ABSTRACT

Renogram is an essential functional imaging procedure used to evaluate renal perfusion, glomerular filtration rate (GFR), and urinary excretion. Technetium-99m Diethylene Triamine Pentaacetic Acid (Tc-99m DTPA), which is primarily excreted through glomerular filtration, serves as an ideal tracer for assessing renal filtration function. In cases of impaired renal function, radiopharmaceuticals may be distributed to non-target organs such as the heart and liver, potentially increasing the absorbed dose in these organs. This study analyzed the distribution and absorbed dose of Tc-99m DTPA in target organs (kidneys) and non-target organs (heart and liver) using the Medical Internal Radiation Dose (MIRD) formalism. Thirty patients undergoing renogram examinations at Dr. Kariadi General Hospital were divided into two groups based on GFR values: low GFR (<60 mL/min/1.73 m^2) and high GFR (≥60 mL/min/1.73 m^2). Radiopharmaceutical activity was quantified using SPECT/CT imaging by defining Regions of Interest (ROI) on the kidneys, heart, and liver through Xeleris 4 software. In the low-GFR group, renal uptake ranged from 17.1–20.5%, while cardiac and hepatic uptake reached 25.0% and 37.4%, respectively. In the high-GFR group, renal uptake increased to 25.4–28.4%, while cardiac and hepatic uptake decreased to 18.7% and 27.5%, respectively. Dose distribution analysis showed that in the low-GFR group, the kidneys absorbed approximately 78% of the total dose, whereas the heart and liver absorbed 7.8% and 14.3%, respectively. In contrast, the high-GFR group demonstrated dominant renal absorption (±90%) with the heart and liver receiving less than 10%. MIRD-based analysis indicated that renal absorbed dose was higher in patients with high GFR, while non-target organs received higher doses in patients with low GFR. Variations in GFR significantly affect the biodistribution and absorbed dose of Tc-99m DTPA. Reduced renal function increases exposure to non-target organs, whereas normal renal function results in higher absorbed doses concentrated in the kidneys. MIRD-based dosimetry is essential for optimizing renogram protocols, improving diagnostic accuracy, and enhancing patient safety in nuclear medicine practice.

Keywords: Tc-99m DTPA, renogram, MIRD, glomerular filtration rate (GFR), absorbed dose, SPECT/CT, nuclear medicine.