AKI WORKGROUP

AKI Reduction Recommendations and Suggestions for Care

OVERVIEW

The following recommendations were developed within the VCSQI AKI Workgroup.
Champion(s): Michael Brown, CCP (Mary Washington), Chris Sytsma, RN, MSN (Winchester), Nicholas Teman, MD (UVA), Kerry Prewitt, MD (Sentara).

Project Members: Denise Cox (Sentara), Bridget Keeley, CCP (Winchester), Jeff Rich, MD (VCSQI), Judy Smith (UVA), Kevin Lobdell, MD (Perfect Care), Shelley Cahalan (Sentara), LouAnn Janney (Carilion), Emaad Abdel-Rahman, MD (UVA), Christine Kim, MD (VCU), Evelyn Dallas, CCP (UVA)

Recognition and a special thanks to Dr. Matthew Cauchi and members of the Carilion Clinic for laying the foundation in developing AKI recommendations for Cardiology. Additional recognition is due to the members of the Sentara Health System for carrying the torch to enhance Cardiology recommendations.

We are also honored to recognize the input of the VCSQI Perfusion Group for providing guidance in this regard.

The following are the definitions of AKI as presented during the 2021 Winter Quarterly Meeting by Dr. Gregory Dehmer (Carilion) Click here to watch the full presentation.

	NCDR	STS
Source	Derives from the consensus statements formulated by the: • Acute Dialysis Quality Initiative (ADQI) group • American Society of Nephrology (ASN) • ARF Advisory group • International Society of Nephrology (ISN), • National Kidney Foundation (NKF) • Kidney Disease: Improving Global Outcomes group (KDIGO)	Derived from the RIFLE criteria **R**isk, **I**njury, **F**ailure, **L**oss of kidney function, **E**nd-stage renal disease
Definition	An abrupt (within 48 hours) reduction in kidney function currently defined as an absolute increase in serum creatinine of ≥ 0.3 mg/dl (≥ 26.4 µmol/l), a percentage increase in serum creatinine of ≥ 50% (1.5-fold from baseline), or a reduction in urine output (documented oliguria of less than 0.5 ml/kg per hour for > six hours).	Renal failure is defined as sCr levels 4 mg/dL or greater (176.8 mmol/L), a 3x or greater increase in sCr levels over the baseline preoperative value, or a new requirement for dialysis
Reference(s)	• Mehta RL, Kellum JA, Shah SV, et al. Crit Care 2007;11:R31 • Kellum JA, Mehta RL, Angus DC, et al. Kidney Int 2002;62:1855-63	Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P and the Acute Dialysis Quality Initiative (ADQI) workgroup. Crit Care. 2004 Aug; 8(4):R204-12

Related Presentations:

AKI: A Case Presentation - Nick Teman, MD (UVA)
AKI: A Cardiologist's Perspective - Kerry Prewitt, MD (Sentara)
AKI: A Cardiac Surgeon's Perspective - Kevin Lobdell, MD, LTC, MC, USAR (Perfect Care)
AKI: A Perfusionist's Perspective - Bridgett Keeley, CCP (Winchester)
AKI Recommendations: Summary and Implementation Steps - Mike Brown, CCP (Mary Washington) Chris Sytsma, RN, MSN (Winchester)

CARDIOLOGY RECOMMENDATIONS
- Pre-Cath
- Intra-Procedure
- Post-Procedure

SURGICAL RECOMMENDATIONS
- Preop
- Intra-op
- Post-op

VIRGINIA CARDIAC SERVICES QUALITY INITIATIVE

AKI WORKGROUP

AKI Reduction Recommendations and Suggestions for Care

The following recommendations were prepared for our cardiology partners to utilize when performing heart cath procedures. These recommendations may be used to serve as a bridge for patients undergoing a cath followed by an invasive procedure.

