Original Article

Role of Computed Tomography Urography in Evaluation of Patients with Obstructive Uropathy

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Abstract

Introduction: CT urography plays an important role in the diagnosis of many diseases of urinary tract and is one of the most advanced developments in uroradiology. The aim of the study is to evaluate role of CT urography in patients presenting with obstructive uropathy and finding its cause and level of obstruction.

Methods: This was a descriptive cross sectional study conducted in Department of Radio-diagnosis in Lumbini Medical College, Palpa, Nepal from June 1st, 2021 to May 31st 2022 .150 patients were enrolled presenting with unilateral or bilateral hydronephrosis diagnosed on ultrasound and were referred for CT urography for the cause and level of obstruction.

Results: Most common cause of urinary obstruction was due to calculus seen in 115 patients (76.7%). PUJ obstruction was seen in 17 patients (11.3%). Extrinsic ureteric obstruction was seen in six cases (4.0%). Ureteric stricture was found in five patients (3.3%). Urinary bladder mass was seen in four patients (2.7%). In three cases one was due to congenital anomaly and two cases were of ectopic ureter insertion. The most common level of obstruction was pelvis found in 50 patients (33.4%). PUJ obstruction was found in 47 patients (31.3%). 20 patients had upper ureter obstruction (13.3%). Distal ureter obstruction was found in 13 patients (8.7%) followed by VUJ obstruction of 10 patients (6.7%). Mid ureter obstruction was the least common site as found in eight patients (5.3%).

Conclusion: CT urography is a modality for evaluating urinary tract abnormalities, especially for obstructive uropathy. Our results showed it is exceptional in diagnosing cause and level of obstruction. The most common cause was stone and most common level was pelvis.

Keywords: *Computed tomography, etiology, obstruction, urography*

Introduction

Obstructive uropathy is defined as obstruction to normal flow of urine which can occur anywhere from renal tubules to urethral tract and can be either due to functional or structural abnormalities of the urinary tract.[1] Various imaging modalities are available to evaluate the patients of obstructive uropathy.[2] Multidetector computed tomography urography (MDCTU) detects not only the cause of obstruction but also its level. New MDCT scanners allow fast acquisition of images with increase in spatial and temporal resolution, volume coverage and reconstructions in any plane.[3] It also allows excellent visualization of any extrinsic causes of urinary obstruction.

Multidetector computed tomography urography (MDCTU) offers several advantages for the imaging of the urinary tract with single breath-hold coverage of the entire urinary tract and rapid imaging with optimum contrast medium opacification.[4] Multiplanar 2D and 3D reformation images can be generated from workshop from axial source images and facilitates virtual cystoscopy.

The aim of this study is to evaluate the cause and level of urinary obstruction in patients with obstructive uropathy using CT Urography.

Methods

This was a descriptive cross sectional study conducted in Department of Radio-diagnosis in Lumbini Medical College & Teaching Hospital, Palpa, Nepal for a duration of one year from June 1st, 2021 to May 31st 2022. Ethical approval was obtained from Institutional Review Committee of the institute (IRC-LMC 05 – B/021). 150 patients were enrolled presenting with unilateral or bilateral hydronephrosis diagnosed on ultrasonography and were referred for further evaluation with CT urography for the cause and level of obstruction. Informed and written consent was obtained from all the patients.

Inclusion criteria:

1. Patients with ultrasound diagnosed obstructive uropathy

Exclusion criteria:

1. Deranged serum creatinine (>2.5mg/dl)
2. Pregnancy
3. History of allergy to iodine contrast media
4. Past history of urinary tract surgery
5. Single kidney

Procedure

CT scan was performed with Siemens Somatom Scope 16 slice. Oral contrast was used depending upon the clinical situation. CT parameters for acquisition were with pitch of 1.4 and collimation of 16 x 1.2mm. Images were reconstructed at slice thickness of 1.5mm. Before beginning the procedure patient's serum creatinine was obtained on same day or within seven days' report was also accepted. Procedure was proceeded only if it was normal. Patient was cannulated with an 18G needle inserted at radial vein or antecubital vein on right hand. Plain CT KUB was taken from dome of diaphragm to below pubis symphysis caudally. Image was viewed by reporting radiologist. Then intravenous contrast was given by single injector at a rate of 3-4ml/s as 1ml/kg. Second phase was arterial/ corticomedullary phase at 35-45 seconds after the contrast administration. Third phase was venous/nephrograhic phase at 120 seconds. Finally delayed phase was taken 10 minutes with further additional films if the situation required. Images were reconstructed. After that kidneys, ureters and bladder were assessed for cause and level of obstruction.

Data regarding age, sex, cause, level and side of obstruction were noted. Data were entered and analyzed using the Statistical Package for the Social Sciences version 20.0 and descriptive statistical analysis was done and expressed as frequency, percentage, mean and standard deviations.

