

The Role of Time to Half-Maximum Activity Clearance of Technetium-99m-Mercaptoacetyltriglycine in the Assessment of Obstructive Uropathy

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Abstract

Objective: We aimed to evaluate the utility of the quantitative time to half-maximum ($T_{1/2}$) value in the detection of obstructive (Ob\HyN) and non-obstructive hydronephrosis (Non-Ob\HyN) using 99mTc-MAG3.

Methods: During 2009, 50 patients (male: 54%) with hydronephrosis (HyN) were referred to the Radiation and Isotopes Centre at Khartoum, Sudan, for a renal scan using 99mTc-MAG3. Standardized diuretic renograms were obtained from all patients.

Results: $T_{1/2}$ readings of 0–8 minutes (min) were considered to be indicative of Non-Ob\HyN, $T_{1/2}$ readings of >8-12 min were considered normal, and $T_{1/2}$ readings of >12 min were considered to be indicative of Ob\HyN. The mean $T_{1/2}$ for the right kidneys with Non-Ob\HyN was 3.1 min, for the normal kidneys was 10.03 min, and for the right kidneys with Ob\HyN was 10.03 min. Moreover, the mean $T_{1/2}$ for the left kidneys with Non-Ob\HyN was 3.84 min, for the normal kidneys was 9.72 min, and for the left kidneys with Ob\HyN was 11.48 min.

HyN affected the right kidney to a greater extent than the left kidney and occurred most frequently in patients aged 28-34 years, representing 31% of the patients in the present study.

Conclusions: We conclude that there is a potential benefit in using the 99mTc-MAG3 renography $T_{1/2}$ value to differentiate between Non-Ob\HyN and Ob\HyN.

Keywords: 99mTc-MAG3; Diuretic renograph; Hydronephrosis; Obstructive uropathy

Introduction

The distinction between mechanical obstruction of renal outflow and dilation not associated with obstruction is essential for patient management [1]. Technetium-99m-mercaptoacetyltriglycine (99mTc-MAG3) diuretic renography is an established method for assessing hydronephrosis (HyN). The renogram pattern during 99mTc-MAG3 diuretic renography usually correlates with the degree of obstruction. A non-obstructed system can be easily identified by the occurrence of prompt tracer washout; however, in cases of obstruction, washout after diuresis remains slow, and prolonged retention of the radiopharmaceutical results in an increased curve [1-3]. However, an obstructive pattern in a non-obstructed hydronephrotic kidney is often encountered during diuretic renography [1,4-8], and early differentiation between a non-obstructed and obstructed kidney without follow-up scanning can be a diagnostic challenge in a number of cases. Patients who fulfill the criteria for non-obstructed kidneys, according to the findings of dual-time renography, can be safely managed with a follow-up scan to avoid unnecessary surgical interventions [9,10].

In the present study, we aimed to assess the role of 99mTc-MAG3 diuretic renography in the differential diagnosis of obstructive (Ob\HyN) and non-obstructive hydronephrosis (non-Ob\HyN).

Material and Methods

This study was conducted during 2009 in the nuclear medicine department at Khartoum Radio Isotopes Centre, Sudan.

Patients

Fifty patients (27 men, 23 women; age range, 22-58 years) with suspected hydronephrotic kidneys were included in the present study. All patients were referred for the assessment of renal outflow obstruction and function. All patients underwent routine 99mTc-MAG3 diuretic renography using standardized protocols, and bladder catheterization was not performed.

Machines

Renography was performed using single-photon emission computed tomography via a Nucline dual-head gamma camera with general purpose parallel-hole collimators (Mediso, Hungary). Informed consent was obtained from all the patients included in the study.

