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Original Research Paper

Radiodiagnosis

ROLE OF CT UROGRAPHY IN THE EVALUATION OF OBSTRUCTIVE UROPATHY

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ABSTRACT Obstructive uropathy refers to the structural or functional changes in the urinary tract that impede normal urine flow. Obstructive uropathy occurs in all age groups and can be due to many different causes. Radiological assessment is vitally important to assess the presence of obstruction, to establish the underlying etiology, and to monitor its progress. . A precise and accurate radiological diagnosis helps to plan appropriate treatment, which can enable restoration of normal drainage and prevent progressive and permanent decline in renal function. . Computed Tomography has virtually replaced all other imaging modalities for this purpose. The concept of CT Urography(CTU) is more appropriate as both the renalparenchyma and urothelium can be evaluated with one relatively non invasive comprehensive examination.Therationale for CT urography is that patients with obstructive uropathy can be fully investigated by a single imaging technique with a high degree of sensitivity and specificity. Multiplanar 2dimensional and 3dimensional reformation images are produced from axial source images during the excretory phase. acquisition of multiple thin overlapping slices provides excellent two-dimensional and three-dimensional (3D) reformations and facilitates virtual cystoscopy.

KEYWORDS : Multidetector computed tomography urography, obstructive uropathy, urinary stone disease

INTRODUCTION

Obstructive uropathy refers to the structural or functional changes in the urinary tract that impede normal urine flow. Obstructive nephropathy refers to the renal disease caused by impaired flow of urine or tubular fluid. Hydronephrosis refers to dilation of the urinary tract. Importantly, hydronephrosis is not synonymous with obstructive uropathy as it can occur without functional obstruction to the urinary tract and can be absent in established obstruction[1]

Obstruction of the urinary tract can occur in any part of the system, including the urethra, the bladder, ureters, or the renal pelvis, and depending on the duration and the specific nature of the blockage, urine may move as far up the urinary tract as the renal pelvis. Obstructive uropathy occurs in all age groups and can be due to many different causes. Radiological assessment is vitally important to assess the presence of obstruction, to establish the underlying etiology, and to monitor its progress. A precise and accurate radiological diagnosis helps to plan appropriate treatment, which can enable restoration of normal drainage and prevent progressive and permanent decline in renal function[2]. Plain film radiography, excretory urography, retrograde pyelography, and ultrasonography have been used in various combinations for the diagnosis of urinary tract stones and urinary tract obstruction in patients presenting with flank pain. Computed Tomography has virtually replaced all other imaging modalities for this purpose[3].

The concept of CT Urography(CTU) is more appropriate as both the renalparenchyma and urothelium can be evaluated with one relatively non invasive comprehensive examination. The rationale for CT urography is that patients with obstructive uropathy can be fully investigated by a single imaging technique with a high degree of sensitivity and specificity. Multiplanar 2dimensional and 3dimensional reformation images are produced from axial source images during the excretory phase. CT urography offers several advantages for imaging of the urinary tract: single breath-hold coverage of the entire urinary tract with absence of respiratory mis-registration, rapid imaging with optimum contrast medium opacification and reduced partial volume effect as appropriate slices can be selected.

In addition, acquisition of multiple thin overlapping slices provides excellent two-dimensional and three-dimensional (3D) reformations and facilitates virtual cystoscopy[4].

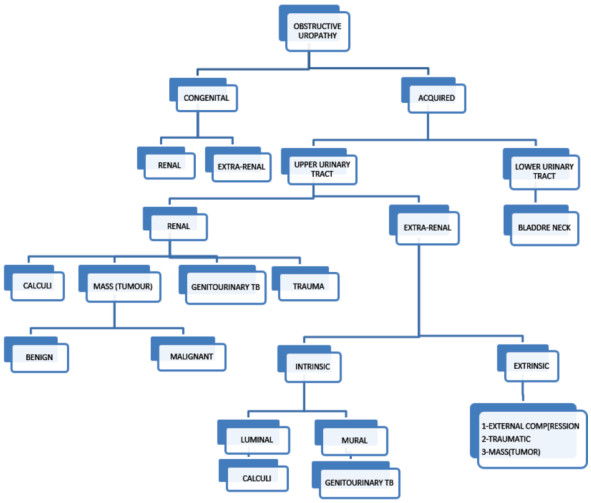
AIMS AND OBJECTIVES

1. To evaluate the cause and level of obstruction.
2. To assess the role and diagnostic accuracy of Computed Tomography Urography in the evaluation of renal function.

