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Emails:
editor@sciencepub.net
nbmeditor@gmail.com

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Characterization of Renal Function and Morphology in Hypertensive Patients Using Renal scintigraphy

Hossam Gasmalseed [1, 2], Mohamed E. M. Garalnabi[1], othila abdalaziz[1], Adil A. Mansour [2], Mohamed Hasaneen [2]

[1]College of Medical Radiological Sciences, Sudan University of Science and Technology, Khartoum, Sudan
[2]Al-Ghad International College of Applied Medical Science, Medical Imaging Technology Department, Dammam, KSA

Abstract: AIM: The aim of study to evaluate renal function in hypertension patients using renogram and correlate it with age, gender, GFR, and duration of disease**. METHODS:** We studied 100 hypertension patients (42Males,58 Females) mean age 60.6 years, Renal scintigraphy was done to all with 99mTc-MAG3, Renal scintigraphy (anterior and posterior images) was obtained within 20 seconds after administration of 185-370MBq (5-10mCi depended patient weight) of 99mTc-MAG3 and results were evaluated quantitatively and qualitatively calculating both kidneys function. **RESULTS:** In case of radionuclide renography, total glomerular filtration rate (GFR) ranged from 130-40 (mean ± SD) 87. 9±17.3(male 86.8±16.3 female 88.8±18.1), correlated GFR with age decline rate was 0.82 (1.2 ml/min/years) Renal Scintigraphy demonstrated 84% Has normal renal function with mild (AORTA- RENAL DELAY), normal cortical and clearance phase 16% had abnormal function (unilateral 93% and bilateral 7% more affected RT kidney than left). both kidneys show decrease renal function with age and duration of disease. The association was stronger in person had uncontrollable and long standing hypertensive disease. Also noted the average peak activity decrease when the duration of disease increase. **CONCLUSIONS:** Studies with 99mTc-MAG3 present high specificity and are useful in patients with high probability for renovascular hypertension, identifying high number of patients with significant renal artery stenosis.
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Introduction:

The kidneys are responsible for regulating water and electrolyte balance, excreting waste, secreting hormones (renin, erythropoietin), and activating vitamin D. Renal parenchymal disease and renovascular abnormalities are the most common causes of secondary hypertension.

Renovascular hypertension (RVH) pertains to the causal relationship between a renal artery stenosis (RAS) and its clinical consequences, namely, hypertension or renal failure. Among the population of hypertensive patients, approximately 1-10%(1). Have true (RVH) However. Among patients with a significant RAS, only two-thirds show improvement of hypertension after revascularization and 27%–80% show improvement or stabilization of renal function. When left untreated, atheromatous RAS tends to worsen, leading to renal artery thrombosis (2).

The kidneys receive 20% of cardiac output, with renal plasma flow (RPF) averaging 600 mL/min. The kidneys clear the plasma and body of waste products. The clearance, or rate of disappearance, of a substance can be measured as:

$$\text{Clearance (mL/min)} = \frac{\text{Urine concentration (mg/mL)} \times \text{Urine flow (mL/min)}}{\text{Plasma concentration (mg/mL)}}$$

Hypertension occurs in approximately 40% of patients with acute renal failure, its prevalence is higher in vascular and glomerular diseases (73%) than in tubular necrosis (15%). In the latter group, hypertension mainly results from the rapid reduction in glomerular filtration rate and consequently salt and water retention, whereas in the acute nephritic syndrome, hypertension may be present in the absence of a marked decline in glomerular filtration rate. Surprisingly, in rapidly progressive glomerulonephritis, blood pressure is normal or slightly elevated, even in patients with severe renal failure and fluid retention. (3)

Radiopharmaceutical used in this study Tc-^{99m} MAG3 because is protein-bound and not filtered, it is

exclusively cleared from the kidney by tubular secretion. It has a much higher first-pass extraction than a glomerular filtration agent such as Tc-99m diethylenetriaminepentacetic acid (DTPA). The normal time to peak activity is 3 to 5 minutes, with a time to half peak (T½) of 6 to 10 minutes. Clearance is bi-exponential, and in patients with normal renal function, 90% of the dose is cleared in 3 hours.

