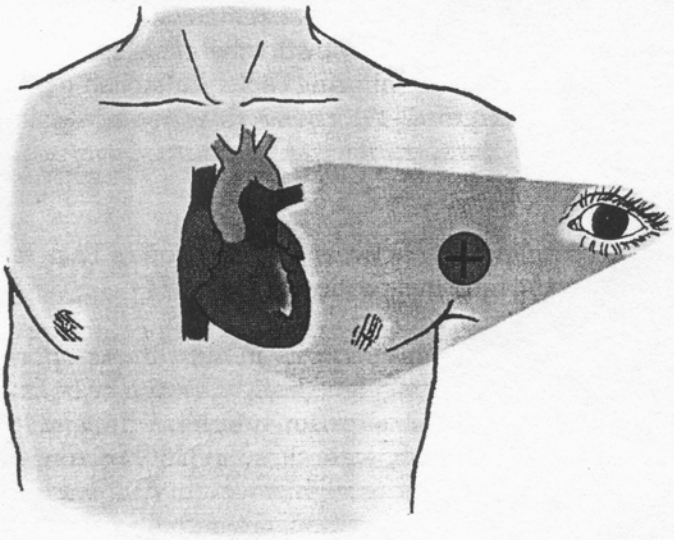

FIGURE **2-20**
Each lead has a negative (−) and positive (+) electrode. The position of the positive electrode on the body determines the portion of the heart "seen" by each lead.

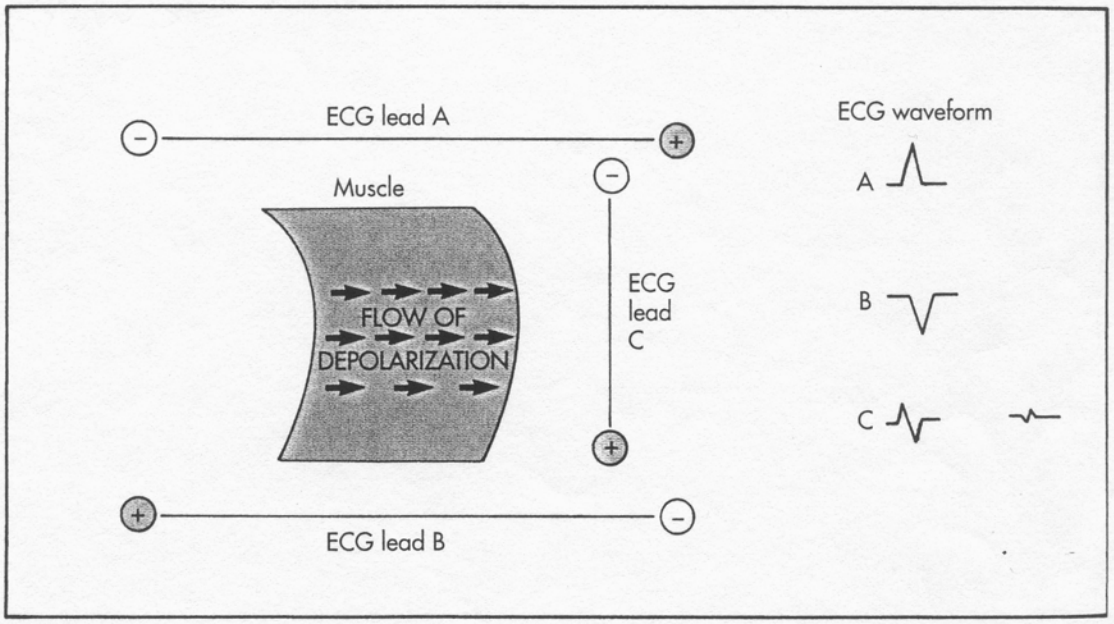

FIGURE **2-21**
A, If wave of depolarization moves toward positive electrode, waveform recorded on ECG graph paper will be upright. **B,** If wave of depolarization moves toward negative electrode, waveform produced will be inverted. **C,** Biphasic (partly positive, partly negative) waveform is recorded when wave of depolarization moves perpendicularly to positive electrode.

negative) waveform or a straight line is recorded when the wave of depolarization moves perpendicularly to the positive electrode (Figure 2-21).

Baseline: Straight line recorded on ECG graph paper when no electrical activity is detected.

