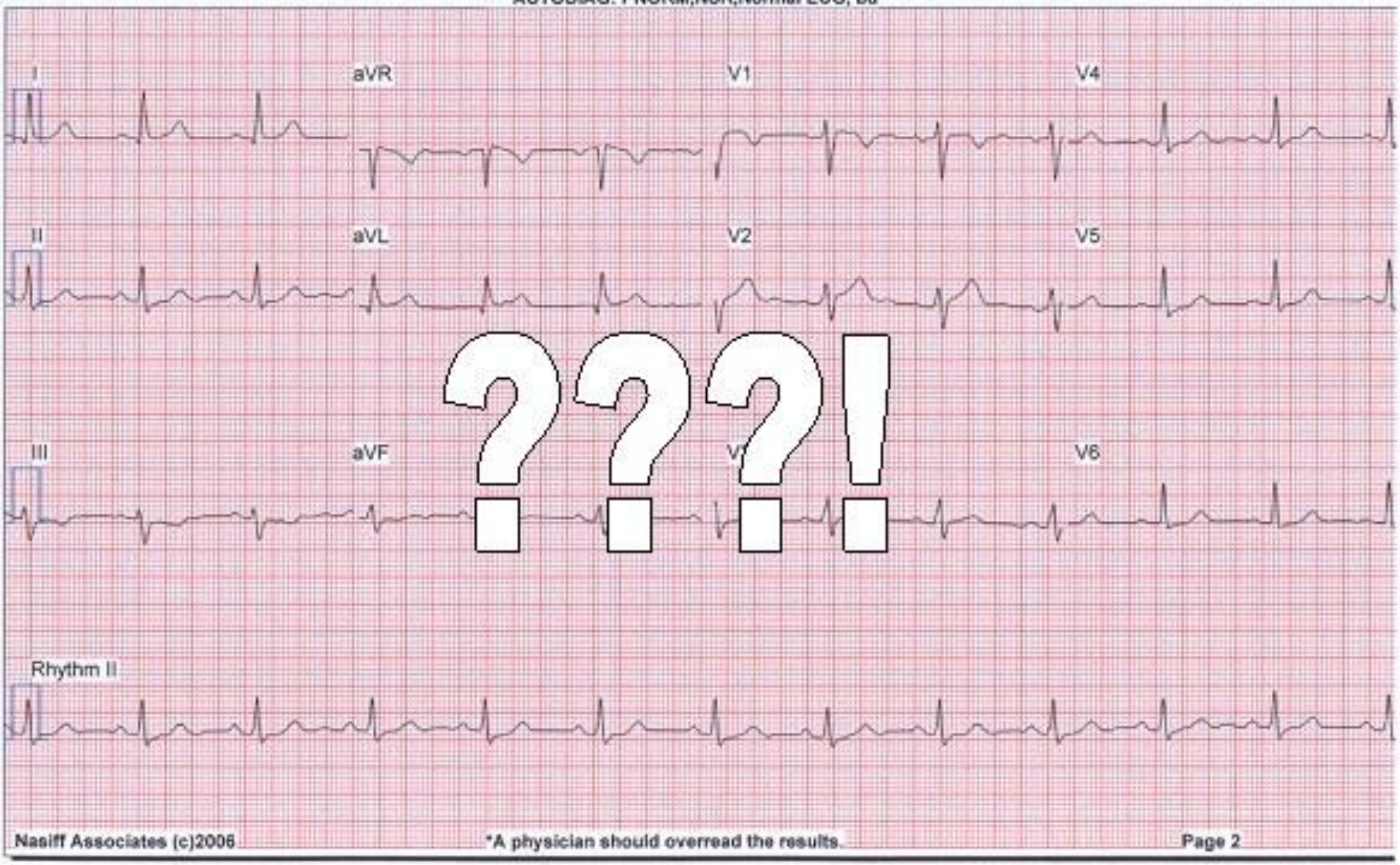
A brief introduction to the standard 12-lead ECG (EKG)

Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:

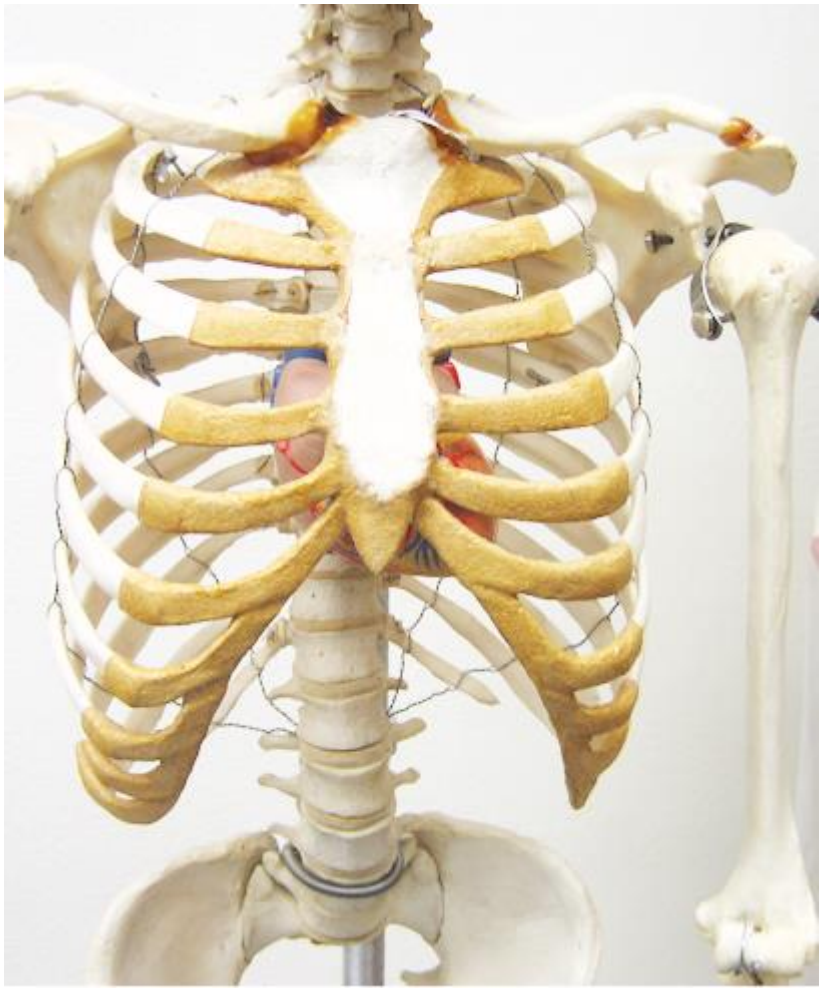
HR (bpm): 70 (lead II)
R-R (ms): 857
P dur (ms): 89
PR int (ms): 176
QRS dur (ms): 104
P/R/T axis: 58/8/18
QT/Qtc (ms): 424/438
Referring:
*** Confirmed by (required):
*** AUTODIAG: PNORM,NSR,Normal ECG, bu

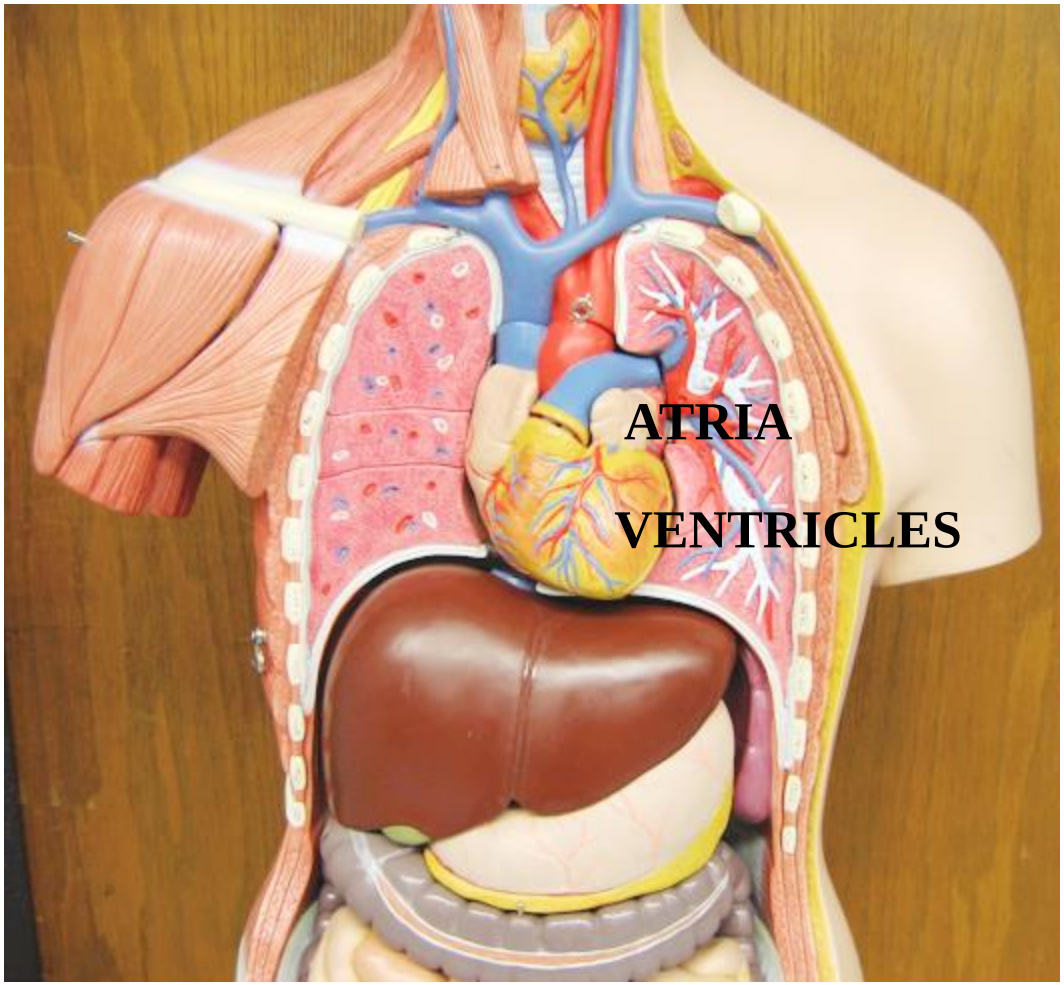
The 12-lead EKG (ECG)