Material and Methods:

This study was carried out in Kingdom of Saudi Arabia during the period from April 2018 up to April 2019. A total of 100 adult patients with essential hypertension examined with renal scintigraphy (Tc-^{99m} MAG3).

Functional imaging of the kidneys may be divided into assessment of blood flow, parenchyma, and excretion. Normally, both kidneys can easily be imaged on a standard- or large-field-of-view gamma camera with a parallel-hole collimator. Image information is usually collected in digital dynamic mode or on an interfaced computer and reformatted in temporal sequences that reflect both initial renal perfusion and subsequent function.

To compare our normal value with those of other authors. Studies with similar patient preparation were selected. Our patient will hydrated, seated, and the kidney was localized after preliminary isotope injection. All studies were made using $1^{1/2}$-in.NAL (TI) crystal and 36-deg collimation using dual detector system Gamma camera.

A renogram is simply a time-activity curve that provides a graphic representation of the uptake and excretion of a radiopharmaceutical by the kidneys. Information is displayed from the time of injection to about 20 to 30 minutes after injection.

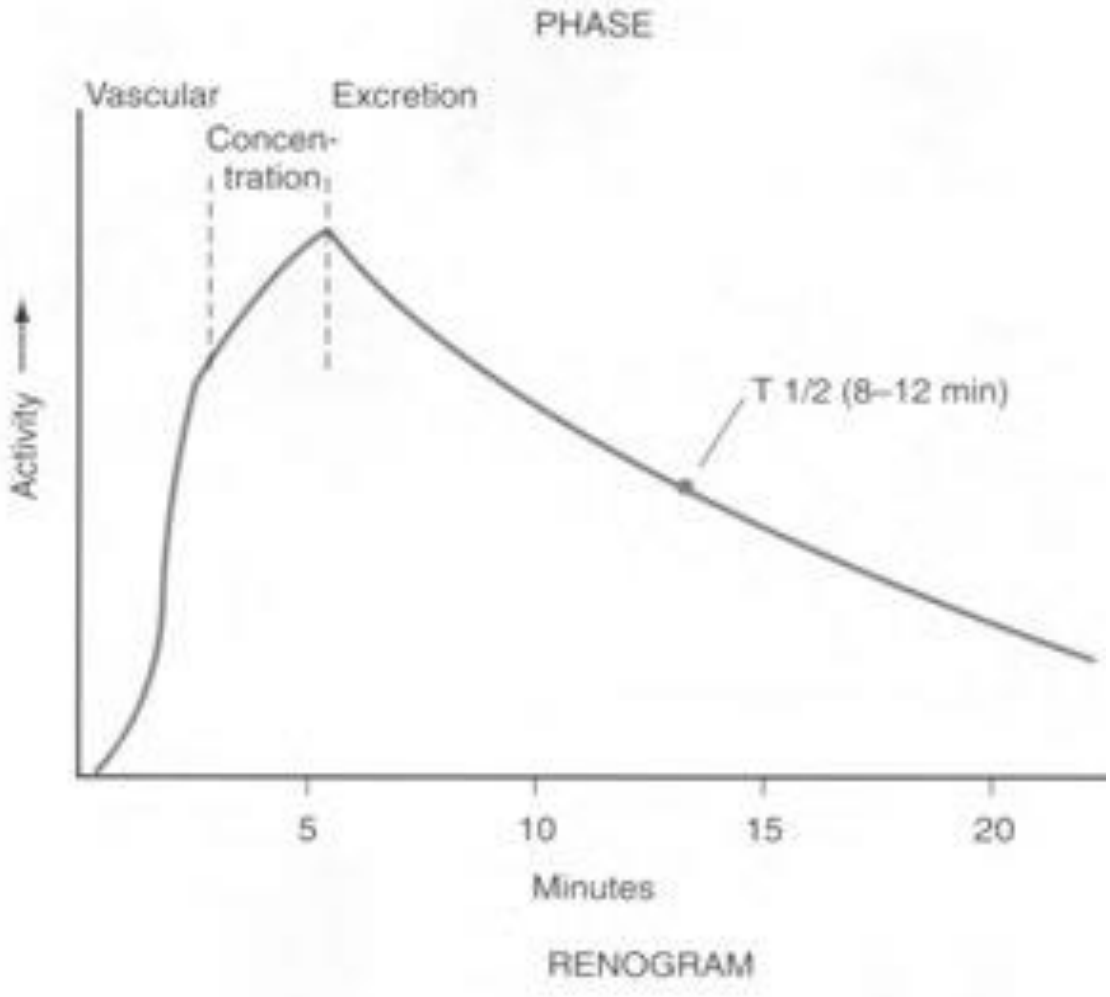

Fig 1: Normal renogram curves demonstrates the conceptual portions of the time-activity curve within the kidney.

COMPUTER ACQUISITION
