International Journal of Frontiers in
Medicine and Surgery Research
Journal homepage: https://frontiersrj.com/journals/ijfmsr/
ISSN: 2783-0489 (Online)

(RESEARCH ARTICLE)

Check for updates

Comparative study of ultrasound abdomen and pelvis with CT urography in diagnosis of benign causes of Hematuria

Saurabh Pandey *, Vishal Gupta, Fathima Febin Salu, Bommu Prateek, Sumit Kumar and Parnit Kalra

Department of Radiodiagnosis, School of Medicine, Sharda University, Greater Noida, UP, India.

International Journal of Frontiers in Medicine and Surgery Research, 2023, 03(02), 015–021

Publication history: Received on 12 May 2023; revised on 27 June 2023; accepted on 29 June 2023

Article DOI: https://doi.org/10.53294/ijfmsr.2023.3.2.0067

Abstract

Background: The presence of more than or equal to 3 RBC/HPF in the sediment is defined as haematuria. It can be symptomatic or asymptomatic. Painless haematuria is most often caused by carcinoma, while painful haematuria is often seen secondary to urolithiasis or infection. The procedure entailed in detection of microscopic haematuria and gross haematuria is the same. But in the microscopic haematuria the focus is on the glomerular causes. In the diagnosis of haematuria radiology plays a very important role. Radiological investigation of upper urinary tract is usually by IVU but has been gradually replaced over the last decade by MDCT Urography as the gold standard imaging modality. CT-Urography (CTU) can accurately identify benign causes of haematuria in about 33-43% cases. The overall sensitivity is 92-100% is for identifying benign causes, while 89-97% gives the specificity for benign causes, especially calculi. Hence, we performed a study to compare the CT and USG findings for haematuria.

Methods: The study included 50 of the patients diagnosed with microscopic or macroscopic haematuria and those above the age of 18 years. We excluded those patients with patients whose serum creatinine value was above 1.5 mg/dL, those that are at a risk for allergic reactions to contrast, those with neoplasms and pregnant patients.

Results- In the present study, we found that the sensitivity and specificity of USG was 87.92% and 86.52% respectively. However, for CT urography, it was 97.62% sensitivity and 92.34% specificity. This shows that CT is more sensitive for identifying benign lesions in the KUB region as compared to USG.

Conclusion- CT urography is more sensitive and specific for benign lesions when compared to USG.

Keywords: Ultrasound Abdomen; Computed Tomography; Ureteric Calculi

1. Introduction

Haematuria is divided into painful and painless or microscopic and macroscopic haematuria. The presence of visible red blood cells in the urine is called macroscopic haematuria. Microscopic haematuria can be defined as the appearance of red blood cells in the urine. In sample of 2 or 3 collected urinalysis specimens, presence of more than or equal to 3 RBC/HPF in the sediment is defined as haematuria. It can be symptomatic or asymptomatic. Painless haematuria is most often caused by carcinoma, while painful haematuria is often seen secondary to urolithiasis or infection[1].

Haematuria is caused by many factors. The most common causes are urolithiasis, cystitis, coagulopathy, renal vein thrombosis, trauma, renal parenchymal disease, malignancy, infectious causes. The primary malignancies associated with gross haematuria are transitional cell carcinoma, renal cell carcinoma (RCC) and prostatic carcinoma (2).

* Corresponding author: Saurabh Pandey

The procedure entailed in detection of microscopic haematuria and gross haematuria is the same. But in the microscopic haematuria the main focus is on the glomerular causes. In the diagnosis of haematuria radiology plays a very important role.

Radiological investigation of upper urinary tract is usually by IVU but has been gradually replaced over the last decade by MDCT Urography as the gold standard imaging modality. [1] With the betterment of spatial resolution, improved speed and improved image reconstruction (multiplanar and volume-rendered), feasibility of the imaging for urinary tract in a single view is best in this way. [1]

CTU is recommended for calculi, neoplasm, inflammatory conditions as well as congenital anomaly. In this we acquire non-enhanced and contrast enhanced images with thin helical CT sections during the excretory phase. The excretory phase produces 2D and 3D multiplanar reformatted images. [2]

CT-Urography gives a complete information on urinary tract. CT-U working group “A diagnostic examination optimized for imaging the kidneys, Ureters and bladder” is definition given by European Society of Urogenital radiology. It uses MDCT which entails thin slices with Intravenous administration of an iodinated contrast medium and imaging in excretory phase". [3] Isotopic CT datasets produce high quality images of the urinary tract and delineates the anatomy. For RCC tumours larger than 10mm, the sensitivity of the CT is very high, staging is performed with renal CT protocols that include unenhanced, corticomedullary and nephrographic phase scans giving a clarity on underlying pathology. [3,4]

CT-Urography (CTU) can accurately identify benign causes of haematuria in about 33-43% cases. The overall sensitivity is 92-100% is for identifying benign causes, while 89-97% gives the specificity for benign causes, especially calculi. CT-Urography (CTU) also helps in better analysis of lower urinary tract, which is the most common site of calculi and other benign lesions. Studies have shown that cystoscopy always is preceded by imaging modality like CT Urography, the overall sensitivity of the cystoscopy is enhanced [5-7].