Each waveform produced is related to a specific electrical event in the heart. When electrical activity is not detected, a straight line is recorded called the **baseline** or **isoelectric line.**

Bipolar lead: ECG lead consisting of a positive and negative electrode.

Frontal Plane Leads

Six leads view the heart in the frontal plane as if the body were flat: three bipolar leads and three unipolar leads. A **bipolar lead** consists of two electrodes of opposite polarity (positive and negative). Each lead records the difference in electrical potential between

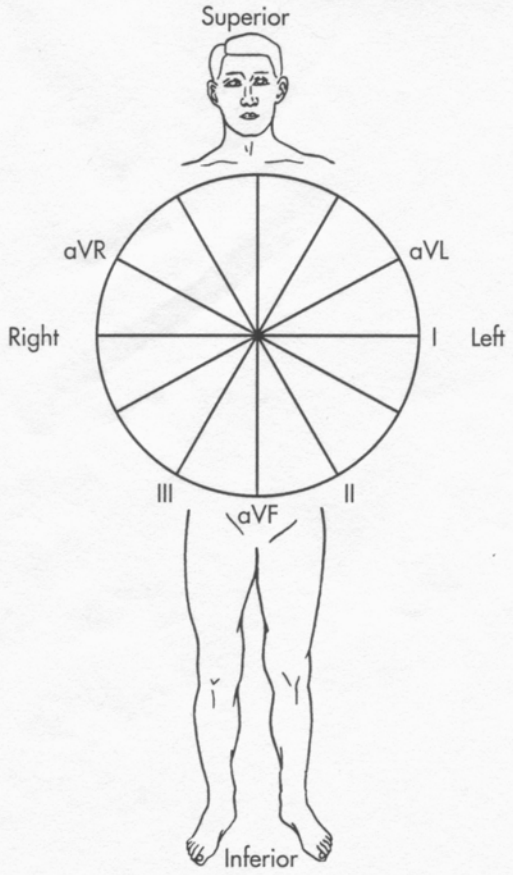

FIGURE **2-22**
Frontal plane leads.

two selected electrodes. Leads I, II, and III are called *standard limb leads* or *bipolar leads* (Figure 2-22).

A lead that consists of a single positive electrode and a reference point is called a **unipolar lead.** These leads are also called *unipolar limb leads* or *augmented limb leads.* The reference point (with zero electrical potential) lies in the center of the heart's electrical field (left of the interventricular septum and below the AV junction).

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Horizontal Plane Leads

Six precordial (chest or V) leads view the heart in the horizontal plane allowing a view of the front and left side of the heart. The precordial leads are identified as V_1, V_2, V_3, V_4, V_5, and V_6. Each electrode placed in a "V" position is a positive electrode. The negative electrode is a zero reference point (central terminal) that combines information from the limb leads. This negative electrode is found at the electrical center of the heart (Figure 2-23). Thus the precordial leads are also unipolar leads.

The precordial leads record differences in electrical potential via electrodes positioned on the chest wall.

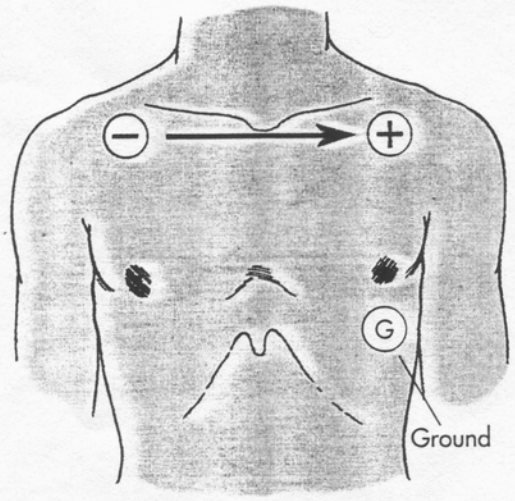


FIGURE **2-25**
Lead I.