Blood flow: 1- to 2-second frames for 60 seconds.
Dynamic: 30-second frames for 25-30 minutes.
Pre void image: 500k count.

PROCESSING
Draw region of interest around kidneys.
Draw background area next to each kidney.
Generate time-activity curves for flow and dynamic phases.
Generate differential function calculation.

Inclusion criteria:

- Patient with different age group included.
- All patients suffered from longstanding hypertension and have request renal scintigraphy.

Exclusion criteria:

- Patient Known Renal failure.
- All pregnant women.
- All women who had given birth in the last 12 months.
- All Patients with congenital anomalies such as a horse shoe-shaped or ectopic kidney.

Result:

Table (1) represents gender of hypertensive patient (mean and SD) related to GFR, function, and(peak time peak activity from injection)

Gender		N	Mean	Std. Deviation
GFR	Male	42	86.810	16.3129
	Female	58	88.810	18.1306
Function RT kidney	Male	42	53.143	12.9588
	Female	58	56.534	15.7271
Function LT kidney	Male	42	56.976	13.0561
	Female	58	61.534	13.3813
RT kidney peak time	Male	42	2.7900	0.51620
	Female	58	2.8812	0.57404
LT kidney peak time	Male	42	2.9921	0.46527
	Female	58	3.0519	0.49106
Peak activity	Male	42	3.4769	0.58249
	Female	58	3.3112	0.61994

Table (2) Comparison of renal function using renogram for hypertensive patient:

	Frequency	Percentage
Normal Function	84	84%
Abnormal function	16	16%
Rt kidney	11	68%
Lt kidney	4	25%
Bilateral	1	7%

