Getting Pumped About STEMI and Cardiogenic Shock

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Amy Shepard MS, RN, ACNS-BC, CCRN-K
STEMI/ Cardiogenic Shock Program Manager
University Hospital

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Objectives

By the end of this presentation, participants will be able to:

- Describe the process for a STEMI through the continuum of care.
- Verbalize time sensitive treatments in the care of a STEMI patient
- Verbalize EMS roles in caring for the STEMI patient.

Statistics

- Heart Disease remains to be the No. 1 cause of death in the US.

American Heart Association, 2017

Statistics (cont.)

Every 40 seconds an American will have a heart attack.

American Heart Association, 2017

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Statistics (cont.)

- About 790,000 people in the US have heart attacks each year. Of those, about 114,000 people will die.

American Heart Association, 2017

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Statistics (cont.)

- Average age at the first heart attack is 65.3 years for males and 71.8 years for females.

American Heart Association, 2017

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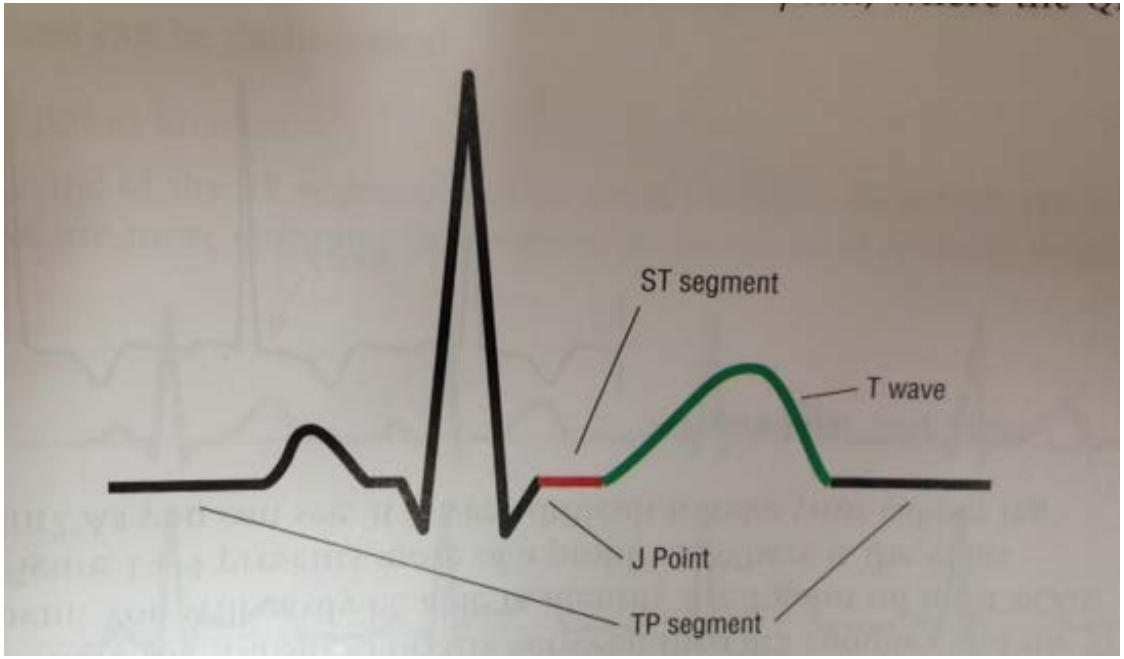
Why is the ST Segment so Important?

- The ST Segment represents the section of the complex in which the ventricles are between electrical depolarization and repolarization.
- It is a key indicator as to whether the patient may be experiencing ischemic insult or injury to the myocardium



STEMI Criteria

- ST elevation at the J point in at least 2 contiguous leads.
- Men ≥2 mm Women ≥1.5 mm in V2-V3
- ≥1 mm in other contiguous chest leads or the limb leads
- ST depression in V1-3 without ST elevation in other leads may indicate a posterior myocardial infarction

American College of Cardiology 2013

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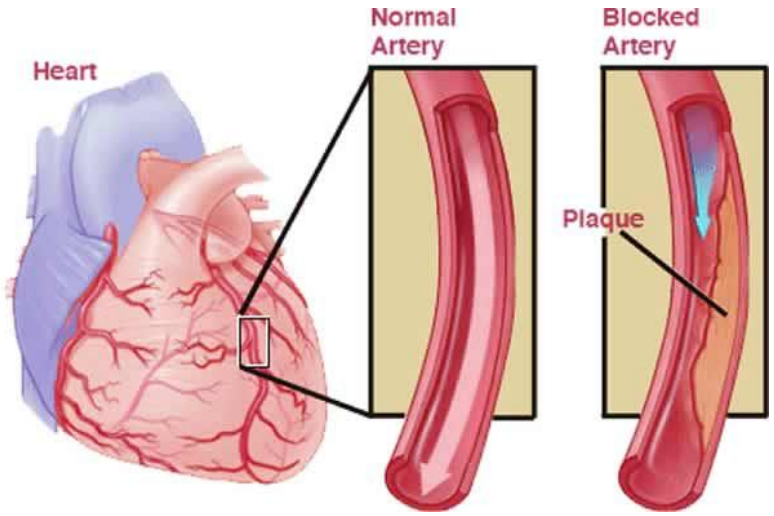
What causes a STEMI?

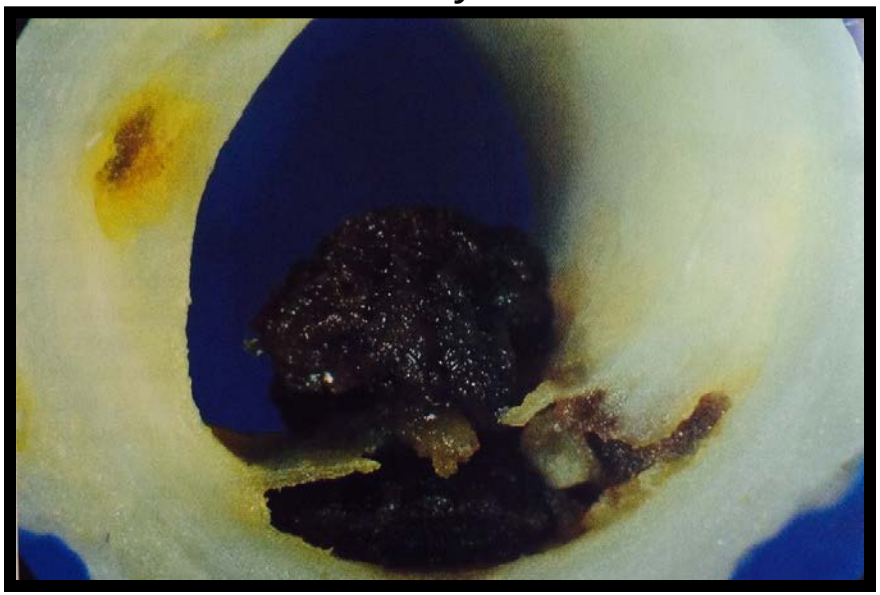


- ST segment
- Elevation
- Myocardial
- Infarction

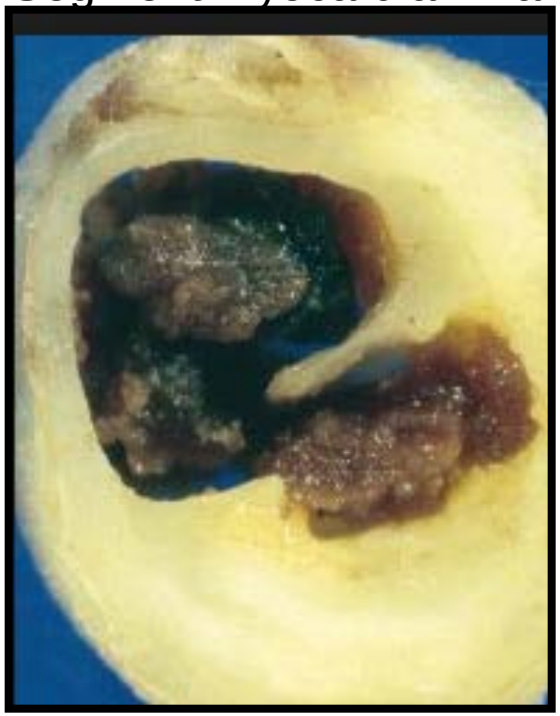
- 1. STEMIs are associated with the build up of plaque which ruptures in the coronary arteries.
- 2. This stimulates platelets to stick together/aggregate and vessels near the rupture to constrict
- 3. If the unstable area becomes totally blocked by a clot, also called a thrombus, a STEMI is occurring.