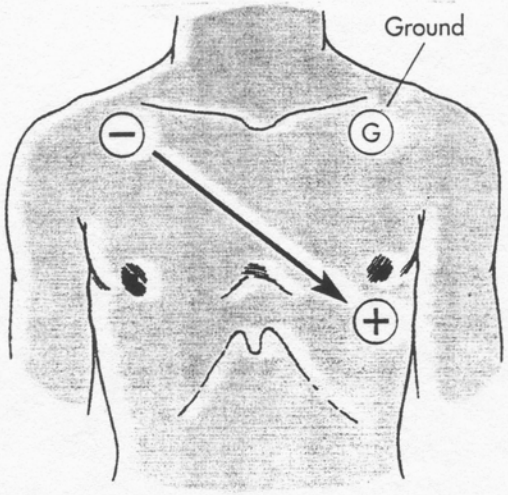


FIGURE **2-26**
Lead II.

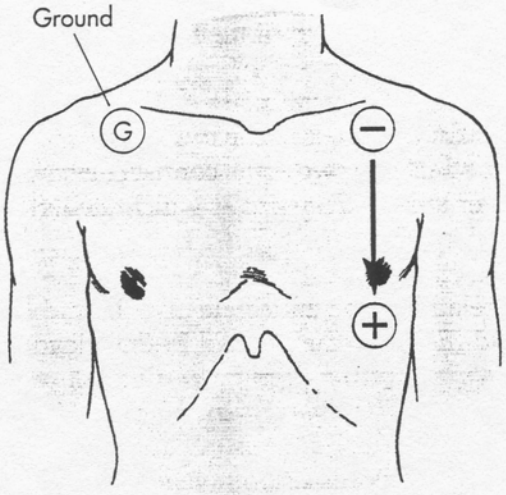


FIGURE **2-27**
Lead III.

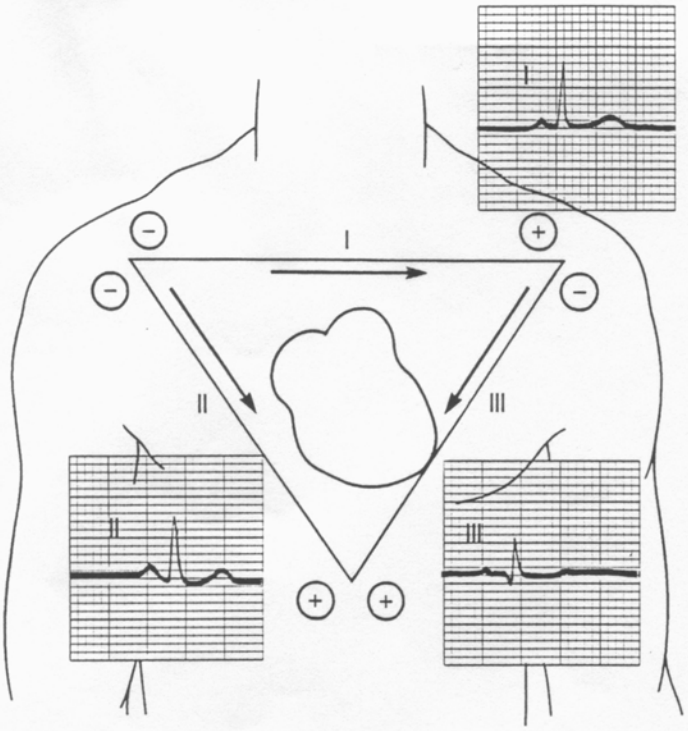


FIGURE **2-28**
Comparison of the waveforms recorded in the standard limb leads.

