Cardiology and Imaging Services Guideline

Prevention of Contrast-Induced Acute Kidney Injury (CI-AKI) in Adult Patients Receiving Iodinated Contrast (IoC)

This guideline was created by a multidisciplinary team based on recently published literature (see reference lists). It outlines recommendations for managing patients at risk for contrast-induced acute kidney injury (CI-AKI) when receiving iodinated contrast (IoC).

Basic Principles

- **Clinical necessity for iodinated contrast and risk for contrast-induced AKI should be carefully determined.** Include a careful history of any procedures involving IoC within the last 3 days or any previous adverse reactions to IoC before all non-emergent procedures that involve IoC. Refer to **Table 1** for indications and recommendations for creatinine testing and estimated glomerular filtration rate (eGFR) determination.

- **Numerous publications have demonstrated that the risk of developing CI-AKI following intravenous (IV) administration of IoC in patients with reduced renal function is far lower than previously thought.** This is largely due to the challenges in separating patients with contrast-associated AKI (AKI from any cause within 48 hours of contrast administration) from patients with contrast-induced AKI (AKI caused by contrast administration) in previous studies.[1-2]

- **In patients without renal dysfunction or with a stable eGFR ≥30, IV administration of IoC has not been shown to be an independent risk factor for the development of CI-AKI.**

- **However, intra-arterial (IA) administration of IoC carries a higher risk of developing CI-AKI than does IV administration of IoC** and therefore warrants further pre-treatment evaluation in some patients.

- **If the patient has acute kidney injury (AKI), the administration of iodinated contrast agent should be avoided until baseline renal function resumes.**

- **.09% normal saline (NS) volume infusion both prior to and following IoC administration is the most proven therapy** to reduce the risk of CI-AKI in patients with renal failure. **Sodium bicarbonate is not favored for routine use;** it has not been shown to have a consistent benefit over saline.

- **N-acetylcysteine (NAC) (Mucomyst) has not been shown to be effective at preventing CI-AKI** based on numerous studies and meta-analyses.[3-5]

- **Use the minimal amount of IoC** needed to adequately perform the procedure. However, ad hoc reduction of the amount of IV IoC routinely used in CT studies is not recommended due to the risk of obtaining a non-diagnostic exam. There is no demonstrated volume-correlated CI-AKI risk reduction at typical doses used in CT.

- **Isovue is the recommended IoC for nearly all patients.** Visipaque, a much more expensive agent, has no clear advantage in preventing CI-AKI. It may be considered by special request for decompensated heart failure patients or patients with a moderate or severe allergy to Isovue.

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Indications for Creatinine and eGFR Assessment

Although routine creatinine and glomerular filtration rate (eGFR) assessment are not necessary for all patients, patients at risk should be evaluated per **Table 1** below. eGFR is the best overall index of kidney function; measure serum creatinine and calculate eGFR whenever possible

(see the National Kidney Foundations GFR Calculator: https://www.kidney.org/professionals/kdoqi/gfr_calculator).

Table 1. Recommendations for creatinine testing and GFR assessment before IoC administration*

A Creatinine testing NOT needed for these patients:
- Age under 60 years

AND
- No risk factors from section C

AND
- Not undergoing cardiac catheterization or angiography Procedures

B Obtain serum creatinine and calculate GFR **within 30 days** of IoC procedure for these patients:
- Age 60 or older

AND
- No risk factors from section C

AND
- Not undergoing cardiac catheterization or angiography procedures

C Obtain serum creatinine and calculate eGFR **within 7 days** of IoC procedure for patients with **ANY** of the following:
- Planned IA injection of contrast (e.g., cardiac catheterization, angiography)
- Personal history of kidney disease (chronic renal insufficiency, hemodialysis or peritoneal dialysis, remote AKI, renal surgery or ablation, renal tumor/cancer, renal transplant, proteinuria, reflux nephropathy, or genitourinary system disease)
- Diabetes mellitus and over age 60
- Cancer undergoing current treatment
- Collagen vascular disease
- Chronic hypertension on medication(s)
- Congestive heart failure
- Hospitalization within the past 30 days, or major surgery within the past 30 days
- Currently taking metformin or nephrotoxic medications (e.g., chemotherapy, high dose NSAIDs, IV antibiotics, especially aminoglycosides, oral antifungals, methotrexate)

