ELECTROCARDIOGRAM

Paper- 403
Msc. 4 sem

BY:

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ELECTROCARDIOGRAM (ECG or EKG)

The biopotentials generated by the muscles of the heart result in the electrocardiogram, abbreviated ECG (sometimes EKG, from the German electroKardiogram)

A graphical recording or display of time variant voltage produced by myocardium during the cardiac.

Electrocardiogram is used clinically in diagnosing various diseases and conditions associated with the heart.

ECG waveform

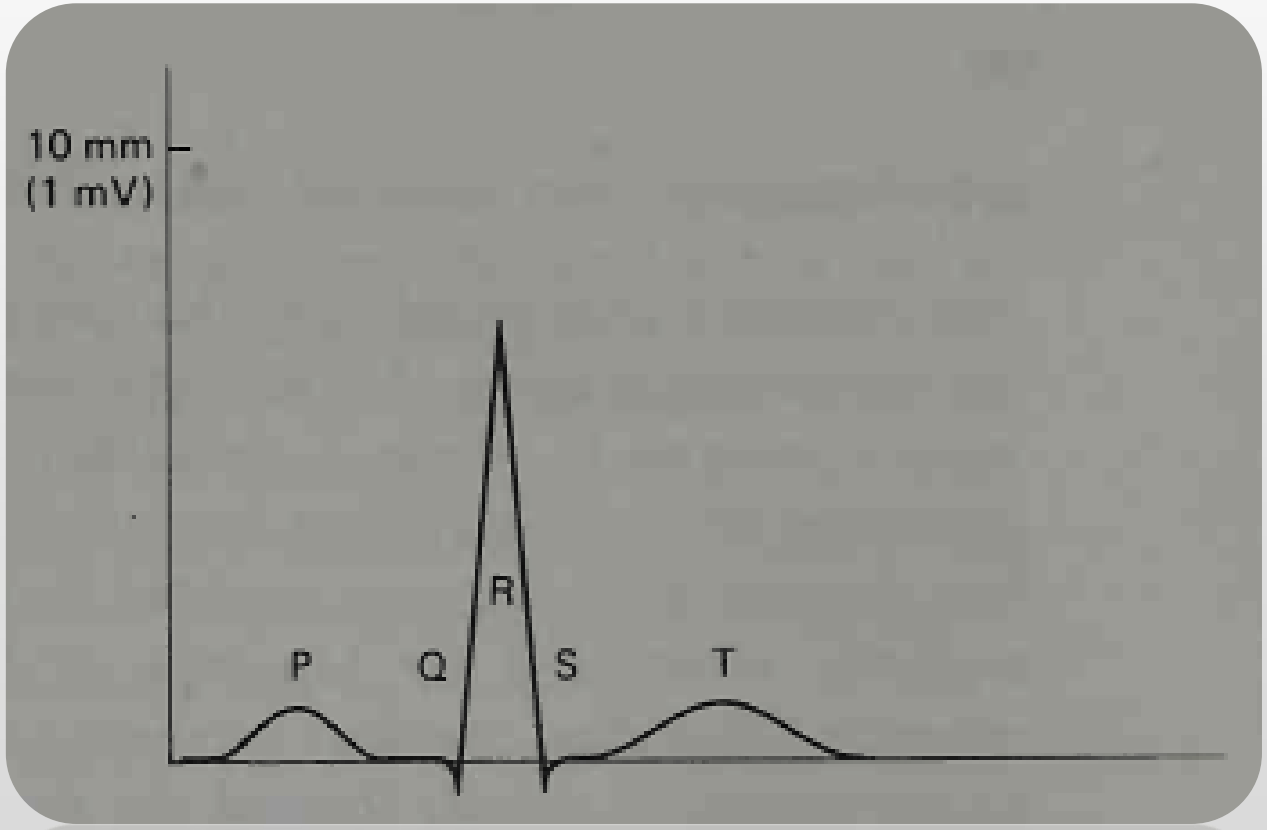
The P, QRS, and T waves reflect the rhythmic electrical depolarization and repolarization of the myocardium associated with the contractions of the atria and ventricles.

