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**Original Research Article**

# "ROLE OF CT UROGRAPHY IN CASE OF HEMATURIA"

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## ABSTRACT

**Aim:**1. To evaluate the role of CT urography in investigating causes of hematuria.
2. To determine the sensitivity and specificity of CT urography in evaluation and differentiation of the upper and lower urinary tract pathologies causing hematuria.

**Material and methods:** A prospective study of 75 patients with urinary Symptomatology was performed who presented at **Index Medical College Hospital and Research Center, Indore (M.P.).** The study was conducted during the period from JAN 2021 to JUL 2022.
75 patients were referred for CT Examination. Almost all these patients were symptomatic and many had multiple symptoms related to urinary tract. However, pain was the predominant symptom in as many as 54 cases. Patient registration in form of individual details, clinical history, past history. Recording of previous X-Ray, USG, IVU & other relevant laboratory reports whenever available for evaluation.

**Results:** Majority of the subjects 68% were male and 32% were female. Majority of the subjects 78.7% had macro hematuria and 21.3% had micro hematuria. Majority of the subjects 72% had hematuria with symptoms and 28% had hematuria without symptoms. Majority of the subjects 36% had Calculi followed by 20% of the subjects had Neoplasm, 16% had Infection, 8% had trauma and 8% had developmental anomaly. Among the subject who had infection as cause for hematuria 100% of subject had hematuria with symptoms. Majority of the subjects who had carcinoma as cause for hematuria had without symptoms. 87.1% of the subject who had macro hematuria had symptoms and 57.1% did not had symptoms. 12.9% of the subject who had micro hematuria had symptoms and 42.9% did not had symptoms. Majority of the subjects who had calculi 48.1% had renal calculi followed by ureteric in 37% and vesical in 14.9%. Majority of the subjects who had developmental anomaly 33.3% had polycystic and ectopic kidney followed by horseshoe shaped kidney and duplication of ureter 16.7%. Equal number of the subjects who had trauma 33.3% had kidney, bladder and uretheral injury.

**Conclusion:** Multidetector CT urography detects with high accuracy the entire spectrum of urinary tract pathologies causing hematuria in comparison with other modalities like X-ray and ultrasonography. Multi detector CT urography is highly sensitive and specific for detecting renal and urinary bladder masses. It is useful for further characterization and

staging of neoplastic masses. Thus, multidetector CT urography has the potential to become a one investigation for evaluation of urinary tract, especially in cases of hematuria.

**Keywords**: MDCT urography, hematuria, calculi, hydronephrosis, neoplasms, ureters.

## 1. INTRODUCTION

Hematuria is one of the many common manifestations of urinary tract pathologies such as calculi, neoplasm, infection, trauma, medications, coagulopathy, developmental anomalies, and renal parenchymal diseases and always warrants serious concern,[1] both to the patient as well as the treating physician.[2] Its reported prevalence does range from 0.2% to 21%.[3] Hematuria, being one of the most common presentations of patients with urinary tract diseases, is a common reason for urinary tract imaging.[4] Hematuria can originate from any site along the urinary tract and, whether gross or microscopic, may be a sign of serious underlying disease including malignancy.[2] The advanced MDCT scanners with its superior spatial resolution, higher speed, and isotropic reconstruction capability has ushered in a revolution in diagnostic imaging of urinary tract disorders.[2]

MDCTU can acquire thinly collimated data sets, which can be used to create excellent 3D quality images of the urinary tract.[3] The MDCTU test has the capacity to function independently as a thorough "one-stop" procedure for imaging the upper and lower urinary tracts.[5] It is especially appropriate for patients who have hematuria and need to have their urinary system checked for kidney and/or urothelial neoplasms as well as stone disease.[5] MDCTU is also regarded as the "gold standard" imaging test for the assessment of renal parenchyma for renal masses in individuals with hematuria.[5]

The American Urological Association (AUA) guidelines recommended upper tract imaging for low-and high-risk patients with microscopic hematuria, defined as three or more Red Blood Cells (RBCs) per high-power field from two of three properly collected urinalysis specimens.[4] Cross-sectional methods like MDCTU are less vulnerable to underlying bowel gas and better capable of detecting calculi and tiny cancers.[4] The etiologies for gross and microscopic hematuria are vast and include multiple systems in numerous anatomic locations along the urinary tract. Organization of these etiologies using a combination of systems and anatomic approach can help the provider make the appropriate diagnosis and treatment.[6]

Purpose of imaging investigations for hematuria Imaging studies may be warranted when certain disease processes are suspected such as urolithiasis and malignancy. These studies include the Intravenous Pyelogram (IVP), CT, ultrasonography, and Magnetic Resonance Imaging (MRI).[7]

Hematuria is determined by nonimaging diagnosis of hematuria and radiology imaging of hematuria. In both the methods, radiologic imaging, plays a major role in the diagnosis of hematuria. However, the performances of individual imaging techniques within a specific diagnostic algorithm for hematuria have not been studied well. Diseases that are the primary causes of hematuria, such as urolithiasis, infections, Renal Cell Carcinoma (RCC), and Urothelial Cell Cancer, require to have their sensitivity and specificity reduced. There are different types of radiology imaging techniques, and each plays adifferent role in the investigation of hematuria.[8] Imaging techniques have gained an increasingly crucial role in diagnosis of bladder cancer; in particular, Intravenous Urography (IVU) has been the reference standard for decades. Currently, ultrasound is the first choice of investigation in clinical practice, but requests for CT have also increased in recent days.[9] CTU is an optimized examination for evaluating kidney or urinary tracts and includes high-resolution

