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Ct Urography in Evaluation of Patients with Macroscopichematuria

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ABSTRACT

Recent improvements in helical CT hardware and software have provided images with the tools to obtain and increasingly large number very thin axial images as define the accuracy of CT urography in the evaluation of patients with macroscopic hematuria.To study the most common etiology of macroscopic hematuria.

Keywords: hematuria,urography and urinary tract

1. INTRODUCTION

Hematuria is one of the most common manifestations of urinary tract. Hematuria can originate from any site along the urinary tract and as wide range of causes including calculi, neoplasm, infection, trauma, meditations, coagulopathy and renal parenchymal diseases. 1

The concept of CT urography (CTU) is more appropriate as both the renal parenchymal and urothelium can be evaluated with one relatively non invasive comprehensive examination 2. The rationale for CT urography is that patients with hematuria can be fully investigated by a single imaging technique with a high degree of sensitivity and specificity 3. It is especially suitable for patients presenting with hematuria where the urinary tract must be assessed for stone disease and neoplasms of kidney and/or urothelium4.CT urography combines the benefit of excretory urography with those of cross sectional imaging into a single study which depicts the renal parenchymal,collecting system and ureters. This technique is based on the acquisition of non enhanced and enhanced CT scan of the abdomen and pelvis, including the essential acquisition of thin section of helical CT scans of urinary tract during the excretory phase of enhancement multiplanar2 dimensional reformation images are produced from axial source

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images during the excretory phase 5. CT urography offers several advantages for imaging urinary tract: single breath hold - coverage of the entire urinary tract with absence of respiratory mis-registration, rapid imaging with optimum contrast medium opacification and reduced partial volume effect as appropriate slice can be selected from the volumetric data6.

2. METHODS AND METHODOLOGY

Source ofdata:

Fifty patients with history of macroscopic hematuria, between 18-75 years of age will be subjected to study which includes out patients, inpatients and referralpatients of Sree balaji medical college and hospital,Chennai.

Method of collection of data:

a) Study design: Prospective study

b)Study Place : Department of radio diagnosis, SBMCH

c) Study duration: 2 years (November 2014 -september2016)

d) Sample Size:50

e) Inclusioncriteria:

1. Patients presenting with macroscopichematuria

f) ExclusionCriteria:

1. Patients below 18 and above 75 years ofage.
2. Pregnant and lactatingpatient
3. Severe renalfailure
4. Cardiacfailure
5. Multiplemyeloma
6. Previous allergic reaction to contrastmedia
7. Patients with non urologic causes ofhematuria.

Method of collection of data was by patients evaluation through detailed history as per standard Proforma. Special attention was given to patients with pain, hematuria loss of weight, limb edema and later physical examination was performed.

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CT Urography technique

Patients were kept nil orally 4 hours prior to the CT scan to avoid complication while administrating contrast medium. Risk of contrast administration were explained to the patient and consent was obtained prior to contrast study. Routine anteroposterior topogram of the abdomen was initially taken in all patients in the supine position with the breath held. Axial plain section of 5 mm thickness was taken from the level of lung base to level of ischial tuberosities. In all the case plain scan was followed by intravenous contrast is suspend. Next was the cortico medullary and nephrographic phase, which was acquired following a delay of 40 – 60 seconds and 90-100 seconds respectively after administration of 120 ml of intravenous iodinated contrast, to evaluated the renal parenchyma.

Followed by phylography phase which was taken 5 to 10 minutes following administration, to evaluate the urothelium from the pelvicalyceal system to the bladder. This was performed with a multidetector row CT scanner (somatom emotion) CT scan will be obtained from the kidneys to bladder with the following technique: a collimator of 5 mm, a pitch of 1.5/2, and with 20 mAS. Images were reconstructed at a thickness of 2.5 mm. Post study reconstruction were done at 2.5 mm sagittal and coronal reconstruction were made done as and necessary. The magnification mode was commonly employed and the scans were reviewed on the direct display console at multiple windows setting (abdomen 320/40; lung window 1400/-600;bone window of 2400/200). The pathological lesion were evaluated with respect to pre and post contrast attenuation values, the size, the location of the lesion, presence of calcification, presence of fat standing and extension in to the adjoining structures.

STATISTICAL METHODS

Descriptive statistical analysis has been carried out in present study. Results on continuous measurement are presented on mean +/- SD (min-max) and results on categorical measurement were presented in number (%). Significance was assessed at 5% level of significance. Exact test was used to find the significance of associated of ct scans findings with final diagnosis, diagnostic statistic such as sensitivity, specificity, PPV, NPV and accuracy has been used to find the correlation of ct scan with final diagnosis.

