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EVALUATION OF CT UROGRAPHY IN INVESTIGATING HEMATURIA

Radiology

Dr. Chetan Prakash Kumawat	Junior Resident
Dr. S. C. Gupta	Professor
Dr. Sunil Kumar Agarwal	Professor
Dr. Himantika Kumawat	Senior Resident

ABSTRACT

Hematuria is the red blood cells present in the urine and may be a symptom of a serious conditions such as any pathology in urinary tract, bladder cell carcinoma, urinary tract and renal cell carcinoma, or stone in urinary tract. Haematuria can be effectively evaluated with a contrast-enhanced multidetector computed tomography (CT) urography protocol that combines imaging of un-enhanced phase, nephrographic and excretory phase. **Material and methods:** In present study, 51 patients presented with macro and microscopic hematuria were evaluating with CT urography. **Results -** The most common age group hematuria the age groups of those who are 15-30 and 46-60 years old constitute 27% of the study group, while the youngest age group is 30-45 years old with 21%.Macroscopic hematuria is more common (57%) than microscopic hematuria (43%).Frequency of painful haematuria(57%) is higher than painless haematuria(43%)The cause of hematuria in 51 patients was the urolithiasis, infectious, inflammatory, congenital, traumatic, tumor and other conditions.In this study cause of hematuria in 19 patients was diagnosed as urolithiasis, including kidney stones, PUJ stones, ureteral stones, and VUJ stones, accounting for approximately 37% and more of all cases as the main cause of hematuria in this study. In this study, the main age of malignant disease is people over 50 years of age, and almost all patients present with painless macroscopic haematuria along with abdominal mass. **Conclusion** - CT Urography has high diagnostic accuracy with a combination of unenhanced, nephrographic and excretory phases.

KEYWORDS

hematuria, urolithiasis, CT urography, renal masses, p-value

INTRODUCTION

Hematuria is the red blood cells present in the urine and may be a symptom of a serious conditions such as any pathology in urinary tract, bladder cell carcinoma, urinary tract and renal cell carcinoma, or stone in urinary tract. It is considered a symptom when blood is seen; nonvisible hematuria is considered a sign[1].

Macroscopic hematuria is defined as the red blood cells present in the urine. Microscopic hematuria is the red blood cells present in the urine. Hematuria is defined as the presence of 3 or more red blood cells per HPF in the urine in 2 or 3 urinalysis samples. It may be symptomatic or asymptomatic.

Haematuria can be effectively evaluated with a contrast-enhanced multidetector computed tomography (CT) urography protocol that combines imaging of un-enhanced phase, nephrographic and excretory phase. For optimal detection of renal stones, a common cause of haematuria unenhanced phase images is taken from the kidneys to the bladder[2].

Hematuria could be divided mainly in two forms:

Macroscopic Hematuria

- macroscopic hematuria is considered blood in the urine is >1 mL
- lower urinary tract source suggested when clots / red-colour urine (more red than brown) present in the urine

Microscopic Hematuria:

asymptomatic / symptomatic and is defined as ≥3 red blood cells/high-powered field (HPF) on 2 out of 3 urinalysis specimens [3]

There are various causes of hematuria, some of the most common are[4,5]:

Macroscopic Hematuria

- Diseases such as cystitis, prostatitis, pyelonephritis
- urinary tract stones
- traumatic hydronephrosis and trauma
- malignant tumors such as urothelial cell carcinoma, prostatic carcinoma and renal cell carcinoma.

Microscopic hematuria

- diseases that involving renal parenchyma, such as kidney disease, glomerulonephritis, interstitial nephromoritis, malignant disease, Alport disease.

The incidence of gross hematuria is four times that of microscopic hematuria. Macroscopic hematuria is a commonest finding in bladder (80%) and renal carcinoma (~50%)[6]. Approx. 5% (range 3-6%) of patients present with macroscopic hematuria and malignancy[6].

