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Tracking Electrolyte Imbalance in CKD: From Early Signs to Advanced Stages

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Objectives : Chronic kidney disease (CKD) is characterized by progressive renal function decline, leading to metabolic disturbances, including electrolyte imbalances. Electrolyte abnormalities such as hyperkalemia, hyponatremia, hyperphosphatemia, and metabolic acidosis contribute to cardiovascular complications and increased mortality in CKD patients. However, the distribution and severity of these imbalances across different CKD stages remain incompletely understood. This study examines trends in serum electrolyte imbalances across CKD stages (1–5) to provide insights into their prevalence and clinical implications.
Methods : This cross-sectional retrospective study included adult CKD patients (stages 1–5) who had at least three recorded electrolyte panels over 12 months. Patients on dialysis, kidney transplant recipients, and those with acute kidney injury (AKI) or active malignancy were excluded. Serum sodium (Na^+), potassium (K^+), phosphate (PO_4^{3-}), bicarbonate (HCO_3^-), and anion gap were analyzed. ANOVA was used to compare mean electrolyte levels across CKD stages, while chi-square tests evaluated the prevalence of electrolyte imbalances. Logistic regression assessed predictors of severe disturbances.
Results : Electrolyte imbalances were more prevalent in advanced CKD. Hyponatremia increased with CKD progression ($p<0.01$), while hyperkalemia was significantly higher in stages 4 and 5 ($p<0.001$). Hyperphosphatemia was more frequent in later CKD stages ($p<0.001$), reflecting reduced renal phosphate excretion. Serum bicarbonate levels declined progressively, indicating worsening metabolic acidosis ($p<0.001$). These findings suggest that electrolyte homeostasis deteriorates with declining renal function, necessitating stage-specific management strategies.
Conclusions : Electrolyte imbalances in CKD follow distinct trends, with increasing severity as renal function declines. Regular monitoring and early intervention are essential to mitigate complications and improve patient outcomes. Future studies should explore targeted therapies to optimize electrolyte management in CKD.

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Electrolyte Imbalances in CKD Stages