Hence, we conducted this study to compare the roles of USG and CT for benign causes of haematuria.

2. Materials and methods

This is a prospective observational study that was conducted in Department of Radiology, School of Medical Science and Research, Greater Noida U.P. The study included outpatients and inpatients referred for Multi-detector CT Urography to the Department of Radio diagnosis, SMS&R Greater Noida U.P for 18 Months w.e.f. 1 February 2021 to 30 July 2022.

2.1. Sample size - 50 patients

The study included those diagnosed with microscopic or macroscopic haematuria and those above the age of 18 years. We excluded those patients with Patients whose serum creatinine value was above 1.5 mg/dL, those that are at a risk for allergic reactions to contrast, those with neoplasms and pregnant patients.

2.2. Equipment – GE 128 SLICE CT with Pressure Injector.

Haematuria can be assessed using a multi-detector CT (MDCT) of the unenhanced without contrast, enhanced nephrographic, and enhanced pyelographic phase. - MDCT without contrast enables imaging from the kidney to the bladder and aids in evaluating nephrolithiasis, one of the main causes of haematuria. - 90–100 s following intravenous non-ionic contrast injection (100–150 mL of 300 mg I/mL at 2-4 mL/s, 2.5–5 mm slice thickness), nephrographic phase-images are acquired. The greatest way to see renal parenchymal abnormalities, especially masses, is on nephrographic phase pictures, which can also be used to assess other abdominal organs. Images taken during the pyelographic phase, which is used to assess urothelium, are collected 5–15 minutes after contrast is administered.

2.3. CT Technique

Patient Preparation- nothing in particular, except for adequate hydration prior to the procedure

Patient Positioning- supine usually, except in VUJ calculus, where prone is preferred for NC and CE phases. In prone, one can differentiate a cyst from communication with the renal pelvis.

2.4. Statistical analysis

Descriptive statistical analysis in terms of percentages and graphical representations were done. Data was coded and recorded in MS excel spreadsheet programme. Diagnostic accuracy of the tests were calculated based on sensitivity and specificity. Statistical significance were kept at $p < 0.05$.

3. Results

This study included 50 participants. Of those, we found that there was a male preponderance with a ratio of 1.78:1.

Table 1 Sex distribution of the participants

Gender	Number of participants (n=50)	Percent
Female	18	36.0
Male	32	64.0

Patients in the study were divided into various age groups. In that, we find that most patients (36%), belonged to the age group of 21-30 years. This was followed by 31-40 years and >60 years age groups, which are extremes of age groups amongst the study participants.

Table 2 Age group frequency in the study participants

Age (years)	Number of participants (n=50)	Percent
21 – 30	18	36.0
31 – 40	10	20.0
41 – 50	6	12.0
51 – 60	6	12.0
> 60	10	20.0

There is a universally accepted classification for haematuria is either as painful or painless. In our study, we find that painful haematuria was the most common type, seen in 60% of study participants.

Most of the study participants had a duration of complaints, either pain or haematuria, lasting less than 15 days. This is due to the fact that gross haematuria associated with any type of pain is a very distressing finding for any patient, irrespective of their age, socioeconomic status, or educational qualification.

Table 3 Duration of complaints in the study participants

Duration (Days)	Number of participants (n=50)	Percent
≤ 15	31	62.0
16 - 30	17	34.0
> 30	2	4.0

Urine microscopy is an important diagnostic modality in patients with haematuria. Most commonly found in the urine of such patients are RBCs (either intact or haemolysed) along with pus cells (28%) patients followed by RBC alone (24%).

USG findings in patients with haematuria and pain can help not only guide the management but also help in deciding on the appropriate higher imaging depending on which system is involved. In this study, we find that hydroureteronephrosis with ureteric stones are the most common findings on USG.

Computed tomography is the modality of choice in urogenital disorders. When there is a suspicion on USG or inconclusive findings clinically/USG, CT can help in delineating the system involved as well as the possible aetiology. CT scan can be performed either with or without contrast, and in our study MDCT urography was performed for all the study participants. In that, we find that the most common finding was renal calculi or concretions, followed by ureteric calculus with HUN, which was different from the USG findings.

