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Comparative evaluation of the role of CT urography in the assessment of renal lesions in patients with hematuria

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Abstract
Background and Aim: CT urography is a single comprehensive modality for the diagnosis of patients suspected with hematuria. Hence, the present study was designed to evaluate the efficacy of role CTU in the diagnosis and assessment of renal lesions in comparison with other diagnostic modalities.
Material and Methods: A total of 83 patients suspected with hematuria between 18-75 years of age presented at the Department of Radio-diagnosis, KMC, Manipal University, Mangalore were selected. The patients were subjected to 3 phase CT examination after obtaining informed consent. Patients' demographic details *viz.* age, gender, and clinical manifestations were recorded. Assessment parameters like sensitivity, specificity, positive predictive value, and negative predictive value were analyzed.
Results: The majority of study subjects with hematuria *i.e.* 28.92% belonged to the age group of 60-70 years with male predominance. The results of the present study revealed that 11 out of 14 cases showed masses confined to the kidney (<7 cm diameter), corresponding to stage T1 RCC according to TMN classification. Cystoscopy was done for 25 cases of which 17 cases showed bladder TCC out of which one was female patient, and all others were male. Gross hematuria is not only a diagnosis. It is a symptom with an underlying cause, which is often serious and 15–28% of patients with gross hematuria have a malignancy in the urinary tract as the underlying cause. When examining patients with gross hematuria, the most common tumor found in up to 20% of patients, is bladder cancer. Other tumors causing gross hematuria are renal cancer, urothelial cell carcinoma (UCC) of the renal pelvis and the ureters, and prostate cancer. The sensitivity and specificity of CTU with regards to renal lesions diagnosis and assessment were reported as 98-100% and 92-100%, respectively.
Conclusion: Most of the renal lesions were diagnosed accurately by CTU as compared to other diagnostic modalities. Hence, CTU could be recommended for the precise and accurate diagnosis of renal lesions.

Keywords: renal lesions, CT urography, sensitivity, specificity, calculi

Introduction

Hematuria is common and can originate from any site in the urinary tract. The presence of gross hematuria usually prompts patients to seek medical attention, and a thorough urologic investigation is warranted to determine its cause. In contrast, the etiology, diagnosis, and management of asymptomatic microhematuria are controversial. Asymptomatic microscopic hematuria is often not a sign of underlying surgical urologic disease. Some degree of hematuria is identified in 9%-18% of normal individuals [1, 2]. With the recent introduction of multidetector-row helical computed tomography (CT), the uroradiological evaluation of patients with the common and complex disease is changing rapidly [3, 4]. Excretory urography (EU) has been the initial modality for upper tract imaging in patients with hematuria, flank pain, and other urologic diseases for the past 5 decades [5, 6]. However, the EU is less sensitive in detecting renal masses than ultrasonography (US), CT, or magnetic resonance (MR) imaging. CT has evolved from single–detector row scanners into multi-detector row helical volumetric acquisition techniques, and these advances have had a significant impact on imaging of the urinary tract. Application of multidetector-row CT to an evaluation of the urinary tract has been termed CT urography [7].

The detection rate of renal masses has increased during the last decades owing to the widespread use of CT and MRI [8]. Therefore, an accurate characterization of renal masses is essential to ensure appropriate case management. Renal masses can be divided into cystic and solid lesions [9]. The most common are cysts in up to 27% of patients over 50 years [10]. CT- or MRI-enhancing masses are classified as solid or complex cystic. Eighty-five percent of expansive solid masses are malignant [11]. Therefore, a solid, enhancing mass must be considered malignant unless proven otherwise. Renal cell carcinoma (RCC) is the most common malignant tumor with a rising incidence of about 3% per year since 1975. The most common subtype of RCC is the clear cell RCC (synonym: common or conventional RCC) with 65% of renal cortical tumors. Further subtypes are papillary (basophilic and eosinophilic) and chromophobe RCCs with about 25% of renal cortical tumors. Clear-cell RCC causes 90% of metastases of all renal malignancies [12, 13]. Other malignant masses include transitional cell carcinoma (TCC), lymphoma (primary and more frequent secondary), metastases from carcinoma and primary/secondary sarcoma. Primary tumors of the lung, breast and gastrointestinal tract are the most common sources of renal metastases [14]. Benign tumors account for approximately 20% of all solid renal cortical tumors, and renal oncocytoma is the most common solid tumor type [15, 16]. Non-neoplastic renal masses include inflammatory pseudotumors with and without abscess formation, renal