Diagnostic statistics

	Disease				
Test	Present	N	Absent	n	Total

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Positive	True positive	A	False positive	c	a+c
Negative	False negative	B	True negative	d	b+ d
Total		a+b		c+d	a+b+c+d

The following statistic can be defined:

Sensitivity: probability that a test result will bepositive when the disease ispresent. (True positive rate, expressed as a percentage). = / (a + b) . **Specificity:** probability that a test result will be negative when the disease is not present (true negative rate, expressed as percentage) =d/ (c+d).

Positive predictive value: probability that the disease is present when the test is positive (expressed as a percentage)=a/(a+ c).

Negative predictive value: probability that the disease is present when the test is negative (expressed as a percentage)= d/(b +d).

Accuracy is the sum of true positive and true negative divided by number of casesmultiplied by 100.

3. RESULTS & DISCUSSION

A study design: A prospective study to find the accuracy of MDCT urography in evaluation of patientswith macroscopichematuria.

Table 2: Age distribution of patient's studies

Age in years	No .of patients	%
<20	1	2
21-30	4	8
31-40	10	20
41-50	14	28
51-60	10	20

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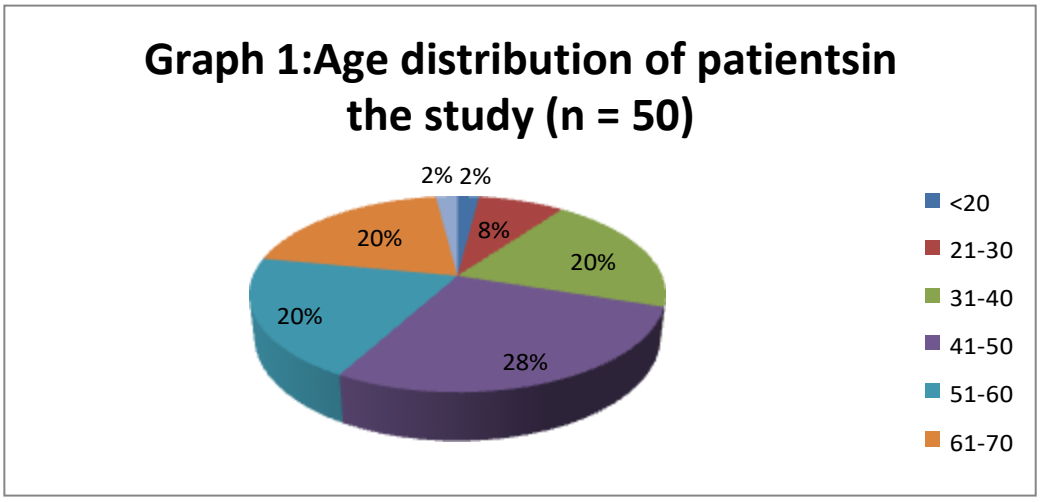
61-70	10	20
>70	1	2
Total	50	100

Graph 1: Age distribution of patients



In this study, the maximum patients were in the age range of 41 -50years.

Table 3: Gender distribution of patients studied

Gender	**No. of patients**	**%**
Male	24	48.0
Female	26	52.0
Total	50	100.0

Fig 3: Different phases of ct urography Corticomedullary phase

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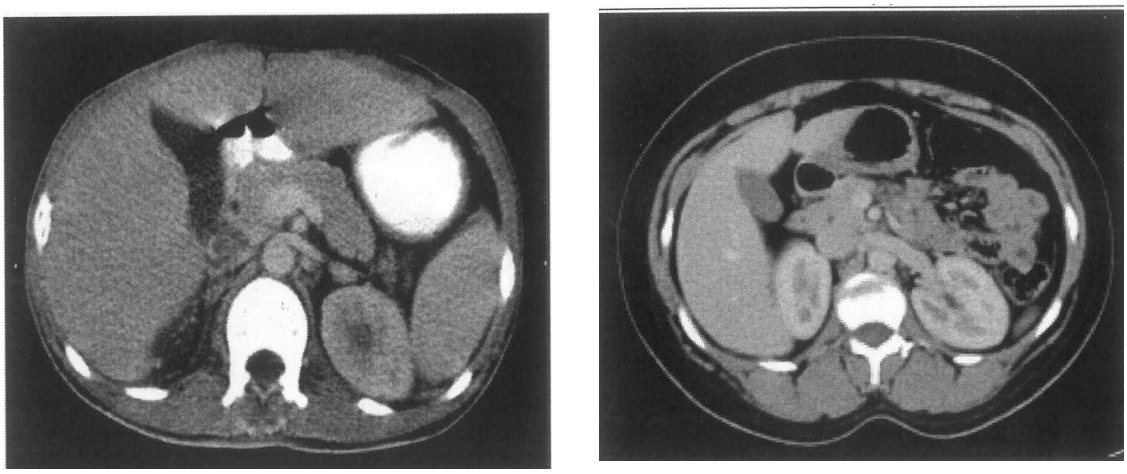
Nephrographic phase Excretory



