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24,25-dihydroxy vitamin D and vitamin D metabolite ratio as vitamin D biomarkers in chronic kidney disease

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Objectives: Vitamin D deficiency is one of causes of secondary hyperparathyroidism and common clinical manifestations of metabolic bone disease (MBD) in patients with CKD. The management of vitamin D deficiency and hyperparathyroidism is important to MBD as well as cardiovascular disorder in CKD. Recently, 24,25-dihydroxyvitamin D (24,25(OH)₂D) and vitamin D metabolite ratio (VMR) which is the ratio of 24,25(OH)₂D to 25(OH)D have emerged as vitamin D biomarkers. We aim to analyze which vitamin D levels is useful for evaluating MBD in patients with CKD.

Methods: We analyzed a subset of blood and urine samples from a total of 208 outpatients who diagnosed CKD stage G2 to G5 with informed consents. We compared the correlation of 25(OH)D, 24,25(OH)₂D, VMR, intact parathyroid hormone (iPTH), and estimated glomerular filtration rate by creatinine-based CKD-EPI equation (eGFR).

Results: The mean values of eGFR, serum calcium, serum phosphate, iPTH, 25(OH)D, 24,25(OH)₂D, and VMR were 39.4±17.5 mL/min/1.73m², 9.4±0.6 mg/dL, 3.8±0.8 mg/dL, 58.5±44.4 pg/mL, 22.8±11.2 ng/mL, 0.8±0.6 ng/mL, and 3.6±1.9, respectively. eGFR and 24,25(OH)₂D showed positive correlation (R²=0.0603, p<0.001), and eGFR and VMR showed positive correlations (R²=0.1523, p<0.001), but 25(OH)D showed no significant correlation with eGFR (R²=0.0011, p=0.632). Negative correlations were found between iPTH and eGFR (R²=-0.0874, p<0.001), between iPTH and 24,25(OH)₂D (R²=-0.072, p<0.001), between iPTH and VMR (R²=-0.0689, p<0.001) and between iPTH and 25(OH)D (R²=0.0277, p=0.016). iPTH increased, and 24,25(OH)₂D and VMR decreased according to CKD stage G increasing (p<0.001). There is no significant difference in 25(OH)D according to CKD stage G increasing (p=0.353).

Conclusions: According to eGFR decreasing, iPTH increased, and 24,25(OH)₂D and VMR decreased in patients with CKD. 24,25(OH)₂D and VMR showed significant correlation with eGFR and iPTH, but 25(OH)D showed no significant correlation with eGFR. So, 24,25(OH)₂D and VMR are more useful than 25(OH) vitamin D as vitamin D markers in patients with CKD.

Figure 1. Change of Chronic Kidney Disease (CKD)-Metabolic Bone Disease Biomarkers according to CKD stage

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