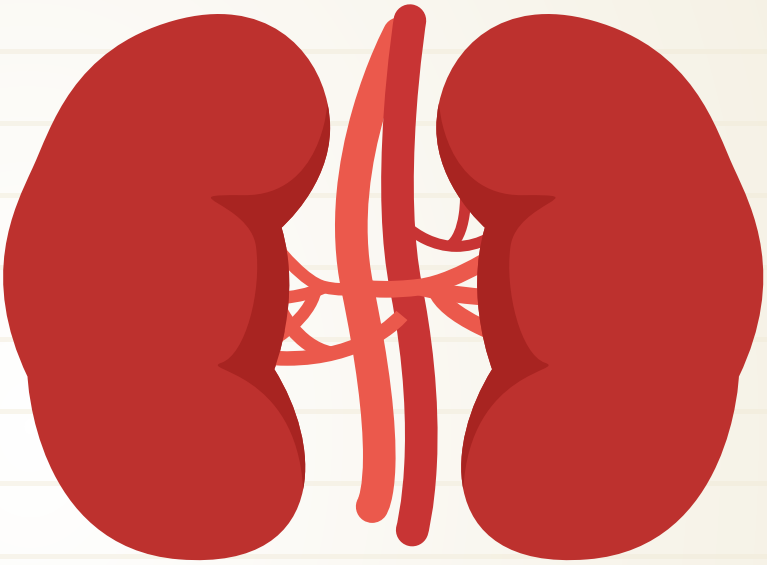
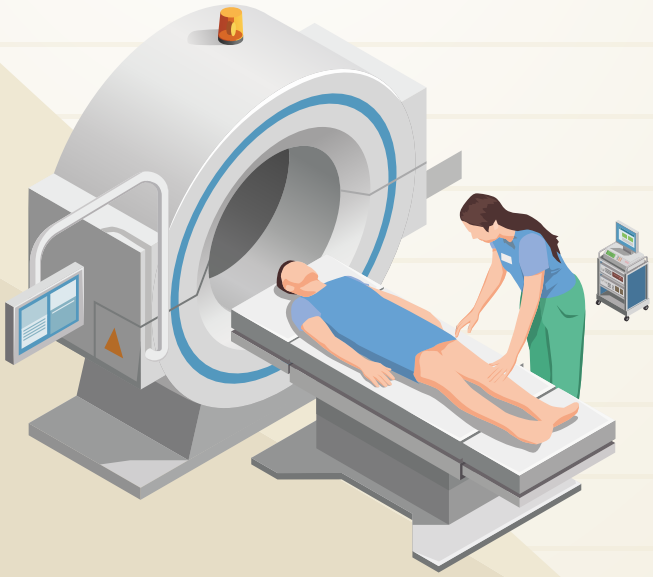
A Handbook for Understanding and Preventing Contrast-Induced Nephropathy





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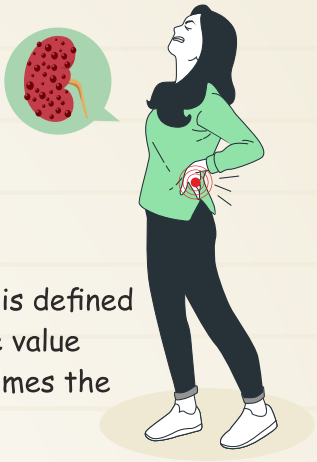
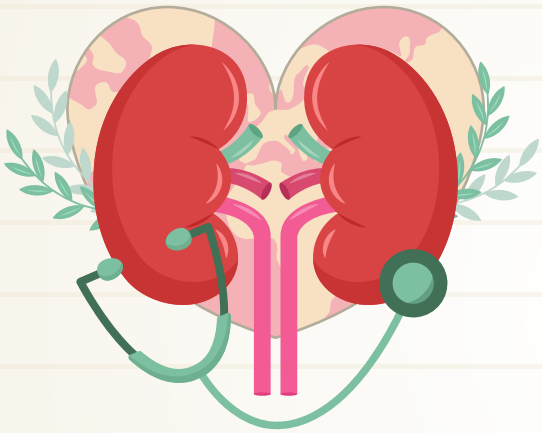
What is Contrast-Induced Acute Kidney Injury (CI-AKI)?

