ST Segment Monitoring

Site Applicability

PHC Critical Care units

Practice Level

Specialized

Registered Nurses who have completed both: a recognized cardiac monitoring course or equivalent; and a written exam.

Need to Know

In-hospital ischemic events are associated with worse patient outcomes, and more than 3/4 of ECG-detected ischemic events are clinically silent. ST segment monitoring provides an accurate, non-invasive means of detecting myocardial ischemia that is more sensitive than patients' signs and symptoms or intermittent observation of the cardiac monitor. Although coronary angiography reveals coronary artery anatomy, it does not provide information about myocardial physiology; for example, a patent coronary artery does not necessarily assure myocardial perfusion.

When performing ischemia (ST-segment) monitoring, it is important to monitor the specific lead combination that is most likely to detect the specific patient's ischemia. A prior 12-lead ECG may show ST deviation in specific leads, but if there is no prior 12-lead ECG available, or no ST deviation is evident on an available 12-lead ECG, the **most sensitive lead combination for detecting ischemia should be used: leads III, aVF, and V3.**

ST segment monitoring is most beneficial in patients:

1. Admitted to critical care (all patients except atrial fibrillation or ventricular paced rhythms)
2. In early phase of acute coronary syndrome (UA, NSTEMI, STEMI)
3. Undergoing catheter-based coronary interventions
4. Post-catheter-based coronary interventions experiencing ischemic symptoms or hemodynamic instability
5. With a cardiac history who are undergoing a surgical procedure
6. Presenting with, or developing ischemic symptoms such as having chest pain or angina equivalent events
7. Post cardiac surgery, during the critical care phase
8. With a history of silent ischemia or cardiac transplantation, who are undergoing a procedure
9. With severe hypotension regardless of etiology

10. Are receiving fibrinolytic therapy for MI
11. Are being weaned from mechanical ventilation

ST segment monitoring may not be appropriate for certain patient groups, e.g.:

- Left Bundle-branch block
- Ventricular paced rhythm
- Confounding arrhythmias that obscure the ST segment
- Agitation causing excessive artifact (agitation may be a symptom of ischemia: optimizing waveforms as much as possible, to obtain at least transient ST-segment data is recommended)

Equipment and Supplies

1. Cardiac monitor with ST-segment monitoring capability and patient cable
2. 5 cardiac electrodes
3. Soap and water in a basin
4. 2 x 2 gauze or terrycloth washcloth
5. Safety razor/clippers
6. Black indelible marker

Procedure

STEPS	RATIONALE
1. Asses 12-lead ECG for the ST segment deviation	The location and particular pattern of ST segment deviation (elevation or depression), as seen on a 12 lead ECG is the best combination and pattern to monitor for recurrent myocardial ischemia
2. Identify patient's baseline ST-segment levels upon initiating ST segment monitoring	
3. Identify the appropriate sites for electrode placement: • **CICU/ICU** – choose precordial lead V3 if initial pattern of ischemia is unknown or uncertain • **CSSU** – Post procedure; monitor the V lead that is most appropriate for the coronary artery that has been dilated. Refer to B-00-13-10090 – CSSU Admission and Discharge if pre-procedure monitoring is required	Refer to Table 1 to determine the ECG leads most sensitive to particular coronary arteries and myocardial territories *For patients with pendulous breasts, place the electrodes for lead V3 through V5 immediately below the breast so that breast lies on top of the electrodes, preventing motion artifact

4. Wash the patient's skin with soap and water and dry it briskly with gauze pads or a washcloth. Ensure the skin is dry before applying electrodes	Moist skin is not conducive to electrode adherence. Wiping the electrode area with gauze pads or wash cloth dries and removes dead skin cells to enhance conduction and decrease artifact. Some electrodes have a skin abrader on the back that can be used to achieve this. ***Do Not** use alcohol for skin preparation as it is drying to the skin *To obtain good skin contact with the electrodes, clip chest hair with surgical clippers as necessary
5. Mark the precordial electrodes locations with an indelible black marker **Note**: this is not usually done in CSSU as most patients are discharged following procedure	ST segments may change if electrode position moves as little as 1 cm from original position, consistency is crucial. Precordial electrodes are often removed during 12 lead ECG acquisition, echocardiograms and assessment of heart sounds, so a landmark is necessary to replace electrode accurately.
6. Select the monitoring leads	Although any ECG lead can be used for ST segment monitoring, monitoring all 12 ECG leads or selecting a lead based on the myocardial zone at risk (e.g. inferior or anterior) is best. See precordial lead placement diagram (Appendix A) and coronary circulation and lead selection by myocardial territory (Table 1)
7. Set ST segment alarms to 1 to 2 mm above and below the patient's baseline ST level	Setting the ST segment alarm maximizes the sensitivity and specificity of ST segment monitoring and may reduce unnecessary false alarms
8. Print the baseline ECG tracing **Note:** this is not usually done in CSSU	Baseline ST segment is compared with subsequent ST segments because ST segment monitoring is based on continuous trending

