Original Article

Radionuclide Renogram Findings in Different Kidney Diseases Referred to Institute of Nuclear Medicine and Allied Science (INMAS)

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Abstract

Renal function evaluation with the use of radio nuclide scanning is a very helpful technique. Renogram is a routine procedure in the Institute of Nuclear Medicine and Allied Sciences (INMAS), Sylhet. This is a tertiary referral hospital to north east part of the country. The aim of this study was to analyze the renal disease pattern and outcome of diuretic renogram of different types of renal diseases. This retrospective study was conducted among 223 patients who underwent 99mTc-DTPA renogram from February to October 2018 in INMAS, Sylhet. Mean age of the patients was 30.04 ± 18.52 year with age range 1 to 80 years, male to female ratio 1.5:1. USG. Clinical information and other adjuvant findings along with the ultrasound findings were collected to categorize the study subject. Most common indication for the renogram was hydronephrosis (HDN) 80.27%, followed by smaller kidney 7.17%, renal parenchymal disease 3.14%, nephrolithiasis 3.14% and others (renal cysts and renal artery stenosis). The mean and standard deviation of serum creatinine was 0.9 ± 0.51, range from 0.30 to 4.50. Among the 179 HDN patients, mild, moderate and severe cases were 37 (20.7%), 44 (24.6%) and 81 (45.3%) respectively. Most common site of involvement was left kidney (n=90, 41.3%), followed by both kidneys (n=67, 30.7%). Overall renographic findings showed obstructive disease in 144 (66.05%) patients and non-obstructive disease in 74 (33.94%) patients. It concluded that isotope renogram is very important in the evaluation of renal function especially differentiate between obstructive from non-obstructive pathology.

Keywords: *Radionuclide renogram, 99mTc DTPA (diethylene-triamine-pentaacetic acid), diuretic challenge, renal diseases*

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INTRODUCTION

Renal scan using 99mTc diethylenetriamine pentaacetate (99mTcDTPA) has proved to be a noninvasive, widely available test that can evaluate renal function and urine transit in a single procedure.[1] It also provides the information about the perfusion and function of individual kidney to determine the differential renal function. This sensitive gold standard nuclear imaging study is available in nuclear medicine centers of different areas of the country and offer functional information and anatomic details as well required for thorough evaluation. Tc-99m-DTPA is filtered by the glomerulus and may be used to measure the glomerular filtration rate (GFR), making it theoretically the best (most accurate) choice for kidney function imaging.[2] The burden of radiation hazard is much lower than other radiological modalities[3] in diagnosis and management of various nephro-urological conditions. The aim of this study was to analyze the disease pattern of outcome of diuretic renogram of different types of renal diseases at INMAS, Sylhet like obstructive & non-obstructive renal disease, chronic renal parenchymal disease, nephrolithiasis and others with their functional information along with drainage pattern which are necessary for a justified management protocol.

MATERIAL AND METHODS

This retrospective study was conducted in the Institute of Nuclear Medicine and Allied Sciences (INMAS), Sylhet. Study subjects comprised of 223 patients between ages 1 to 80 years, with mean age of 30.04 ± 18.52 years who underwent 99mTc-DTPA renogram from February 2018 to October 2018. Among them male and female patients were 136 (61%) and 87 (39%) respectively. The method of