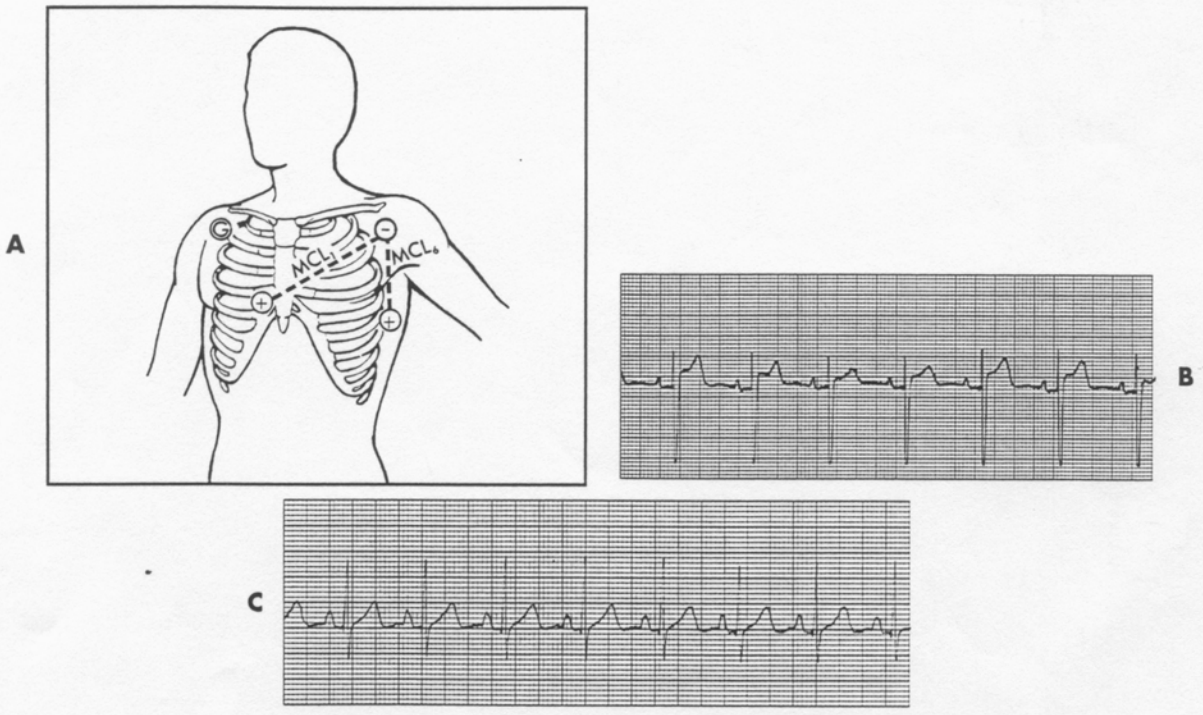
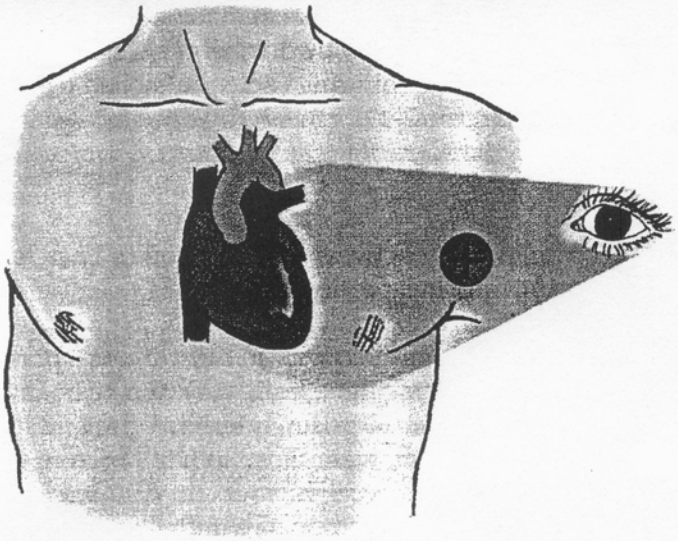


FIGURE **2-29**
A, Electrode placement for MCL_1 and MCL_6. **B,** Typical ECG tracing in MCL_1. **C,** Typical ECG tracing in MCL_6.