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excretory phase–enhanced CT. There are 2 major approaches in terms of contrast material delivery and CT acquisitions: a single-bolus contrast medium injection technique with 3 CT acquisitions during the unenhanced, nephrographic, and excretory phases (i.e., single-bolus CTU) and a split-bolus contrast medium injection technique with 2 CT acquisitions during the unenhanced and synchronous nephrographic and excretory phases (i.e.,split-bolus CTU). One of the main problems with CTU, especially withthe single-bolus CTU protocol, is a higher radiation exposure, however new imaging techniques have arisen to lower the radiation dosage of CTU.[10]

**Aim:**

1. To evaluate the role of CT urography in investigating causes of hematuria.
2. To determine the sensitivity and specificity of CT urography in evaluation and differentiation of the upper and lower urinary tract pathologies causing hematuria.

## 2. MATERIAL AND METHODS

A prospective study of 75 patients with urinary Symptomatology was performed who presented at **Index Medical College Hospital and Research Center, Indore (M.P.).** The study was conducted during the period from JAN 2021 to JUL 2022.

**Inclusion criteria:**

- Patients presenting with hematuria referred to department of radio-diagnosis
- Patients having normal renal function as assessed by Serum Creatinine level & Estimated GFR (eGFR)
- Patients with good breath-holding capacity

**Exclusion criteria:**

- Patients below 17 and above 75 years of age.
- Severe renal failure
- Cardiac failure
- Previous allergic reaction to contrast media
- Pregnant and lactating patient

## 3. METHODOLOGY

75 patients were referred for CT Examination. Almost all these patients were symptomatic and many had multiple symptoms related to urinary tract. However, pain was the predominant symptom in as many as 54 cases.

Patient registration in form of individual details, clinical history, past history.

Recording of previous X-Ray, USG, IVU & other relevant laboratory reports whenever available for evaluation.

One litre of drinking water was given 30 minutes prior to the scan.

Oral positive iodinated contrast was given whenever necessary or requested by the consulting physician.

**Patient position:** Supine with axial images taken, with respiration suspended at mid–inspiration. Prone scans whenever necessary for demonstration. Hands were raised above the head.

To clear the area of interest of removable metal objects to avoid artifacts.
Breath-holding technique was practiced on table with patient, as it improves patient compliance, decreases patient anxiety and may lessen artifacts during acquisition.
Patients were informed about the experience of diffuse warmth at the end of the injection.
**Intravenous injection:** An intravenous line of no. 20 gauge intracath was taken on the forearm.
Contrast concentration used was 350 mg iodine/ml. Normally amount of contrast used was 80 ml. A saline chaser of 40 ml was used. Rate of injection was 3 ml per second (Using Auto-injector).
**Equipment:** All patients were scanned with a SIEMENS GO TOP 128-slice CT scanner equipped with a new feature in multislice CT technology, so called z-axis flying focus technology. A topogram was performed followed by a plain scan from a level just above the domes of diaphragm to the level of pubic symphysis. Then 3-phase CT Urography as described below was performed. Additional phases, e.g. arterial phase for renal tumors and delayed prone scans for demonstration of ureters were taken as and when needed. After the procedure, the patient was kept under observation for 15 to 30 minutes.
**Image post-processing:** The axial images were generated from the source raw data images. The slice thickness of 1.0 mm with reconstruction increment of -1.0 mm was used. The images were then transferred to a dedicated GE Workstation for image post-processing techniques. The various techniques used were Multiplanar Reconstruction (MPR), Maximum Intensity Projection (MIP), Curved Planar Reconstruction (CPR) and Volume Rendering Technique (VRT). Although from the radiological point of view, the axial images were sufficient to diagnose, the referring urologists/physicians preferred the 3D images. In addition to film interpretation, image interpretation was performed on the dedicated 3D (GE) Workstation in an interactive manner. Two or three dimensional post processing displays such as MPR, MIP, cMPR and VRT may be helpful for a first glance to see the course of the ureters. It should be considered that any 2D or 3D reconstruction may come along with a loss of spatial resolution. Smaller calculi for instance, which are visible in the axial source, may not be seen in volume rendered images and the diagnosis can be completely missed. Therefore the primary axial slices are superior to any post processing method.

## 4. RESULTS

**Table 1. Distribution of the subjects according to the age group**

| Age group | No. of case | Percent % |
|---|---|---|
| 18-27 | 11 | 14.7 |
| 28-37 | 13 | 17.3 |
| 38-47 | 10 | 13.3 |
| 48-57 | 20 | 26.7 |
| 58-67 | 9 | 12 |
| 68-75 | 12 | 16 |
| **Total** | **75** | **100** |

Majority of the subjects 26.7% were in 48-57 yrs age group followed by 17.3% were in 28-37yrs age group, 16% were in 68-75 yrs age group, 14.7% were in 18-27 yrs age group, 13.3% were in 38-47 yrs age group and 12% were in 58-67yrs age group. Majority of the subjects 68% were male and 32% were female.

**Table 2. Distribution of the subjects according hematuria**

| Hematuria | No.of case | Percent % |
|---|---|---|
| Macro | 59 | 78.7 |
| Micro | 16 | 21.3 |
| **Total** | **75** | **100** |

Majority of the subjects 78.7% had macro hematuria and 21.3% had micro hematuria.
Majority of the subjects 72% had hematuria with symptoms and 28% had hematuria without symptoms.

