AACN Practice Alert

Accurate Dysrhythmia Monitoring in Adults

Scope and Impact of the Problem

Accuracy of cardiac monitoring (electrode placement, lead selection, interval assessment, and rhythm interpretation) is an important component of patient safety in hospitalized patients who meet the criteria for dysrhythmia monitoring. Quality dysrhythmia monitoring requires nurses to have high levels of knowledge and skill for accuracy and effective clinical decision-making. Gaps in practice related to dysrhythmia monitoring have been documented.[1-4] Inaccurate placement of electrodes can affect the morphology (shape) of the QRS complex and result in misinterpretation of a rhythm.[5,6]

AACN Levels of Evidence

Level A Meta-analysis of quantitative studies or metasynthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment (including systematic review of randomized controlled trials)

Level B Well-designed, controlled studies with results that consistently support a specific action, intervention, or treatment

Level C Qualitative studies, descriptive or correlational studies, integrative reviews, systematic reviews, or randomized controlled trials with inconsistent results

Level D Peer-reviewed professional and organizational standards with the support of clinical study recommendations

Level E Multiple case reports, theory-based evidence from expert opinions, or peer-reviewed professional organizational standards without clinical studies to support recommendations

Level M Manufacturer's recommendations only

Expected Nursing Practice

General

1. Ensure proper placement of electrodes to obtain accurate diagnosis of cardiac rhythm (see Figure). Palpate patient to ensure proper intercostal spaces. Electrodes should be placed under the breast tissue in women. [level B]
2. Provide proper skin preparation for electrocardiography (ECG) electrodes. Change ECG electrodes daily. [level B]
3. Individualize limits on heart-rate alarms and other alarm settings on the basis of the goals of patient care. [level D]
4. Do not transport patients for diagnostic testing who have a corrected QT interval (QTc) of 0.50 seconds (500 milliseconds) or greater while in the hospital until the prolonged QTc has been addressed. [level B]
5. Provide continuous uninterrupted cardiac monitoring for the first 48 hours from admission for patients with an ST-segment elevation myocardial infarction and in high-risk patients with non–ST-elevation acute coronary syndrome (ejection fraction ≤ 40%, hemodynamic instability, unsuccessful revascularization/awaiting revascularization) because of the risk for life-threatening ventricular arrhythmias. [level A]
6. Identify leads on posted rhythm strips. [level D]

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Correction: This article was corrected on June 12, 2023, to include more contributing authors.

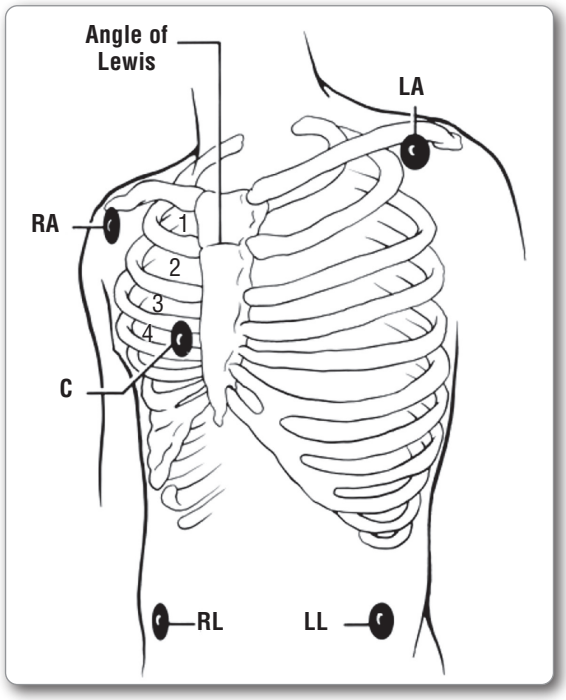

Figure Placement of electrodes.