PRE-CATHETERIZATION RECOMMENDATIONS

Obtain baseline Serum Creatinine level:
- A. No known kidney disease: within 30 days
- B. Known kidney disease or risk factors for disease: within 7 days of known contrast exposure
- C. Unstable renal function: within 24-48 hours of known contrast exposure

Hold Nephrotoxic Medications 24 hours prior to procedure
- A. NSAIDS
- B. Metformin
- C. Aminoglycosides
- D. Anti-Virals (Acyclovir, Foscarnet)
- E. Amphotericin B
- F. ACE/ARB/ARNI

Hold diuretics day of procedure

Calculate Risk Assessment using Mehran Score or SCAI (optional)

1. **Avoid contrast loads within 72 hours of procedure**
2. **Prior to angiography, identify ideal, acceptable, and maximum contrast volume and included in the pre-procedure time out:**
   - A. Ideal: 2x eGFR
   - B. Acceptable: 3x eGFR
   - C. Maximal: 5x eGFR

Hydration (If BMI > 35, use ideal weight)
- A. **For all patients <u>except</u> patients with ESRD and/or active or decompensated HF:**
  1) Oral: 16 oz water night before procedure and 16 oz water morning of procedure
  2) IV: NS 3 mL/kg/hr x 1 hour
  3) After 1 hour: Standard Rate of 1.5 mL/kg/hr for fluid maximum of 500 mL

A. Standard Hydration Therapy

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1) 1.5mL/kg/hr plus 32 ounces of water
OR
2) 1.5mL/kg/hr x 4 hours

B. LVEDP Guided Hydration Therapy:
1) LVEDP < 18 mmHg 3 mL/kg/hr x 2 hrs plus 32 oz of water
OR
2) 3 mL/kg/hr x 4 hrs

~~3)~~

INTRA-PROCEDURE RECOMMENDATIONS

1. **Communication During Time Out**
   A. Serum Creatinine level
   B. Ideal and Acceptable Contrast Limits

2. **Contrast**
   A. Minimize contrast volume
   B. For GFR < 30, consider contrast saving device and/or iso-osmolar contrast
   C. Stage procedures as necessary

3. **Hydration**

~~A. IV fluids should be continued during procedure at Standard Rate of 1.5 mL/kg/hr~~

~~B. If the LVEDP is known, consider **LVEDP Guided Hydration Therapy** during the procedure:~~
~~LVEDP < 18 mmHg infuse 3mL/kg/hr~~

C. Standard Hydration Therapy
3) 1.5mL/kg/hr plus 32 ounces of water
OR
4) 1.5mL/kg/hr x 4 hours

D. LVEDP Guided Hydration Therapy:
3) LVEDP < 18 mmHg 3 mL/kg/hr x 2 hrs plus 32 oz of water
OR
4) 3 mL/kg/hr x 4 hrs
~~1)~~

4. **Communicate During Procedure**
   The primary operator should be notified when:
   A. Approaching the ideal contrast volume limit
   B. Approaching the acceptable contrast volume limit
   C. Approaching the maximal contrast volume

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POST-PROCEDURE RECOMMENDATIONS

RISK REDUCTION: POST-PROCEDURE

1. Communication

The primary operator should be informed of:

A. Serum Creatinine level
B. Total contrast volume given

2. Hydration

A. Continue **Standard Hydration Therapy** post-procedure
   1) 1.5 mL/kg/hr ~~x 2 hours plus 32 ounces of water~~ plus 32 ounces of water
   OR
   ~~1)~~2) 1.5mL/kg/hr x 4 hours
   ~~**OR**~~
   ~~2) 1.5 mL/kg/hr x 4 hours~~

B. If the LVEDP is known, consider **LVEDP Guided Hydration Therapy** post-procedure; adjust fluid rate prior to leaving cath lab:
   1) LVEDP < 18 mmHg 3 mL/kg/hr x 2 hrs plus 32 oz of water
   OR
   2) 3 mL/kg/hr x 4 hrs
   ~~1) LVEDP < 18 mmHg infuse 3 mL/kg/hr x 2 hours plus 32 ounces of water~~
   ~~**OR**~~
   ~~2) 3 mL/kg/hr x 4 hours~~

3. Serum Creatinine

A. Patients at high risk for Contrast-Induced Nephropathy[1] should have a serum creatinine obtained 48-72 hours post procedure
B. The Interventional Cardiologist who performed the procedure should then be notified in order to provide further management

4. Medications

A. Re-assess for resumption of diuretics the day after procedure
B. The following medications should be held 24 hours pre-procedure and for 48 hours post-procedure
   1) NSAIDS
   2) Metformin
   3) Aminoglycosides
   4) Anti-virals (Acyclovir, Foscarnet)
   5) Amphotericin B
   6) ACE/ARB/ARNI

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[1]**Characteristics of High Risk for Contrast-Induced Nephropathy:** Age ≥ 75 years, Diabetes Mellitus, Pre-existing CKD (eGFR < 60ml/min per m2 or serum creatinine), History of CHF, Cardiogenic shock, Repeated exposure to iodinated contrast over a period of a few days, Previous episodes of CI-AKI

SURGICAL RECOMMENDATIONS

The following recommendations were prepared for our cardiac surgery partners to utilize when performing invasive surgical procedures. These recommendations may be used with our cath recommendations to serve as a bridge in reducing the rate of AKI.