Regarding age distribution among individual pathologies in our study, Out of 50 cases 28 cases were diagnosed to have urolithiasis, 8 cases of renal neoplasm, 7 cases of bladder and ureteric neoplasm and other inflammatory and non tumorous lesions were 5 cases.

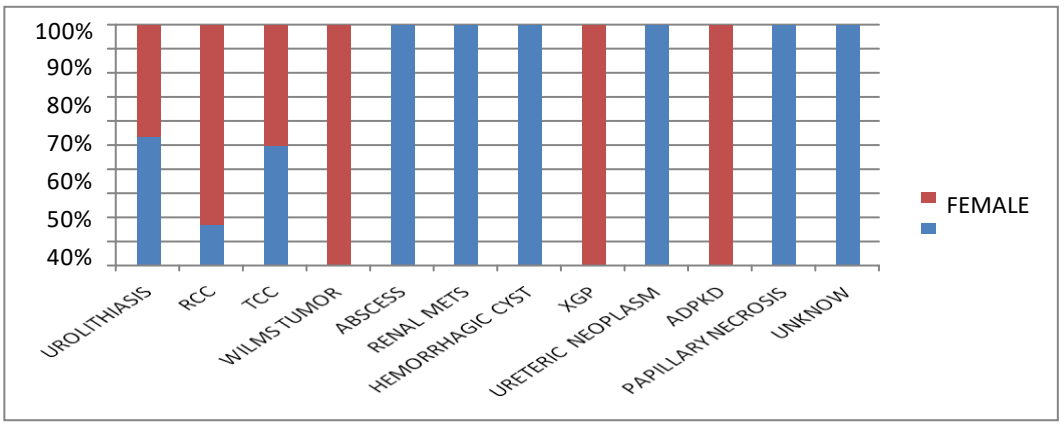
8 out of 28 patients (28.5%) of urolithiasis were in the age group of 31 – 40 years.

3 out of 6 patients (50%) of patients with renal cell carcinoma were in the age group of 41-60 years while 3 out 6 patients (50%) of bladder cell carcinoma were in the age group of 61-70 years.

1 out of 1 (100%) of patients with wilms tumor were in age group of < 20 years.

Graph 4: Urinary abnormalities distribution based on gender

In this study over all there were 26 males (56%) and 24 females (48%), male to female ratio1.08:1



There was a slight male (53.6%) preponderance in patients with urolithiasis

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when comparedto females (46.4%)

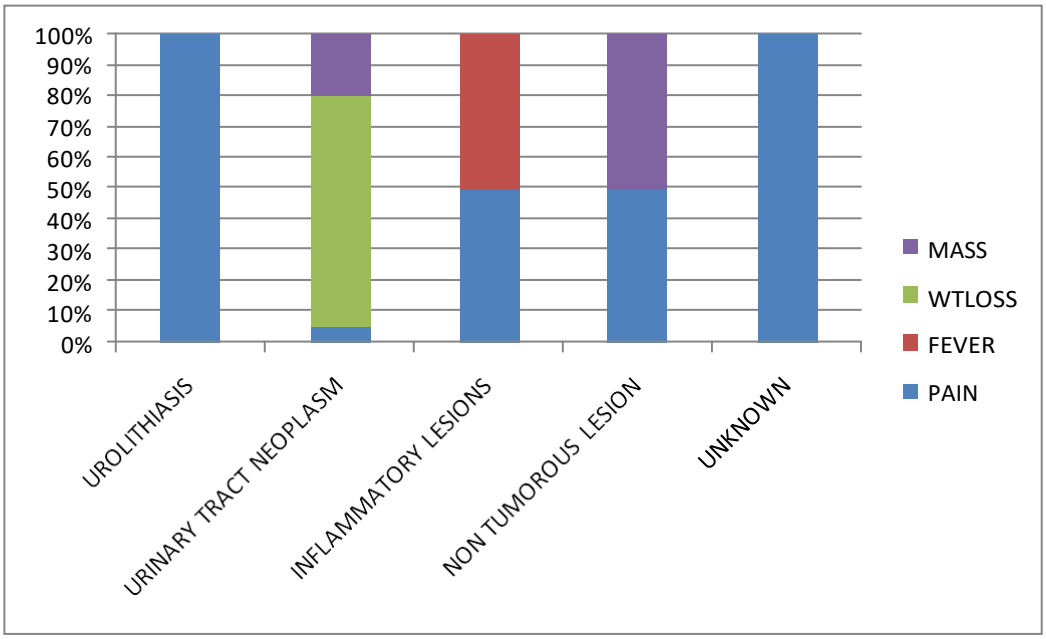
There was a female preponderance (83.4%) in patients with RCC when compared to males (16.6%)