Dysrhythmia Identification

1. Document the onset and offset of new dysrhythmias. [level D]
2. Select the best monitoring leads for identifying dysrhythmia (see Table) according to the needs of the patient (display 2 leads when possible). Lead selection requires critical thinking and may require integration of leads for ST-segment monitoring with leads for dysrhythmia monitoring. See the American Association for Critical-Care Nurses (AACN) Practice Alert: Ensuring Accurate ST-Segment Monitoring. [level B]
3. Obtain 12-lead ECG in a stable wide complex tachycardia to provide additional information to aid in interpretation. [level B]
4. Report episodes of paroxysmal atrial fibrillation in patients with no documented history of atrial fibrillation, as paroxysmal atrial fibrillation increases stroke risk. [level A]
5. Report a short PR interval of less than 0.12 seconds (120 milliseconds). This short an interval may represent the presence of an accessory pathway. [level B]
6. Request consultation for device interrogation in patients with a permanent device who have paced rhythms that are difficult to interpret. [level D]

QT-Interval Monitoring

1. Measure QT interval and calculate QTc (rate-adjusted QT interval) by using the same lead where there is a T-wave amplitude of at least 2 mm and a clearly identified T-wave end. [level C]
2. Do not include a distinctly separate U wave in the measurement of the QT interval. [level C]
3. Assess and document QTc at least once per shift in patients who meet criteria for QT interval monitoring as identified in the American Heart Association Scientific Statement: Practice Standards for Electrocardiographic Monitoring in Hospital Settings.[7] Also consider QTc monitoring as a routine practice in patients with 1 or more high-risk features for torsades de pointes. [level D]
4. Assess QTc more frequently in patients with baseline QTc prolongation, the initiation or dosage increase of a drug that prolongs QTc, or in patients with other warning signs for

Table Lead selection

Lead	Clinical application
V_1	Differentiation of right bundle branch block from left bundle branch block when patient is in sinus rhythm or other baseline rhythm; differentiation of cause of premature beats as ventricular or supraventricular with bundle branch block; differentiation of cause of a wide complex tachycardia as ventricular or supraventricular with bundle branch block
V_6	Alternative lead for diagnosing wide complex QRS or as a second lead in conjunction with lead V_1 in patients at high risk for life-threatening ventricular arrhythmias
II	Clear identification of atrial activity if unclear in V_1 or V_6 and for R-wave visualization when performing a synchronized cardioversion
Lewis or atrial	Assessment for atrial activity when atrial activity is unclear in other leads

torsades de pointes observed on the monitor. [level B]

5. Assess QTc before and after administration of a drug that prolongs the QTc by using the same lead, the same device, and the same formula for heart-rate correction. [level D]
6. Use QTc to differentiate torsades de pointes from polymorphic ventricular tachycardia with normal QT interval. [level B]
7. Report a QTc greater than 0.50 seconds (500 milliseconds) or any increase in the QTc of more than 0.06 seconds (60 milliseconds) after administration of a QTc-prolonging medication. Report any new finding of a QTc greater than 0.50 seconds (500 milliseconds). [level D]
8. Review the patient's medication list for actual or potential QT-prolonging medications whenever QT prolongation is a concern. Consider collaboration with a clinical pharmacist when reviewing the medication profile. [level D]

Supporting Evidence

General

1. Selection of patients for dysrhythmia monitoring is important for the detection of and intervention in both life-threatening and other cardiac rhythm disturbances.[7] Some evidence indicates overuse of dysrhythmia monitoring according to current recommendations.[8-12] Use of cardiac monitoring in patients without a clear clinical indication may have adverse unintentional patient-specific (eg, aggravation of delirium[13]) and organizational (eg, increased cost[11]) consequences. Conversely, beneficial unintentional consequences may occur when patients who do not meet current recommended criteria (eg, detection and stroke prevention treatment in paroxysmal atrial fibrillation[14] and early intervention and improved outcomes in patients with cardiac arrest[15-19]) are monitored. Cardiac monitoring is used in a wide variety of patient care settings within hospitals. Nurses in all areas should be prepared to respond appropriately to all cardiac monitor alarms and events.[7] [level B]
2. Staffing practices may affect response times to cardiac alarms and potentially affect patient safety.[20] [level C]
3. Dysrhythmia monitoring is complex and requires a high level of clinical decision-making. Initial training, continuing education, and competency assessment are important criteria for safe and high-quality cardiac monitoring. Additionally, accurate interpretation of cardiac rhythm involves a specific set of knowledge and skills. Gaps in knowledge and skills related to cardiac monitoring are evident.[1,2,21-28] [level A]
4. Electrode site preparation includes clipping excessive hair and cleansing oily skin with alcohol. Failure to prepare skin properly before electrode placement may cause inappropriate monitoring alarms.[29-31] Electrodes should be changed daily as a strategy for reducing alarms.[32] Additional strategies can be effective in reducing alarm fatigue and facilitating appropriate response to monitor alarms.[32-36] See the AACN Practice Alert: Alarm Management. [level A]