infarct, hematoma and replacement lipomatosis with coexistent xanthogranulomatous pyelonephritis [17, 18].
CTU offers a few imperative points of interest for imaging of the urinary tract: single breath-hold coverage of the whole urinary tract with an absence of respiratory misregistration, quick imaging with ideal contrast medium opacification and decreased partial volume effect as fitting cuts can be chosen from the volumetric figures. With this background the present study was designed to evaluate the role of CTU in the assessment of renal masses in patients suffering from hematuria in comparison with other diagnostic modalities *viz.* intravenous urography, ultrasonography, CT, retrograde urethrography and pyelography, cystoscopy, and ureteroscopy.

Materials and Methods

Study subjects

A total of 83 patients suspected with a history of hematuria between 18-75 years of age presented at the Department of Radio-diagnosis, KMC, Manipal University, Mangalore were selected for this study.

Inclusion criteria

- Patients presented with microscopic and macroscopic hematuria

Exclusion criteria

- Patients below 18 and above 75 years of age.
- Pregnant and lactating patient
- Patients with Serum Creatinine >1.8 and cases not on dialysis
- Cardiac failure
- Multiple myelomas
- Previous allergic reaction to contrast media
- Patients with known bleeding disorders

Imaging technique

The patients underwent a 3 phase CT examination after obtaining informed consent in written form. First was the initial non-contrast phase (Oral and rectal water - one liter). After half an hour contrast test dose was given. The corticomedullary phase was acquired 15-25 seconds after administration of intravenous non-ionic contrast [100 ml at a rate of 2 ml/sec.]. The next phase was the nephrographic phase, which was acquired following a delay of 30-55 seconds to evaluate the renal parenchyma. Followed by the pyelographic phase which was taken 8-15 min. following administration, to evaluate the urothelium from the pelvicalyceal system to the bladder. This was performed with a Multidetector CT scanner (G E Bright speed). CT scans were obtained from the kidneys to the bladder with the following technique: 100- 120 kv. 300- 350 mAs. [Auto mAs] Images were reconstructed at a thickness of 5 mm. Three-dimensional (3D) reconstructions of the non-enhanced, nephrogenic phase and excretory phase were performed.

Ethical approval

Clearance from the ethical committee of KMC, Manipal University, Mangalore was sought and obtained before the initiation of the study.

Data analysis

Patients' demographic details *viz.* age, gender, and clinical manifestations were recorded. Assessment parameters like sensitivity, specificity, positive predictive value, and negative predictive value were analyzed.

Results

The majority of the study subjects in our study i.e. 24/83 (29%) belonged to the age group of 60-70 years followed by 25% in 50-60 years. Male predominance (83.13%) of study subjects was observed as compared to females (16.87%). The demographic profile of the study subjects was plotted in Figure 1.

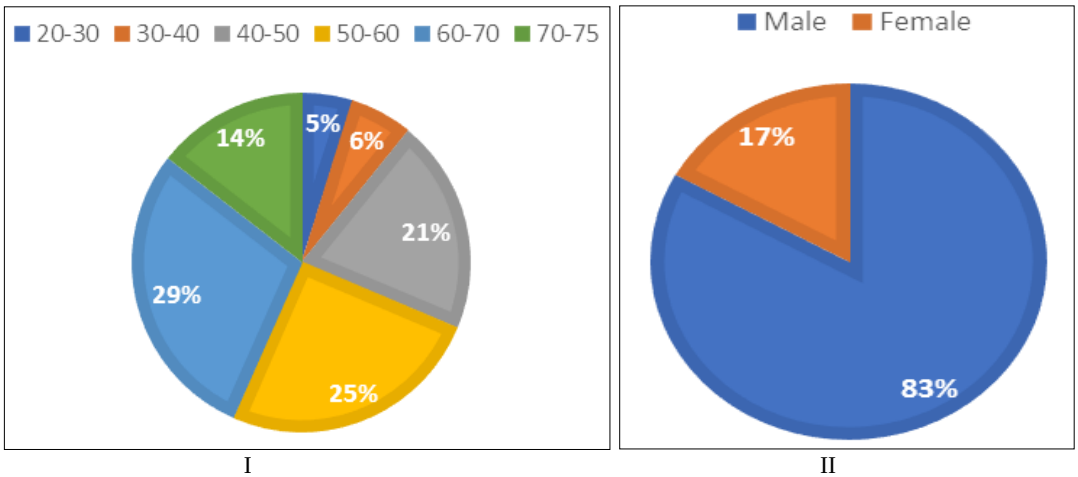


Fig 1: [I]-Age wise distribution pattern of study subjects; [II]- Gender wise distribution pattern of study subjects

