When attaching a cardiac monitor, assess patient’s need for 3 potential goals of monitoring:

- **Arrhythmia**
- Ischemia? (ST-segment monitoring)
- QT interval?

**Recommendations:**
1. Monitor at least 2 leads
2. Leads V1 & II

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**Practice Standards for ECG Monitoring**

**Arrhythmia Monitoring**

1. Select the best ECG leads for arrhythmia diagnosis
Advantages of Lead II

- Provides a tall R wave in most people (accurate heart rate detection, less noisy signal)
- Shows clear-cut saw-tooth atrial waves in atrial flutter

Advantage of Lead V₁

- Diagnosis of rhythms with a wide QRS complex (e.g., BBB)
- Distinguish VT from SVT with aberrant conduction

V₁ is the best Lead to diagnose Right Bundle Branch Block (RBBB)

Advantages of V₁ for arrhythmia monitoring

Occlusion of the LAD with acute anterior MI may cause bundle branch & fascicular block

Patient in CCU with acute anterior MI

Patient A has VT (dx from EP study)

Taller Left Peak Pattern = VT

Drew & Scheinman, PACE 1995;18:2194
Patient B has SVT with aberrant conduction (dx from EP study)

rsR' or rR' pattern = SVT

Patient C has VT (dx from EP study)

QRS onset to S nadir interval > .06 sec
notch on S downstroke = VT

Patient D has SVT with aberrant conduction (dx from EP study)

ALL of these criteria in both V₁ & V₂ plus no Q in V₆ = SVT

V₁ requires 5 electrodes

Arrhythmia Monitoring

2. Place electrodes in their correct anatomic site
How accurate is Lead placement?
Random survey of RN's in USA

<table>
<thead>
<tr>
<th># RNs</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>23%</td>
<td>77%</td>
<td></td>
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What were the errors?

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Arrhythmia Monitoring

3. Print out an AEG whenever a post-op. cardiac surgery patient develops a tachycardia of unknown mechanism


Recording an AEG from epicardial pacemaker wires

Wear rubber gloves to protect patient from microshocks

Either atrial wire may be used

Use chest (V) lead-wire (brown)

Wrap atrial wire in chest lead-wire
Printing an AEG

1. Set up printer to print simultaneous limb & “V” lead
2. Print a long strip of the rhythm. Re-label the “V” lead as “AEG”

Sample AEG

AEG has larger P waves than monitor leads

From Marion McRae, Acute Care Nurse Practitioner, Cardiac Surgery, Toronto General Hospital

What is the rhythm?

Lead II
70 y/o post-cardiac surgery patient
Heart rate 146 bpm

AEG

Sinus tachycardia

From Marion McRae, Acute Care Nurse Practitioner, Cardiac Surgery, Toronto General Hospital

Atrial fibrillation

What is the rhythm?

Ischemia (ST-segment) Monitoring

1. Identify patients who need ST-segment monitoring

Top priority for ST segment monitoring

1. Present to the ED with chest pain
2. Admitted to the hospital with acute coronary syndrome (unstable angina or acute MI)
3. Post PCI with complications in the cath lab (vessel dissection) or a suboptimal angiographic result

AHA Practice Standards for ECG Monitoring in Hospital Settings Circulation 2004
ST alarm is an earlier sign of abrupt reocclusion following PCI than chest pain.


Best ECG leads to detect occlusion of the 3 main coronary arteries.

Aldrich HR et al. Am J Cardiol 1987;59:20
Bush HS et al Am Heart J 1991;121:1591
Drew BJ & Tisdale LA. Am J Crit Care 1993:2:280

Recommended leads for ST-segment monitoring: II or III + V3

Initial ECG in 40 y/o male presenting to the ED with increasing chest pain episodes; Troponins negative

5:00 pm

6 days following hospital discharge, patient was brought to ED after witnessed collapse on golf course

Rapidly developed profound shock, could not be resuscitated, and died

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**Practice Standards for ECG Monitoring**

**QT Interval Monitoring**

1. Measure QT intervals to prevent cardiac arrest due to drug-induced Torsades de Pointes

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**Torsades de Pointes**

Upper limits of normal = 460 ms, males
470 ms, females

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**Things to know about QT measurement**

- QT interval gets shorter with increasing HR and longer with decreasing HR
- QT must be corrected for heart rate (QT<sub>C</sub>)
- QT<sub>C</sub> tells you what the QT interval would be if the HR were 60 bpm
- QT<sub>C</sub> > 500 ms is dangerous; consider stopping the drug to prevent TdP

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**QT prolonging drugs**

www.torsades.org

**Risk Factors:**

- Rapid administration (IV route)
- Renal / hepatic dysfunction
- Hypokalemia, hypomagnesemia
- Bradyarrhythmias with long pauses (sinus arrest, CHB)
- Female gender (70% of drug-induced TdP cases are women)
- Advanced age
- Heart disease (LVH, HF)
- Poly-pharmacy

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**Case Example**

78 y/o woman started on IV erythromycin

Baseline QT interval prior to start of drug = 0.44 sec (440 ms)

HR = 60, QT<sub>C</sub> = 440 ms

On the next shift, her QT interval on the drug = 440 ms

HR = 80, QT<sub>C</sub> > 500 ms

What else do we need to know?
Incidence of drug-induced events

- TdP: Rare
- QTc > 500 ms: Uncommon
- QT Prolongation: Common

Heist & Ruskin, Heart Rhythm 2005; S1-S8.

Distinguishing TdP from ventricular fibrillation

64 y/o male on no medications presents to the emergency dept. with symptoms of acute MI

Methods to monitor QTc in hospital units

1. Standard "diagnostic" 12-lead ECG
   Typically, only one/day
2. Manually with calipers; apply correction formula
   Time-consuming; inter-rater differences
3. E-calipers from the Central Monitoring Station
   Still time-consuming; inter-rater differences
4. Continuous QT monitoring
   Measures QTc every 5 mins; no inter-rater differences; alarm alerts for QTc from baseline >60 ms or QTc >500 ms

Elderly woman in the ICU being treated with IV erythromycin

Sequence of ECG events in TdP

- ↑ QTc >500 ms after start of drug
- Polymorphic PVC’s & couplets
- T wave alternans may/may not occur
- Non-sustained TdP after pause
- Sustained TdP and cardiac arrest

One hour earlier...

Drug should have been stopped here to prevent TdP !!!