Dysrhythmia Monitoring and Identification

1. Two leads should be displayed whenever available to aid in accurate rhythm interpretation. Nurses do not always use 2 leads for bedside monitoring when appropriate and the leads are available.[3,37] [level C]
2. Chest leads V_1, V_2, and V_4 require palpation to locate the correct intercostal space. Current guidelines recommend electrode placement under breast tissue in women. When an electrode is misplaced by as little as 1 intercostal space, QRS morphology can change and misdiagnosis may occur (eg, ventricular tachycardia may be misidentified as supraventricular tachycardia or vice versa).[4,5] [level B]
3. Document onset and offset of dysrhythmias.[7] [level C]
4. A short PR interval on a resting ECG may be associated with the presence of an accessory pathway.[28] [level B]
5. The percentage of patients with acute coronary syndrome who have life-threatening ventricular

arrhythmias has decreased with the use of reperfusion in ST-segment elevation myocardial infarction and with the use of evidence-based medications in all patients with acute coronary syndrome (with and without ST-segment elevation).[38,39] Still, patients with acute coronary syndrome (ST-segment elevation myocardial infarction and high-risk non–ST-elevation presentation) are at higher risk for ventricular arrhythmias, with the vast majority of life-threatening arrhythmias occurring within 48 hours of the event.[38,40,41] High-risk features in a patient with non–ST-segment elevation acute coronary syndrome include arrhythmias, hemodynamic instability, ejection fraction less than 40%, and failed reperfusion or pending revascularization of major coronary arteries.[42] Life-threatening arrhythmias early in the hospital course are associated with worse short-term outcomes. However, patients who have a late ventricular arrhythmia (> 48 hours from time of event) have a higher long-term risk for sudden cardiac death and will need an electrophysiology referral for possible use of a wearable cardioverter defibrillator and subsequent use of an implantable defibrillator.[38] Additionally, the presence of ventricular arrhythmias in a patient with acute coronary syndrome is used to stratify risk, and risk stratification is used to guide treatment.[42,43] [level A]

6. Paroxysmal atrial fibrillation is a risk factor for stroke, and anticoagulation for stroke prevention is warranted because of the patient's stroke risk.[44-51] Paroxysmal atrial fibrillation may be an incidental finding while a patient is receiving inpatient hospital monitoring. Reporting of paroxysmal atrial fibrillation may lead to treatment for stroke prevention, a reduction in stroke risk, and improved outcomes for patients. [level A]
7. Accurate interpretation of wide complex tachycardias is important for patient safety because supraventricular tachycardia with bundle branch block and ventricular tachycardia are treated differently. Inappropriate treatment can lead to adverse outcomes.[52-54] [level B]
8. ECG criteria are needed for the differentiation of ventricular tachycardia from supraventricular tachycardia with bundle branch block because clinical tolerance of the rhythm is insufficient for differentiation.[55] [level C]
9. Several algorithms for the interpretation of wide complex tachycardias (differentiating ventricular tachycardia from supraventricular tachycardia with bundle branch block) have been proposed. The algorithms involve criteria that require the completion of a 12-lead ECG to determine cardiac axis, QRS morphology in multiple leads, and the presence of concordance in the precordial leads.[56-60] [level B]
10. The criterion of atrioventricular (AV) dissociation for the diagnosis of ventricular tachycardia does not require any specific monitoring lead. However, P waves are not always visible in a wide complex tachycardia, and thus the nurse cannot rely on the presence of AV dissociation to confirm ventricular tachycardia. Additionally, not all ventricular tachycardias have AV dissociation. Some ventricular tachycardias will conduct retrograde, resulting in a P wave after each QRS complex.[56-61] [level B]
11. Lead aVR and lead II have been proposed as useful leads for differentiating wide complex tachycardias. However, lead aVR and lead II are not recommended leads for the differentiation of right and left bundle branch block patterns.[21,60,62-64] [level B]
12. Leads V_1 and V_6 are 2 leads referenced in several algorithms for the differentiation of wide complex tachycardias. Leads V_1 and V_6 are also components of published criteria for the recognition of patterns of right and left bundle branch block (in sinus rhythm or during a supraventricular tachycardia). V_1 is the preferred bedside monitoring lead for dysrhythmia monitoring. When V_1 electrode placement is not possible (eg, in a patient with a surgical dressing at that spot), V_6 may be used. When 2 chest leads are available, the combination of V_1 and V_6 is preferred for dysrhythmia monitoring.[7,56-59,62,65-76] [level A]

