STANDARDIZED MANAGEMENT OF STEMI'S:
FROM BALLOON TO DOOR

Why Standardize Care?
- 17.5% of heart attack patients are readmitted to *** within 30 days
- Why do they come back?
  - MANY reasons including: recurrent chest pain, arrhythmias, fever, anxiety
- Prevent readmissions through standardization of post-STEMI care by:
  - Improving communication between medical practitioners and patients thereby setting clear expectations for discharge
  - Ensuring correct medications and med access
  - Ensuring firm follow-up arrangements have been made
- Allows application of up-to-date ACC/AHA guidelines to the cardiology service

Complications of MI:
- Complications will usually mean that you need to deviate from the protocol. You may be able to return to it after the complication resolves.
- What complications can you expect post-MI?
  - Mechanical: LV failure, RV failure, cardiogenic shock
  - Structural: Free wall rupture, VSD, papillary muscle rupture
  - Electrical: Arrhythmias, conduction abnormalities
  - Other: Pericarditis, Dressler's syndrome
  - Stent-related: In-stent thrombosis, re-stenosis

Post-STEMI Care:
Immediate post-cath management:
- Interventionalist meets with the patient's family in the Family Waiting Room
- If family not immediately available, the cardiology fellow will speak with the family in the CICU
- Initial treatment plan established including code status if appropriate
- Review records and labs from sending hospital (CXR - *have images uploaded to PACS if available*, BMP, EKG, Enzymes)

Day 1: CICU
- Cardiology admits patient in CICU with help of fellow
- Perform detailed history and exam, document in EHR
- Enter orders using appropriate order sets
- Enter "time zero" labs (trop, CK isoenzymes) if not done at cath
- Order CK isoenzymes (3 sets at 8h intervals), need to capture peak CKMB (trop only necessary at time zero)
  - Troponins are deemed more sensitive and specific than CK-MB, however take longer to rise and fall
  - CK-MB begins to rise 4-6 hours after the onset of infarction but falls within 36-48 hours
  - In order to diagnose an acute MI, troponin and CKMB should be elevated beyond the 99th percentile of the normal range and a rise and fall should be observed.
- Order post-cath ECG to assess ST elevations post revascularization.
  - Important to have new baseline ECG in case patient develops chest pain post cath
- Secondary prevention: Check HbAIc, fasting lipid panel in am. Initiate statin therapy regardless of LDL. Insulin sliding scale if appropriate.
- Meds:
  - ASA 325 mg qd *(A weak platelet inhibitor which works by irreversibly acetylating COX)*

        - After PCI ASA should be continued indefinitely
        - The new PCI guidelines state that "after PCI, it is reasonable to use aspirin 81 mg per day in preference to higher maintenance doses". Order 325 mg dose to start and decrease dose later if appropriate.
    - Clopidogrel 75 mg qd *(Thienopyridine derivative that inhibits binding of ADP to platelet receptors)*
        - BMS - min 1 month (1 year preferred based on results of CURE trial)
            - Less likely to cause in-stent thrombosis due to rapid endothelialization
            - Higher risk of re-stenosis
        - DES - min 1 year
            - Associated with late in-stent thrombosis
            - Lower risk of re-stenosis
        - Patient should have received a loading dose of 300-600 mg prior to or during the cath
    - Prasugrel 10 mg qd (alternative to Clopidogrel)
        - Prasugrel should not be used in patients with history of CVA or TIA
    - Statin (ex/ atorvastatin 40-80 qhs) *(Hmg-CoA reductase inhibitor)*
        - Lowers cholesterol through inhibition of HMG-CoA reductase; reduces inflammation and has a myocyte protective effect
        - Avoid simvastatin 80 mg qd (unless established on med for >1 yr) due to increased risk of rhabdo
    - Beta blocker
        - Dose at q6 intervals, include hold parameters (ex/ metoprolol 12.5 mg PO q6, hold if SBP <90 or HR <55)
- If no LV gram at cath (usually not done due to elevated creatinine) consider transthoracic echo to assess EF.

