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Effects of Body Characteristics on Total GFR Using Gamma Camera

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Abstract **Original Research Article**

Background: The aim of this study was to study the effects of body characteristics on total GFR using Gamma Camera. ***Methods*:** The data of this study was collected from 150 patients both gender referred to nuclear medicine department in Radiation and Isotopes Centre -Khartoum (RICK) - Sudan whom underwent renal scintigraphy. ***Results:*** The age and weight affected the result of total GFR in an inverse linear relationship therefore the GFR decreased linearly when age and weight increases by 0.087 ml/year and 0.06 ml/Kg respectively, while the increase of height directly increases the total GFR values linearly by 0.14 ml/cm. ***Conclusions:*** Body characteristics correlated with the amount of total GFR therefore consideration of it is impact will give an accurate assessment of total GFR.

Keywords: Glomerular filtration rate (GFR), Body Characteristics, Gamma Camera, Renal Scintigraphy.

INTRODUCTION

Glomerular filtration rate (GFR) is defined as the volume of plasma that is filtered by the glomeruli per unit of time, and is usually measured by estimating the rate of clearance of a substance from the plasma [1]. The normal level for GFR varies considerably according to age, sex, body size, physical activity, diet, pharmacologic therapy, and physiologic states [2] the normal average GFR values are approximately 130 and 120 mL/min/1.73 m^2 for young men and women, respectively [3-5]. Glomerular filtration rate (GFR) is the best indicator of renal function and it is used to diagnose, stage, and manage chronic kidney disease (CKD), intervening early to prevent end-stage renal failure [6]. Chronic kidney disease (CKD) encompasses a continuum of renal impairment characterized by decreasing glomerular filtration rate (GFR) GFR < 60 ml/min/1.73m^2 [7, 8]. There are five stages of kidney disease. Determines the stage of kidney disease, based on the presence of kidney damage and the glomerular filtration rate (GFR) [9].

Stages of Kidney Disease

Stage	Description	Glomerular Filtration Rate (GFR)*
1	Kidney damage (e.g., protein in the urine) with normal GFR	90 or above
2	Kidney damage with mild decrease in GFR	60 to 89
3	Moderate decrease in GFR	30 to 59
4	Severe reduction in GFR	15 to 29
5	Kidney failure	Less than 15

Measurement of the GFR is based on the plasma clearance of a substance by glomerular filtration. In order for the clearance of a substance to be the same as the GFR the clearance marker should be in a stable concentration in the plasma, eliminated from the blood only by the kidneys, freely filtered by glomeruli, not secreted, synthesised or metabolised within the kidney and not reabsorbed from the filtrate. The GFR varies according to age, gender and body size. By convention the GFR is adjusted to a standard body

surface area (BSA) of 1.73 m^2 for adults. Plasma clearance markers may be endogenous or exogenous. The ideal exogenous marker is inulin, and it is the gold standard. The isotopic markers ^{51}chromium ethylene-diaminetetra-acetic acid (^{51}Cr-EDTA), ^{99}mtechnetiumlabelled diethylene-triamine-pentacetate (^{99m}Tc-DTPA) and ^{125}I-iothalamate, as well as non-radioisotopically labelled markers like iohexol, produce measures of GFR that correlate well with inulin clearance. Their use, however, is considered costly and impractical for routine clinical use. The Endogenous plasma markers include serum creatinine (S-Cr) and cystatin C (S-Cys C) [10].

MATERIALS AND METHODS

The data of this study was collected from 150 patients both gender suffering from renal disorder and referred to nuclear medicine department in Radiation and Isotopes centre -Khartoum (RICK)–Sudan who underwent renal scintigraphy. The patient's variables were age, weight, hight, BMI. And the data were analyzed by the Statistical Package for Social Studies (SPSS) program (ver 20) and presented in tables and graphs.