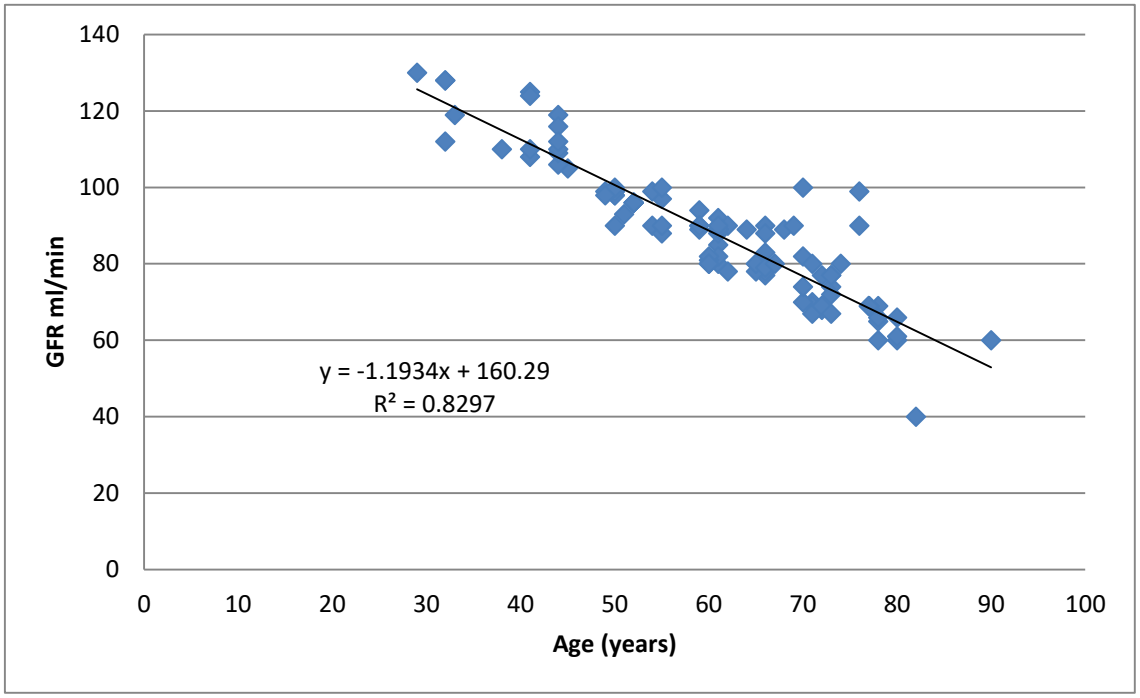

Fig (2) correlation GFR with age shows linear decrease glomerular filtration rate with age decline rate was 0.82 (1.2 ml/min/years)

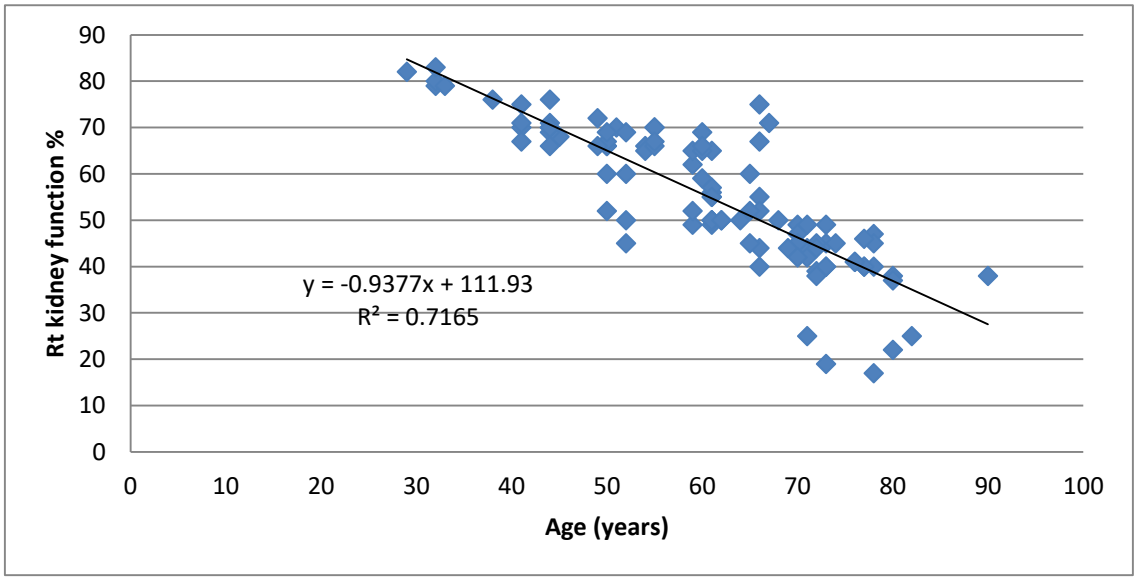

Fig (3) correlation RT kidney with age of hypertensive patient shows linear decrease function with age.

