Original Article

Correlation and comparison of CT Urography and non contrast MR Urography in evaluation of malignant urinary tract lesions- A study of 54 patients

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ABSTRACT

Background: Now a day with wider availability of multislice CT scanner and modern MR machines, it is possible to characterize various malignant urinary tract lesions with greater details on imaging.

Aims and objective : To characterize various malignant urinary tract lesions on the basis of their location, internal characteristics, adjacent and distant spread and histopathological correlation on imaging by CT Urography and non contrast MR Urography and to compare the results by these two modalities.

Material and Method: Selected patients underwent CT urography in 16 slice CT scan machine and non contrast MR urography in 1.5 T 16 channel MRI machine.

Results: Kidney is most commonly involved organ by malignant lesions in urinary tract with renal cell carcinoma is frequently observed malignancy. CT Urography is better modality for internal characterization and adjacent vascular spread of malignant lesion than non-contrast MR Urography.

Conclusion: For internal characterization and spread of malignant urinary tract lesions, CT Urography is better modality than non-contrast MR Urography.

Key words: CT Urography, non contrast MR Urography, malignant lesions, urinary tract.

INTRODUCTION

Over the years, the use of intravenous urography (IVU) has become somewhat less due to the advent of cross sectional imaging, but nevertheless remained in general use because of its low cost. IVU has the disadvantage of using ionizing radiation and iodinated contrast media, both of which contribute to some extent to morbidity and mortality [1]. The use of ionizing radiation may also be an issue, particularly in children, young adults and obviously during pregnancy.

Ultrasonogram has significantly reduced the referrals for IVU as it is safe, non-invasive method of assessment of urinary tract dilatation, but visualization of non-dilated collecting system needs contrast opacification [2]. However above mentioned non-ionic contrast media cannot be administered in patients with poor renal function.

Till recently i.e. for the last three decades, all renal masses detected by urography or retrograde studieswere subjected to surgical exploration due to the inability to differentiate between benign and malignant lesions preoperatively. As expected, the IVU could only indicate the presence of a mass. The exact site of the mass and evaluation of its internal characteristics, adjacent and distant spread required cross sectional imaging i.e. multislice CT or MRI.

Although CT urography is nearing its potential interms of spatial resolution, tissue differentiation,and elucidation of the renal anatomy, non contrastMR urography is an evolving group of techniques with the potential to noninvasively provide the most comprehensive and specific imaging test available for many urinary tract abnormalities without the use of ionizing radiation [3,4].

Non contrast MR Urography allows multiplanar imaging, good soft tissue contrast and resolution and no need for contrast agents. So it is useful for imaging of non – functioning kidneys. There is lack of ionizing radiation with this procedure, so it is useful in children, during pregnancy [3] and those who require repeated examination of urinary tract.An advantage of CT urography is that CT urography can depict not only opacified ureters but also unopacified ureters, which cannot be visualized on non contrast MR urography.

Anatomy of kidneys

Kidneys lie retroperitoneally along the lateral borders of psoas muscles. They lie obliquely with extent is from upper border of L1 vertebra to lower border of L3 vertebra. On longitudinal section, kidney is made up of outer cortex, central medulla and internal calyces and pelvis. The Collecting system of urinary tract comprises of upper urinary tract, which consists of main urinary outflow conduits from the kidney (renal calyces, renal pelvis and ureter). The lower urinary tract consists of urinary bladder and urethra (This separation is arbitrary). Malignant lesions of kidneys include Wilm's tumor, renal cell carcinoma, transitional cell carcinoma of renal pelvis, multiple myeloma, metastatic lesions, etc.

Anatomy of ureters

Ureters are muscular tubes that course from renal pelvis to bladder in retroperitoneum. Adult ureter measures 25 – 30 cm in length and continuous superiorly with the funnel shaped renal pelvis. The ureteric diameter is about 3 mm and it has three constrictions along its course. a) Where the renal pelvis joins the ureter. b) At the pelvic brim where it crosses the iliac vessels c) where it traverses the vesicle wall (narrowest part). These constrictions (stricture mimics) should be interpreted with care. Malignant lesions involving ureters include transitional cell carcinoma, metastatic lesions.

Anatomy of urinary bladder

The urinary bladder is a hollow muscular organ and is solely a reservoir of urine. The ureters enter the posterolateral angles and urethra leaves inferiorly at the narrow neck which is surrounded by internal urethral sphincter. Superiorly it is loosely covered by peritoneum, which separates it from loops of small bowel and sigmoid colon. The bladder is an extraperitoneal structure Adult bladder has a capacity of 350-450ml.Malignant lesions of urinary bladder include transitional cell carcinoma, squamous cell carcinoma, metastatic lesions.

MATERIAL AND METHODS

Sample size, study area& duration of study: Total 54 patients were selected for present study. Patients were coming at M.P. Shah Medical College and G.G.Hospital, Jamnagar, Gujarat from December, 2013 to December, 2015.

Methodology: Patients are selected for this study who presented with clinical symptoms and signs related to urinary tract diseases as well as suspicious malignant lesion on IVU or Ultrasonogram. All selected patients undergone both CT Urography and non contrast MR Urography. Results checked by two radiologist and final comparative data given with counting risk factor of ionizing radiation and intra venous contrast toxicity.