  If LV gram done at cath – DEFER echo unless separate indication
- Consider heparin gtt if patient had large anterior MI (definite if patient has an intra-aortic balloon pump (IABP)
    - With large anterior MI there is an associated wall motion abnormality (WMA) which means the patient is at risk for thrombus formation and some will require long term anticoagulation
    - Discuss need for heparin/Coumadin with attending if appropriate
- Patient should be on bed rest/minimal activity for the 12 hours after infarction to decrease the work of the heart and therefore infarct size
- Consider social work consult for med access, insurance, etc.
- If smoker order tobacco cessation counseling.
- Groin check/management at 4-6 hrs after sheath removal: If the patient winces when light pressure is applied with the stethoscope during auscultation you should be concerned. If you are concerned for a complication the next step is usually an ultrasound. This should be discussed with your attending prior to being ordered.
- Document location of MI, complete/incomplete revascularization, EF and type of stent in admission note. This info can be found in the interventionalist's procedure note.

Day 2: Transfer to Tele bed (if no complications)
- Check overnight telemetry
    - If frequent PVC's or runs of NSVT consider increasing beta blocker dose
- Assess enzyme curve – order further enzymes if peak CK-MB not captured
    - Peak CK and CKMB values and area under the curve calculations have significant correlation with functional outcomes and death or CHF outcomes in the setting of STEMI's.
- Check BMP
    - Contrast induced AKI is defined as a 25% or 0.5 mg/dL increase in serum creatinine within 48

hours of the procedure
- Check CBC
  - Even mild anemia (Hb 10-12) is associated with higher post-PCI mortality. Moderate to severe anemia (Hb<10) is associated with an even higher mortality
- Check FLP
  - Goal LDL <70 for secondary prevention of ACS
- Consider starting beta blocker if not done day one
- Consider initiating ACE inhibitor
  - Shown to be of most benefit for patients with EF<40%, large anterior MI, patients with prior history of MI or diabetes
  - Often start with Lisinopril (once daily dosing) or Captopril (often dosed q6-8 if the patient has borderline low BP)
- Patient should begin to ambulate (on tele)
- Identify outpatient cardiologist to follow (usually done by Attending)

Day 3: Tele bed
- Check ECG
  - Important to establish new baseline prior to discharge
- Review overnight telemetry
- Review daily labs/vitals: renal function, glycemic control, BP control, HR control, etc
- Consider transthoracic echo on Day 3. Usually done to assess for improvement of wall motion abnormalities with large anterior MI or low EF at cath.
- Now is a good time to reevaluate ACE-I, BB dosage and **change to once daily or twice daily** dosing. Ideally this should be done at least one day prior to discharge so that the patient can be observed on the dose they will go home on.
- Confirm cardiac rehab progress and plan. Discuss importance of rehab with patient including 20% decrease in all cause mortality in patients enrolled in programs.
- Discuss activity and return to work date with patient
- Discuss importance of aspirin and clopidogrel compliance
- Finalize coumadin plan based on echo results
- Schedule outpatient appointments (PCP, Cardiologist). Ideally every patient should be seen by a care provider (cardiologist, NP or PCP) within 7 days of discharge.

Day 4: Tele bed
- Review all pending labs/tests and assess if patient is ready for discharge
- Review overnight telemetry
- Sit with patient – Discuss new meds. Reiterate once again the importance of taking daily ASA and Clopidogrel. Discuss duration of therapy with the patient (ASA for life, Clopidogrel for 1-12 months).
- Discuss activity and return to work
  - Some general recommendations:
    - Treat the few days after discharge like “sick days” ie/minimal exertion
    - Abstain from sexual activity until able to climb a flight of stairs without shortness of breath
    - Stay out of work for minimum 2 weeks
    - No driving on the day of discharge
- Basic medications:
    - ASA 325 mg qd (#90 with refills x 1yr)
    - Clopidogrel 75 mg qd (#90 with refills x 1yr)

** **Need to write indication and date – ex/ Ix: bare metal stent, 1/1/2012** **

    - A beta blocker (keep in mind cost – ie/ Metoprolol tartrate is more cost effective than Toprol XL) (#30 with 3 refills – allow PCP to titrate)

- Statin (ex/ Atorvastatin 40 mg qhs)
- Sublingual Nitroglycerin tabs for PRN use
- ACEi, Coumadin, Nicotine replacement, etc.

