

ORIGINAL RESEARCH

Causes of Hematuria Evaluation by Computed Tomography

¹Dr. Pratik Mittal, ²Dr. Nitin Khantal, ³Dr. Sonika Rani¹Junior resident, ²HOD & Professor, ³Assistant Professor, Department of Radiodiagnosis, Chirayu Medical College & Hospital, Bhopal, Madhya Pradesh, India

Corresponding author

Dr. Pratik Mittal

Junior resident, Department of Radiodiagnosis, Chirayu Medical College & Hospital, Bhopal, Madhya Pradesh, India

Email: mittalpratik5@gmail.com

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Abstract

Background: Hematuria is a renal condition leading to the presence of blood or RBC in urine (gross or microscopic). It is related to significant clinical symptom that can be caused due to Urinary tract abnormalities such as calculi, infection, drug toxicity, neoplasms etc. The present study was conducted to assess imaging findings of various causes of hematuria, to differentiate neoplastic from non-neoplastic renal masses, various upper and lower urinary tract lesions, to analyse the efficacy of CT Urography in adjunct with histopathological correlation or follow up whenever possible in correctly diagnosing the causes of hematuria.

Materials & Methods: 52 patients with complain of gross hematuria or positive for hematuria of all age group irrespective of sex, who undergo contrast MDCT with renal protocol for evaluating a cause of hematuria. 16-slice multidetector CT with pressure injector was the equipment used for study. Patients with normal serum creatinine value (<1.5 mg/dl) were permitted for the study. Renal specific contrast phases -Arterial phase (25 - 40 sec), Venous phase (80 - 120 sec), Delayed phase (240 - 300 sec) were acquired. All images were evaluated in various window settings on dedicated CT workstations.

Results: The age of the patients ranges from 3 years to > 80 years. The majority of subjects are between age group 41-60 years (32.7%). Males (65.4%) are more in number than females (34.6%). All patients were diagnosed with microhematuria and around 13 patients were also diagnosed with macrohematuria. Macrohematuria was mainly diagnosed in patients with bladder cancer (15.4%), renal injury (38.5%) and malignant renal tumor (30.8%). In addition, dysuria with abdominal pain was observed as a major symptom in most of the patients.

Conclusion: Hematuria is a common clinical symptom, has a prevalence rate of 9-18% and can originate from any site along the urinary tract. Multidetector CT urography aids in detecting the entire spectrum of urinary tract pathologies spread accountable for hematuria with high accuracy.

Key words: Hematuria, MDCT, urography, Renal injury, calculus, renal tumors.

Introduction

The urinary tract (UT) evaluation is required in patient presenting with hematuria or associated clinical symptoms. Urography is mainly needed to assess UT to rule out urinary tract leakage after injury or surgical procedures, evaluate suspected congenital disabilities or complicated infections and look for UT malignancies. (1). IVU's has low sensitivity for

detecting renal tumors smaller than 3 cm, many lesions may go undetected (2). Computed tomography (CT) is considered one of the most sophisticated techniques in radiological imaging. It has been used to accurately evaluate renal infections, renal calculi, genitourinary trauma and urinary tract calculi (3). Compared to conventional CTs with only one row of CT detectors, MDCTs have multiple detector rows and produce images of multiple sections. MDCTs have excellent Z-axis resolution covering the whole target organ, thereby providing a wider scanning range per scan (5). CT KUB procedure used on patients with acute renal colic detected bladder and ureteric calculi with 94-100 percent specificity and approximately 100 percent sensitivity (4). For detecting renal masses, multiphase contrast-enhanced CT has a higher sensitivity rate of 94 percent, gives an excellent characterization of lesions and imaging of retroperitoneum areas, thereby providing crucial information about the malignant growth and spread (5).

Radio imaging would help determine the exact cause and help treat patients suffering from hematuria. Until the 1980s, IVUs were considered the most useful diagnostic technique in hematuria examination. With the advent in technology MDCTUs imaging can be performed in three phases-unenhanced phase, nephrographic-phase and excretory phase. Calculi can be easily detected using non-contrast images, whereas a combination of nephrographic (contrast) and non-contrast images can be used to detect renal masses. The excretory-phase images provide an evaluation of urothelium. The radiation dose of the MDCTU is eight times higher than IVUs. Recent studies on low radiation dose CT could differentiate renal calculi from urinary calculi. However, the quality of the images was low and could not be appropriately interpreted under all conditions. Hence, the present study is focused on using imaging modalities (conventional CTs, MDCTUs) for hematuria patients.

