American College of Cardiology
20th Congress 2017

Observation Medicine ECG
Instructor Workshop, Version 1
Part 1

Principles and Practices of Continuous ST-Segment Monitoring

By: Wayne W Ruppert, CVT, CCCC, NREMT-P
Observation Medicine ECG Course

BASIS:

• Current ACC/AHA Guidelines and Recommendations
• Multiple additional recent Evidence-Based Publications
• ECGs from case files of the author, Wayne Ruppert
• Graphic art / images from published textbooks authored by Wayne Ruppert
• Acute Coronary Syndrome
• Acute Coronary Syndrome
• Atrial Fibrillation
• Heart Failure
• QT syndrome abnormalities
• Wayne Ruppert, Cardiovascular Coordinator
  Bayfront Health Dade City, Dade City, Florida
  Community Health Systems
Wayne Ruppert bio:

- Cardiovascular Coordinator 2012-present (coordinated 4 successful accreditations)
- Interventional Cardiovascular / Electrophysiology Technologist, 1995-Present.
- Author of: “12 Lead ECG Interpretation in Acute Coronary Syndrome with Case Studies from the Cardiac Cath Lab,” 2010, TriGen publishing / Ingram Books
- Author of: “STEMI Assistant,” 2014, TriGen publishing / Ingram Books
- Florida Nursing CE Provider # 50-12998
- 12 Lead ECG Instructor, 1994-present (multiple hospitals, USF College of Medicine 1994)
- Website: www.ECGtraining.org
To download this course, go to www.ECGtraining.org, select “Downloads PDF” then select download(s) desired:

- Download Sudden Cardiac Death Prevention - ACC / SCPC 19th Congress
- Download Initial Stabilization of the Atrial Fib Patient - SCPC 19th Congress
- Download QTc Monitoring Policy for Patients on QT Prolonging Meds
- Download A-Fib / Flutter ER Physician’s Order Set - BHDC
- Download A-Fib / Flutter Flowchart Emerg Care BHDC
- Download Team Driven Performance Improvement - SCPC 19th Congress
- Download TDPI in Ambulance Industry Journal
- Download TJC Sentinel Event Alert - Disruptive Physicians
- Download ACLS 2015 Algorithm Cheat Sheets
- Download 2015 ACLS Algorithms with ECG examples
- Download Neighbors Saving Neighbors Program
- Download Basic ECG Course with 2015 ACLS Algorithms
- Download STEMI Assistant
- Download ECG ID of SADS CONDITIONS
- Download ECG Review of Hypertrophy
- Download 14 Point AHA Screening Form for Genetic and Congenital Heart Conditions
- Download Preoperative ECG Evaluation 2016
- Download Perioperative Considerations for Patients with CIEDs
- Download 12 Lead ECG in ACS Handout
- Download LQTS in Anesthesia
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All cardiovascular subject-related images, graphics and diagrams were created by the author, Wayne Ruppert, and have been taken from his two published textbooks, “STEMI Assistant” and “12 Lead ECG Interpretation in ACS with Case Studies from the Cardiac Cath Lab,” are Copyright protected, and may not be removed from this PowerPoint presentation. This presentation may not be used as part of a profit-generating program without prior written consent from the author.

Wayneruppert@aol.com
Suggested **Prerequisite Knowledge:**

Basic ECG Rhythm Interpretation Skills.

*This course does not teach how to interpret basic ECG rhythms.* Although it is not necessary to know Basic ECG Rhythms to understand the material in this course, it is strongly suggested that this course be used as “the next level” of education for health care providers who are already proficient in basic single-lead ECG rhythm strip interpretation.
Objectives (Part 1):

• Review The Joint Commission (TJC) National Patient Safety Goal #6: “Clinical Alarms”
• Review ACC/AHA ECG Monitoring Guidelines for Hospitals
• Learn correlation of ECG leads with specific coronary anatomy
• Learn the ECG Markers of ACS
• Learn which leads to select for “Continuous ST-Segment Monitoring”
Reference Sources:

- TJC National Patient Safety Goals 2013-2017
- American Journal of Critical Care

See last section of this handout for downloads of all reference source materials.
The Joint Commission (TJC) National Patient Safety Goals (NPSG)