TCC was distributed equally between males (50%) and females (50%)

1 out of 1 (100%) renal metastases were in males patients.

ribution of symptoms associated with hematuria

Painful hematuria was found in 28 out 28 (100%) of patients with urolithiasis while



hematuria was painless in 14 out of 15 cases (93.4%).

3 out 3 (100%) patients with inflammatory lesions had fever associated withhematuria.

Table 7: Renal masses with respect tolocation

SITE	FREQUENCY	PERCENT
RIGHT	5	62.5%
LEFT	3	37.5%
TOTAL	8	100%

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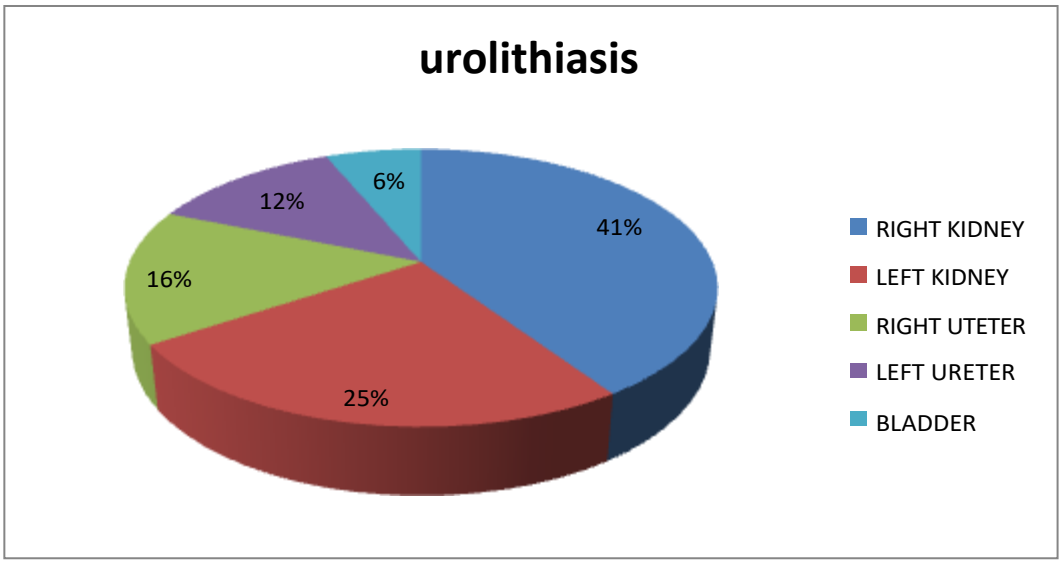
GRAPH 7: Urolithiasis location



Over all there were 32 calculi in urinary tract.

21 out 32 (65.25) calculi were there in kidneys, 9out of 32 (27.9%) were there in ureters and 2 out of 32 (6.3%) were inbladder.