Ruptured Plaque

Non-ST Elevated Myocardial Infarction



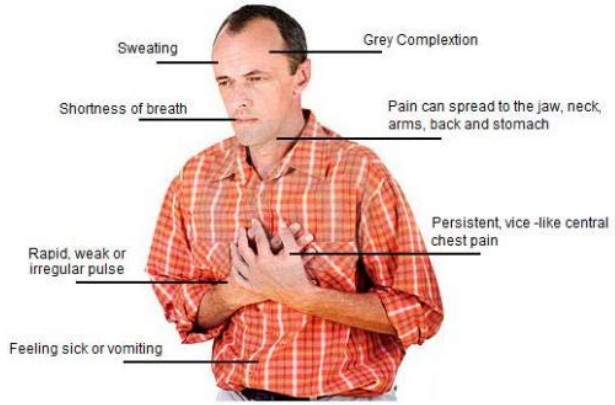
ST Segment Myocardial Infarction



Symptoms of a Heart Attack

Well-Known

- **Pressure, squeezing or fullness in chest**
- **Pain radiating to the arms.**



More Subtle

- **Nausea**
- **Shortness of Breath**
- **Fatigue**
- **Jaw pain**
- **Back pain**
- **Stomach pain**
- **Light headedness**

American Heart Association 2015

Women's Symptoms

- Extreme Fatigue
- Lower chest / upper abdominal pain
- Nausea/Vomiting
- Shortness of Breath
- Light headedness
- Dizziness
- Upper back pain

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“Time is Muscle”

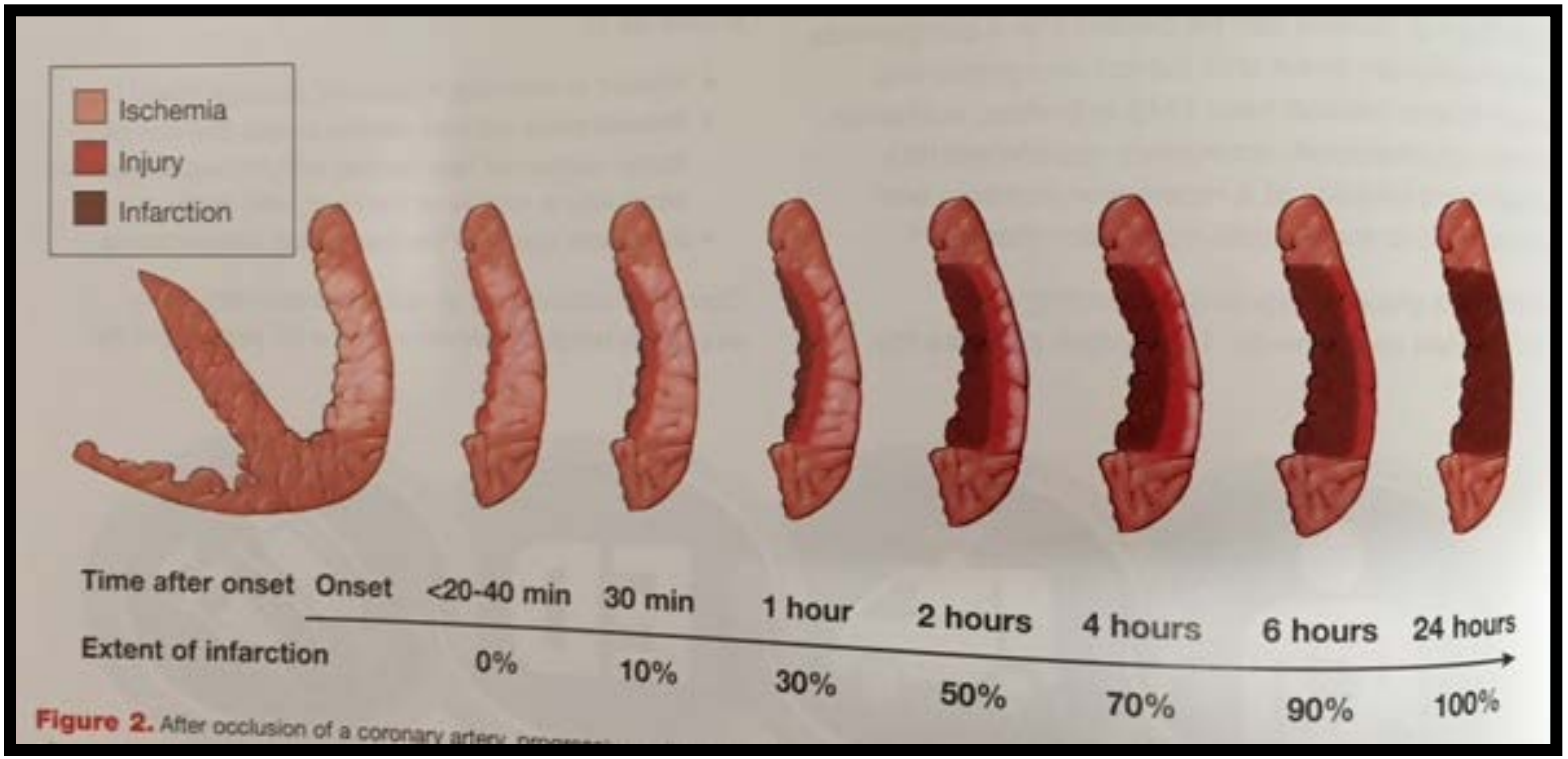


Figure 2. After occlusion of a coronary artery, progress

American Heart Association, 2011

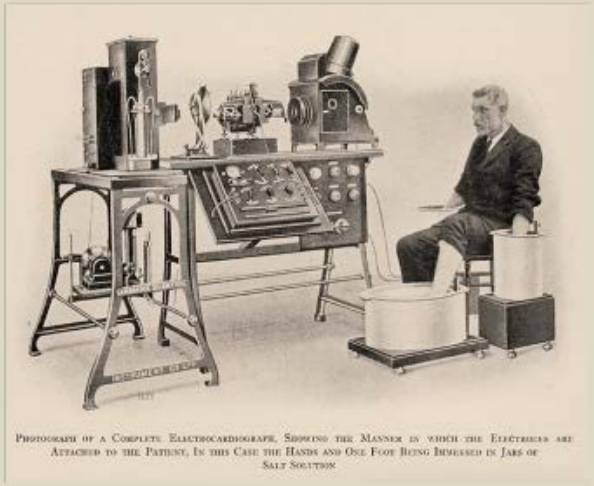
ECG Then and Now

THE HISTORY OF ECG MACHINE

1903

Willem Einthoven

A Dutch doctor and physiologist. He invented the first practical electrocardiogram and received the Nobel Prize in Medicine in 1924 for it



Photograph of a Complete Electrocardiograph, Showing the Manner in which the Electrodes are Attached to the Patient, In this Case the Hands and One Foot Being Immersed in Jars of Salt Solution

NOW

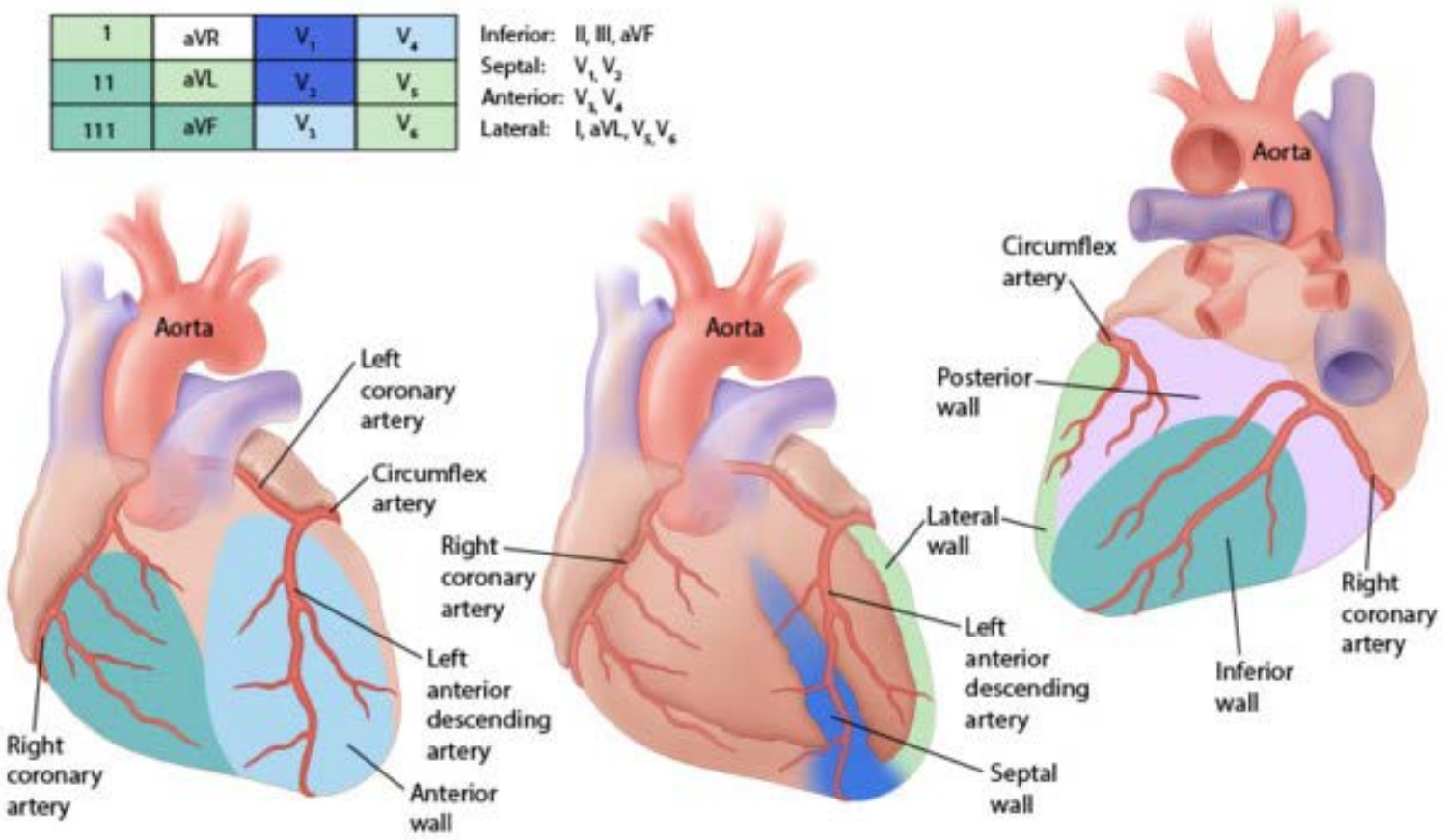
Modern ECG machine

has evolved into compact electronic systems that often include computerized interpretation of the electrocardiogram.