Contrast-Induced Acute Kidney Injury (CI-AKI) is a condition characterized by a sudden decline in kidney function following exposure to contrast media used in medical imaging procedures. It is considered a significant cause of renal dysfunction, particularly in patients undergoing procedures that involve the use of contrast agents.



According to KDIGO (Kidney Disease Improving Global Outcomes), CI-AKI is defined as a creatinine level increase of ≥ 0.3 mg/dl (26.5 µmol/l) above the baseline value within 48 hours of contrast media exposure, or an increase of at least 1.5 times the baseline value within 7 days.



Need of avoiding CI-AKI?

CI-AKI is a significant concern due to its potential to cause acute renal failure, which can lead to severe complications and even mortality. It is reported as the third most common cause of renal insufficiency among hospitalized patients.

CI-AKI can lead to prolonged hospital stays, increased morbidity and mortality and poorer clinical outcomes.

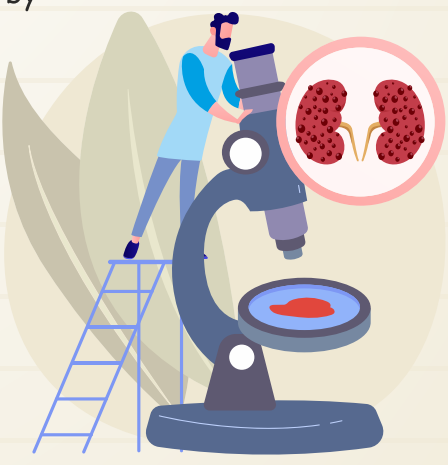
The misuse or inappropriate use of contrast media can predispose individuals to renal toxicity, leading to pathological mechanisms such as apoptosis, inflammation and oxidative stress.

CI-AKI can interact with cardiovascular disorders, further exacerbating heart and kidney dysfunction.

Pathophysiology of CI-AKI?

Contrast media can directly damage renal tubules, causing nephrotoxic effects such as osmotic nephrosis, decreased oxygen delivery, mitochondrial dysfunction, cellular apoptosis or necrosis, interstitial inflammation and overall tubular injury.

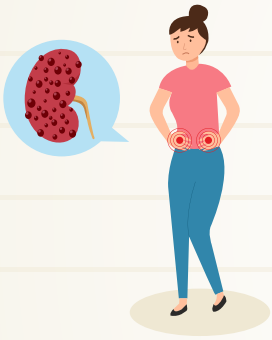
Contrast agents can induce hemodynamic changes in the kidneys by altering the balance of vasoactive molecules. They promote vasoconstriction through increased release of endothelin and adenosine, while reducing vasodilators like prostaglandins and nitric oxide. These changes lead to intrarenal vasoconstriction, medullary hypoxia and impaired renal function.



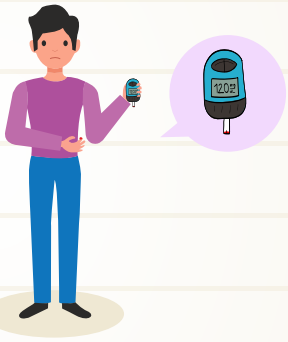
Contrast media induce oxidative stress and cell injury in the kidneys through the generation of reactive oxygen species (ROS). This leads to increased oxidative stress, decreased antioxidant enzyme activity and damage to renal cells, particularly affecting the vulnerable renal medulla with its low partial pressure of oxygen.

Chandiramani, R., Cao, D., Nicolas, J., et al. (2020). Contrast-induced acute kidney injury. Cardiovascular Intervention and Therapeutics, 35(2), 209-217.

CONTRAST INDUCED NEPHROPATHY

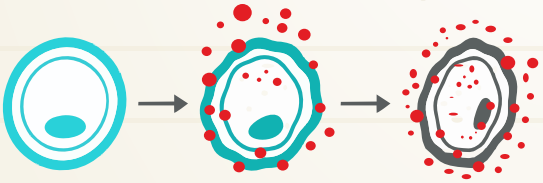


Chronic Kidney Disease (CKD)



