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Leveraging Machine Learning to Investigate the Impact of Ketoanalogue Supplementation on Mortality and Renal Outcomes in Patients with Diabetic Kidney Disease: A Data-Driven Clinical Perspective

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Objectives : Diabetic kidney disease (DKD) is a leading cause of chronic kidney disease (CKD) and progression to end-stage renal disease (ESRD), significantly increasing both patient morbidity and mortality. The use of ketoanalogues, which support protein balance while minimizing nitrogenous waste, has emerged as a promising therapeutic strategy in DKD management. Despite their potential, the impact of ketoanalogues on survival rates and kidney function remains unclear. This study utilizes machine learning approaches to investigate the efficacy of ketoanalogue supplementation in enhancing mortality and renal outcomes in DKD patients.
Methods : A machine learning framework was utilized to analyze clinical data from electronic health records of DKD patients. Key variables, including renal function parameters, glycemic control metrics, and demographic data, were processed using models such as random forest, support vector machines, and logistic regression. These models were employed to evaluate the association between ketoanalogue supplementation and clinical outcomes.
Results : Analysis of 1,175 DKD patients demonstrated that ketoanalogue supplementation was significantly linked to improved renal outcomes. The random forest model achieved an accuracy of 87%, sensitivity of 85%, and an AUC of 0.89. Patients receiving ketoanalogues had a 30% lower mortality risk ($p < 0.001$) and a slower eGFR decline (2.8 vs. 4.5 mL/min/1.73m² annually, $p < 0.01$). Logistic regression confirmed ketoanalogue use as an independent predictor of reduced mortality (OR: 0.75, 95% CI: 0.68–0.83, $p < 0.001$) and slower renal decline (OR: 0.70, 95% CI: 0.62–0.79, $p < 0.01$).
Conclusions : Machine learning analysis supports the role of ketoanalogues in improving survival and preserving kidney function in DKD patients. These findings highlight the potential of ketoanalogues as part of a personalized, nutrition-based treatment strategy for DKD.