AMPLITUDE:

P	: 0.25 mV
R	: 1.60 mV
Q	: 25% of R Wave
T	: 0.1 to 0.5 mV

DURATION:

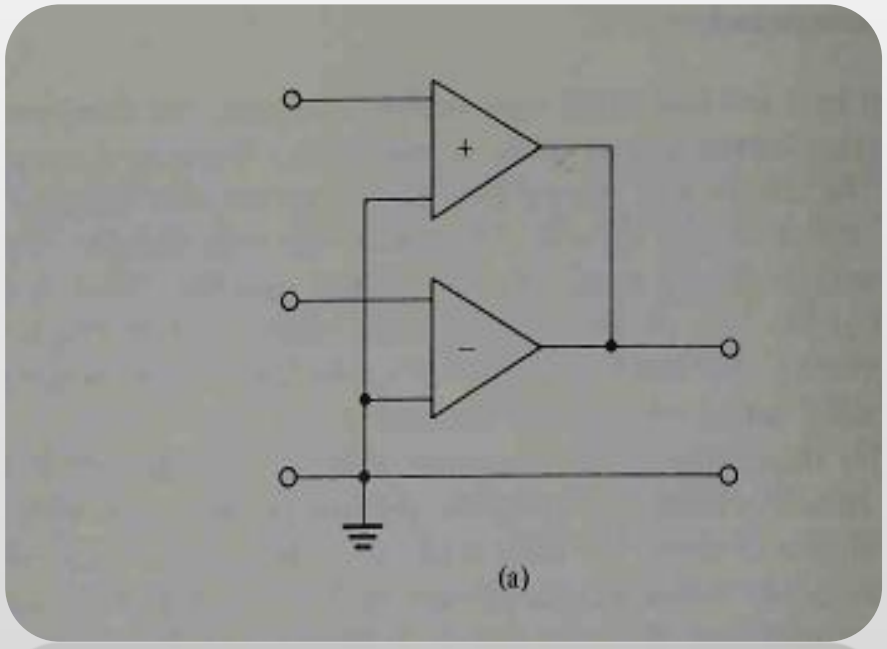
P-R interval	: 0.25 mV
Q-T interval	: 1.60 mV
S-T segment	: 25% of R Wave
P wave interval	: 0.1 to 0.5 mV

