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Technical note

Comparison of relative renal functions calculated with ^{99m}Tc-DTPA and ^{99m}Tc-DMSA for kidney patients of wide age ranges

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ABSTRACT

Renal scintigraphy is an imaging method that uses small amount of radioactive materials called radiotracers, a Gamma camera and a computer to evaluate kidney functions and its anatomy. The present work reports the comparison of the relative renal functions (RRF) calculated with technetium-99m dimercaptosuccinic acid (^{99m}Tc-DMSA) and technetium-99m diethylenetriaminepentaacetic acid (^{99m}Tc-DTPA) for kidney patients of ages between 5 months and 71 years. A total of 50 patients including 29 male and 21 female has been selected and studied for renography. The mean RRFs have been found to be 52.68 ± 23.63% and 47.32 ± 23.63% respectively for the left and right kidneys with ^{99m}Tc-DMSA measurement. With ^{99m}Tc-DTPA the values are 52.74 ± 23.54% and 47.26 ± 23.54% for the same. In bivariate correlation analysis, a significant positive correlation ($r = 0.996$, $P < .001$) has been found between the RRFs calculated with the two methods. Following the patients' diagnosis, in ANOVA test, no difference has been found between the RRFs calculated for the left and right kidneys. In Bland-Altman plots, the mean difference between the two methods has been found to be 0.1 and the correlation limit lies between −4.3 and 4.2. According to the result obtained in the present work, both the ^{99m}Tc-DMSA and ^{99m}Tc-DTPA scanning methods provide almost the same RRF values. It is, therefore, always not necessary to calculate the RRFs with both the methods. This study suggests that ^{99m}Tc-DMSA may be the primary choice for the evaluation of RRF, but if the glomerular filtration rate (GFR) and renogram curve are required, ^{99m}Tc-DTPA can be the obvious selection.

1. Introduction

The relative renal function (RRF), expressed as a percent of total renal function [1], is important in the initial assessment and treatment of patients having renal diseases. RRF has traditionally been measured by radionuclide renal scintigraphies using different tracers for a long time [2]. Different radiopharmaceuticals such as technetium-99m-diethylenetriaminepentaacetic acid (^{99m}Tc-DTPA), technetium-99m-dimercaptosuccinic acid (^{99m}Tc-DMSA), technetium-99m-mercaptoacetyltriglycine (^{99m}Tc-MAG3), Iodine-131-orthoiodihippurate (^{131}I-OIH), and more recently technetium-99m-ethylenedicysteine (^{99m}Tc-EC) are used to measure the relative renal functions [3].

^{99m}Tc-DMSA is a static agent that is actively taken up by the proximal and distal renal tubular cells, directly from the peritubular vessels and accumulates in the renal cortex [4]. Its binding level to protein in mammals is 90% which prevents significant glomerular filtration. DMSA renal scan images provide a good definition of the cortical outline, as well as they show the relative distribution of functional tissue. It is primarily used in humans for cortical imaging and estimation of functional renal mass [5–7], the applications of which include detection of pyelonephritis [8] and renal scars [9,10]. On the other hand, ^{99m}Tc-DTPA dynamic agent is freely filterable at the glomerular function, but it is neither secreted nor resorbed by the kidney tubules. Although this method used to measure total and individual kidney functions, it can also be used for the glomerular filtration rate (GFR) [11].

There are many works comparing RRFs calculated with ^{99m}Tc-DTPA and ^{99m}Tc-DMSA in adults and children. Çelik et al. [12] studied the comparison of RRFs using ^{99m}Tc-DTPA and ^{99m}Tc-DMSA for children and found a good correlation between the two methods. Arteaga et al. [13] have performed renal studies for newborns and 1-year old children using ^{99m}Tc-DTPA, ^{99}Tc-MAG3 and ^{99m}Tc-DMSA radiopharmaceuticals, and found the lowest absorbed dose for ^{99}Tc-MAG3 and the highest for ^{99m}Tc-DMSA. Lee et al. [14] have shown the reliability of ^{99m}Tc-DTPA as ^{99m}Tc-DMSA to calculate the relative renal functions for rabbits with unilateral ureteral obstruction. In their works, Domingues et al. [15] and Itoh et al. [16] mentioned that ^{99m}Tc-DTPA is not as good as ^{99m}Tc-DMSA in relative renal function calculation for humans. However, there is no consensus about the results and no extensive studies have been