**Table 3. Distribution of the subjects according causes of hematuria**

| Cause | No.of case | Percent % |
|---|---|---|
| Calculi | 27 | 36 |
| Infection | 12 | 16 |
| Neoplasm | 15 | 20 |
| Developmental Anomaly | 6 | 8 |
| Trauma | 6 | 8 |
| Miscellaneous | 9 | 12 |
| **Total** | **75** | **100** |

Majority of the subjects 36% had Calculi followed by 20% of the subjects had Neoplasm, 16% had Infection, 8% had Trauma and 8% had Developmental Anomaly.

**Table 4. Distribution of the subjects according causes of hematuria and type of hematuria**

| Cause | Hematuria | | Total |
|---|---|---|---|
| | Macro | Micro | |
| Calculi | 23 (85.2%) | 4(14.8%) | 27 (100%) |
| Infection | 7(58.3%) | 5(41.7) | 12 (100%) |
| Neoplasm | 15(100%) | 0 | 15 (100%) |
| Developmental Anomaly | 3(50%) | 3(50%) | 6 (100%) |
| Trauma | 6(100%) | 0 | 6 (100%) |
| Miscellaneous | 5(55.5%) | 4(44.5%) | 9 (100%) |
| **Total** | **59(78.7%)** | **16(21.3%)** | **75 (100%)** |

Among the subject who had calculi as cause for hematuria 85.2% of subject had macro hematuria and 14.8% had micro hematuria. All the subjects who had neoplasm & trauma had macro hematuria. Majority of the subjects with infection had macro hematuria. Among the subject who had developmental anomaly as cause for hematuria 50% of subject had macro hematuria and 50% had micro hematuria.

**Table 5. Distribution of the subjects according causes of hematuria and type of symptom**

| Cause | Hematuria | | Total |
|---|---|---|---|
| | Symptom | Asymptomatic | |
| Calculi | 23(85.2%) | 4 (14.8%) | 27 |
| Infection | 12 (100%) | 0 | 12 |
| Neoplasm | 6 (40%) | 9(60%) | 15 |

| | | | |
|---|---|---|---|
| Developmental Anomaly | 0 | 6(100%) | 6 |
| Trauma | 6(100%) | 0 | 6 |
| Miscellaneous | 7(77.8%) | 2(22.2%) | 9 |
| **Total** | **54** | **21** | **75** |

Among the subject who had calculi as cause for hematuria 85,2%% had hematuria without symptoms. Among the subject who had infection as cause for hematuria 100% of subject had hematuria with symptoms. Majority of the subjects who had carcinoma as cause for hematuria had hematuria without symptoms.

**Table 6. Distribution of the subjects according symptom and type of hematuria**

| **Symptoms** | **Hematuria** | | **Total** |
|---|---|---|---|
| | **Macro** | **Micro** | |
| Symptomatic | 47 (87.1%) | 7(12.9%) | 54 |
| Asymtomatic | 12 (57.1%) | 9(42.9%) | 21 |
| **Total** | **59** | **16** | **75** |

87.1% of the subject who had macro hematuria had symptoms and 57.1% did not had symptoms. 12.9% of the subject who had micro hematuria had symptoms and 42.9% did not had symptoms.

**Table 7. Distribution of the calculi according location**

| **Calculi** | **No. of case** | **Percent %** |
|---|---|---|
| Renal calculi | 13 | 48.1 |
| Ureteric calculi | 10 | 37 |
| Vesical calculi | 4 | 14.9 |
| **Total** | **27** | **100** |

Majority of the subjects who had calculi 48.1% had renal calculi followed by ureteric in 37% and vesical in 14.9%.

**Table 8.Distribution of the calculi according sex**

| Calculi | No. of case | Percent % |
|---|---|---|
| Male | 15 | 55.6 |
| Female | 12 | 44.4 |
| **Total** | **27** | **100** |

Majority of the subjects i.e. 55.6% who had calculi were male and rest were female.

**Table 9. Distribution of the calculi cause of hydronephrosis**

| Cause | Hydronephrosis | | Total |
|---|---|---|---|
| | Present | Absent | |
| Renal calculi | 9 (69.2%) | 4 (30.8%) | 13 |
| Ureteric calculi | 10 (100%) | 0 | 10 |
| Vesical calculi | 0 | 4(100%) | 4 |
| **Total** | **19** | **8** | **27** |

69.2% of the subject who had renal calculi had hydronephrosis and 30.8% did not had hydronephrosis. 100% of the subject who had ureteric calculi had hydronephrosis. 100% of the subject who had vesical calculi did not had hydronephrosis.

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**Table 10. Distribution of the subjects according to infection**

| Infection | No. of case | Percent % |
|---|---|---|
| Renal | 5 | 41.7 |
| Bladder | 6 | 50 |
| Urethra | 1 | 8.3 |
| **Total** | **12** | **100** |

Majority of the subjects who had infection 50% had bladder infection followed by renal in 41.7% and uretheral in 8.3%.

**Table 11. Distribution of the infection according sex**

| Infection | No. of case | | Percent % |
|---|---|---|---|
| | Male | Female | |
| Renal | 3 (60%) | 2(40%) | 5 |
| Bladder | 3 (50%) | 3 (50%) | 6 |
| Urethra | 1 (100%) | 0 | 1 |
| **Total** | **7** | **5** | **12** |

60% of the subject who had renal infection were male and 40% were female. 50% of the subject who had bladder infection were male and 50% were female. 100% were male with uretheral infections.

