Introduction to 12 Lead ECGs

McHenry Western Lake County
EMS System
Objectives

- Why 12 Lead ECGs?
- Critical Concepts in ACS
- Monitoring vs Diagnostic ECGs
- Acquisition & Transmission
Why 12 Lead ECGs?

- Demonstrated Advantages
  - Rapid identification of infarction/injury
    - diagnosis made sooner in many cases
  - Decreased time to reperfusion treatment
    - speeds preparation of & time to reperfusion therapies
  - Increased index of suspicion
  - Modification to therapies
Why 12 Lead ECGs?

- **Perceived Disadvantages**
  - Increased time spent on scene
    - demonstrated at 0-4 min increase
  - Cost
    - equipment & training
  - No clinical advantage to patient & “our transport times are short”
    - demonstrated decrease in time to treatment
    - compare to early notification for trauma patients
  - Not helpful in “our system”
    - STEMI is very useful protocol!
STEMI

- STEMI stands for:
  - ST elevated myocardial infarction
    - The object is to decrease the time of MI to reperfusion by identifying the MI, and getting the patient the reperfusion as fast as possible.
Why 12 Lead ECGs?

“The US National Heart Attack Alert Program recommends that EMS systems provide out-of-hospital 12-lead ECGs to facilitate early identification of AMI and that all advanced lifesaving vehicles be able to transmit a 12-lead ECG to the hospital”

Critical Concepts in ACS

- **Ischemia**
  - lack of oxygenation
  - ST segment depression or T wave inversion

- **Injury**
  - prolonged ischemia
  - ST segment elevation

- **Infarct**
  - prolonged injury results in death of tissue
  - may or may not show Q wave
Critical Concepts in ACS

- ST elevation - the key to the acute reperfusion therapy subset

- You can’t see ST elevation without a 12-lead ECG
  - Perform on *every* patient suspected of ACS
  - Obtain early
  - Repeat frequently
Critical Concepts in ACS

Will Infarct Occur?

- Tissue Death?
  - Collateral Circulation
  - Plaque Rupture
  - Thrombus Formation
  - Myocardial Oxygen Demand
  - Coronary Vasoconstriction
Critical Concepts in ACS

Chest pain or anginal equivalent suspicious of ischemia

Immediate assessment and initial general treatment

Assess initial ECG

ST elevation or new BBB

Prepare and evaluate for reperfusion therapy

Fibrinolytics or primary PTCA

ST depression or T inversion

Nondiagnostic - no ST-T deviation

Our Focus is Here!
Critical Concepts in ACS

Acute Reperfusion Therapies

- **Fibrinolytics**
  - Retaplace (rPA)
  - Actiplase (tPA)
  - Streptokinase (rarely used today)

- **Percutaneous Transluminal Coronary Angioplasty (PTCA)**
  - Balloon angioplasty
  - Stent placement
  - Atherectomy
Critical Concepts in ACS

- Pain is Injury
- Pain-Free is the Goal
- Time is Muscle
- Door to Reperfusion Therapy Time is the issue
Monitoring vs Diagnostic ECGs

- Extra wires
  - 3 wires vs 10 wires
- Are there other differences?
  - Discuss your departments situation with monitors
Monitoring vs Diagnostic ECGs

- Monitoring Quality ECG
  - Designed to provide information needed to determine rate and underlying rhythm
  - Designed to “filter out” artifact
    - Reduces the amount and degree of electrical activity seen by the ECG monitor
Monitoring vs Diagnostic ECGs

Monitor Quality

- **QRS Complex**
- **Skeletal Muscle**
- **60 Cycle**
- **Implanted Pacemaker**
- **ST Segment**
- **ECG Baseline**

Frequency Range: 0.05 Hz to 150 Hz
Monitoring vs Diagnostic ECGs

- Diagnostic Quality ECG
  - Designed to accurately reproduce QRS, ST and T waveforms
  - Designed to look more broadly at the cardiac electrical activity
  - Unfortunately, may result in greater artifact being visible
Monitoring vs Diagnostic ECGs

Diagnostic Quality
Monitoring vs Diagnostic ECGs

- Frequency Response
  - Term used to describe the breadth of the electrical spectrum viewed by the ECG monitor
  - Diagnostic quality is usually 0.05 Hz to 150 Hz
  - Monitor quality is usually 0.5 Hz to 20-50 Hz
  - Usually printed on the ECG recording strip
Monitoring vs Diagnostic ECGs
Monitoring vs Diagnostic ECGs
Acquisition & Transmission