- Send discharge summary to PCP and Cardiologist. Should be done within 24 hours of discharge.
- Discharge Letter is dictated by Cardiology Attending

STEMI criteria:

- ST elevation greater than **2 mm** in at least 2 contiguous precordial leads (V1-V6) or at least **1 mm** in 2 adjacent limb leads
- New LBBB

(*If initial ECG is not diagnostic but suspicion is high for STEMI, obtain serial ECG's at 5-10 minute intervals)*

Distribution of MI:

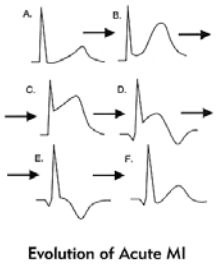
- Anterior: V3, V4 [LAD – Diagonal branch]
- Septal: V2, V3 [LAD – Septal branch]
- Anteroseptal: V1,2-V4,5 [LAD]
- Lateral: V5, V6 [Circumflex]
- Inferior: II, III, aVF [RCA]
- Posterior: Consider if prominent R wave in V2 – think about ordering posterior EKG

LVEDP/Wedge pressure:

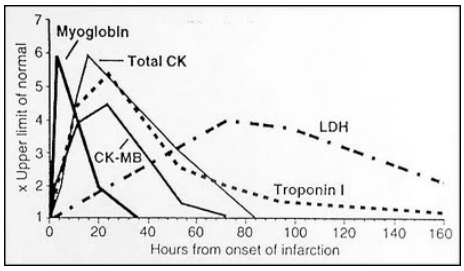
- LVEDP = Direct measurement of left ventricular preload
- In most cases wedge pressure can be used as an indirect surrogate measurement for LVEDP (can be measured using Swan Ganz catheter)

LVEDP ≈ LAP ≈ Wedge pressure

- Normal wedge pressure ~ 8-12 mmHg
- Elevated LVEDP/wedge is suggestive of volume overload
- Low LVEDP/wedge is suggestive of low circulating volume



Evolution of Acute MI



Med C STEMI Protocol

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Day 1: CICU

- ☐ Admit patient to CICU (detailed H&P documented in EHR)
- ☐ Place orders using appropriate order sets
  - ☐ Cardiac enzymes q5-6h (trend until peak CKMB observed)
  - ☐ Order ECG (assess ST segments post-cath)
  - ☐ Orders for daily BMP, CBC x 3 days
  - ☐ Check HbAIc, fasting lipid panel in am
  - ☐ Order/review meds:
    - □ ASA 325 mg qd

- □ Clopidogrel 75 mg qd
- □ Statin (ex/ simvastatin 40 mg po qhs, or atorvastatin 40-80 qhs)
- □ Beta blocker - dose at q6 intervals, include hold parameters (ex/ metoprolol 12.5 mg PO q6, hold if SBP <90 or HR <55)

- ☐ If no LV gram at cath consider transthoracic echo to assess EF
- ☐ Stop heparin infusion UNLESS - large anterior MI or IABP
- ☐ Document length of clopidogrel therapy (BMS – minimum one month or DES – minimum one year)
- ☐ Social work consult if necessary
- ☐ Consider consults such as diabetes education, nutrition, tobacco cessation, etc.
- ☐ Groin check/management at 4-6 hrs post cath – document in chart

Day 2: Transfer to Tele bed

- ☐ Recheck ECG
- ☐ Evaluate enzyme curve (make sure peak CKMB captured)
- ☐ Review telemetry for past 24hrs
- ☐ Consider Beta blocker if not done day one
- ☐ Consider starting ACEi if EF<40%, ant MI or prior history of MI
- ☐ Document groin if not already done Day 1 (ultrasound if indicated)
- ☐ Anticoagulation if indicated (initiate bridge to Coumadin)
  - □ LV thrombus or aneurysm
  - □ EF <30%
  - □ History of thromboembolism
  - □ Atrial fibrillation
- ☐ Discuss Clopidogrel compliance and cost with patient
- ☐ Patient should begin to ambulate
- ☐ Identify outpatient cardiologist to follow (usually done by Attending)