Fig 17: Coronal reformatted CTU image in nephrographic phase showing right renal cell carcinoma invading inferior surface of liver

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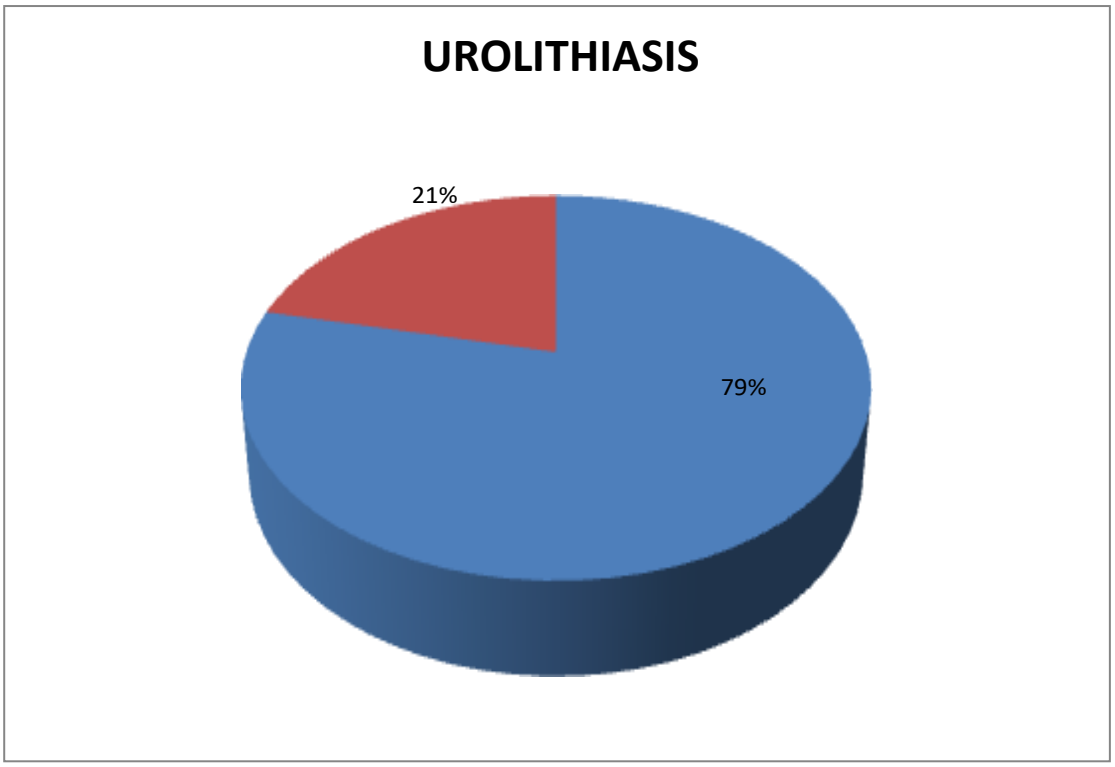
Graph 9: Distribution of according to obstructive /non obstructiveurolithiasis

22 out of 28 (78.6) of patients with urolithiasis were diagnosed to have obstructive urolithiasis as against 6out of28 patients (21.4%) who were



diagnosed to have non obstructiveurolithiasis.

