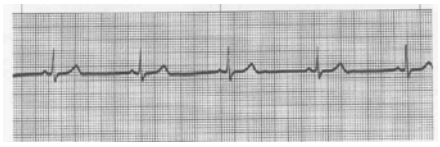
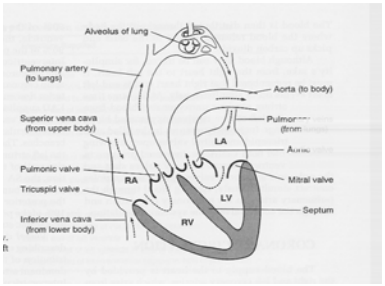
Electrocardiography Review and the Normal EKG Response to Exercise



Cardiac Anatomy



Quick Quiz

- Which valves are the a-v valves?
- Closure of the a-v valves is associated with which heart sound?
- Which are the semilunar valves?
- Closure of the semilunar valves is associated with which heart sound?

Electrical Pathways in the Heart

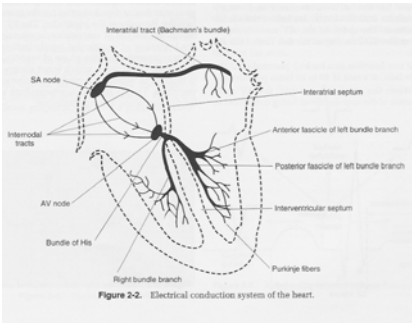
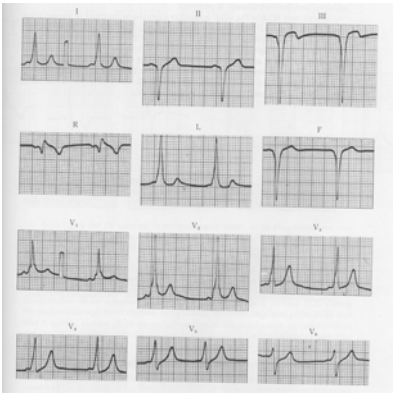
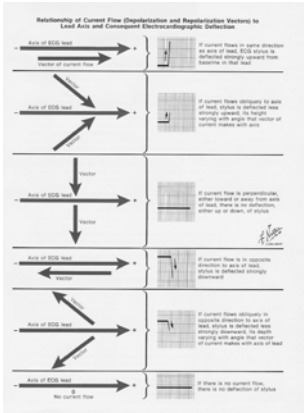


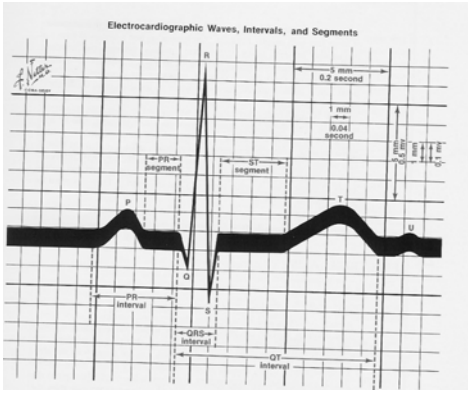
Figure 2-2. Electrical conduction system of the heart.

Quick Quiz

- What abnormal cardiac rhythm is caused by an accessory conducting pathway between the atria and ventricles that causes premature contraction of part of the ventricles? (Bundle of Kent)
- Hint, this causes a "slurring" of the QRS complex (a delta wave).







Quick Quiz

- How long is a normal PR interval?
- How long should the QRS interval be?
- What arrhythmia is characterized by a prolonged PR interval?

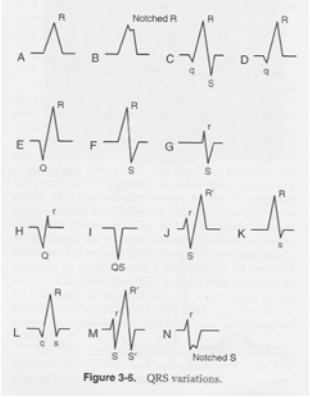
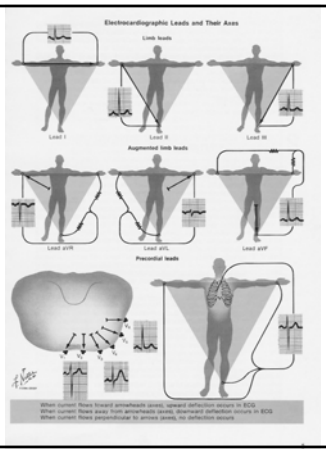


Figure 3-6. QRS variations.