Table 1: Causes of haematuria in different locations

	Organ Site	Tumor/Malignancy	Inflammation	Stones	Anatomic Abnormality
Upper urinary tract	Kidney	Renal cell carcinoma, renal pelvis urothelial cell carcinoma, renal lymphoma, angiomylipoma, oncocytoma	Nephropathy, pyelonephritis, renal abscess, renal tuberculosis	Renal stones	Polycystic kidney disease, medullary sponge kidney, hydronephrosis, arteriovenous malformation
	Ureter	Ureteral urothelial cell carcinoma		Ureteral stones	Ureteral stricture, fibroepithelial polyp
Lower urinary tract	Bladder	Bladder urothelial carcinoma, squamous cell carcinoma	Bacterial bladder cystitis, tuberculous cystitis, radiation cystitis, <i>Schistosoma haematobium</i>	Bladder stones	Vesicoureteral reflux, cystocele, bladder papilloma, trabeculated bladder
	Prostate	Prostate cancer	Prostatitis	Prostate stone	Benign prostatic hyperplasia
	Urethra/Penis	Urethral cancer, penile cancer	Urethritis		Urethral stricture, urethral diverticulum

Materials & methods

The present study consisted 52 patients with complain of gross hematuria or positive for hematuria of all age group irrespective of sex, who undergo contrast MDCT with renal protocol for evaluating a cause of hematuria.

All were informed regarding the study and their written consent was obtained. Data such as name, age, gender etc. was recorded. All patients were evaluated by contrast CT scan (Renal protocol) using a 16 slice multidetector CT machine with a pressure injector. Patients with normal serum creatinine value (<1.5 mg/dl) were permitted for the study. Patient was advised nil per oral 6 to 8 hours prior to the scan. Non-contrast imaging of the abdomen was performed, followed by Renal specific contrast phases. All the sections were acquired in the Axial plane with a slice thickness of 5mm and then underwent reconstruction to the thickness of 1.5mm in the axial, coronal and sagittal planes with 2D/3D multiplanar reformation and volume rendering. All images were evaluated in various window settings.

Results

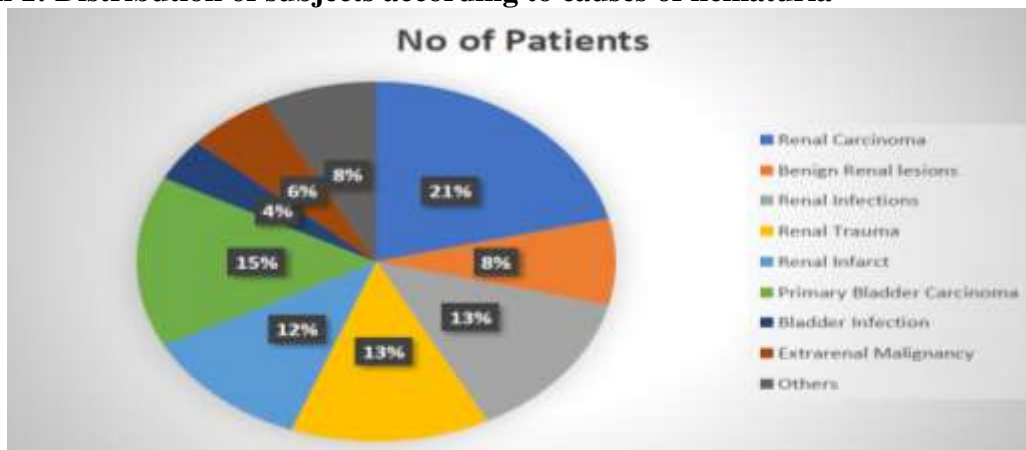
Data contains measurements on 52 subjects whose age ranges from 3-82 with mean age 48.31 $0\pm$ 19.63 years. 17 (32.7%) were in the age group 41-60 years, followed by 15 (28.8%) in 21-40 and 61-80 years. 34 (65.4%) of the subjects were male, and 18 (34.6%) were female. 52 (100%) subjects had Micro Hematuria. 13 (25%) of subjects had Macro Hematuria. The majority of 15 (28.8%) subjects had complaints of dysuria, followed by 6 (11.5%) subjects with dysuria with abdominal pain.

Major causes of hematuria were renal carcinoma (11 patients), Benign renal lesions (4 patients), renal infections (7 patients), renal trauma (7 patients), renal infarct (6 patients), primary bladder carcinoma (8 patients), bladder infection (2 patients), extrarenal malignancy (3 patients) and others (4 patients). As shown in the **figure -1**.