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**Table 12. Distribution of the subjects according to neoplasm**

| Neoplasm | No. of case | Percent % |
|---|---|---|
| Renal ca. | 7 | 46.6 |
| Bladder ca. | 4 | 26.7 |
| Urethral ca. | 0 | 0 |
| Prostate ca. | 4 | 26.7 |
| **Total** | **15** | **100** |

Majority of the subjects who had neoplasm 46.6% had renal carcinoma followed by Ca bladder and Ca prostate 26.7%.
71.4% of the subject who had renal cancer were male and 28.6% were female. 100% of the subject who had bladder cancer were male.

**Table 13. Distribution of the subjects according to developmental anomaly**

| Developmental Anomaly | No. of case | Percent% |
|---|---|---|
| Polycystic kidney | 2 | 33.3 |
| Horseshoe shape | 1 | 16.7 |
| Ectopic kidney | 2 | 33.3 |
| Duplication of ureter | 1 | 16.7 |
| **Total** | **6** | **100** |

Majority of the subjects who had developmental anomaly 33.3% had polycystic and ectopic kidney followed by horseshoe shaped kidney and duplication of ureter 16.7%.
50% of the subject who had polycystic kidney and ectopic kidney were male and 50% were female. 100% of the subject who had horseshoe shaped kidney and duplication of ureter were male.

**Table 14. Distribution of the subjects according to trauma**

| Trauma | No. of case | Percent% |
|---|---|---|
| Kidney injury | 2 | 33.3 |
| Bladder injury | 2 | 33.3 |
| Urethral injury | 2 | 33.3 |
| **Total** | **6** | **100** |

Equal number of the subjects who had trauma 33.3% had kidney, bladder and uretheral injury.

100% of the subject who had kidney, bladder and uretheral injury were male.

**Table 15. Distribution of the subjects according to miscellaneous**

| Miscellaneous | No. of case | Percent% |
|---|---|---|
| BPH (bening prostatic hyperplasia) | 4 | 44.5 |
| Renal cysts | 2 | 22.2 |
| Post operative | 1 | 11.1 |
| Urethral stricture | 2 | 22.2 |
| **Total** | **9** | **100** |

Majority of the subjects in miscellaneous who had BPH 44.5% followed by renal cysts and uretheral stricture 22.2% and post- operative were 11.1%.

100% of the subject who had BPH and uretheral stricture were male. Equal number of male and female subjects of renal cysts. 100% of the subjects who had post operative category were females.

**Table 16. Distribution of the subjects according age group and causes of hematuria**

| Age group | Calculi | Infection | Neoplasm | Developmental Anomaly | Trauma | Miscellaneous |
|---|---|---|---|---|---|---|
| 18-27 | 3 (11.1%) | 3 (25%) | 0 | 1 (16.7%) | 2(33.3 %) | 1 (11.1%) |

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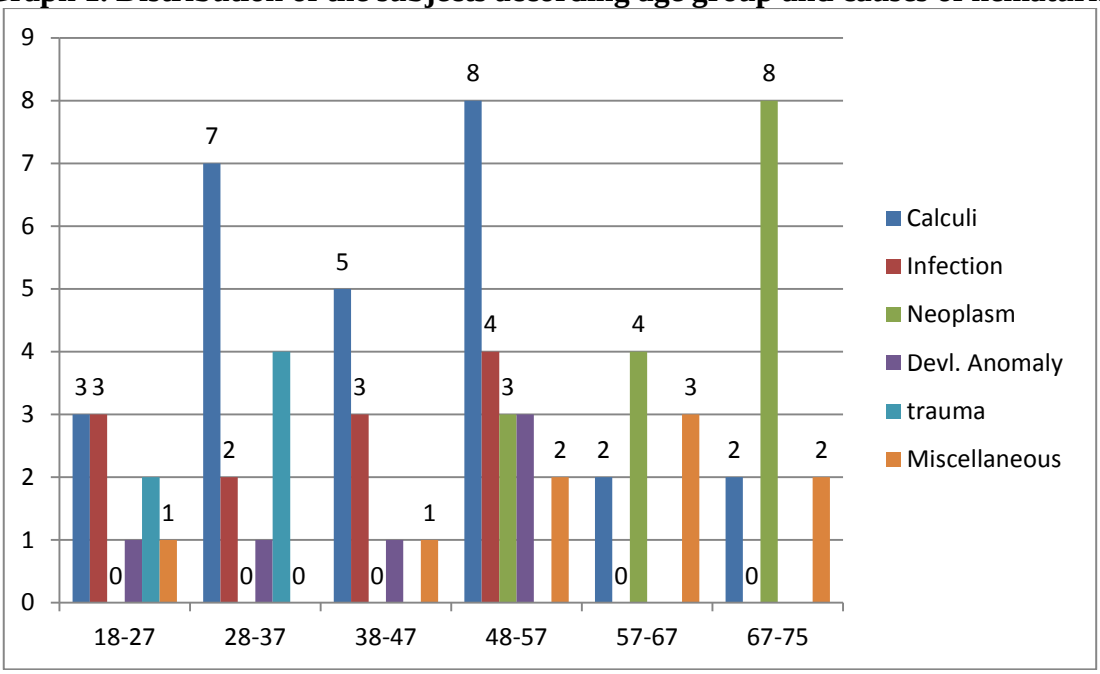
| | | | | | | |
|---|---|---|---|---|---|---|
| 28-37 | 7 (25.9%) | 2 (16.7%) | 0 | 1 (16.7%) | 4 (66.7%) | 0 |
| 38-47 | 5 (18.6%) | 3 (25%) | 0 | 1 (16.7%) | 0 | 1 (11.1%) |
| 48-57 | 8 (29.6%) | 4 (13.3%) | 3 (20%) | 3 (50%) | 0 | 2 (22.2%) |
| 57-67 | 2 (7.4%) | 0 | 4 (26.7%) | 0 | 0 | 3 (33.3%) |
| 67-75 | 2 (7.4%) | 0 | 8 (53.3%) | 0 | 0 | 2 (22.2%) |
| **Total** | **27** | **12** | **15** | **6** | **6** | **9** |