The Role of MDCT

MDCT has many advantages in urine examination and diagnosis. –

- Power to provide the entire urinary tract thin collimated data in a single and short breath hold with the absence of respiratory mis-registration[7].
- produces higher spatial resolution with sub millimeter scans.
- This allows for realistic fast imaging with visible contrast agent opacity, resulting in a true multiplanar reconstruction of the dataset and reduces partial volume effects since appropriate slices will be selected from the excellent 2D and 3D volume profile provided by MDCT
- Provides thin collimated multiphase scans that can produce isotropic or near isotropic date sets. This helps in true multiplanar reconstruction of the date sets a reality
- MDCT provides very good 2D and 3D reformations which helps in virtual cystoscopy[8].
- MDCT helps in imaging the entire abdomen and pelvis in a single breath hold with thin collimated images[7].
- Due to these advantages MDCT is used for many urologic disease like urolitiasis, renal masses, UTI etc.
- Rare causes of hematuria, such as vascular diseases can be diagnosed with Multidetector Computed tomography

Due to these advantages, MDCT is used in urolithiasis, kidney disease, urinary tract infection, etc. It can be used for various urinary problems such as: > CT urography provides the best results of excretory urography, with images collected in a single study showing the renal parenchymal collecting system and ureters[9].

In this study, non-contrast and contrast-enhanced abdomen and contrast-enhanced scans are performed during the development of the excretory level. the pelvis was obtained, and thin-section spiral CT scans of the urine were also collected. Multiplayer 2D and 3D editing

images are created from axial positions. Urography provides an understanding of the symptoms but more importantly the anatomical relationship. Additionally, because CT is a cross-sectional imaging and overlapping techniques (e.g., bowel control) that have long interval and been a critical issue in urography but have not been a problem in CT urography. Thus, CT urography combined with multidetector CT allows a complete evaluation of the kidneys, urinary tract, ureters, and bladder[10].

Consequently, indications for CT expansion include hematuria, and CT urography essentially replaces the vessels in urography in most applications.

Increasing role of CT Urography:

For a CT urography intravenous contrast is administered for the urinary tract for its opacification. So intravenous pyelogram can be obtained immediately as the intravenous contrast is already administered for CT. Intravenous like images can be alternatively obtained by reformatting delays coronal and sagittal plane CT images. This is comparable with a standard IVP tests.

For the procedure of CT urogram, the patients are given water, this hydrates the both kidney and distends the urinary tract. Next to analyze renal calculi, A non-Contrast helical CT of the kidneys is performed. Then an iodinated contrast media is injected and High resolution nephrographic phase (1 to 2mm) and high-resolution delayed phase (5-10 min) are collected and further analyzed. The latter may be used to reconstruct and urinary tract evaluation.

Virtual Cystoscopy is a 3D rendering of various organs like colon stomach, bladder, Virtual cystoscopy is used to get the 3D renders of the bladder, which enhances the evaluations of causes Hematuria. Virtual Cystoscopy is just an additional tool and it can't replace the actual cystoscopy. This is because virtual cystoscopy is not accurate in detecting lesions near the ureteric orifices and small lesions.

MATHODS AND MATERIALS-

In present study, 51 patients presented with macro and microscopic hematuria were evaluating with CT urography.

Criteria which are included

1. All patients who present with complain of hematuria
2. Patients who gave written and informed consent for study.
3. Patients who referred to the CT-KUB with complain of hematuria.

Criteria which are excluded

1. Patients do not give written and informed consent for study.
2. Patients more than 75 years of age and below, severe renal failure, pregnant and lactating patient, allergic reaction to contrast media previously.

First phase is the initial non-contrast phase. Second phase is the nephrographic phase, which will be acquired following a delay of 90-100 seconds after administration of 100-120ml of intravenous iodinated contrast, to evaluate the renal parenchyma. Followed by the pyelographic phase which will be taken 8 -10 minutes following administration, to evaluate the urothelium from the pelvicaliceal system to the bladder.

The main parameters of MDCT are pitch and slice collimation. These measurements are combined with the power tube and tube load to determine the raw data. In all CT machines, the tube voltage to the patient is generally 120 KV. However, a lower KVp is used to reduce the dose. Lower Z-axis resolution (coarser collimation) was used in the non-contrast and nephrographic phase compared to the excretory phase.