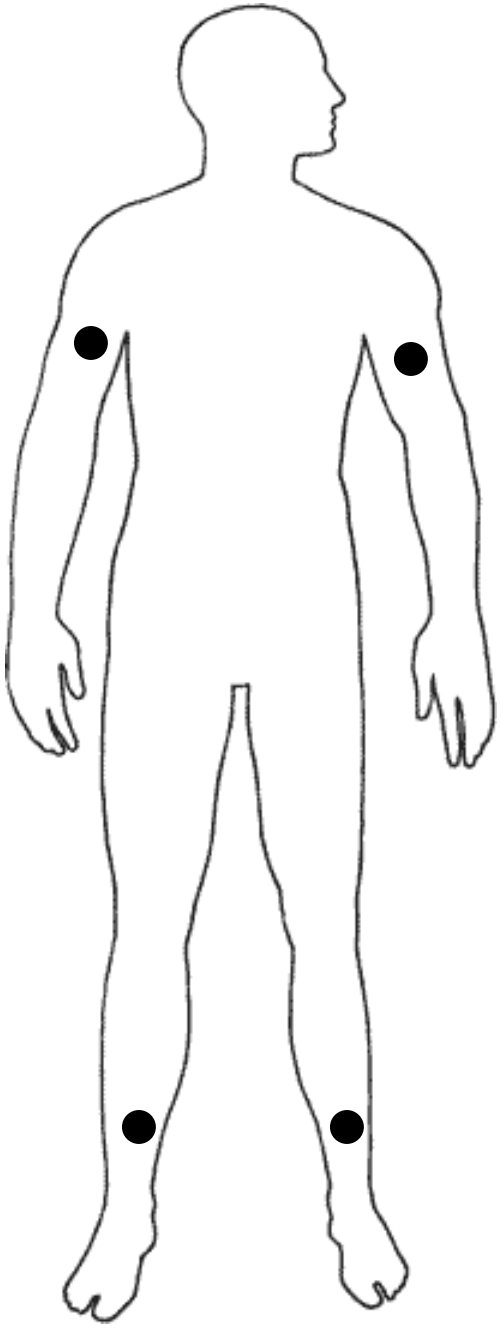
*A physician should overread the results.

The heart



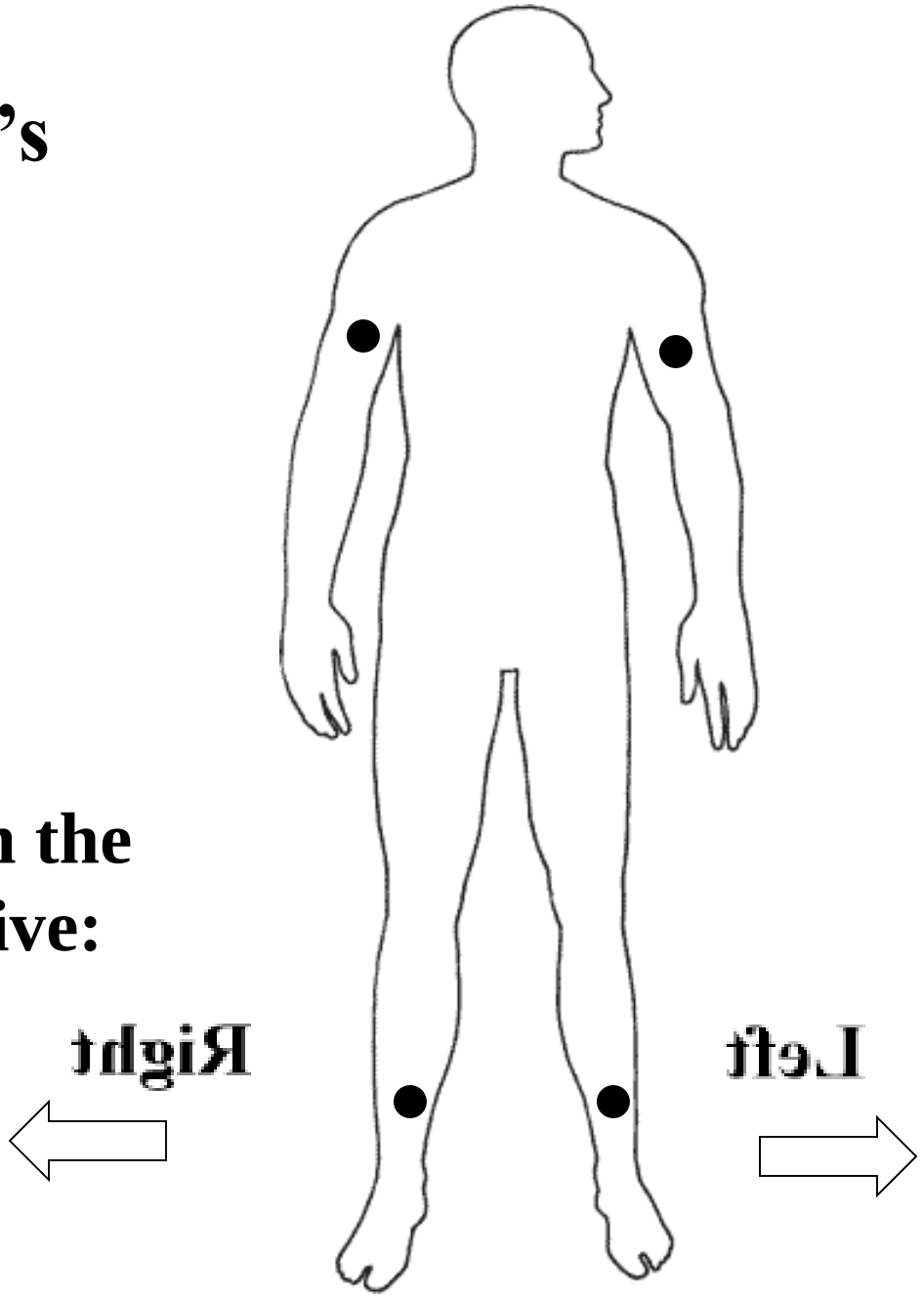


Sensing the heart's electrical activity via electrodes
(contacts placed on the surface of the body)

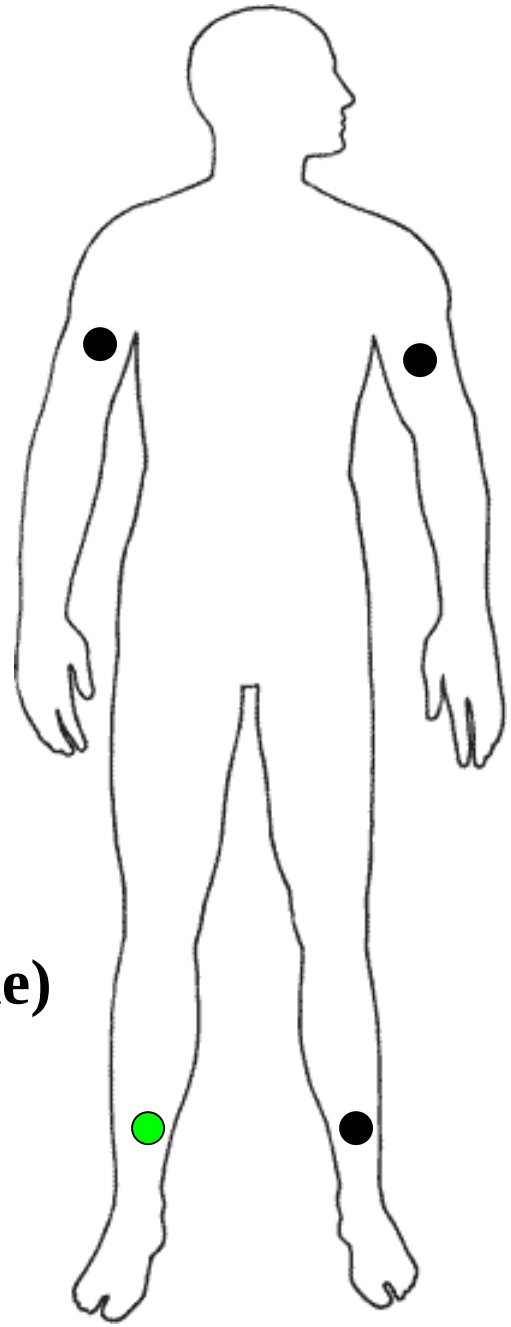


Sensing the heart's electrical activity via electrodes
(contacts placed on the surface of the body)

Note: anatomical orientation is from the subject's perspective:



The basic four limb electrodes:



right arm

left arm

electrical polarity:

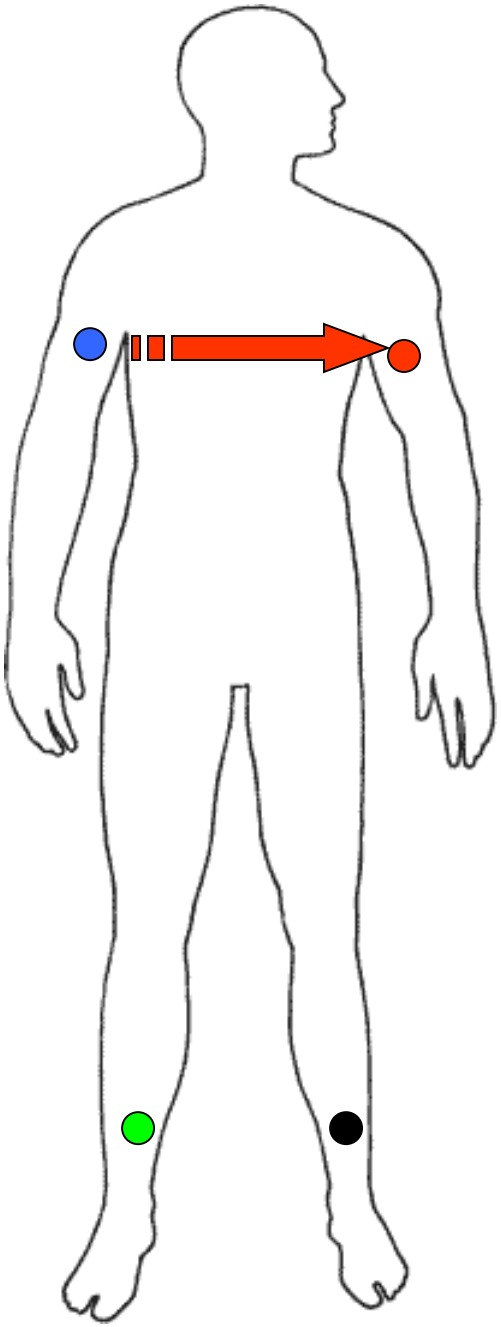
- neutral or ground
- negative
- positive