CT scan additionally helps in delineating the level of lesion in the study participants. In our study, kidney was the most common site seen in 46% patients.

The average size of the calculus on CT scan was 9.2 +/- 0.2 MM.

When we divide the aetiological findings following CT imaging in such patients, we find that calculus was the most common painful cause of haematuria (83.3%).

Biopsy results in these patients are confirmation of the CT findings. Inflammation was the most common finding, which corroborates with infection/inflammatory processes being the most frequently identified lesion on USG and CT.

Table 4 Aetiology of masses- painless and painful

Painful/Painless	Aetiology	USG	CT
Painful	Calculus	22	25
Painful	Infective And Inflammatory	5	6
Painless	Idiopathic	2	2
Painless	Benign Mass	18	15

In the present study, we found that the sensitivity and specificity of USG was 87.92% and 86.52% respectively. However, for CT urography, it was 97.62% sensitivity and 92.34% specificity. This shows that CT is more sensitive for identifying benign lesions in the KUB region as compared to USG.

Figure 1 Tuberculosis of the urinary bladder with irregular contracted bladder and internal heterogenous enhancement. USG of this patient showed only bladder wall thickening

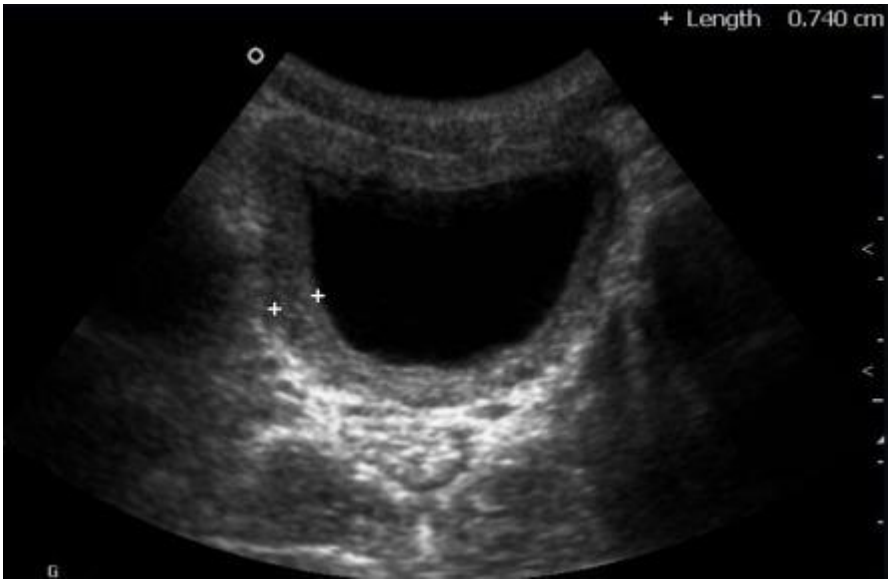

Figure 2 Bladder wall thickened in the USG of the above patient

4. Discussion

Haematuria is a fairly common complaint noted in the outpatient and emergency department. However, the causes are variable, and clinically often missed/misdiagnosed. A sound imaging to support the history can help clinch the diagnosis. While ultrasound is a quick and non-invasive modality, with good sensitivity and specificity for urogenital tract lesions, it is often operator dependent. Aside from the issues associated with contract, CT urography has a better ability to delineate the urogenital anatomy.

Fifty individuals with haematuria with benign causes that underwent USG and MDCT urography evaluation were included in our study. This comprised delayed, contrast-enhanced, and non-contrast photos.

Urolithiasis, congenital diseases, mass, infections, cystic disorders, bladder pathologies, collecting system abnormalities, papillary abnormalities, and post-operative patients were the different categories for urinary tract abnormalities. Secondary symptoms as dilated UT and delayed excretion were noted.

Four kinds of clinical characteristics were recorded, including abdominal discomfort, fever, weight loss, and haematuria. In our analysis, the most typical urinary tract abnormalities were urolithiasis and neoplasia.

Urolithiasis was the most often identified abnormality. MDCT is crucial for this preliminary study in order to record the number, location, and morphology. MDCT Urography's pre contrast phase could accurately identify calculi in all.

4.1. Study group characteristics

Table 5 Age and sex distribution comparison in different studies.

Study	Study sample size	M:F ratio	Age (years)
Present study	50	1.77:1	18-80 (mean 43.4)
WC LIN et al [1]	102	1.48:1	5-84 (Mean 53.4)
Caoili et al [8]	51	1.4:1	10-74 (Mean 47.4)

The patients in our study were 43.4 years old on average. It is in line with investigations conducted by Caoili et al [8]. and WC LIN et al [1]. Age and the renal tract abnormalities identified in our investigation did not significantly correlate with one another.