D Obtain serum creatinine and calculate eGFR **on the day of** IoC administration for patients with **ANY** of the following:
- Evidence of or concern for acute kidney injury/insufficiency
- Evidence of, or potential for, volume depletion:
- Fever/SIRS
- Vomiting or diarrhea
- Anorexia/decreased PO intake
- Hypotension
- Decreased urine output

E Obtain serum creatinine and calculate eGFR **within 48 hours** of IoC administration for any inpatient

* **Note:** iStat is acceptable as a screening result if creatinine (Cr) is <2.0 mg/dL (interactions may artificially raise the Cr value). If iStat Cr is ≥2.0 mg/dL, send a blood sample to the facility lab and apply the lab result to the treatment recommendations in **Table 2**.

These guidelines apply to common clinical circumstances and may not be appropriate for certain patients or situations. Treating clinicians must use judgment in applying them to the care of individual patients.

Numbered References

1. Davenport MS, Perazella MA, Yee J et al. Use of Intravenous Iodinated Contrast Media in Patients with Kidney Disease: Consensus Statements from the American College of Radiology and the National Kidney Foundation. Radiology 2020;294(3): 660–668 https://doi.org/10.1148radiol.2019192094. PubMed Link, Google Scholar
2. American College of Radiology. Committee on Drugs and Contrast Media. ACR Manual on Contrast Media, 2020. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf (Accessed on February 09,2021).
3. Ellis JH, Cohan RH. Reducing the risk of contrast-induced nephropathy: a perspective on the controversies. AJR Am J Roentgenol. 2009;192(6):1544-1549.
4. Amini M, Salarifar M, Amirgaigloo A, Masoudkabir F, Esfahani F. Nacetylcysteine does not prevent contrast-induced nephropathy after cardiac catheterization in patients with diabetes mellitus and chronic kidney disease: a randomized clinical trial. Trials. 2009;10:45.
5. Thiele H, Hildebrand L, Schirdewahn C, et al. Impact of high-dose N-acetylcysteine versus placebo on contrast-induced nephropathy and myocardial reperfusion injury in unselected patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. The LIPSIA-N-ACC (Prospective, Single-Blind, Placebo-Controlled, Randomized Leipzig Immediate Percutaneous Coronary Intervention Acute Myocardial Infarction N-ACC) Trial.J Am Coll Cardiol. 2010;55(20):2201-2209.

Treatment Guidelines Based on eGFR

Based on the calculated eGFR, adjust contrast therapy as recommended in Tables 2A and 2B below.

Table 2A. Treatment guidelines for IV IoC administration based on eGFR

eGFR	Treatment Adjustment
eGFR greater than or equal to 30	Provide adequate fluids to achieve euvolemia, but no additional therapy required
eGFR less than 30	• Avoid contrast if possible • If IoC administration is absolutely necessary • Limit contrast volume • Do careful volume loading with at least 500 mL NS before and after the study • Check BUN/Cr 24 and 48 hours after the study

Table 2B. Treatment guidelines for IA IoC administration based on eGFR

eGFR	Treatment Adjustment
eGFR greater than or equal to 60	Provide adequate fluids to achieve euvolemia, but no additional therapy required
eGFR 30-59	• Give NS IV 500 mL before the study • Consider NS IV 500 mL after study if the patient is high risk or volume-depleted **Note:** Infuse each 500 mL over 1 to 2 hours if no history of heart failure; infuse over 3 to 4 hours if heart failure or potential volume overload. Emergency department patients may require the bolus over a shorter period at the discretion of the emergency physician.

eGFR less than 30	• Avoid contrast if possible
	• If IoC administration is absolutely necessary
	  ○ Limit contrast volume
	  ○ Do careful volume loading with at least 500 mL NS before and after the study
	  ○ Check BUN/Cr 24 and 48 hours after the study

