Right-Sided and Posterior Electrocardiograms (ECGs)

Clinical Significance Prompt identification of ST-elevation myocardial infarction (STEMI) is critical to guide reperfusion therapies that are time-sensitive. Right-Sided and posterior ECGs may be useful in identifying STEMI of the right ventricle and/or posterior wall.

Populations Applies to the adult and geriatric population. There is insufficient evidence to recommend this in the pediatric population.

Translation Into Practice: TIPs for Right-Sided ECGs

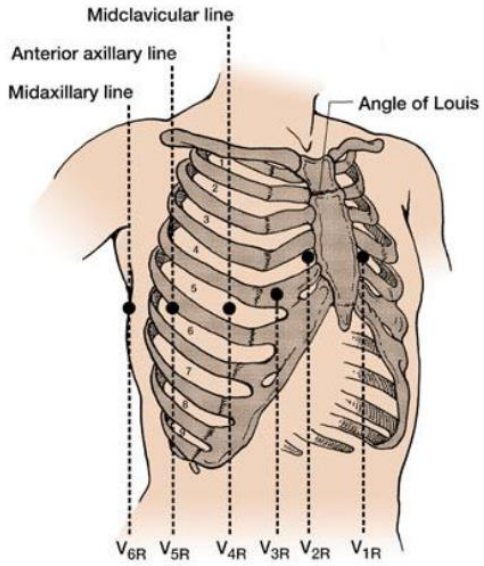
Right-Sided ECG

Recommended Clinical Practice

To detect right ventricular STEMI associated with occlusion of the right coronary artery, obtain a right-sided ECG. [1-3] **[Level A Recommendation]**

When a 15-lead &/or 18-lead ECG machine is not available, manipulation of the leads from a standard 12-lead ECG machine allow additional areas of the heart to be imaged.[4-5]

- Indications of a RV wall infarction may include:[4-7]
  - ST elevation in the inferior leads, II, III, and aVF[4-6]
    - ST elevation that is greatest in lead III is especially significant[5,8-9]
  - ST elevation in V_1 (considered to be the only precordial lead that faces the RV on the standard 12-lead ECG)[4-6,8]
  - Other findings may include: right bundle branch block, second- and third- degree atrioventricular blocks, ST segment elevation in lead V_2 50% greater than the magnitude of ST segment depression in lead aVF[5,8]
  - Hypotension and clear lung fields[6,10]
- Place ECG electrodes (stickers) as follows[4] (Figure 1):



Right-sided ECG Electrode Placement

V_1R: 4th intercostal space, left sternal border

V_2R: 4th intercostal space, right sternal border

V_3R: halfway between V2R and V4R, on a diagonal line

V_4R: 5th intercostal space, right midclavicular line

V_5R: right anterior axillary line, same horizontal line as V4R and V6R

V_6R: right mid-axillary line, same horizontal line as V5R and V6R

Arm and leg electrodes remain unchanged from standard 12-lead ECG

Figure 1 used with permission from Barbara J. Drew, RN, PhD, FAAN, FAHA [Drew, B. J., & Ide, B. (1995). Right ventricular infarction. *Progress in Cardiovascular Nursing, 10*, 46.]

- Place ECG lead cables as follows (using a 12-lead machine):
  - A right-sided ECG is a "mirror reflection" of the standard left sided 12-lead ECG. Begin with lead cable V_1 and attach it to electrode V_1R, continue connecting lead cables to electrodes in sequence until lead cable V_6 is connected to electrode V_6R
  - Arm and leg electrodes and lead cables remain unchanged from the standard 12-lead ECG placement

Right-Sided and Posterior Electrocardiograms (ECGs)

TIP: Right-Sided ECGs – continued

Right-Sided ECG

- Label the Right-sided ECG[4] (Figure 2):
  - Note "Right-sided ECG" in the machine, if able
  - Handwrite "Right-sided ECG" on the 12-lead ECG printout if not already part of the electronic printout
  - Re-label $V_1 – V_6$ on the printout to $V_1R – V_6R$
- Presence of a right ventricular wall infarction is seen when there is ST elevation greater than 1 mm in V_4R [5,11]

