	47.20 ± 17.52	41.80 ± 15.56	0.938	0.453
Stone size (mm)	4.00 ± Nil	3.22 ± 3.04	6.67 ± 2.73	4.19 ± 3.88	5.61 ± 3.23	1.159	0.348
Stone Hounsfield unit	471.48 ± Nil	1642.54 ± 2863.42	748.00 ± Nil	848.29 ± 400.52	324.59 ± Nil	0.177	0.946

Fig. 1 is showing a bar chart with the prevalence of stones in the study, 33.6% (n=47) had stones while 66.4% (n=93) had no stones.

Table 1 reveals the mean, medium and maximum age, stone size and Hounsfield unit of the stones seen in the study. The mean age was 44.71 years and ranges from 4 to 93 years. The mean stone size was 4.20mm and ranges from 0.34 to 10.00mm. The Hounsfield unit was 1092.52 and ranges from 80.00 to 9698.71.

The Fig. 2 simply shows the sex distribution in this study, with males presenting with more urinary stones than females (61% vs 39%).

Fig. 3 depicts the locations of the stones irrespective of age group and sex. The commonest site for stones are the kidneys, followed by the pelviureteric junction, the vesicoureteric junction, the ureters and urinary bladder in a descending order.

Table 2 showed the relationship between the stone location with reference to age, stone size and Hounsfield unit and it is not statistically significant.

Table 3 showed that age 41 to 50 years had the highest prevalence of stones (n=17), followed by age 31 to 40 (n=10), age 51 to 60 years and 61 to 70 years had equal values (n=6), greater than or equal to 71 years of age (n=4) then less than or equal to 19 years of age had the least prevalence of stones.

Table 4 revealed that kidney stones are commoner in male than females, left renal stones are seen more in males when compared to females who have right sided prevalence. Pelviureteric junction stones are more prevalent in males than females with both sexes showing right side preponderance. Ureteric stones are also seen more in males with one on each side while only one on the left side for females. Vesicoureteric stones are more in females with right side greater than left while the male showed both sides.

Table 5 showed that the age range with highest occurrence for stones in female is 31 to 40 years while 41 to 50 years in male. There is a significant association between age and sex with a p-value of 0.005. It also showed that no superior pole renal stones are seen in females; both superior and middle poles have equal numbers in males. Also, the middle and inferior poles are equal in females. However, the middle and inferior poles stones are more prevalent in males. Overall inferior pole stones are more common. The pelviureteric junction stones are commoner in males and vesicoureteric stones are seen more in females. Urinary bladder stone was seen only in the males. There is no significant relationship between stone locations and sex with p-value of 0.243.

Table 3. Presence of stone based on age and sex in the study population

Variables	Stone		Total n (%)
	Present n (%)	Absent n (%)	
Age Category			
≤19 years	1 (20.0)	4 (80.0)	5 (100.0)
20 – 30 years	3 (18.8)	13 (81.2)	16 (100.0)
31 – 40 years	10 (28.6)	25 (71.4)	35 (100.0)
41 – 50 years	17 (37.0)	29 (63.0)	46 (100.0)
51 – 60 years	6 (35.3)	11 (64.7)	17 (100.0)
61 – 70 years	6 (50.0)	6 (50.0)	12 (100.0)
≥71 years	4 (44.4)	5 (55.6)	9 (100.0)
	Fisher's exact = 4.547; p-value = 0.616		
Gender			
Female	16 (29.1)	39 (70.9)	55 (100.0)
Male	31 (36.5)	54 (63.5)	85 (100.0)
	Chi-square = 0.815; p-value = 0.367		

Table 4. Side distribution of stone by gender

Side	Gender		Total n (%)
	Male n (%)	Female n (%)	
Kidney			
Right	4 (23.5)	2 (33.3)	6 (26.1)
Left	5 (29.4)	1 (16.7)	6 (26.1)
Both	8 (47.1)	3 (50.0)	11 (47.8)
Total	17 (100.0)	6 (100.0)	23 (100.0)
PUJ			
Right	3 (42.9)	2 (66.7)	5 (50.0)
Left	2 (28.6)	1 (33.3)	3 (30.0)
Both	2 (28.6)	0 (0.0)	2 (20.0)
Total	7 (100.0)	3 (100.0)	10 (100.0)
Ureter			
Right	1 (50.0)	0 (0.0)	1 (33.3)
Left	1 (50.0)	1 (100.0)	2 (66.7)
Both	0 (0.0)	0 (0.0)	0 (0.0)
Total	2 (100.0)	1 (100.0)	3 (100.0)
VUJ			
Right	0 (0.0)	2 (50.0)	2 (40.0)
Left	0 (0.0)	1 (25.0)	1 (20.0)
Both	1 (100.0)	1 (25.0)	2 (40.0)
Total	1 (100.0)	4 (100.0)	5 (100.0)

Table 5. The distribution and relationship between Age and stone location among patients presenting for CTU

