

# Multi-detector CT Urography in the diagnosis of urinary tract abnormalities

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## Abstract

**Introduction:** Different imaging techniques are being used in the diagnosis of urinary tract abnormalities. IVU, magnetic resonance (MR) imaging, ultrasonography (US), computed tomography (CT), retrograde ureterography, pyelography, cystoscopy, and ureteroscopy are used to diagnose patients with urinary complaints. Non contrast MDCT is now routinely used to evaluate calculi, Renal masses, ureteral abnormalities and urinary bladder masses. Excretory-phase CT can now be used to evaluate the ureter. Preliminary results of excretory-phase CT demonstrate a high sensitivity (95%) in diagnosing upper urinary tract uroepithelial malignancy. CT usually demonstrates bladder disease, but flat tumours of the bladder are difficult to be identified with CT, and the cystoscopy remains the study of choice in evaluating for bladder malignancy. Now with the help of MDCT protocol, comprehensive evaluation of renal disease can be performed, **Material and Methods:** It is a retrospective study of 60 patients, From May 2013 to November 2014. 60 patients (41 male and 19 were females with mean age 44 yrs (age range 27 – 61 years) were selected in this study. All the patients underwent CT scan study with or without intravenous contrast medium. CT scan study was performed on a MDCT scanner (Siemens Medical Systems). **Result:** Out of 60 patients, 42 (70 %) had urolithiasis. The unenhanced CT examination provides adequate information of all urinary calculi and associated hydronephrosis. 18 cases (30 %) demonstrated non urolithiasis abnormality. Out of 18 cases, 6 (10 %) cases demonstrated unenhanced mass, 8 (13.33 %) cases demonstrated inflammatory changes. Congenital anomalies were found in 4 patients (6.66%). **Conclusion:** MDCT urography is the best modality with a combination of unenhanced, nephrographic-phase and excretory-phase in wide spectrum of urinary tract abnormalities. CT urography demonstrates both intrinsic and extrinsic abnormalities of ureter than IVU.

**Key words:** MDCT, Urinary tract, Urography, Urinary tract abnormalities.

## Introduction

Various imaging modalities are being used in the evaluation of patients with urinary tract abnormalities. In past imaging of urinary tract abnormalities in such patients was primarily carried out using intravenous urography (IVU) [1,2]. Currently, IVU, magnetic resonance (MR) imaging, ultrasonography (US), computed tomography (CT), retrograde ureterography and pyelography, cystoscopy, and ureteroscopy are used to evaluate patients with urinary complaints [3]. Non contrast CT is routinely used to evaluate for calculi and hydronephrosis. Renal masses are normally

characterized with CT, US, or MR imaging. IVU or retrograde ureterography and pyelography have traditionally been used to diagnose urothelial diseases. Excretory-phase CT can now be used to evaluate the ureters. Preliminary results of excretory-phase CT demonstrate a high sensitivity (95%) in diagnosing upper urinary tract uroepithelial malignancy. CT usually demonstrates bladder disease, but flat tumours of the bladder are difficult to be identified with CT, and cystoscopy remains the study of choice in evaluating for bladder malignancy [3].

Comprehensive evaluation of patients with a single examination is now possible with the arrival of spiral

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CT and MDCT in particular. CT urography can be performed with a combination of unenhanced, nephrographic-phase, and excretory-phase imaging. The plain CT images are ideal for detecting calculi. Renal masses are detected and characterized with a combination of unenhanced and nephrographic-phase imaging.

The excretory-phase images provide evaluation of the urothelium. Three-dimensional (3D) reformation of the excretory-phase images can produce images that mimic the appearance of intravenous urograms, thus providing images in a format that is very useful to referring clinicians. Alternatively, post-CT conventional radiography can provide similar information [4].

Greater speed of acquisition and higher resolution images are the advantages offered by Multi-detector row CT over single-detector helical CT. The more thin collimated transverse images obtained in a breath hold and the subsequent better quality of reformatted coronal images should further increase the ability of CT to depict the renal collecting systems accurately. The purpose of study is to evaluate role of multi-detector CT urography for detection of urinary tract abnormalities.

## Aims & Objectives

1. To evaluate efficacy of MDCT urography in various urinary tract abnormalities.
2. To study spectrum of MDCT urography in urinary tract abnormalities.

## Material and Methods

It is a retrospective study of 60 patients, From May 2013 to November 2014. 60 patients (41 male and 19 were females with mean age 44 yrs ( age range 27 – 61 years ) were selected in this study.

Patients with flank pain, burning micturition and hematuria were clinically suggestive of disorders related to urinary system.

All the patients underwent CT scan study with or without intravenous contrast medium. CT scan was done for all patients with or without administering intravenous contrast medium, except patients who had poor renal function or history of allergy and pregnant. CT scan study were performed on a MDCT scanner (Siemens Medical Systems) in Department of Radio diagnosis Peoples College of Medical Sciences and

Research Centre Bhopal (M.P) All imaging was performed with a 1.5:1 pitch, 40 detector rows, and a table speed of 15 mm per rotation. Typically, the examinations were performed at 120 kV and 340 mA with a rotation time of 0.8 seconds.

To facilitate 3D reformatting, orally administered contrast material was not used for this technique. Plain study images were obtained from the level of kidneys to the urinary bladder. Omnipaque non ionic contrast was administered intravenously at the rate of 2 mL/sec, and nephrographic-phase images of the abdominal organs were obtained. Following the injection of contrast material, a 250-mL of normal saline solution was administered rapidly by intravenous drip to distend the ureters. 8 minutes after contrast material administration excretory-phase images were obtained. Excretory-phase data was reconstructed and the resulting images were sent to a workstation. Maximum-intensity-projection (MIP) or volume rendering (VR) techniques were used for three-dimensional reformation. Although both techniques demonstrate the urinary tract well. The unenhanced images were obtained to assist in the characterization of renal masses and to evaluate the urinary tract for calculi.

