Comparison between CT UROGRAPHY and MR UROGRAPHY in cases of Hematuria

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Abstract:

Hematuria is the presence of blood in the urine and may be macroscopic or microscopic. This study was conducted to assess the role of CT and MRI in evaluating causes of hematuria. This study was a cross-sectional observational hospital-based study including 50 cases of hemturia. It was carried out from March 2016 to June 2018 at Fayoum University Hospital and Fayoum General Hospital. Out of the 50 cases, 47 (94.0%) with variety of UT abnormalities were identified. Renal masses were the most abnormalities detected 19/47 (40.0%), followed by bladder masses15/47 (31.9%), urolithiasis 10/47 (21.3%) and renal injury 3/47(6.4%). No abnormalities were found in 3/50 (6%) of the patients with hematuria. This study revealed the following findings; Both CTU and MRU can detect stones, but CTU can also differentiate types of stones by measuring their denisities. Both CTU and MRU can diagnose urinary tract neoplasms, MRU is more useful in tissue discrimination, as MRU offers superior soft tissue resolution and CTU is more helpful in local staging.

KeyWords: Hematuria, CTU, MRU

Introduction

Hematuria is the presence of blood in the urine and may be macroscopic or microscopic. Hematuria is most accurately defined as: the presence of three or more red blood cells per high powered field in two or three properly collected urine analysis specimen [(1 & 2)].

The more common causes of hematuria include urinary tract infection, urolithiasis, trauma, renal parenchymal disease, and malignancy [(3)].

Historically, Excretory Urography (EU) has been recommended as the initial imaging test in the evaluation of hematuria. However; Computed tomography (CT) has been proven to be useful in evaluating a variety of urinary conditions including: urolithiasis,urinary tract infections,renal masses,and trauma [(4)].

CT without and with contrast has been found to be more sensitive than Excretory Urography and Sonography in detecting urolithiasis,and superior to both in detecting and characterization of renal masses.

Magnetic Resonance Urography (MRU) is the only other alternative study, which can image all the anatomic components of the urinary tract in a single test [(5)].

MRI can be used in helping to define the internal composition of some renal masses and can be useful in renal cystic disease by detecting signs of hemorrhage in cysts.

CT Urography(CTU) greatest use is when it is combined with urographic MRU technique to detect the certain the level and cause of urinary tract obstruction [(6)].

This study was conducted to assess the role of CT and MRI in evaluating causes of hematuria.

Methodology

- **Study design**

This study was a cross-sectional observational hospital-based study. It was carried out from March 2016 to June 2018.

- **Study setting**

Our study was conducted in Fayoum University Hospital and Fayoum General Hospital.

- **Study population**

A sample size of 50 cases of hematuria was included. Their age was 1-70 years.

- **Data collection**

All patients were subjected to the following :

1. Socio demographic information including age and sex alongside with present history for the medical problems for which patient is seeking medical advice were collected by interviewing patients using a questionnaire form.

2.Unenhanced CT examand CT Urography with contrast: Urography using with CT TOSHIPA Multi-four-detector Machine made in Japan was performed.

The multidetector arrays enable acquisition of isotropic volume data, which is routinely reformatted into axial, coronal, and sagittal image series. In addition, the data are amenable to multiplanar reformatting and 3D manipulation, either within the CT scanner work console, at standalone computer workstations.

3. Magnetic Resonance Imaging: a closed TOSHIPA MRI Machine of 1.5 Tesela made in Japan was used.

- **Statistical Analysis**

The collected data was organized, tabulated and statistically analyzed using SPSS software statistical computer package version 18 (SPSS Inc, USA). For quantitative data, the mean and standard deviation were calculated. For qualitative data the number and percent distribution was calculated.

- **Ethical consideration**

This study was reviewed by the faculty of Medicine Research Ethical committee. The researcher informed the participants about the objectives of the study, the examinations, investigations that would be done, also the confidentiality of their information and their right not to participate in the study.

Results

This was a cross-sectional study included 50 patients complaining of hematuria from Fayoum General and University Hospitals. Out of them, 47 (94.0%) cases with variety of UT abnormalities were identified.Renal masses were the most abnormalities detected 19/47 (40.0%), followed by bladder masses15/47 (31.9%), urolithiasis10/47 (21.3%) and renal injury 3/47(6.4%). No abnormalities were found in 3/50 (6%) of the patients with hematuria as shown in **figure (1)**.