	Sex							
Variables	**Female**		**Male**		**Total**		**Chi-square**	**p-value**
	N	**(%)**	**N**	**(%)**	**N**	**(%)**		
Age Category (N=140)								
≤19 years	1	(1.8)	4	(4.7)	5	(3.6)		
20 – 30 years	7	(12.7)	9	(10.6)	16	(11.4)	17.657	0.005*
31 – 40 years	23	(41.8)	12	(14.1)	35	(25.0)		
41 – 50 years	12	(21.8)	34	(40.0)	46	(32.9)		
51 – 60 years	3	(5.5)	14	(16.5)	17	(12.1)		
61 – 70 years	5	(9.1)	7	(8.2)	12	(8.6)		
≥71 years	4	(7.3)	5	(5.9)	9	(6.4)		
Stone location (N=42)								
Pelviureteric junction	3	(21.4)	7	(25.0)	10	(23.8)		
Renal-superior	0	(0.0)	4	(14.3)	4	(9.5)	7.400	0.243
Middle/renal sinus	3	(21.4)	4	(14.3)	7	(16.7)		
Inferior	3	(21.4)	9	(32.1)	12	(28.6)		
Ureters	1	(7.1)	2	(7.1)	3	(7.1)		
Vesicoureteric junction	4	(28.6)	1	(3.6)	5	(11.9)		
Urinary bladder	0	(0.0)	1	(3.6)	1	(2.4)		

***Statistically significant*

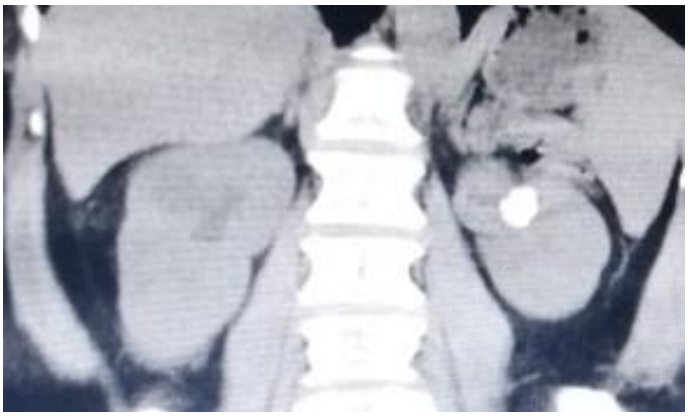

Fig. 4. Contrast enhanced coronal reformatted CT scan of the kidneys showing a hyperdense focus (calculus) in the middle pole of the left kidney

Fig. 5. Non-contrast enhanced coronal reformatted CT scan of both kidneys, showing a hyperdense focus (stone) seen in its inferior pole of the left kidney with resultant hydronephrosis

Fig. 6. Sagittal reformatted non-contrast enhanced CT scan of the left collecting system showing a merging stones lodged at the pelvicureteric junction with dilatation of its proximal collecting system

4. DISCUSSION

Urolithiasis is a global health challenge in both developing and developed countries. The mean age was the 41 to 50 years age group. This is similar to 40 to 49 years age group in an earlier study done in Port-Harcourt [13] as well as that observed in similar studies with a peak incidence between 30-49 years age group [10,15-17]. In contrast to our study, Chand et al. [8] in a study done in Nepal documented a younger age group 20 to 29 years age range. This study also showed that stones are seen more in males than females, with male: female ratio of 1.8:1. This is closely related to 1.35:1 and 2.13:1 as documented by Chand et al. [8] and Danjem et al. [10] in their respective studies in Nepal and Northern Nigeria respectively. It also corroborated with previous studies with male preponderance other than with higher male: female ratios ranging from 2.5 to 12:1 [13,17-23]. The rationale for the male dominance and high prevalence of urinary stone in this age group is not well-known, however some investigators have diverse observations which may relate to diet, hypercalcuria, hyperparathyroidism, hypocitruria as well as/coupled with large muscle mass of men when compared to that of women

[8,24]. A study has established that men have mean higher oxalate concentration than women [25].

Renal calculi are the most frequent and urinary bladder calculi is the least in our study, which is in tandem with some studies [10,17,26]. On the contrary, other studies [8,15,18] have documented urinary bladder calculi as the most prevalent. The pelvicureteric junction, vesicoureteric junction and the ureter are the order of prevalence of urinary calculi in this index study. This disagrees with earlier studies done [10,13]. This could be due to difference in location and probably methodology.

It is worthy of note that left-sided renal stones was seen in males and right-sided renal stones seen in females. It was also noted that inferior pole stones were more common than either middle or superior poles stones. This is consistent with findings reported by Chand et al [8]. This differs from the study done by Danjem et al. [10] who reported more calculi in the middle pole followed by lower and upper poles respectively. This difference in distribution of calculi is unexplainable due to limited literature review on the subject-matter. This is a gray area open for further research.

In this index study, there is a significant association with age and sex, p-value is 0.005 while there is no significant relationship between stone location and sex, p-value is 0.243. This is in contrast with a previous study which documented a significant association between age and stone location [13]. Note that in this study no significant association was seen with stone size and location as well as stone location and Hounsfield unit. This corroborates with Raphael et al. [14] in a study in Port-Harcourt.

5. CONCLUSION

Urolithiasis is a common health issue in low resource setting, with the reproductive aged male afflicted more in comparison to females. The location of calculi in the urinary tract is in the kidney, PUJ, VUJ, ureters and the urinary bladder in a downhill order correspondingly. The inferior pole is the most prevalent site for renal stones and VUJ stones are more frequent in females while other locations are seen more in males. Interestingly, age and sex showed significant association [27].

6. STUDY LIMITATION

The study design is retrospective and so some information were not obtained and a prospective study should be considered in a related study in the future.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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