This study was carried out using a dose calibrator to measure the activity of radiopharmaceutical before administration to the patient; as well the data acquired form the region of interest using SPECT gamma camera in the renal scintigraphy. as follows: firstly as patient preparation instruct the patient to hydrate well (water; up to 10 mL/kg) and void just before test, before start the scan should be measure the count of syringe before and after injection to calculate the GFR. Then the patient should be lie in supine position and the camera posterior to the patient, in the pelvic kidney we use two detectors one anterior and one posterior to the patient. The position camera by point source over xiphoid, umbilicus, pubic symphysis, and sides in field of view. Insert intravenous butterfly with 3-way stopcock, inject normal saline flush, inject 5 mCi ^{99m}Tc-DTPA intravenously in one bolus, wait until they see activity blush in the abdomen (the "umbrella" effect caused by the heart-liver-spleen and descending aorta) then start the camera. Inject furosemide after 15 to 20 minutes the start of the scan, Acquire serial (dynamic) 1-minute images for 30 minutes.

RESULT AND DISCUSSION

This retrospective study is conducted in the nuclear medicine department at Radiation and Isotope Center of Khartoum (RICK), Sudan. The data were collected from one hundred fifty patients who underwent renal scintigraphy.

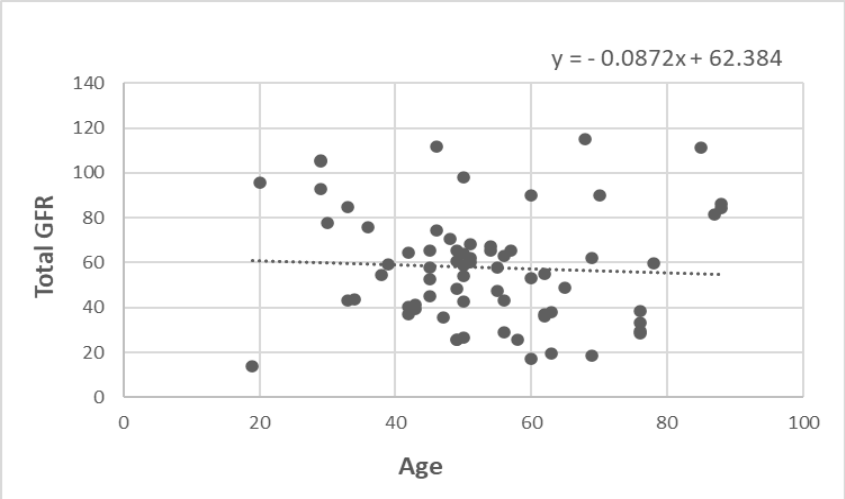

Fig-1: A scatter plot shows an inverse linear relationship between GFR result using renal scintigraphy and patient age

According to Figure (1). The age affected the result of total GFR in an inverse linear relationship therefore the GFR decreased linearly when age increases by 0.087 ml/year starting at 62.4 ml/min; although the decreased values were insignificance but advances in age indicate decrease in the total GFR as usual result.

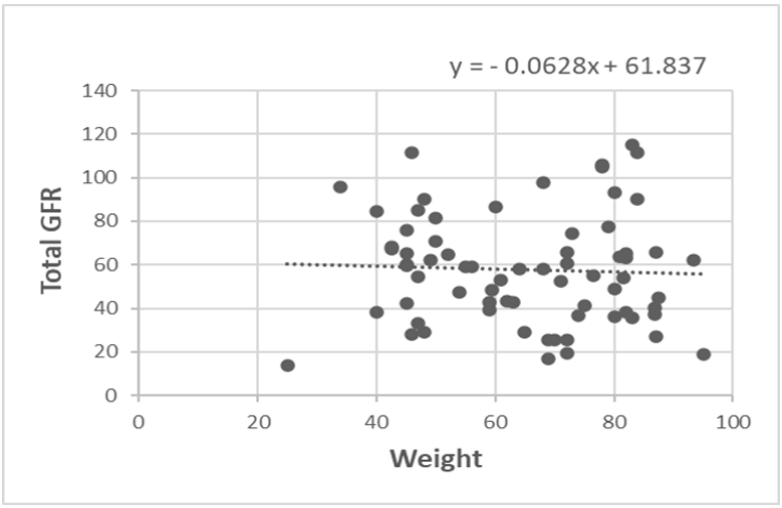

Fig-2: A scatter plot shows an inverse linear relationship between GFR result using renal scintigraphy and patient weight

Similarly the weight also creases the total GFR value linearly by 0.06 ml/Kg, which means heavy weight play a significant role in the decreases of the total GFR from the normal values as show in Figure (2), but height increases the total GFR values linearly; therefore as height of the respondent increases the total GFR increased by 0.14 ml/cm as shown in Figure (3) below.