Among the subject who had calculi 29.6% were in 48-57yrs, 25.9% in 28-37 yrs, 18.6% in 38-47 yrs age group, 11.1% in 18-27yrs age group and 7.4% in 57-67 yrs and 67-75 yrs age group. Among the subject who infection 25% were in 18-27 yrs and 38-47yrs and 16.7% in 28- 37yrsage group and 13.3% in 48-57 yrs age group.

Among the subject who had neoplasm 53.3% were in 67-75yrs and 26.7% in 57-67 yrs and 20% in 48-57 yrs. Among the subject who had developmental anomaly 50% were in 48-57yrs,16.7% in 18-27yrs, 28- 37 yrs age group and 38-47 yrs age group. Among the subject who had trauma 66.7% were in 28-37yrs and 33.3% in 18-27 yrs.

**Graph 1. Distribution of the subjects according age group and causes of hematuria**



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## 5. DISCUSSION

One of the most typical symptoms of disorders of the urinary system is hematuria. It has a variety of causes, including calculi, neoplasms, infections, trauma, medicines, coagulopathies, and renal parenchymal disorders, and it can develop from any point along the urinary system. The evaluation of urological malignancies is perhaps the most crucial factor in determining the importance of these patients in order to make an early and correct diagnosis. As a result, highly sensitive exams are crucial for neoplasm detection. It's also crucial to be able to identify additional potential causes of hematuria.

Present study comprised of 75 patients who presented with hematuria (both macroscopic and microscopic) and were referred to radiology department for work up with CT urography. All the patients underwent CT urography and diagnosis was established after analyzing all the phases of study with required post processing techniques. In this study the macroscopic hematuria was seen in 59 patients which constituted 78.7% and microscopic hematuria was seen in 16 patients which constituted 21.3% .

In this study, prevalence of painful hematuria (54) was more common than painless haematuria (21). Macroscopic hematuria constitutes (78.7%) which was more than microscopic hematuria. Abdominal pain was the most common complaint other than hematuria followed by fever. In these 75 patients, the cause of hematuria was divided into uro-lithiasis, infective, neoplasm, developmental anomalies, traumatic, and other miscellaneous conditions.

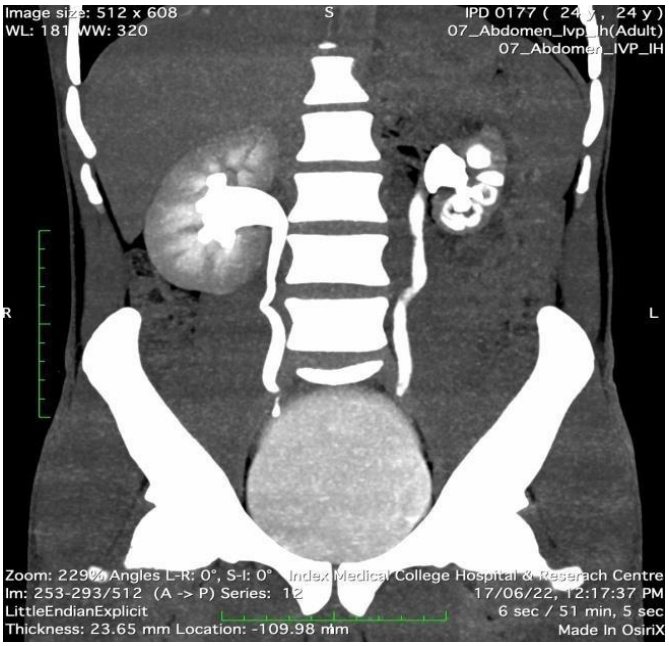


**Figure 1. Normal CT Urogram coronal image**

**Urolithiasis:** In the present study, CT Urography detects 27 patients having urolithiasis (small calculs as well as staghorn calculus) as the cause for hematuria including renal, pelviureteric junction, ureteric, vesico-ureteric junction and vesical calculi and which constitutes to nearly about 36% in the total number of cases and thus becomes the main cause of hematuria in the present study. Urolithiasis was identified as the source of microscopic

hematuria in roughly 24% of patients in a study by Mahmoud MA et al (2015) on the use of Multi-detector row computed tomography urography (MDCTU) in the evaluation of microscopic hematuria in adults.[11] The majority of urolithiasis patients exhibit excruciating microscopic hematuria, and in the current investigation, the ureteric (35%) and VUJ (23%) regions were the most often affected. Most urolithiasis patients also have hydronephrosis, with ureteric calculus being the most frequent cause of this condition.