13. A 5- or 6-lead monitoring system is required to monitor true V (chest) leads. MCL leads are modified chest leads. True chest leads should be used rather than modified chest leads whenever available. A 5-lead monitoring system provides the ability to monitor in 1 true V lead. When a 5-lead system is used, lead V_1 should be the monitoring lead of choice for dysrhythmia monitoring. If a true V lead is not available (as with a 3-lead monitoring system), an MCL_1 lead may be used. A 6-lead monitoring system provides the ability to monitor in 2 true V leads at the same time. In a 6-lead system, V_1 and V_6 could be simultaneously monitored for dysrhythmia monitoring or V_1 and V_3 could be simultaneously monitored for combined dysrhythmia monitoring and ST-segment monitoring. When using a 5-lead monitoring system, V_1 and an MCL_6 may be used for dysrhythmia monitoring. Nurses must be aware that limb lead placement is altered (and thus the accuracy of limb lead recordings is altered) when modified chest leads are used. For example, using an MCL_6 for dysrhythmia monitoring would prohibit the simultaneous monitoring of lead III for ST-segment monitoring.[68,69] [level C]
14. When a derived ECG monitoring system is being used at the bedside, the full-disclosure view allowing 12 leads to be displayed should be used to aid in the interpretation of any wide complex tachycardia.[77] The derived ECG may have limitations in morphology assessment compared with the standard ECG.[78,79] [level B]
15. Obtain an atrial electrogram in cardiac surgical patients with atrial epicardial wires to assist in identifying atrial activity.[80-82] Use the Lewis lead in patients without epicardial pacing wires to identify atrial activity when P waves are not clear. The Lewis lead takes a close-up look at right atrial activity and can identify P waves in atrial tachycardia or flutter waves in atrial flutter that are not otherwise seen in other monitoring leads. The Lewis lead has also been used to identify AV dissociation during a wide complex tachycardia.[83] [level C]

QTc Interval Monitoring

1. The QTc interval should be measured once per shift in patients who meet criteria for QT-interval monitoring. More frequent assessment is indicated on the basis of additional ECG and clinical high-risk features. Use a consistent lead, and document the lead that is being used for QT-interval monitoring.[84,85] [level C]
2. Measurement of the QT interval has some technical considerations. U waves that are distinctly separate from the T wave should not be included in the measurement. Additionally, an increase in QRS duration as seen with bundle branch blocks will prolong the QT/QTc. However, an increased QT/QTc from a conduction delay does not carry the same risk for torsades de pointes as does a prolonged QT/QTc caused by a delay in repolarization (the T wave is associated with ventricular repolarization).[84,86] [level C]
3. The QT interval should be corrected for heart rate (QTc). There are several formulas (Bazett, Fridericia, Framingham) for correcting the QT interval for heart rate in patients with a regular R-R interval. No consensus has been reached regarding one optimal method to be used in clinical practice.[84,86-89] Additionally, it is difficult to assess the QTc in patients with atrial fibrillation because of the irregular R-R interval. Several methods have been proposed, including standard heart correction formulas, identifying the longest and shortest R-R intervals, using each to calculate the QTc and taking the average; additionally, a long rhythm strip can be printed to assess if the interval from R wave to the peak of the following T wave is more than half of the preceding R-R interval. (Note: this method does not provide an actual QTc but rather an indicator for a QT interval that is too long.) [level B]
4. QTc prolongation in hospitalized patients is associated with adverse clinical outcomes. QTc greater than 0.50 seconds (500 milliseconds) is dangerously prolonged and associated with risk for torsades de pointes. A QTc of more than 0.50 seconds (500 milliseconds) or more than 0.06 seconds (60 milliseconds) from baseline is