PRE-OPERATIVE CARDIAC SURGERY RECOMMENDATIONS

Obtain Serum Creatinine level prior to procedure	
For patients with a high risk for AKI or pre-existing AKI <u>AND</u> contrast exposure prior to surgery consider continuing IV hydration	
Avoidance of nephrotoxic medications A. Discontinue ACE/ARB/ARNI 48 hours prior to procedure B. Consider DC Metformin 24 hours prior to surgery C. Avoidance of NSAIDS	(Class I-A)
Renal consult for post-cath AKI/pre-op AKI for GFR <45 A. Consider delaying surgery 48-72 hours B. Consider surgery once GFR returns to nadir or improves	(Class IIC) Rationale: delay in surgery may allow kidneys to recover from contrast induced nephropathy.
Consider atrial natriuretic peptide (ANP) pre-surgery	(Class IIA, Level B-R). Rationale: May improve renal blood flow and sodium excretion.
Recommend IABP for patients with low EF	(Class IIA, Level B-R). Rationale: May improve renal perfusion with pulsatility.
<u>DO NOT USE</u> dopamine infusion for renal protection pre-operatively	(Class III: No benefit, Level A)
Consider fenoldopam infusion pre-operatively	(Class IIB, Level B-R). Rationale: D1 antagonist may improve renal function when hypotension is unavoidable.

INTRA-OPERATIVE CARDIAC SURGERY RECOMMENDATIONS

Avoidance of Hyperglycemia (Maintain BS <u>≤</u>180)	KDIGO Bundle (Class IIA, Level B-R)
Avoid Mannitol in CPB prime	(Class III No Benefit, Level B-R)
Avoid Hyperthermia on CPB	Maintain arterial line temperature, 37° C (Class1, Level B-R)
Goal-Directed Oxygen Delivery on CPB	Avoid DO2i below 270 ml/min/m^2 (Class1, Level B-R)
Consider identifying blood pressure baseline pre-induction/establish and maintain mean pressure	Rationale: If DO2i is > 270 ml/min/m^2 it may be reasonable to establish a goal mean BP
Consider minimally invasive extracorporeal circulation techniques (reducing prime volume of bypass circuit)	(Class IIB, Level B-R)
Consider fenoldopam infusion during CPB	(Class IIB, Level B-R)
<u>DO NOT USE</u> dopamine infusion for renal protection during CPB	(Class III: No benefit, Level A)
Recommend IABP for patients with low EF: A. Consider IABP use during CPB to generate pulsatile perfusion	(Class IIA, Level B-R)
Consider limiting ultrafiltration with following exceptions: A. Processing residual pump blood after termination of CPB B. Excessive hemodilution/hypervolemia	Impact of Ultrafiltration on Kidney Injury After Cardiac Surgery: The Michigan Experience (Ann Thoracic Surg 2015; 100:1683–8) Conventional Ultrafiltration During Elective Cardiac Surgery and Postoperative Acute Kidney Injury jvca.2020.11.036.
Cerebral Oximetry	(Class I, Level B-R)

POST-OPERATIVE RECOMMENDATIONS

Scheduled post-op serum BUN/creatinine	
Consult nephrology for pre-existing AKI or new post-op AKI GFR < 45 and/or anuria	
Avoid PO/IV diuretics until POD2	
DO NOT USE dopamine infusion for renal protection during CPB	(Class III: No benefit, Level A)
For patients with high risk for AKI after cardiac surgery: KDIGO Bundle A. Avoidance of hyperglycemia B. Avoidance of nephrotoxic medications (Metformin, NSAIDs) C. Hold ACE/ARB/ARNI x 48 hours D. Close urine output monitoring E. Close hemodynamic monitoring (consider minimally invasive monitoring strategies) F. Goal-directed volume therapy G. Avoid contrast agents	(Class IIA, Level B-R)
Evidenced Based Bundle of Care (For patients undergoing cardiac surgery with CPB) A. Ongoing hemodynamic monitoring B. Consider use of renal biomarkers C. Consider liberal transfusion threshold D. Avoidance of nephrotoxic medications	(Class1, level B-R)