Table 10: secondary signs of obstruction in ureterolithiasis

SECONDARY SIGNS	NO OF PATIENTS	PERCENT
HYDROURETER	8	100
PERIURETERIC STRANDING	6	75

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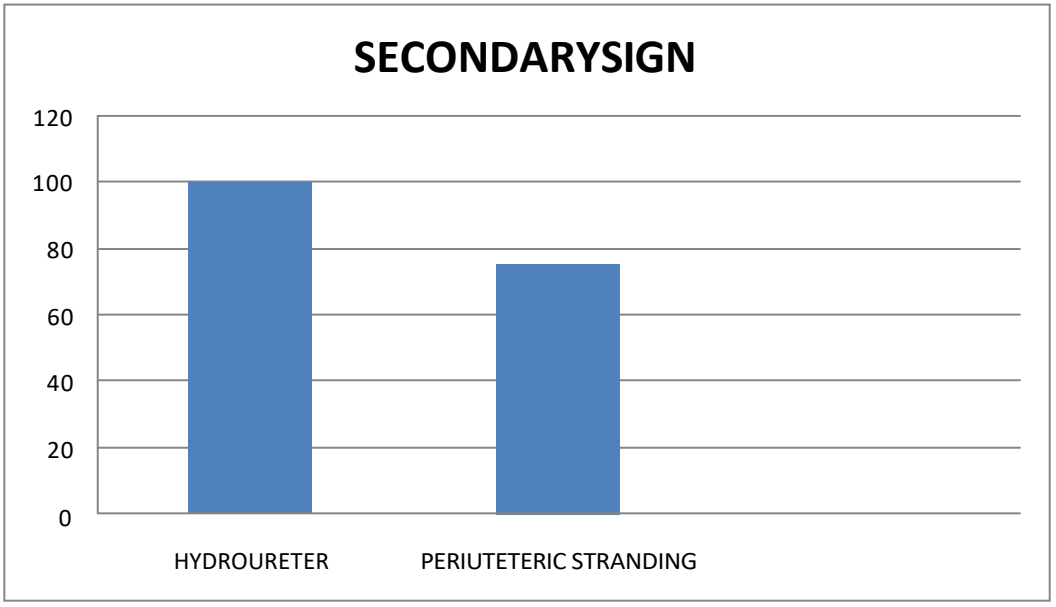
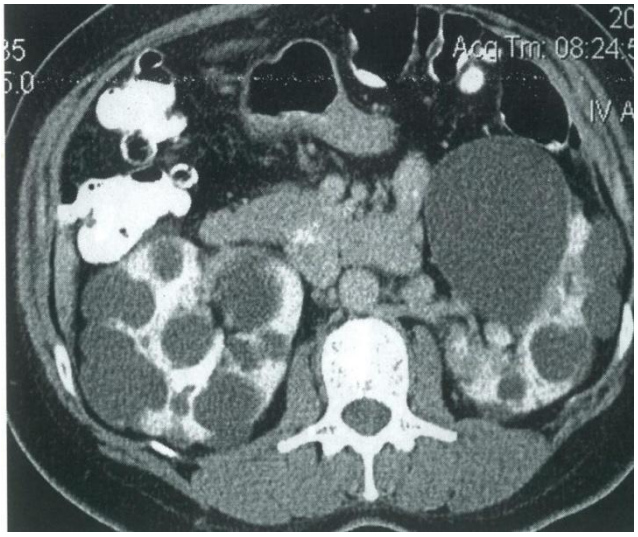
Graph 9: secondary signs of obstruction in ureterolithiasis

100% of patients with urolithiasis had secondary sign of hydroureter and 75



% of patients with ureterolithiasis had a periuretericstranding.

Fig 16: Axial CTU image showing multiple low attenuation cystic lesions of varying sizes inbilateral kidneys-Autosomal dominant polycystic kidney.



Most common causes was nephrolithiasis in 18 out of 31 patients accounting for (58%) with renalpathologies.

Second most common renal pathology was RCC with out of 31 patients(19%)

10 out of 18 (55%) patients had right nephrolithiasis.

4 out of 6 (66.6%) patients with RCC were on right side.

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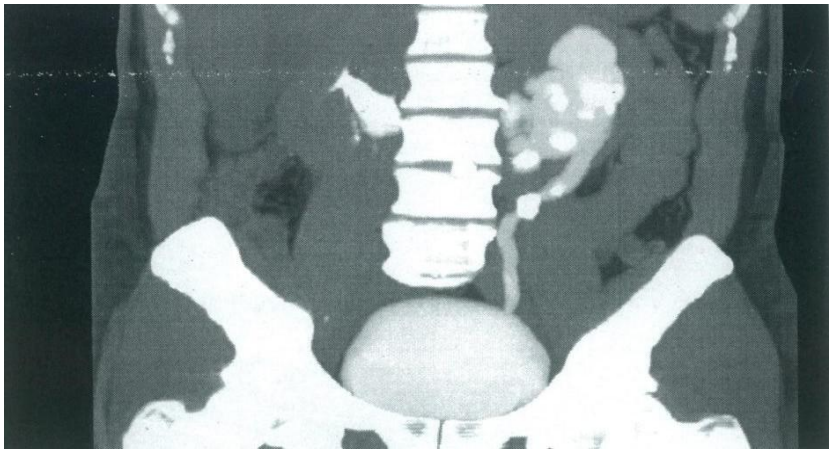
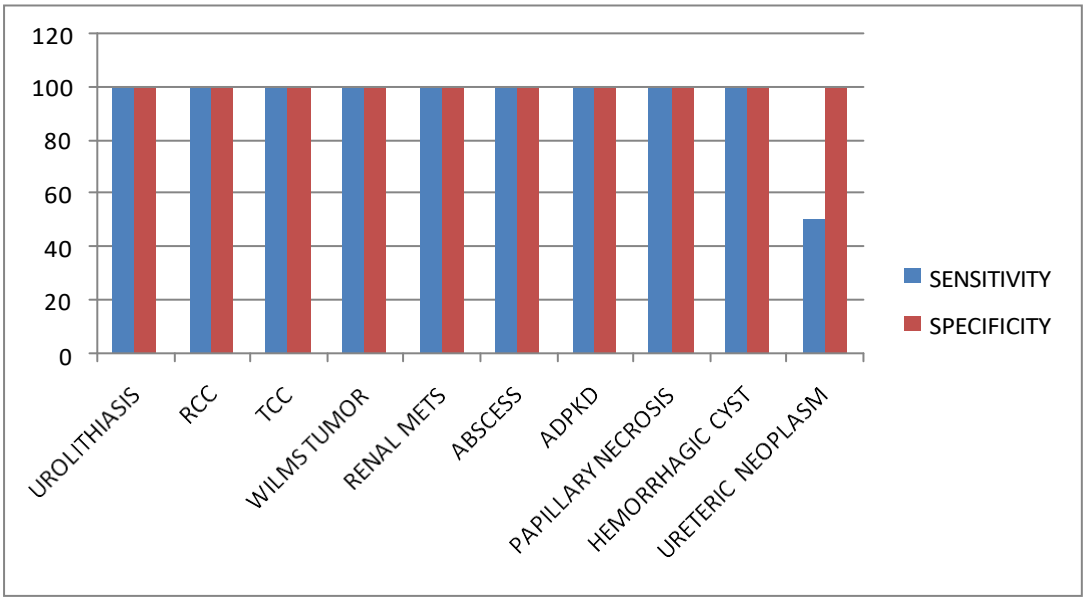
1 out of 19 (100%) of ADPKD and XGP had bilateral lesions.