Frontal Leads?



Horizontal Plane Leads?

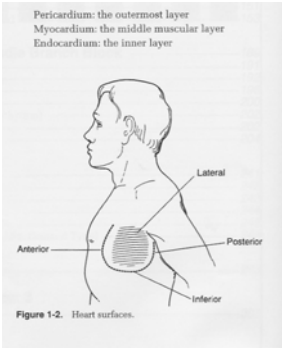


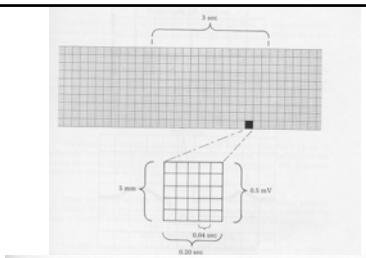
Figure 1-2. Heart surfaces.

Anterior leads: V3, V4

Lateral leads: I, aVL, V5, V6

Inferior leads: II, III, aVF

Septal leads: V1, V2



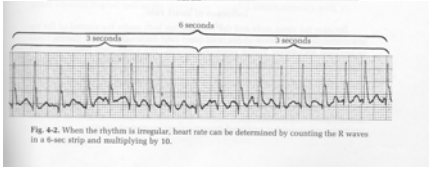


Fig. 4-2. When the rhythm is irregular, heart rate can be determined by counting the R waves in a 6-sec strip and multiplying by 10.

Steps for Analyzing an EKG strip

Rhythm, rate, P waves, PR interval, QRS interval, QT interval, ST, T/U waves, interpretation

Table for Small Box Method to measure HR

Electrocardiographic Conversion Table for Heart Rate

Number of Small Spaces	Rate per Minute	Number of Small Spaces	Rate per Minute	Number of Small Spaces	Rate per Minute
5	300	26	58	47	32
6	250	27	56	48	31
7	214	28	54	49	31
8	188	29	52	50	30
9	167	30	50	52	29
10	150	31	48	54	28
11	136	32	47	56	27
12	125	33	45	58	26
13	115	34	44	60	25
14	107	35	43	62	24
15	100	36	42	64	23
16	94	37	41	68	22
17	88	38	40	72	21
18	84	39	39	76	20
19	79	40	38	80	19
20	75	41	37	84	18
21	72	42	36	88	17
22	68	43	35	92	16
23	65	44	34	96	15
24	63	45	33	104	14
25	60	46	33	112	13

(Modified from Meltzer LE et al: Intensive Coronary Care: A Manual for Nurses. Bowie, MD: Charles Press, 1979.)

See back cover of Huff

Quick Quiz

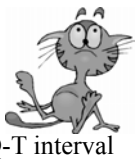
- For the rhythm to be called "irregular", the distance between R waves would vary by more than how many small blocks?
- How many large blocks do you count to mark 6 seconds?
- Once you count the R waves for 6 seconds, what do you do next to estimate the HR?

QT interval is dependent on HR and gender (below)

Data for computing heart rate, with maximum QT intervals at various rates

Heart rate ↓	Cycle time (0.04-second intervals)	Maximum QT (seconds) Male	Maximum QT (seconds) Female	Heart rate ↓	Cycle time (0.04-second intervals)	Maximum QT (seconds) Male	Maximum QT (seconds) Female
300	5	.19	.20	68	22	.38	.41
250	6	.20	.22	65	23	.38	.42
214	7	.21	.23	62	24	.39	.43
187	8	.23	.25	60	25	.40	.44
166	9	.24	.26	57	26	.41	.45
150	10	.25	.28	55	27	.42	.46
136	11	.26	.29	52	28	.42	.47
125	12	.28	.30	50	30	.44	.48
115	13	.29	.32	46	32	.45	.50
107	14	.30	.33	43	34	.47	.51
100	15	.31	.34	41	36	.48	.53
93	16	.32	.35	39	38	.49	.54
88	17	.33	.36	37	40	.51	.56
83	18	.34	.37	35	42	.52	.57
78	19	.35	.38	34	44	.53	.58
75	20	.36	.39	32	46	.54	.60
71	21	.37	.40	30	50	.57	.62

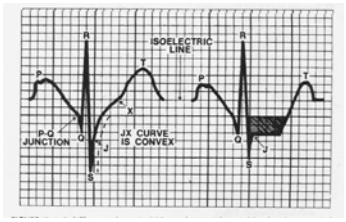
Quick Quiz



- Why is it dangerous when the Q-T interval is prolonged?
- Congenital Long QT syndrome (pg 224)
  - family history of sudden death
  - unexplained syncope
  - prolongation of QT interval during exercise

Normal PR changes with exercise

1. Shortened PR interval
2. Taller P waves
3. A Ta wave may occur with exercise and cause downward displacement of the PQ jn. This may look like ST depression. (measure from the PQ jn not the isoelectric line). Common in young boys and athletic men.



