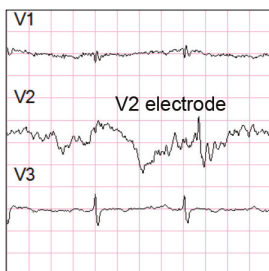
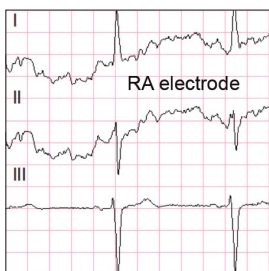


## Minimizing ECG artifact

ECG artifact nearly always originates from sources unrelated to the monitor. The following are best practice suggestions for minimizing artifact.

### Identifying the culprit electrode

- If the artifact is in leads I and II but not III, the RA electrode is the source
- If the artifact is in I and III but not II, the LA electrode is the source
- If the artifact is in II and III but not I, the LL electrode is the source
- If the artifact is unique to one V lead, its V electrode is the source



### Minimizing motion artifact

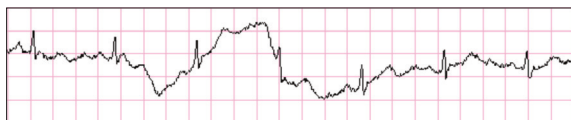
Mild skin abrasion with fine sandpaper or gritty gel effectively minimizes all types of motion and electrostatic artifact (medical products are available for this)

Respiration: Low frequency (0.4–2 Hz)



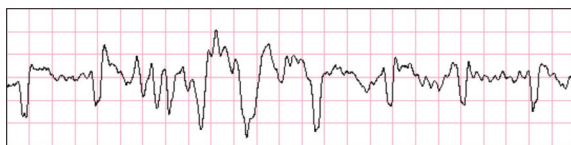
- Check for dried gel
- Abrade skin
- Have patient take deep breath, let half out and hold while acquiring the ECG

Patient movement: Low frequency (1–3 Hz)



- Check for dried gel
- Abrade skin
- Have patient lie still and stop talking

Transport: Medium frequency (3–15 Hz)

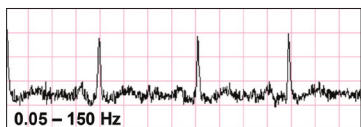


- Check for dried gel
- Abrade skin
- Stop ambulance to get clean ECG

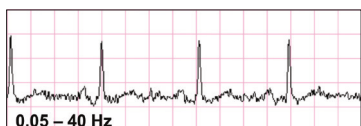
### Minimizing muscle artifact

Skin prep will not help, but other techniques can help

Muscle tension: High frequency (20–150 Hz)

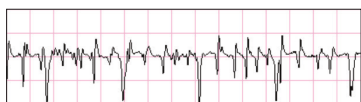


- Assure that limbs are supported and the patient is lying flat
- Ask the patient to relax
- Consider pain Rx if pain is the likely cause



- Reducing the upper cutoff frequency filter from 150 to 40 Hz reduces muscle artifact

Muscle tremor: High frequency (20–150 Hz) and/or medium frequency (3–5 Hz)



- If shivering, cover with a blanket
- Move limb electrode elsewhere on limb to avoid culprit muscle
- Abrade skin if there is motion artifact

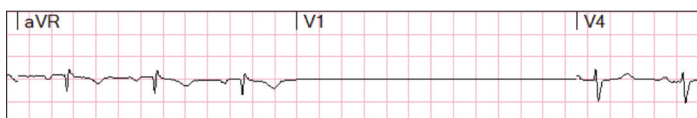
### Intermittent or missing leads

Intermittent lead



- Check for dry electrodes
- Shave or clip hair from electrode site if excessive hair is present
- Alcohol wipe if skin is oily or sweaty
- Check for intermittent cable failure by trying a different cable
- For intermittent connector on ECG device, service call needed

