ERAS® CARDIAC

Acute Kidney Injury Prevention

Preoperative
• **Perform a kidney health assessment, to include medical and medication history, baseline kidney function, previous episodes of AKI, nephrotoxin exposure, assessment of anemia.**
• *Perform a complete urinalysis: consult nephrology for proteinuria*
• **Optimize glycemic control by maintaining blood glucose <180 mg/dL**
• **Hold ACE inhibitors and ARBs for 48 hours preoperatively**
• *Limit aminoglycoside antibiotics unless there is a history of anaphylaxis to penicillin or cephalosporins, or infectious indication. The nephrotoxicity of the glycopeptide antibiotic vancomycin is controversial, and it should be used judiciously.*
• **Give clear liquids until 2 hours before general anesthesia to reduce the risk of dehydration**
Intraoperative
• **Optimize glycemic control by maintaining blood glucose <180 mg/dL with an insulin infusion**
• *Limit aminoglycoside antibiotics*
• **Perform goal-directed perfusion targeting global oxygen delivery (DO_2) > 270 ml/min/m^2**
• **Avoid >37° C on rewarming from cardiopulmonary bypass**
Postoperative (first 24-48 hours)
• **Optimize glycemic control by maintaining blood glucose >80 and <180 mg/dL with an insulin infusion**
• **Hold ACE inhibitors and ARBs in oliguric/high AKI risk patients**
• **Limit aminoglycoside antibiotics**
• *Avoid NSAIDs*
• **Avoid intravenous radio-contrast agents if possible**
• **Monitor sCr daily and UO hourly until there are no further indicators of CSA-AKI, call for oliguria (UO <0.5 cc/kg/hr using lean body mass)**
• *Utilize continuous invasive or noninvasive functional hemodynamic hourly monitoring to maintain optimal intravascular blood volume:* ○ *Fluid challenges with lactated ringers for responsiveness if oliguric, cardiac index < 2.0 L/min/m^2 and CVP <5 mmHg, PAD <14 mmHg* ○ *Diuretics for CVP >15 mmHg or PAD > 20 mmHg. Consider ultrafiltration if diuretic unresponsive.*
• *Implement goal-directed hemodynamic therapy in oliguric/high AKI risk/positive biomarker patients (Nephrocheck >0.7): Utilizing fluids, diuretics, and inotropes to maintain:* ○ *SBP 100 - 130 mmHg or MAP 65 – 90 mmHg* ○ *Cardiac Index >2.2 L/min/m^2* ○ *UO >0.5 ml/kg/hr* ○ *SVO2 > 55% (optimize Hg, PaO_2, and Cardiac Index)*
• *Limit transfusion of PRBC to a Hgb < 7.0 and evidence of oliguria, lactic acidosis, low cardiac output or positive urinary biomarkers*
• **For persistent oliguria (UO < .5 cc/kg/hr for 3 hours) or SCr rise > 0.3 mg/dL:** ○ **Verify the patency of the urinary catheter** ○ **Adjust medication dosing/interval for renal function per institutional policies or discontinue nephrotoxic medications (e.g., gentamycin, enoxaparin, etc.)**

Legend**: Orders in Bold** are based on Class I or IIA recommendations,
Orders in italics were inconsistently Class I or IIA, or Class IIB/supported by evidence published in peer-reviewed journals.

Abbreviations-DAPT-dual antiplatelet Therapy, DOAC-direct-acting oral anticoagulants, Hgb-hemoglobin, IV-intravenous, CPB-cardiopulmonary bypass, ACT-activated clotting time, PT-prothrombin time, PTT-partial thromboplastin time, FFP-fresh frozen plasma, PRBC-packed red blood cells, DDAVP- deamino-8-D-arginine vasopressin

