Basics of Intervention

14

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Preprocedural evaluation (focused history, physical examination, stress test and risk grading, evaluating the appropriateness for coronary intervention) and adequate postprocedural care are critical for both procedural and clinical success.

Preprocedural Evaluation Components

History

- Current symptoms, presentation, and angina classification.
- Any symptoms of heart failure.
- History of any cardiac procedures – in patients with known preexisting coronary artery disease, a comprehensive information of all prior catheterizations, percutaneous interventions and cardiac surgeries is vital. Review of prior angiograms to identify location of prior bypass graft origins and type of catheters/devices used is important.
- PVD – information regarding prior peripheral vascular interventions and surgeries is also vital in planning access as is history of claudication.
- CKD – identify patients at risk for contrast-induced nephropathy.
- Smoking, alcohol and substance abuse history, and possibility of withdrawal.
- History of obstructive sleep apnea and lung disorders in regard to the effects of sedation.

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- Ability to take dual antiplatelet therapy and any surgeries/procedures planned within the next year to decide on the type of stent that can be inserted.
- Any history of prior allergic reactions.

Focused physical examination

- Height, weight, body mass index.
- Blood pressure [BP], heart rate [HR], and pulse oximetry.
- Signs of HF [rales, JVD, edema].
- Focused neurological exam.
- Peripheral bilateral lower extremity pulses must be documented.
- Allen and Barbeau's test if radial access is planned.

Prior studies

- Old labs and EKG if available as a baseline for future comparisions.
- Prior PCI, CT surgery reports or CABG reports.
- Prior echocardiogram if available.
- Stress test and risk grading of stress test (see Chap. 5).

Informed consent

Informed consent, risks, benefits, and alternatives of the procedure are explained in layman's terms to the patient. A documentation of the following should be in the patient's chart prior to procedure. "The risks, benefits, and alternatives of cardiac catheterizations/interventions including but not limited to neurovascular trauma, MI, CABG, or death were explained to the patient and/or designated power of attorney. They entirely understand the procedure and have signed the informed consent" (see Table 14.1).

Table 14.1 Major complications of PCI

Complications from NCDR CathPCI Registry	NCDR CathPCI Registry	Mount Sinai Heart
	2010 –July 2012	2010–2012
2010 through July 2012	*n* = 787,980 [1]	*n* = 14,584
Any adverse event	1.53 %	1.0 %
Cardiogenic shock	0.47 %	0.08 %
Pericardial tamponade	0.07 %	0.08 %
CVA/stroke	0.17 %	0.05 %
New requirement for dialysis	0.19 %	0.01 %
Emergent CABG performed during admission	0.17 %	0.02 %
Any vascular complication requiring treatment	0.44 %	0.09 %

Contraindications

There are no absolute contradictions to cardiac catheterization/PCI in acute STEMI/cardiogenic shock other than patient refusal or inadequate equipment or cardiac catheterization facility. As most procedures are elective, the patient can be rescheduled if they have the following:

- Acute flares of other systemic disorders
- Active infection/septic shock
- Acute gastrointestinal bleeding or severe anemia which has not been worked up
- Electrolyte imbalance
- Pregnancy
- Recent cerebrovascular accident (<1 month)
- Rising creatinine but patient not on dialysis
- Acute exacerbation of congestive heart failure
- INR > 3.5 for radial or INR > 2.5 for femoral
- Alcohol intoxication or acute substance abuse