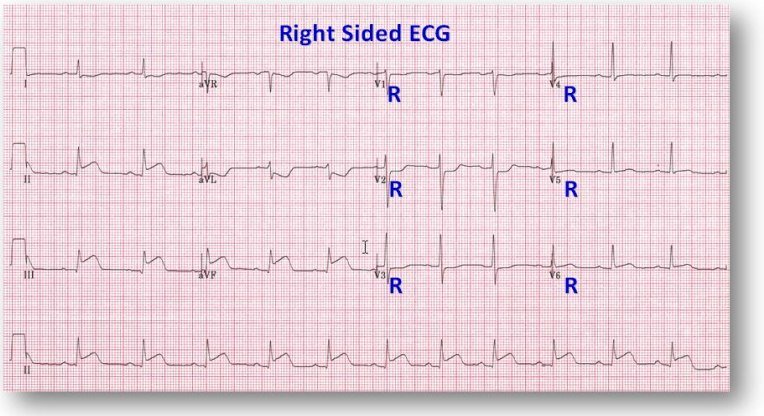


Figure 2: Labeling the Right-Sided ECG

Supporting Rationale: Right-Sided ECGs

Right-Sided ECG

- Up to 50% of patients with an inferior wall MI may have RV infarction or ischemia [6,16]
  - Occlusion of the right coronary artery proximal to the right ventricular branch is associated with inferior wall MI involving the RV[1-3,5,8-9,11,16]
  - In approximately 10% of the population, the left circumflex artery supplies the right ventricle and may therefore cause an associated lateral wall MI in conjunction with the RV infarction[5,8]
  - Patients with coexisting RV infarct have more myocardium involved, increasing their risk of complications up to and including death[8,17]
  - Isolated RV infarct is rare; reported to be <3%[11]
- Hypotension results from the RV dysfunction – patients are preload dependent / they rely on RV filling pressure to maintain cardiac output – use of vasodilators should be avoided[6,8,10,16-17]
- ST elevation > 1mm in lead V_4R is sensitive for RV infarction (88-100% sensitivity, 78-82% specificity, 83-92% diagnostic accuracy)[6,8]

Translation Into Practice: TIPs for Posterior ECGs

Posterior ECG

Recommended Clinical Practice

To detect posterior STEMI associated with occlusion of the circumflex artery or dominant right coronary artery, obtain a posterior ECG. [2-3] **[Level A Recommendation]**

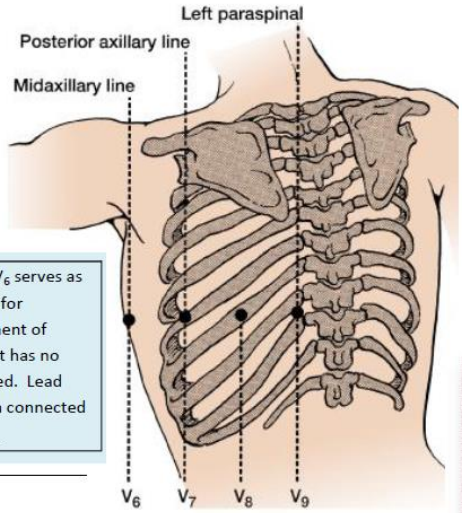
When a 15-lead &/or 18-lead ECG machine is not available, manipulation of the leads from a standard 12-lead ECG machine allow additional areas of the heart to be imaged.[4-5]

- Indications of a posterior wall infarction may include:[4-5,13]
  - Changes in $V_1 – V_3$ on the standard 12-lead ECG predominantly, which include:
    - Horizontal ST depression
    - A tall, wide R wave
    - A tall, upright T wave
    - R/S wave ratio greater than 1
  - Inferior or lateral wall MI (especially if accompanied by ST depression or prominent R waves in leads V_1-V_3)[2-3,5]