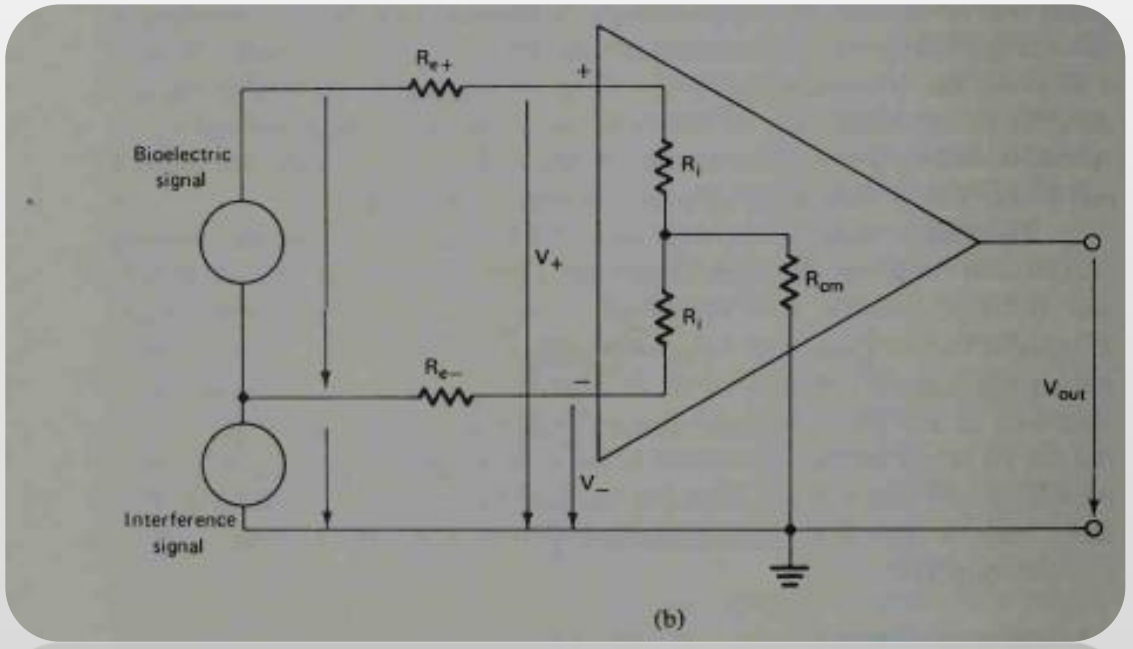


ECG Amplifiers

The technique usually used, not only in electrocardiography but also in the measurement of other bioelectric signals, is the use of a differential amplifier.

A differential amplifier used as two amplifiers with separate inputs, but with a common output terminal which delivers the sum of the two amplifier output voltages.





ECG Amplifiers

If the two amplifier inputs are connected to the same input source, the resulting common-mode gain should be zero, because the signals from the inverting and the noninverting amplifiers cancel each other at the common output.

Gain of the two amplifiers is not exactly equal, this cancellation is not complete, rather, a small residual common-mode output remains.

When one of the amplifier inputs is grounded and a voltage is applied only to the other amplifier input, the input voltage appears at the output amplified by the gain of the amplifier.

Gain is called the differential gain of the differential amplifier.

The ratio of the differential gain to the common-mode gain is called the common-mode rejection ratio of the differential amplifier, which in modern amplifiers can be as high as 1,000,000:1.

When a differential amplifier is used to measure bioelectric signals that occur as a potential difference between two electrodes, as shown in, the bioelectric signals are applied between the inverting and noninverting inputs of the amplifier. The signal is therefore amplified by the differential gain of the amplifier.

Electrodes and Leads

To record an electrocardiogram, a number of electrodes, usually five, are affixed to the body of the patient.

The electrodes are connected to the ECG machine by the same number of electrical wires.

These wires and, in a more general sense, the electrodes to which they are connected are usually called leads.

The electrode applied to the right leg of the patient, for example, is called the RL lead.

For the recording of the electrocardiogram, two electrodes or one electrode and an interconnected group of electrodes are selected and connected to the input of the recording amplifier.

Electrodes

The placement of the electrodes, as well as the color code used to identify each electrode.

Einthoven had found it advantageous to record the electrocardiogram from electrodes placed vertically as well as horizontally on the body.

The early electrocardiograph machines thus employed three electrodes, of which only two were used at one time. With the introduction of the electronic amplifier, an additional connection to the body was needed as a ground reference.