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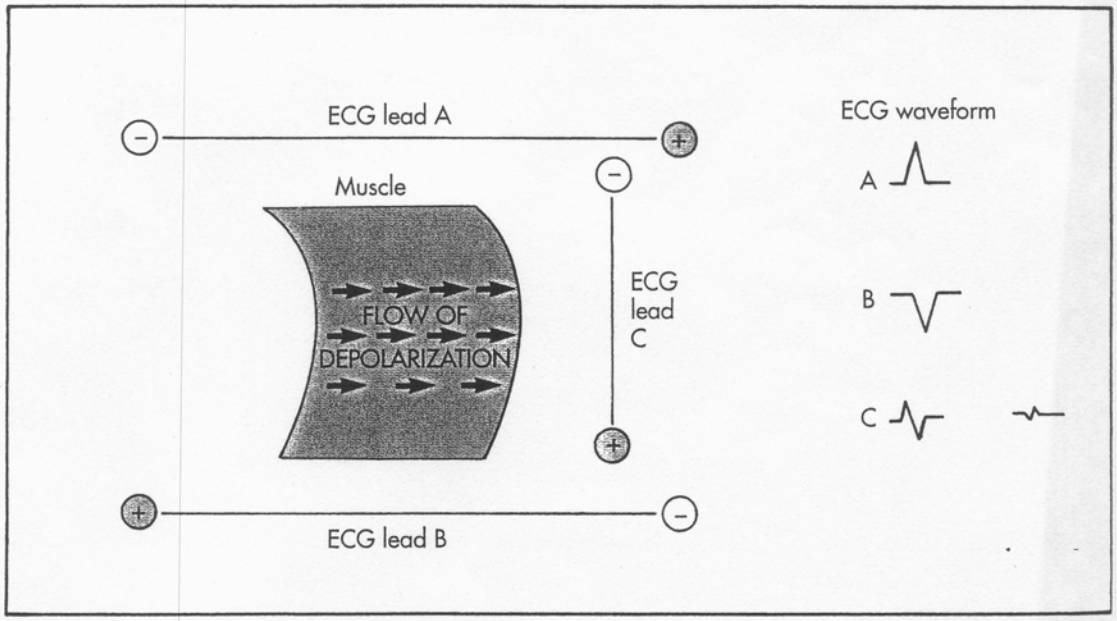

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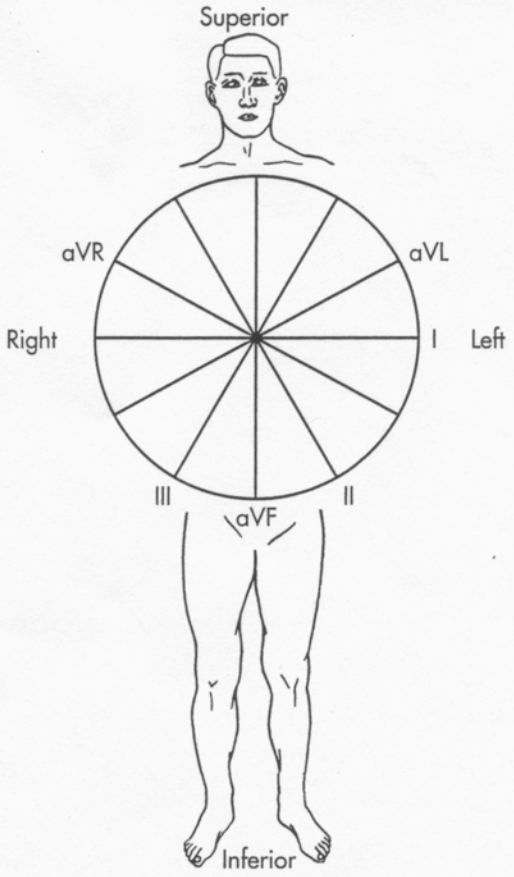

FIGURE **2-22**
Frontal plane leads.

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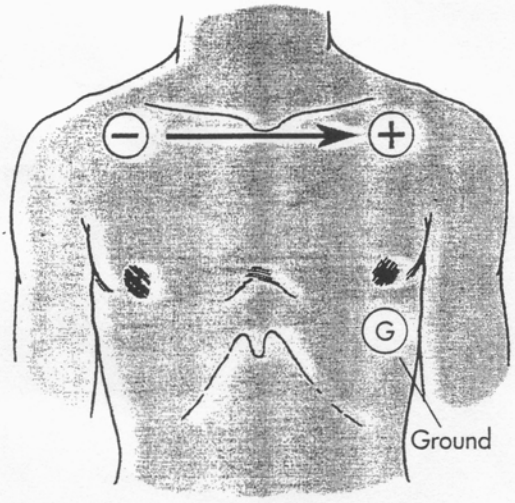

FIGURE **2-25**
Lead I.

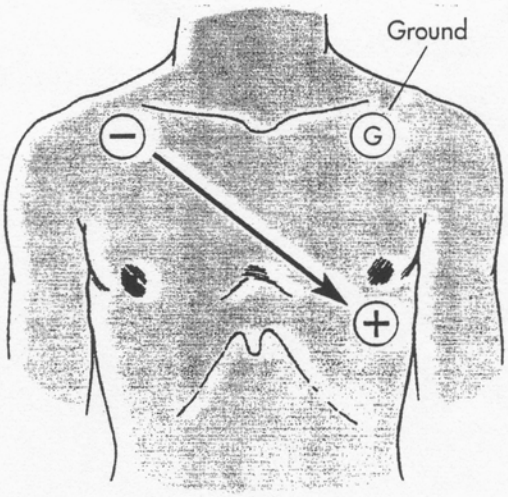

FIGURE **2-26**
Lead II.