(manipulated by the EKG machine)

right leg

left leg

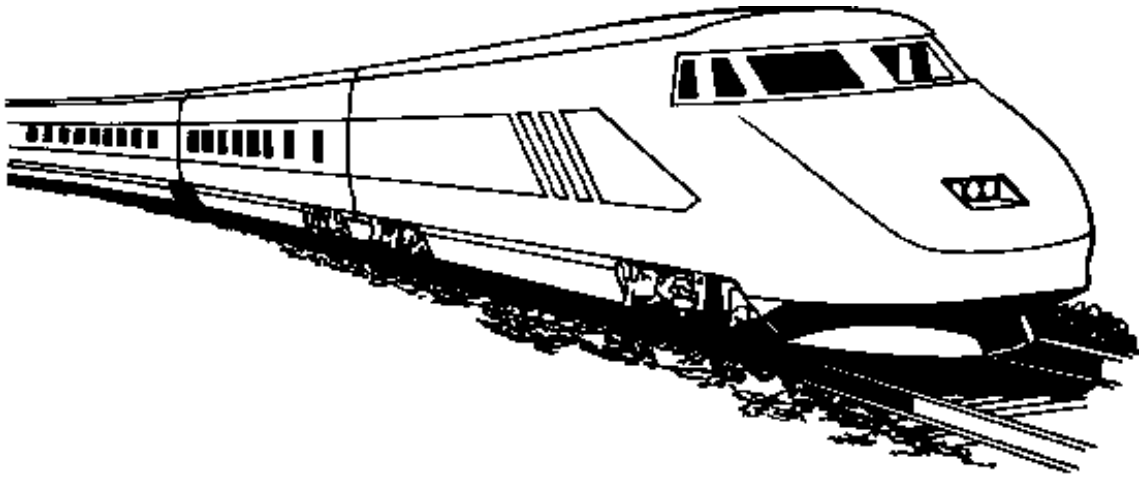
Lead I (toward left arm)



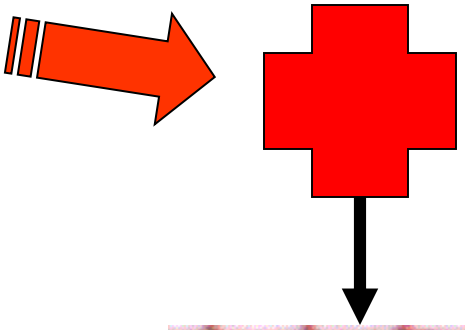
electrical polarity:

- neutral or ground
- negative
- positive

Interpreting the view from an electrode

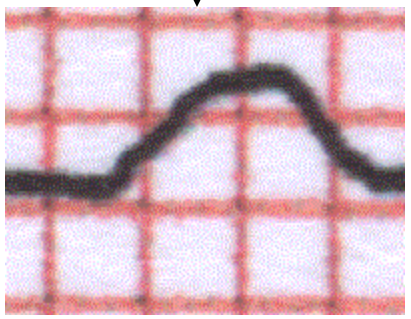


for any given viewing (positive) electrode:

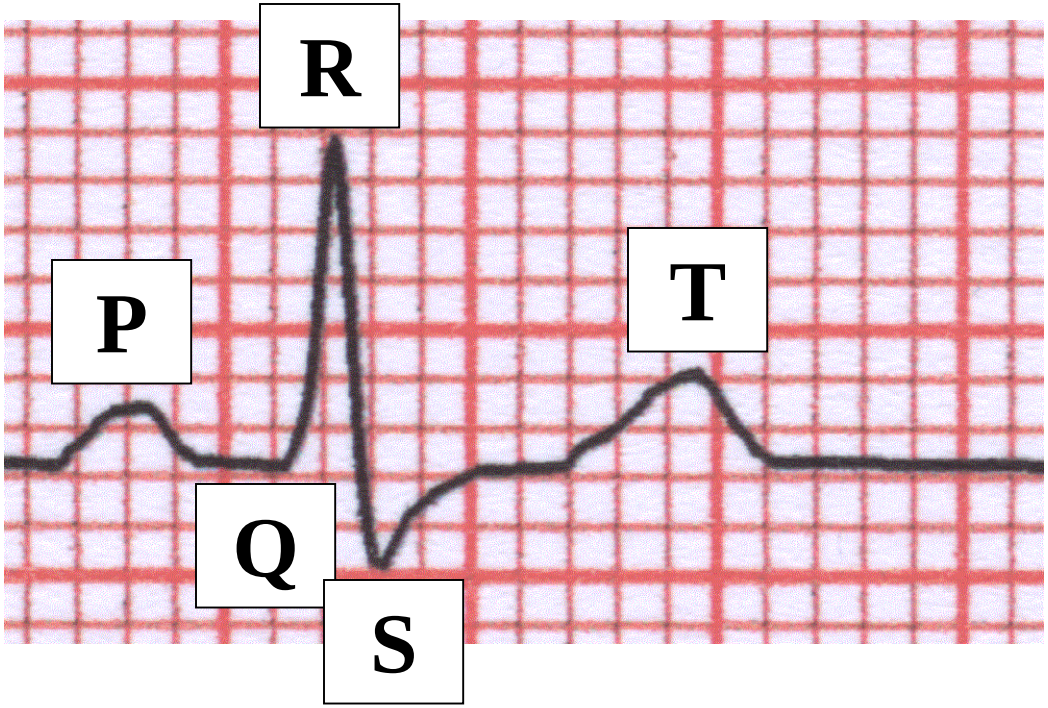


An approaching train of muscle fiber depolarizations (or repolarizations moving away) **is seen as an upward trace on the recording**

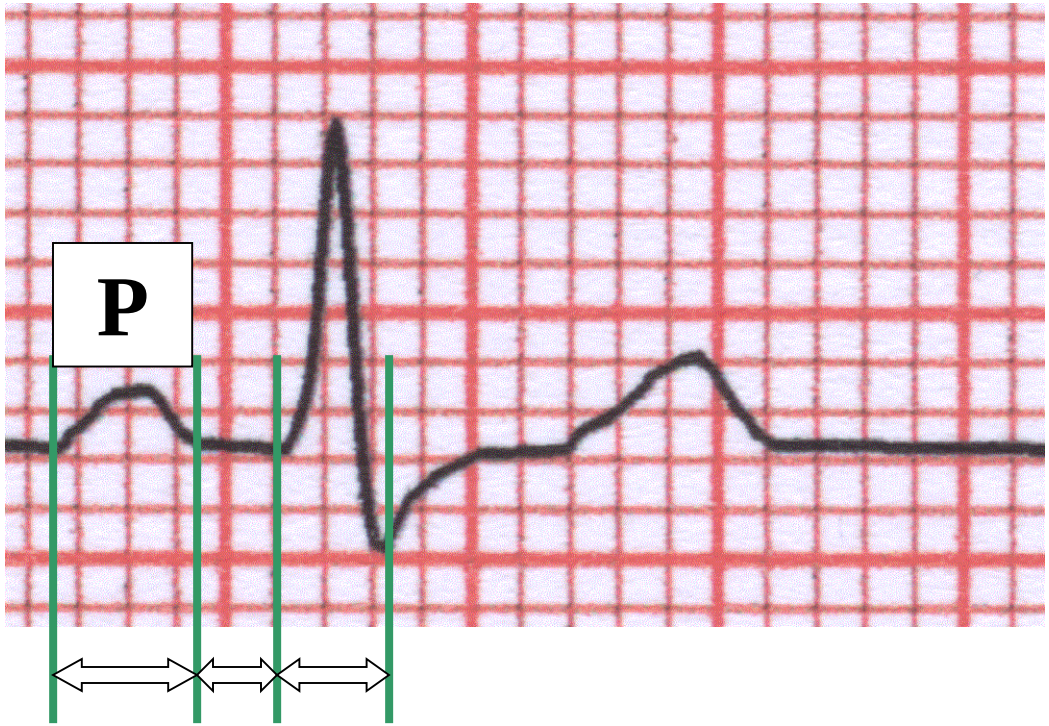
(opposite movement = downward trace)



Note: the normal average direction for the heart's electrical activity is from the upper right, in the right atrium, to the lower left.

