Artificial Intelligence and Acute Kidney Injury

By Tushar Bajaj and Jay L. Koyner

Artificial intelligence (AI) in nephrology has begun to demonstrate potential clinical utility including machine learning for acute kidney injury (AKI) risk prediction, identification, phenotyping, and imaging transcriptomics. Machine learning has shown promise as a method to transform vast quantities of data into tools capable of predicting important patient outcomes (AKI, need for dialysis, and mortality).

The current gold standard for diagnosis of AKI relies on serum creatinine and urine output, both of which are flawed (1). Similarly, no other novel biomarker of AKI has been consistently shown to improve outcomes after detecting early AKI. This gap in AKI care opens opportunities for machine learning to create AKI risk prediction algorithms and improve outcomes.

Many risk scores have already been published, using methods such as gradient boosting, neural networks, deep learning, and random forests to identify high-risk patients. Many of these AI applications can accurately predict AKI up to 24–48 hours before changes in serum creatinine (2–4). These studies have taken place in variable clinical settings, including the entire hospital, adult intensive care units, and among perioperative patients. Advanced learning techniques have also been implemented to detect patterns within specific AKI settings, with some work identifying two to three different, distinct sub-phenotypes within large cohorts of patients with sepsis-associated AKI (5).

Importantly, just because a risk score can accurately predict AKI outcomes in one cohort does not mean it can in other settings. Many risk scores have high specificity and negative predictive value; however, the scores uniformly suffer from lower-than-optimal positive predictive values (20%–50%), which has limited their wide-scale implementation. Future risk scores may use advanced learning techniques (e.g., natural language processing) to optimize the positive predictive value to successfully identify patients at high risk for severe AKI, rather than the current scores that excel at identifying patients at low risk for severe AKI (e.g., “ruling out” AKI). Regardless of the test characteristics, data on the clinical implementation and validation of these AI scores are lacking.

In the near future, the Kidney Precision Medicine Project will obtain kidney biopsies from patients with AKI, and analyses of these samples with AI techniques may lead to tools that are even more accurate to assist bedside physicians (6) (Figure 1). It is essential, as these tools are developed and validated to minimize bias. The future of AI in AKI requires controlled, clinical trials paired with clinically meaningful outcomes.

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No AI tool was used to write this article.

References


Figure 1. Flow chart for an AI-AKI tool

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