



ORIGINAL RESEARCH PAPER

Radiodiagnosis

COMPUTED TOMOGRAPHY UROGRAPHY IN EVALUATION OF PATIENTS WITH HEMATURIA

KEY WORDS: Hematuria, Calculus, Multi-detector CT Urography, Excretory urography, Flexible cystoscopy, Intravenous urography, Renal cell carcinoma, Transitional cell carcinoma.

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ABSTRACT

Objective: The objective of the work was to evaluate the diagnostic efficacy of computed tomography urography in patients with hematuria.

Methods: MDCT Urography of 50 patients with history of hematuria were evaluated for various causes of hematuria and to determine the diagnostic efficacy in terms of sensitivity and specificity of MDCTU.

Result and Conclusion: In our study, maximum incidence of hematuria was found in older age group of 50 years or more with male preponderance. Majority of lesion were benign with calculus being the most common ,other benign lesions included pyelonephritis, Pyonephrosis, ureteric strictures , ureteritis, Angiomyolipoma ,etc and Malignant lesions included Renal cell carcinoma and UB mass. We had a sensitivity of MDCTU being 91.84%, specificity of 100.00%, positive predictive value 100.00%, and accuracy of 92.00% . Our study identifies the contribution of MDCTU in identifying surgically or medically treatable causes of hematuria and thus aid in early and timely treatment.

INTRODUCTION

Hematuria is one of the most common manifestations of urinary tract which can originate from any site along the urinary tract and has a wide range of causes including calculi, neoplasm, infection, trauma, medications, coagulopathy and renal parenchymal diseases⁽¹⁾. The concept of CT Urography (CTU) is more appropriate as both the renal parenchyma 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 the kidney and /or urothelium⁽⁴⁾. CT urography combines the benefits of excretory urography with those of cross-sectional imaging into a single study which depicts the renal parenchyma, collecting system and ureters. Risk factors for significant urologic disease include gross hematuria, irritable voiding symptoms, history of smoking, history of occupational exposure to chemicals or dyes (benzenes or aromatic amines), all adults older than 40 years, history of urologic disorder or disease, history of recurrent urinary tract infection, history of pelvic irradiation, analgesic abuse (eg, phenacetin) and hereditary nonpolyposis colorectal cancer (HNPCC) syndrome (Lynch syndrome)^(6,7).

METHODS

A prospective observational study on 50 patients was conducted in the Department of Radiology at GMCH, Udaipur. The Multi-detector Computed Tomography Urography examination included unenhanced, nephrographic, and excretory-phase images through the abdomen and the pelvis, transverse images and 3D reformations was taken and reviewed. All multi- detector row CT urographic examinations were performed with a 64 slices multi- detector row CT scanner SOMATOM Sensation (SIEMENS). One scout was acquired in the antero-posterior view. The examination was planned on these scouts from the level of the diaphragmatic cupola to the perineum caudally, and then the unenhanced (precontrast) sequence was performed. A single bolus injection of contrast was administered (100 ml of iohexol 350 mg/ml) before images of the nephrographic and the excretory phases were obtained. Nephrographic-phase images were obtained 120s after the initiation of the injection of the contrast material. Excretory-phase images were then obtained beginning 8–10 min after the initiation of the injection. 3D reconstructions in the coronal and the coronal oblique projections were created with maximum intensity projection (MIP), curved multiplanar

reformation and volume-rendering algorithms⁽⁸⁾. The follow up diagnosis was established on the basis of histopathologic findings or the findings at a urologic procedure (cystoscopy, ureteroscopy and retrograde pyelography) wherever possible.

RESULTS

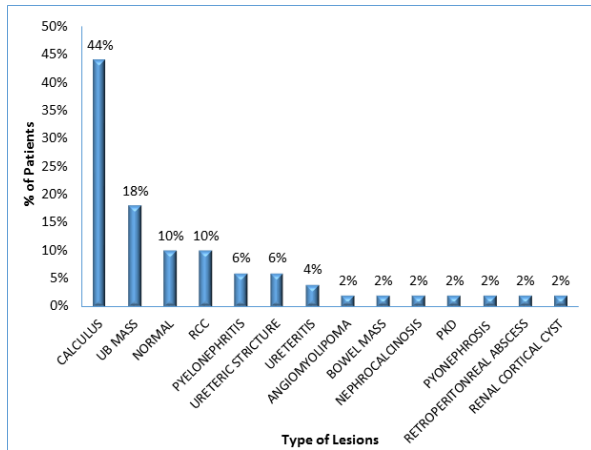
The study revealed that, Maximum (64%) prevalence of hematuria was found in patients 50 years and above⁽¹¹⁾. Among 45 positive cases, total 58 lesions were found, out of them 44 were benign and 14 were malignant cases. Out of 14 malignant patients, maximum patients were of urinary bladder (9 cases), followed by Kidney (5 cases). Kidney was the most common calculus location (72.73%) diagnosed on MDCTU in our study. Other urologic diseases, e.g. bowel mass, retroperitoneal abscess were diagnosed in one of the patients with visible hematuria and in one of the patients with non-visible hematuria and other symptoms, respectively. Calculus was the most common type of lesion found by MDCTU in both visible (16) as well as non-visible hematuria (6), followed by UB mass, RCC, pyelonephritis, ureteric strictures etc. Only 4 cases were wrongly diagnosed as positive cases by MDCTU with and diagnostic accuracy of 92%. There was one case which was negative by both the techniques. Sensitivity of MDCTU was 91.84%, specificity of 100.00%, positive predictive value of 100.00%, and accuracy of 92.00% and p value = 0.002