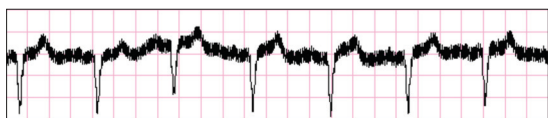
Missing lead



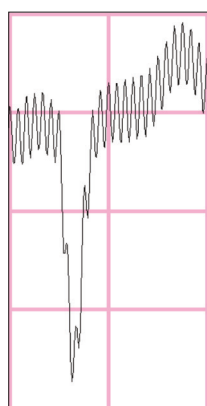
- Check for dry electrodes
- Verify that electrode and lead wire are attached to patient
- Replace worn or broken lead wire or patient cable
- For worn or broken connector on ECG device, service call needed

## Minimizing electromagnetic interference (EMI)

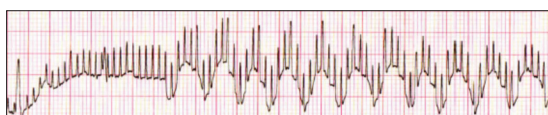
Power line: High frequency (16.7, 50, 60, 100, 120, 150, 180 Hz)



- Identify likely source, turn off or increase distance
- Inverse square law: increasing the distance to the EMI source by 10x decreases the artifact to 1/100th
- If it happens often, verify that ECG device is set to correct line frequency filter (50 or 60 Hz)
- Skin abrasion and wet gel sometimes solve it



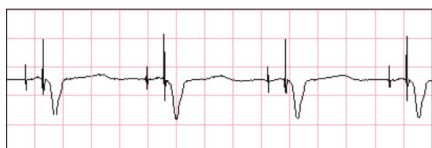
Cell phone or other equipment: High frequency



- Identify likely source, turn off or increase distance

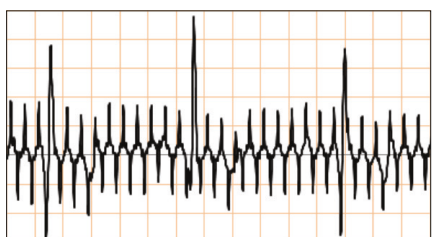
## Implanted pacemakers and stimulators

Paced rhythm: High frequency spikes (>100 Hz)



- Change upper cutoff frequency to 150 Hz if you want to increase the visibility of pacemaker spikes

Gastric or other stimulator: High frequency spikes (>40 Hz)



- Look for a lead with low stimulator artifact
- Record a 12-lead ECG and select a lead with low stimulator artifact
- Some devices can be temporarily turned off with a magnet

- Other stimulators include occipital nerve stimulators, deep brain stimulators, sacral nerve stimulators and carotid stimulators

## Skin preparation techniques

- Choose an ECG electrode site away from areas with a large amount of adipose tissue, major muscle groups or bony prominences
- Excessive hair should be clipped or shaved
  - Hair can prevent ECG electrode adhesion to the skin
- Mild skin abrasion with fine sandpaper or gritty gel (medical products are available for this purpose)
  - Swipe an X with sandpaper to scratch the skin and place the electrode gel on the center of the X
  - Skin abrasion minimizes motion artifact, but not muscle artifact
- Dry towel or gauze pad skin rub
  - Useful for patients with sweaty or oily skin to improve electrode adhesion
  - Does not reduce motion or muscle artifact
- Isopropyl alcohol wipe
  - This can help the electrodes stick to the skin, but it does not reduce motion or muscle artifact

Types of ECG artifact	Cause
Motion artifact	Occurs when the skin is stretched, resulting in a change to the skin voltage at the stratum lucidum, the second layer down in the skin
Muscle artifact	Generated by skeletal muscles
Electrostatic artifact	When an electrostatically charged person moves near the patient or ECG device, currents flow through the high resistance of the stratum corneum (top skin layer) and generate a voltage
Poor contact artifact	Caused by dried gel, excessive hair, poor adhesion or when breaks in connectivity occur anywhere between the electrode and the monitor
Electromagnetic Interference (EMI)	Generated by items like power lines, cell phones or radios; relatively uncommon
Implanted stimulators	Artifact is greatest in leads parallel to the stimulus lead; pacemakers are common but other stimulators are rare