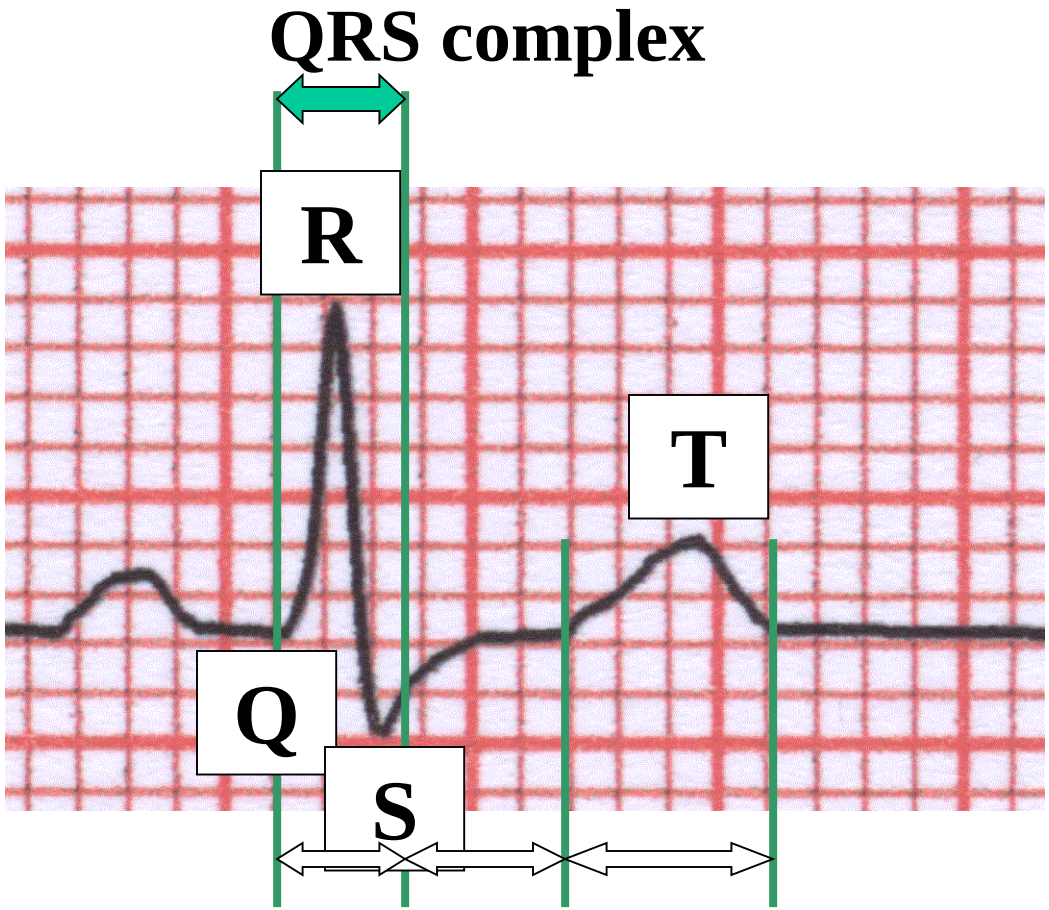


The main, typical waves of an EKG



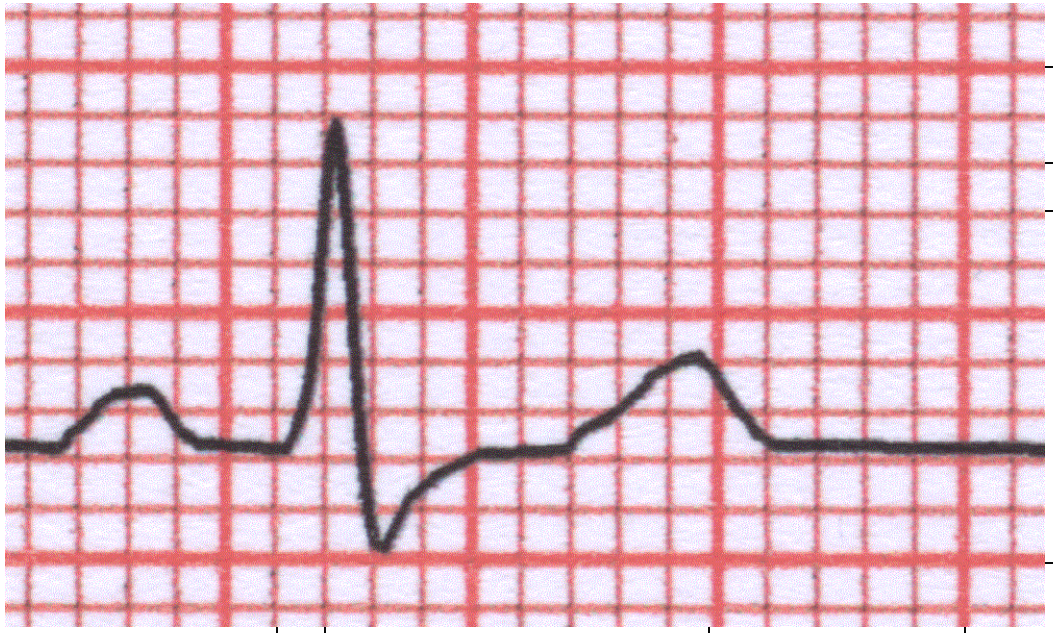
ATRIA: depol-pause-repol

(atrial repolarization is obscured by ventricular depolarization)



VENTRICLES: depol-pause-repolarize

Standard calibration of EKG recordings



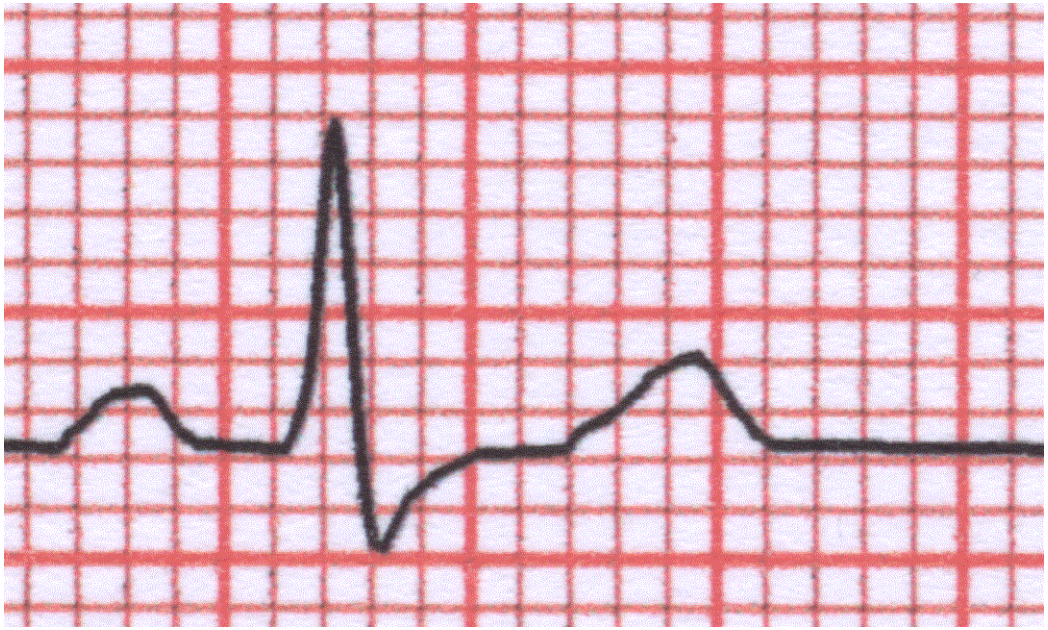
1 mm = 0.1 mV

1 cm = 1 mV

1 mm = 0.04 seconds

25 mm/second

5 mm = 0.20 seconds



The appearance depends on the location of the electrode and what the heart's electrical activity is doing (resting or active, normal vs various abnormalities, etc.).

In addition to Lead I, here are the others …(following pages)

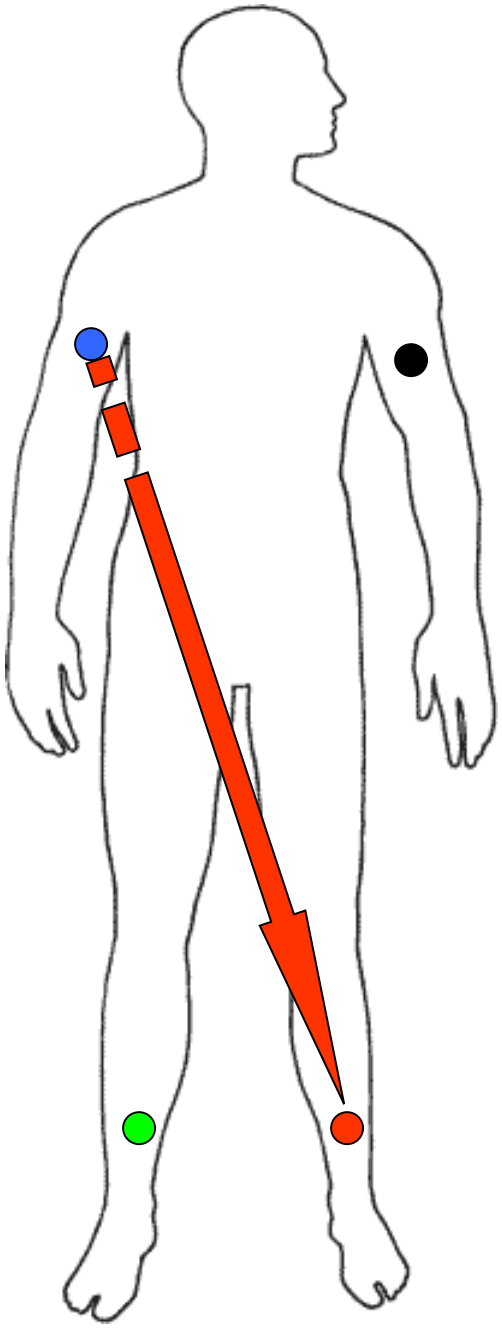
Lead II (from the right arm toward the left leg)

right arm

left arm

electrical polarity:

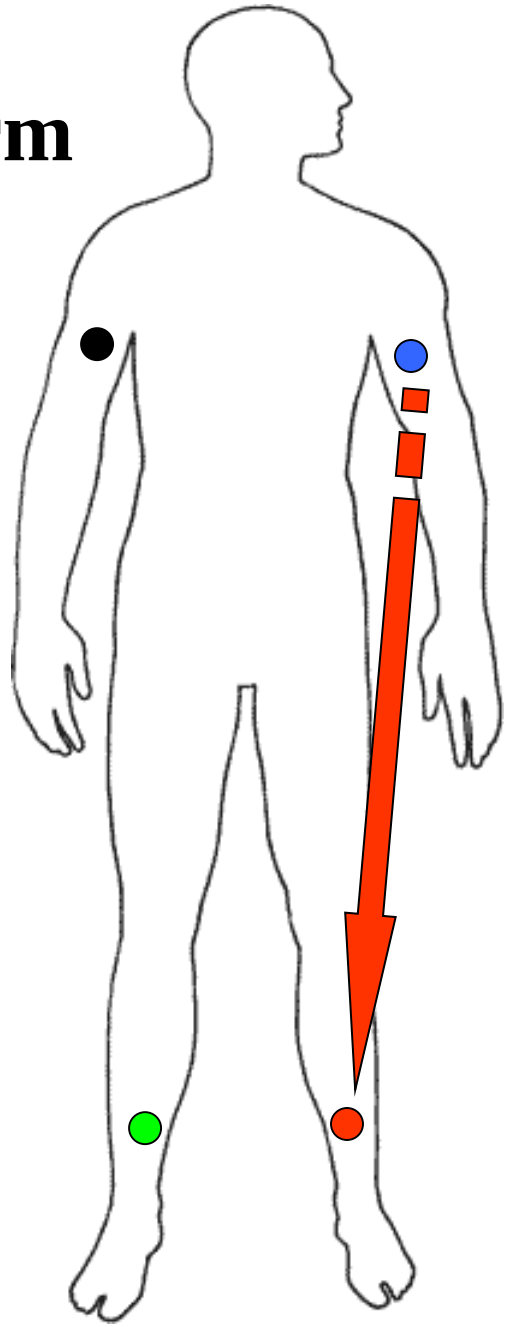
- neutral or ground
- negative
- positive



right leg

left leg

Lead III (from the left arm toward the left leg)



electrical polarity:

- neutral or ground
- negative
- positive

Leads I, II, & III together

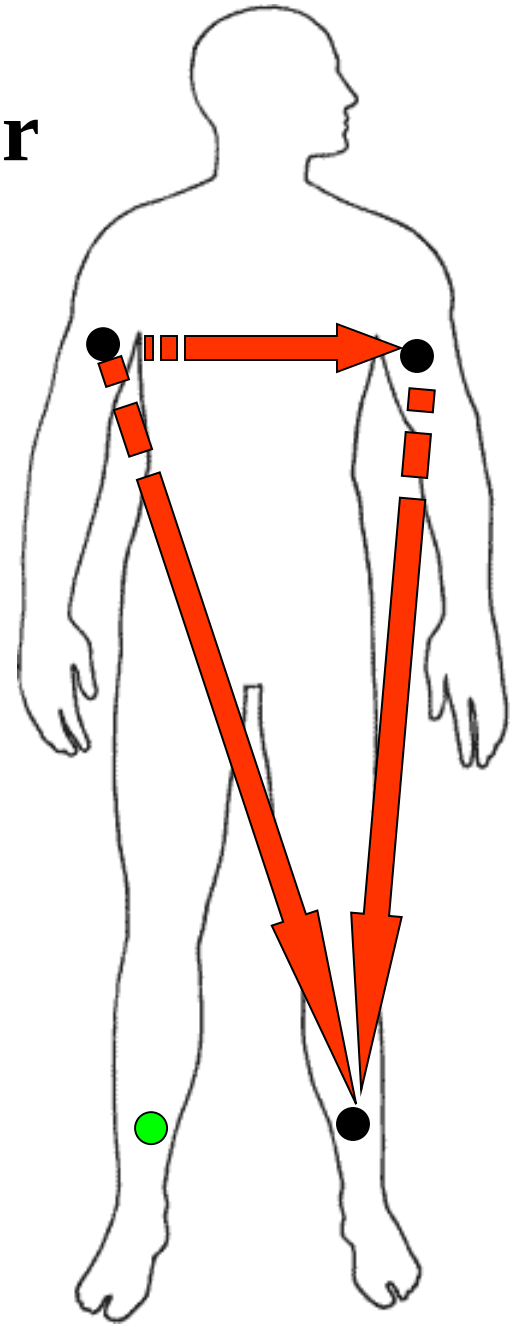
("Einthoven's triangle")

right arm

left arm

electrical polarity:

- **neutral or ground**
- **negative**
- **positive**

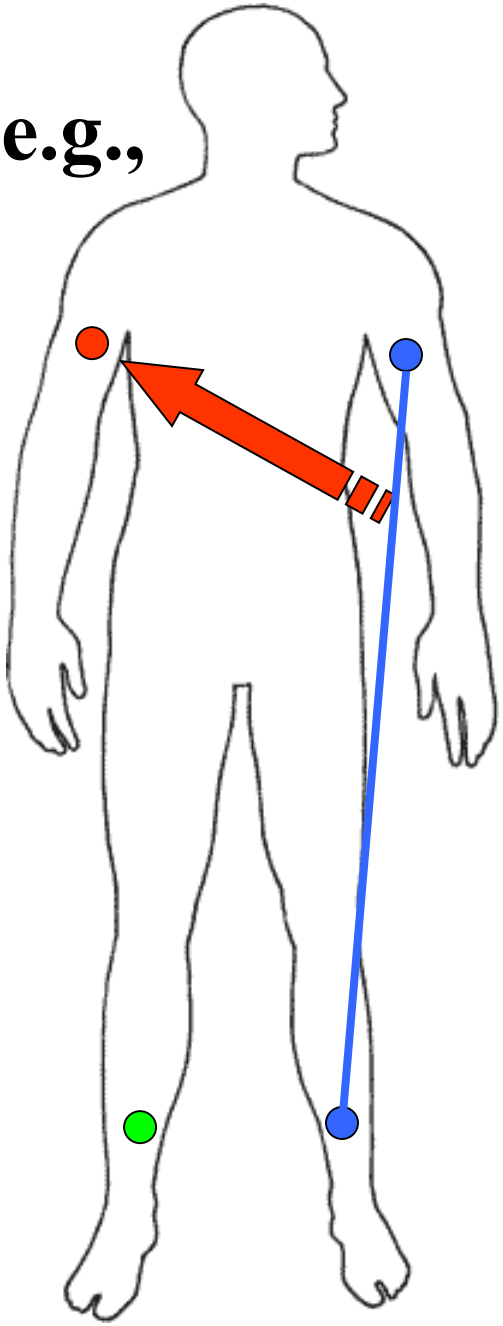


right leg

left leg

Plus “augmented” leads, e.g.,

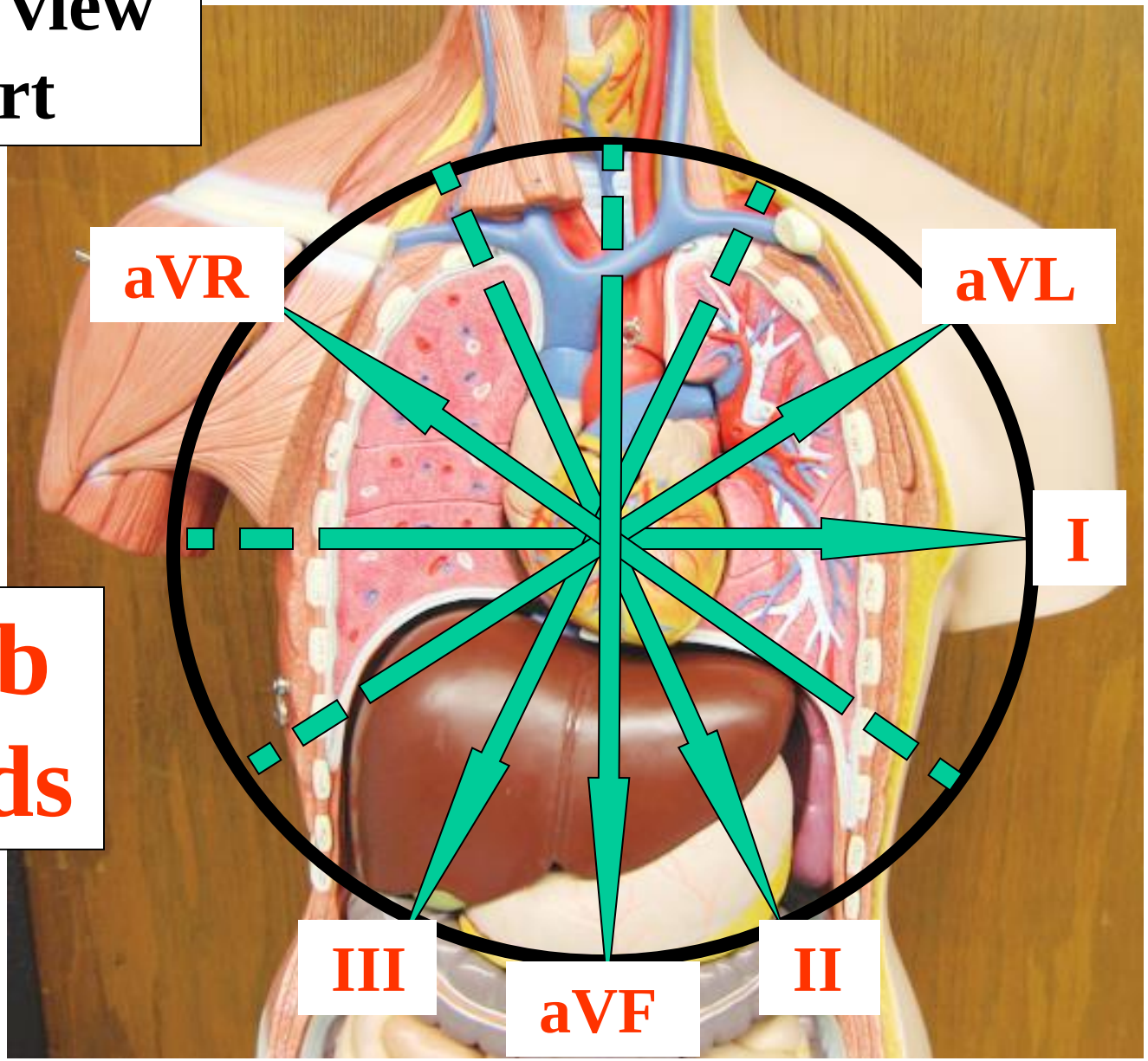
aVR



electrical polarity:

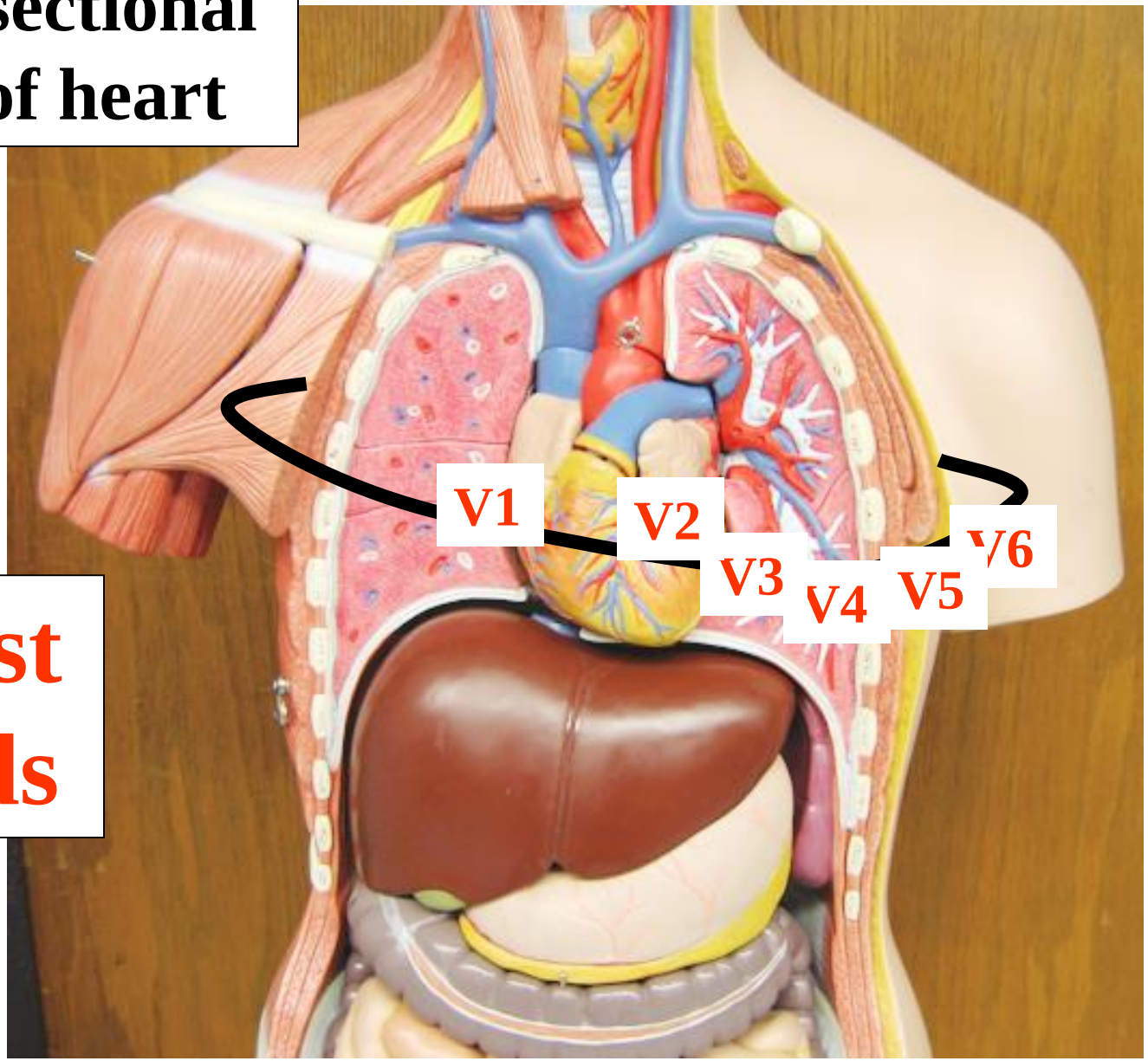
- **neutral or ground**
- **negative**
- **positive**