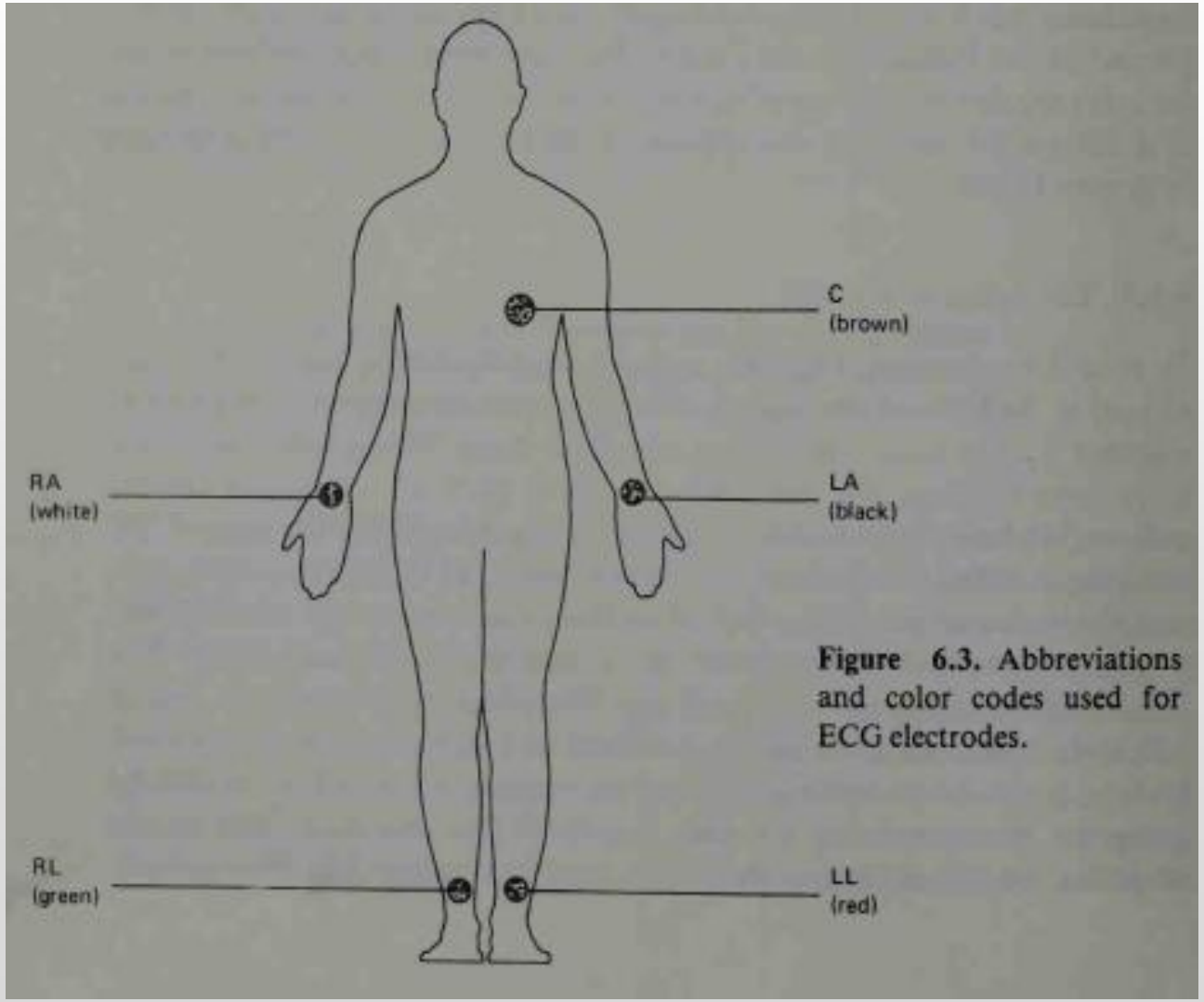


Figure 6.3. Abbreviations and color codes used for ECG electrodes.

Leads

In the normal electrode placement, four electrodes are used to record the electrocardiogram; the electrode on the right leg is only for ground reference. Because the input of the ECG recorder has only two terminals, a selection must be made among the available active electrodes.

The 12 standard leads used most frequently.

The three bipolar limb lead selections first introduced by Einthoven called bipolar because for each lead the electrocardiogram is recorded from two electrodes and the third electrode is not connected.

- Lead I: Left Arm (LA) and Right Arm (RA)
- Lead II: Left Leg (LL) and Right Arm (RA)
- Lead III: Left Leg (LL) and Left Arm (LA)