reportable. The time frames for and duration of assessment of the QTc after administration of a QT-prolonging drug will vary depending on the onset, peak, and duration of the drug. Ideally, the QTc should be measured when there is peak plasma concentration. Multiple medications carry the risk for QTc prolongation, and the risk may be dependent on other clinical features. High-risk clinical features for torsades de pointes include genetic predisposition, severe bradycardia, long pauses, any drug overdose, hypokalemia, hypomagnesemia, hypocalcemia, advanced age, female sex, low ejection fraction, left ventricular hypertrophy, renal or hepatic dysfunction, history of stroke, hyperglycemia, and hypothyroidism.[7,74,84-87,90-104] [level A]

5. In addition to clinical features and QTc prolongation, additional warning signs for torsades de pointes can be observed on the cardiac monitor, including T-wave or U-wave distortion, visible T-wave alternans, new-onset ventricular ectopy, and nonsustained polymorphic ventricular tachycardia often occurring after a pause.[84,85,105] [level B]
6. The QTc can be used to differentiate torsades de pointes from polymorphic ventricular tachycardia with a normal QT interval. The treatment differs for these 2 dysrhythmias.[106] [level B]

Implementation/Organizational Support for Practice

Monitor patients for dysrhythmias according to the recommendations in the American Heart Association Scientific Statement: Practice Standards for Electrocardiographic Monitoring in Hospital Settings.

When replacing current bedside monitoring equipment, **evaluate** for the number of chest leads and for the technology related to continuous assessment of the QT interval.

Review organizational policies and protocols related to cardiac monitoring to ensure the same standard of care across settings. Ensure that monitoring policies and protocols are based on needs of the patient and integrate both dysrhythmia monitoring priorities and ST-segment monitoring priorities.

Determine a consistent method for QT heart-rate correction to be used for bedside monitoring in hospital- or unit-based protocols. Determine the method for QT heart-rate correction in patients with atrial fibrillation.

Provide appropriate initial and continuing education for staff, including but not limited to electrode placement, lead selection, recognition of right and left bundle branch block patterns, identification of heart blocks, recognition of QRS morphology seen in ventricular tachycardia, criteria for differentiating wide complex tachycardias, heart rate correction methods for QT interval, warning signs for torsades de pointes, reportable conditions, and emergency response to life-threatening arrhythmias. Include didactic content and "hands-on" practice with return demonstration of lead placement.

Develop competency standards for all staff involved in dysrhythmia monitoring to ensure patient safety related to implementation of cardiac monitoring standards and accurate cardiac rhythm interpretation.

Consider cardiac monitoring responsibilities in staffing assignments.

Conduct audits at regular intervals to ensure actual practice matches recommended practice for dysrhythmia monitoring: accurate electrode placement, appropriate lead selection, accurate rhythm interpretation and QT assessment, and appropriate documentation.

Need More Information or Help?

1. Go to www.aacn.org, click Clinical Resources, and scroll down to select AACN Practice Resource Network.
2. Review the standards. AHA Scientific Statement: Practice Standards for Electrocardiographic Monitoring in Hospital Settings. http://circ.ahajournals.org/content/110/17/2721.full.pdf+html. Accessed July 14, 2016.
3. AACN Practice Alert: Alarm Management. http://www.aacn.org/wd/practice/content/practicealerts/alarm-management-practice-alert.pcms?menu=practice.

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Financial Disclosures
None reported.

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