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Artificial Intelligence for Prediction and Management of CKD-MBD (AI 를 이용한 CKD-MBD 예측과 치료)

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Chronic kidney disease–mineral and bone disorder (CKD-MBD) is a complex condition characterized by dynamic interactions among mineral metabolism, bone remodeling, and cardiovascular complications. Current management is largely based on surrogate biomarkers such as calcium, phosphorus, and parathyroid hormone (PTH), yet substantial inter-individual variability often limits optimal treatment. Artificial intelligence (AI) offers new opportunities to better understand and manage this complexity. This lecture reviews the evolution of AI applications in CKD-MBD, from early physiology-based mathematical models to contemporary machine learning (ML) and quantitative systems pharmacology (QSP) approaches. Recent studies have demonstrated the potential of ML for predicting clinically relevant outcomes, including osteoporosis and future PTH levels, while QSP models provide a mechanistic framework for simulating disease progression and treatment responses. The lecture will highlight how AI is evolving beyond risk prediction toward individualized disease simulation and treatment optimization. The strengths, limitations, and future clinical implications of these approaches will be discussed, with a focus on their potential role in advancing precision medicine for CKD-MBD.

Keywords: CKD-MBD, artificial intelligence