TIPs: Posterior ECGs – continued

Posterior ECG

- Place three additional ECG electrodes (stickers) as follows (Figure 3) – *TIP: start at V_9 (the last electrode) and work forward*:[4,14]
  - **V_9 – left spinal border, same horizontal line as V_{4-6}**
  - **V_8 – midscapular line, same horizontal line as V_7 and V_9**
  - **V_7 – posterior axillary line, same horizontal line as V_{4-6}**
- Place ECG lead cables as follows (using a standard 12-lead machine):
  - Locate lead cables V_1-V_6. Connect lead cables to electrodes as follows (Figure 3):
    - Lead cable V6 connects to electrode V9
    - Lead cable V5 connects to electrode V8
    - Lead cable V4 connects to electrode V7
    - Lead cables V1-V_3 are connected the same way as when obtaining a standard 12-lead ECG:
      - Lead cable V_1 connects to electrode V_1
      - Lead cable V_2 connects to electrode V_2
      - Lead cable V_3 connects to electrode V_3
  - Arm and leg electrodes and lead cables remain unchanged from the standard 12-lead ECG placement
- Label the Posterior ECG:[4]
  - Note "Posterior ECG" in the machine, if able
  - Handwrite "Posterior ECG" on the 12-lead ECG printout if not already part of the electronic printout
  - Re-label V_4 – V_6 on the printout to V_7 – V_9 (Figure 4)



Note: Electrode V_6 serves as a reference point for horizontal placement of electrodes V_{7-9} but has no lead cable attached. Lead cables V_{1-3} remain connected to electrodes V_{1-3}.

Figure 3 is used with permission from Barbara J. Drew, RN, PhD, FAAN, FAHA [Drew, B. J., & Ide, B. (1995). Right ventricular infarction. *Progress in Cardiovascular Nursing, 10*, 46.]

Posterior ECG Electrode Placement

V_9: left paraspinal line at the same level as V_{4-6}

V_8: halfway between V_7 and V_9 / mid scapular line

V_7: posterior axillary line at the same level as V_{4-6}

V_1-V_3: remain unchanged from standard 12-lead ECG

Labeling the Posterior ECG

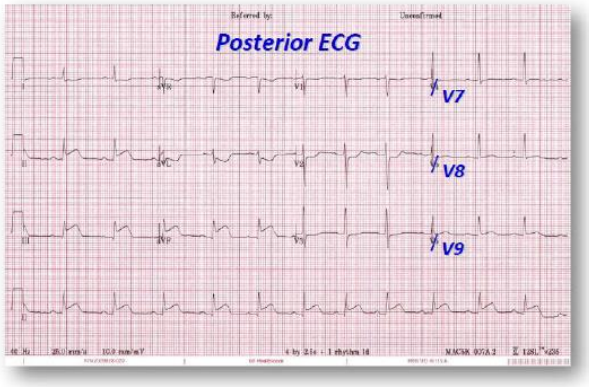


Figure 4: Labeling the Posterior ECG

- Presence of a posterior wall MI is seen when there is ST elevation greater than 0.5 mm[7,9,11-12,15] to 1 mm in V_8-V_9[2-3,5]

Right-Sided and Posterior Electrocardiograms (ECGs)

Supporting Rationale: Posterior ECGs

Posterior ECG

- Approximately 15-20% of all myocardial infarctions involve the posterior wall of the left ventricle and when found in conjunction with an inferior or lateral wall MI, it significantly increases mortality.[5,8,12] Up to 11% of all MIs are thought to be isolated posterior wall MIs[8,12]
  - In the majority of patients, the posterior wall is supplied by the left circumflex artery (and less frequently a dominant right coronary artery with prominent posterior-lateral or posterior descending branches) which means that inferior or lateral MIs frequently occur in conjunction with the posterior wall MI[5]
- ST elevation > 0.5mm in leads V_{8-9} is sensitive for posterior wall infarction (as high as 90%, with predictive accuracy up to 93.8%)[2-3,5,8]
- Due to the distance of the heart (which is more anterior in the chest), voltage recorded in the posterior leads is often less[8,11,15,18]

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Key for Level of Evidence Recommendation

A	**Level A (High) Recommendation:**	Based on consistent and good quality of evidence; has relevance and applicability to emergency nursing practice.
B	**Level B (Moderate) Recommendation:**	There are some minor inconsistencies in quality evidence; has relevance and applicability to emergency nursing practice.
C	**Level C (Weak) Recommendation:**	There is limited or low-quality patient-oriented evidence; has relevance and applicability to emergency nursing practice.

NR	**Not Recommended:**	Based upon current evidence.
	I/E:	Insufficient evidence upon which to make a recommendation.
	N/E:	No evidence upon which to make a recommendation.

Disclaimer

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