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Early assessment of renal impairment in patients undergoing Peptide Receptor Radionuclide Therapy evaluated by MAG3 renal scintigraphy

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Objectives: Due to the potential nephrotoxicity of Peptide Receptor Radionuclide Therapy (PRRT), pre-therapeutic assessment of kidney function is mandatory. Radiation damage of irradiation is the proximal tubuli reabsorbing the radionuclide and the interstitium retaining the radioactivity. Therefore, kidney function test measuring tubular extraction, like mercaptoacetyltriglycine (^{99m}Tc-MAG3), provides additional information in early stages of suspicious renal failure. The aim of this study was an early assessment of renal impairment after treatment with ^{177}Lu-octreotide to investigate the potential loss of kidney function as a function of the administered activity. Materials and Methods: From March 2011 to December 2014, renal impairment was analyzed prior to 136 treatments (32 patients) using ^{99m}Tc-MAG3 clearance (mean follow-up, 366 ± 201 days). Subsequently, PRRT was performed with a mean cumulative activity of 32.2 GBq ^{177}Lu-octreotide (3-7 cycles, standard intervals of 3 months). The ratio of the MAG3 tubular extraction rate (TER) to TER of lower limit (RaTER) was calculated and analyzed as a function of the cumulative administered activity by linear regression analysis. Results: Prior to PRRT, 12 patients showed impaired renal function and 20 patients demonstrated normal kidney function, as indicated by ^{99m}Tc-MAG3 renal scintigraphy (mean TER, 233.5 ± 52.6 ml/min/1.73 m^2). RaTER was 131 ± 0.25 %. Linear regression analysis revealed a median shift of renal function of -0.03% per administered GBq (quartile, -0.34%/GBq, +0.14%/GBq). The following equation was utilized: (relative change in TER per GBq of ^{177}Lu) = 0.0088 - 0.0106 x (initial TER/TER$_{lower\ limit}$). Furthermore, negative gradients showing a high loss of TER per administered activity were observed in patients with a good kidney function whereas in the cohort with initial renal impairment the TER remained almost constant. To illustrate this, we found in 13 patients having an initial TER of <1.3*TER of lower limit that the worst reduction of kidney function was only 0.21% per administered GBq. Conclusion: Only patients with an appropriate kidney function prior to the start of PRRT seem to be at risk of developing renal impairment in the course of therapy. On the other hand, an initially reduced ^{99m}Tc-MAG3- clearance prior to the first treatment cycle seems not to be an exclusion criteria for PRRT. In this study investigating the early assessment of renal function by ^{99m}Tc-MAG3 renal scintigraphy, a low risk of PRRT related renal damage was demonstrated even in a long-term follow-up over one year.