- 2013 TJC Sentinel Event identified “Alarm Fatigue” as a cause of mortality and established the need for Clinical Alarms Management.
- 2014 added “Clinical Alarms Management” to its list of NPSGs.
- 2017 NPSG requires hospitals to have developed and implemented policies and procedures for clinical alarms management.
The Joint Commission (TJC) National Patient Safety Goals (NPSG)

- Hospital units with continuous automated ST Segment monitoring capabilities should establish and follow a policy and procedure for monitoring ST segment changes in patients suspected of ACS, or who have the potential to develop ACS.
ST Segment monitor alarm setting:

• Example for patients with suspected ACS:
  – Set baseline ST segment measurement to patient’s admission ECG (J point + 60ms)
  – Set to alarm if there is a deviation (elevation or depression) of 0.10mv (1mm) from baseline ECG (J point + 60ms)
Critical Baseline Settings:

- **Heart Rate** (upper / lower)
  - Keeps you informed of patient condition changes
  - Aids you in medication rate management (IV infusions, e.g.: Cardizem)
- **ST-Segment** (ACS)
- **QT Interval** (all patients, patients receiving QT prolonging medications)
If the ST-Segment alarm activates, what should you do ??
If the ST-Segment alarm activates, what should you do??

• Go assess the patient!
  – Are there any symptoms now present?
  – Changes in prior symptoms?

• Get a STAT 12 Lead ECG! . . . And
If the ST-Segment alarm activates, what should you do??

• Go assess the patient!
  – Are there any symptoms now present?
  – Changes in prior symptoms?

• Get a STAT 12 Lead ECG! . . . And

• Compare it to the last ECG(s)!
Clinical Alarm Management Resources

- American Journal of Critical Care – Monitoring Clinical Alarms.

- To download a sample CLINICAL ALARMS MONITORING POLICY and a CLINICAL ALARMS PARAMETERS example, CLICK HERE. This will take you to my “PDF Downloads” page on my website.
Continuous ST-Segment Monitoring

“The practice of continuously monitoring of the ST-Segment of ECG Lead(s) viewing the region of the myocardium where potential or actual ischemia exists.”
Objectives of Continuous ST-Segment Monitoring:

• Detection of SILENT ISCHEMIA.
Objectives of Continuous ST-Segment Monitoring:

• Detection of SILENT ISCHEMIA.
• Detection of developing / worsening ischemia, early detection of infarction / STEMI
Hold on there!
Does this mean we’re no longer just monitoring every patient in limb lead II ???
What’s wrong with TRADITIONAL ECG Monitoring using Lead II ? ?
Lead II: sees good P waves

VS.
Lead II: sees good P waves

vs.

The ECG Lead viewing region of suspected myocardial ischemia: detection of worsening ischemia and early infarction.
What’s the rationale behind monitoring the ECG lead viewing the region of known/suspected ischemia?
The “common sense” rationale:

If your friend says, “pick me up in front of my house in 15 minutes.”
You wouldn’t drive around to the back of the house and watch for your friend at the back door.
If you were only monitoring Lead II on this patient with *suspected* Anterior Wall ischemia . . . . .
YOU WOULD MISS THIS:

AND you may have noted the subtle ECG changes LONG BEFORE the patient’s MI evolved into this massive ANTERIOR LATERAL STEMI.

Notice the ECG COMPUTER missed this OBVIOUS massive STEMI!
ST Segments often elevate *within seconds* of acute obstruction

S-T segments can elevate within seconds of coronary artery occlusion:

We don't want to miss this!!

This patient – in Cath Lab, ST segments immediately elevated in response to inflation of PTCA balloon in RCA
Continuous ST-Segment Monitoring;

Scientific Support:

• 1999 – JACC paper establishes Continuous 12 Lead ECG ST Segment Monitoring is beneficial for ACS / suspected ACS patients
Between 60-70% of episodes of transient myocardial ischemia are unreported by patients. (Drew et. Al, Am J Crit Care)

• Prevalence of transient myocardial ischemia in:
  – Telemetry Units: 15%
  – Coronary Care Units: 19%
Continuous ST-Segment Monitoring;

**Scientific Support:**

- AJCC: National Survey of Cardiologists’ Standard of Practice for Continuous ST-Segment Monitoring

- Critical Care Nurse J 2009: vol 29: Continuous ST-Segment Monitoring: Protocol for Practice
What’s the benefit of continuous ST-Segment Monitoring?
What’s the benefit of continuous ST-Segment Monitoring?