99mTc-DTPA was used for evaluation of renal function was as following. Patients stay well hydrated and then void before starting procedure. First we calculation of full syringe count. Then the patients are placed in supine position in a single photon emission computed tomography (SPECT) digital dual head gamma camera (e-cam series, Siemens from Germany) with detector placed behind. A low-energy high-resolution parallel hole collimator was used, with matrix size 64 x 64, energy peak 140 Kev, and window width 20%. After administration of an intravenous bolus injection of 3-5 mCi 99mTc-DTPA for adult patient and 1-2 mCi 99mTc-DTPA for children, perfusion images are obtained in every 01 second for the first minute followed by acquisition of dynamic images in every 20 seconds for the next 29 minutes. Diuretic is administered intravenously to adult patient according to patient's serum creatinine level within 10^{th} –15^{th} minute after tracer injection and for children it is administered along with the tracer at 0 (zero) minute. In a dilated system, prolonged retention of contrast or radiopharmaceutical is seen because of a reservoir effect. The addition of furosemide (diuretic) to the protocol allows accurate identification of patients affected by obstruction. If mechanical obstruction is present, the narrowed lumen prevents augmented washout; prolonged retention of tracer proximal is seen and can be quantified on the time-activity curves were also calculate the empty syringe count. Time–activity curves from the region of interests are computed and corrected for physical decay. Processing units of gamma camera software measured 99mTc-DTPA renogram clearance for the determination of glomerular filtration rate (GFR). Software also calculate differential renal function (DRF) or split function (SF). In general, in a normally functioning kidney, a half-time of less than 10 minutes from the time of diuretic effect constitutes a normal response. A rapid washout of the isotope in a dilated pelvicalyceal system is considered non obstructed. Persistence of the isotope suggests that the system is not only dilated but also obstructed. The statistical analyses were done by IBM SPSS Statistics (version 25).

RESULTS

Table I Shows the distribution of socio-demographic characteristics of the study population. Among the 223 individuals age of the patients ranged from 1 to 80 years with the mean age of 30.04 ± 18.5 year. Among them 80 (35.9%) patients were in 1-20 years' age group and lowest number 15 (6.7%) were in 61-80 years' age group. Distribution of sex shows that 61% were males and the remaining 39% were females. The mean and standard deviation of age for male and female were 27.79 ± 19.27 years and 33.55 ± 16.78 years respectively.

Table I: Age and sex distribution of the study subjects (n=223)

Parameters		Frequency	Percentage
Age (years)	1-20	80	35.9
	21-40	76	34.1
	41-60	52	23.3
	61-80	15	6.7
Sex	Male	136	61
	Female	87	39

Table II Shows the distribution of common indication for renogram among the study population. Among the study subjects (80.3%). Were indicated for HDN followed by smaller kidney (7.2%), renal parenchymal disease (3.14%), nephrolithiasis (3.14%) and others (renal cysts and renal artery stenosis). The mean and standard deviation of serum creatinine was 0.9 ± 0.51, range from 0.30 to 4.50. Among the 179 HDN patients, mild, moderate and severe cases were 37 (20.7%), 44 (24.6%) and 81 (45.3%) respectively.

Table II: Distribution of common indication for DTPA renogram

Indications	Frequency	Percent
Hydronephrosis	179	80.3
Nephrolithiasis	7	3.1
Renal parenchymal disease	7	3.1
Smaller kidney	16	7.2
Non visualized	2	0.9
Ectopic	5	2.2
Post pyeloplasty	5	2.2
Renal cyst	1	0.4
Renal artery stenosis	1	0.4
Total	223	100.0

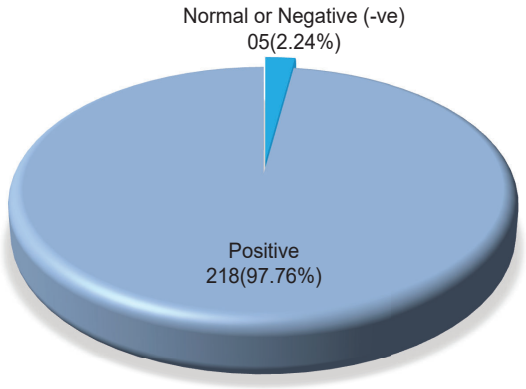

Figure 1: *Radionuclide renogram findings*

Figure-1 Shows the radionuclide renogram findings, among 223 cases, 218 (97.76%) had positive findings on renogram while rest were normal.