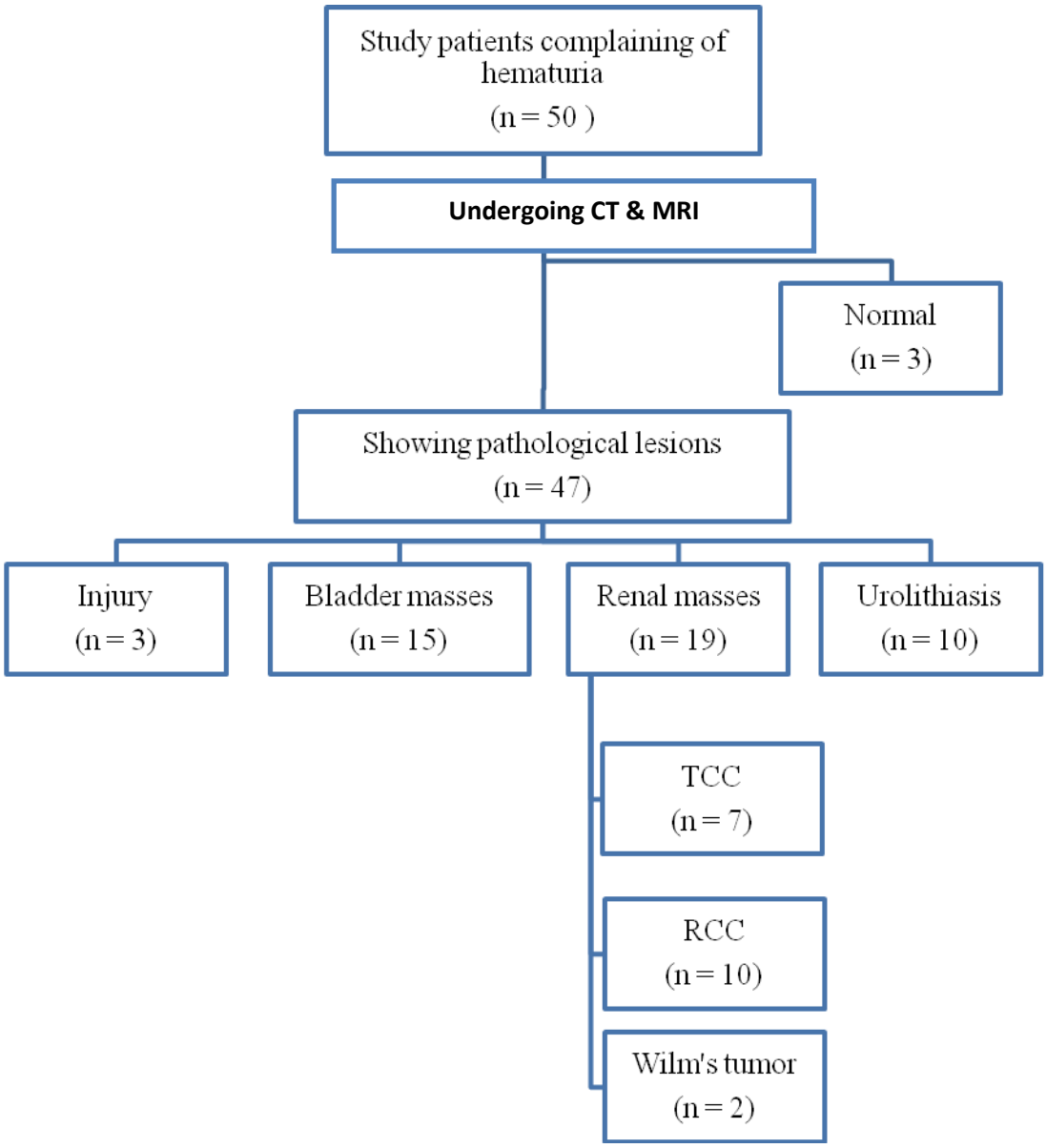


Figure (1): Flow chart showing study patients

Table (1): Other complaints in different categories of patients

Pathology		Flank pain	Acute urine retention	Abdominal mass
		N (%)		
Bladder masses (N=15)		6 (40.0)	3 (20.0)	0 (0.0)
Renal masses	**RCC (N=10)**	3 (30.0)	0 (0.0)	1 (10.0)
	Wilm's tumor (N=2)	1 (50.0)	0 (0.0)	1 (50.0)
Urolithiasis (N=10)		5 (50.0)	0 (0.0)	0 (0.0)

In patients with bladder masses, more than one third 6/15 (40%) had flank pain and one fifth3/15 (20%) had acute urine retention. In renal RCC, about one quarter 3/10 (30%) had flank pain, while one case experienced appearance of abdominal mass. In two children with Wilm`s tumour, one case had flank pain and the other one had an abdominal mass. As regards renal stone, half of cases were found to have flank pain, as demonstrated in **table (1)**.

Table (2): Findings of both CT & MRI in patients with renal injury (N=3)

N	**CT**		**MRI**	**Diagnosis**
	Without contrast	**With contrast**	**T1 &T2**	
1	Rt renal hypodenisty, not linear & sharply demarcated	Rt Infarcted segment was non-enhancing	Low signal	Post traumatic segmental infarction
2	Rt renal hypodense sub-capsular homogenous collection.	Rt non-enhancing sub-capsular renal homogenous collection.	RT High signal sub-capsular renal homogenous collection.	Right acute sub-capsular renal hematoma
3	Rt Irregular hypodense renal parenchymal area	Rt Irregular non-enhancing renal parenchymal area	High signal (sub-acute blood)	Right sub-acute renal contusion

Table (2) shows the following; three cases of injury in the right kidney were detected. First case was diagnosed as post traumatic segmental infarction. It appeared as a hypodenisty, not linear & sharply demarcated area. In CT with contrast, it was not enhanced. At MR it was low signal in both T1 and T2.