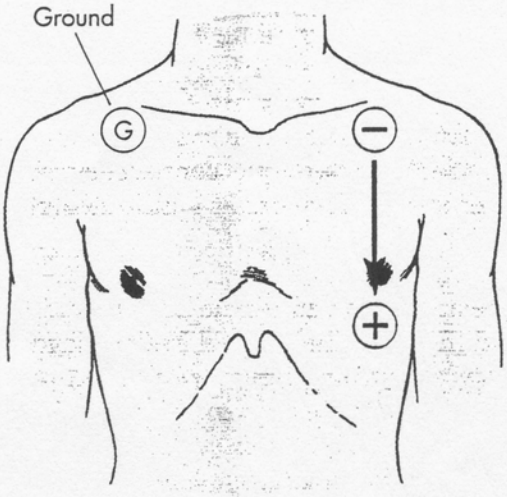

FIGURE **2-27**
Lead III.

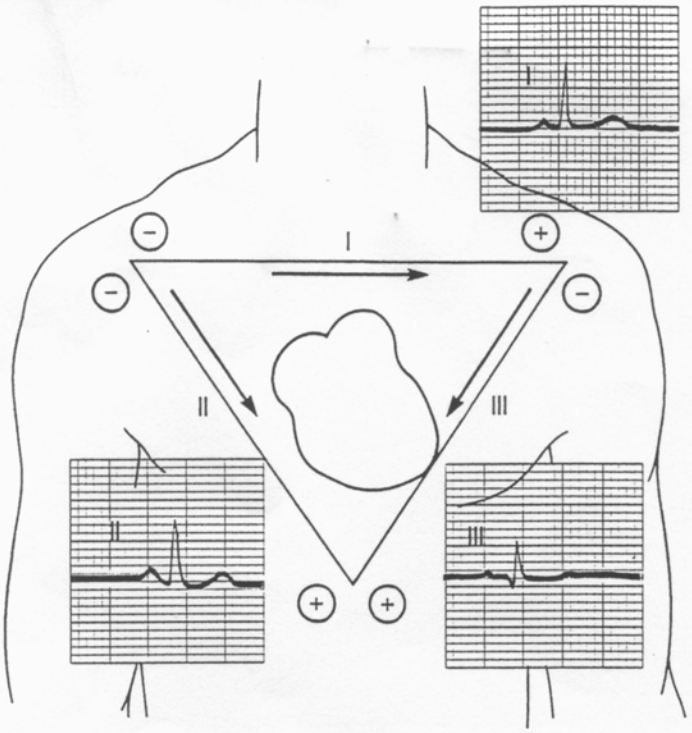

FIGURE **2-28**
Comparison of the waveforms recorded in the standard limb leads.