Leads with Corresponding Wall Involvement

1	aVR	V_1	V_4
11	aVL	V_2	V_5
111	aVF	V_3	V_6

Inferior: II, III, aVF
Septal: V_1, V_2
Anterior: V_3, V_4
Lateral: I, aVL, V_5, V_6



Reciprocal Changes

Leads opposite injured area may show ST depression due to two leads viewing the MI from opposite angles.

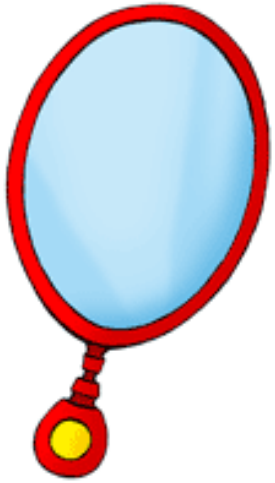
Inferior (II, III and aVF) → V leads

Lateral (V5-6, I, and aVL) → II, III, and aVF

RV → none

Anterior wall (V1-4) → II, III and aVF

Posterior wall (V7-9) → V1-3



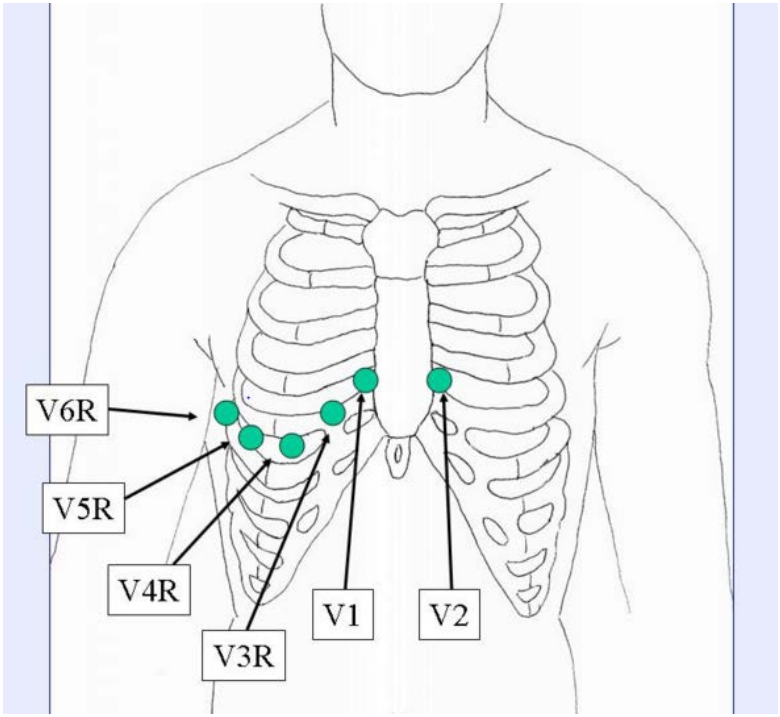
What About Right Sided ECG's?

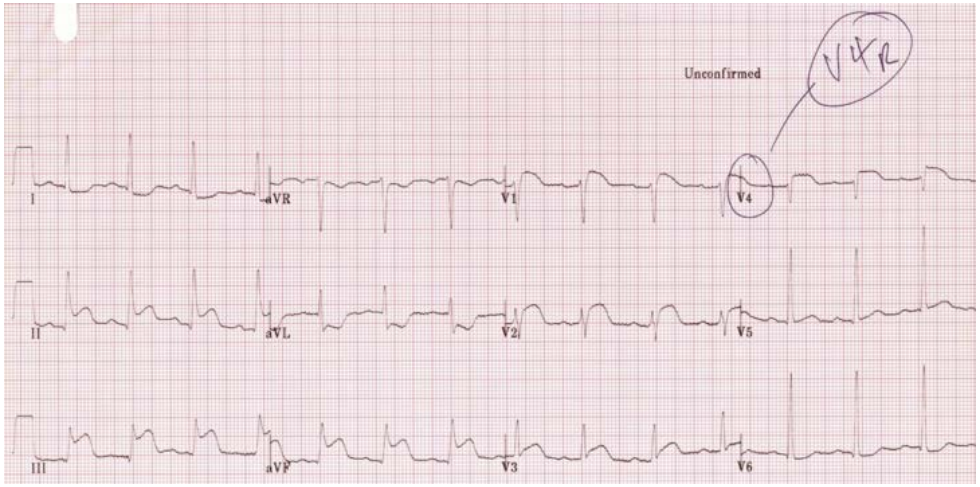
- Right sided ECG's are performed to help diagnose Right Ventricular Myocardial Infarction.
- ECG leads are placed in the mirror image on the right side of the chest as compared to the left side of the chest.
- Elevation in the right sided leads you can suspect a right sided infarct.
- V4R is the most sensitive and specific lead

Right Sided ECG's (cont).

- If you have a patient that has definite ST-segment elevation, it is best to load them into the ambulance and get them to the Cath Lab ASAP.
- Do not delay patient transport to perform a right sided ECG.

Right Sided ECG





Posterior Wall MI

- Posterior MI's are associated with inferior wall MI's and Right Ventricular Infarcts.
- With normal lead placement, a posterior ECG will present as ST segment depression in the septal leads V1 and V2.

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Posterior ECG

- If ST segment depression is noted in V1 and V2, suspect Posterior Wall MI.
- Why ST depression and not elevation?
- Do not delay transport to obtain a posterior ECG.

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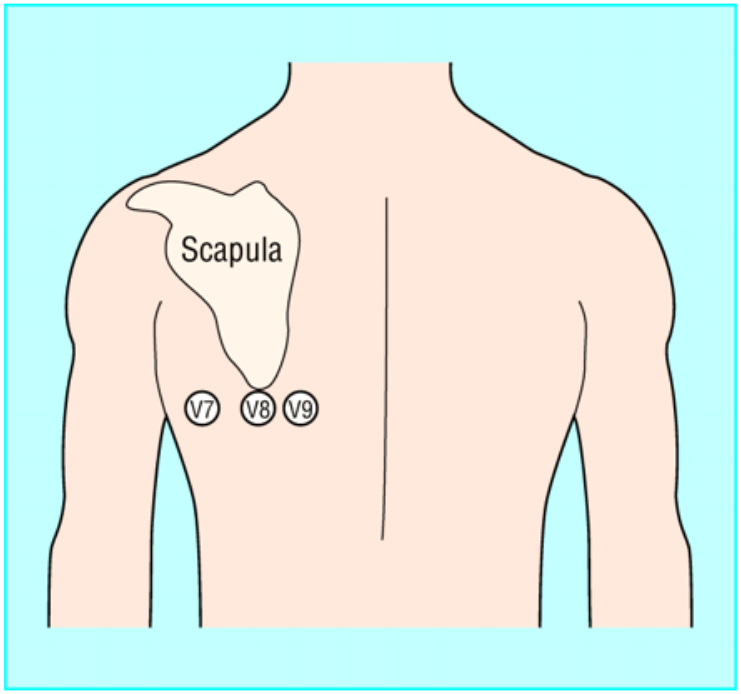
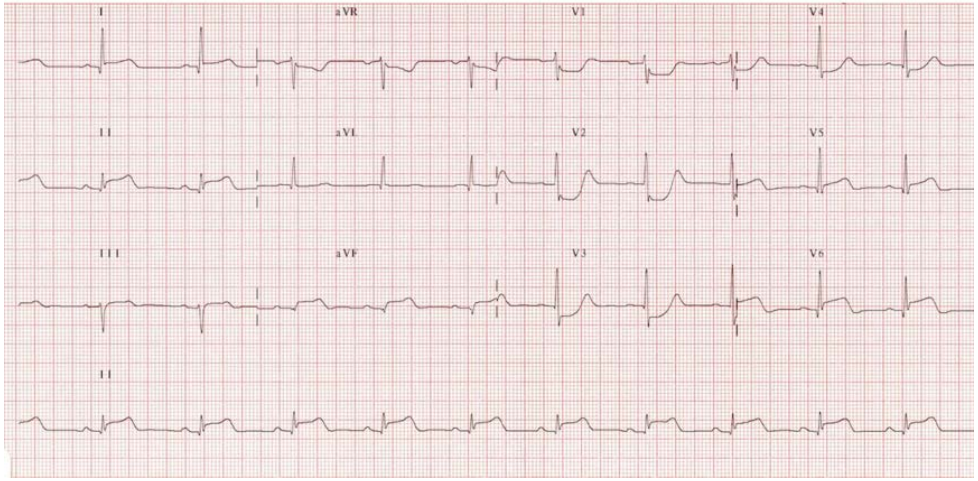
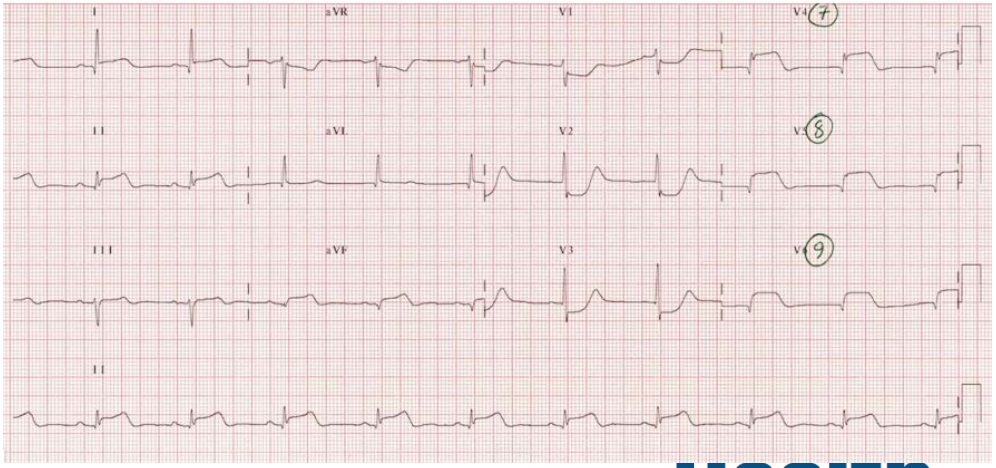
Posterior ECG's