The second one was diagnosed as right acute sub-capsular renal hematoma. It appeared as a hypodense sub-capsular renal homogenous collection in CT without contrast. It was not enhancedin CT with contrast. At MR it was high signal in both T1 and T2.

The third case was diagnosed as a sub-acute renal contusion. It appeared as an irregular hypodense renal parenchymal area in CT without contrast. It was not enhanced in CT with contrast. At MR it was high signal in both T1 and T2.

Table (3): Findings of both CT & MRI in patients with carcinoma of urinary bladder

N	CT		MRI	
	Without contrast	**With contrast**	**T1**	**T2**
1	A well demarcated cauliflower space occupying lesion lies in left lateral bladder wall	An enhanced well demarcated cauliflower space occupying lesion lies in left lateral bladder wall (3 cm width, 2 cm length & 2 cm thickness), with slight invastion	**All lesions are Iso-intense to muscle**	Lesion is Slightly hyperintense to muscle, invasion of lt lateral wall bladder by 2 mm
2	Focal thickening of the RT bladder wall	Enhanced focal thickening of the RT bladder wall (maximum width 5mm)		Lesion is Slightly hyperintense to muscle
3	A well demarcated space occupying lesion oval in shape lies at left bladder wall	An enhanced well demarcated space occupying lesion lies at left bladder wall (3.5 cm width, 1.5 cm length & 3 cm thickness), no invasion of bladder walls		Lesion is Slightly hyperintense to muscle, no invasion of bladder walls
4	A space occupying lesion near urethral orifice, hypodense& rounded in shape	An enhanced rounded well demarcated A space occupying lesion near urethral orifice (2 cm diameter & 2 cm thickness), invasion of posterior bladder wall by 2 mm		Lesion is Slightly hyperintense, invasion of posterior bladder wall by 2 mm
5	Focal regions of thickening of the bladder wall	Enhanced focal thickening of the bladder walls (maximum 5mm)		Lesion is Slightly hyperintense
6	Calcified focal thickening of the bladder walls	Enhanced focal thickening of the bladder walls (maximum 3mm)		Slightly hyperintense
7	A space occupying lesion near urethral orifice, hypodense& rounded in shape	An enhanced rounded well demarcated A space occupying lesionnear urethral orifice (3 cm diameter & 2 cm thickness), invasion of posterior bladder wall by 3 mm		Slightly hyperintense, invasion of posterior bladder wall by 3 mm
8	Rt bladder wall space occupying lesion protruding into lumen, hypodense& oval in shape	An enhanced well demarcated space occupying lesion in Rt bladder wall (1.5 cm width, 1 cm length &1 cm thickness), no invasion of bladder walls		Slightly hyperintense, no invasion of bladder walls
9	Focal region of thickening of Lt bladder wall	Enhanced focal thickening of the bladder walls (maximum width 3mm)		Slightly hyperintense
10	Focal thickening of Rt bladder wall	Enhanced focal thickening of the bladder wall (maximum width 4mm)		Slightly hyperintense
1	Lt bladder wall space occupying lesion,	An enhanced well demarcated		Slightly hyperintense,

1	hypodense&rounded in shape Lt hydroureter&hydronephrosis	space occupying lesion in lt bladder wall (2 cm diameter &3 cm thickness), invasion of lt bladder wall by 1 mm		invasion of lt bladder wall by 1 mm
12	A space occupying lesion near urethral orifice, hypodense&oval in shape	An enhanced rounded well demarcated space occupying lesion near urethral orifice (2 cm width, 2.5 cm length &3 cm thickness), invasion of posterior bladder wall by 2.5 mm		Slightly hyperintense, invasion of posterior bladder wall by 2.5 mm
13	Rt bladder wall space occupying lesion protruding into lumen, hypodense&rounded in shape	An enhanced well demarcated space occupying lesion in Rt bladder wall (1.5 cm diameter& 2 cm thickness)		Slightly hyperintense
14	Space occupying lesion near urethral orifice, hypodense&oval in shape	An enhanced rounded well demarcated space occupying lesion near urethral orifice (1 cm width, 1.5 cm length &2 cm thickness), no invasion of bladder walls		Slightly hyperintense, no invasion of bladder walls
15	Rt bladder wall space occupying lesion, hypodense&rounded in shape	An enhanced well demarcated space occupying lesion in Rt bladder wall (0.5 cm diameter&1.5 cm thickness), no invasion of bladder walls		Slightly hyperintense, no invasion of bladder walls

Table (4): CT Characteristics of patients with Carcinoma of urinary bladder

Nature	**Site**	**Shape**	**Measurements in cm**		
			Width Or diameter	**length**	**Thickness**
	(N, %)		**Mean ± SD (Range)**		
Mass (N=10)	**Lateral wall** (6, 60%) **Near urethral orifice** (4, 40%)	**Oval** (4, 40%)	2±1.1 cm (1-3.5)	1.6±0.6 cm (1-2.5)	2.3±1.0 cm (1-3)
		Rounded (5, 50%)	1.8±0.9 cm (0.5-3)	-----	2.1±0.5 cm (1.5-3)
		Cauliflower (1, 10%)	3	2	2
Wall thickening (N=5)	**Bladder wall** (5, 100%)		4±1 cm (3-4)		