Methods

All patients were asked to drink 300–500 mL of oral fluids 30 minutes (min) before the 99mTc-MAG3 injection. Furosemide (1 mg/kg) was intravenously administered 20 min before the 99mTc-MAG3 injection (F+20 protocol). Approximately 1.85 megabecquerels (MBq)/kg of 99mTc-MAG3 were administered intravenously, with a minimum dose of 45 MBq. The dynamic imaging study was set at 2 frames/s for the first minute followed by 1 frame/minute for the next 20 minutes. Regions of interest (ROIs) were marked over the entire kidney as well as the background on each side, to measure differential renal function and for renogram generation. The kidney background was manually marked using a crescent shape over the outer aspect of the kidney on images obtained after 1-2 minutes.

Data were analyzed using SPSS software (version 10). The mean, standard deviation (SD), and range were used to describe the normal values.

	Non-obstructive hydronephrosis	Normal	Obstructive hydronephrosis
Mean	3.1	10.03	10.03
SD	2.51	0.89	0.89
Range	0.59–5.61	9.14–10.92	<10.03

Table 1: Time to half-maximum activity clearance (T½) readings of the right kidney using technetium-99m-mercaptoacetyltriglycine.

	Non-obstructive hydronephrosis	Normal	Obstructive hydronephrosis
Mean	3.84	9.72	24.48
Standard Deviation(SD)	3.08	1.15	1.27
Range	0.7–7	8.57–11	11>

Table 2: Time to half-maximum activity clearance (T½) readings of the left kidney using technetium-99m-mercaptoacetyltriglycine.

	Non-obstructive hydronephrosis (%)	Normal (%)	Obstructive hydronephrosis (%)
Right kidney	9	9	7
Left kidney	7	7.5	10.5

Table 3: Frequencies of each pathological condition in each kidney detected using technetium-99m-mercaptoacetyltriglycine.

	Frequency (%)
Non-obstructive hydronephrosis	28
Normal	35
Obstructive hydronephrosis	37

Table 4: Frequencies of each pathological condition in the entire sample detected using technetium-99m-mercaptoacetyltriglycine.

Discussion

This study revealed that some of the patients with Non-Ob\HyN and T½ readings of 0–8 min were correctly diagnosed as having a kidney with Non-Ob\HyN, and those with normal T½ readings (>8–12 min) were correctly diagnosed as having normal kidneys. The results also showed that patients with Ob\HyN and T½ readings of

Results

Time to half-maximum activity clearance (T½) was calculated from the time taken for the renogram curve to decrease to half that of the maximum count. The patients were categorized into 3 groups using the whole kidney ROIs: (a) Non-Ob\HyN, (b) normal, and (c) Ob\HyN [11]. The mean ± SD T½ values for the right kidney for each group were as follows: Non-Ob\HyN, 3.1 ± 2.51; normal, 10.03 ± 0.89; and Ob\HyN, 10.03 ± 0.89 (Table 1). The mean ± SD T½ values for the left kidney for each group were as follows: Non-Ob\HyN, 3.84 ± 3.08; normal, 9.72 ± 1.15; and Ob\HyN, 11.48 ± 1.27 (Table 2). The frequencies of the different pathological conditions for each kidney are reported in (Table 3), whereas the frequencies of each condition in the entire sample are reported in (Table 4).

>12 min were correctly diagnosed as having a kidney with Ob\HyN. These values are consistent with those reported by Mettler and Guiberteau [11], Jamar et al. [13], and Esteves et al. [14], although the values are not consistent with those reported by Kletter and Nürnberger [12]. Similar findings have also been reported by Salih et al. [15].

In the present study, we noted that HyN primarily affected patients aged 28–34, with this age group representing 31% of the cases. Therefore, this may be considered as the “critical age” for HyN in Sudan. This finding is consistent with those of other studies performed on this topic [16-18].

Conclusions

The results of the current study indicated the potential advantage of using the ^{99m}Tc-MAG3 renography T_{1/2} value to differentiate between Ob\HyN and non-Ob\HyN. The T_{1/2} value, determined using ^{99m}Tc-MAG3, can aid diagnosis and facilitate appropriate patient management. However, additional studies are required to determine the increased prevalence of HyN in patients aged 28–34 and to determine the relationships between sex, age, and the T_{1/2} value obtained using ^{99m}Tc-MAG3.

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