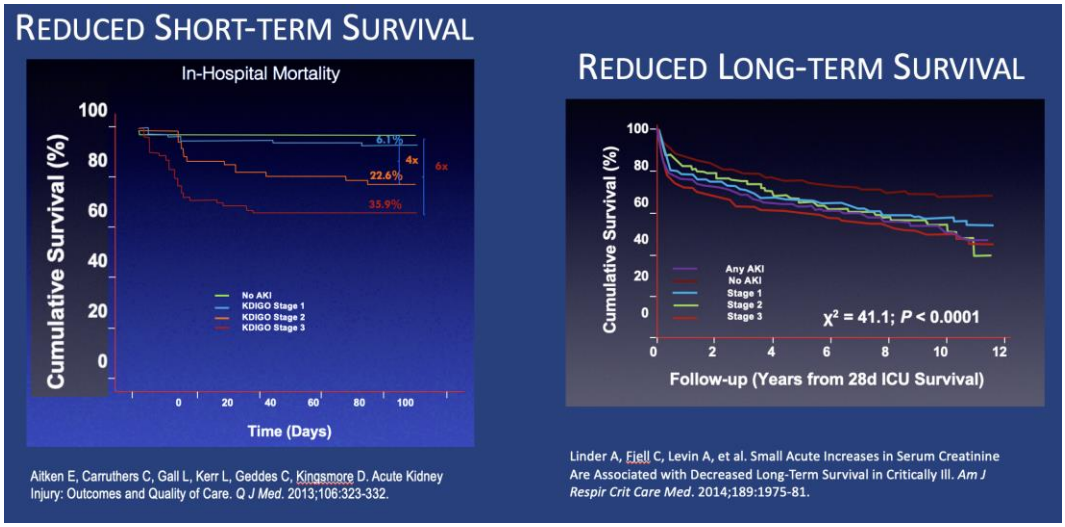

TABLE 1 Comparison of Cardiac Surgery–Associated Acute Kidney Injury Consensus and Guideline Publications

Strong and Moderate Recommendations	STS/SCA/AmSECT Guidelines[2]	ADQI Consensus[3]	ERAS Cardiac Guidelines[4]	POQI/ERAS Consensus[a]
Preoperative				
Perform a kidney health assessment				✓
Consume clear liquids up until 2-4 hours before general anesthesia			✓	✓
Discontinue ACE inhibitors and ARBs	✓	✓		✓
Optimize preoperative glycemic control by maintaining blood glucose <180 mg/dL		✓	✓	
Intraoperative				
Preserve adequate intravascular volume in the setting of dynamic fluid shifts and cardiopulmonary compromise				✓
Restrict the use of excessive ultrafiltration and hemoconcentration during cardiopulmonary bypass		✓		✓
Use individualized, perioperative goal-directed therapy to reduce the incidence of CSA-AKI				✓
Avoid hyperthermic perfusion (>37 °C) on cardiopulmonary bypass	✓		✓	
Use a goal-directed oxygen delivery strategy on cardiopulmonary bypass.	✓			✓
Optimize intraoperative glycemic control by maintaining blood glucose 80-180 mg/dL	✓	✓	✓	✓
Use intraoperative blood salvage to maintain hematocrit above a prescribed threshold				✓
Postoperative				
Avoid prophylactic or otherwise routine use of diuretic therapy		✓		✓
Refer new KDIGO stage 2 or 3 CSA-AKI for long-term follow-up				✓
Perform a multidisciplinary review of all new, persistent, dialysis-dependent CSA-AKI				✓
Implement a KDIGO bundle of care[b] for patients at high risk for AKI	✓	✓	✓	✓
Optimize postoperative glycemic control by maintaining blood glucose 80-180 mg/dL	✓	✓	✓	✓
Use a low tidal volume ventilation strategy (<10 mL/kg)		✓	✓	

[2] Brown JR, Baker RA, Shore-Lesserson L, et al. The Society of Thoracic Surgeons/Society of Cardiovascular Anesthesiologists/American Society of Extracorporeal Technology Clinical Practice Guidelines for the Prevention of Adult Cardiac Surgery–Associated Acute Kidney Injury. Ann Thorac Surg. 2023;115:34-42.

[3] Nadim MK, Forni LG, Bihorac A, et al. Cardiac and vascular surgery- associated acute kidney injury: the 20th International Consensus Conference of the ADQI (Acute Disease Quality Initiative) Group. J Am Heart Assoc. 2018;7:e008834.

[4] Engelman DT, Ben Ali W, Williams JB, et al. Guidelines for perioperative care in cardiac surgery: Enhanced Recovery After Surgery Society recommendations. JAMA Surg. 2019;154:755-766.

[a] Brown J, Shaw AD, Mythen MG, et al. Adult Cardiac Surgery Associated Acute Kidney Injury: Joint Consensus Report of the PeriOperative Quality Initiative (POQI) and the Enhanced Recovery After Surgery (ERAS®) Cardiac Society. Submitted to J Cardiothorac Vasc Anesth.