9. If ST segments deviate 2 mm or more from baseline or zero for more than 2 minutes; assess for other signs and symptoms of myocardial ischemia: • VS (HR, BP, SpO_2, T, RR), including changes in hemodynamic status (clinically or invasively monitored), hypovolemia • Presence of chest, arm, shoulder/neck/throat/jaw pain or pressure, SOB, dizziness, nausea, sweating or vague uneasiness • If side lying, reposition into supine position and reassess ST segments **If ST changes persist, inform physician and obtain 12 lead ECG**	A 12 lead ECH definitively determines ischemia location and type. Assessment of signs and symptoms determines the patient response to ischemia
10. Monitor the patient's skin for an allergic reaction to the adhesive. • Evaluate skin integrity around the electrode daily • Change the electrodes every 24 to 48 hours to reduce the number of electrode related technical alarms • Rotate sites when changing electrodes if sites are irritated • Change all electrodes if a problem occurs with one	Skin integrity must be maintained to have a clear ECG tracing Replacing electrodes every 24 to 48 hours prevents the drying of the gel and may decrease the number of false technical alarms Electrode resistance changes as the gel dries, so changing all electrodes at once prevents differences in resistance among them
11. Check electrode placement every shift and PRN	Accurate interpretation and comparison of ST segments depends on proper placement of the electrodes

TABLE 1 Coronary circulation and lead selection, by myocardial territory

Myocardial Territory	Coronary Supply	Optimal Lead for ST Changes
Lateral Wall	LCx	I, aVL, V_5, V_6
Inferior Wall	RCA	II, III, aVF
Septal Wall	LAD	V_1, V_2
Anterior Wall and or Apex	LAD	V_3, V_4
Posterior	LCx or RCA	No direct view of all (tall R waves V_1 – 4)
Right Ventricle	RCA	V_4R, V_5R, V_6R (right sided)

Documentation

1. **Nurses' Notes** (PHC-NF035) or **Cardiac Short Stay Record (PHC-NF233**) as appropriate:
   Date, time, presence of chest pain or other ischemic symptoms at time ST deviation detected, interventions implemented and responses, physician communication
2. **ECG Rhythm Strip Flow Sheet** (PHC-IC004): Cardiac rhythm strip, ST-segment analysis strip (see Appendix B)

   Print ST-segment analysis from central monitor printer (using Form No. PHC-IC056) and file in ECG section once each shift and with any ST changes and any signs or symptoms of myocardial ischemia. Include date and time, ST analysis, and signature
3. **MAR** (PH464-MA): Medications administered

Patient and Family Education

Refer to B-00-13-10011 – Cardiac Monitoring Protocol

Encourage the patient to report chest pain or angina equivalent

Related Documents

1. B-00-13-10017 – Physical Assessment (Critical Care Areas)
2. B-00-13-10011 – Cardiac Monitoring Protocol
3. B-00-13-10021 – Myocardial Ischemia (CICU): Care of the Patient

References

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2. Hamm, C. W., Bassand, J., Agewall, S., Bax, J., Boersma, E., Bueno, H., Widimsky, P. (2011).

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4. American Association of Critical- Care Nurses (AACN). (2016). Practice alert: Ensuring accurate ST-segment monitoring. *Critical care Nurse, 36*(6), e18-e25. Doi:10.4037/ccn2016935 (Level D)
5. American Association of Critical- Care Nurses (AACN). (2018). AACN practice alert: Managing alarms in acute care across the life span; Electrocardiography and pulse oximetry. *Critical Care Nurse, 38*(2), e16-e20. (Level D)
6. Cvach, M.M and others. (2013). Daily electrode change and effect on cardiac monitor alarms: An evidence-based practice approach. *Journal of Nursing Care Quality, 28*(3), 265-271. doi:10.1097/NCQ.0b013e31827993bc
7. Wiegand, D.L. (Ed.). (2017). *AACN procedure manual for high acuity, progressive, and critical care* (7th ed.)

Persons/Groups Consulted:

Nurse Educator ICU

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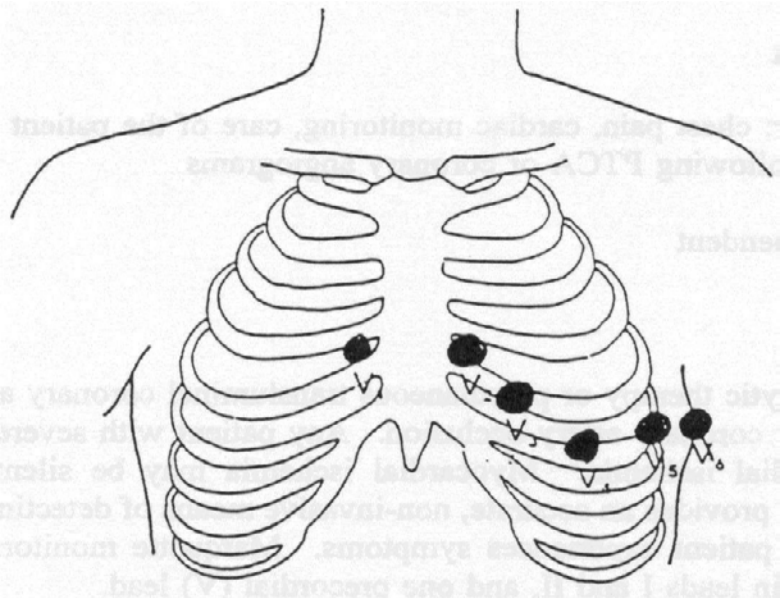
Appendix A: Precordial Lead Placement



Appendix B: ST Segment Analysis Strip