Lesions at Different Locations (n=50)

		Visible haematuria	Non Visible hematuria
Kidney	Tumour/ Complex cyst	5	1
	Stone	13	3
	Infection/ Inflammation	3	1
	Others	2	1
Ureter (including PUJ & VUJ)	Tumour/ Complex cyst	0	0
	Stone	6	5
	Infection/ Inflammation	2	0
Urinary Bladder	Tumour/ Complex cyst	6	3
	Stone	2	0
	Infection/ Inflammation	0	0
Others	Tumour/ Complex cyst	1	0
	Infection/ Inflammation	0	1
	Others	0	0

Other urologic diseases, e.g. bowel mass, retroperitoneal abscess were diagnosed in one of the patients with visible hematuria and in one of the patients with non visible hematuria and other symptoms, respectively.

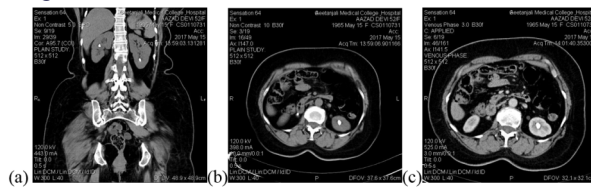
Type of Lesions found in 45 patients out of 50 patients by MDCTU



Results for the Diagnostic Accuracy of MDCTU for patients presenting with Hematuria and confirmed by Histopathology/ Nephroureteroscopy/ Cystoscopy/ Follow-up scan

Findings of MDCTU	Histopathology/ Nephroureteroscopy/ Cystoscopy/ Follow-up scan		
	Positive	Negative	Total
Positive	45	0	45
Negative	4	1	5
Total	49	0	50

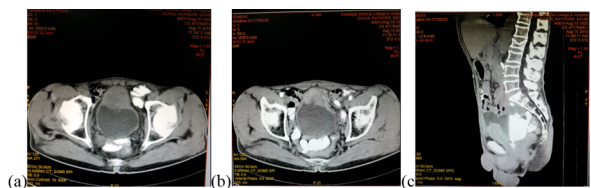
**Case 1
Diagnosis: B/I Renal Calculi**



(a) Non contrast coronal (b) Non contrast axial (c) Post contrast axial

There is a right renal calculus (10mm) in middle calyx. There is a left renal calculus (19mm) in inferior calyx. There is right upper ureteric calculus (9mm) resulting in mild proximal ipsilateral hydronephrosis

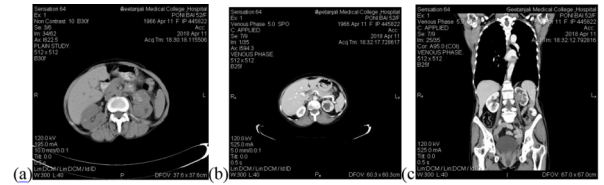
**Case 2
Diagnosis: UB mass with Vesical diverticula**



(a) Non contrast axial (b) Post contrast axial (c) Delayed Sagittal

There is heterogeneously enhancing abnormal ill defined soft tissue mass (66mm x 52mm x 48mm) along anterior wall of urinary bladder extending anteriorly infiltrating perivesical fat suggestive of UB mass. UB shows diverticulum along anterior superior aspect.

