Massive single-cell survey of kidney cell types reveals new paths to disease

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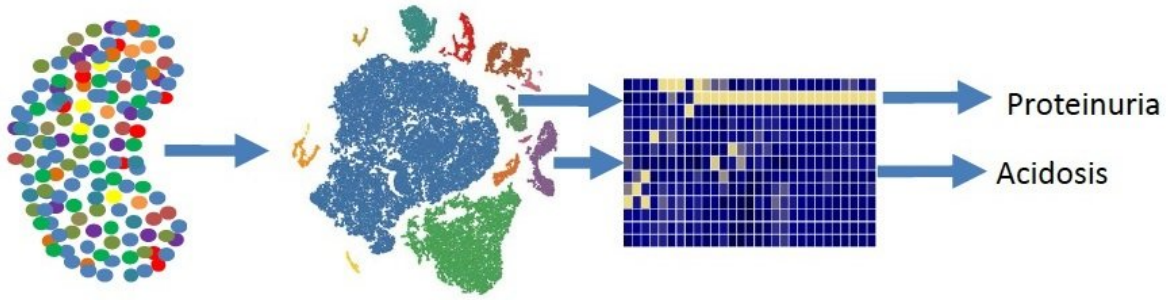

Cell function by disease gene mapping. Credit: Katalin Susztak, Perelman School of Medicine, University of Pennsylvania

The kidney is a highly complex organ - far beyond a simple filter. Its function requires intricate interactions between many highly specialized cell types to extract waste, balances body fluids, form urine, regulate blood pressure, and secrete hormones. New research from a team in the Perelman School of Medicine at the University of Pennsylvania shines a light on specific cell types that drive normal or diseased kidney function at the molecular level.

By sequencing the RNA from 57,979 cells from healthy mouse kidneys, the team found that mutations in genes that have similar characteristics are expressed in a single unique differentiated cell type. The study, led

by Katalin Susztak, MD, PhD, a professor of Renal-Electrolyte and Hypertension and Genetics, also identified three novel cell populations, along with all previously described kidney cell types. They published their findings online this week in *Science*.

"The work provides unprecedented insight into kidney physiology and disease," Susztak said. "Each cell in the kidney seems to have a unique non-redundant function, and dysfunction of specific cell types present with specific symptoms in people. Using our approach we are starting to understand how kidney disease develops at the level of a single cell." The overall prevalence of chronic kidney disease in America is about 14 percent, according to the National Institute of Diabetes and Digestive and Kidney Diseases.

The Penn team unexpectedly found that what they thought were two irreversibly differentiated and distinct cell types in the kidney could convert to each other. The interconversion was also observed in kidney disease mouse models. They analyzed a large cohort of human patient samples from the human kidney biobank managed by Susztak and found that the interconversion might also occur in patients with kidney disease and likely contributes to a condition when the kidneys cannot remove enough acid from the body.

"Knowledge from our survey will enhance our understanding of the roles that different cell types play during normal kidney functioning and dynamic changes occurring during disease development," Susztak said. "When combined with existing knowledge, this study provides a new roadmap for future studies to identify the underlying causes of chronic kidney disease. A change in the basic identity of the cells, means that kidney disease 'reprograms' the kidney. Our goal is to find methods to undo this reprograming."

More information: J. Park el al., "Single-cell transcriptomics of the

mouse kidney reveals potential cellular targets of kidney disease," *Science* (2018). science.sciencemag.org/cgi/doi … 1126/science.aar2131