Fig 4: Coronal MIP reconstruction CT urography image showing obstructive proximal left ureteric calculi and multiple left renal calculi.



Graph 14 : Sensitivity and specificity of MDCT urography for urinary tract abnormalities



There was female preponderance in cases of renal cell carcinoma (53.4%) when compared to males (16.6%). There was equal distribution among males and females cases of transitional cell carcinoma with male to female ratio 1:1 .15 out of 28 urolithiasis cases were in males (53.6%).1 out of 1 case (100%) case of ADPKD and papillary necrosis were in

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females.Pain full hematuria was found in 35 out of 5 (70%) of patients with urolithiasis while hematuria was painless in rest of the patients (30%). 3 out of 3 (100%) of patients with urolithiasis had painful hematuria.28 out of 28(100%)of patients with urolithiasis had a painful hematuria.15 out of 15(100%) of patients with urothelial neoplasm had weight loss. Along with hematuria at 4 out of 5 patients with urothelial neoplasm had per abdomen.Non tumor benign lesion presented with either mass (50%) or fever (50%).7

In this regarding the distribution of urinary tract abnormalities,There were28 cases of urolithiasis, 15 urothelial neoplasm ,3 inflammatory lesion viz renal abscess (n-1), Xanthogranulomatous, pyelonephritis (n-1) and2 non tumorous lesions which includes ADPKD (n-1)hemorrhagic cyst (n-1).A positive diagnosis was established in 48 out of 50(96%) of patients who underwent CT urography. The positive diagnosis was confirmed by histopathological testing in all case of neoplasm, and by urological follow up in all inflammatory and non tumorous condition. In 1 patient CT urography failed to identify the causes of hematuria but neither did theurological surveillance protocol with follow up for least the 5 next 6 months. Out of 8 renal masses, 6 were diagnosed to have renal carcinoma, I was diagnosed to renal metastases from colonic carcinoma and I was diagnosed to have wilms tumor.8However, CT failed to recognize a lesion which was later identified by the urological surveillance protocol and established a false –positive diagnosis in 1 patient. Over all the CT protocol established the correct diagnosis in 48 of the 50 patients (96%). Our ct urogram protocol identified 28 out of 28 cases of urolithiasis (100%) which deemed responsible for hematuria.One case was false negatively diagnosed to be normal which later provided on to be ureteral transitional cell carcinoma.9

Justin m albani et in 2007 determined the usefulness of computerized tomography urography for the initial evaluation of patients with hematuria as an alternative to excretory urography. A source of hematuria was identified in 107 patients (41.3%) in computerized tomographic urography cohort. The most commonly diagnosed lesions being renal calculi (18.9%), ureteral calculi (2.7%) and renal pelvis (5.4%) and inflammatory disorder (3.5 %) in lower tract. Computerized tomography urography exhibited a significantly high sensitivity in detecting upper tract pathology (94.1%).

