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Exploring the Impact of Serum Phosphate Levels on Left Ventricular Function and Hypertrophy in End-Stage Renal Disease: Unraveling the Cardiovascular Consequences of Mineral Dysregulation

Roland Helmizar[1], Dian Puspita[2]
[1]Department of Internal Medicine, Baiturrahmah University, Indonesia
[2]Department of Cardiovascular, Baiturrahmah University, Indonesia

Objectives : Cardiovascular complications, particularly left ventricular hypertrophy (LVH) and dysfunction, are major causes of morbidity and mortality in end-stage renal disease (ESRD). Elevated serum phosphate levels contribute to vascular calcification, arterial stiffness, and myocardial remodeling, yet their direct effect on left ventricular (LV) structure and function remains unclear. This study examines the relationship between serum phosphate levels, LV function, and LV mass in ESRD patients.
Methods : A cross-sectional study was conducted on 96 hemodialysis-dependent ESRD patients at a tertiary hospital from January 2022 to December 2024. Patients were stratified into normophosphatemia (≤4.5 mg/dL) and hyperphosphatemia (>4.5 mg/dL) groups. Echocardiographic assessments measured LV mass index (LVMI), ejection fraction (EF), and diastolic function parameters. Pearson's correlation and multiple linear regression analyses were performed to assess associations between phosphate levels and cardiac parameters.
Results : The mean serum phosphate level was 5.0 ± 1.2 mg/dL, with 63.3% of patients exhibiting hyperphosphatemia. Compared to the normophosphatemic group, hyperphosphatemic patients had significantly higher LVMI (140.3 ± 26.1 g/m² vs. 115.5 ± 22.4 g/m², $p < 0.001$) and lower EF (52.0 ± 7.6% vs. 56.4 ± 6.2%, $p = 0.003$). Pearson's correlation revealed a positive association between phosphate levels and LVMI ($r = 0.44$, $p < 0.001$) and a negative correlation with EF ($r = -0.37$, $p = 0.002$). Multivariate analysis confirmed hyperphosphatemia as an independent predictor of increased LVMI ($\beta = 0.34$, $p < 0.001$) and reduced EF ($\beta = -0.26$, $p = 0.005$), after adjusting for age, blood pressure, and dialysis duration.
Conclusions : Hyperphosphatemia in ESRD is associated with increased LV mass and impaired systolic function, underscoring its role in cardiovascular remodeling. Effective phosphate control may be key to reducing cardiovascular risk in this population.