Abnormal Changes in P Waves

- An increased duration of the P wave (> 5 small boxes, 20 msec) is a sign of ischemia (64% specificity)
- Loss of ventricular compliance causes blood to back up in the atria. Increased distending pressure reduces blood flow in atria wall and slows deplorarization
- Thus P wave is prolonged.

Normal QRS Changes with Exercise

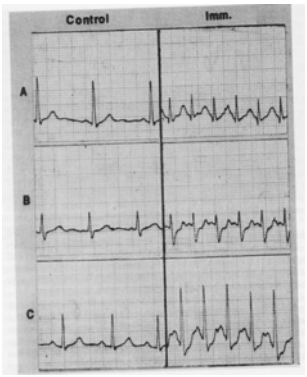
- R-wave amplitude increases at the start of exercise
- QRS duration, reduces slightly due to cats increasing conduction velocity.
- QRS amplitude decreases near peak workload or just after exercise (R & S)
  - •Brody effect.
  - •Occurs when CO is falling rapidly after exercise.

Rest Post-exercise

A. Normal decrease in R wave--rest to immediate post-exer.

B. No change in R wave/ST depression (mild ischemia but good left-ventricular fn.)

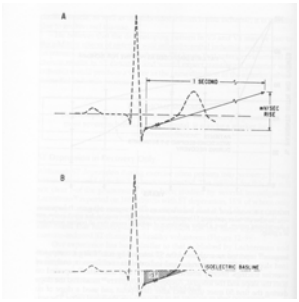
C. Marked increase in R wave/ST depression. (bad ventricular fn).



Lateral precordial leads

Normal ST segment changes during exercise

A normal response is a transient decrease in J point, followed by rapidly upsloping ST segment that returns to baseline within 0.04 to 0.06 s. J point depression is a normal finding.



Intermittent ST depression

- ST segment depression varying with respiration
  - related to different rates of ventricular filling
  - with inspiration increased filling causes transient ischemia in persons with a stiff ventricle
- Occurs in unconditioned subjects, near maximal stress levels
  - where cardiac compliance is reduced due to high cats and increased venous return with deep breathing

QT Interval

- Normally, QT interval decreases with increasing HR during exercise
- Prolonged QT indicates disorganized repolarization, a sign of cardiac disease
- Prolonged QT is a concern for the R on T phenomena and fibrillation

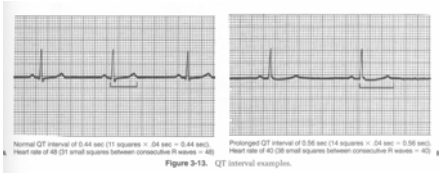


Figure 3-13. QT interval examples.

T wave changes with exercise

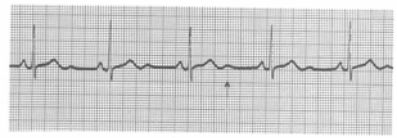
- T waves normally increase in height during and after exercise
  - associated with increased filling
- Often occurs in healthy young boys after exercise when HR drops rapidly leaving a very large SV.
- Also may be related to elevated K during and after exercise

T wave and ST changes with hyperventilation

- Hyperventilation before exercise testing?
- Changes in T waves may occur with hyperventilation
  - mediated by sympathetic nervous system
  - not indicative of ischemia
  - sometimes indicative of mitral valve prolapse
- If abolished by beta-blockers--proves it was related to ANS

U Waves?

- Caused by delayed ventricular repolarization
- Usually upright if T wave is upright
- Appears during low HR, disappears HR > 90
- U wave inversion occurs with ischemia (20%), but most due to LVH
- Associated with large diastolic volume, hypokalemia, digitalis, calcium.



ECG with U wave

Figure 3-15. U wave examples.

Practice EKGs

From: Huff: ECG Workout

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CREDITS

Skitter Support
Cat