Docket #: S23-452

Non-invasive profiling of urinary tract tissues with urine liquid biopsy

Researchers at Stanford and UCSF have determined methods of performing cell-free RNA (cfRNA) transcriptomics and metabolomics on urine samples.

Urine is assayed alongside blood in medicine, however current clinical diagnostic tests exploit only a minor fraction of its biomolecular repertoire, thereby foregoing high-resolution insights into human health and disease. For instance, current state-of-the-art liquid biopsies are largely focused on nucleic acids in blood plasma. Urine is the ultra-filtrate of blood; some molecules that are present at very low levels in the blood are hyper-concentrated in urine, offering an orthogonal readout to a plasma liquid biopsy. Additionally, urine provides a direct, noninvasive window into the health and functioning of cell types and tissues with low representation in blood. Therefore, the replacement or use of a urine liquid biopsy relative to current clinical readouts on urine (e.g., albumin, urine dipstick, serum creatinine, etc.) may provide a more direct readout into underlying disease.

Stage of Development
Research – in vitro

Stage of Research
The inventors have developed methods of detecting cell-free RNA (cfRNA) as well as metabolites in urine samples. This method can be applied as a direct readout for disease, for example as a method of evaluating kidney function, prostate function, or bladder function in a human.

Technology Reference Numbers
CZ Biohub SF ref. no. CZB-298S
Stanford ref. no. S23-452
UCSF ref. no. SF2024-079

Applications

- Characterization of the urine transcriptomic landscape.
- Urine liquid biopsies exhibit distinct cell types of origin from the plasma cell-free RNA transcriptome.
- Untargeted metabolomics for a functional readout of the urinary metabolic landscape.

Advantages

- For organs interfacing with other bodily fluids, blood may not facilitate sufficient analytical sensitivity on their health and function.
- While RNA offers insights into the underlying changes in gene expression, metabolomics provides a functional readout.
- The ability to non-invasively resolve bladder urothelial, renal and prostate epithelia at cell type resolution.

Publications

- Vorperian, S., Bertozzi, C., Quake, S., et al., Multiomics characterization of cell type repertoires for urine liquid biopsies. bioRxiv (October 2023).

Patents

- Published Application: WO2025085722

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