**Case 3
Diagnosis: of Renal cell carcinoma**



(a) Non contrast axial (b) Post contrast axial (c) Post contrast coronal

There is heterogeneously enhancing lobulated ill defined abnormal soft tissue mass (59mm x 39mm x 57mm) in left kidney predominantly involving interpolar region and infiltrating ipsilateral pelvicalyceal system. The mass lesion extends in surrounding perinephric area and crosses anterior pararenal fascia anteriorly. Findings suggest possibility of Renal cell carcinoma

DISCUSSION:

The present study aims at describing the spectrum of findings in patients presenting with hematuria, to compare them with HPR/ureteroscopy/cystoscopy/ follow up scan as gold standard. In the group presenting with visible hematuria (gross), MDCTU revealed no abnormalities in 1 out of 50 patient. 5 Renal cell carcinoma (all females), 13 renal calculi and 3 cases of pyelonephritis were found. In the ureters 6 patients with calculi at different levels, 2 cases of ureteritis and ureteral stricture were diagnosed, respectively. 6 patients with UB mass were found and 2 with vesical calculi. In the group presenting with non-visible haematuria . MDCTU revealed no abnormalities in 4 out of 50 patient . 3 patients with renal calculi, 1with PKD, 1 with Pyonephrosis along with retroperitoneal abscess and other disease like Nephrocalcinosis and ruptured Angiomyolipoma were found. 5 patients with ureteral calculi at different levels, 1 with ureteral stricture and 3 patients with bladder carcinoma were found.

In a similar study by Bretlau⁽¹⁰⁾ et al total of 771 patients had hematuria diagnosed at the time of referral. In 137 patients (18%), a tumor and / or a complex cyst was found in the urinary tract (renal, ureteral, or bladder), in 68 (9%) a calculi, in 118 (15%) other disease (i.e. infection or anomaly) was found. No abnormalities were found at CT urography in 455 (58%) of the patients with hematuria. Lesions were found more frequently in patients with visible hematuria than in patients with non- visible hematuria (48% vs. 29%). In a study done by Cowan et al ⁽²⁾prevalence rates were highest for calculus and bladder cancer similar to our study. In our study calculus was the most common type of lesion (Table 9) found followed by TCC, RCC, Pyelonephritis(6%) , Ureteric strictures(6%) similar to the proportions in previous reports.

Khadra et al prospectively studied 277 patients aged 40 years and younger who were referred to a hematuria clinic with either gross or microscopic hematuria. Although seven cases of bladder cancer were detected with cystoscopy, no upper urinary tract malignancies were found on ultrasound or excretory urography. In comparison in our study, 9 patients aged 40 years or younger with gross or microscopic hematuria only 1 patient of bladder cancer was detected and no upper urinary tract malignancy.

In a study, CT urography yielded a clinically significant diagnosis in 22.1% of young adult patients with gross or microscopic hematuria. The majority (75.3%) of clinically significant findings were renal or ureteral calculi⁽¹²⁾. However, they also detected malignancies in four patients. All tumors were renal or perirenal masses, with no confirmed urothelial lesions detected (Lokken P). Our results were comparable as majority (4 out of 9 i.e 44%) had either renal or ureteral calculi and one patient with bladder cancer. 3 out of 9 patients were reported as normal, out of them 2 were later diagnosed as urethral strictures on cystoscopy.

Our study showed 45 patients with lesions out of 50 which were later confirmed on histopathologic findings or the findings at a

urologic procedure (cystoscopy, ureteroscopy and retrograde pyelography) wherever possible.. Positive predictive value came out to be 100%, Negative predictive value of 20% 4 patients out of 5 normal reported on MDCTU were later diagnosed as urethral strictures. Sensitivity and Specificity of MDCTU are 91.84% and 100% respectively with accuracy of 92% which is comparable to previous studies.

CONCLUSION

Present study was conducted on fifty patients with history of hematuria, which includes out patients, inpatients, referral patients of Geetanjali Medical College & Hospital, Udaipur.

Our study can be summarized as:

- The maximum(64%) prevalence of hematuria was found in patients under age group 50 years or more with male preponderance
- Among 45 positive cases there were a total of 58 lesions , out of them 44 were benign lesions and 14 were malignant lesions.
- Calculus was the most common type of lesion found by MDCTU in both visible (16) as well as non-visible hamaturia (6), followed by UB mass, RCC, pyelonephritis, ureteric strictures etc.
- We had a sensitivity of 91.84%, specificity of 100.00%, positive predictive value 100.00%, and accuracy of 92.00% in our study.

In conclusion, MDCT urography performed in 64 slice MDCT scanners can detect all possible causes of hematuria (UTI excluded) including calculi ,being the most common cause , malignant lesions like Renal cell carcinoma and UB mass and other causes like Pyelonephritis , Pyonephrosis, ureteric strictures , ureteritis, Angiomyolipoma etc . Our study has several important limitations. The findings of this study may throw some light on the role of Multi-detector Computed Tomography Urography in hematuria management in the setting of a developing country like ours and guide further research in the direction of cost effectiveness and optimization of use of MDCTU in diagnosing the cause of hematuria and its management.

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