Urinary Extracellular Vesicle miRNA Profiling for Detecting Cardiac Surgery-Associated Acute Kidney Injury

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Objectives: Cardiac surgery-associated acute kidney injury (CSA-AKI) is an important complication associated with poor short-term and long-term outcome, including chronic kidney disease even end stage kidney disease. This study analyzed the expression profile of miRNAs in urinary extracellular vesicles in patients with CSA-AKI.

Methods: A total of 119 patients receiving cardiac surgery and admitted to the cardiac surgery intensive care unit were enrolled from 2014 to 2019. The urine samples were collected 0 hour and 12 hours after surgery. In the discovery cohort, profiles of miRNA expression levels in urinary extracellular vesicles were assessed by next generation sequencing and then verified by real-time quantitative RT-PCR analysis. MiRNAs candidates with altered expression between AKI and non-AKI groups were further analyzed. The score model based on miRNA expression was validated in the validation group. TargetScan 7.1 and miRDB databases were used for target prediction and KEGG was used for pathway analysis.

Results: A total of 137 abundant miRNAs were identified in the urinary extracellular vesicles. There were 29 significantly altered miRNAs found by MWU test. The score model, comprising three ratios (miR-21-5p/miR-204-5p, miR-21-5p/miR-10b-5p and miR-21-5p/miR-125a-5p), had a good performance in predicting development of CSA-AKI (AUC 0.758, sensitivity 90.0%) and non-recovery of CSA-AKI (AUC 0.875, sensitivity 72.7%). Target prediction and pathway analysis revealed that the altered miRNAs were associated with HIF-1 signaling pathway.

Conclusions: The score model derived by ratios of urinary extracellular vesicular miR-21-5p/miR-204-5p, miR-21-5p/miR-10b-5p and miR-21-5p/miR-125a-5p can predict development of CSA-AKI and non-recovery of CSA-AKI.

Figure 1. Graphic abstract