Figure (2): Site of mass of urinary bladder Carcinoma

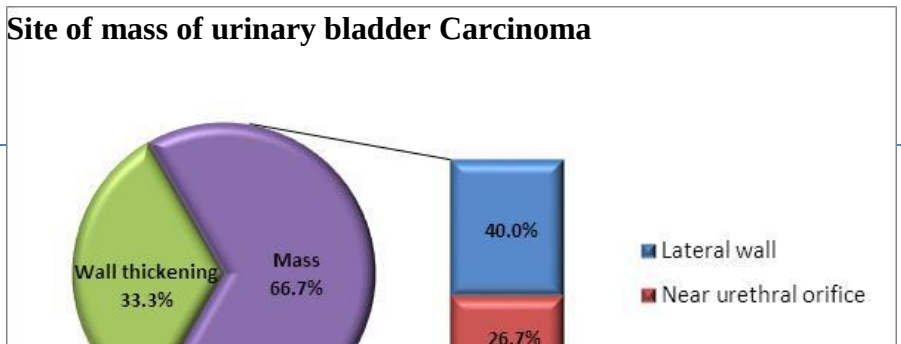
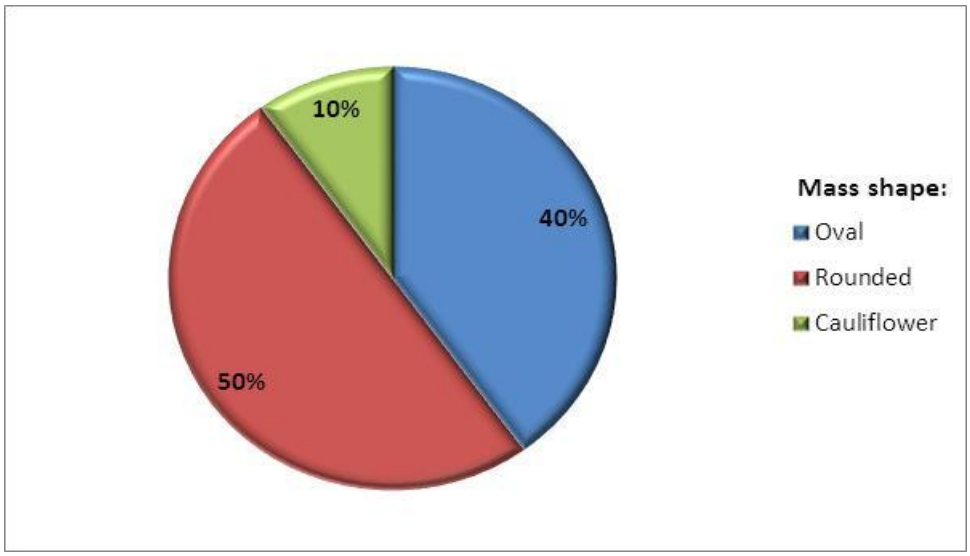


Figure (3): Shape of mass of urinary bladder Carcinoma



15 cases of UB soft tissue mass lesions (10 cases) or focal thickening (5 cases) were detected at **MDCT**. All patients were diagnosed by MDCT criteria to be UB carcinoma (confirmed by biopsy as TCC). All focal thickening lesions were found in UB walls. As regards masses, most lesions were detected in the lateral wall 6/10 (60%) while 4/10 (40%) of masses were identified near urethral orifice. Half of detected masses were rounded in shape with mean ± SD of 1.8 ± 0.9cm and 2.1 ± 0.5cm for diameter and thickness, respectively. Oval-shaped masses were identified in 4/10 (40%) with mean ± SD of 2.0 ± 1.1 cm, 1.6 ± 0.6cm and 2.3 ± 1.0cm for width, length and thickness, respectively. One case was cauliflower in shape. It was 3 ×2×2.By **MRI**, lesions appeared to beiso-intense to muscle in T1, and slightly hyperintense to muscle in T2, **table (5&6) and figure (2&3)**.

Table (5): Other findings in CT of patients with Carcinoma of urinary bladder

Nature	Other findings	N	%

Mass (N=10)	**Invasion of wall**	6	60.0
	Bladder outlet obstruction	3	30.0
	Hydroureter&hydronephrosis	1	10.0
Wall thickening (N=5)	**Calcifications**	1	20.0

Table (5) reveals other findings detected in cases with UB TCC. In UB masses, the most common finding was invasion of wall 6/10 (60%), followed by bladder outlet obstruction 3/10 (30%), and hydroureter&hydronephrosis in one case. One the other hand, only one lesion of focal wall thickening had been calcified.