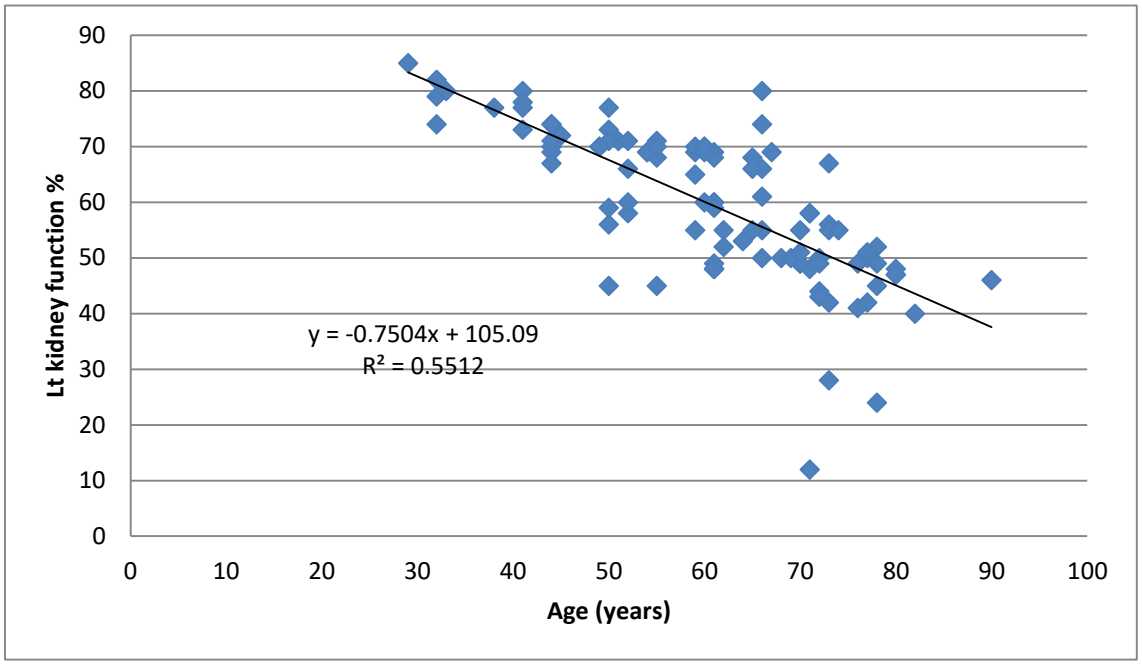

Fig (4) correlation LT kidney with age of hypertensive patient shows linear decrease function with age.