• IT ALLOWS YOU TO CONTINUOUSLY EVALUATE THE REGION OF THE HEART WITH SUSPECTED or KNOWN ISCHEMIA.
What’s the benefit of continuous ST-Segment Monitoring?

• IT ALLOWS YOU TO CONTINUOUSLY EVALUATE THE REGION OF THE HEART WITH SUSPECTED or KNOWN ISCHEMIA.”

• IF THE ISCHEMIA WORSENS – or STEMI DEVELOPS – you may detect it on the ECG BEFORE the patient complains of any symptoms
“Silent Ischemia”

• First described in the 1970s
“Silent Ischemia”

- First described in the 1970s
- Patients may be asymptomatic during episodes of ischemia.
“Silent Ischemia”

- First described in the 1970s
- Patients may be asymptomatic during episodes of ischemia.
- ECG changes may be visible before the patient experiences symptoms.
“Silent Ischemia”

- First described in the 1970s
- Patients may be asymptomatic during episodes of ischemia.
- ECG changes may be visible before the patient experiences symptoms.
- Patients who are diabetic, female, over age 65, past history of CVA or heart failure frequently do not have chest pain with ischemia (Canto et al).
Detecting ACS on the ECG – what are we looking for?
Detecting ACS on the ECG – what are we looking for?

Changes in the ECG markers of Acute Coronary Syndrome
The ECG markers of Acute Coronary Syndrome = abnormal changes to:

- J Points
- ST-Segments
- T Waves
Detecting ACS on the ECG:
Before we can determine what is “ABNORMAL,” we must first define what is NORMAL.
Defining NORMAL:
Note: The criteria presented here for evaluating the markers of ACS is for patients with narrow QRS complexes (QRSd <120ms).

Criteria for evaluating the markers of ACS for patients with WIDE QRS complexes (QRS duration 120ms or more) is covered in the Session 3.
When QRS duration is NORMAL (< 120 ms):

**NORMAL ST - T WAVES**

- WHEN QRS WIDTH IS NORMAL (< 120 ms)

ASSESS:

- J POINT: ISOELECTRIC (or < 1 mm dev.)
- ST SEG: SLIGHT, POSITIVE INCLINATION
- T WAVE: UPRIGHT, POSITIVE

*in EVERY LEAD EXCEPT aVR!*
THE J POINT SHOULD BE...

WITHIN 1 mm ABOVE OR BELOW the ISOELECTRIC LINE
...the “flat line” between ECG complexes, when there is no detectable electrical activity...
The Isoelectric Line - *it’s not always isoelectric!*

**THE ISOELECTRIC LINE**

EKG from 13 y/o girl in ACCELERATED JUNCTIONAL RHYTHM. note: upsloping T-P interval, and P buried in T waves.
... is the POINT where the P-R SEGMENT ends and the QRS COMPLEX BEGINS.

THE S-T SEGMENT

SHOULD HAVE
A "SLIGHT POSITIVE"
INCLINATION
THE S-T SEGMENT

SHOULD BE "CONCAVE" IN SHAPE . . .
THE S-T SEGMENT

AS OPPOSED TO "CONVEX" IN SHAPE

SHOULD BE "CONCAVE" IN SHAPE...
THE T WAVE

AMPLITUDE GUIDELINES:

- IN THE LIMB LEADS, SHOULD BE LESS THAN 1.0 mv (10 mm)
- IN THE PRECORDIAL LEADS, SHOULD BE LESS THAN 0.5 mv (5 mm)
- SHOULD NOT BE TALLER THAN R WAVE IN 2 OR MORE LEADS.
Patients with normal QRS duration (QRS < 120 ms):

ECG MARKERS of NORMAL PERFUSION

J POINT ISOELECTRIC
ST SEGMENT: "MILD POSITIVE INCLINATION"
T WAVE: SAME POLARITY AS QRS
QUESTION:
If we just defined *NORMAL*, what is *ABNORMAL* ? ?
ANSWER:

EVERYTHING ELSE.
If it isn’t NORMAL is ABNORMAL !!
Simply stated, if the

- J Points
- ST-Segments
- T Waves

are NOT NORMAL,
they are ABNORMAL. . . .
And whenever the
- J Points
- ST-Segments
- T Waves
are **ABNORMAL**, it can be an **INDICATION** of **ACUTE CORONARY SYNDROME**!
13 ECG PATTERNS of ACS & ISCHEMIA