Some investigators used arterial-phase images through the kidneys and bladder for evaluation of vascular abnormalities Lang EK et al [5]. Vascular abnormalities like aberrant renal veins and venous thrombosis can usually be seen on nephrographic-phase images. Others investigators advocate the addition of corticomedullary-phase imaging of the abdomen for better characterization of renal masses and particularly for better evaluation of the liver[6,7], but in our opinion, routine use of corticomedullary-phase imaging is not justified because of the potential risks posed by the additional radiation dose [8]. Recently with use of a dual contrast material bolus, excretory-phase imaging and nephrographic- phase imaging can be performed concurrently, thereby reducing the number of images and radiation dose to the patient [9].

## Results

Out of 60 patients, 41 (68.33 %) were men and 19 ( 31.66%) women.

Out of 60 patients, 42 (70 %) had urolithiasis. The unenhanced CT examination provides adequate information of all urinary calculi and associated hydronephrosis. 18 cases (30 %) demonstrated non

urolithiasis abnormality. Out of 18 cases, 6 (10 %) cases demonstrated masses. 8 (13.33 %) cases demonstrated inflammatory changes. Congenital anomalies was found in 4 patients (6.66%).

Non contrast CT examination diagnose all cases of urolithiasis, pre and post contrast CT urography is required is non urolithiasis group for better delineation of soft tissue lesions

## Discussion

Due to high resolution and fast scan by MDCT, it has become a promising modality for diagnosing various urinary tract abnormalities.

**Calculi:** Calculi of kidney, ureter and bladder are a common cause of hematuria. Twelve percent of people develop kidney stones at some point during their lifetime [10]. The unenhanced CT is the best imaging modality for evaluation of calculi in patients with history of renal colic [11, 12]. The unwanted side effects due to IV contrast medium during intravenous pyelography could also be prevented.

According to recent study, non contrast CT demonstrated superior sensitivity to IVU in detecting Renal tract calculi.

Conventional radiography may also detect urinal calculi but its sensitivity is less than the unenhanced CT [13]. Ultra Sound is also useful in detection of renal calculi and associated hydronephrosis. Although ureteric calculi are often not detected by Ultra Sound [14, 15]. In our study the unenhanced CT examination provides optimal detection of all urinary calculi and associated hydronephrosis.

**Renal Masses:** Patients with Hematuria presented frequently with renal masses. Differentiation of renal mass as a simple cyst, complex cyst or a solid mass is essential. Further evaluation of simple cyst is not required as they are benign. Complex cysts were evaluated for wall thickness, calcifications, presence and thickness of septa, foci of enhancement and attenuation of cyst. Cystic renal masses are characterized according to the Bosniak classification system [16, 17]. According to Bosniak classification system, simple cyst are classified as Category I lesions. Slightly more complicated lesions showing a few thin calcifications, thin septa, or high-attenuation fluid are Category II lesions. Category III lesions are still more

complex and might contain foci of wall or septal thickening. Lesions with solid enhanced areas are Category IV. Category I and II lesions are considered benign while Category III and IV lesions are considered malignant and require surgery. Small renal masses are difficult to characterize because of inaccurate evaluation of enhancement characteristics due to volume averaging [18].

MRI, CT and Ultra Sound imaging modalities are very well capable of differentiating renal cysts from neoplasms. Characterization of a renal mass for CT scan depends on unenhanced and enhanced CT imaging. The nephrographic phase is best phase for characterization of a renal masses [4, 19]. US can very well differentiate between cystic and solid renal masses but is less sensitive in detecting solid masses which may be isoechoic relative to normal renal parenchyma. MR imaging is also excellent for characterization of renal masses. Calcification in these masses is not clearly demonstrated by MR imaging..

**Renal Pelvic and Ureteral Disease:** Neoplasm, Calculus, Blood Clot or Vascular Impression represented as a filling defect in renal pelvis or ureter. Narrowing of the ureter is due to stricture or extrinsic disease. IVU or retrograde ureterography only demonstrate the lumen of the ureter so that extrinsic abnormalities of the ureter are not visualized. CT may directly demonstrate the vessel that is causing the extrinsic compression over the ureter. For better visualization arterial-phase imaging should be considered as additional study if there is a suspicion of crossing vessel as a cause of extrinsic impression on the ureter [9]. Both the periureteral and ureteral lumen abnormalities are well visualized in excretory-phase CT.

**Bladder Diseases:** Bladder abnormalities include neoplasm, usually transitional cell carcinoma, and less commonly squamous cell carcinoma and adeno cell carcinoma. The other abnormalities of urinary bladder were cystitis and diverticulum, Bladder distension is essential for optimal CT evaluation. CT cystography provides adequate contrast to visualize bladder diseases however flat tumors of the bladder may not be seen, therefore cystoscopy remains the standard examination for evaluation of bladder masses [20].

**Congenital Anomalies:** Congenital anomalies of kidney and ureter include anomalies of position, form and number. Most renal anomalies are well visualized

on MDCT, ureteral anomalies are best visualized by either IVU or excretory-phase CT [3,21].

## Conclusion

Many different modalities including CT, US, IVU and MR imaging demonstrate urinary tract abnormalities. MDCT urography is the best modality with a combination of unenhanced, nephrographic-phase and excretory-phase in wide spectrum of urinary tract abnormalities especially radiolucent stones and renal masses. CT urography demonstrates both intrinsic and extrinsic abnormalities of ureter than IVU. Excretory-phase imaging findings mimic IVU findings and allow excellent evaluation of collecting system and ureter.

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