Nuclear Medicine & Radiation Therapy

Salih et al., J Nucl Med Radiat Ther 2014, S6:020
http://dx.doi.org/10.4172/2155-9619.1000169

Research Article Open Access

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

**Suliman Salih**[1,2*], **Mohammed El-Wathiq Mabrook**[3], **Mohamed Yousef**[1,3] **and Mohammed A Ali Omer**[3]

[1]*Faculty of Applied Medical Sciences, Taibah University, Saudi Arabia*

[2]*National Cancer Institute - University of Gezira, Sudan*

[3]*College of Medical Radiological Sciences Faculty of Medicine, University of Khartoum, Sudan*

[*]**Corresponding author**: Suliman Salih, Department of Diagnostic Radiologic Technology, Faculty of Applied Medical Sciences, Taibah University, Saudi Arabia, Tel: +966597883039; E-mail: salim_suliman@hotmail.com, ssalim@tabiabahu.edu.sa

**Rec date:** Feb 22, 2014, **Acc date:** Mar 25, 2014, **Pub date:** Mar 31, 2014



## Abstract

**Objective:** We aimed to evaluate the utility of the quantitative time to half-maximum (T½) 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:** T½ readings of 0–8 minutes (min) were considered to be indicative of Non-Ob\HyN, T½ readings of >8-12 min were considered normal, and T½ readings of >12 min were considered to be indicative of Ob\HyN. The mean T½ 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 T½ 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 T½ 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 perform Ked.

### 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.

**Citation:** Salih S, Mabrook ME, Yousef M, Omer MA (2014) The Role of Time to Half-Maximum Activity Clearance of Technetium-99m-Mercaptoacetyltriglycine in the Assessment of Obstructive Uropathy. J Nucl Med Radiat Ther S6: 169. doi: 10.4172/2155-9619.1000169



## 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

## 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).

## 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 >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 99mTc-MAG3 renography T½ value to differentiate between Ob\HyN and non-Ob\HyN. The T½ value, determined using 99mTc-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 T½ value obtained using 99mTc-MAG3.

## Acknowledgments

The authors thank all the staff at the nuclear medicine department, Khartoum Radio-Isotopes Centre, for helping with data collection.

## References

1. Boubaker A, Prior JO, Meuwly JY, Bischof-Delaloye A (2006) Radionuclide investigations of the urinary tract in the era of multimodality imaging. J Nucl Med 47: 1819-1836.
2. Rossleigh MA (2001) Renal cortical scintigraphy and diuresis renography in infants and children. J Nucl Med 42: 91-95.
3. Thrall JH, Koff SA, Keyes JW Jr (1981) Diuretic radionuclide renography and scintigraphy in the differential diagnosis of hydroureteronephrosis. Semin Nucl Med 11: 89-104.
4. Reilly PH, Testa HJ, Lawson RS, Farrar DJ, Edwards EC (1984) Diuresis renography in equivocal urinary tract obstruction. Br J Urol 56: 84.

5. O'Reilly PH (1992) Diuresis renography. Recent advances and recommended protocols. Br J Urol 69: 113-120.
6. English PJ, Testa HJ, Lawson RS, Carroll RN, Edwards EC (1987) Modified method of diuresis renography for the assessment of equivocal pelviureteric junction obstruction. Br J Urol 59: 10-14.
7. Conway JJ, Maizels M (1992) The "well-tempered" diuretic renogram: a standard method to examine the asymptomatic neonate with hydronephrosis or hydroureteronephrosis. A report from combined meetings of The Society for Fetal Urology and members of The Pediatric Nuclear Medicine Council--The Society of Nuclear Medicine. J Nucl Med 33: 2047-2051.
8. Gordon I, Dhillon HK, Gatanash H, Peters AM (1991) Antenatal diagnosis of pelvic hydronephrosis: assessment of renal function and drainage as a guide to management. J Nucl Med 32: 1649-1654.
9. Alkhawaldeh K, Khraisat S, Hazza I (2009) Dual time 99MTC-MAG3 diuretic renography and new criteria in the assessment of obstructive uropathy. JRMS 16: 47-54.
10. Eshima D, Taylor A Jr (1992) Technetium-99m (99mTc) mercaptoacetyltriglycine: update on the new 99mTc renal tubular function agent. Semin Nucl Med 22: 61-73.
11. Mettler FA Jr, Guiberteau MJ (2006) Essentials of Nuclear Medicine Imaging. Elsevier Inc.
12. Kletter K, Nürnberger N (1989) Diagnostic potential of diuresis renography: limitations by the severity of hydronephrosis and by impairment of renal function. Nucl Med Commun 10: 51-61.
13. Jamar F, Piret L, Wese FX, Beckers C (1992) Influence of ureteral status on kidney washout during technetium-99m-DTPA diuresis renography in children. J Nucl Med 33: 73-78.
14. Esteves FP, Taylor A, Manatunga A, Folks RD, Krishnan M, et al. (2006) 9mTc-MAG3 renography: normal values for MAG3 clearance and curve parameters, excretory parameters, and residual urine volume. AJR Am J Roentgenol 187: W610-W617.
15. Suliman Salih, Mohamed Yousef, Mohammed El-Wathiq Mabrook, Mohammed A, Ali Om (2013) Evaluation of 99mTc-MAG3/DTPA Radiopharmaceuticals in Detection of Hydronephrosis. Life Science Journal 10 (4).
16. El Imam M, Omran M, Nugud F, Elsabiq M, Saad K, et al. (2006) Obstructive uropathy in Sudanese patients. Saudi J Kidney Dis Transpl 17: 415-419.
17. Karam M, Feustel PJ, Goldfarb CR, Kogan BA (2003) Diuretic renogram clearance half-times in the diagnosis of obstructive uropathy: effect of age and previous surgery. Nucl Med Commun 24: 797-807.
18. Routh JC, McGee SM, Ashley RA, Reinberg Y, Vandersteen DR (2010) Predicting renal outcomes in children with anterior urethral valves: a systematic review. J Urol 184: 1615-1619.


This article was originally published in a special issue, entitled: **"Cancer Radiation Therapy",** Edited by Xin Chen,University of Arkansas for Medical Sciences, USA