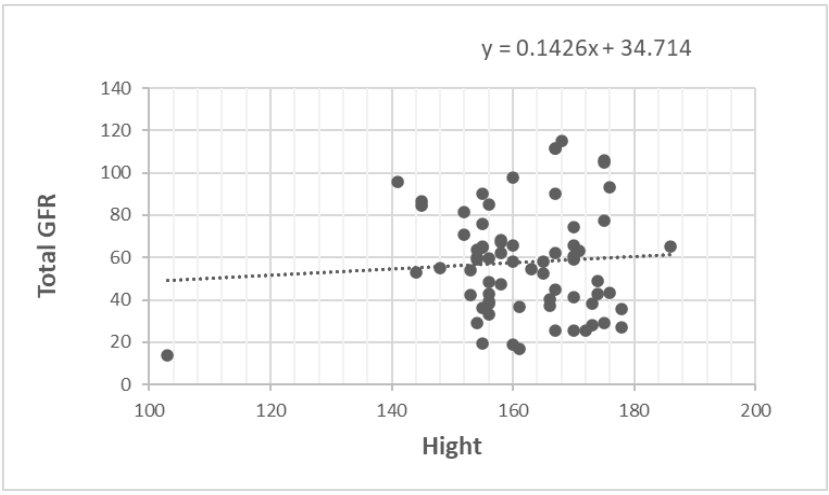

Fig-3: A scatter plot shows a direct linear relationship between GFR result using renal scintigraphy and patient hight

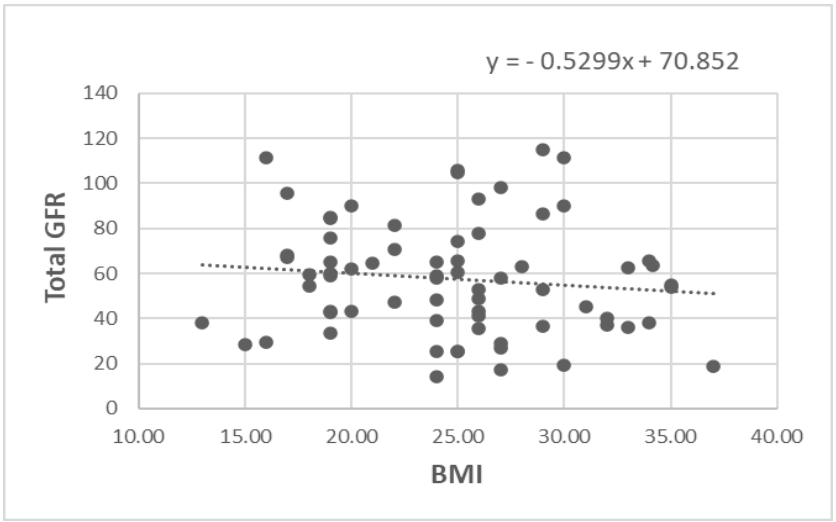

Fig-4: A scatter plot shows an inverse linear relationship between GFR result using renal scintigraphy and BMI.

Since the height increase the total GFR linearly; but when the height integrated with the weight to generate the BMI, the relation of BMI showed an inverse linear relationship with total GFR where the total GFR decreases by 0.53 ml/kg/m^2 (Figure 4) since BMI indicate body mass index the weight play an obviously role in the decrease as show before.

CONCLUSION

This study was carried out in order to study the effects of body characteristics on total GFR using Gamma Camera. The data of this study was collected from one hundred fifty patients their renal function was assessed using renal scintigraphy in Radiation and Isotope Centre in Khartoum (RICK).

The results of this study showed that the age and weight affected the result of total GFR in an inverse linear relationship, therefore the GFR decreased linearly when age and weight increases by 0.087 ml/year and 0.06 ml/Kg respectively. While the increase of height directly increases the total GFR values linearly by 0.14 ml/cm. The weight when integrated with the height to generate the BMI, the relation of BMI showed an inverse linear relationship with total GFR where the total GFR decreases by 0.53 ml/kg/m^2, since BMI indicate body mass index we conclude in our study that the weight play an obviously role in the decrease.

Finally we recommended it is necessary to take the patient body characteristic (age, weight, hight, BMI) for all patients referred to nuclear medicine department for renal scintigraphy and take them into consideration for their important in the total GFR result.

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