Preprocedural Preparation

- Patient and family teaching (procedure, results, complications).
- Labs:
  - Type and cross match
  - Complete blood cell and platelet counts
  - Prothrombin time [PT], partial thromboplastin time [PTT]
  - Electrolytes, blood urea nitrogen [BUN], creatinine
- 12-lead ECG.
- One or two peripheral IV lines
- Skin-shave and prepare both inguinal areas or the wrist for radial artery.
- *Dietary status*, NPO for at least 4 h:
  - Patients scheduled for morning to noon procedures should be NPO since midnight except for scheduled medications.
  - Patients scheduled for afternoon procedures should have a full breakfast and then placed NPO except for scheduled medications.
  - Patients scheduled for evening procedures should have a full breakfast and lunch and then placed NPO except for scheduled medications.
- *Allergic reactions*:
  - *Aspirin allergy and aspirin desensitization:* Allergic reactions to aspirin include aspirin-exacerbated respiratory disease and angioedema. As dual antiplatelet therapy is required in all patients receiving stents for at least 1 month up to 1 year or longer, aspirin desensitization in aspirin-allergic patients should be performed. This can be completed in a day in conjunction with an allergist/immunologist in CCU/general cardiology ward or over a few days to a week as an outpatient.

Table 14.2 Preprocedural hydration

Start hydration with normal saline [0.9NS] 3 h prior to procedure if outpatient and 12 h prior if inpatient	
LVEF	For all patients but especially if SCr >1.3
>50	1–2 mL/kg/h
31–50	0.5 mL/kg/h
<30	0.3 mL/kg/h for 3 h only for all patients

Table 14.3 Intraprocedural and postprocedural hydration

Continue hydration with normal saline [0.9 NS] during procedure and for 6–8 h post procedure if outpatient and 12 h if inpatient	
LVEF	For all patients but especially if SCr >1.3. If SCr <1.3, IVF can be given for a shorter duration with liberal discharge oral hydration
>50	1–2 mL/kg/h
<50	Measure LVEDP in the catheterization lab. Give a bolus of NS as per LVEDP
	<12: 500 cc
	12–18: 250 cc
	>18: no bolus
31–50	0.5 mL/kg/h
<30	0.3 mL/kg/h

  - *Contrast allergy*, all patients reporting true allergy to contrast media should be premedicated. Seafood allergy does not require pretreatment:
    - Prednisone 40 mg orally (or hydrocortisone 100 mg IV/methylprednisolone 40 mg IV) the night prior and on the day of the procedure
    - Antihistamines (Benadryl 25–50 mg orally or IV the night prior and the morning of the procedure
- *Medications on procedure day*:
  - Aspirin 162 mg orally.
  - Continue patient's regular antihypertensive medications, statins, and immunosuppressive medications.
  - Hold oral hypoglycemic medications.
  - Usual dose of basal insulin or a half to one-third dose of NPH insulin can be given on the morning of procedure. Hold short-acting insulin.
- *Hydration* (see Tables 14.2 and 14.3).

Vitals

BP, HR, and pulse oximetry are documented at the start of procedure, every 5 min. continuously during procedure, and every 15 min post procedure for the first 2 h and hourly thereafter.

Medications

- Conscious sedation
  - Versed (midazolam): start with 0.5 mg IV in the elderly and patients with systemic diseases and 1–2 mg in other patients and then as needed to achieve sedation.
  - Morphine sulfate for analgesia: 2–4 mg IV to start and then as needed.
  - Meperidine for patients with morphine allergy: 50–150 mg given 30–90 min before the beginning of anesthesia either subcutaneously or intramuscularly.
  - Acetaminophen: 1 g IV to reduce the need for narcotic analgesia.
  - Metoclopramide: 5 mg IV to prevent opiate-induced nausea.
- Antidotes for conscious sedation:
  - Flumazenil: 0.2 mg over 15 s and repeat doses at 1 min intervals if required to a maximum of 1 mg. In the event of resedation, 0.2 mg at 20 min intervals as needed to a maximum of 3 mg/h.
  - Naloxone: 0.4–2 mg and repeat doses at 2 min intervals if required to a maximum of 10 mg. If no response after 10 mg total, consider other causes of respiratory depression.
- Anticoagulation for diagnostic procedures
  - Heparin: 1,500–2,000 U in patients with prior CABG prior to engagement of grafts or in patients with severe aortic stenosis prior to crossing the valve.
  - Heparin 2,500 U in radial access.
  - If heparin needs to be reversed use:
    - 1 mg of protamine for every 100 U of heparin [maximum dose is 50 mg]
    - 0.5 mg protamine/100 U of heparin if heparin was discontinued 30 min to 1 h prior to procedure
    - 0.25 mg protamine/100 U of heparin if heparin was stopped over 2 h prior to procedure
- Anticoagulation and antithrombotic regimens during PCI (Chap. 5):
  - Bivalirudin: bolus (0.75 mg/kg) and continuous infusion (1.75 mg/kg/h). If creatinine clearance is <30 ml/min, bolus dose remains the same, but infusion dose is reduced to 1 mg/kg/h or 0.25 mg/kg/h if on dialysis. If ACT < 250 3 min after bolus, administer additional 1/2 bolus of bivalirudin or administer additional 1/3 bolus if ACT is 251–299.
  - ReoPro: single bolus only [per nomogram].
  - Integrilin: 1–2 boluses of 180 mcg/kg intravenously 10 min apart in PCIs of very complex lesions, edge dissections, side branch closures, slow flow, no reflows, embolizations, or thrombi.
  - If PCI is planned, load patient with:
    - Clopidogrel – 600 mg if clopidogrel naïve [<5 days on clopidogrel] or 300 mg if on daily maintenance of clopidogrel].
    - Prasugrel – 60 mg if prasugrel naïve or 30 mg if on daily maintenance of prasugrel. Contraindications are active pathological bleeding, prior TIA or stroke, hypersensitivity to prasugrel, and age >75. If switching from clopidogrel to prasugrel, then give 30 mg of prasugrel.