- V6 connects to V9
- V5 connects to V8
- V4 connects to V7

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Complications From STEMI

- Ventricular Septal Defect
- Papillary muscle rupture or dysfunction,
- Cardiac free wall rupture
- Ventricular Aneurysm
- LV outflow tract obstruction
- **LV or RV Failure with Cardiogenic Shock**

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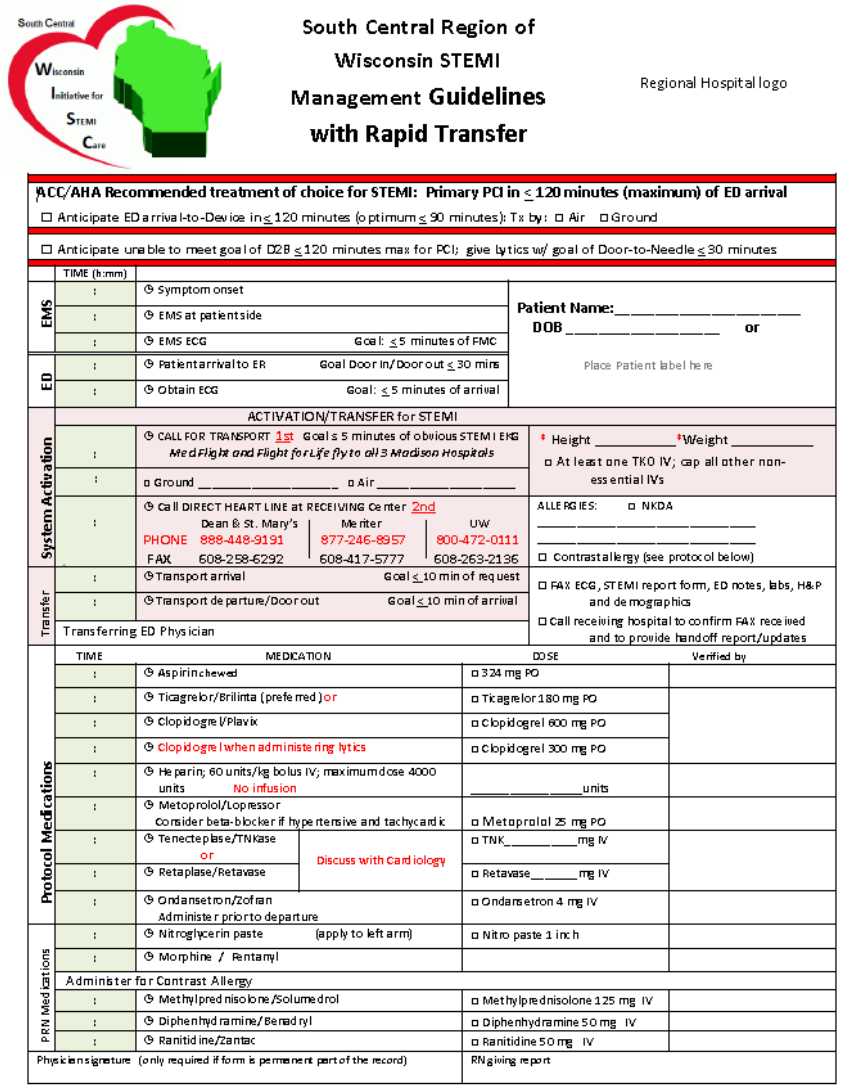
Guidelines for Transfer



South Central Wisconsin Initiative for STEMI Care

South Central Region of Wisconsin STEMI Management Guidelines with Rapid Transfer

Regional Hospital logo

ACC/AHA Recommended treatment of choice for STEMI: Primary PCI in ≤ 120 minutes (maximum) of ED arrival

☐ Anticipate ED arrival-to-Device in ≤ 120 minutes (optimum ≤ 90 minutes): Tx by: ☐ Air ☐ Ground

☐ Anticipate unable to meet goal of D2B ≤ 120 minutes max for PCI; give lytics w/ goal of Door-to-Needle ≤ 30 minutes

	TIME (h:mm)		
EMS	:	◷ Symptom onset	**Patient Name:**_____ **DOB** _____ **or** Place Patient label here
	:	◷ EMS at patient side	
	:	◷ EMS ECG — Goal: ≤ 5 minutes of FMC	
ED	:	◷ Patient arrival to ER — Goal Door In/Door out ≤ 30 mins	
	:	◷ Obtain ECG — Goal: ≤ 5 minutes of arrival	

ACTIVATION/TRANSFER for STEMI

System Activation	:	◷ CALL FOR TRANSPORT 1st Goal ≤ 5 minutes of obvious STEMI EMS *MedFlight and Flight for Life fly to all 3 Madison Hospitals* — * Height _____ *Weight _____ ☐ At least one TKO IV; cap all other non-essential IVs
	:	☐ Ground _____ ☐ Air _____
	:	◷ Call DIRECT HEART LINE at RECEIVING Center 2nd — Dean & St. Mary's: PHONE 888-448-9191, FAX 608-258-6292; Meriter: 877-246-8957, 608-417-5777; UW: 800-472-0111, 608-263-2136 — ALLERGIES: ☐ NKDA _____ ☐ Contrast allergy (see protocol below)
Transfer	:	◷ Transport arrival — Goal ≤ 10 min of request
	:	◷ Transport departure/Door out — Goal ≤ 10 min of arrival — ☐ FAX ECG, STEMI report form, ED notes, labs, H&P and demographics ☐ Call receiving hospital to confirm FAX received and to provide handoff report/updates
		Transferring ED Physician

	TIME	MEDICATION		DOSE	Verified by
Protocol Medications	:	◷ Aspirin chewed		☐ 324 mg PO	
	:	◷ Ticagrelor/Brilinta (preferred) or		☐ Ticagrelor 180 mg PO	
	:	◷ Clopidogrel/Plavix		☐ Clopidogrel 600 mg PO	
	:	◷ Clopidogrel when administering lytics		☐ Clopidogrel 300 mg PO	
	:	◷ Heparin; 60 units/kg bolus IV; maximum dose 4000 units No infusion		_____ units	
	:	◷ Metoprolol/Lopressor Consider beta-blocker if hypertensive and tachycardic		☐ Metoprolol 25 mg PO	
	:	◷ Tenecteplase/TNKase or	Discuss with Cardiology	☐ TNK_____ mg IV	
	:	◷ Retaplase/Retavase		☐ Retavase_____ mg IV	
	:	◷ Ondansetron/Zofran Administer prior to departure		☐ Ondansetron 4 mg IV	
PRN Medications	:	◷ Nitroglycerin paste (apply to left arm)		☐ Nitro paste 1 inch	
	:	◷ Morphine / Fentanyl			
		Administer for Contrast Allergy			
	:	◷ Methylprednisolone/Solumedrol		☐ Methylprednisolone 125 mg IV	
	:	◷ Diphenhydramine/Benadryl		☐ Diphenhydramine 50 mg IV	
	:	◷ Ranitidine/Zantac		☐ Ranitidine 50 mg IV	

Physician signature (only required if form is permanent part of the record) — RN giving report

- First Medical Contact Time
- ECG Time
- System activation/call for transport
- Transfer out
- Medication Administration

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PCI Time Benchmarks

- **Transport to a PCI Capable Facility:**

  Ideal First Medical Contact (FMC)-to-device time of **90 minutes** or less.

- **Transport from a Non–PCI-capable Facility to a PCI Capable Facility:**

  FMC-to-device time system goal of **120 minutes** or less.*18–21 *(Level o*

American Heart Association Mission Lifeline, 2012

What is First Medical Contact?

- First Medical Contact (FMC) is the time when the patient is first evaluated by either EMS or another health care professional prior to arrival at the PCI facility.
- For EMS cases, the FMC time is when the health care provider is at the patient.
- For arrival by private vehicle it is the arrival time to the ED
- The 90/120 minute clock starts at the time of FMC.