-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

<table>
<thead>
<tr>
<th>S-T SEGMENT ELEVATION at J POINT</th>
<th>ACUTE MI</th>
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<tbody>
<tr>
<td></td>
<td>ACUTE PERICARDITIS / MYOCARDITIS</td>
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<tr>
<td></td>
<td>EARLY REPOLARIZATION</td>
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</tbody>
</table>

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<tr>
<th>FLAT or CONVEX J-T APEX SEGMENT</th>
<th>ACUTE MI</th>
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<tbody>
<tr>
<td></td>
<td>ISCHEMIA</td>
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</tbody>
</table>

| HYPER-ACUTE T WAVE              | HYPERKALEMIA |
|                                 | TRANSMURAL ISCHEMIA |
|                                 | ACUTE MI |
|                                 | HYPERTROPHY |

<table>
<thead>
<tr>
<th>DEPRESSED J pt. DOWNSLOPING ST and INVERTED T</th>
<th>ACUTE (NON-Q WAVE) MI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACUTE MI</td>
</tr>
<tr>
<td></td>
<td>(RECIPROCAL CHANGES)</td>
</tr>
<tr>
<td></td>
<td>ISCHEMIA</td>
</tr>
<tr>
<td>Condition</td>
<td>ECG Findings</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Inverted T wave</td>
<td>[Graph of inverted T wave]</td>
</tr>
<tr>
<td>Sharp S-T T angle</td>
<td>[Graph of sharp S-T T angle]</td>
</tr>
<tr>
<td>Bi-Phasic T wave (Wellen's)</td>
<td>[Graph of bi-Phasic T wave]</td>
</tr>
<tr>
<td>Depressed J Point with Upsloping ST</td>
<td>[Graph of depressed J point with upsloping ST]</td>
</tr>
<tr>
<td>Downsloping S-T Segment</td>
<td>[Graph of downsloping S-T segment]</td>
</tr>
</tbody>
</table>
Some less common, less reliable possible indicators of ACS:

- Flat S-T segment > 120 ms
- Low voltage T wave with normal QRS
- U wave polarity opposite that of T wave
A CRITICAL INDICATOR of worsening ischemia and/or EARLY INFARCTION is DYNAMIC CHANGES to the patient’s J Points, ST-Segments and T Waves.
Dynamic ST-T wave changes . . .
Potential Issues?

1. Progressive Inferior ischemia
2. NSTEMI
3. Reciprocal ST Changes from Anterior STEMI
What should you do ??

• STAT patient evaluation !
  – Are there any symptoms now present?
  – Changes in prior symptoms?

• Get a STAT 12 Lead ECG !
What should you do??

• STAT patient evaluation!
  – Are there any symptoms now present?
  – Changes in prior symptoms?

• Get a STAT 12 Lead ECG!

• And compare it to previous 12 Lead ECG(s)!!
Indications for Continuous ST-Segment Monitoring:

- Patients with known or suspected ACS / ischemia
Indications for Continuous ST-Segment Monitoring:

- Patients with known or suspected ACS / ischemia
- Patients who have just undergone Percutaneous Coronary Intervention (PCI)
Indications for Continuous ST-Segment Monitoring:

- Patients with known or suspected ACS / ischemia
- Patients who have just undergone Percutaneous Coronary Intervention (PCI)
  - IN STENT THROMBUS
  - CORONARY ARTERY DISSECTION ("Edge Dissection")
Determining the appropriate ECG Lead(s) for Continuous ST-Segment Monitoring:

• Obtain and interpret the 12 Lead ECG:
Locations of Positive Electrodes

STANDARD LEAD PLACEMENT ---
12 LEAD ECG

- V4 is at 5th INTERCOSTAL SPACE. V5 & V6 are on the SAME HORIZONTAL PLANE.
- PATIENT SHOULD LAY AS FLAT AS POSSIBLE
- LIMB LEADS SHOULD BE PLACED AS DISTALLY AS POSSIBLE
Wherever it’s positioned on the body, that’s the perspective of the heart it’s seeing . . . .
Which Lead(s) on the 12 Lead ECG shows the most profound ABNORMAL:
- J Points
- ST-Segments
- T Waves
???
V1 - V4 View the Anterior-Septal Wall of the Left Ventricle

V1, V2 - Anterior / Septal
V3, V4 - Anterior
LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE