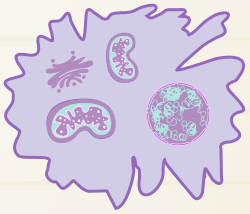
Diabetes

Heart Failure

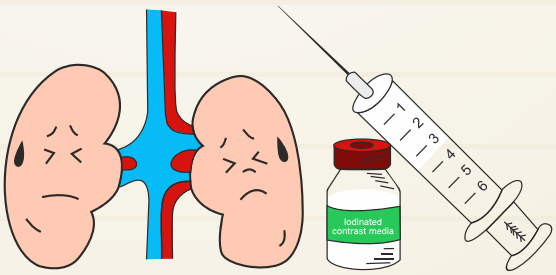


Oxidative Stress

Renal Vasoconstriction



Tubular Cell Damage



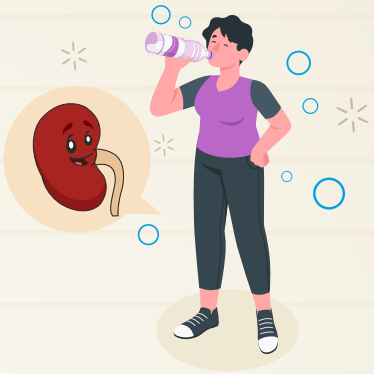
Contrast-Induced Nephropathy (CIN)

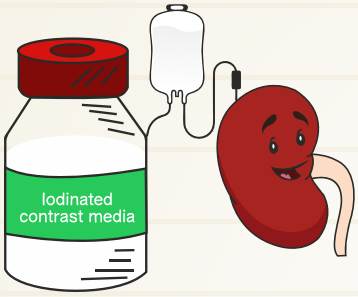
Faucon, A.-L., Bobrie, G., Clément, O., et al. (2019). Nephrotoxicity of iodinated contrast media: From pathophysiology to prevention strategies. European Journal of Radiology, 116, 231-241.

Prevention of CI-AKI

Hydration:

Adequate Hydration: Ensure adequate hydration before and after contrast-based procedures to reduce the risk of CI-AKI. Intravenous isotonic saline hydration is particularly effective in preventing kidney injury.





Contrast Media Selection:

Low-Osmolar or Iso-Osmolar Contrast Agents:
Utilize low-osmolar or iso-osmolar contrast agents instead of high-osmolar agents to lower the risk of nephrotoxicity and CI-AKI.

Minimize Contrast Volume:
Limit the amount of contrast media used during procedures, especially in high-risk patients, to reduce the risk of CI-AKI.

Statin Therapy:

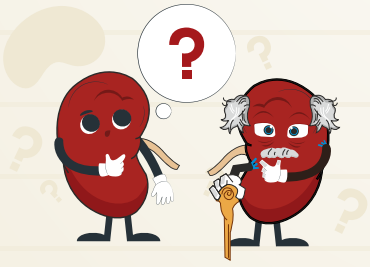
Consider high-dose statin therapy, which may provide protective effects on renal function and reduce the incidence of CI-AKI. Statins are medications primarily used to lower cholesterol levels, but they also have anti-inflammatory and antioxidant properties that can help protect the kidneys from damage.

Avoidance of Nephrotoxic Agents:

Patients at risk of CI-AKI should avoid using other nephrotoxic agents, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and certain antibiotics, to prevent further kidney damage.

Monitoring and Individualized Care:

Regular Monitoring: Monitor renal function before and after contrast procedures to identify early signs of kidney injury and guide appropriate management.

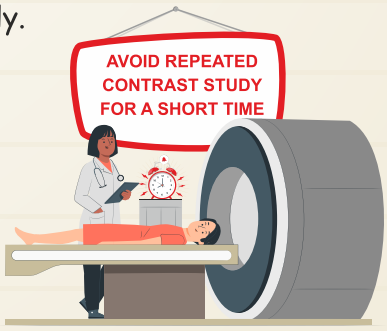


Individualized Risk Assessment:

Conduct individualized risk assessments for patients undergoing contrast media procedures to identify high-risk individuals and tailor preventive strategies accordingly.

Procedure Timing:

Avoid Repeat Procedures:
Whenever possible, avoid repeat contrast-based procedures within a short time frame to prevent cumulative kidney injury.



McCullough, P. A., Choi, J. P., Feghali, G. A., et al. (2016). Contrast-induced acute kidney injury. Journal of the American College of Cardiology, 68(13), 1465-1473.