Frontal view of heart



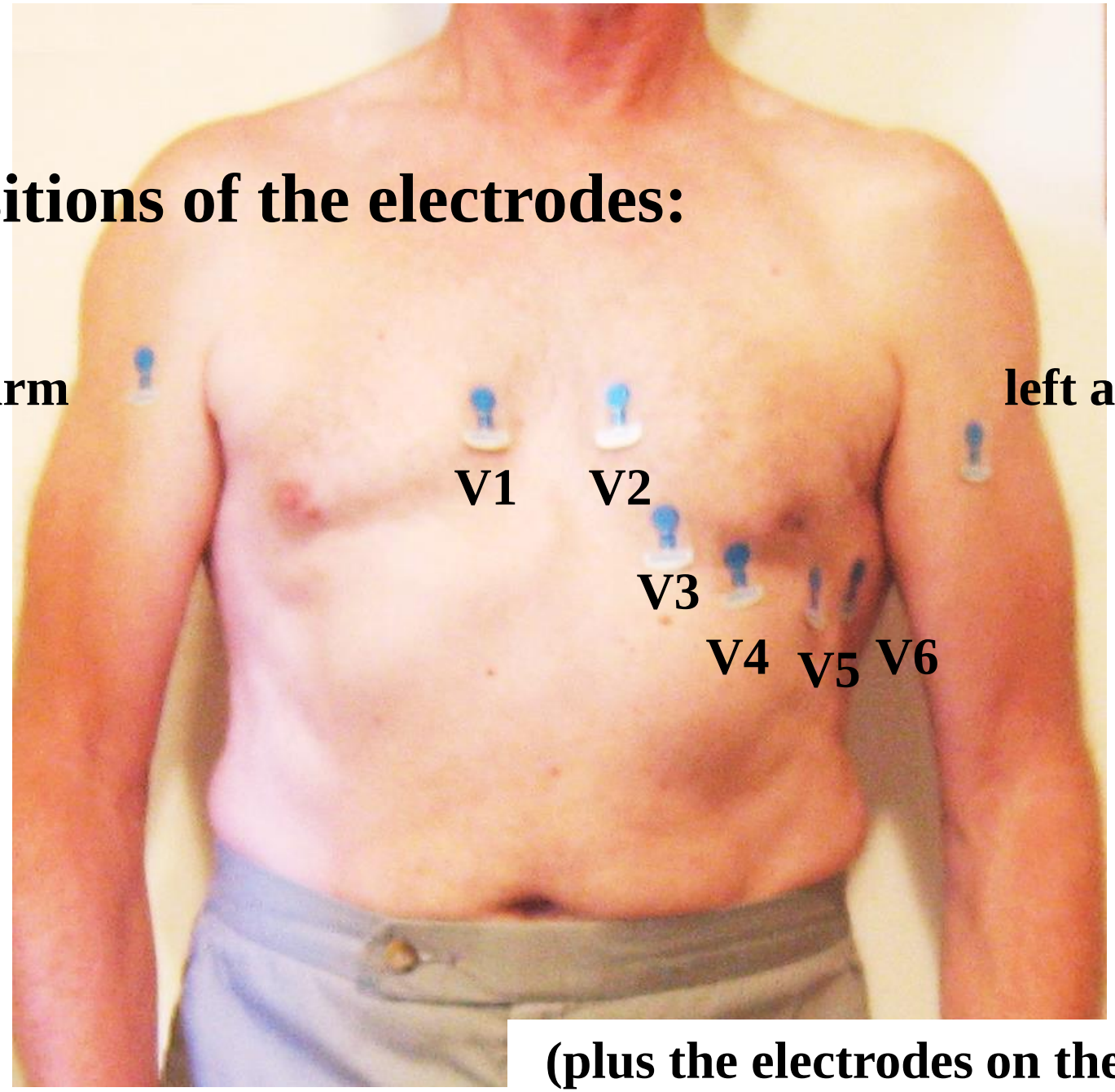
Limb Leads

Cross sectional view of heart



Chest leads

Positions of the electrodes:



(plus the electrodes on the legs)

Summary: the 12 standard leads are :

Limb leads –

I, from the right arm (-) toward the left arm (+)
II, from the right arm toward the left leg
III, from the left arm toward the left leg

(taken together, these three form the classic "Einthoven's triangle")

aVR, augmented lead toward the right (arm)
aVL, augmented lead toward the left (arm)
aVF, augmented lead toward the foot

(note: aVR is approx. opposite of I and should essentially mirror the shape of I vertically)

Chest leads –

V1 through V6, starting over the right atrium with V1, and placed in a semi-circle of positions leftwards, to the left side of the left ventricle

The normal progression of muscular contractions, hence, electrical activity, travels from the upper right part of the atria downward and leftwards to the ventricles, with the left ventricle being the strongest.

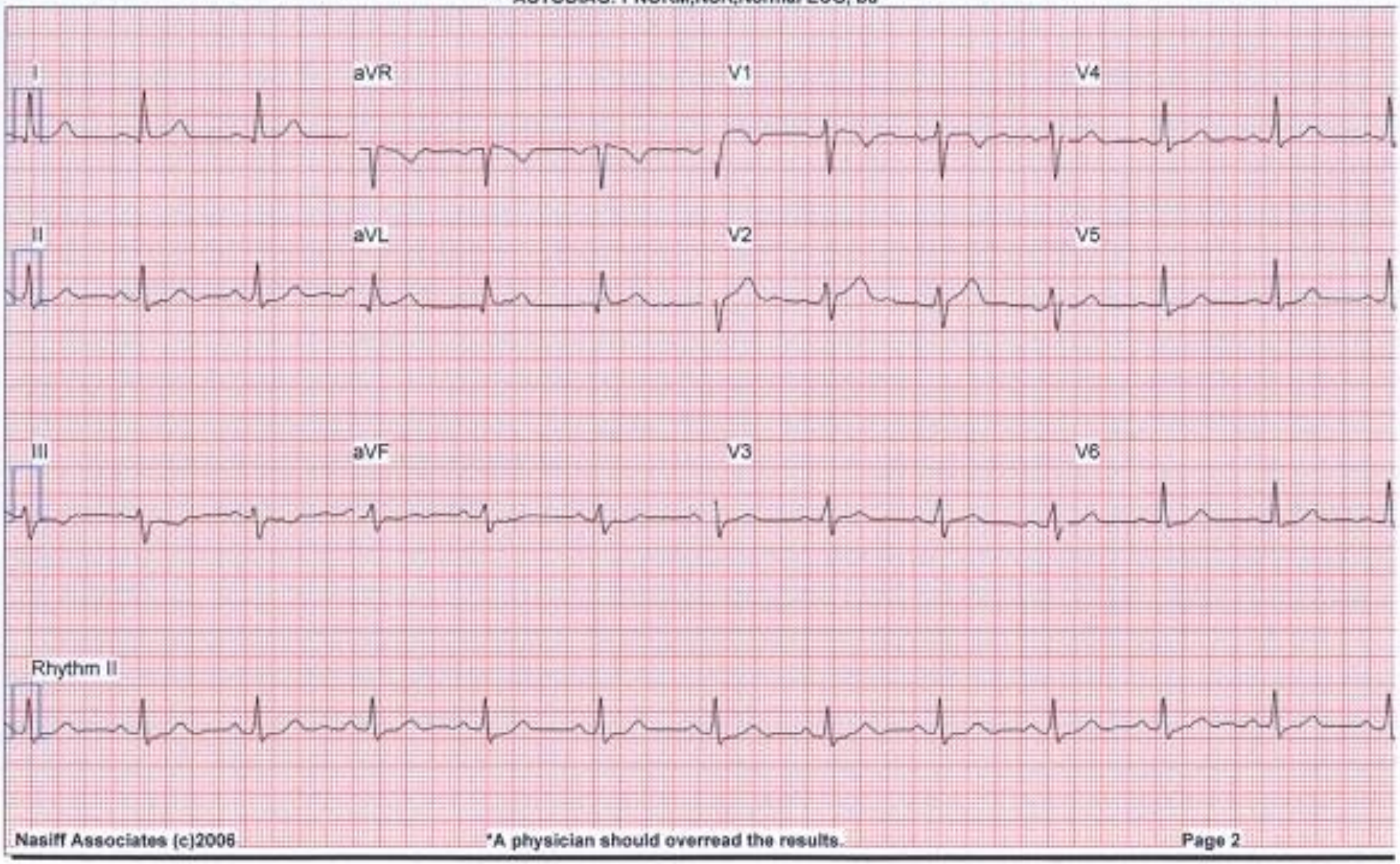
Various combinations of limb leads and chest leads taken together provide a three-dimensional view into the electrical activity and workings of the heart for anyone who knows how to read an EKG.

Abnormalities, such as heart attacks, arrhythmias, congenital problems, and a host of diseases and factors that affect the heart will cause sometimes major and sometimes subtle changes to the EKG patterns, which can be interpreted by a trained, experienced observer.