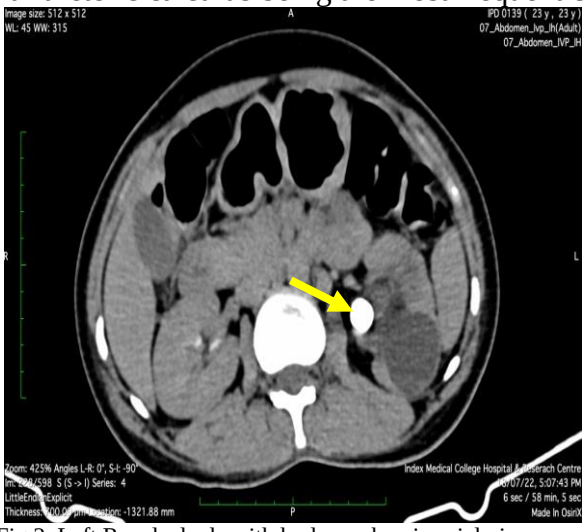


Fig 2. Left Renalcalculs with hydronephrosis axial view

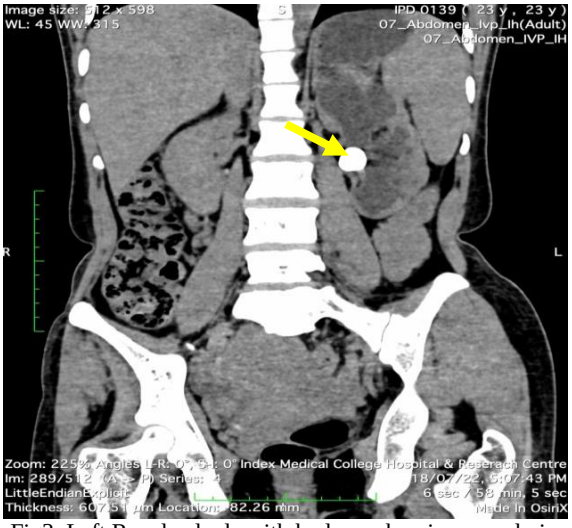


Fig3. Left Renal calculs with hydronephrosis coronal view

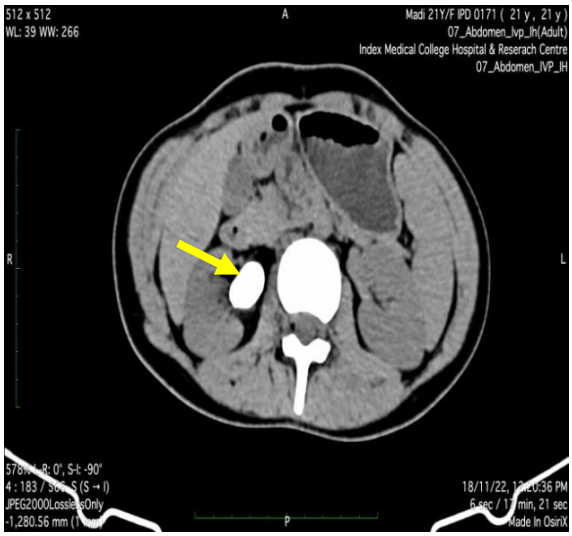


Fig 4. Right Staghorn calculs axial view


Fig 5. Right staghorn calculus contrst enhance coronal view

**Infection:** In present study 6 cases, presented with fever since 2 months, weight loss and on urine examination red blood cells were noted and on further investigation with CT urography, it revealed thimble shaped bladder with circumferential wall thickening. **O'malley ME et al**(2003), similar study conducted on patients presenting with painless hematuria in sample of 91 patients by CT urography, about two patients confirmed of cystitis.[12] **Shinagare AB et al** (2011), described many infective and inflammatory causes of bladder such as cystitis which simulate as bladder carcinoma on CT urography and concluded that they should be confirmed by cystoscopic biopsy.[13]

**Developmental Anomaly:** In present study, a case of 56 year old female patient presented with microscopic painless hematuria. On CT urographic evaluation, cause of hematuria was found to be ectopic kidney with renal calculus, both acting synergistically as cause for hematuria in the present case. In a similar study by **Bhoil R et al(2015),** described a similar case of ectopic kidney with renal calculus as source of hematuria. In present study, another male patient of 50 years age, presented with painless hematuria and revealed horseshoe kidney with renal calculus on CT urography as cause of hematuria.[14] CT urography detect most anomalies of renal position, number, and form. The exact orientation and position of the ureters and pelvicalyceal system can be determined. The superior z-axis reconstructions with multidetector CT aid in obtaining high diagnostic quality three dimensional reconstructions, particularly in the coronal plain **(Kalra et al.).**[15] In our study we detected 2 cases of ectopic kidney, 2 cases of adult polycystic kidney, 1 case of pelvicalyceal and ureteric duplication and 1 case of horseshoe kidney.