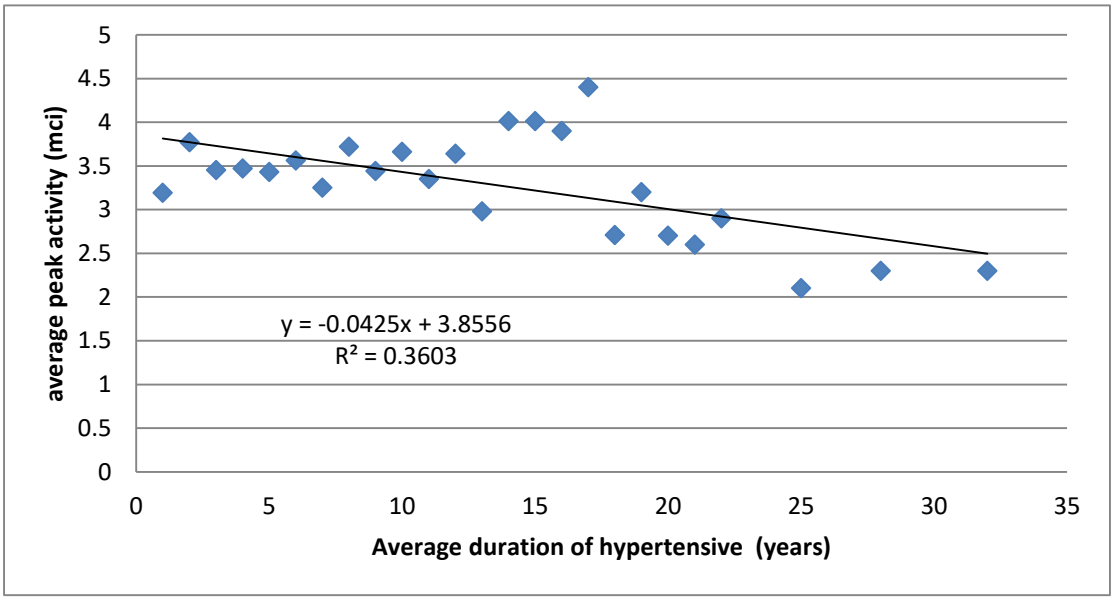

Fig (5) correlation of duration of hypertension and average activity (increase the duration decrease the average peak activity for both kidneys)

Discussion:

The renal function status was evaluated by renogram. All patients underwent a dynamic renal radioisotope using 99mTc-MAC3 to quantify renal functions and estimate the GFR using single injection**.**

In this study Age was found to be important factor for hypertension, ranging between 29 and 90 years most of the patients were in the age groups more than 55 years. Similar finding where reported by other studies. [2,3] also where advancing age was positively related to hypertension (because when increasing age, the aorta and arteries wall will be stiffened, decrease renal blood flow and reduction in nephrons number.) [2,3,4]

The percentage of patient's gender was 42% males and 58% female, similarly various study came out with higher percentage of hypertension in women than men [3,4]

In this study total glomerular filtration rate (GFR) ranged from 130-40 (mean ±SD) 87.9±17.3(male 86.8±16.3 female 88.8±18.1) female had higher GFR than male (shows table 1), correlated GFR with age decline rate was 0.82 (1.2 ml/min/years) **(**shows fig 2) agreement with other study [4,5]

Among those patient's understudy using renal scintigraphy for diagnosis renal hypertension 84% Has normal renal function with mild (AORTA- RENAL DELAY), normal cortical and clearance phase 16% had abnormal function (unilateral 93% and bilateral 7% more affected RT kidney than left shows table 2). Significant renal artery stenosis (60% to 75%) decreases afferent arteriolar blood pressure, which stimulates renin secretion by the juxtaglomerular apparatus. Renin elicits the production of angiotensin I, which is acted on by ACE to yield angiotensin II. Angiotensin II induces vasoconstriction of the efferent arterioles, which restores glomerular filtration pressure and rate. ACE inhibitors, such as captopril, prevent the production of angiotensin II, so that in patients with renal artery stenosis and compensated renal function, pre glomerular filtration pressures are no longer maintained. This results in a significant sudden decrease in glomerular filtration.

Among this study strong correlation of duration of hypertension and average activity when increase the duration of disease decrease the average peak activity absorbed by both kidneys. previous study has not reported.

Conclusion:

Radionuclide techniques in the present study were confirmed as the appropriate to assess renal functions. This study revealed that isotopic renogram is sensitive, readily available and non-invasive and is more reliable for the evaluation of renal functional status.

Reference:

[1]. Mann SJ, Pickering TG. Detection of renovascular hypertension: state of the art—1992. Ann Intern Med 1992; 117:845-853.

[2]. Zierler RE, Bergelin RO, Isaacson JA, et al. Natural history of atherosclerotic renal artery stenosis: a prospective study with duplex ultrasonography. J Vasc Surg 1994; 19:250-258.

[3]. Jansen SE. Three radionuclide techniques in healthy volenteers: S A Society of Nuclear Medicine, 8th Biennial and Second African Congress - Cape Town; 1998.

[4]. Ahasan MM, Shah KZ, Ahmed FU, Zaman A, Khanam MN. Ultrasonography & Scientigraphy of Kidney -Experience in Nuclear Medicine Centre, Rajshahi. Bangladesh J Nucl Med 2002; 5:20-22.

[5]. Donker AJ, van der Hem GK, Sluiter WJ, Beekhuis H. A radioisotope method for simultaneous determination of the glomerular filtrationrate and the effective renal plasma flow. Neth J Med 1977; 20:97-103.

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