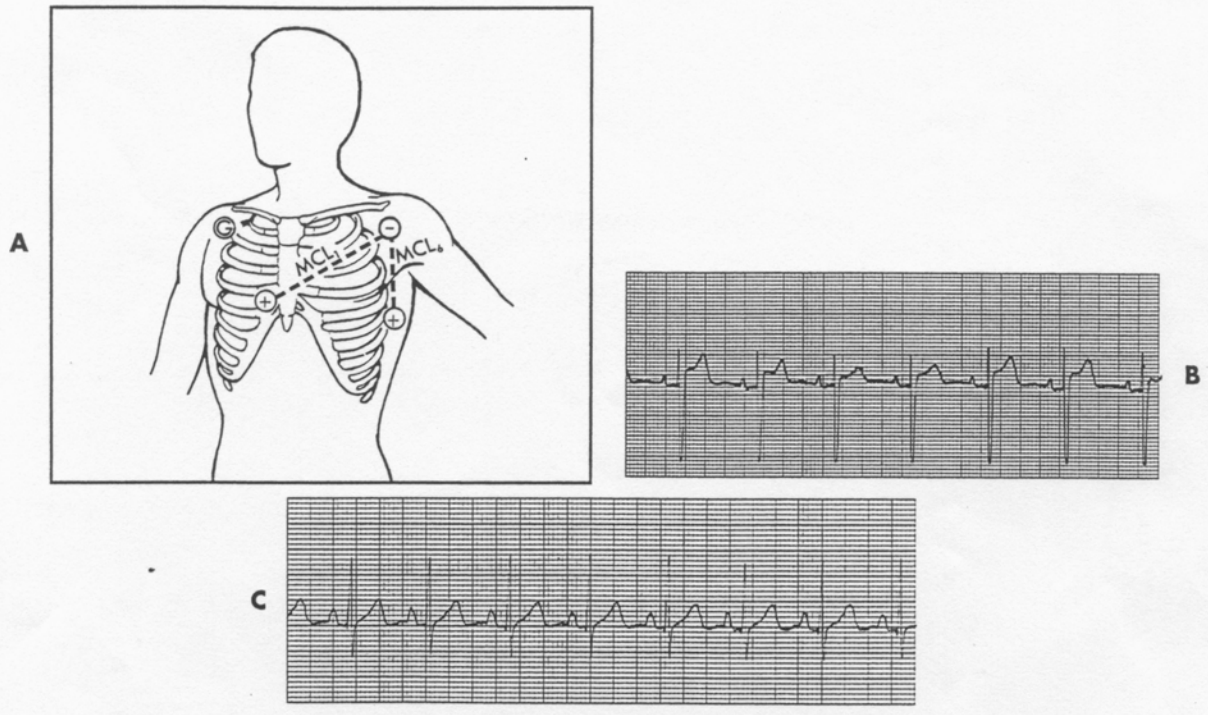

FIGURE **2-29**
A, Electrode placement for MCL_1 and MCL_6. **B,** Typical ECG tracing in MCL_1. **C,** Typical ECG tracing in MCL_6.

FIGURE **2-54**
Loose electrode.

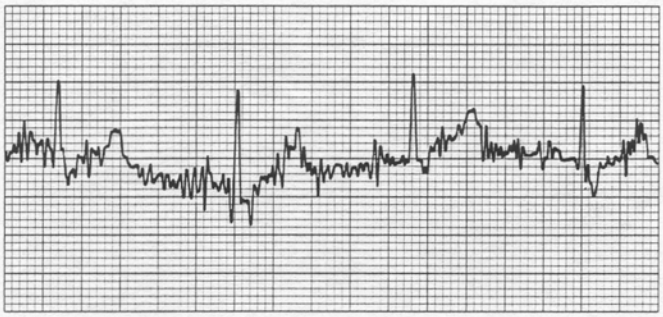

FIGURE **2-55**
Artifact caused by muscle tremors.

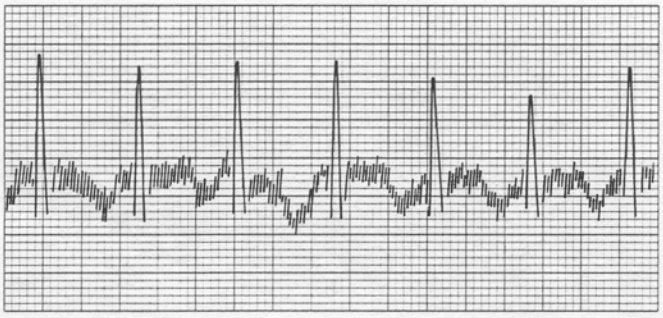

FIGURE **2-56**
60-cycle interference.

is observed, check for crossing of cable wires with other electrical wires (e.g., bed control) or frayed and broken wires. Verify that all electrical equipment is properly grounded and that the cable electrode connections are clean.

RATE MEASUREMENT

There are several methods used for calculating heart rate (Figure 2-57).

Method 1: Six-Second Method

Most ECG paper in use today is printed with 1-sec or 3-sec markers on the top or bottom of the paper. To determine the ventricular rate, count the number of *complete* QRS complexes within a period of 6 seconds and multiply that number by 10 to find the number of complexes in 1 minute. This method may be used for regular and irregular rhythms and is the simplest, quickest, and most commonly used method of rate measurement.

5 large boxes = 1 second.

15 large boxes = 3 seconds.

30 large boxes = 6 seconds.

Method 2: Large Boxes

To determine the ventricular rate, count the number of large boxes between two consecutive R waves (R-R interval) and divide into 300. To determine the atrial rate, count the