    - Ticagrelor – 180 mg if ticagrelor naïve or 90 mg if on daily maintenance of ticagrelor. Contraindications are hypersensitivity to ticagrelor, active pathological bleeding, history of intracranial hemorrhage, and severe hepatic impairment. If switching from Clopidogrel to Ticagrelor give 180 mg of Ticagrelor.
  - Anticoagulation for diagnostic procedures
- IC nitroglycerin for more accurate stenosis severity visualization: 100–200 mcg boluses. If hypotension occurs, administer IV fluid boluses if no volume overload or congestive heart failure is present. Avoid in patients with severe AS. It is contraindicated in right ventricular infraction or after recent use of sidenafil/vardenafil (<24 hrs) or tadalafil (<48 hrs).
  Mix: 25 mg in 250 D5W solution = 100 mcg/ml. Use proper medication bottle/tubing.
- IC verapamil: for SVG graft stenosis/slow flow, 250–500 mcg boluses. Monitor for bradycardia.
  Mix: 1 ml = 2.5 mg, dilute in 10 mL NS syringe = 250 mcg/ml
- IC nitroprusside for slow flow: up to 50–100 mcg or as needed.
  Mix: 12.5 mg in 250 mL D5W solution = 50 mcg/mL. Cover the medication bottle with dark plastic bag to retain medication potency.
- IC phenylephrine: 100–200 mcg boluses. Give 100 mcg IV (1 mL) initially followed by NS flush. Monitor for bradycardia. Higher dosage may cause nausea and may require intravenous metoclopramide or ondansetron.
  Mix: 1 mg in 10 mL NS solution; 100 mcg = 1 mL.

Equipment

- *Vascular access* (please refer to Chap. 2)
- *Temporary pacemaker insertion* (4 F) via 5Fr sheath prior to the procedure in:
  - Complex interventions, use of rotablation or Angiojet mechanical thrombectomy in dominant RCA/LCX
  - The last remaining vessel supplying collaterals to the AV nodal artery
  - BAV
  - Alcohol septal ablation
  - TAVR
- *Guide catheter preparation* (please refer to Chap. 7)
- *Guidewire Shaping* (please refer to Chap. 8)
  - Shaping the wire:
    - C curve for LAD and RCA.
    - L curve for LCX.
    - 1–2 mm sharp angle CTO curves.
    - Another alternative is double curve (primary for the branch, secondary for main vessel).
  - Crossing the lesion with the guidewire:
    - Wiggle the wire.

