Identification of end stage renal disease metabolic signatures from human perspiration

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Abstract

End stage renal disease (ESRD), characterized by cessation in kidney function, has been linked to severe metabolic disturbances, caused by buildup of toxic solutes in blood. To remove these solutes, ESRD patients undergo dialysis. As a proof of concept, we tested whether ESRD-related metabolic signatures can be detected in perspiration samples using a combined methodology. Our rapid methodology involves swabbing a glass slide across the patient's forehead, detecting the metabolites in the imprint using desorption electrospray ionization mass spectrometry, and identifying the key differences using machine learning methods. Based on collecting 42 healthy and 27 ESRD samples, we find saturated fatty acids are consistently suppressed in ESRD patients, with little change after dialysis. Also, our method enables the detection of uremic solutes, where we find elevated levels of uric acid (6.7 fold higher on average) that sharply decrease after dialysis. Beyond the study of individual metabolites, we find that a lasso model, which selects for 8 m/z fragments from 24,602 detected analytes, achieves area under the curve performance of 0.85 and 0.87 on training (n=52) and validation sets (n=17) respectively. Together, these results suggest that this methodology is promising for detecting signatures relevant for Precision Health.

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