FED by the RCA (75 - 80 % pop) or the CIRCUMFLEX (10 - 15 %)
V5 - V6 VIEW THE LATERAL WALL of the LEFT VENTRICLE
AREAS VIEWED by 12 LEAD ECG

- AVR: BASILAR SEPTAL
- AVL, I: LATERAL ANTERIOR
- V1, V2: ANTERIOR
- V3, V4: SEPTAL
- V5, V6: POSTERIOR (recip.)
- II, III, AVF: INFERIOR
<table>
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<tr>
<th>Area Viewed by 12 Lead ECG</th>
<th>Typical Arterial Distribution</th>
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<tbody>
<tr>
<td>AVR Basilar Septal</td>
<td>1st Septal Perforator</td>
</tr>
<tr>
<td>AVL, I Lateral Anterior</td>
<td>1st Diagonal or Ramus or</td>
</tr>
<tr>
<td></td>
<td>1st Obtuse Marginal</td>
</tr>
<tr>
<td>V1, V2 Anterior</td>
<td>Left Anterior Descending</td>
</tr>
<tr>
<td></td>
<td>Left Anterior Descending</td>
</tr>
<tr>
<td>V3, V4 Septal</td>
<td>Posterior Lateral Vessels</td>
</tr>
<tr>
<td></td>
<td>Posterior Lateral Vessels</td>
</tr>
<tr>
<td>V5, V6 Lateral</td>
<td>CIRCUMFLEX</td>
</tr>
<tr>
<td>II, III, AVF Inferior</td>
<td>Right Coronary Artery or</td>
</tr>
<tr>
<td></td>
<td>CIRCUMFLEX</td>
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</table>
Continuous ST monitoring

- Ideal condition: your unit has the capability for continuous monitoring of all 12 leads.
Continuous ST monitoring

• Ideal condition: your unit has the capability for continuous monitoring of all 12 leads.

• If your unit does not have continuous 12 lead monitoring capabilities, monitor the lead that demonstrates the highest degree of ischemic changes.
Units WITH continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
Units **WITH** continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
- Continuously monitor all 12 Leads for signs of progressing ischemia / early infarction.
Units **WITHOUT** continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
Units WITHOUT continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
- Identify ECG lead(s) showing most profound J Point, ST-Segment and T Wave abnormalities.
Units **WITHOUT** continuous 12 Lead monitoring capabilities:

- Obtain baseline ECG
- Identify ECG lead(s) showing most profound J Point, ST-Segment and T Wave abnormalities.
- Select the leads identified in the above step as the lead(s) for continuous monitoring.
Automated ST-Segment Monitoring Systems – MEASUREMENT:

Vary based on manufacturer. Multiple recent evidence-based papers recommend:

• **J Point + 60ms** (1.5mm on ECG recorded at standard 25mm/sec speed).
J point + 60ms detects ST-segment shift when J Point remains isoelectric.
Automated ST-Segment Monitoring Systems – MEASUREMENT:

Vary based on manufacturer. Multiple recent evidence-based papers recommend:

• J Point + 60ms (1.5mm on ECG recorded at standard 25mm/sec speed).

• More accurate method, compensates for heart rate variation: J Point + 1/16 R-R Interval
Automated ST-Segment Monitoring Systems – MEASUREMENT:

Vary based on manufacturer. Multiple recent evidence-based papers recommend:

• **J Point + 60ms** (1.5mm on ECG recorded at standard 25mm/sec speed).

• More accurate method, compensates for heart rate variation: **J Point + 1/16 R-R Interval**

• Set to alarm 1 mm (0.1mv) above patient’s baseline ST-segment measurement.
5 Lead Tele System

• White lead – Right Shoulder
• Black lead – Left Shoulder
• Red lead – Left Lower Chest / Abdomen
• Green lead – Right Lower Chest / Abdomen
• Brown (chest) lead: V3 or V5 position (to be determined by 12 Lead ECG findings).
LEAD PLACEMENT

5 WIRE TELEMETRY UNIT
Let’s Practice . . . .
What leads show signs of possible ACS?
12 Lead ECG shows ISCHEMIC CHANGES Anterior Wall:
V1 - V4 VIEW THE ANTERIOR-SEPTAL WALL of the LEFT VENTRICLE

V1, V2 - ANTERIOR / SEPTAL
V3, V4 - ANTERIOR

RUPPERT, WAYNE  ID: 7445683659  05-OCT-2006  JOHNS-HOPKINS UNIV.
38 Yrs MALE  Vent. Rate: 68
P-R Int.: 160 ms  Normal Sinus Rhythm
QRS: 100 ms  Normal EKG
Very Healthy Athletic EKG!