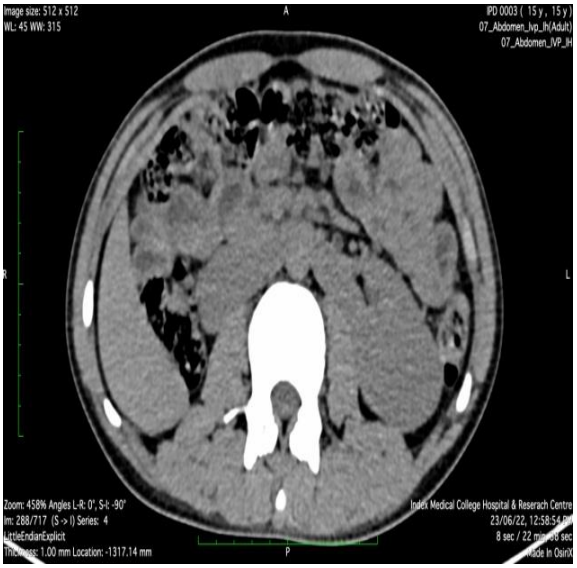

Fig 6. Horseshoe shape kidney axial view

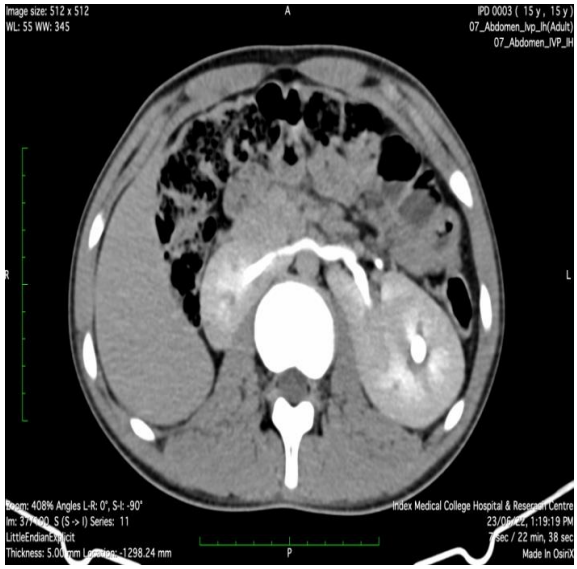

Fig 7. Horseshoe shape kidney contrast axial view

**Trauma:** In present study, 6 cases of trauma were evaluated who presented with painful macroscopic hematuria. They underwent CT urographic examination that revealed contrast extravasation into peritoneal cavity in pyelographic delayed scans and was diagnosed as a case of intra-peritoneal bladder rupture. Nephrogenic phase is helpful in diagnosing upper urinary tract injuries (mostly renal injuries) and pyelographic phase is helpful in diagnosing lower urinary tract injuries (mostly bladder injuries). Important anatomical and physiological data from CT urography helps doctors manage injuries to the urinary tract. It aids in the precise assessment of pelvicalyceal disruption, the degree of perirenal bleeding, the extent of parenchymal devascularization, and the existence of significant vascular pedicle damage. **(Kalra et al.).**[15]

**Neoplasms:** There were 15 cases of neoplasm in our study,7 of renal, 4 of urinary bladder and 4 of prostate. In malignant cases the predominant age group in present study was above 50 years and almost all the cases presented with painless macroscopic hematuria along with abdominal mass.

In present study, a total of 7 renal neoplasms were identified as cause of hematuria out of which 6 were detected to be malignant, 1 case was benign neoplasm. Bladder carcinoma was found to be a major cause of hematuria in lower urinary tract neoplasms in the present study. All the cases of lower urinary tract neoplasms presented with macroscopic painless hematuria. Lower urinary tract neoplasms were about 26.7% of all cases, that is about 4 cases. In a study by **Chow NC et al**, 500 patients (327 patients with painless hematuria) underwent CT urography for urinary tract abnormalities and it was concluded that CT urography detected all proven cases of renal cell carcinoma yielding high sensitivity and specificity.[16] Venous phase images in coronal plane reveal heterogeneously enhancing soft tissue mass lesion involving the upper pole of right kidney with extension of tumor thrombus into the ipsilateral renal vein & IVC, a feature highly suggestive of renal cell carcinoma. Final histopathological diagnosis was high-grade renal cell carcinoma. Prostate carcinoma was identified as cause of haematuria in lower urinary tract neoplasms in the present study. All the cases of lower urinary tract neoplasms presented with macroscopic painless hematuria. Prostate carcinomas were about 26.7% of all cases, that is about 4 cases.

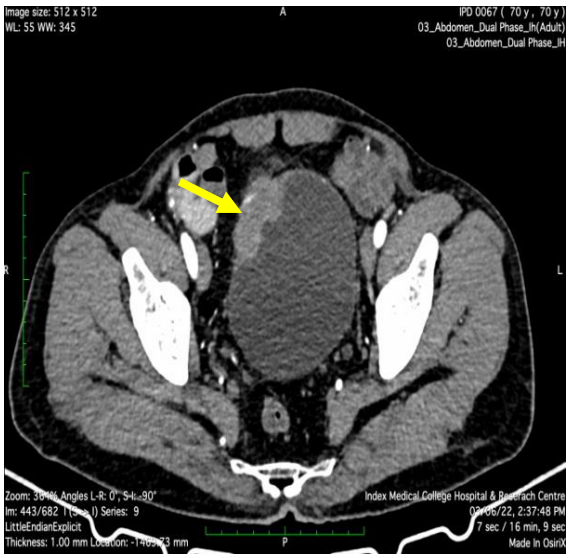


Fig 8.Right lat. wall of Bladder carcinoma contrast axial view

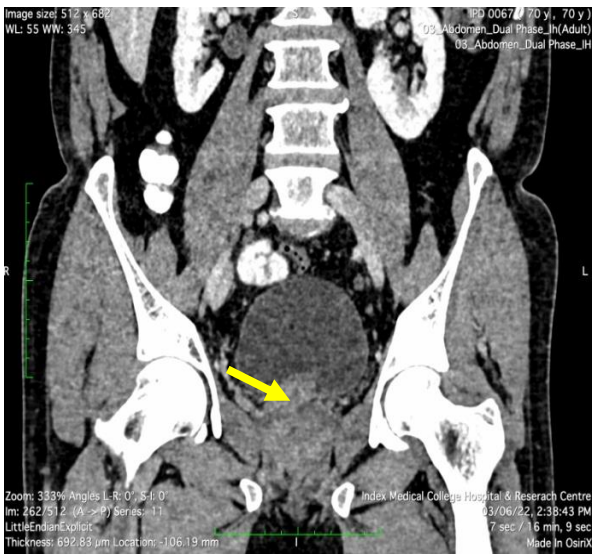


Fig 9.Right lat. wall of Bladder carcinoma contrast coronal view

**Miscellaneous:** Ct urography revealed BPH, uretheral stricture, post operative and multiple simple and complex cysts, in kidneys with no involvement of other organs. In present study, about 4 cases presenting with macroscopic hematuria were detect on CT urography as having BPH. In present study, about 2 cases presenting with microscopic hematuria were confirmed on CT urography as having cysts in kidneys. Diagnostic accuracy of CT Urography in evaluating the etiology of hematuria.