Example of a complete 12-lead EKG (ECG)

Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:

HR (bpm): 70 (lead II)
R-R (ms): 857
P dur (ms): 89
PR int (ms): 176
QRS dur (ms): 104
P/R/T axis: 58/8/18
QT/Qtc (ms): 424/438
Referring:
*** Confirmed by (required):
*** AUTODIAG: PNORM,NSR,Normal ECG, bu



*A physician should overread the results.

Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:

HR (bpm): 70 (lead II)
R-R (ms): 857
P dur (ms): 89
PR int (ms): 176
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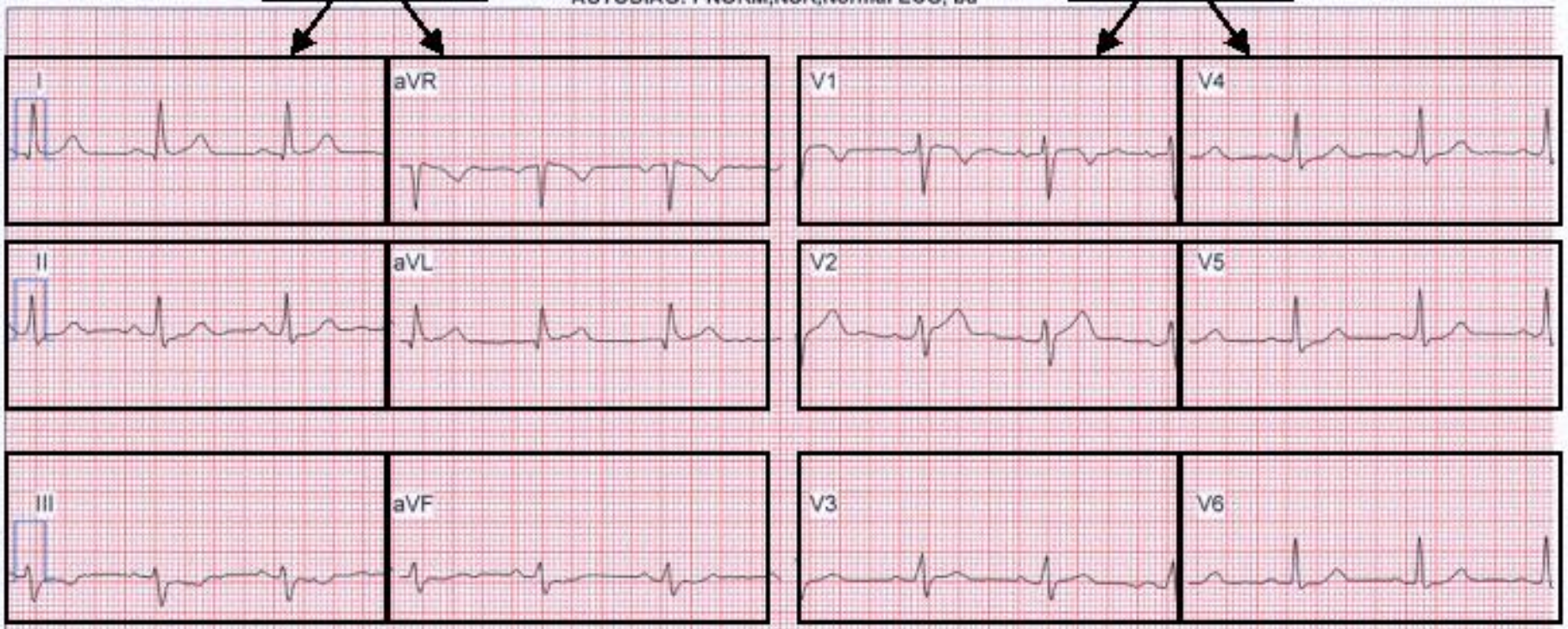
QT/Qtc (ms): 424/438
Referring:
*** Confirmed by (required):
*** AUTODIAG: PNORM,NSR,Normal ECG, bu

Example of a complete 12-lead EKG (ECG)

limb leads

chest leads



Layout of the outputs from the 12 leads on the recording. Other arrangements also are used, but this is the main, routine way of showing them.

*A physician should overread the results.

Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:

HR (bpm): 70 (lead II)
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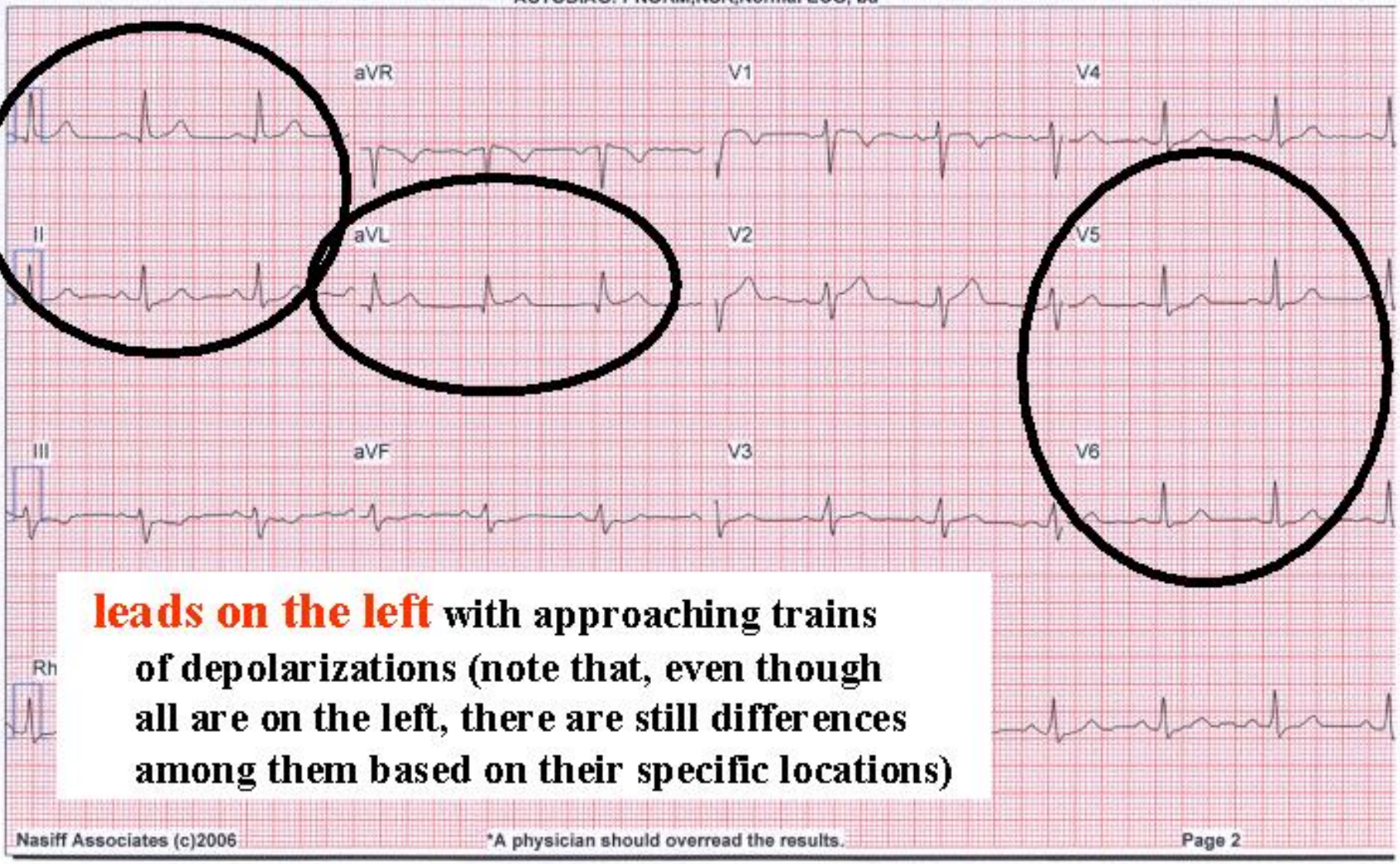
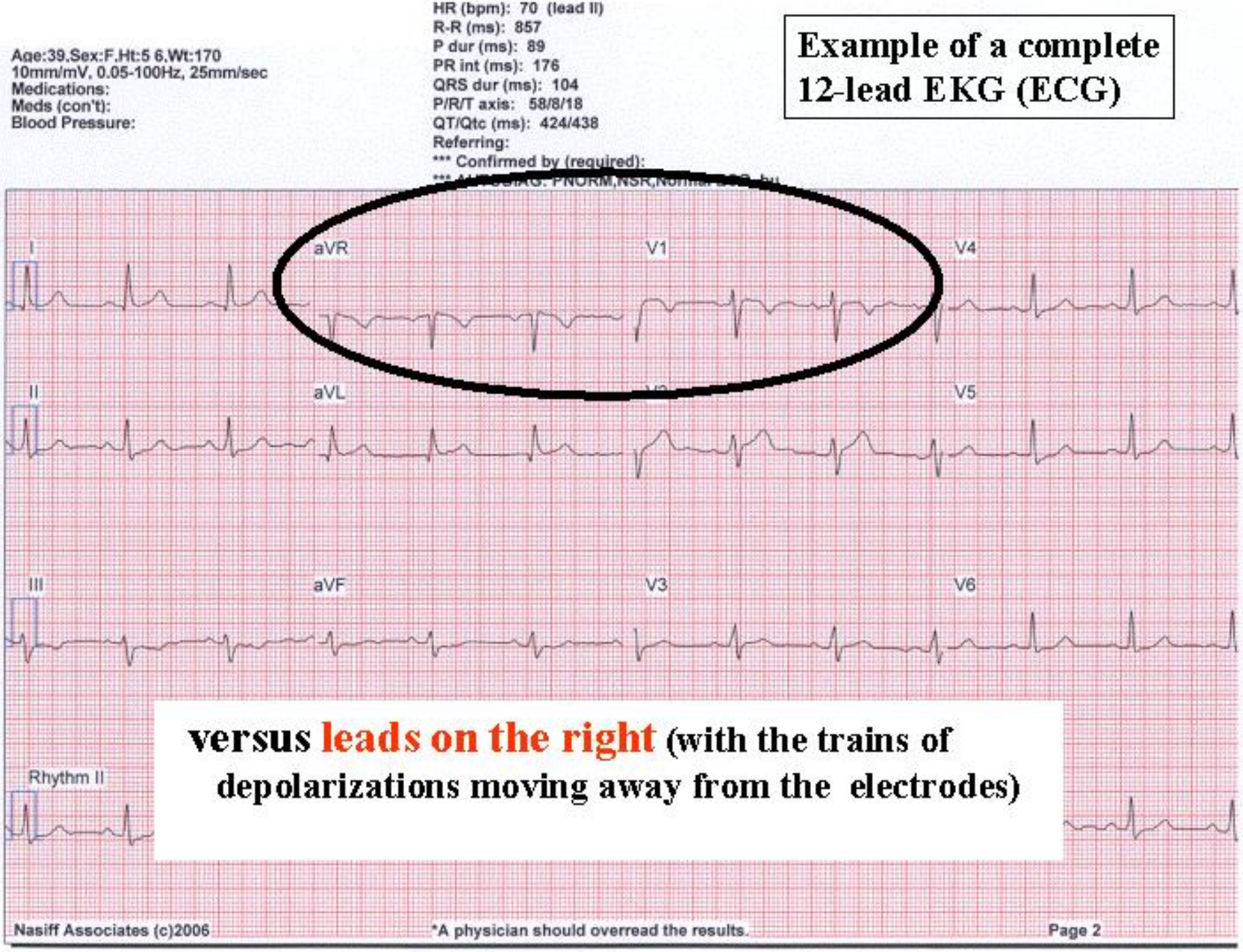
Example of a complete 12-lead EKG (ECG)



leads on the left with approaching trains of depolarizations (note that, even though all are on the left, there are still differences among them based on their specific locations)

*A physician should overread the results.