ACC/NCDR, GWTG, 2007

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Transfer Considerations

- Receiving ER is placed on STEMI alert
- The cath lab makes a room available
- The ICU staff ensures a bed is ready
- Med Flight is activated if needed
  - Weather impacts response times

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EMS Barriers

- Resources – 12 Lead ECG machine equipment and training, lack of transmission capabilities, personnel
- Not always possible to get ALS or air transport to get patient to PCI center

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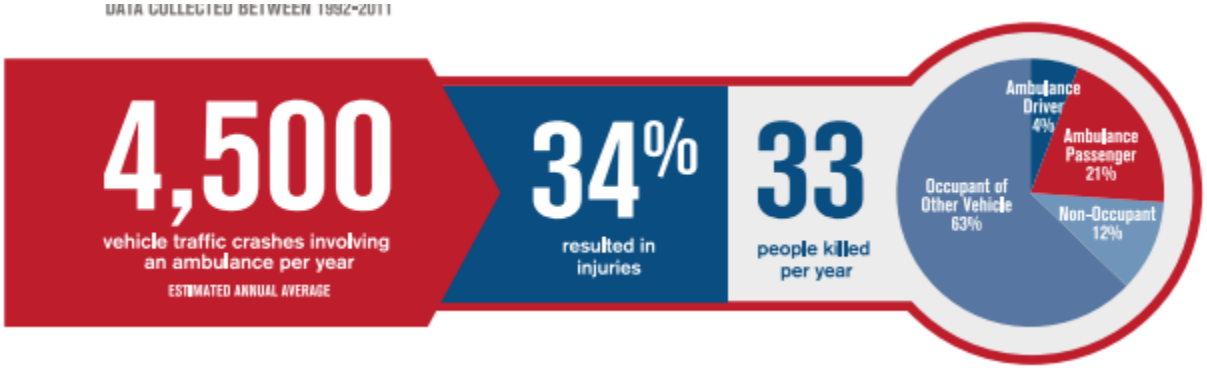
EMS Barriers Continued

- Weather

Safety First!



Infographic courtesy of EMS.gov

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EMS Responsibilities

- Obtain 12 Lead ECG within **5 minutes – preferred, 10 minutes benchmark** of first medical contact.
- If transmission capabilities exist, transmit ECG to nearest hospital **IMMEDIATELY**
- If transmission capabilities do not exist, notify receiving hospital that you are bringing in a suspected STEMI.
- Limit scene time to **15 minutes**.

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EMS Responsibilities (cont.)

- Provide copies of the run report to hospital and upload to database within 24-48 hours.
- Provide hospital providers with a thorough handoff.
- **Always send cardiac arrest rhythm strips and 12 leads with patient to the hospital.**

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Tips for Referring Hospitals

- Obtain ECG within **5 minutes** of patient arrival
- **5 Minutes** STEMI ECG to decision, contact PCI Center and transport within 5 minutes of obvious STEMI ECG.
- **Goal: Door in door out = 30 Minutes**

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Tips for Referring Hospitals (cont.)

- If ECG does not meet STEMI criteria: perform serial 12 leads every 15 minutes to monitor for evolving STEMI or if patient condition changes.
- Contact cardiology for a consult. This can be done by calling the UW Access Center.
- If transport is delayed due to weather or availability, consider thrombolytic therapy.
- Goal: **Door to needle = 30 Minutes**

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Tips for Referring Hospitals (cont.)

- If transport is delayed due to weather or availability, consider thrombolytic therapy.
- Goal: **Door to needle = 30 Minutes**
- Send copies of all documentation from current ED visit and EMS documentation – **Including all pre-hospital and in-hospital significant rhythms strips**

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Tips for Referring Hospitals (cont.)

- Discontinue IV drips
- Explain to patients what is happening and that things will be moving fast.
- Send along family information if the information is readily available.

Quality

- Feedback will be provided within 24 to 48 hours.
- Feedback can only be provided if documentation is available to obtain times and details of the case. Expect longer wait times for feedback if documentation is not completed in a timely manner.
- Beneficial to review cases with all staff

Transfer Considerations

- Receiving ER is placed on STEMI alert
- The cath lab makes a room available
- The ICU staff ensures a bed is ready
- Med Flight is activated if needed
  - Weather impacts response times

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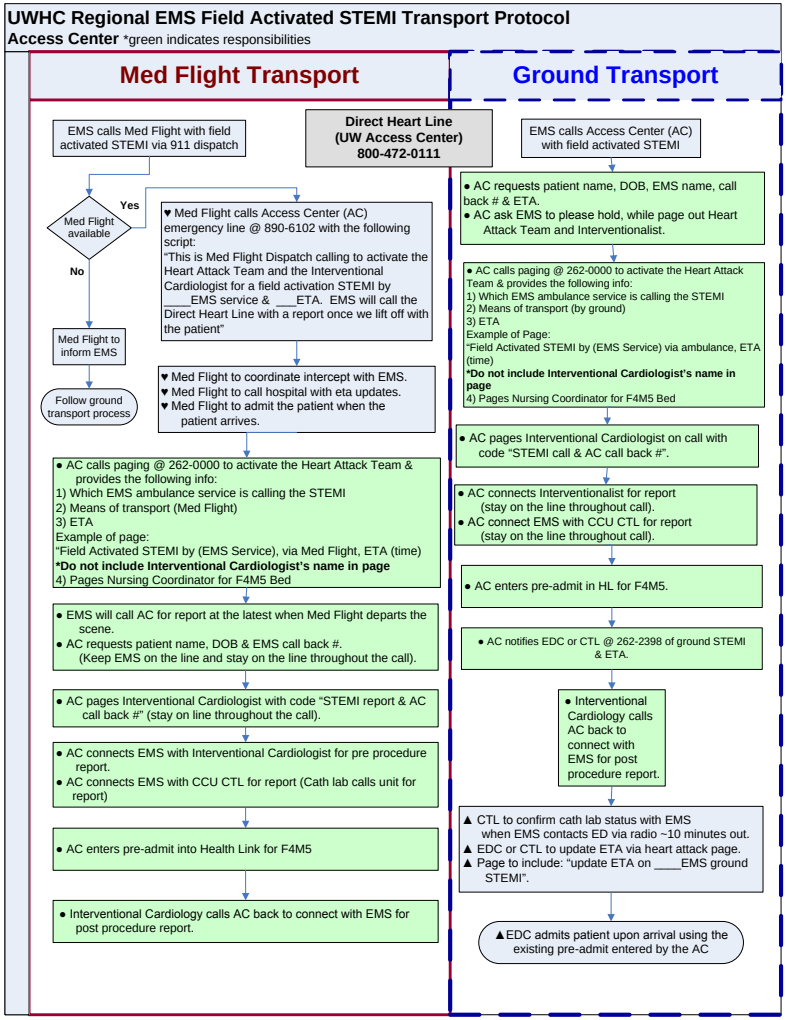
Regional Field Activation Protocol



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Cardiogenic Shock

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What is Cardiogenic Shock?

Cardiogenic shock is when the heart is unable to pump enough blood to meet the body's needs.

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Statistics

- Cardiogenic shock complicating AMI results in 5-15% which equals approximately 40,000-50,000 people in the US per year.
- Leading cause of death in AMI with mortality rates of 40-50%

Thiele, Ohman, Desch, Eitel, de Waha, (2015).

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Causes of Cardiogenic Shock

- Myocardial Infarction
- Myocarditis
- Endocarditis
- Weakened heart from any cause
- Arrhythmias
- Tamponade
- Pulmonary Embolism

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Symptoms

- Systolic BP of < 90mmHG
- Elevated left-sided filling pressures
- Impaired organ tissue perfusion as evidenced by:
  - Altered mental status
  - Oliguria
  - Cool, clammy skin
  - Elevated serum lactate levels

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Assessment

- Mental Status
  - Is the patient alert and oriented or confused and/or lethargic?
- Vital Signs
  - Is the SBP < or > 90
  - Heart rate and rhythm
  - Respiratory status
    - Breathing fast and labored or normal
    - Oxygen saturation

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Assessment (cont.)

- Physical assessment
  - Cardiac and Pulmonary auscultation
    - New Murmurs or rales
  - Peripheral vascular assessment
    - Cool and clammy to the touch
    - Strength of peripheral pulses
  - Urine output
    - Is it adequate?

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Treatments

- Oxygen, Bi-PAP, CPAP, or intubation if necessary
- Inotropes
- Vasopressors
- Mechanical circulatory assist device

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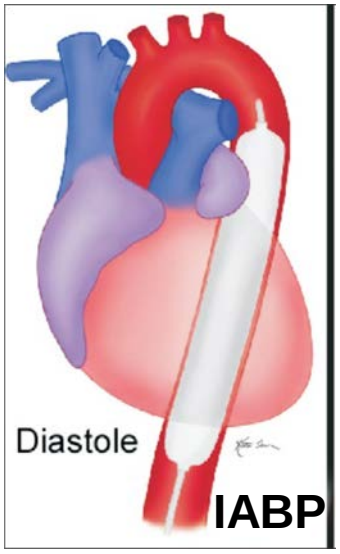
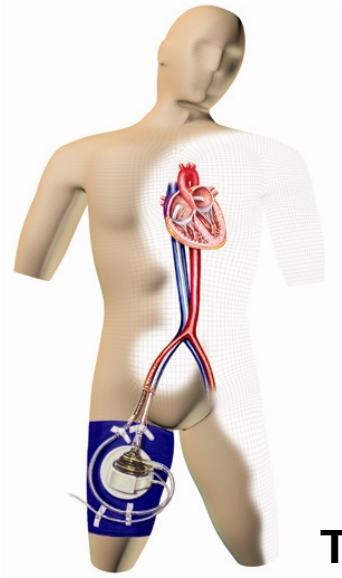
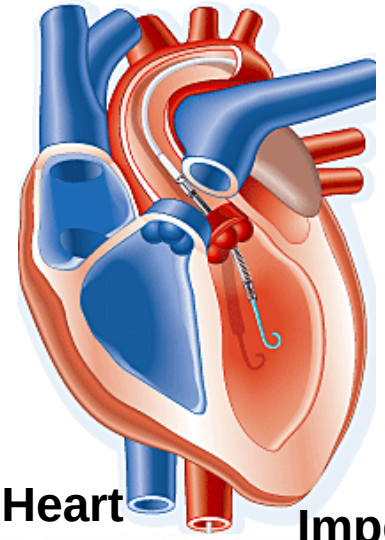
What are Mechanical Circulatory Support Devices?