Table 6 Comparison of Incidence of Urolithiasis in different studies

Study	Study sample size	Urolithiasis
Present study	50	14%
WC LIN et al [1]	102	38%
Caoili et al [8]	51	8%

The most frequent abnormality of the renal tract identified in our investigation, present in 14% of patients, was urolithiasis. These findings were discovered to have a substantially lower incidence than those observed in the research done by WC LIN et al [1], where 38% of the patients had urolithiasis detected. Our study's findings were consistent with those of Caoili et al [8] study in which only 8% of patients with haemturia had urolithiasis identified by MDCT urography.

The majority of patients with urolithiasis had a diagnosis between the ages of 21 and 30. Apart from haematuria, pain in the abdomen was the important clinical characteristic linked to urolithiasis in our investigation. However, no association between clinical symptoms and diagnosis was found in the other investigations.

In our study 20 participants had painless haematuria. Out of these 20 participants, in 18 participants (90%) cause of haematuria was neoplasia. No of participants with painful haematuria was 30, out of these in 25 patients (93.3%) cause of haematuria was calculi. Hence most common cause in the painless haematuria was neoplasia and in painful haematuria was calculi in our study.

Table 7 Incidence of congenital anomalies in different studies

Study	Study sample size	Congenital anomalies
Present study	50	14%
WC LIN et al [1]	102	4%
Caoili et al [8]	51	8%

Congenital abnormalities were identified in 8% of the individuals in our study, which is equivalent to research by WC LIN et al [1]. and Caoili et al [8]. In our investigation, diagnosis of congenital abnormalities occurred most frequently between the ages of 31 and 40. Pelviureteric junction blockage, which was seen in 3 patients, was the most frequent congenital defect found in our investigation, followed by UB diverticulum, residual urachus, and malrotated kidney. These could not have been detected by USG, highlighting the value of MDCT urography. In our investigation, there was no discernible association between clinical features and congenital defects.

5. Conclusion

CTU is a good imaging modality for evaluating patient with haematuria, whether painful or painless when compared to USG. While CT is better modality for bone and calcification, it can still be sensitive for soft tissue lesions such as tumours and inflammation.

Compliance with ethical standards

Disclosure of conflict of interest

None to declare.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Wen-Chiung Lin , Jia-Hwia Wang , Chao-Jun Wei , Cheng-Yen Chang. Assessment of CT Urography in the Diagnosis of Urinary Tract Abnormalities .J Chin Med Assoc Feb 2004 ;67 (2): 73-78.

[2] Justin M. Albani,Michael W. CiaschiniStevan B. Streem,Brian R. Herts, Kenneth W. Angermeier. The Role of Computerized Tomographic Urography in the Initial Evaluation of Haematuria. The Journal of Urology. February 2007; 177 (2): 644– 648.

[3] Masahiro Jinzaki, Jeffrey D. McTavish, Kelly H. Zou, Philip F. Judy and Stuart G. Silverman. Evaluation of Small (≤ 3 cm) Renal Masses with MDCT: Benefits of Thin Overlapping Reconstructions. American Journal of Roentgenology. 2004;183: 223-228.

[4] Seung-Kwon Choi, Seung Hyun Jeon, Sung-Goo Chang. Characterization of Small Renal Masses Less than 4 cm with Quadriphasic Multidetector Helical Computed Tomography: Differentiation of Benign and Malignant Lesions. Korean J Urol. 2012 Mar; 53(3): 159–164.

[5] Weichung Liu1, Koenraad J. Mortelé, Stuart G. Silverman. ncidental Extraurinary Findings at MDCT Urography in Patients with Haematuria: Prevalence and Impact on Imaging Costs. AJR.October 2005; 185:1051–1056.

[6] Lang EK, Macchia RJ, Thomas R, Ruiz-Deya G, Watson RA, Richter F, Irwin R R, Marberger M, Mydlo J, Lechner G, Cho KC, Gayle. Computerized tomography tailored for the assessment of microscopic haematuria. B.J Urol. 2002 Feb; 167(2 Pt 1):547-54. Page 75

[7] Sultana SR, Goodman CM, Byrne DJ, Baxby K. Microscopic haematuria: urological investigation using a standard protocol . Br J Urol. 1996 Nov;78(5):691-6; discussion 697-8

[8] Elaine M. Caoili, Richard H. Cohan, Melvyn Korobkin et al. Urinary Tract Abnormalities: Initial Experience with Multi–Detector Row CT Urography. Radiology. 2002;222: 353-36