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Multi Detector Computed Tomography Urography in the Evaluation of Hematuria

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Abstract: ***Background: Computed Tomography Urography (CTU) is a highly sensitive modality for evaluating hematuria and detecting urinary tract pathologies, surpassing traditional intravenous urography in diagnostic accuracy. Aim: To assess the role of multi - detector CT urography in diagnosing causes of hematuria. Methods: A cross - sectional observational study was conducted at the Radiology Department, Pacific Institute of Medical Sciences, Udaipur, from June 2023 to November 2024. CTU was performed on 150 patients using a 128 - slice MDCT scanner (SIEMENS SOMATOM Perspective) with a three - phase protocol. Results: The study population (mean age 44.4 years) had a slight male predominance. Painless and macroscopic hematuria were more common. Urolithiasis was the most frequent cause (76.67%), followed by TCC (9.33%) and RCC (8%). Renal pathologies predominated. Conclusion: CTU is a valuable, non - invasive tool in the diagnostic evaluation of hematuria, effectively identifying diverse etiologies and anatomical sites.***

Keywords: Hematuria, Computed Tomography Urography, CT Urography, Urolithiasis, Transitional Cell Carcinoma (TCC), Renal Cell Carcinoma (RCC), Multi - detector CT, Urinary Tract Imaging, Painless Hematuria, Urinary Tract Malignancy

1. Introduction

Computed Tomography Urography (CTU) is a specialized imaging modality that has emerged as the preferred diagnostic tool for evaluating the urinary tract, including the kidneys, ureters, and bladder, particularly in patients presenting with hematuria. CTU utilizes multidetector computed tomography (MDCT) with thin - slice imaging, intravenous contrast administration, and multiphase acquisition—typically including non - contrast, nephrographic, and excretory phases—to provide high - resolution anatomical and functional details.

Hematuria, the presence of red blood cells in the urine, can be classified into microscopic and gross types. While microscopic hematuria may be incidentally detected, it carries the potential risk of underlying urologic malignancy in up to 10% of adults. Gross hematuria often prompts immediate investigation due to its association with significant pathologies such as urinary tract stones, tumors, and infections. Historically, imaging modalities like intravenous urography (IVU) and ultrasonography (US) were used to assess hematuria, but they are now largely supplanted by CTU due to its superior sensitivity and specificity, especially for detecting upper tract urothelial cancers and small renal masses.

Despite its advantages, CTU is associated with limitations such as high radiation exposure and the risk of nephrotoxicity from iodinated contrast agents. Advances like low - dose protocols and dual - energy CT have been developed to address these concerns. Moreover, risk stratification based on age and clinical presentation helps optimize patient selection. CTU continues to evolve, offering comprehensive evaluation and early detection of urinary tract abnormalities, making it a critical tool in the diagnostic workup of hematuria.

2. Materials and Methods

This cross - sectional observational study was conducted at the Radiology Department of Pacific Institute of Medical Sciences, Umarda, Udaipur, from June 1, 2023, to November 30, 2024. A total of 150 patients presenting with hematuria and referred for CT urography were included. The inclusion criteria comprised all patients with hematuria undergoing CTU. Exclusion criteria included pregnant or lactating women, individuals with severe renal or cardiac failure, multiple myeloma, contrast media allergy, non - urologic causes of hematuria, or those unwilling to participate.

All patients underwent MDCT urography using a 128 - slice Siemens SOMATOM Perspective scanner. The imaging protocol consisted of unenhanced, nephrographic, and excretory phases. Patients were positioned supine, and an 18–20G IV catheter was placed in the antecubital vein. A scout image was followed by unenhanced scans, then 100 ml of iohexol (350 mg/ml) was injected at 3–4 ml/s. Nephrographic - phase images were acquired at 120 seconds, and excretory - phase images at 8–10 minutes post - injection.

Clinical history and renal function tests were reviewed before scanning. Informed consent was obtained from all participants. Where feasible, final diagnoses were confirmed by histopathology or urological procedures such as cystoscopy, ureteroscopy, or retrograde pyelography.

3. Result and Observations

A total of 150 patients with hematuria were included in this study.

Age Distribution: Patients ranged from 6 to over 80 years, with the majority (34.67%) in the 41–60 years age group. The mean age was 44.4 ± 18.12 years.

Gender Distribution: There was a slight male predominance—80 males (53.33%) and 70 females (46.67%).

Type and Nature of Hematuria:
- Painless hematuria was more common (62%) than painful hematuria (38%).
- Macroscopic hematuria occurred in 57% of cases, while 42% had microscopic hematuria.

Etiology of Hematuria:
- Most common cause: Urolithiasis (76.67%)
- Malignancies: TCC (9.33%), RCC (8%), and urinary bladder cancer (3.33%)
- Other causes included cystitis, staghorn calculi, urothelial thickening, and various rare etiologies.