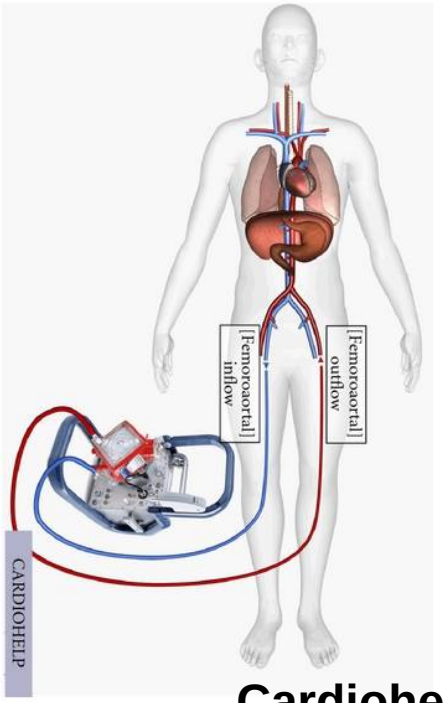
IABP



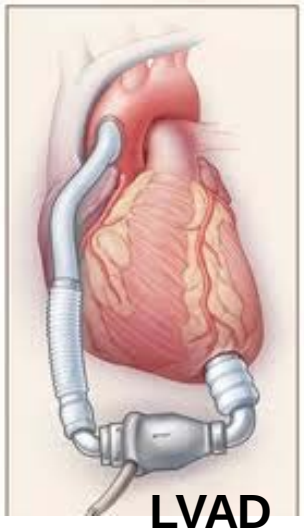
TandemHeart



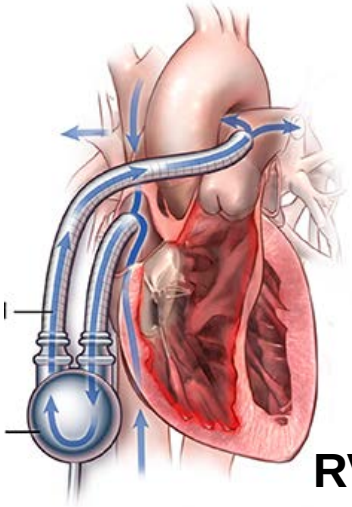
Impella



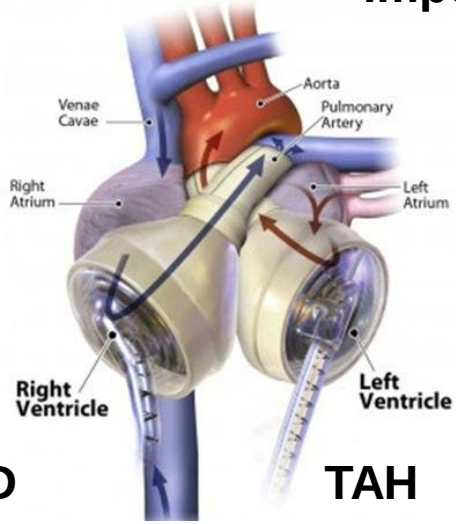
Cardiohelp



LVAD



RVAD



TAH

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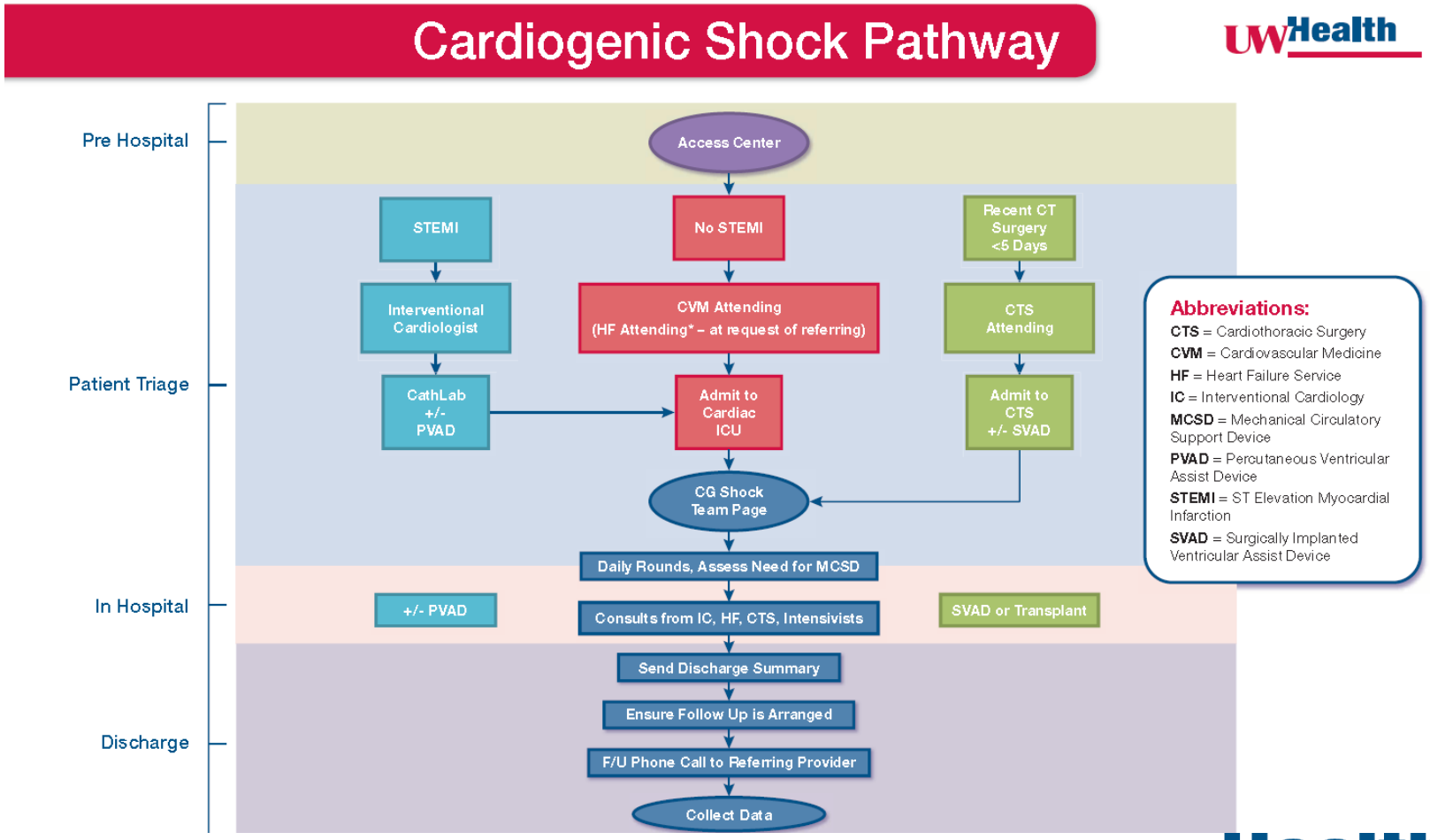
Systematic Approach



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STEMI / Cardiogenic Shock Case Study

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The Story

- 49 y.o. male with a positive family history of heart disease, obesity, and seizure disorder who began to experience chest pain after dinner which was associated with vomiting and diaphoresis. His mother heard him collapse, so she ran to help. Unfortunately she was unable to move him. She used her Life Alert to summon help. The patient did not receive CPR until the EMS arrived (amount of time without CPR 5-10 minutes). He was found to be in VF and was shocked once and then went into PEA.

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EMS Radio Call into UW

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EMS ECG at 1952

EMS Treatment

- CCR upon arrival
- Rhythm VF defibrillated, remained in VF Compressions resumed
- High flow oxygen via NRB
- IV Left AC due to failed IO
- Fluid bolus
- 1mg Epi
- Glucose checked

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EMS Treatment (cont.)

- Defib charged – patient in PEA, charged dumped, compressions resumed
- Organized rhythm with pulse, agonal respirations. Patient moved to stretcher. BVM to assist respirations.
- 12 lead done en route to UW which revealed anterior STEMI

ED Treatment

- 12 Lead upon arrival
- Second IV placed
- Intubation
- Propofol
- Cooling blankets
- Patient sent to CT scan to rule out head bleed.