Table (6): Findings of both CT & MRI in patients with Renal masses (TCC)

N	**CT**		**MRI**
	Without contrast	**With contrast**	**T1 &T2**
1	A well demarcated space occupying lesion lies at upper pole of right kidney lateral wall showing focal contour bulging.	Mildly enhanced well demarcated space occupying lesion lies at upper pole of right kidney lateral wall (2 cm width, 1.5 cm length & 2 cm thickness).	**All lesions are Isointense to renal parenchyma.**
2	Large irregular filling defect at pelvis of Rt kidney.	Large irregular filling defect appears in excretory phase in renal pelvis of Rt kidney well delineated (1 cm width -0.5 cm length – 1.5 cm thickness).	
3	large oval shaped soft tissue space occupying lesion obliterates Rt renal sinus fat & distorting renal outline with center of necrosis	Large mildly enhanced soft tissue space occupying lesion obliterates Rt renal sinus fat (3 cm width - 4 cm length – 3 cm thickness)	
4	Lobulated soft tissue space occupying lesion dilating the lower calyces of Rt kidney & extending into renal pelvis.	Lobulated soft tissue space occupying lesion with mild enhancement dilating the lower calyces of Rt kidney (3 cm maximum width, maximum length 2 cm& 2.5 cm thickness)	
5	Large irregular filling defect at upper calyces of Lt kidney.	Large irregular filling defect appears in excretory phase in upper calyces of Lt kidney (0.5 cm width -1 cm length – 1 cm thickness)	
6	Rounded shaped soft tissue space occupying lesion obliterates Rt renal sinus fat & distorting renal outline with center of necrosis.	Mildly enhanced soft tissue space occupying lesion obliterates Rt renal sinus fat (3 cm diameter – 1 cm thickness)	
7	Oval shaped soft tissue space occupying lesion in the lower	Mildly enhanced soft tissue space occupying lesion in the lower	

N	CT		MRI
	Without contrast	**With contrast**	**T1 &T2**
	calyces of Lt kidney.	calyces of Lt kidney (1 cm width - 2 cm length – 2.5 cm thickness)	

Table (7): CT Characteristics of patients with TCC of kidney

Site	**Shape**	**Measurements in cm**		
		Width Or diameter	**Length**	**Thickness**
(N, %)		**Mean ± SD (Range)**		
Upper pole (1, 14.3%)	**Oval** (2, 28.6%)	2±1.4 cm (1-3)	3.0±1.4 cm (2-4)	2.8±0.4 cm (2.5-3)
Renal Pelvis (1, 14.3%)	**Filling defect** (2, 28.6%)	0.8±0.4 cm (0.5-1)	0.8±0.4 cm (0.5-1)	1.3±0.4 cm (1-1.5)
Renal sinus (2, 28.6%)	**Rounded** (1, 14.3%)	3 cm	----	1 cm
Upper calyces (1, 14.3%)	**Bulging** (1, 14.3%)	2 cm	1.5 cm	2 cm
Lower calyces (2, 28.6%)	**Lobulated** (1, 14.3%)	3 cm	2 cm	2.5 cm

Table (8): Other findings of patients with TCC of kidney

	N	**%**
Distortion of renal outline	2	28.6
Central necrosis	2	28.6
Obliteration of renal sinus fat	1	14.3
Extension to renal pelvis	1	14.3

Table (8) reveals other findings detected in cases with renal TCC. More than one quarter of lesions 2/7 (28.6%) caused distortion of renal outline. In another one quarter of lesions, central necrosis was identified.Both obliteration of renal sinus fat and extension to renal pelvis was detected in one lesion.

Table (9): Findings of both CT & MRI in patients with Renal masses (RCC)

N	CT		MRI	
	Without contrast	**With contrast**	**T1**	**T2**
1	A well demarcated space occupying lesion lies at posterior wall of upper pole of left kidney showing Focal contour bulge, with soft tissue density 55 HU	Mildly enhanced well demarcated space occupying lesion lies at upper pole of left kidney posterior wall with soft tissue density 55 HU (3 cm width, 2 cm length & 3 cm thickness).	**All lesions are Heterogeneous mixed hyper & hypo intense due to hemorrhage necrosis**	**Hyperintense to renal parenchyma.**
2	Slightly rounded solid space occupying lesion at lower pole of Lt kidney with focal contour bulge.	Large homogeneously enhanced soft tissue space occupying lesion arising from lower pole of Lt kidney (5 cm diamter&4 cm thickness).		
3	Small oval solid soft tissue space occupying lesion bulging from lateral border of lower pole of Rt kidney	Small homogeneously enhanced soft tissue space occupying lesion at lower pole of Lt kidney confined to renal capsule (1.5 cm width, 2 cm length & 2.5 cm thickness)		
4	Small oval solid soft tissue space occupying lesion bulging from lateral border of upper pole of Rt kidney	Small well defined homogeneously enhanced soft tissue space occupying lesion affecting lateral border of upper pole of Rt kidney (6 cm width, 3 cm length &4 cm thickness).		
5	Rt kidney shows a pelvic irregular filling defect	An ill-defined minimally enhanced space occupying lesion could be detected involving lower pole of Rt kidney and protruding into its pelvis (8mm width, 2mm length& 3mm thickness).		
6	Large oval solid soft tissue space occupying lesion bulging from lateral border of lower pole of Lt kidney	Large heterogeneously enhanced well-defined soft tissue space occupying lesion bulging from lateral border of lower pole of Lt kidney (5 cm width, 4 cm length &3 cm thickness)		
7	Large slightly rounded solid space occupying lesion at upper pole of Rt kidney with Focal contour bulge	Large heterogeneously enhanced soft tissue space occupying lesion arising from upper pole of Rt kidney (3 cm diameter& 2 cm thickness)		
8	Small oval solid soft tissue space occupying lesion	Small homogeneously enhanced Lt renal soft tissue space occupying		