Malignancy Analysis:
- 24% of patients had malignancies.
- TCC was most frequent (9.33%), followed by RCC (8%) and bladder cancer (3.33%).

Age - wise Malignancy Trends:
- RCC and TCC mostly occurred in the 41–60 and 61–80 age groups.
- Bladder masses were seen only in the 61–80 age group. No malignancies were noted in patients over 80.

Benign Pathology Distribution by Age:
- Calculus disease was highest in the 21–40 age group.
- Cysts and infections were more frequent in the 41–60 age group.

Anatomical Distribution:
- Most commonly affected site: Kidneys (right: 24%, left: 19.33%, bilateral: 24%)
- Renal pelvis (8% each side), PUJ (left: 1.33%, right: 4.67%), ureters, VUJ, and urinary bladder also showed notable involvement.

4. Discussion

Hematuria, a key manifestation of urinary tract disorders, can result from a broad spectrum of causes ranging from urolithiasis and infection to malignancies. Prompt and accurate diagnosis is critical, particularly in identifying underlying neoplastic conditions. In this context, multi - detector computed tomography urography (CTU) has emerged as a comprehensive, high - resolution modality capable of detecting a wide range of urinary pathologies through its unenhanced, nephrographic, and excretory phase imaging.

In our study involving 150 patients, the mean age was 44.4 ± 18.12 years, with the highest incidence in the 41–60 year age group (34.67%). This aligns with similar findings by Kumar et al. and Pusthey et al., who also reported clustering in middle - aged individuals. A slight male predominance (53.33%) was noted, consistent with prior literature suggesting higher male susceptibility, possibly due to lifestyle and occupational risk factors.

Painless hematuria was more common (62%), often associated with malignancies or benign findings, while painful hematuria (38%) correlated more frequently with urolithiasis. Macroscopic hematuria (57%) was more prevalent than microscopic (42%), reflecting higher clinical suspicion and diagnostic yield in overt cases, as supported by Lokken et al.

Urolithiasis emerged as the predominant cause of hematuria (76.67%), followed by malignancies including transitional cell carcinoma (9.33%), renal cell carcinoma (8%), and bladder carcinoma (3.33%). These findings correlate with previous studies by Pusthey et al., Cowan et al., and Bansal et al., reinforcing the role of CTU in detecting both calculi and neoplastic lesions.

Malignancy was more prevalent in older age groups, particularly 41–60 and 61–80 years, with bladder tumors mostly confined to the latter. Although age distribution differences across cancer types were not statistically significant ($p=0.18$), the trend supports established evidence, as described by Bromage et al., of increasing malignancy risk with age.

Benign causes were also age - dependent. Calculus disease peaked in the 21–40 years group, while infections, cysts, and anatomical abnormalities were more common in the 41–60 years range. This pattern, though not statistically significant ($p=0.12$), parallels findings by Patel et al. and Gillatt et al.

Anatomically, the kidneys were the most frequently involved sites (left: 19.33%, right: 24%, bilateral: 24%). Lower tract involvement included the renal pelvis, PUJ, ureters, VUJ, and urinary bladder, with notable findings such as cystitis (7.33%) and vesical calculi (5.33%). These results reaffirm prior data by Bretlau et al. and Pusthey et al., highlighting the widespread distribution of pathology across the urinary tract.

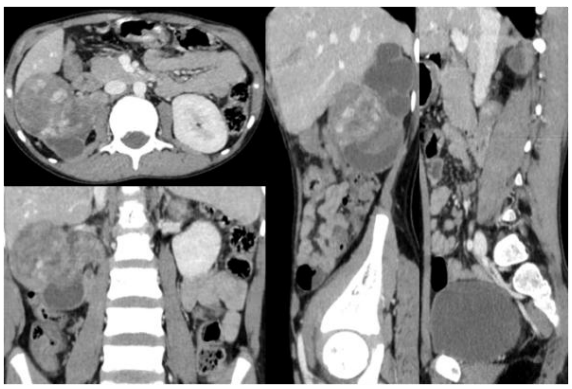

Figure 1: Right renal cell carcinoma showing heterogeneous enhancement seen involving the renal pelvis and middle calyces with extension into the upper ureter, infiltration into

the segment VI of right lobe of liver, abutment of the duodenum and hepatic flexure of colon. There is gross hydronephrosis with severely thinned out renal parenchyma.