<table>
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<tr>
<th></th>
<th>I</th>
<th>AVR</th>
<th>V1</th>
<th>V4</th>
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<tr>
<td></td>
<td>II</td>
<td>AVL</td>
<td>V2</td>
<td>V5</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>AVF</td>
<td>V3</td>
<td>V6</td>
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Left Anterior Descending Artery (LAD) provides ANTERIOR WALL blood supply.
POST – PCI of the LAD or DIAGONAL BRANCHES:

Monitor Lead V3 for ST changes resulting from compromised blood flow due to:

- Acute STENT Thrombus
- STENT induced CORONARY ARTERY DISSECTION.
Anterior Wall Ischemia / Post-PCI of Left Anterior Descending or Diagonal Artery:

Monitor chest lead with most profound ST changes.

If there is no single lead with clearly the most degree of ST changes, **monitor lead V3**.

- 12 LEAD ECG INDICATES: **ANTERIOR WALL ISCHEMIA / INFARCTION**

- PCI / STENT TO **LEFT ANTERIOR DESCENDING ARTERY (LAD)**
LEAD PLACEMENT

5 WIRE TELEMETRY UNIT
What leads show signs of possible ACS?
12 Lead ECG shows ISCHEMIC CHANGES Inferior Wall:
LEADS II, III, and aVF VIEW
INFERIOR WALL of the LEFT VENTRICLE

FED by the RCA (75 - 80 % pop) or the CIRCUMFLEX (10 - 15 %)
RIGHT DOMINANT

LV

RV

SA NODE
AV NODE
RCA

CX

75 - 80% POPULATION

POSTERIOR VIEW
LEFT DOMINANT

15 - 20 % POPULATION

POSTERIOR VIEW
In THIS case . . . .
PTCA to the RCA
PTCA to the RCA x2!
POST – PCI of the RCA or DOMINANT Circumflex Artery:

Monitor Lead III for ST changes resulting from compromised blood flow due to:

• Acute STENT Thrombus
• STENT induced CORONARY ARTERY DISSECTION.
Inferior Wall Ischemia / Post-PCI of Right Coronary Artery:

Monitor Inferior Lead (II, III or AVF) with most pronounced ST abnormalities.

If there is no single lead with clearly the most degree of ST changes, MONITOR LEAD III.

-12 lead ECG indicates "INFERIOR WALL ISCHEMIA / INFARCTION"

-PATIENT HAD BALLOON / STENT WORK TO RIGHT CORONARY ARTERY (RCA) or Dominant Circumflex Artery
LEAD PLACEMENT

5 WIRE TELEMETRY UNIT
What leads show signs of possible ACS?
12 Lead ECG shows ISCHEMIC CHANGES Lateral Wall:
V5 - V6 VIEW THE LATERAL WALL of the LEFT VENTRICLE

RV

LV

ANTERIOR CHEST WALL

SPINE

V5 V6

V1 V2 V3 V4

RUPPERT, WAYNE
ID: 7445683659
05-OC-2006
JOHNS-HOPKINS UNIV.

38 Yrs MALE

Vent. Rate: 68
P-R Int.: 160 ms
QRS: 100 ms
NORMAL SINUS RHYTHM
Normal EKG
Very Healthy Athletic EKG!

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<td>V3</td>
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<td>V3</td>
<td>V4</td>
<td>V5</td>
<td>V6</td>
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I
II
III
The Circumflex (CX) Artery provides Lateral Wall blood supply.
POST – PCI of the (non-dominant) Circumflex Artery:

Monitor V5 for ST changes resulting from compromised blood flow due to:

• Acute STENT Thrombus
• STENT induced CORONARY ARTERY DISSECTION.
Lateral Wall Ischemia / Post-PCI of Circumflex Artery:

Monitor chest lead with most profound ST changes.