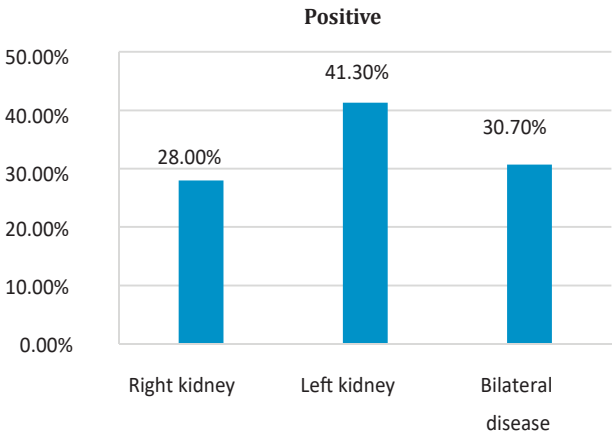

Figure 2: *Site of distribution of renal disease in the study population (n=223).*

Figure-2 Shows the site of distribution of renal disease; the whole group based on site of involvement in renogram was divided as right, left, both kidneys, 90 (41.3%) involvement was in left kidney followed by 61 (28.0%) in right kidney and both kidneys was 67 (30.7%)

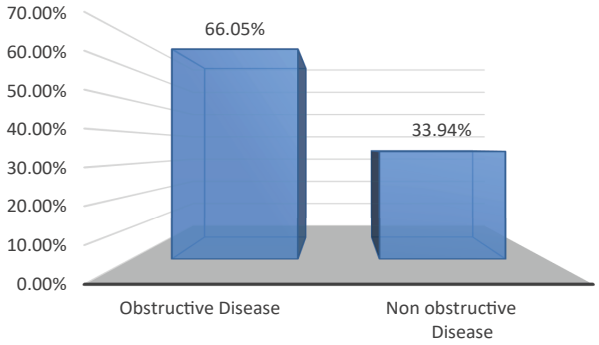

Figure 3: *Renogram findings (in percentages) according to nature of involvement (n=218)*

Figure 3 Shows two main groups as obstructive disease (obstructive uropathy and obstructive nephropathy) and non-obstructive disease (non-obstructive HDN; parenchymal impairment and nonfunctioning kidney). Here obstructive disease was found in 144 (66.05%) patients and non-obstructive disease in 74 (33.94%) patients

Table III Shows the pattern of renogram findings in five groups. In the right kidney (n=61), obstructed nephropathy (obstruction with parenchymal impairment) was 39.3% and others OU, NO, PI and NF were 11.5%, 1.6%, 36.1% and 11.5% respectively ; whereas in the left kidney obstructed uropathy was 33.3% kidney (n=90) and others ON, NO, PI and NF were 30.0%, 3.3%, 22.2% and 11.1% In case of bilateral disease involvement, obstructed nephropathy was (67.2%), others OU, NO, PI, and NF were 16.4%, 00%, 16.4%, 00% respectively.

Table III: Pattern of renogram findings

	Pattern of renogram findings					
Site of involvement	**Obstructed uropathy (OU)**	**Obstructed nephropathy (ON)**	**Non Obstructed (NO)**	**Parenchymal impairment (PI)**	**Non-functioning (NF)**	**Total**
Right kidney	7(11.5%)	24(39.3%)	1(1.6%)	22(36.1%)	7(11.5%)	61(100)
Left kidney	30(33.3%)	27(30.0%)	3(3.3%)	20(22.2%)	10(11.1%)	90(100)
Bilateral	11(16.4%)	45 (67.2%)	0	11(16.4%)	0	67(100)

DISCUSSION

A renogram is simply a time-activity curve that provides a graphic representation of the uptake and excretion of a radiopharmaceutical by the kidneys. Renogram curve can be revealed easily in patients with suspected renal diseases, with disturbances of the renal circulation, with functional obstruction of the upper urinary tract, and specially in the impairment of tubular function. Renogram objectively measures individual renal function and it is considered as the imaging modality of choice for the assessment of the individual renal function[5]. The importance of isotope renogram for evaluating individual kidney's function were previously reported.[6,7]