METHOD AND MATERIAL

Present descriptive cross sectional study were conducted on the 90 patient attending outdoor and indoor department of Radiodiagnosis of Maharani Laxmi Bai medical college,Jhansi from the period MAY 2019 to SEPT 2020 with signs and symptoms related to obstructive uropathy (flank pain, oliguria, anuria, hematuria.) in patients with serum creatinine less than 1.5mg/dl) by using PHILIPS- Multidetector 16 slice CT machine.

The CTU study does not require any special preparation. It avoids dehydration, promotes diuresis and acts as a negative contrast medium for the gastrointestinal tract. Up to 1,000 ml of water in 20–60 min before CT has been used .



OBSERVATION AND RESULT

Table 1: Distribution of cases according to cause of obstructive uropathy in percentage.

Causes of Obstruction	No. of Cases	Percentage of Cases
Calculi	39	43.3
PUJ Obstruction	15	16.6
Genitourinary T.B.	3	3.3
Congenital Malformation	3	3.3
Stricture	4	4.4
Trauma (Urionamas)	2	2.2
Mass (Tumour)	9	10.0
Extrinsic compression of ureter	8	8.8
Bladder neck obstruction	7	7.7
Total	90	100

Out of 90 patients the majority of patients with obstructive uropathy, the cause of obstruction was calculi, constituting (43.3%) of patients followed by PUJ Obstruction in 16.6% of patients

Table 2: Distribution of cases according to cause of PUJ obstruction

PUJ Obstruction Causes	No. Of Cases
Idiopathy	9
Calculi	5
Oragnised Clot	1
Total	15

Out of 15 cases with PUJ obstruction, idiopathic was commonest cause constituting 9cases.

SINGLE BOLUS TECHNIQUE	SPLIT BOLUS TECHNIQUE
Dosage and interval-Single-bolus CM injections use 100–150 ml of non-ionic CM injected at a rate of 2–3 ml/s. The nephrographic phase starts after a delay of 90–110 s after start of the CM injection, while for the final excretory phase a fixed delay of 240–480 s after the start of CM injection has been used.	Split-bolus CM injections use first injection of 30–50 ml at a rate of 2 ml/s, followed 2–15 min later by a larger second injection of 80–100 ml at 2–2.5 ml/s is used. Subsequently, the combinednephrographic–excretory phase is performed at 90 s after the second contrast dose[35].
Planes Acquired-1-Unenhanced phase: axial plane (3 mm thickness/3 mm reconstruction interval) 2-Nephrographic phase: axial and coronal planes (3 mm thickness/3 mm reconstruction interval) 3-Excretory phase: axial and coronal planes (3mm thickness/3 mm reconstruction interval)	1-Unenhanced phase: axial and coronal planes (3 mmthickness/3 mm reconstruction interval). 2-Combined nephrographic and excretory phase: axial and coronal planes (3 mm thickness/3 mm reconstruction interval) [36]
Radiation dose: High Radiation dose	Low Radiation dose[36]
Number of Images: The single-bolus technique produces a mean of 528 images.	The split-bolus group produces a mean of 371 images[35].
No streak artifact. More sensitive for the detection of smaller renal cell carcinomas since more post-contrast phases are available	There may be streak artifact present from contrast in the collecting system. Less sensitive for the detection of smaller renal cell carcinomas since fewer post-contrast phases are available
This technique has better contrast opacification and distension of the urinary tract.	This technique has poor contrast opacification and distension of the urinary tract since only a part of the total contrast bolus contributes to the excretory phase[36].
Advantages: 1- More sensitive for the detection of smaller renal cell carcinomas. 2-Produces a mean of 528 images. 3- This technique has better contrast opacification and distension of the urinary tract. 4-No streak artefact	1-Recommended in younger patients because it reduces the radiation dose.
Disadvantages: 1-More radiation exposure.	1-It is less sensitive for the detection of smaller renal cell carcinomas. 2-This technique has poor contrast opacification and distension of the urinary tract. 3- Streak artefact may be present. 4- Produces a mean of 371 images.

Table 3: Distribution of cases according to causes of bladder neck obstruction .

Bladder Neck Obstruction	No. of Cases
BPH	4
Cystitis	1
Bladder calculi	2
Total	7

Of 7 cases of bladder neck obstruction, BPH was commonest cause with 4 cases

Table 4: Distribution of cases according to obstruction by mass(tumor).

Nature of Tomour	No .Of Cases
Benign	4
Malignant	5
Total	9

Of 9 patients of obstructive uropathy by mass (tumour),4 cases were benign cause and 5 cases were malignant cause.

Table 5: Distribution of cases according to benign tumours.

Location	Causes	No. Of Cases
Renal	Angiomyolipoma	2
	Oncocytoma	1
Extra renal	Papilloma	1
Total		4

Table 6: Distribution of cases according to malignant tumours.