In present study group of 75 patients, all the patients having upper urinary tract pathologies were diagnosed accurately with CT urography. There were no false negatives or false positive results among those patients of upper urinary tract pathologies.

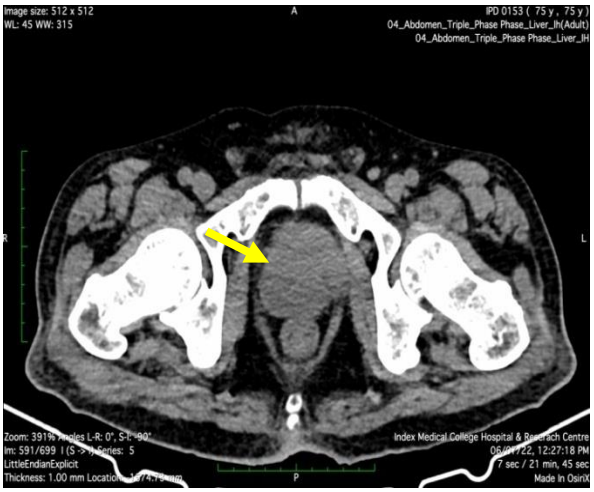


Fig 10. Prostatomegaly axial view

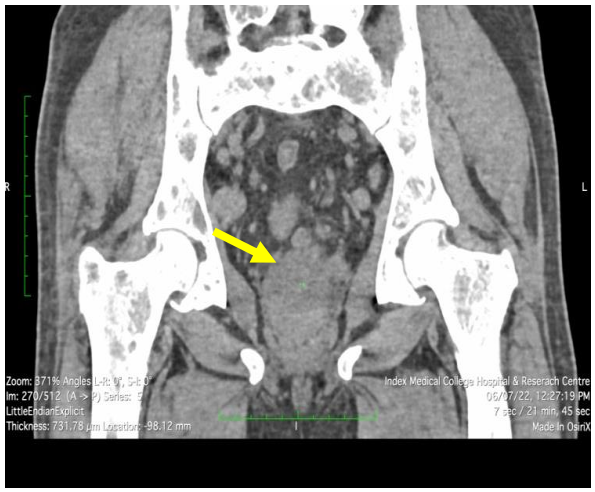


Fig 11. Prostatomegaly coronal view

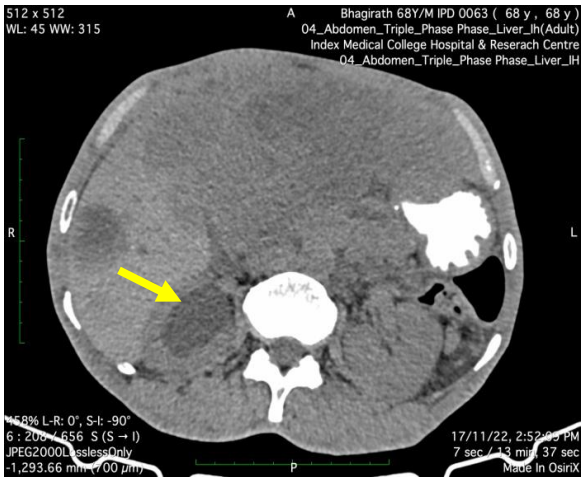


Fig 12. Right Renal cyst axial view

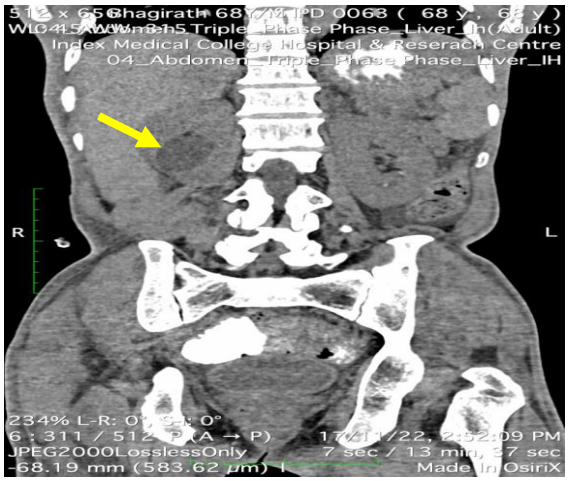


Fig 13. Right Renal cyst coronal view

## 6. CONCLUSION

Multidetector CT urography detects with high accuracy the entire spectrum of urinary tract pathologies causing hematuria in comparison with other modalities like X-ray and ultrasonography. Multi detector CT urography is highly sensitive and specific for detecting renal and urinary bladder masses. It is useful for further characterization and staging of neoplastic masses. Thus, multidetector CT urography has the potential to become a one investigation for evaluation of urinary tract, especially in cases of hematuria. Even through dedicated protocols, side effects of contrast material, radiation exposure and time consumption are limitations of MDCTU.

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