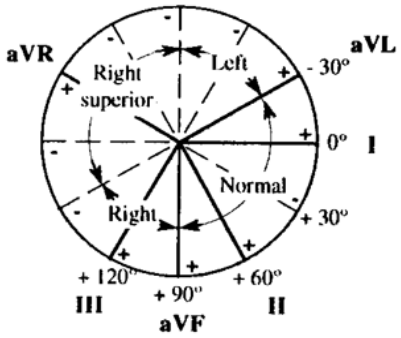
Day 3: Tele bed

- ☐ Review telemetry for past 24hrs
- ☐ Order transthoracic echo if:
  - □ Large anterior MI
  - □ Low EF at cath (<40% per LV gram)
- ☐ Plan for discharge: write scripts, update discharge summary, arrange follow-up with PCP and cardiologist. Discuss discharge plans with patient.
- ☐ Reevaluate ACE-I, BB dosage
  **** Change to once daily or twice daily dosing ****

Day 4: Tele bed

- ☐ Review telemetry for past 24hrs
- ☐ Confirm cardiac rehab plan
- ☐ Reiterate Clopidogrel and ASA compliance
- ☐ Sit with patient – New meds, activity, appointments, return to work
- ☐ Discharge Summary to PCP and Cardiologist

ECG Basics

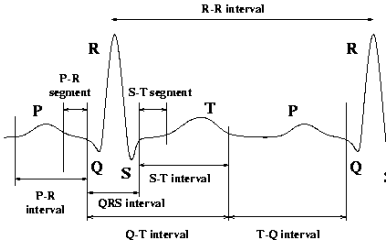


Structure for reading ECG's:

1. Rate
2. Rhythm
3. Axis/R-wave progression
4. Intervals
5. Conduction deficits
6. ST changes
7. Other

Normal Intervals and Amplit

Amplitudes	
P wave	0.25 mV
R wave	1.60 mV
Q wave	25% of R wave
T wave	0.1-0.5



Duration	
PR interval	0.12-0.20 sec
QT interval	0.35-0.44 sec
ST segment	0.05-0.15 sec
QRS interval	<0.12 sec