- ECG quality begins with skin preparation and electrodes
  - Hair removal
  - Skin preparation
  - Age & Quality of Electrodes & Cables
  - Electrode Placement
Acquisition & Transmission

- Hair Removal
  - Clipper over razor
    - Lessens risk of cuts
    - Quicker
    - Disposable blade clippers available
  - Most EMS systems use razors
Acquisition & Transmission
Acquisition & Transmission

- Skin Preparation
  - Helps obtain a strong signal
  - When measured from skin, heart’s electrical signal about 0.0001 - 0.003 volts
  - Skin oils reduce adhesion of electrode and hinder penetration of electrode gel
  - Dead, dried skin cells do not conduct well
Acquisition & Transmission

Rubbing skin with a gauze pad can reduce skin oil and remove some of dead skin cells.
Acquisition & Transmission

- Other causes of artifact
  - Patient movement
  - Cable movement
  - Vehicle movement
  - Electromagnetic Interference (EMI)
Acquisition & Transmission

- Patient Movement
  - Make patient as comfortable as possible
    - Supine preferred (30 degree angle)
  - Look for subtle movement
    - toe tapping, shivering
  - Look for muscle tension
    - hand grasping rail, head raised to “watch” causes muscle tremors
Acquisition & Transmission

- Cable Movement
  - Enough “slack” in cables to avoid tugging on the electrodes
  - Many cables have clip that can attach to patient’s clothes or bed sheet
Acquisition & Transmission

Vehicle Movement

- Acquisition in a moving vehicle is NOT recommended
  - May or may not be successful

Tips

- Pull ambulance over for 10-20 seconds during acquisition
- Acquire ECG while stopped at traffic light
Acquisition & Transmission

- Electromagnetic Interference (EMI)
  - Can interfere with electronic equipment
  - 60 cycle interference is a type of EMI
  - Look for nearby cell phones, radios or electrical devices
  - No contact between cables & power cords
  - Turn off or move away from AC devices
  - Use shielded cables; inspect for cracks
Acquisition & Transmission

- Things to look for
  - Little or no artifact
  - Steady baseline
Bad Tracing
Acquisition & Transmission

ECG Accuracy depends upon
- Lead placement
- Frequency response
- Calibration
- Paper speed
Limb Lead Placement

Avoid placing on the trunk!!!

Traditional Placement

Acceptable Placement
Chest Lead Placement

- V1: fourth intercostal space to right of sternum
- V2: fourth intercostal space to left of sternum
- V3: directly between leads V2 and V4
- V4: fifth intercostal space at left midclavicular line
- V5: level with V4 at left anterior axillary line
- V6: level with V5 at left midaxillary line
Chest Lead Placement
ECG Accuracy

Look for:

- Negative aVR
  - if aVR upright, look for reversed leads
- One complete cardiac cycle in each lead
- Diagnostic frequency response
- Proper calibration
- Appropriate speed
ECG Accuracy

- Frequency Response
  - Display screen is non-diagnostic
  - Use the printed ECG for ST segment analysis
ECG Accuracy

- Calibration
  - Voltage measured vertically
  - Each 1 mm box = 0.1 mV
  - 1 mV = 10 mm
    - calibration standard
- Confirm calibration
  - calibration impulse should be 10 mm (2 big boxes tall)
  - stated calibration should be “x 1.0”
Calibration

Calibration

Calibration
ECG Accuracy

- **Paper Speed**
  - Standard is 25 mm/sec
    - Faster paper speed means the rhythm will appear slower and the QRS wider
    - Slower paper speed means the rhythm will appear faster and the QRS narrower
Paper Speed
When to Acquire

Note times and differences in these two ECGs for the same patient.
When to Acquire

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When to Acquire

**Assessment**
- Vital Signs
- Oxygen Saturation
- IV Access
- 12-Lead ECG
- Brief History

**Treatment**
- Oxygen
- Aspirin
- Nitroglycerin
- Fentanyl

Exposing the Chest

Immediately upon suspecting ACS...

- Remove all clothing above the waist
  - Or, open shirt/blouse
- Replace with gown (if possible)
  - Allows for complete exam
  - Minimizes wire entanglement
  - Enhances quick defib if VF occurs
Transmission

- Transmit information as soon as possible
  - Can use patient’s land-line
  - Many EMS systems use cell phone enroute

- Coordinate with ED
  - Correlate ECG with a specific patient
  - Early notification of AMI is key!!!
  - Remember STEMI !!!
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