Renal Cell Carcinoma (RCC) Cases: 11 out of 14 cases showed masses confined to the kidney (<7 cm diameter), which is corresponding to stage T1 RCC according to TMN classification. The attenuation difference of 20 HU or more between non-contrast and post-contrast images was diagnostic for pathological enhancement. In one case the mass was more than 7 cm in diameter, confined to the kidney and associated with enlarged regional lymph nodes (corresponding to grade T2 and N2). Two cases showed renal vessel infiltration, corresponding to stage T3B. All the cases underwent nephrectomy and biopsy showed 3 as clear cell carcinoma [Figure 2].

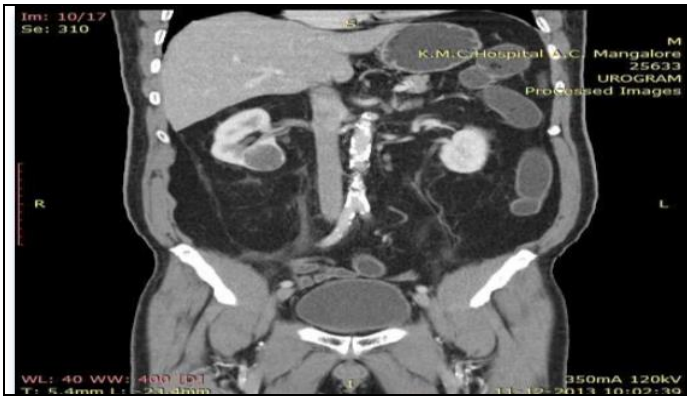
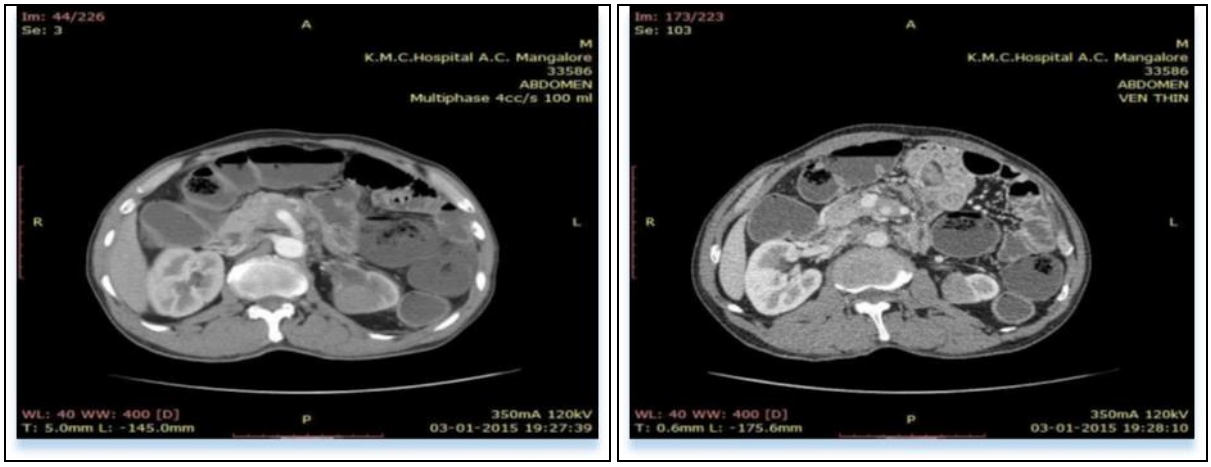


Fig 2: Image showing of right RCC case

Renal lymphoma was found in one case and appeared like the right renal homogenous mass lesion associated with para-aortic enlarged lymph nodes [Figure 3**].**



I II

Fig 3: [I]-Showing case of lymphoma in the left kidney; [II]- Showing case of lymphoma in the left kidney with mesenteric and paraaortic lymph nodes

TCC CT axial image showing enhancing lesion in the left posterolateral wall with involvement of left VUJ 3 were low grade urothelial carcinoma. [Figure 4 & 5].