R peter lokken et al in 2012 march conducted a study to evaluate the diagnostic yield of CT urography in evaluation of young adults with hematuria. A cli nically significant source was found in 83 of 375 examination (22.1%), including 42 of 142 (29.6%) for gross hematuria, 29

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of 181 (16.0%) for microscopic hematuria, and 12 of 52

23.1%) for hematuria of unspecified subtype. The most common clinically significantly findings were renal or ureteral calculi (75.3%); four malignancies were also detected.10

In a study conducted by EK Lange et al in 2001, detect and characterize the abnormalities causing hematuria by obtaining the results from the helical multiphase computed tomography urography. All cases of congenital renal lesions, calculus disease, ureteral lesions and neoplastic lesions of bladder were correctly diagnosed, as were 40 of 41 inflammatory renal 21 of 23 renal, masses and 13 of 16 inflammatory bladder lesions. in 27 patients with renal calculi the study was limited to pre- enhancement spiral ct. a positive diagnosis rate of 45.1% for the causes of hematuria with high sensitivity and specificity to the effectiveness of ct urography.11

EK Lang et al in another study in 2004, evaluated multiphasic helical computed tomography for the characterization of lesions responsible for hematuria not diagnosed on prior urological surveillance studies. He causeof microscopic hematuria was established in 256 of 600 patients with prior negative urological surveillance examination with 0.91 sensitivity and 0.94 specificity. The diagnosis was corrected in all subsequently proven cases of calculus and renal vascular disease.12 A total of 67 of 70 inflammatory kidney lesions, 24 of 25 renal neoplasm, 15 of 16 bladder neoplasm, 27 of 35 inflammatory bladder conditions and 21 of 23 ureteral lesions were also correctly diagnosed. Multiphasic helical computerized tomography diagnosed lesions responsible for hematuria in 42.6% of 600 patients with negative urological surveillance examination.

Table16: Comparison with sensitivity and specificity with other studies.

Study	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**Accuracy**
Current					
Justin malbani	94.1%	93%	83%	NA	NA
Ek lang(2001)	92	94	94	92	NA
Ek lan(2004)	91	94	93	93	NA
RpeterLokken	97.5%	100%	NA	NA	NA

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Urolithiasis was most common in the age group of 31 -40 years 8 out of 28 patients (28.5%).There was a slight male (53.6%) preponderance in patients with urolithiasis when compared to females (46.4%)Painful hematuria was found in all 28 out of 28 (100%) of patients with urolithiasis. 21 out of 32 (65.25%) calculi were there in kidneys. 9 out of 32 (27.9%) were there in ureters and 2 out of 32 (6.3%) were in bladder.Nephrolithiasis was the most common renal pathology deemed to be responsible for hematuria 18 out o 31 patients (58%).Renal cell carcinoma showed a larger attenuation in nephrographic phase with a mean HU value of different between nephrographic phase and unenhanced scan was the greatest with a mean HU value of HU.The involvement of renal vein, inferior vena cava, adrenal , lymph nodes ,liver and appendicular skeleton was seen only in malignant renal cell carcinoma and wilms tumor.13-17

In this study all this malignant renal neoplasm showed soft tissue attenuation on pre contrast scans and showed mean attenuation value of 51 +/8.2 HU in corticomedullary phase and 79 +/- 16.4 in the nephrographic phase. Of importance is the difference in attenuation between the cortico medullary and nephrographic phases, malignant lesion showed a mean increased by HU the findings in present study correlate well with zagoria et al study where in the author has found that vascular solid renal neoplasm showed mean attenuation value of 104+/-46 and 90+/- 37 in CPM and NP respectively.

CONCLUSION

Out of 50 cases, 35 cases were diagnosed to be non neoplastic and 15 cases were diagnosed to neoplastic. The most common pathology was urolithiasis accounting for 56% of the pathology causing hematuria.Overall there were 26 male and 24 females and male to female ratio was almost equal 1.0.8:1.MDCT urography was able to define lesions with a sensitivity of 97%, specificity of 100%, and accuracy of 98% when the images were evaluated in unenhanced, cortico medullary and nephrographic phases.

Renal cell carcinoma showed a heterogeneous enhancement with an increased of more than 20HU, renal vein and inferior vena caval invasion was highly specific for malignancy. The difference in density was maximum in the unenhanced and urographic group when compared to unenhanced and cortico medullary group, indicating the malignant renal masses being very vascular would show

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Ethical approval: The study was approved by theInstitutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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