**Heart failure exacerbates renal medullary hypoxia and risk of acute kidney injury after cardiopulmonary bypass**

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**Introduction.** Acute kidney injury (AKI) is a major complication of cardiac surgery, especially in patients with heart failure (HF). Mechanistic insight has been limited by the lack of clinically relevant models.

**Aims**. To determine how pre-existing HF affects renal oxygenation and function before, during and after cardiopulmonary bypass (CPB), and to identify the mechanisms underlying postoperative AKI.

**Methods**. Female sheep were surgically instrumented under isoflurane anaesthesia (2.0-2.5% in oxygen-air mixture), for continuous monitoring of renal blood flow (RBF), renal oxygen delivery (RDO₂), renal cortical and medullary tissue oxygenation (PO₂) and urine output during 3 phases: pre-CPB (conscious), during CPB (anesthetized), and post-CPB (conscious). HF was induced via progressive coronary ligation and defined by a ≥25% fall in ejection fraction. HF (n=10) and control (n=10) animals underwent 2-h CPB with aortic cross-clamp followed by 48-h recovery.





**Results.** CPB reduced RBF and renal medullary (but not cortical) tissue PO₂ in both groups (all *P*time ≤0.001). Postoperatively, medullary PO₂ recovered in healthy controls but remained suppressed in sheep with HF (*P*group <0.001), despite a similar recovery of RBF. Animals with HF also had persistently lower haemoglobin and RDO₂ across the perioperative phase (both *P*group ≤0.05). In the HF group, postoperatively urine output was lower (*P*=0.039) and AKI occurred more frequently (50% vs. 11%; OR 9.0, *P*=0.14). Histopathology showed acute tubular necrosis and peritubular inflammation after CPB (50% [HF] vs. 37% [control]), with no group differences.

**Discussion.** Pre-existing HF amplifies renal vulnerability to CPB by preventing recovery of renal medullary oxygenation, implicating sustained tissue hypoxia as a driver of postoperative AKI and a potential target for renoprotection.