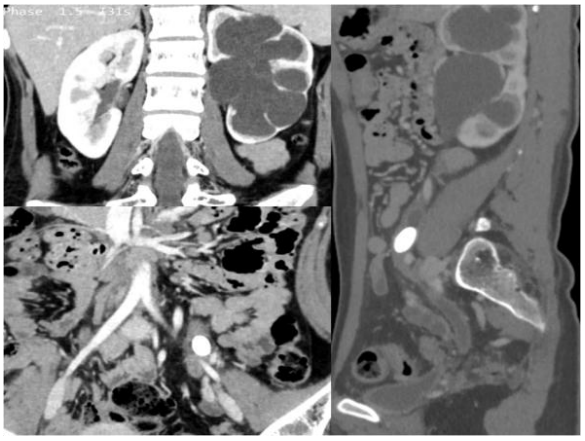

Figure 2: Enlarged left kidney with cortical thinning. There is a left mid ureteric calculus seen just before crossing of iliac vessels causing moderate hydroureteronephrosis.

5. Summary

In this study of 150 patients presenting with hematuria, the majority were middle - aged, with a mean age of 44.4 years. A slight male predominance was noted (53.33%). Most patients (62%) had painless hematuria, and macroscopic hematuria was more common (57%) than microscopic (42%). A history of trauma was rare, seen in only 0.67% of cases. Urolithiasis emerged as the leading cause, accounting for 76.67% of cases. Malignancies were identified in 24% of patients, with transitional cell carcinoma (9.33%) being the most common, followed by renal cell carcinoma (8%) and bladder cancer (3.33%). Malignant cases were more frequent in the 41–60 and 61–80 age groups. Among benign causes, cystitis and staghorn calculi (7.33% each) were next to urolithiasis. Anatomically, the kidneys were the most affected sites, with both unilateral and bilateral involvement. Bladder lesions such as cystitis and vesical calculi were also observed in a notable number of patients.

6. Conclusions

The evaluation of hematuria using computed tomography urography (CTU) demonstrated that the condition predominantly affects middle - aged individuals, with a slight male predominance. The majority of patients presented with painless and macroscopic hematuria. Urolithiasis was identified as the most common etiology, followed by malignancies including transitional cell carcinoma, renal cell carcinoma, and urinary bladder cancer. Benign causes such as cystitis and staghorn calculi were also frequently encountered. Malignancies were more prevalent in older age groups, with a notable predilection for the kidneys and urinary bladder. Anatomical analysis revealed that the kidneys were the most commonly involved sites, with both unilateral and bilateral findings. CTU proved highly effective in detecting the wide spectrum of underlying causes and localizations of hematuria, providing detailed anatomical and pathological information. These findings highlight the critical role of CTU in the comprehensive assessment of hematuria, facilitating early diagnosis and appropriate clinical management across a range of urological conditions.

References

[1] Van Der Molen AJ, Cowan NC, Mueller - Lisse UG, Nolte - Ernsting CC, Takahashi S, Cohan RH, et al. CT urography: definition, indications and techniques. A guideline for clinical practice. Eur Radiol.2008; 18 (1): 4–17.
[2] Wang LJ, Wong YC, Huang CC, Wu CH, Hung SC, Chen HW. Multidetector computerized tomography urography is more accurate than excretory urography for diagnosing transitional cell carcinoma of the upper urinary tract in adults with hematuria. J Urol.2010; 183 (1): 48–55.
[3] Caoili EM, Cohan RH, Inampudi P, Ellis JH, Shah RB, Korobkin M, et al. MDCT urography of upper tract urothelial neoplasms. AJR Am J Roentgenol.2005; 184 (6): 1873–81.
[4] Martingano P, Stacul F, Cavallaro M, et al.64 - slice CT urography: 30 months of clinical experience. Radiol Med.2010; 115 (6): 920–35.
[5] Silverman SG, Leyendecker JR, Amis ES Jr. What is the current role of CT urography and MR urography in the evaluation of the urinary tract? Radiology.2009; 250 (2): 309–23.
[6] Sudakoff GS, Dunn DP, Guralnick ML, Hellman RS, Eastwood D, See WA. Multidetector computerized tomography urography as the primary imaging modality for detecting urinary tract neoplasms in patients with asymptomatic hematuria. J Urol.2008; 179 (3): 862–7.
[7] Edwards TJ, Dickinson AJ, Natale S, Gosling J, McGrath JS. A prospective analysis of the diagnostic yield resulting from the attendance of 4020 patients at a protocol - driven haematuria clinic. BJU Int.2006; 97 (2): 301–5.
[8] Khadra MH, Pickard RS, Charlton M, Powell PH, Neal DE. A prospective analysis of 1930 patients with hematuria to evaluate current diagnostic practice. J Urol.2000; 163 (2): 524–7.
[9] Lokken RP, Sadow CA, Silverman SG. Diagnostic yield of CT urography in the evaluation of young adults with hematuria. AJR Am J Roentgenol.2012; 198 (3): 609–15.
[10] Albani JM, Ciaschini MW, Streem SB, Herts BR, Angermeier KW. The role of computerized tomographic urography in the initial evaluation of hematuria. J Urol.2007; 177 (2): 644–8.