If there is no single lead with clearly the most degree of ST changes, **MONITOR LEAD V5**

-12 LEAD ECG INDICATES: LATERAL WALL ISCHEMIA / INFARCTION

- PCI / STENT TO CIRCUMFLEX ARTERY (Cx)
LEAD PLACEMENT

5 WIRE TELEMETRY UNIT

Monitor Lead V5
Patients with suspected ACS (LRCP) or NSTEMI with normal 12 Lead ECGs:
Patients with suspected ACS (LRCP) or NSTEMI with normal 12 Lead ECGs:

**ECG normal:** monitor Lead III and V3

MONITOR LEADS III and V3
Patients with suspected ACS (LRCP) or NSTEMI with NORMAL 12 Lead ECGs:

Why Lead III and V3 are good choices:

• Lead III should indicate ischemia / early infarction of INFERIOR wall (blocked RCA)
• Lead V3 should indicate ischemia / early infarction of either ANTERIOR and/or LATERAL region(s) (blocked LAD/Cx)
ECG Lead Placement - patients with LRCP, UA or NSTEMI – with NORMAL ECGs:

• Monitor Leads III and V3
Indications of ACS:

- Changes to J Point
- Changes to ST-Segment
- Changes to T wave
Post-workshop Questions:

1. What are the BEST ECG leads to use for continuous monitoring of a patient with suspected Acute Coronary Syndrome (ACS)?
   a. Lead II – it shows good P Waves
   b. Lead MCL1 (V1) – shows good P waves and R vs. L bundle branch blocks and R vs. L ventricular ectopy
   c. Depends- use the lead that views the region of the myocardium with suspected ischemia.
   d. Same as above (c.) but add: “obtain baseline 12 Lead ECG – use whatever lead shows the most profound ST – T wave (ischemic) abnormalities.”
Post-workshop Questions:

1. What are the BEST ECG leads to use for continuous monitoring of a patient with suspected Acute Coronary Syndrome (ACS)?

a. Lead II – it shows good P Waves

b. Lead MCL1 (V1) – shows good P waves and R vs. L bundle branch blocks and R vs. L ventricular ectopy

c. Depends - use the lead that views the region of the myocardium with suspected ischemia.

d. Same as above (c.) but add: “obtain baseline 12 Lead ECG – use whatever lead shows the most profound ST – T wave (ischemic) abnormalities.”
2. Important objective(s) of continuous ECG monitoring in patients with SUSPECTED ACS is (are):
   a. monitor for dynamic J point, ST segment and T wave changes.
   b. Determine left vs. right ventricular ectopy
   c. Monitor ventricular heart rate for dangerous bradycardias and tachycardias
   d. Both a and c
Post-workshop Questions:

2. Important objective(s) of continuous ECG monitoring in patients with SUSPECTED ACS is (are):

a. Monitor for dynamic J point, ST segment and T wave changes.

b. Determine left vs. right ventricular ectopy

c. Monitor ventricular heart rate for dangerous bradycardias and tachycardias

d. Both a and c
Post-workshop Questions:

3. Which patient described below potentially warrants a STAT call to *Interventional Cardiology*? Both patients are hemodynamically stable.

a. 68 y/o male, ECG changes from normal sinus rhythm (NSR) to accelerated junctional rhythm, rate 56. Patient is asymptomatic.

b. 44 y/o female, asleep, NSR, rate 70, T waves increase approx. 7mm in amplitude, J point raises 1mm.
Post-workshop Questions:

3. Which patient described below potentially warrants a STAT call to *Interventional Cardiology*? Both patients are hemodynamically stable.

a. 68 y/o male, ECG changes from normal sinus rhythm (NSR) to accelerated junctional rhythm, rate 56. Patient is asymptomatic.

b. 44 y/o female, asleep, NSR, rate 70, T waves increase approx. 7mm in amplitude, J point raises 1mm.
4. A low risk chest pain (LRCP) patient is being held in observation. His 12 Lead ECG does not show any abnormalities. Which statement is true?

a. If your Obs. Unit does not have continuous 12 Lead ECG monitoring capabilities, monitor Leads III and Chest Lead 3 (V3) for J Point, S-T and T wave changes.

b. If his 12 Lead ECG is normal, he cannot be suffering from ACS.
Post-workshop Questions:

4. A low risk chest pain (LRCP) patient is being held in observation. His 12 Lead ECG does not show any abnormalities. Which statement is true?

a. If your Obs. Unit does not have continuous 12 Lead ECG monitoring capabilities, monitor Leads III and Chest Lead 3 (V3) for J Point, S-T and T wave changes.