Rate: 300, 150, 100, 75, 60, 50, 42, 38

Big box = 0.20 sec = 5 mm
Small box = 0.04 sec = 1 mm

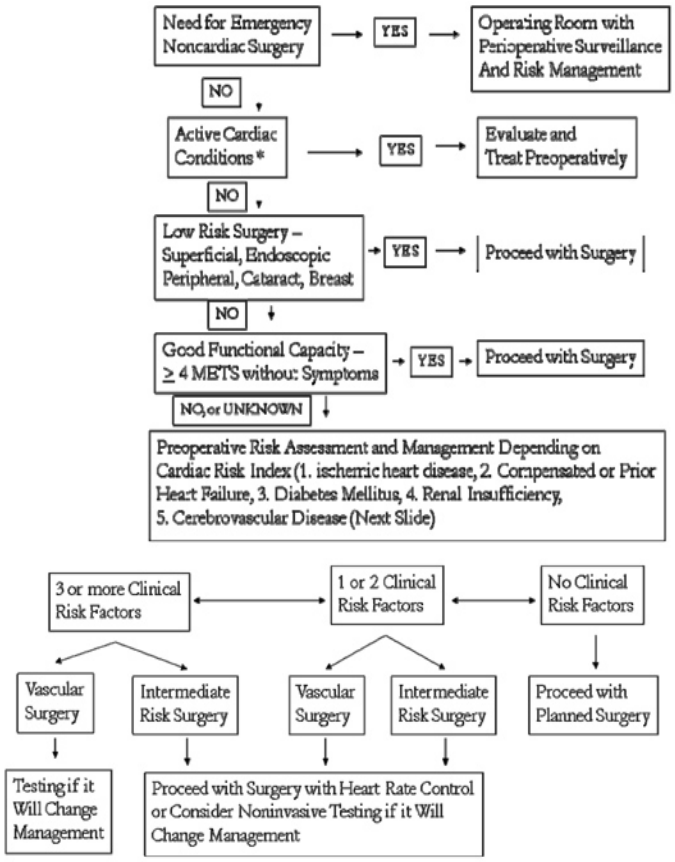
$QTc = QT/(RR)^{1/2}$

Goldman's Preoperative Cardiac Risk Index

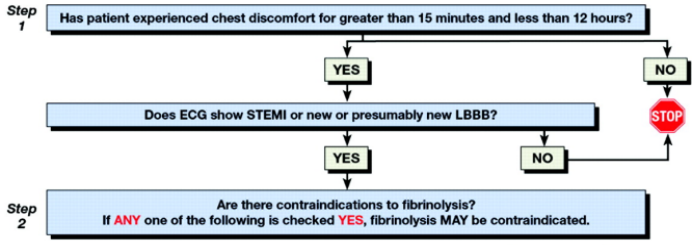
Risk	Points
S3 gallop or JVD on preop exam	11
Transmural or subendocardial MI <6mos ago	10
PVCs, more than 5/min at any time	7
Rhythm other than sinus or PACs on last EKG	7
Age>70	5
Emergency operation	4
Intrathoracic, intraperitoneal or aortic site of surgery	3
Evidence of important aortic stenosis	3
Poor general medical condition	3

Risk of cardiac complications based on index score		
Class I	**0-5 points**	1%
Class II	**6-12 points**	5%
Class III	**13-25 points**	11%
Class IV	**>25 points**	22%

Metabolic Equivalent Tasks (METs)	METs
Walking at a slow pace (1-2 mi/hr), golf using power cart, bowling, fishing, walking downstairs, cooking, light housekeeping, shopping, pushing stroller with child, walking dog	2-3
Walking at a brisk pace (1 mi/20 min), weight lifting, water aerobics, golf not carrying clubs	3.5
Walking at a very brisk pace (1 mi/17 to 18 min), climbing stairs, bicycling <10 mph, heavy yardwork/gardening, golf carrying clubs	4-5
Hiking	6-7
Aerobics, racquetball, jogging, skiing	6-12


Need for Emergency Noncardiac Surgery
YES
Operating Room with Perioperative Surveillance And Risk Management
NO
Active Cardiac Conditions*
YES
Evaluate and Treat Preoperatively
NO
Low Risk Surgery – Superficial, Endoscopic Peripheral, Cataract, Breast
YES
Proceed with Surgery
NO
Good Functional Capacity – ≥ 4 METS without Symptoms
YES
Proceed with Surgery
NO, or UNKNOWN
Preoperative Risk Assessment and Management Depending on Cardiac Risk Index (1. ischemic heart disease, 2. Compensated or Prior Heart Failure, 3. Diabetes Mellitus, 4. Renal Insufficiency, 5. Cerebrovascular Disease (Next Slide)
3 or more Clinical Risk Factors
1 or 2 Clinical Risk Factors
No Clinical Risk Factors
Vascular Surgery
Intermediate Risk Surgery
Vascular Surgery
Intermediate Risk Surgery
Proceed with Planned Surgery
Testing if it Will Change Management
Proceed with Surgery with Heart Rate Control or Consider Noninvasive Testing if it Will Change Management

Prehospital Fibrinolytic Checklist



Step 2 — **Are there contraindications to fibrinolysis?**
If ANY one of the following is checked YES, fibrinolysis MAY be contraindicated.

Systolic BP >180 to 200 mm Hg or diastolic BP >100 to 110 mm Hg	○ **YES**	○ NO
Right vs left arm systolic BP difference >15 mm Hg	○ **YES**	○ NO
History of structural central nervous system disease	○ **YES**	○ NO
Significant closed head/facial trauma within the previous 3 weeks	○ **YES**	○ NO
Stroke >3 hours or <3 months	○ **YES**	○ NO
Recent (within 2-4 weeks) major trauma, surgery (including laser eye surgery), GI/GU bleed	○ **YES**	○ NO
Any history of intracranial hemorrhage	○ **YES**	○ NO
Bleeding, clotting problem, or blood thinners	○ **YES**	○ NO
Pregnant female	○ **YES**	○ NO
Serious systemic disease (eg, advanced cancer, severe liver or kidney disease)	○ **YES**	○ NO

Step 3 — **Is patient at high risk?**
If ANY one of the following is checked YES, consider transfer to PCI facility.

Heart rate ≥100/min AND systolic BP <100 mm Hg	○ **YES**	○ NO
Pulmonary edema (rales)	○ **YES**	○ NO
Signs of shock (cool, clammy)	○ **YES**	○ NO
Contraindications to fibrinolytic therapy	○ **YES†**	○ NO
Required CPR	○ **YES**	○ NO

†Consider transport to primary PCI facility as destination hospital.