Result

A total of 150 patients presenting with obstructive uropathy were included for study. The minimum age was 10 years and maximum age was 80 years with male predominance (M:F, 1.5:1). The mean age was 41.40 years ±16.66. Most of the patients were in the age group of 21 to 40 years (46.7%). (Table 1, 2)

Most common cause of urinary obstruction was due to calculus seen in 115 patients (76.7%). Following that PUJ obstruction was seen in 17 patients (11.3%). Extrinsic ureteric obstruction was seen in six cases (4.0%). Ureteric stricture was found in five patients (3.3%). Urinary bladder mass was seen in four patients (2.7%). In three cases (2.0%) one was due to congenital anomaly and two cases were of ectopic ureter insertion. (Table 3)

The most common level of obstruction was pelvis which was found in 50 patients (33.4%). PUJ obstruction was found in 47 patients (31.3%). 20 patients had upper ureter obstruction (13.3%). Distal ureter obstruction was found in 13 patients (8.7%) followed by VUJ obstruction of 10 patients (6.7%). Mid ureter obstruction was the least common site as found in eight patients (5.3%). Two patients (1.3%) had ectopic insertion of ureter causing hydroureteronephrosis. (Table 4) Obstruction was more commonly found on right side in 80 patients (53.3%). Left sided obstruction was found in 62 patients (41.3%). Bilateral obstruction was found in only eight patients (5.4%). (Table 5)

Table 1. Sex distribution

	Frequency (n)	Percent (%)
Male	91	60.7
Female	59	39.3
Total	150	100.0

Table 2. Age group

Age group (years)	Frequency (n)	Percent (%)
20≥	11	7.3
21-40	70	46.7
41-60	45	30
60<	24	16
Total	150	100
Mean age ± SD 41.40 years ± 16.66		

Table 3. Causes of urinary obstruction

	Frequency (n)	Percent (%)
Urinary calculi	115	76.7
PUJ obstruction	17	11.3
Extrinsic ureteric obstruction	6	4.0
Ureteric stricture	5	3.3
Urinary bladder mass	4	2.7
Others 3 2.0		
total	150	100.0

Table 4. Level of obstruction

	Frequency (n)	Percent (%)
Pelvis	50	33.4
PUJ	47	31.3
Upper ureter	20	13.3
Mid ureter	8	5.3
Distal ureter	13	8.7
VUJ	10	6.7
Ectopic insertion of ureter	2	1.3
Total	150	100.0

Table 5. Side of obstruction

	Frequency (n)	Percent (%)
Right	80	53.3
Left	62	41.3
Both	8	5.4
Total	150	100.0

Discussion

Imaging plays an important role in diagnosis and management of diseases and there are different imaging modality for it but it is important to choose which imaging gives the most accurate finding. Generation of CT has evolved from single–detector row scanners to multi–detector row helical volumetric acquisition techniques, and these advances have significant impact on imaging of the urinary tract. The use of multi–detector CT to evaluate the urinary tract has been termed CT urography. CT urography is the imaging of choice for many urological diseases including evaluation of urinary tract obstruction, hematuria, malignancy, infection and also of renal vasculature anatomy for interventional procedures. [5]

In the present study, 150 patients diagnosed with obstructive uropathy were included. Most common cause of obstruction was due to urinary calculus which was present in two third of cases (76.7%). This finding is consistent with the study done by Ahmed Moawad MM et al [6] and Sen KK et al. [7] This could be due to dietary intake/life style pattern, obesity and fluid intake. Most of the patients were male. Similar finding was seen in study done by Sharma K et al.[8] In our study group 21-40 years was the most common age group. This correlates with study done by Joshi HN et al.[9]

Other causes were PUJ obstruction which was more commonly found in young adults. Less common causes were ureteric stricture, bladder mass and extrinsic ureteric obstruction. Three of the cases were also evaluated for hydronephrosis where one was due to congenital anomaly and two cases were of ectopic ureter insertion. CT not only detected the presence of stone but also helped in determining composition of stone, although it is not diagnostic. With CT urography the excretion and functional status of kidney can also be evaluated simultaneously.[10] With acute obstruction there is associated renal enlargement, hydronephrosis, perinephric fat stranding/fluid and delayed and persistent nephrogram. Further decreased attenuation or enhancement of the obstructed kidney has also been described.[11] Chronic obstruction was associated with renal parenchymal thinning and delayed or poor excretion of kidney.

Ureteric stricture was of short segment associated with upstream dilatation of ureter and pelvicalyceal system. There was associated mild smooth ureteric wall thickening and periureteric fat strandings. Imaging findings of stricture alone could not clearly differentiate between benign or malignant stricture and most cases required further work-up. This finding is similar to the study done by Wasnik AP et al.[12] Bladder mass was seen in older patients where there was involvement of unilateral or bilateral VUJ causing hydroureteronephrosis. CT not only helps in diagnosing the cases but also in staging of the malignancy and surveillance of upper urinary tract.[13]

In 50 cases (33.1%) pelvis was the most common level of obstruction followed by PUJ and upper ureter. Mid and distal ureter were less common. In a study done by Youssef MA et al [14] they showed lower ureter (58.46%) as

most common level of obstruction. Comparing on the laterality of obstruction right side was more common than left side. Our study contradicts with study done by Goyal V et al, where laterality played no significant role.[15]

Recently it is widely acknowledged that CT is superior to US and MRI in detecting urolithiasis. It is also superior to US in its ability to detect and characterize renal masses. Its main limitation is in limited accuracy in assessment of mucosal surface. However with recent development of helical CT, it has become possible to image very thin sections of CT images in a very short time with detailed evaluation of urothelium. [16]

Reconstruction techniques can be applied for CT urography including maximum intensity projection (MIP) and volume rendering (VR) which can further help in clearly depicting the anatomy and lesions of urinary tracts thus helping in accurate diagnosis.[17] It can also detect associated findings which can have significant bearing on patient management.

Limitation

Cases were included as obstructive uropathy priorly diagnosed by ultrasonography. Patients with benign prostatic hyperplasia even though presenting with obstructive uropathy were not included in the study which was already diagnosed with the help of USG. Modified CT urography techniques were not used thereby introducing more radiation to patients.

Conclusion

CT enabled an accurate diagnosis of cause and level of obstruction, especially in cases of urolithiasis. Its strength is that it is non- invasive and allows complete study of kidneys, collecting system, ureters and bladder as well as extra-genitourinary disease in a single examination. In our study, the most common cause was stone and most common site was pelvis.

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