CONTRAINDICATIONS AND COMPLICATIONS OF CORONARY ANGIOGRAPHY

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I CONTRAINDICATIONS (ACC/AHA GUIDELINES)

- **The Core Principle:** There are virtually **no absolute contraindications** to coronary angiography in the setting of a life-threatening emergency (such as STEMI or cardiogenic shock), where the procedure is always weighed against the risk of imminent death.
- **Relative Contraindications (Require Mitigation Before Elective or Urgent Cases):**
  - **Systemic Infection:** Unexplained fever or active untreated infection due to the risk of bacteremia on implanted stents or valves.
  - **Hematologic Derangements:** Severe uncompensated anemia (hemoglobin less than 8 g/dL) or active gastrointestinal bleeding.
  - **Electrolyte Imbalance and Drug Toxicity:** Severe hypokalemia, hyperkalemia, or digitalis toxicity, which can precipitate fatal ventricular arrhythmias upon catheter engagement.
  - **Coagulopathy:** Severe coagulopathy or bleeding diathesis, although the transradial approach has substantially mitigated this risk.
  - **Renal Dysfunction:** Active acute renal failure or severe chronic kidney disease (CrCl less than 30 mL/min) without a post-procedure dialysis support plan.
  - **Contrast Allergy:** Known severe allergy to iodinated contrast material, requiring a strict premedication protocol of oral corticosteroids plus H1/H2 antihistamines starting 13 hours prior to the procedure.

II MAJOR CARDIOVASCULAR COMPLICATIONS (THE “BIG THREE”)

- **Overall Incidence:** The overall major complication rate for purely diagnostic coronary angiography is **less than 1 percent**.
- **Death or Acute Myocardial Infarction (Less Than 0.1 Percent):** The most catastrophic complications, typically caused by iatrogenic left main catheter dissection, massive air embolism injected from the manifold, or dislodgment of a calcific aortic root plaque into the coronary arteries.
- **Stroke or Transient Ischemic Attack (0.1 to 0.2 Percent):** Ischemic strokes caused by atheroembolic debris scraped from the aortic arch by the catheter, or thromboemboli formed inside inadequately flushed catheters.
- **Ventricular Arrhythmias:** Ventricular Fibrillation (VF) can occur if the catheter is deeply wedged (damped) in the Right Coronary Artery (RCA) or conus branch causing transient ischemia, or from the direct myocardial toxicity of injecting contrast or air.

III ACCESS-SITE COMPLICATIONS (FEMORAL VS. RADIAL)

A Transfemoral Complications

- **Retroperitoneal Hemorrhage:** The most lethal hidden vascular complication, resulting from a high posterior wall puncture above the inguinal ligament and presenting with unexplained sudden hypotension, tachycardia, and flank or lower abdominal pain.
- **Pseudoaneurysm:** Failure of the arterial puncture site to seal, leading to a pulsating encapsulated hematoma connected to the femoral artery by a persistent neck.
- **Arteriovenous (AV) Fistula:** Inadvertent simultaneous puncture of the adjacent femoral artery and vein, creating a continuous high-flow connection.

B Transradial Complications

- **Radial Artery Spasm:** Painful alpha-1 adrenergic muscular constriction that can cause catheter entrapment; prevented routinely by administering an intra-arterial **spasmolytic cocktail** (Verapamil plus Nitroglycerin).
- **Radial Artery Occlusion (RAO):** Often clinically silent due to dual palmar arch collateral supply via the ulnar artery, but precludes future transradial access or radial graft harvesting for CABG; minimized by adequate heparinization and **patent hemostasis** protocols (deflating the compression band to allow trace antegrade flow).

Access Route	Key Vascular Complications	Primary Preventive Strategy
Transfemoral Access	Retroperitoneal hemorrhage, pseudoaneurysm, AV fistula	Avoid high puncture above inguinal ligament; ultrasound guidance
Transradial Access	Radial artery spasm, radial artery occlusion (RAO)	Intra-arterial spasmolytic cocktail (Verapamil + NTG) and patent hemostasis

IV CONTRAST-INDUCED ACUTE KIDNEY INJURY (CI-AKI)

- **Definition:** An absolute increase in serum creatinine by **0.5 mg/dL or greater** (or **0.3 mg/dL or greater** per KDIGO criteria) or a **25 percent or greater relative increase** within 48 to 72 hours of contrast exposure.
- **Pathophysiological Mechanism:** Driven by direct renal tubular cytotoxicity and intense outer medullary ischemia.
- **Prevention (Class I, LOE A):** Adequate intravenous volume expansion with **isotonic saline** (1 mL/kg/hr for 12 hours before and after the procedure) is the primary universally proven preventive measure.
- **The Landmark Evidence (POSEIDON Trial):** Demonstrated that Left Ventricular End-Diastolic Pressure (LVEDP)-guided personalized fluid hydration in the catheterization laboratory is superior to standard fixed hydration for preventing CI-AKI in high-risk patients.

V THE PARADIGM SHIFT AND LANDMARK TRIALS

- **The Past Paradigm:** The transfemoral approach was the historical default for all coronary procedures, carrying a higher burden of major bleeding and vascular access-site complications.
- **The Present Paradigm ("Radial-First" — Class I, LOE A):** The transradial approach is recommended as the default access site for both diagnostic angiography and PCI in Acute Coronary Syndromes (ACS).
- **The Landmark Evidence (MATRIX Trial):** Proved that the transradial approach significantly reduces major bleeding, vascular access-site complications, and **all-cause mortality** compared to transfemoral access in patients with ACS.

VI PRACTICAL CONSIDERATIONS IN THE INDIAN CLINICAL CONTEXT

- **Mitigating the Diabetic Nephropathy Burden:** Due to the high prevalence of diabetic nephropathy in India, calculating the **Mehran Risk Score** prior to elective angiography and utilizing **ultra-low contrast techniques** (keeping total contrast volume strictly **less than 3 times the eGFR**) with iso-osmolar or low-osmolar contrast media in patients with eGFR less than 45 mL/min helps prevent dialysis-requiring renal failure.
- **Same-Day "Lounge" Transradial Cardiology:** Widespread adoption of transradial access in high-volume Indian hospitals enables rapid ambulation and same-day discharge, reducing hospital length of stay, lowering costs, and avoiding prolonged supine bed rest in elderly patients.

KEY REFERENCES

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