RESULTS-

The most common age group hematuria the age groups of those who are 15-30 and 46-60 years old constitute 27% of the study group, while the youngest age group is 30-45 years old with 21%.(Table no-01). In our study with 51 patients with hematuria, men are dominant and constitute approximately 55% of them (28). Women constitute approximately 45% (23).(Table n0-02). Macroscopic hematuria is more common (57%) than microscopic hematuria (43%).(Table no-03). Frequency of painful haematuria(57%) is higher than painless haematuria(43%).(Table no-04). The cause of hematuria in 51 patients was the urolithiasis, infectious, inflammatory, congenital, traumatic, tumor and other conditions.(Table no -05). The most common age for hematuria is under 50 years of age, accounting for approximately 79% of all urolithiasis cases, but the two factors are not significant in the number of patients in the age group over 50 years of age. -value is close to 0.15. (P<0.05 significant),(Table no -06). In this study cause of hematuria in 19 patients was diagnosed as urolithiasis, including kidney stones, PUJ stones, ureteral stones, and VUJ stones, accounting for approximately 37% and more of all cases as the main cause of hematuria in this study. Most patients with urinary tract stones will develop microscopic hematuria. The most common location of urinary stones in this study was the kidney (57%), followed by the ureter,(Table no - 07). Most of the tumor cases in this study are over 50 years old, this table shows the age at which the tumors were found. The relationship between them has a positive relationship with p-value. Their value is approximately 0.02, which is less than 0.05. (P<0.05 significant),(Table no - 08).

Table No - 01 Distribution Of Patients According To Age

AGE INTERVAL(YEAR)	CASE
15-30	14
31-45	11
46-60	14
>60	12

Table No – 02: Distribution Of Patients According To Gender

GENDER	CASE
MALE	28
FEMALE	23

Table No – 03: Distribution Of Patients According To Nature

HEMATURIA	CASE
MICROSCOPIC	22
MACROSCOPIC	29

Table No - 04 Pain Among Patients With Hematuria In Present Study

PAIN	CASE
ABSENT	22
PRESENT	29

Table No – 5: Distribution Of Patients According To Cause Of Hematuria

DISEASE	CASE
UROLITHIASIS	19
VESICO-VAGINAL FISTULA	4
RENAL COMPLEX CYST	4
PYELONEPHRITIS	4
BLADDER CARCINOMA	4
INJURY	3
CYSTITIS	3
PCKD	2
RCC	2
URINOMA	2
ECTOPIC KIDNEY	1
UROGENITAL TB	1
HORSE SHOE KIDNEY	1
ANGIOMYOPLIPOMA	1

Table No – 6: Distribution Of Patients With Urolithiasis According To Age Group

AGE GROUP (YEAR)	TOTAL CASE	CALCULUS CASE	p - value
<50 AND 50	31	15	0.15
>50	20	4	

Table No – 7: Distribution Of Patients According To Location Of Calculus

LOCATION OF CALCULUS	CASE
RENAL PARENCHYMA	11
PUJ	2
URETERIC	4
VUJ	2

Table No – 8: Distribution Of Patients With Neoplasms According To Age Group

AGE GROUP(YEAR)	TOTAL CASE	NEOPLASM CASE	P - value

<50 AND 50	31	1	0.02
>50	20	6	

DISCUSSION-

Haematuria is the leading most common symptoms of urinary tract disease. It can occur anywhere in the urinary tract and is caused by stones, tumors, infections, injuries, drugs, coagulation disorders and diseases of renal parenchyma.

Evaluation of malignancies of urinary tract is the most important reason for evaluate the patients for accurate and early diagnosis. Therefore, sensitivity testing is important in cancer diagnosis. The ability to identify other possibilities of haematuria is important also.

Haematuria can be effectively evaluating with a contrast-enhanced multidetector computed tomography (CT) protocol that combines imaging of un-enhanced, nephrographic and excretory phase. For better detection of renal stones, a leading cause of haematuria unenhanced stage images is provided from the kidneys to the bladder.