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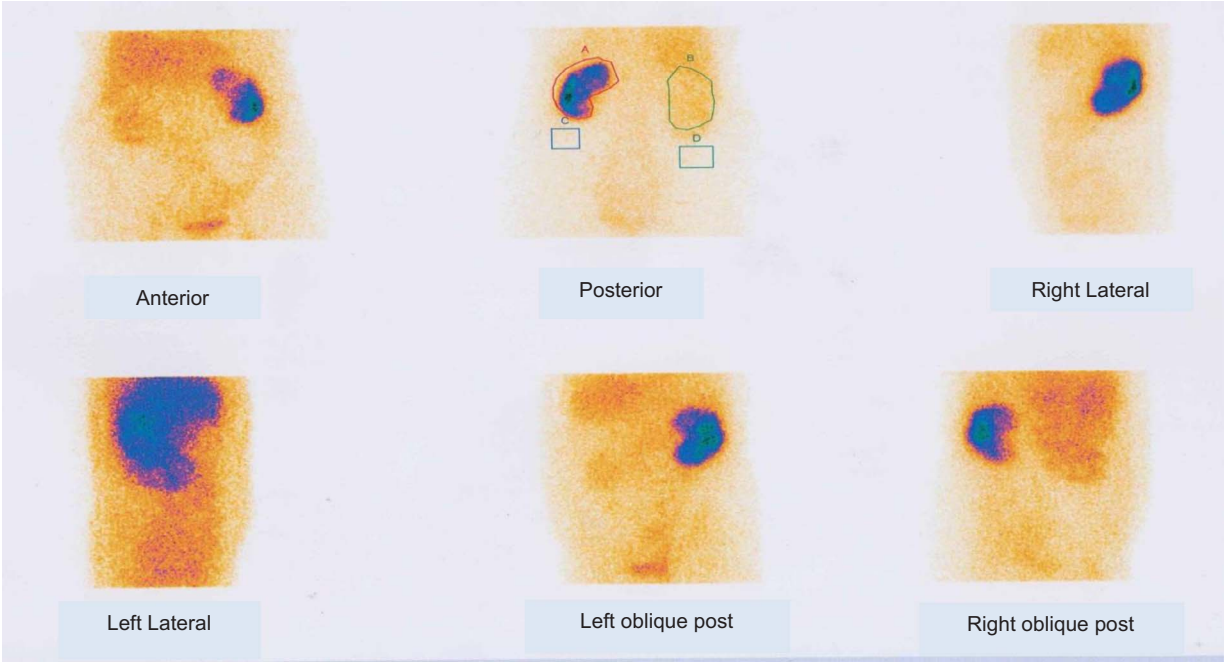
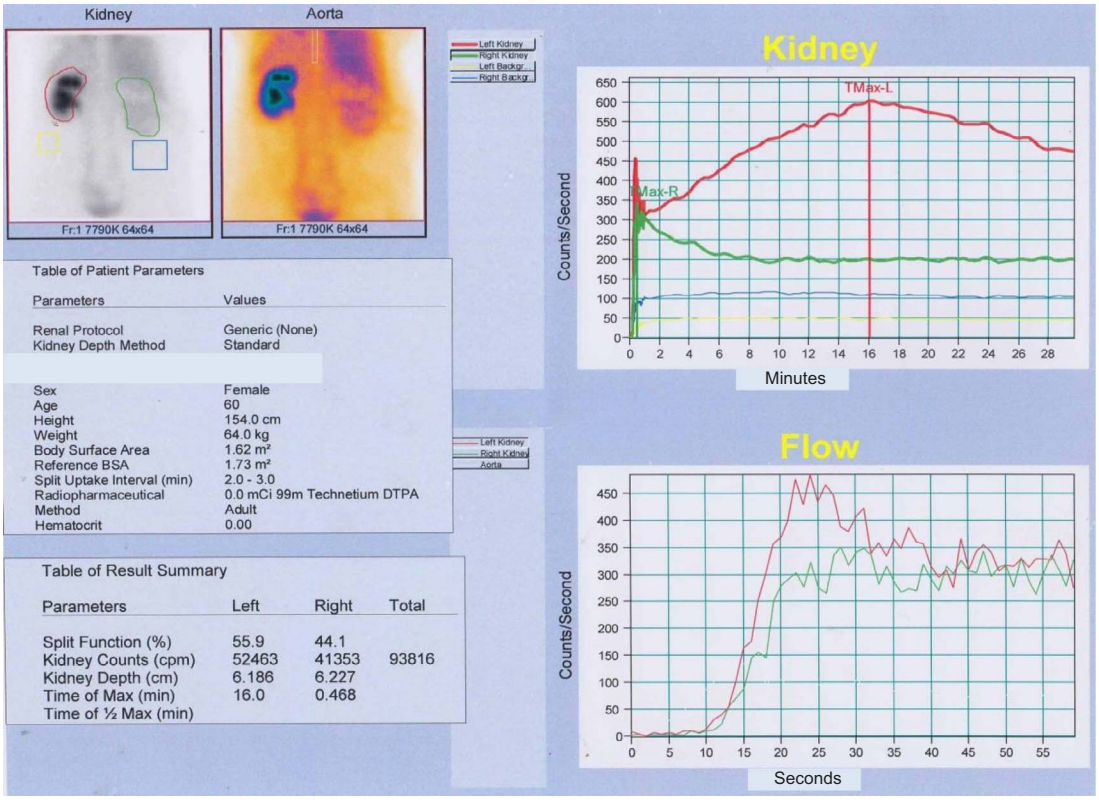


(a)



(b)

Fig. 1. Kidney image of a patient using (a) ^{99m}Tc-DMSA scan, (b) ^{99m}Tc-DTPA scan.