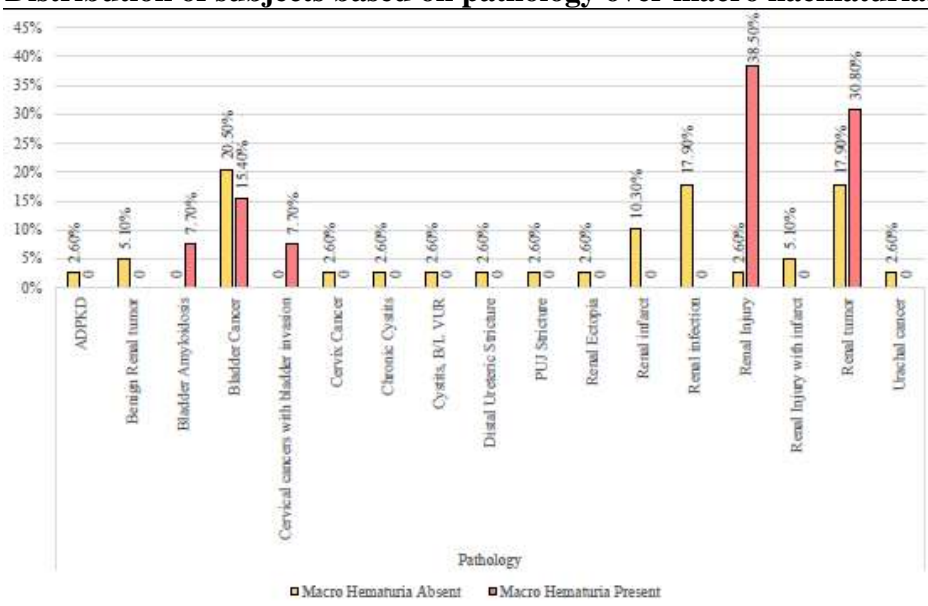
Table 2: Descriptive data of the subjects- Variables	Sub Category	Number of Subjects (%)
Age (years)	3-20	4 (7.7%)
21-40		15 (28.8%)
41-60		17 (32.7%)
61-80		15 (28.8%)
>80		1 (1.9%)
Mean \pm SD		48.31 \pm 19.63
Median (Min, Max)		46.5 (3, 82)
Gender	Female	18 (34.6%)
	Male	34 (65.4%)
Micro Hematuria	Absent	0
	Present	52 (100%)
Macro Hematuria	Absent	39 (75%)
	Present	13 (25%)
Chief Complaints	Abdominal Distension, Weight Loss	1 (1.9%)
	Bleeding PR	1 (1.9%)
	Bleeding PV	2 (3.8%)
	Blunt Trauma	1 (1.9%)
	Burning Micturition	1 (1.9%)
	Dysuria	15 (28.8%)
	Dysuria, Fever	3 (5.8%)
	Dysuria, Flank Pain	3 (5.8%)
	Dysuria, Incontinence	1 (1.9%)
	Dysuria, Malaise	2 (3.8%)
	Dysuria, Pain Abdomen	6 (11.5%)

Dysuria, Weight Loss	1 (1.9%)
Fever, Lumbar Pain	1 (1.9%)
Flank Pain, Burning Micturition	1 (1.9%)
Hematuria	2 (3.8%)
Pain Abdomen	2 (3.8%)

Graph 1: Distribution of subjects according to causes of hematuria



Graph 2: Distribution of subjects based on pathology over macro haematuria.



Discussion

Hematuria is considered as one of the most common urological symptoms caused due to renal and urinary tract malignancies, renal masses and other urinary tract pathologies. It has a high prevalence rate of 4 per 1000 individual per year accounting to 6% new patients every year (6)(7)(8). Imaging modalities are considered as main diagnostic techniques to evaluate the causes of hematuria. With the advent of multi-detector computed tomography (MDCTU) examination of urinary system can be done easily in a single shot yielding 2D and 3D reformations of the urinary system (9) (10) (11). A similar study by Kumar et al., (12) the majority of cases were found in men between the ages of 51 and 60. In the age range of 31–40 years, there were seven cases (14%) while in the age range of 41–50 years, there were six cases (12%). The youngest and oldest patients ranged in age from 19 to 74. Many patients

with haematuria had more than one of the concomitant symptoms. Abdominal pain was the most typical symptom in 24 cases (48%). Malignancy was present in 28% of patients with haematuria in this investigation, with bladder urothelial carcinoma accounting for 18% of cases, renal cell carcinoma for 6%, UTUC for 4%, prostatic carcinoma for 2%, and TCC for 1%. Similar to our study, Britton et al., 1990 reported increased incidence of hematuria in smokers compared to non-smokers (13).

Conclusion

Hematuria is a common clinical symptom, has a prevalence rate of 9-18% and can originate from any site along the urinary tract. It is the gold standard in the detection of renal parenchymal masses, urothelial tumors, and extrinsic lesions. Hence many authors consider it as a potential one-stop investigation for the spectrum of urinary tract disorders presenting with hematuria. Multidetector CT urography aids in detecting the entire spectrum of urinary tract pathologies and secondary metastatic spread accountable for hematuria with high accuracy. Most common etiology of hematuria in our setting was renal cell carcinoma as established by MDCT urography with 100% sensitivity. MDCTU should be considered as the first-line imaging modality for the detection of urinary neoplastic masses, their staging, complications and prognosis.

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