Location	Causes	No. of Cases
Renal	Renal cell carcinoma	2
	Lymphoma	1
Extra renal	Transitional cell Carcinoma	1
	Prostate Cancer	1
Total		5

In malignant tumour.as cause of obstruction, renal location was more common with 3 cases as compared to extra renal with 2 casesn malignant tumour.as cause of obstruction, renal location was more common with 3 cases as compared to extra renal with 2 cases

Table 7: Distribution of cases according to obstruction due

to congenital malformation

Congenital Anamoly	No. Of Causes
Duplex Ureter of Uretrocoele	1
Crossed Fused Ectopia (Functional Cause)	1
Malrotated Kidney with tortuous Megaureter	1
Total	3

In 3 patients showing both renal and extra renal as site of obstruction.

Table 8: Distribution of cases according to obstruction due to extrinsic compression of ureter

Extrinsic compression of ureter	No. of cases
Colon Cancer	1
Serous Cystadenoma	2
Dilated Bowel Loops (Instestinal obstruction)	3
Multi Loculated collection (Abdominal T.B.)	2
Total	8

Out of 8 patients of obstructive uropathy due to external compression of ureter, dilated bowel loops (intestinal obstruction) was commonest cause with 3 cases followed by multiloculated collection (abdominal tuberculosis) and serous cystadenoma of ovary with 2 cases each.

DISCUSSION

- In the present study, maximum number of cases of age group of the patients with obstructive uropathy were 26-35 yrs. This was consistent with the study by Garima Sharma et al in which maximum patients were of age group21-30 yrs[5]
- In the present study, there was male predominance which was 70% of patients. This was in agreement with the study by Sonali Mhaske et al in which 76% of patients were males[6].
- The most common presenting complaints in our study were loin pain (86.6%), which was consistent with the study by Garima Sharma et al[7].
- In our study, the sensitivity and the specificity of different MDCT techniques for calculi diagnosis were very high, reaching up to 100%, which was in agreement with Boulay et al., who stated that unenhanced CT has been found to have a high degree of sensitivity (95–98%) and specificity (96–100%) in the diagnosis of urolithiasis[8].
- Out of 90 patients, maximum cases of obstructive uropathy were by urolithiasis constituting 43.3% of the cases, which was consistent with the study by Mahmoud M Ahmed Moawad et al[9] in which urolithiasis constituted 46.6% of the cases. This was in agreement with Chevalier and Klahr[10], who reported that upper urinary tract obstructions usually involve renal stones that create a ureteral obstruction, and also agreed with Cronin et al. [11], who stated that the unenhanced portion of their CT examination provides optimal evaluation of all urinary calculi as well as the evaluation of the level of obstruction and demonstrates reliable secondary signs of obstructing calculi.
- In our study, more than one level of obstruction, were diagnosed by MDCTU, beginning from the PUJ, ureters (upper, mid, and lower ureters), and bladder neck obstruction, which agreed with Yarger, who stated that obstructive uropathy can occur in any part of the urinary tract including the urethra, the bladder, ureters, or the renal pelvis[12].
- The second most common cause of obstructive uropathy in this study was PUJ Obstruction which represented 16.6% of the cases, which was in agreement with K.K. Sen et al. [13]
- In this study, eight (8.8%) cases were diagnosed by MDCTU as ureteric compression and six cases showed bilateral compression upon ureter, two by large pelvic cystic lesion(serous cystadenoma of ovary), three cases by small bowel loops dilatation(intestinal obstruction) and one case by multiple pockets of collection (abdominal tuberculosis). Only two cases showed unilateral compression upon left ureter, exerting mild back pressure on the left side, one case was of colon carcinoma and another case of multiple pockets of collection (abdominal tuberculosis).

CONCLUSION

The study approved that majority cause of obstructive uropathy was due to calculi in urinary tract , commonly located at renal/pelvis site (left side obstructive uropathy was more common than right side).

CT Urography can very well differentiate acute from chronic cause of obstruction by outlining the structural anatomy and morphology of the urinary tract , helpful to detect incidental associated findings outside the urinary tract also .

The split bolus technique employed as CT Urography technique, significantly reduces radiation dose and should be employed in young patients , three-dimensional nature of MDCT urography that allows reconstructions in all planes , very sensitive for the detection of calcifications (stones) and is the technique of choice in the diagnosis and monitoring of tumors of the urinary system.

Multidetector CT urography detects the entire spectrum of urinary tract pathologies causing obstructive uropathy with high accuracy.

Multidetector CT urography has the potential to become a one stop shop for evaluation of urinary tract, especially in cases of obstructive uropathy which deranged the renal function.

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