    - Avoid 360° turns.
    - Avoid end loop before crossing the lesion.
    - Take end loop after crossing the lesion.
- Please refer to Chapter 10: Intracoronary devices for balloon selection and dilatation.
  - Pre-stent deployment: 8–12 atm
  - Stent deployment: 10–12 atm
  - Post-stent deployment: 16–20 atm
- Evaluation of the acute angiographic outcome:
  - Inflow
  - Outflow
  - Dissection
  - Any under-expansion
  - Uncovered area

Postprocedural Considerations

Bed rest

- Coronary angiogram [no AC] with successful VCD deployment: 2 h
- Coronary angiogram [no AC] with manual hold hemostasis: [sheath size-2] hours
- PCI with successful VCD deployment: 2 h post discontinuation of anticoagulation
- PCI with manual hold hemostasis: [sheath size-1] hours after sheath removal

Fluids Continue as per Table 14.2.

Labs

- CBC, BMP, and troponin I at 3–6 h in all patients and subsequently if there are any lab abnormalities
- CBC, BMP, and troponin I at 12–18 h if monitored overnight and subsequently if there are any laboratory abnormalities

Imaging

- *EKG:* 3–6 h after procedure and subsequently as per symptoms
- *Echo:* after NSTEMI/STEMI to evaluate LV function if a ventriculogram is not performed

Disposition after the procedure

- Diagnostic procedure – same day discharge:
  - 2 h discharge if closure device was used successfully
  - 4 h discharge if manual compression hemostasis was achieved (5–6 Fr sheaths)

- Simple PCI – same day discharge:
  - 4–6 h if closure device was used successfully
  - 6–8 h if manual compression hemostasis was achieved
- Inpatient admission – any patient who needs inpatient monitoring:
  - Presentation as STEMI or non-STEMI or hemodynamic instability (cardiogenic shock, CHF, significant brady- or tachyarrhythmia)
  - Major vascular complications:
  - Age > 85 years
  - Significant comorbid conditions:
    - Ventricular arrhythmia or rapid atrial arrhythmia
    - Decompensated systolic heart failure or LVEF <30 %
    - Chronic renal insufficiency (SCr ≥ 1.8 mg/dl)
    - Prior organ transplant or immunosuppressive state
  - Complex or high-risk coronary intervention such as:
    - Unprotected LM or LM equivalent
    - Vein or arterial graft intervention
    - Bifurcation lesion requiring both branch interventions
    - Use of atherectomy devices
    - Use of thrombectomy devices
    - CTO requiring bilateral injection
    - Prolonged procedure with fluoro time >60 min
  - Procedural complications such as:
    - No flow/slow flow
    - Side branch closure
    - Perforation
    - Residual dissection [type C or more]
    - Thromboembolism
    - Postprocedural chest pain or EKG changes
    - Hemodynamic instability requiring treatment
    - Elevated cardiac enzymes: CK-MB >3 × baseline
  - Inability to ambulate due to:
    - Poor coordination
    - Vasomotor instability
    - Dizziness or suspected neurological issues/events
  - High-risk patients requiring therapeutic long-term anticoagulation
  - No social support or inability to get access to medical care in case of an emergency

Post-PTCA pharmacology

- Hold metformin for 48 h post procedure.
- Dual antiplatelet therapy for at least 4 weeks after stenting with a bare metal stent and 12 months with a drug-eluting stent.

- Start high dose statin therapy.
- Evaluate the need for cardiac rehabilitation.
- Smoking cessation counseling in indicated patients.
- Dietary counseling and risk factor/life style modification.
- Anti-anginal therapy and maximal medical management as indicated by current guidelines.

Reference

1. Dehmer GJ, Weaver D, Roe MT, Milford-Beland S, Fitzgerald S, Hermann A, Messenger J, Moussa I, Garratt K, Rumsfeld J, Brindis RG. A contemporary view of diagnostic cardiac catheterization and percutaneous coronary intervention in the United States: a report from the CathPCI Registry of the National Cardiovascular Data Registry, 2010 through June 2011. J Am Coll Cardiol. 2012;60(20):2017–31. doi:10.1016/j.jacc.2012.08.966. Epub 2012 Oct 17. PubMed PMID: 23083784.