	bulging from lower pole of Lt kidney withfocal contour bulge.	lesion confined to renal capsule (2 cm width, 1.5 cm length & 2.5 cm thickness)		
9	Lt kidney shows a pelvic irregular filling defect	An ill-defined heterogeneously enhanced space occupying lesion protruding into the pelvis of Lt kidney (4mm width, 1mm length& 2mm thickness)		
10	Rt kidney shows lower pole irregular filling defect	An ill-defined heterogeneously enhanced space occupying lesion could be detected involving lower pole of Rt kidney (4mm width, 2 length & 1.5mm thickness)		

Table (10): CT Characteristics of patients with RCC of kidney

Site	**Shape**	**Measurements in cm**		
		Width Or diameter	**length**	**Thickness**
(N, %)		**Mean ± SD Range**		
Upper pole (3, 30%)	**Oval** (4, 40%)	3.6±2.2 cm (1.5-6)	2.6±1.1 cm (1.5-4)	3.0±0.7 cm (2.5-4)
Lower pole (5, 50%)	**Filling defect** (3, 30%)	5.3±2.3 cm (4-8)	1.7±0.6 cm (1-2)	2.2±0.8 cm (1.5-3)
	Rounded (2, 20%)	4.0±1.0 cm (3-5)	-----	3.0±1.0 cm (2-4)
Renal Pelvis (2, 20%)	**Bulging** (1, 10%)	3 cm	2 cm	3 cm

Figure (4): Site of renal RCCmasses

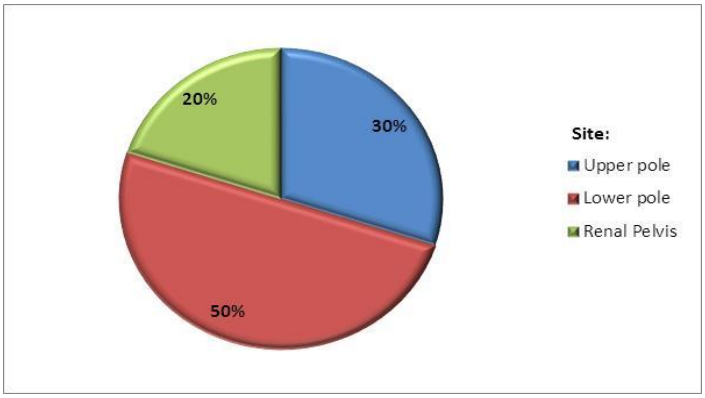


Table (11): Findings of both CT & MRI in infants with Renal masses (wilm's tumor)

N	CT		MRI	
	Without contrast	**With contrast**	**T1**	**T2**
1	Huge space occupying lesion involving upper pole of Rt kidney	Heterogeneously enhanced soft tissue space occupying lesion involving upper pole of Rt kidney (7 cm width, 6 length & 8 cm thickness)	**Hypointense to renal parenchyma**	**Hyperintense to renal parenchyma**
2	Large soft tissue space occupying lesion arising from inferior portion of lt kidney	heterogeneously enhanced soft tissue space occupying lesion with well-defined margins (11 cm width, 11 length & 9 cm thickness) A claw of renal parenchyma was identified around part of lesion		

Table (12): Findings of both CT & MRI in patients with urolithiasis

N	CT		MRI
	Without contrast	**With contrast**	**T1& T2**
1	RT vesicoureteric junction hyper-dense lesion, rounded in shape with 1024 Hounsefield Units, 5 mm in diameter, and 1 cm in thickness.	**Contrast obscures previously detected stone.**	**All lesions are signal void**
2	LT upper ureteric hyper-dense lesion, rounded in shape with 220 Hounsefield Units, 4 mm in diameter, and 2 cm in thickness.		
3	Hyper-dense lesion at pelvis of RT kidney, oval in shape with 440 Hounsefield Units, 1 cm maximum width, 0.5 cm in length and 1.5 cm in thickness.		
4	Hyper-dense lesion at pelvis of LT kidney, oval in shape with 1600Hounsefield Units, 0.5 cm maximum width, 1 cm in length and 2 cm in thickness.		
5	Hyper-dense lesion at base of urinary bladder, oval in shape with 1040Hounsefield Units, 3 cm maximum width, 0.5 cm in length and 3 cm in thickness.		
6	Hyper-dense lesion at upper pole of LT kidney, oval in shape with 1600Hounsefield Units, 0.5 cm maximum width, 1 cm in length and 2 cm in thickness.		
7	Hyper-dense lesion at upper pole of RT kidney, oval in shape with 1600Hounsefield Units, 1 cm maximum width, 0.5 cm in length and 1.5 cm in thickness.		
8	Hyper-dense lesion at lower pole of RT kidney, rounded in shape with 400Hounsefield Units, 1 cm diameter and 2 cm in thickness.		
9	Hyper-dense lesion at upper pole of LT kidney, rounded in shape with 400Hounsefield Units, 2 cm diameter and 1.5 cm in thickness.		
10	LT mid ureteric hyper-dense lesion, rounded in shape with 220 Hounsefield Units, 5 mm in diameter, and 1 cm in thickness.		