Cardiac Catheterization

- Staff involved:
  - 2 Physicians
  - 2 RNs and 1 Cardiovascular Tech
  - Consent is obtained
- Patient prep:
  - ECG, pulse oximetry, BP
  - Table is only 22 inches wide (holds 500 lbs.)
- Procedure:
  - Sterile drape placed
  - Access (Radial or Femoral)
  - Interventional guide inserted
  - Wire inserted into culprit vessel
  - Coronary balloon, stent balloon or aspiration catheter inserted
  - Goal Cath door to balloon inflation (DBT) 25 minutes

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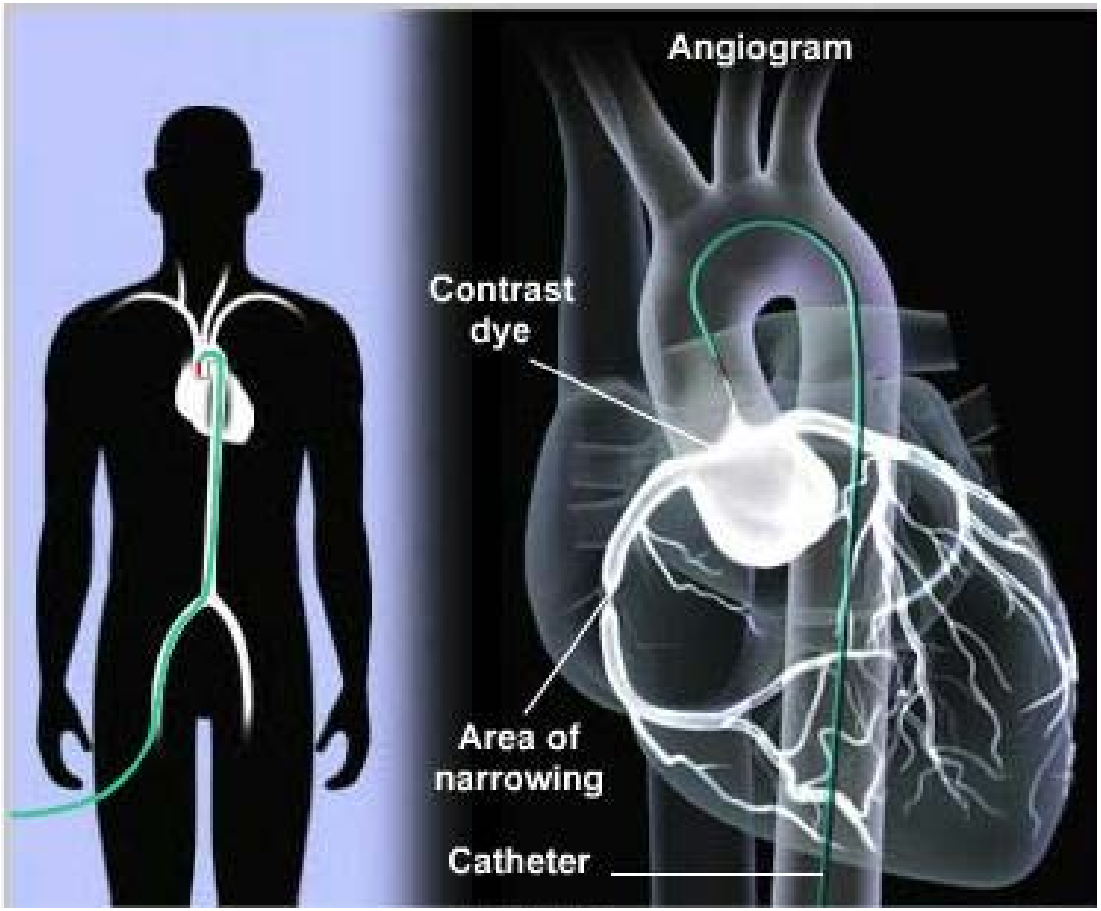
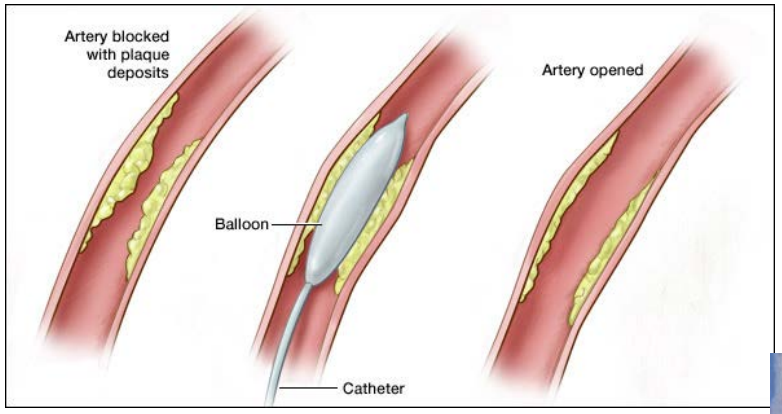
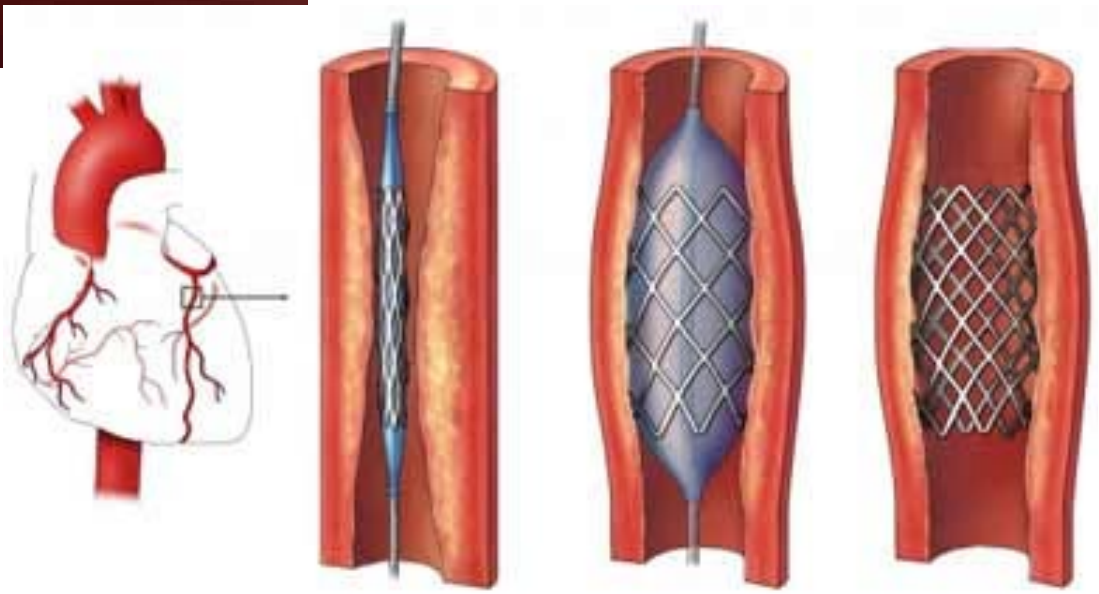
Coronary Angiogram



Angioplasty and Thrombectomy



Stenting



Cath Lab Interventions

- 100% Proximal Left Anterior Descending
- 3.0mm x 38mm drug-eluting stent placed
- Patient developed acute stent thrombosis while still in the Cath Lab, so two additional drug-eluting stents needed to be placed.
- Cardiohelp (ECMO) placed
- Swan-Ganz and cooling catheter inserted

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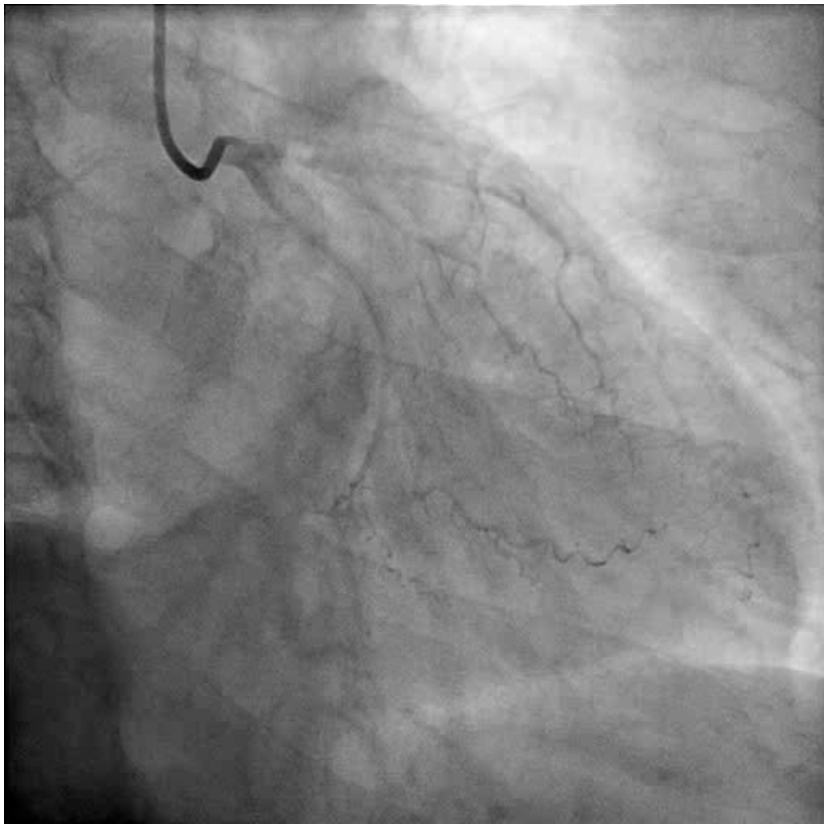
100% LAD
(Different Patient)



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Stented LAD (Different Patient)