Description of tools:

Clinical: All the patients were subjected to detailed clinical history and examination**.**

Investigation: Routine blood investigations were documented in needy patients like complete haemogram, which includes Haemoglobin level, total and differential white blood cell count, erythrocyte sedimentation rate and serum creatinine level.

Radiological investigations:

It includes Magnetic resonance imaging (MRI) and Computed tomography UrographyMRI system consists of the following sequences.(Magnetic resonance imaging Machine: 1.5 T MagnetomEssenza Siemens, 16channels.)

1. **Coronal T2-weighted half Fourier single-shot turbo spin echo sequence (HASTE) (TR infinite, TE 120 ms, flip angle 90°, breath-hold),** serving as a localizer, but also supplying valuable T2-weighted information. The limitation of this sequence is arelatively low signal-to-noise ratio**.**
2. **Axial T2-weighted turbo spin echo sequence with fat suppression (TR 2,000 ms, TE 100 ms, flip angle 90°, respiratory triggering).** This sequence provides for more detailed T2-weighted information. The T2-weighted sequence is especially helpful in characterizing cysts and intraparenchymal abscesses and in evaluating hydronephrosis. Furthermore, the T2-weighted sequence is helpful in detecting solid lesions.

3. **Axial T1-weighted gradient echo sequence, in-phase and opposed-phase (TR 180 ms, TE 2.3 ms/4.6 ms, flip angle 90°, breath-hold), preferably asdual-echo sequence**. Many solid renal lesions are hypointense compared to the renal parenchyma on T1-weighted images, but lesions with haemorrhage, lesions with macroscopic fat, melanin-containing lesions and cysts with high protein content may show hyperintense signal. Opposed-phase T1weighted gradient echo sequences can be used to prove the presence of small amounts of fat.

Computed tomography Urography

(Machine: 16-slice Computed tomography scanner)In multi–detector row Computed

tomography urographic procedure with imagesobtained during unenhanced, nephrographic, early excretory, and delayed excretory phases. The unenhanced images are obtained through the abdomen and pelvis at 4 × 3.75-mm collimation each (four detector rows at 3.75-mm collimation) and are reconstructed at a 5-mm section thickness. Nephrographic phase images are obtained 100 seconds after the initiation of an intravenous injection of low-osmolality nonioniccontrast material (150 ml of Omnipaque300 at 3 ml/sec). Nephrographic phase images are obtained from the diaphragm through the kidneys by using 4 × 2.5-mm collimation and reconstructed at 5-mm section thickness. Early and late excretory phase images were obtained at 300- and 450-second delays, respectively, with the following technique: 4 × 1.25-mm collimation, reconstructed section thickness of 2.5 mm, and 50% (1.25-mm) overlapping intervals. Allimaging examinations are performed at 120 kVp and 120–280 mA. Three-dimensional reconstructions of the twoexcretory phase scans are created at an independent workstation.

Inclusion Criteria:

a) Patients with clinical symptoms of malignanturinary tract lesions.
b) Suspicious malignant urinary tract lesion on IVU or Ultrasonogram.
c) Incidentally detected lesions of urinary tract lesion on IVU or Ultrasonogram.
d) Previous history of contrast allergy.
e) Renal failure
f) Poorly functioning kidneys where contrast is contraindicated.

Exclusion Criteria:

a) Cardiac Pacemaker
b) Metallic implants
c) Claustrophobia
d) Non co-operative patient
e) Excessive fluid in bowel loops
f) Pregnant or lactating women

Ethical clearance: Ethical clearance has been taken from the ethical committee of the institute.

RESULTS

In our study, total 54 patients were diagnosed to have malignant urinary tract lesion on both CT Urography and non contrast MR Urography. The findings in both of these modalities were compared.

In our study, out of 54 patients, 21 (38.88%) patients belong to age group between 50-59 years.

The gender distribution in our study shows male preponderance. Total 39 (72.22%) males and 15 (27.77%) females were affected and Male: Female ratio was 2.6:1.

Table-1: Age and Gender Distribution

Age(years)	No of patients (%,n=54)
40-49	12 (22.22%)
50-59	21 (38.88%)
60-69	18 (33.33%)
70-79	3 (5.55%)
80-89	0

Table 2: Site of Malignancy

Site of malignancy	CT Urography (%,n=54)	Non-contrast MR urography (%,n=54)
Kidney	32 (59.25%)	32 (59.25%)
Ureter	3 (5.55%)	3 (5.55%)
Bladder	19 (35.18%)	19 (35.18%)

In our study, most of malignancy involves kidneys in 32 (59.25%) out of total 54 patients.

Table 3: Type of malignancy on histopathology

Type of neoplasm	(%,n=54)
Typical renal cell Carcinoma	24 (44.44%)
Atypical renal cellCarcinoma	3 (5.55%)
Ureteral transitional cell Carcinoma	3 (5.55%)
Bladder squamous cell Carcinoma	8 (14.81%)
Bladder transitional cell Carcinoma	13 (24.07%)
Metastatic renal cell Carcinoma	3 (5.55%)

In our study, most of malignancy is renal cell carcinoma – 27(50%) patients out of 54 with malignancy).