Table (13): CT Characteristics of patients with urolithiasis

Site	**Shape**	**Measurements in cm**			**HU**
		Width Or diameter	**length**	**Thickness**	
N (%)		**Mean ± SD Range**			**Mean ± SD Range**

Site	Shape	Measurements in cm			HU
		Width Or diameter	length	Thickness	
Upper pole (3, 30%) **Renal Pelvis** (2, 20%)	**Oval** (5, 50%)	1.2±1.0 cm (0.5-3)	0.7±0.3 cm (0.5-1)	2.0±0.6 cm (1.5-3)	854.4±588.8 cm (220-1600)
Lower pole (1, 10%) **Upper ureteric** (1, 10%) **Mid ureteric** (1, 10%) **Vesico-ureteric** (1, 10%) **Base of urinary bladder** (1, 10%)	**Rounded** (5, 50%)	3.4±1.8 cm (1-5)	-----	1.5±0.5 cm (1-2)	

Table (12&13) demonstrates that ten urinary tract calculi were detected by **MDCT** in ten patients. Near one third of them 3/10 were detected in the renal upper pole, 2 stones (20%) were identified in the pelvis while one stone were detected in every of lower pole upper ureteric, mid ureteric, vesico-ureteric, and base of the urinary bladder. Half of the detected stones were oval in shape with mean ± SD of (1.2 ± 1.0) cm, (0.7 ± 0.3) cm and (2.0 ± 0.6) cm for width, length and thickness, respectively. Another half of calculi were rounded with mean ± SD diameter of (3.4 ± 1.8) cm and thickness of (1.5 ± 0.5) cm. HU of calculi was large (mean ± SD = 854 ± 588.8) cm. At **MRI**, all stones appeared as filling defect in T1 and T2.

Discussion

Hematuria is a common urological problem that accounts for 4%–20% of all urologic visits. The prevalence of asymptomatic microscopic hematuria varies from 0.6%–21% and is among the most important clinical signs of a urologic malignancy [7, 8 & 9].

The goal of imaging is to detect neoplasms, including renal cell carcinoma (RCC), and the less prevalent transitional cell carcinoma (TCC), of the renal pelvis and ureters, urinary tract calculi, renal cystic disease, and obstructive lesion [4].

There is no universal agreement about the optimal imaging work-up of hematuria. Traditionally, excretory urography (intravenous pyelogram) was the standard, but the establishment of this practice preceded the development of high-quality ultrasonography, CT, and magnetic resonance imaging (MRI).

This study was carried out on 50 patients complaining of hematuria

(37 males and 13 females). The patients' ages ranged between 1 and 70 years old.

The results of the present study showed that 15 cases of UB carcinomas were accurately diagnosed by MDCT. The results in this study go with that of ***Sung et al.*** [10] who stated that, there are benefits from using MDCT as the initi bladder examination.

Regarding solid renal masses, ten cases of RCC were diagnosed using MDCT in the current work. Similarly,***O`Connor et al.,*** [14],and ***Bilodeau and Asadov*** [15] reported diagnosing many cases of RCCs using MDCT.

First, MDCT can be used to evaluate both the upper and lower urinary tracts in one session. **Second**, performing MDCT before conventional cystoscopy or trans-urethral biopsy can improve the local staging of bladder cancer because MDCT does not induce tissue edema and perivesical changes that can mimic perivesical tumor extension.

Also, CT urography can be helpful in assessing the upper tracts for synchronous or metachronous urothelial neoplasms in patients with current or previously treated bladder cancers [11].

MRI has excellent soft tissue resolution and multiplanar capabilities, which has made it an important staging modality for bladder cancer. Fundamental to its importance in local staging is the ability to manipulate image contrast by using different sequences. On T2-weighted images the bladder tumor is usually more conspicuous [12].

Regarding **renal masses**, MDCT is actually the most effective method in the detection and characterization of renal masses [4].

MDCTU is the single most effective imaging modality for the diagnosis and staging of RCC. In the majority of patients, it is the only imaging test needed prior to surgical management and for follow up [13].