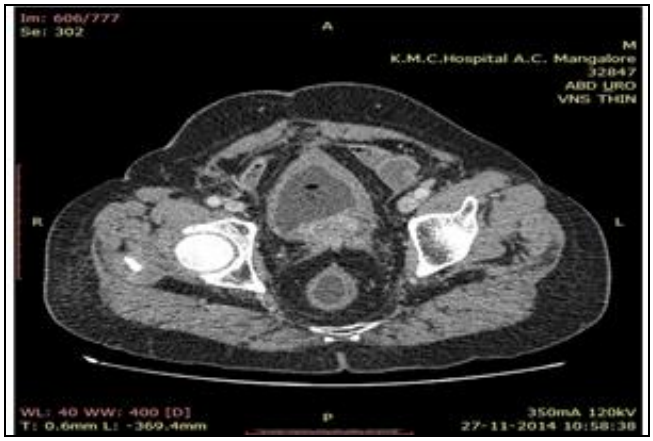


Fig 4: Case of urinary bladder lesion

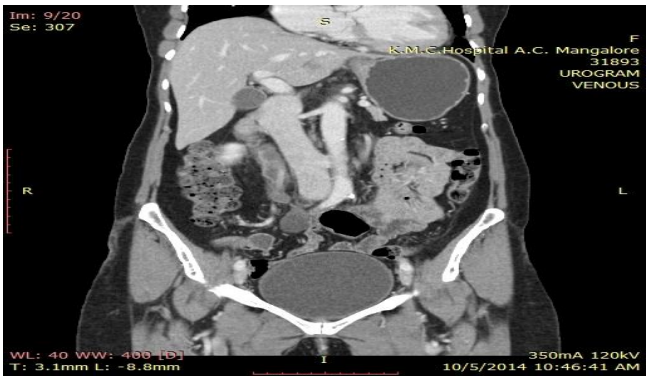


Fig 5: Enhancing lesion in right upper and mid ureter –ureteric TCC

Discussion

Owing to the widespread use of abdominal imaging studies the detection rate of solid renal masses has increased, and accurate characterization of imaging features of renal masses has become more essential for case management.

Hence, the present study was designed to evaluate the role of CTU in the assessment of renal masses in patients suffering from hematuria in comparison with other diagnostic modalities *viz.* intravenous urography, ultrasonography, CT, retrograde urethrography and pyelography, cystoscopy, and ureteroscopy.

In our study MDCT accurately diagnosed the nature of renal masses in 98% of cases and there were 14 cases of RCC diagnosed with sensitivity and specificity of 100% and 98% respectively, positive predictive value (PPV) of 93% and negative predictive value (NPV) of 100%. It also helped in the accurate staging of renal cell carcinoma in all cases. These findings were in concurrence with findings of Maheshwari *et al.,* who stated that CT has a staging accuracy of up to 91%, making it the imaging method of choice for most patients.

Imaging parameters of renal masses are helpful in the characterization of renal masses focusing especially on the differentiation between cystic and solid lesions [19]. CT It is helpful to differentiate category I, III and IV cysts. Depending on the size and location, it is critical to differentiate between complicated cysts of categories II and III [20]. We used non-contrast scan for renal masses to assess the baseline attenuation and degree of post-contrast enhancement as well as to detect calcification and hemorrhage, this is in agreement with Sheth *et al* expressed an underlying arrangement of unenhanced scans through the kidneys ought to be a piece of each convention for assessment of a speculated renal mass; it gives a gauge to quantify the upgrade inside the injury after the organization of intravenous complexity material. Since most renal cell carcinomas have a rich vascular stockpile, they enhance altogether after the organization of complex material. Enhancement values of more than 12 HU are viewed as suspicious for malignancy [21]. We used the corticomedullary phase to detect the arterial supply of renal masses, collateral vessels as well as the involvement of the renal vein. These findings are in corroboration with findings of Sheth *et al* also wherein the corticomedullary phase is essential for accurate staging of renal cell carcinoma. Maximal opacification of the renal arteries and veins occurs, allowing confident diagnosis of venous extension of tumoral tissue.

Conclusion

In conclusion, many imaging techniques are used for the diagnosis and assessment of renal lesions. In this study, CTU shows high accuracy, sensitivity and specificity in the detection of different cases of renal cell carcinoma. Most of the renal lesions were diagnosed accurately by CTU as compared to other diagnostic modalities *viz.* renal calculi, renal injuries, and neoplastic lesions Hence, CTU could be recommended for the precise and accurate diagnosis of renal lesions.

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