Age:39.Sex:F.Ht:5 6.Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
Meds (con't):
Blood Pressure:
HR (bpm): 70 (lead II)
R-R (ms): 857
P dur (ms): 89
PR int (ms): 176
QRS dur (ms): 104
P/R/T axis: 58/8/18
QT/Qtc (ms): 424/438
Referring:
*** Confirmed by (required):
Example of a complete 12-lead EKG (ECG)
I
aVR
V1
V4
II
aVL
V5
III
aVF
V3
V6
Rhythm II
versus leads on the right (with the trains of depolarizations moving away from the electrodes)
Nasiff Associates (c)2006
*A physician should overread the results.
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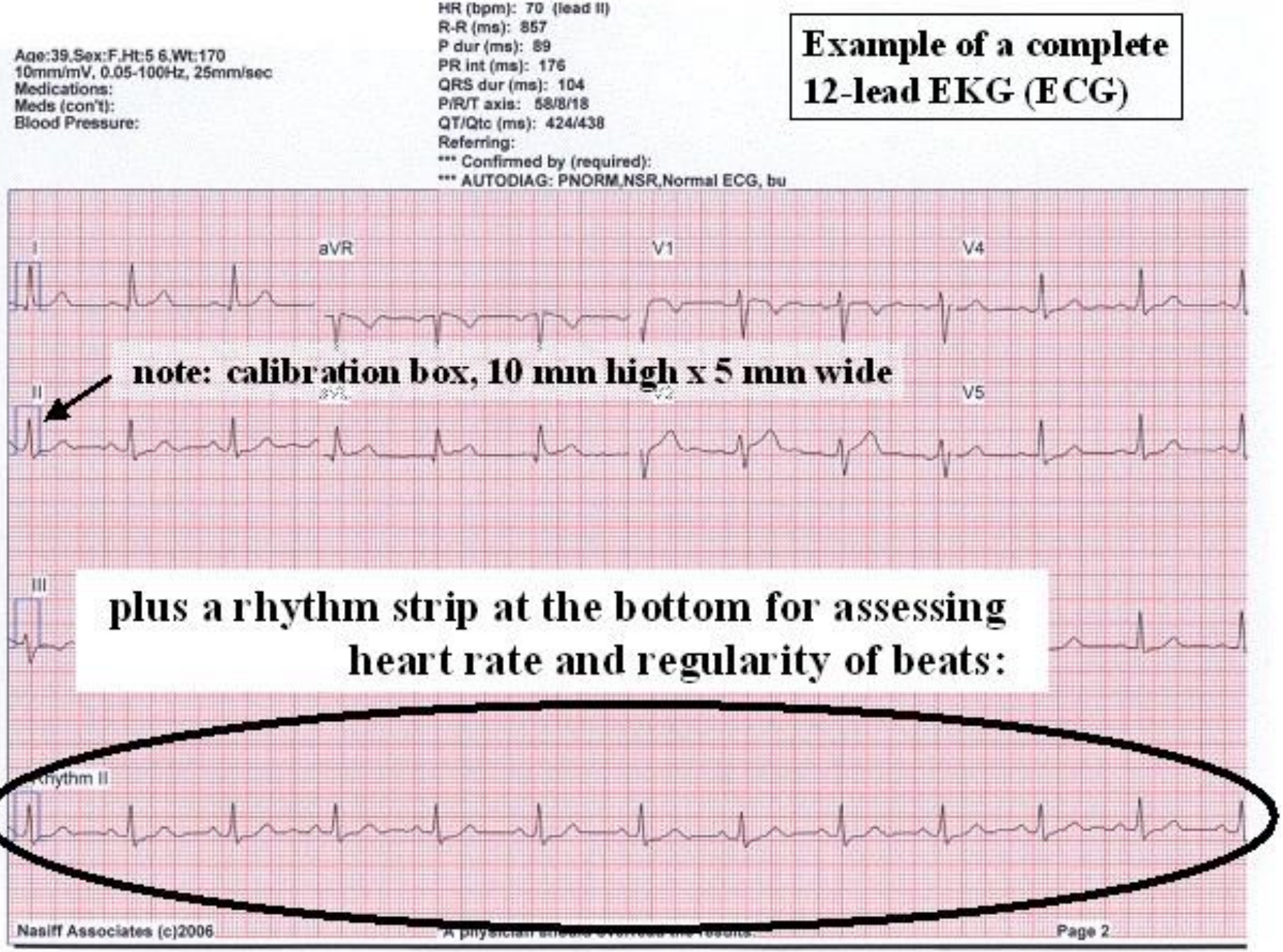
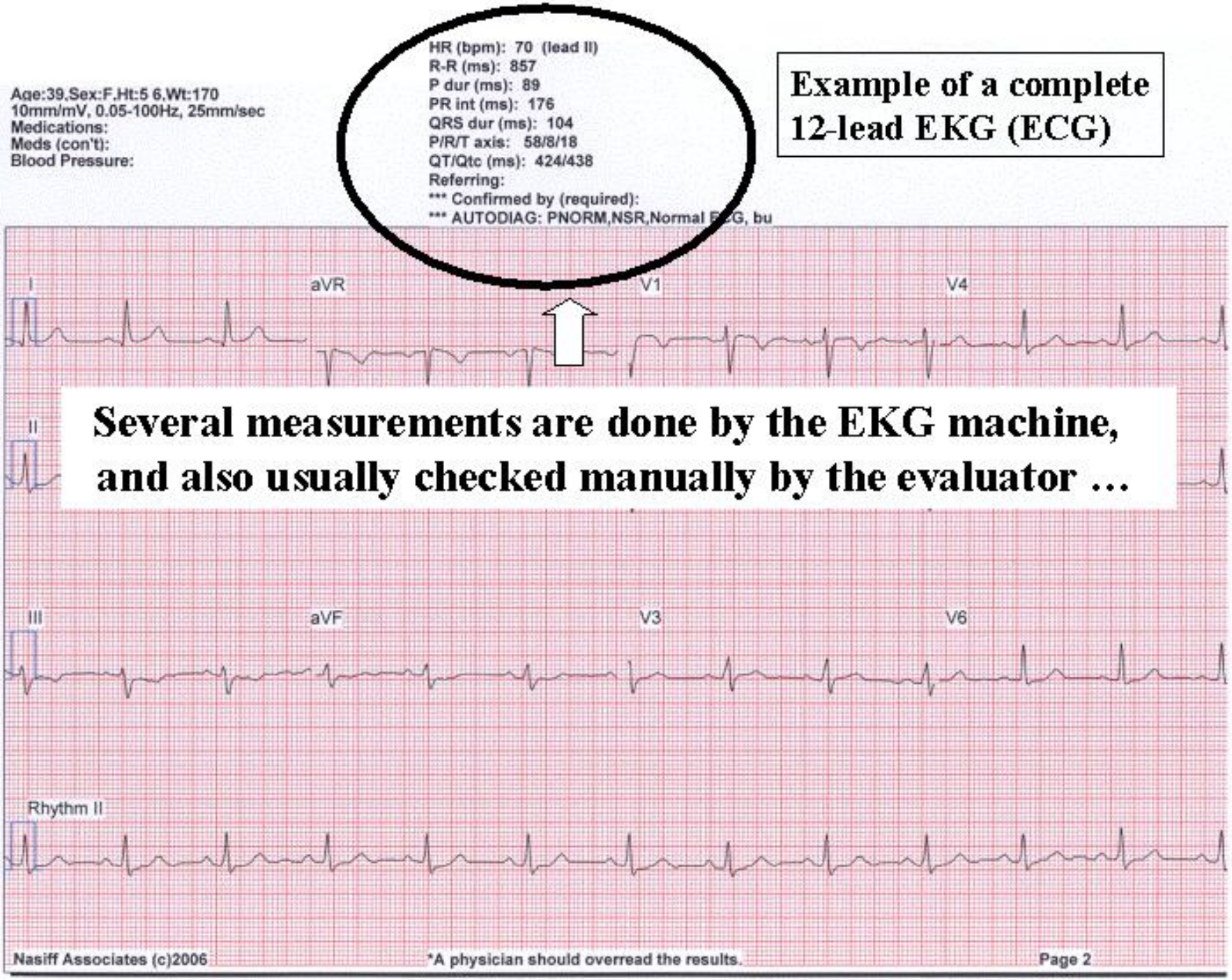
Example of a complete 12-lead EKG (ECG)




Age:39,Sex:F,Ht:5 6,Wt:170
10mm/mV, 0.05-100Hz, 25mm/sec
Medications:
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Blood Pressure:
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QT/Qtc (ms): 424/438
Referring:
*** Confirmed by (required):
*** AUTODIAG: PNORM,NSR,Normal ECG, bu
Example of a complete 12-lead EKG (ECG)
I
aVR
V1
V4
II
Several measurements are done by the EKG machine, and also usually checked manually by the evaluator …
III
aVF
V3
V6
Rhythm II
Nasiff Associates (c)2006
*A physician should overread the results.
Page 2

Example of a complete 12-lead EKG (ECG)