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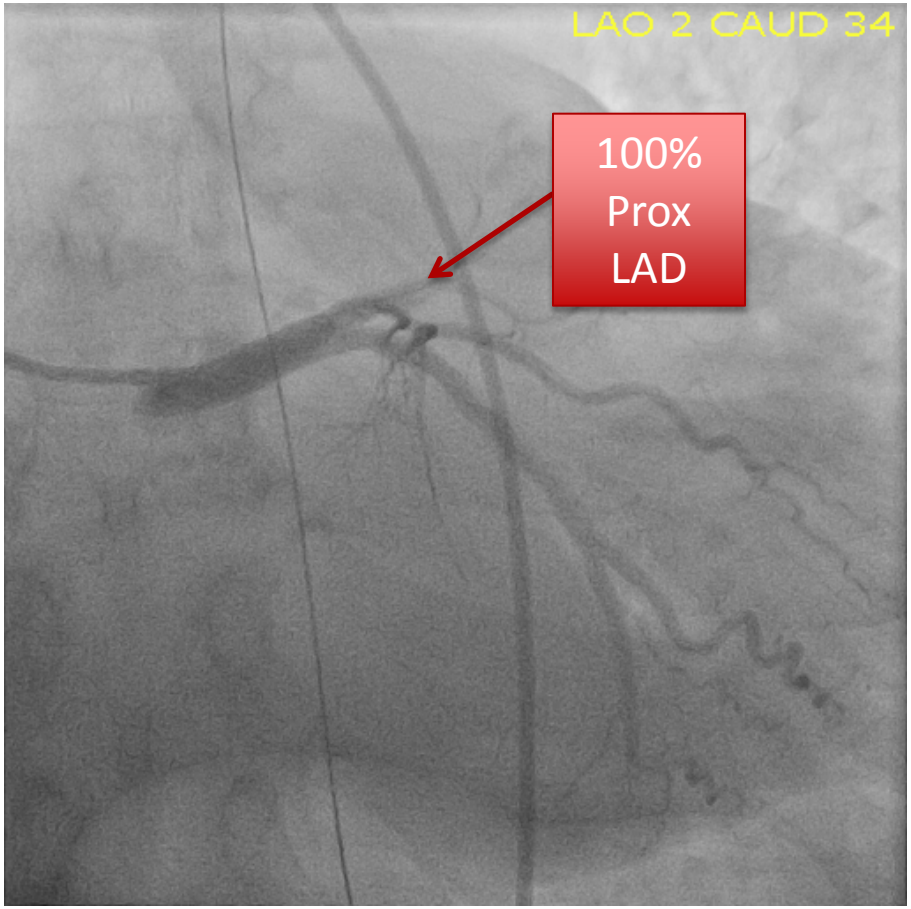
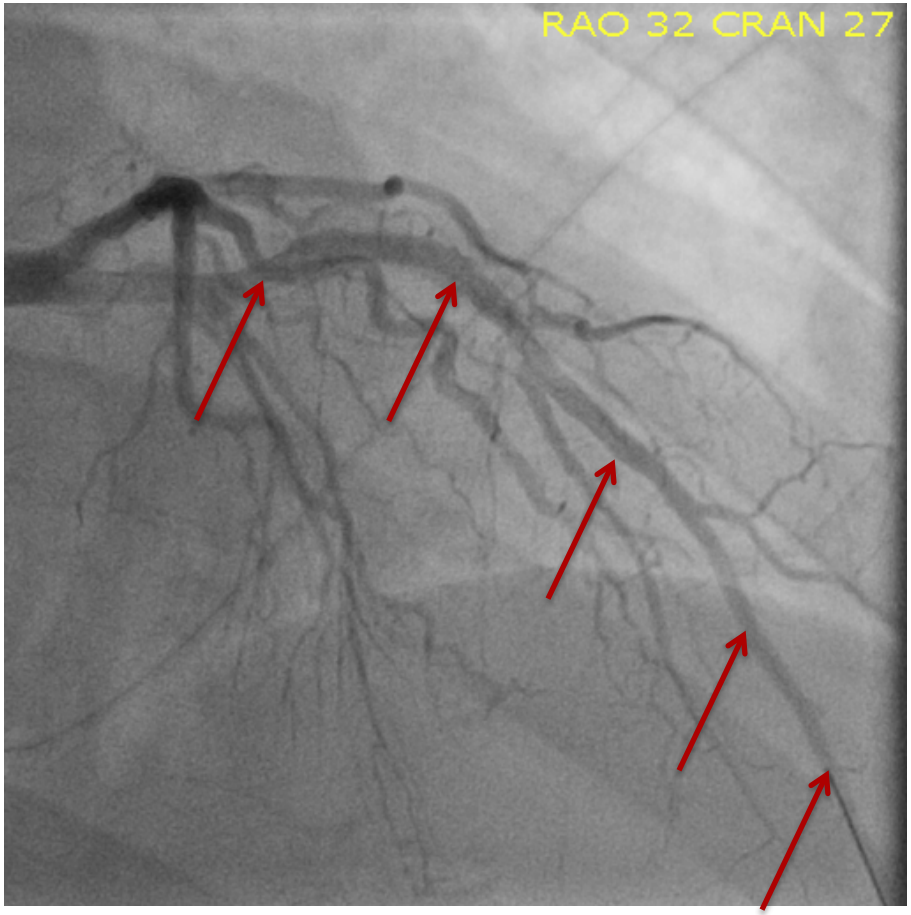
Left Anterior Descending Culprit Lesion Case Study Patient

Pre-Intervention



Post-Intervention



Hospital Course

- **5/15** - Patient's right foot became ischemic due to large cannulas from ECMO. HE was taken back to the Cath Lab for revision from VA ECMO to veno-venus. IABP placed to off load the LV. Temporary bypass of SFA with arterial to arterial bypass.
- **5/19** – ECMO decannulated
- **5/21** – Extubated and following commands
- **5/31** – Discharged to rehab facility

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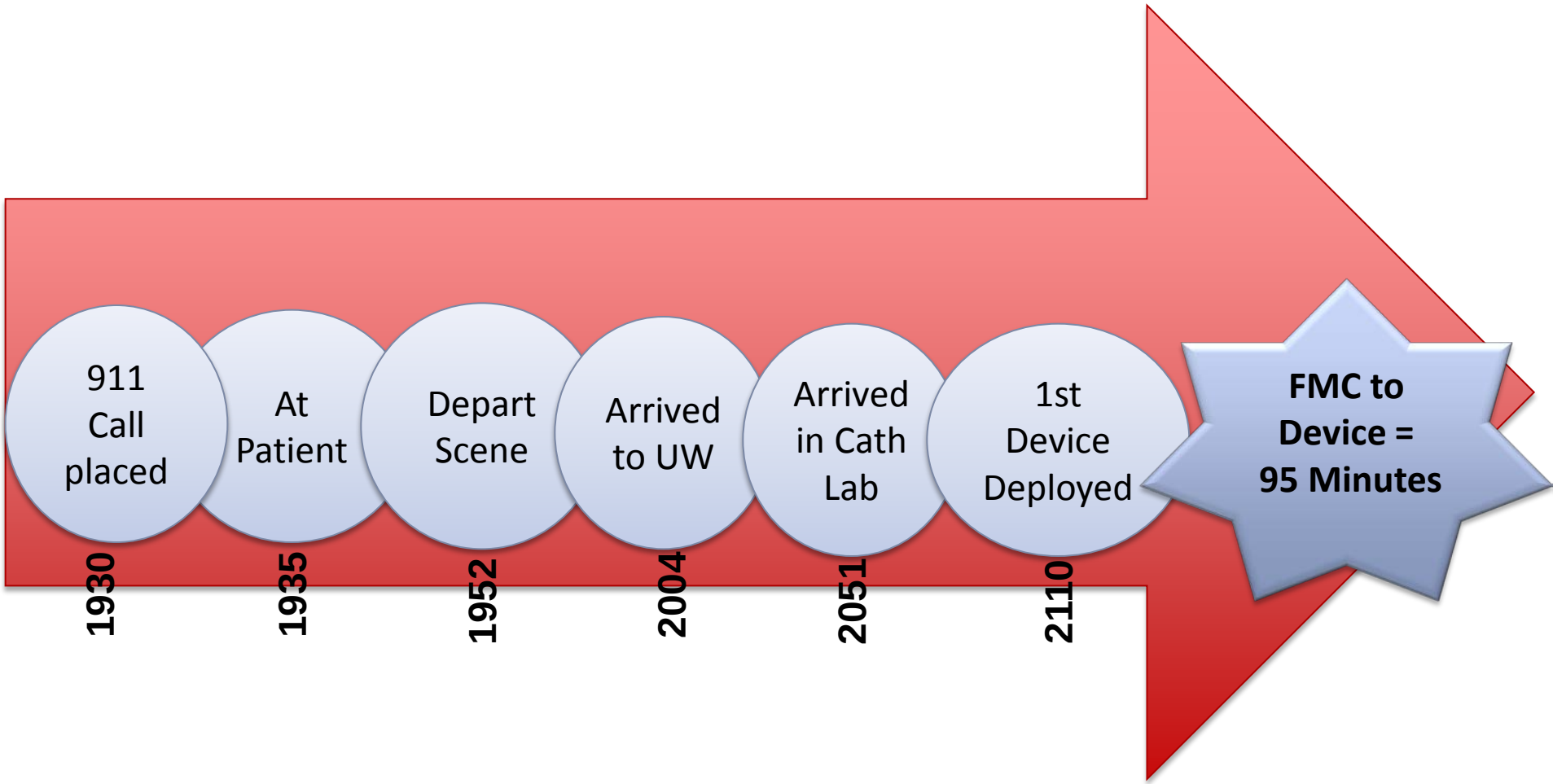
Pre-Hospital to Cath Lab Time Line



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Key Points

- High Quality CPR is vital to patient survival
- Transmit STEMI ECG's IMMEDIATELY to receiving center to expedite patient care
- Time is critical for STEMI and Cardiogenic Shock patients
- Detailed handoffs and providing all documentation from the field are essential to expedite continuity of care.

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Key Points (cont.)

Teamwork is the key to success!

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