Abnormalities of renal parenchyma especially tumours, are best seen imaging on nephrographic stage. From the kidneys to the bladder Thin-section delayed images show dilation of the urinary tract with contrast material and can be used to detect urothelial disease.

This study included 51 patients presented with complaints of hematuria (macroscopic and microscopic) and were referred from the urology department to the radiology department for CT urography.

In a similar study, Albani JM et al (2007)[11] The role of computed tomography urography in the early evaluation of hematuria in 107 patients and reporting that: The most leading cause of hematuria was Urinary tract stone symptoms (26%). Many patients with urinary tract stone have microscopic hematuria, and in this study the most leading site of Urinary tract stone was the ureter (35%), followed by the vesicoureteral junction.

In a similar study Mahmoud MA et al. (2015)[12] examining the role of multidetector computed tomography urography (MDCTU) in the diagnosis of microscopic hematuria in adults, urolithiasis causing microscopic hematuria was identified in approximately 24% of patients.

Acute pyelonephritis is often characterized by MDCT Urography presenting as renal swelling and a "striated nephrogram" with perirenal fat stranding. Occasionally, pelvic wall thickening may occur and may also show mucosal enhancement. CT urography in acute pyelonephritis often shows single or multiple hypodense areas with corticomedullary differentiation loss. While CT images obtained in the nephrographic phase provide the best evidence of parenchymal abnormalities, images obtained in the excretory phase are more suitable for the diagnosis of renal abscesses than images obtained in the nephrographic phase in the corticomedullary phase. The nephron pyelography phase of the two-stage protocol combines the advantages of two stages in a single acquisition.

Another study by Bhoil R et al (2015)[13] described a case of ectopic kidney with kidney stones as the source of haematuria.

In another study by Ramchandani P et al (2009)[14], genitourinary trauma was described by the CT urography along with other imaging modalities in and it was explained that voluntary presentation of CT urography helps to see the upper and lower urinary tract.

When evaluating renal malignancy, many important observations are made, such as the nephrographic phase that best defines the lesion depending on the homogenous enhancement of background of the renal parenchyma. In this study, the total radiation dose was reduced and the corticomedullary by-passed without losing any clinical findings. Renal artery invasion, urinary tract infiltration and renal calyx distortion are clearly seen with high sensitivity.

In a similar study, Blick CG et al (2012)[15] using CT urography and modified cystoscopy as a better test for rigid cystoscopy concluded that good diagnosis and follow-up had good outcomes with patients having good results on CT urography. Patients with a positive CT urography score were referred directly for rigid cystoscopy, but other patients underwent flexible cystoscopy.

CONCLUSION

The main indication of CT urography is the evaluating the causes of haematuria. Rapid advances in multidetector CT imaging have enabled high-resolution CT urography studies by allowing multiple analysis of isotropic data.

The accuracy of CT urography for diagnosis of stones, nephrographic CT imaging for renal masses, and excretory-CT imaging for malignant tumours is high (compared to other modalities), making CT urography the most effective method recommended first for patients with haematuria.

The simple scanning phase of CT urography can be used to identify urolithiasis, the nephrography phase is usually used for upper urinary tract disease, and the pyelography phase can be used to identify lower urinary tract disease.

According to this study, CT urography has a higher accuracy in diagnosis of upper urinary tract infections than for lower urinary tract infections. In lower urinary tract diseases, especially cancer, cystoscopy is superior to CT urography for definitive diagnosis.

Patients diagnosed with urothelial cell carcinoma of upper urinary tract by CT urography should confirmed by biopsy (ureteroscopy or retrograde ureteropyelography) before surgery for confirmation by histopathologically.

Dual energy CT and MR imaging will play an important role in haematuria in the future. By not using of ionizing radiation, MR urography has few advantages over CT urography, but the resolution of MR urography is currently lower than CT urography when looking for minor diseases in the urinary tract. CT urography is now the test of choice and is recommended for screening in adults over age 40 with significant haematuria after UTI has been ruled out. In conclusion, CT urography is preferred as the first modality test in haematuria patients at high risk for urothelial cell carcinoma.

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