Numbered References

1. Davenport MS, Perazella MA, Yee J et al. Use of Intravenous Iodinated Contrast Media in Patients with Kidney Disease: Consensus Statements from the American College of Radiology and the National Kidney Foundation. Radiology 2020;294(3): 660–668 https://doi.org/10.1148radiol.2019192094. PubMed Link, Google Scholar
2. American College of Radiology. Committee on Drugs and Contrast Media. ACR Manual on Contrast Media, 2020. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf (Accessed on February 09,2021).
3. Ellis JH, Cohan RH. Reducing the risk of contrast-induced nephropathy: a perspective on the controversies. AJR Am J Roentgenol. 2009;192(6):1544-1549.
4. Amini M, Salarifar M, Amirgaigloo A, Masoudkabir F, Esfahani F. Nacetylcysteine does not prevent contrast-induced nephropathy after cardiac catheterization in patients with diabetes mellitus and chronic kidney disease: a randomized clinical trial. Trials. 2009;10:45.
5. Thiele H, Hildebrand L, Schirdewahn C, et al. Impact of high-dose N-acetylcysteine versus placebo on contrast-induced nephropathy and myocardial reperfusion injury in unselected patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. The LIPSIA-N-ACC (Prospective, Single-Blind, Placebo-Controlled, Randomized Leipzig Immediate Percutaneous Coronary Intervention Acute Myocardial Infarction N-ACC) Trial.J Am Coll Cardiol. 2010;55(20):2201-2209.

Table 3. Treatment guidelines for metformin

eGFR	Treatment Adjustment
eGFR <30	• Metformin contraindicated. Contact patients primary care provider; no contrast without clearance
eGFR >=30	• No need to hold metformin or recheck eGFR

Other Treatment Recommendations

Dialysis-dependent patients

- IoC administration is **not recommended in patients undergoing intermittent dialysis** as this may cause permanent worsening of their renal function. This is not an absolute contraindication if contrast is urgently needed.
- In dialysis dependent patients, there **is no need for urgent dialysis** following IoC administration, unless there is significant cardiac dysfunction or large volumes of IoC are used (>200mL).

Other issues

- **Solitary kidney:** Risk and pretreatment should be based on eGFR and clinical history rather than absence or partial absence of a kidney.
- **Nephrotoxic medications:** In patients with eGFR ≤ 30 receiving IV IoC and in patients with eGFR ≤ 60 receiving IA IoC (particularly those with DM), withholding nephrotoxic medications 24 hours prior and 48 hours after IV administration of contrast is recommended at the discretion of the prescribing physician. This includes diuretics, NSAIDs, chemothera peutics, methotrexate, many IV antibiotics, and Neo-Fradin.
- **Statin therapy:** Early studies have shown a benefit to continuing or administering statins as an adjunctive therapy to prevent CI-AKI in patients with eGFR ≤ 30, but there are no clear guidelines by major societies at this time.
- **Withholding of Renin-Angiotensin-Aldosterone inhibitors (RAASi):** Have shown mixed findings and is not recommended at this time.
- **Preparation:** Clear liquids only for 3 hours before, and NPO 1 hour prior to examination requiring IV IoC administration.
- **Breastfeeding:** No specific concerns or requirements.
- **Pregnancy or potential pregnancy:** No requirements at typical IoC doses if there are no other risk factors (see **Table 1**). However, consider avoiding ionizing radiation.

Addendum Emergency Department Guideline for the Prevention of Contrast-Induced Acute Kidney Injury

- General Guidance:
  - The Emergency Department physician or APP should evaluate the risk and benefits of contrast administration in all situations before ordering IoC. The Cardiology and Imaging Services Guideline, "Prevention of Contrast-Induced Acute Kidney Injury (CI-AKI) in Adult Patients Receiving Iodinated Contrast (IoC)," outlined above, provides specific guidance and helpful resources in evaluating this risk.
    - This document will be referred to as the "CI-AKI Guideline."

- Time-sensitive Conditions:
  - If a patient has a critical medical condition where IoC administration is essential to making a time-sensitive diagnosis (e.g., aortic dissection), eGFR or any other laboratory testing should not delay obtaining appropriate imaging.

- Routine Conditions:
  - Emergency Department patients are outpatients and should follow the outpatient recommendations listed in the CI-AKI Guideline.
    - Specifically, Section E does not apply to Emergency Department patients.
  - Clinical judgment should be used for patients without a personal history of kidney disease but who have a risk for AKI based on presentation. Section D of the CI-AKI Guideline includes some of these risk factors. Duration, severity, and clinical appearance should guide the Emergency Department Physician or APP's decision to obtain an eGFR before IoC administration in these patients.
    - The Emergency Department Physician or APP should determine risk based on this criterion and will make the final determination if eGFR should be obtained before IoC administration.