b. If his 12 Lead ECG is normal, he cannot be suffering from ACS.
NEXT SLIDES: Hyperlinks to the evidence-based publications that were used to develop this curriculum:
AHA Scientific Statement

Practice Standards for Electrocardiographic Monitoring in Hospital Settings

An American Heart Association Scientific Statement From the Councils on Cardiovascular Nursing, Clinical Cardiology, and Cardiovascular Disease in the Young

Endorsed by the International Society of Computerized Electrocardiology and the American Association of Critical-Care Nurses

Barbara J. Drew, RN, PhD, Chair; Robert M. Califf, MD; Marjorie Funk, RN, PhD; Elizabeth S. Kaufman, MD; Mitchell W. Krucoff, MD; Michael M. Laks, MD; Peter W. Macfarlane, DSc, FRCP; Claire Sommargren, RN, PhD; Steven Swiryn, MD; George F. Van Hare, MD

Abstract—The goals of electrocardiographic (ECG) monitoring in hospital settings have expanded from simple heart rate and basic rhythm determination to the diagnosis of complex arrhythmias, myocardial ischemia, and prolonged QT interval. Whereas computerized arrhythmia analysis is automatic in cardiac monitoring systems, computerized ST-segment ischemia analysis is available only in newer-generation monitors, and computerized QT-interval monitoring is currently unavailable. Even in hospitals with ST-monitoring capability, ischemia monitoring is vastly underutilized.
AHA/ACC/HRS Scientific Statement

Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part I: The Electrocardiogram and Its Technology

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Paul Kligfield, MD, FAHA, FACC; Leonard S. Gettes, MD, FAHA, FACC; James J. Bailey, MD; Rory Childers, MD; Barbara J. Deal, MD, FACC; E. William Hancock, MD, FACC; Gerard van Herpen, MD, PhD; Jan A. Kors, PhD; Peter Macfarlane, DSc; David M. Mirvis, MD, FAHA; Olle Pahlm, MD, PhD; Pentti Rautaharju, MD, PhD; Galen S. Wagner, MD
AHA/ACC/HRS SCIENTIFIC STATEMENT

Recommendations for the standardization and interpretation of the electrocardiogram

Part II: Electrocardiography diagnostic statement list

A Scientific Statement from the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Jay W. Mason, MD, FAHA, FACC, FHRS; E. William Hancock, MD, FACC; Leonard S. Gettes, MD, FAHA, FACC

Abstract— This statement provides a concise list of diagnostic terms for ECG interpretation that can be shared by students, teachers, and readers of electrocardiography. This effort was motivated by the existence of multiple automated diagnostic code sets containing imprecise and overlapping terms. An intended outcome of this statement list is greater uniformity of ECG diagnosis and a resultant improvement in patient care. The lexicon includes primary diagnostic statements, secondary diagnostic statements, modifiers, and statements for the comparison of ECGs. This diagnostic lexicon should be reviewed and updated periodically.

KEYWORDS AHA Scientific Statements; electrocardiography; computers; diagnosis

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AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part III: Intraventricular Conduction Disturbances: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society: Endorsed by the International Society for Computerized Electrocardiology

Borys Surawicz, Rory Childers, Barbara J. Deal, Leonard S. Gettes
AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part IV: The ST Segment, T and U Waves, and the QT Interval: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society. Endorsed by the International Society for Computerized Electrocardiology

Pentti M. Rautaharju, Borys Surawicz, Leonard S. Gettes

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Originally published March 16, 2009
AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part V: Electrocardiogram Changes Associated With Cardiac Chamber Hypertrophy: A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society: Endorsed by the International Society for Computerized Electrocardiology

E. William Hancock, Barbara J. Deal, David M. Mirvis, Peter Okin, Paul Kligfield, Leonard S. Gettes

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AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram

Part VI: Acute Ischemia/Infarction

A Scientific Statement From the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society

Endorsed by the International Society for Computerized Electrocardiology

Galen S. Wagner, MD; Peter Macfarlane, DSc; Hein Wellens, MD, FAHA, FACC; Mark Josephson, MD, FACC, FHRS; Anton Gorgels, MD; David M. Mirvis, MD; Olle Pahlm, MD, PhD; Borys Surawicz, MD, FAHA, FACC; Paul Kligfield, MD, FAHA, FACC; Rory Childers, MD; Leonard S. Gettes, MD, FAHA, FACC
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