In this study, distribution of gender showed that 61% were males and the remaining were females. Age ranged from 1 to 80 years. The mean and standard deviation of age was 30.04 ± 18.52 years. These findings are similar to previous study.[9] The range of serum creatinine was 0.30 – 4.50 mg/dl (mean 0.9 ± 0.51). Hosen et al.[8] reported serum creatinine range from 0-5 -12.9 mg/dl (mean 1.75 ± 12.1) that differ from this study could be due to presence of outlier.

This study showed 97.76 % (n=218) cases had positive findings on renogram while rest were normal. Hosen et al.[8] reported normal cases of about 14.29% that is higher than current study might be due to selective referral of the renal patients.

This study revealed that most common site of involvement was left kidney (41.3%, n=90), followed by both kidneys (30.7%, n=67) (figure I). Hosen M et al.[8] reported that 42.86% had pathology in right kidney, 24.49% had in left kidney, 18.37% had bilateral disease and 14.29% had normal findings. This difference of involvement may be due to different method of analysis.

In our institute prior to renogram, renal US is routinely done. HDN is defined as a significant increase in the diameters of the collecting system on US.[9] We classified HDN into three groups according to ultrasound measurement of the renal pelvis diameter: mild (Anterior posterior diameter (APD) 5–9.9 mm), moderate (APD 10–14.9 mm) and severe (APD ≥ 15 mm). The degree of HDN is used to assist in decision making with regard to management and some prognostic information. However, controversy exists over size cutoffs and significant pathology.

In this study, US revealed HDN in 179 (80.3%) patients, smaller kidneys in 16 (7.2%) patients, nephrolithiasis 7 (3.1%) patients, renal parenchymal disease in 7 (3.1%) and others (ectopic kidney, post pyeloplasty, non-visualized kidney etc.). Among the 179 HDN patients, mild, moderate and severe cases were 20.7% (n=37), 24.6% (n=44) and 45.3% (n=81) respectively. By reviewing all the laboratory investigations, the causes of HDN was identified pelvi-ureteric junction obstruction (PUJO) was 46 (25.7%), calculus was 14 (7.8%) and unknown 119 (66.5%).

Overall renographic findings in 218 patients showed obstructive disease in single or both kidneys in 144 (66.05%) patients and non-obstructive disease in 74 (33.94%) patients which is slightly more than Hosen M et al.[8] possibly due to selected group of patients

Diuretic renogram is a dynamic, noninvasive test which was developed to distinguish between the dilated non-obstructed and the dilated obstructed upper urinary tract. [10]. Renogram curves which show an obstructed pattern can be subjected to an increased flow rate as a consequence of the IV administration of a diuretic. Differential renal function (DRF) is the contribution of each kidney to sum of both left and right renal activities, normally ranging from 45% to 55%.[11], although ranges of 42–58% have also been reported in normal adults for 99mTc-MAG 3 imaging[12,13]. A DRF <40% or a decrease of DRF of >5% on successive diuretic renogram studies is indicative of renal function deterioration.

The results were classified into five groups. Among the right kidney (n=61), most common findings were obstructed nephropathy (obstruction with parenchymal impairment) (39.3%), whereas obstructed uropathy (33.3%) in the left kidney(n=90). In bilateral disease involvement, obstructed nephropathy was the common findings (67.2%) (Table –III).

CONCLUSIONS

Evaluation of different renal pathologies & functions by 99mTc-DTPA at INMAS, Sylhet reveals various pattern of nephro-urological disorders. This study analyses the outcome of different renographic findings; mostly unilateral or bilateral obstructive or non-obstructive pattern, parenchymal impairment, functional assessment. The association of our study & clinical presentation of the patients can be sufficient for the clinicians to establish a causal link for the better management of the patients.

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