Table 4: Internal characteristics of malignancy

Internal characteristic of Malignancy	CT Urography (n=54)	Non-contrast MR urography (n=54)
Calcification	16 (29.62%)	0
Hemorrhage	3 (5.55%)	3 (5.55%)
Necrosis	22 (40.74%)	22 (40.74%)

Above table shows, internal characteristics of tumour (calcification, hemorrhage and necrosis) are better evaluated by CT urography than non-contrast MR urography

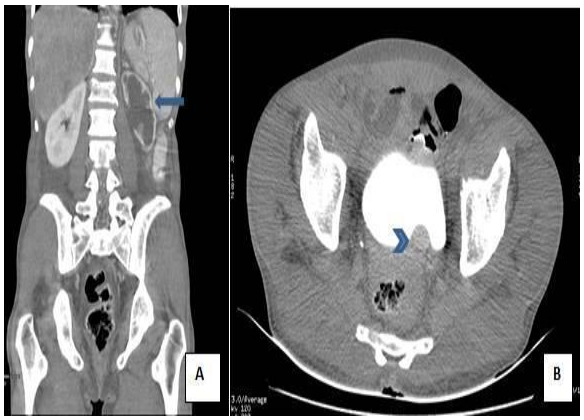
Table 5: Spread of malignancy

Spread of malignancy	CT Urography (n=54)	Non-contrast MR urography (n=54)
Metastatic	9 (16.66%)	9 (16.66%)
Adjacentorgan involvement	32 (59.25%)	32 (59.25%)
Renal veinthrombosis	6 (11.11%)	0 (0%)

In our study, the spread of tumour (direct infiltration or metastases) is better evaluated by CT urography than non contrast MR urography.

Out of 54 patients, the renal vein thrombosis was detected in 6 (11.11%) patients on CT urography which was not detected on non contrast MR urography
In our study, the spread of tumour (direct infiltration or metastases) is better evaluated by CT urography than non contrast MR urography.
Figure 1 and 2 nicely show left vesico-ureteric junction mass and right renal cell carcinoma respectively.

Figure 1 : Left vesico-ureteric junction mass: A (Coronal CT image in nephrogenic phase)- Left gross hydronephrosis with Hydroureter (arrow). B (Axial CT image in delayed phase)- A heterogeneously enhancing intra luminal soft tissue density lesion involving lower half of left ureter upto left vesicoureteric junction (arrow head).

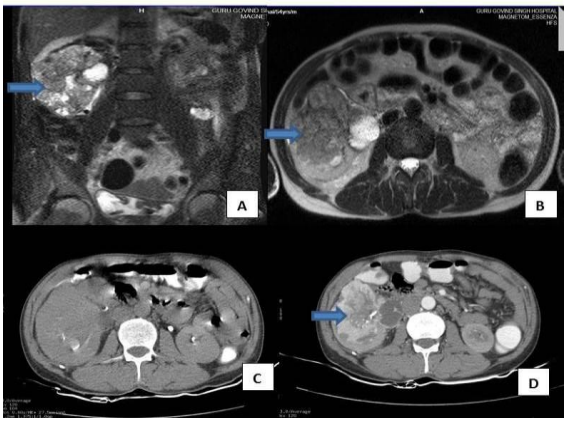


DISCUSSION

In our study, 54 patients were diagnosed having malignant urinary tract lesions on both CT urography and non contrast MR urography.
Out of 54 cases of malignant lesions in our study, the malignant lesions involves kidney in 32 (59.25%) cases, ureter in 3 (5.55%) case and urinary bladder in 19 (35.18%) cases. While in studies done by Caoili et al [5] and Maheshwari et al [6], urinary bladder is affected more by malignancy. This discrepancy in finding is mostly due to geographical variation in study population group.

In our study, out of 54 patients, the renal vein thrombosis was detected in 6 (11.11%) patients on CT urography which was not detected on non contrast.

Fig. 2 : right renal cell carcinoma: A and B (T2W MR Images) - Large well defined mass lesion (arrow) with internal cystic and necrotic areas arising from lower pole of right kidney.C and D (post contrast axial CT images) - Large well defined heterogeneously enhancing soft tissue density mass lesion (arrow) with internal cystic and necrotic areas arising from lower pole of right kidney.



MR urography. In study conducted by Hallscheidt PJ et al,14 (60.86%) patients out of 23 patients having malignant lesion are found to have renal vein thrombosis on CT urography, while 13 (56.52%) patients out of 23 patients detected having renal vein thrombosis on contrast MR urography. Discrepancy in results of two study is possibly due to use of contrast in MR urography in Hallscheidt PJ et al study [7].

CONCLUSION

The patients having malignant lesions are found in both CT urography and non contrast MR urography in equal number. However, the calcification as an internal characteristic of malignant lesion and involvement of renal vein is detected only in CT urography than non contrast MR urography. This concludes that for internal characterization of tumours and renal vein involvement by tumour, CT urography is better modality than non contrast MR urography.

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