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Noninvasive Urine Oxygen Monitoring and the Risk of Acute Kidney Injury in Cardiac Surgery

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Abstract:

Background: Acute kidney injury (AKI) is a common complication of cardiac surgery. An intraoperative monitor of kidney perfusion is needed to identify patients at risk for AKI. The authors created a noninvasive urinary oximeter that provides continuous measurements of urinary oxygen partial pressure and instantaneous urine flow. They hypothesized that intraoperative urinary oxygen partial pressure measurements are feasible with this prototype device and that low urinary oxygen partial pressure during cardiac surgery is associated with the subsequent development of AKI.
Methods: This was a prospective observational pilot study. Continuous urinary oxygen partial pressure and instantaneous urine flow were measured in 91 patients undergoing cardiac surgery using a novel device placed between the urinary catheter and collecting bag. Data were collected throughout the surgery and for 24h postoperatively. Clinicians were blinded to the intraoperative urinary oxygen partial pressure and instantaneous flow data. Patients were then followed postoperatively, and the incidence of AKI was compared to urinary oxygen partial pressure measurements.
Results: Intraoperative urinary oxygen partial pressure measurements were feasible in 86/91 (95 %) of patients. When urinary oxygen partial pressure data were filtered for valid urine flows greater than 0.5 ml kg-1 h-1, then 70/86 (81 %) and 77/86 (90 %) of patients in the cardiopulmonary bypass (CPB) and post-CPB periods, respectively, were included in the analysis. Mean urinary oxygen partial pressure in the post-CPB period was significantly lower in patient who subsequently developed AKI than in those who did not (mean difference, 6 mmHg; 95 % CI, 0 to 11; P = 0.038). In a multivariable analysis, mean urinary oxygen partial pressure during the post-CPB period remained an independent risk factor for AKI (relative risk, 0.82; 95 % CI, 0.71 to 0.95; P = 0.009 for every 10-mmHG increase in mean urinary oxygen partial pressure).
Conclusion: Low urinary oxygen partial pressures after CPB may be associated with subsequent development of AKI after cardiac surgery.

Keywords: acute kidney injury, urine oxygen partial pressure, cardiac surgery, catheter, urinary oximeter, urine flow