The importance of the corticomedullary phase in detection and staging of RCC was agreed upon with other authers such as, ***Bilodeau and Asadov*** [15] who reported that the corticomedullary phase is essential for accurate staging of RCC during which maximal opacification of the renal arteries and veins occur. Accurate delineation of the arterial anatomy is helpful in selected cases to plan nephron-sparing surgery. In addition, hypervascular metastases to the liver are most conspicuous in this phase.

In the current study at MRI, renal cell carcinoma lesions appeared to be heterogeneous mixed hyper &hypointense due to hemorrhage necrosis in T1, and hyperintense to renal parenchyma in T2. MRI is not only excellent at imaging the kidneys and locally staging tumor, but is also able to suggest the likely histology [16].This is, in part, due to the fact that MR imaging offers superior soft tissue contrast resolution and better detection of contrast enhancement [17].

Three lesions were identified on the renal pelvis or sinus and ranged in size from small filling defects to large lobulated and bulging masses. These findings was comparable with ***Vikramet et al*** [18] who reported that renal lesions of TCC are usually centered in renal pelvis rather than the renal parenchyma as is the cases of RC.

In the current study on MRI, renal TCC lesions appeared to be isointense to renal parenchyma in T1 and T2. At this stage these is a little role for MR urography outside of research and in selected patients with allergy to iodinated contrast [19].

In this study, the unenhanced phase of MDCT examination provides optimal evaluation of all urinary calculi as well as evaluation for secondary signs of obstruction. We were able to detect 10 stones in 10 patients some were obstructing while others were not. Hydronephrosis and hydroureter were readily recognized by axial, coronal or sagittal reformatted images as a dilatation of the collecting system and ureter. Calculi can be detected a any site of UT: calyceal, renal pelvis, upper, middle, lower ureteric and UB [20].

These results agreed with ***Cowan*** [21], who stated that the unenhanced portion of their CT examination provides optimal evaluation of all urinary calculi as well as evaluation for the level of obstruction and demonstrate reliable secondary signs of obstructing calculi.

Urological management of urinary tract calculi relies on several different factors such as stone size, location, number, anatomy and chemical composition. Precise pre-treatment determination of urinary stone composition is essential and considerably impacts appropriate management [22, 23, 24 & 25]. More recently, CT is being increasingly used for the *in vivo* determination of stone composition and the emergence of new technological innovations such as Dual-Energy Computed Tomography (DECT) permits reliable determination of stone composition [25]. The HU measurements of the various urinary stones at 120 kV usually fall under the following range: Uric acid, 200–450 HU; struvite, 600–900 HU; cysteine, 600–1100 HU; calcium phosphate, 1200–1600 HU; and calcium oxalate monohydrate and brushite, 1700–2800 HU [20].

In the present work renal calculi produce no signal on MRI. However stones were visualized as a filling defect in the ureter and collecting system. ***Smith et al.,*** [26] stated that stone are not seen on MRI because they produce no signal.Note that MR urography is relatively insensitive for the detection of renal and ureteral calculi when compared to CT scanning [27, 28, 29, 30, 31, 32, 33].

In fact, the results of our study are encouraging and demonstrated that many

causes of hematuria could be successfully detected with MDCT and MRI. This agreed with the results of ***Peter et al.*** [34] who were able to diagnose many renal, ureteral, and bladder abnormalities using MDCT. To date, magnetic resonance (MR) urography has been used in patients with urinary tract dilation or urinary obstruction who either cannot receive iodinated contrast material or in whom imaging using ionizing radiation is undesirable [35, 36]. As such, the patient populations in which this modality has been most widely used include children and pregnant patients [17].

Regarding other causes of hematuria were detected in this study, there were three cases of renal trauma diagnosed by MDCTU.According to American College of Radiology (ACR), MDCTU was useful to assess the integrity of the urinary tract status post trauma, particularly in situations in which cross-sectional imaging is unavailable or inappropriate [17].

Limitation of the study:

There were limitations to this study. First, although a variety of lesions were seen, our study population consisted of small numbers of patients with each of these abnormalities. With respect to detecting neoplastic disease in the upper collecting tracts, a large number of patients would be needed to assess the effectiveness of MDCT and MRI because the frequency of ureteral tumors is small.

Conclusion

This study was conducted to assess the role of CT and MRI in evaluating causes of hematuria.

This study revealed the following conclusions:

- Both CTU and MRU can detect stones, but CTU can also differentiate types of stones and measure their sizes.
- Both CTU and MRU can diagnose urinary tract neoplasms, MRU is more useful in tissue discrimination, as MRU offers superior soft tissue resolution and CTU is more helpful in local staging.

Recommendations

Based on the findings revealed from this study, the following is recommended:

- CTU without contrast is the first modality in cases of hematuria due to its easy availability, short time of examination and high accuracy in detection of urinary tract calculi, and excluding other abnormalities.
- CTU with contrast is a good modality for diagnoses of urinary tract neoplasms, confirmation of invasion and local staging, however, this examination has very big limitations, especially when I.V. contrast is contraindicated.
- MRU is a perfect alternative modality for diagnoses of urinary tract neoplasms with high accuracy of tissue discrimination, in patients in whom I.V. contrast is contraindicated.

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