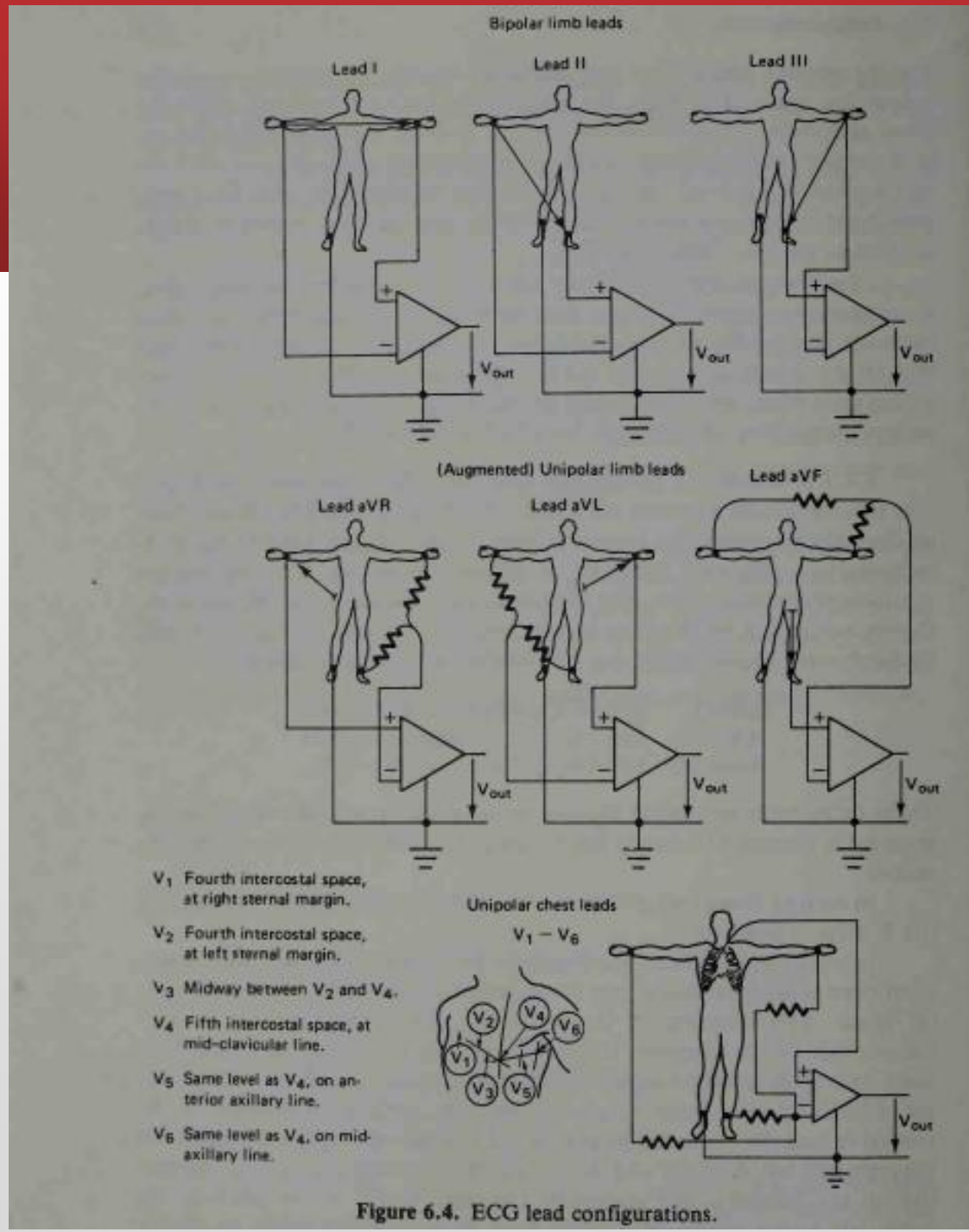


Figure 6.4. ECG lead configurations.

Leads

The other leads are of the unipolar type, which was introduced by Wilson

For unipolar leads, the electrocardiogram is recorded between a single exploratory electrode and the central terminal, which has a potential corresponding to the center of the body.

The potential at the connection point of the resistors corresponds to the mean or average of the potentials at the three electrodes.

In the unipolar limb leads, one of the limb electrodes is used as an exploratory electrode as well as contributing to the central terminal.

This double use results in an ECG signal that has a very small amplitude. In augmented unipolar limb leads, the limb electrode used as an exploratory electrode is not used for the central terminal, thereby increasing the amplitude of the ECG signal without changing its waveform appreciably.

For the unipolar chest leads, a single chest electrode (exploring electrode) is sequentially placed on each of the six predesignated points on the chest. These chest positions are called the precordial unipolar leads and are designated F, through Vs.

Leads

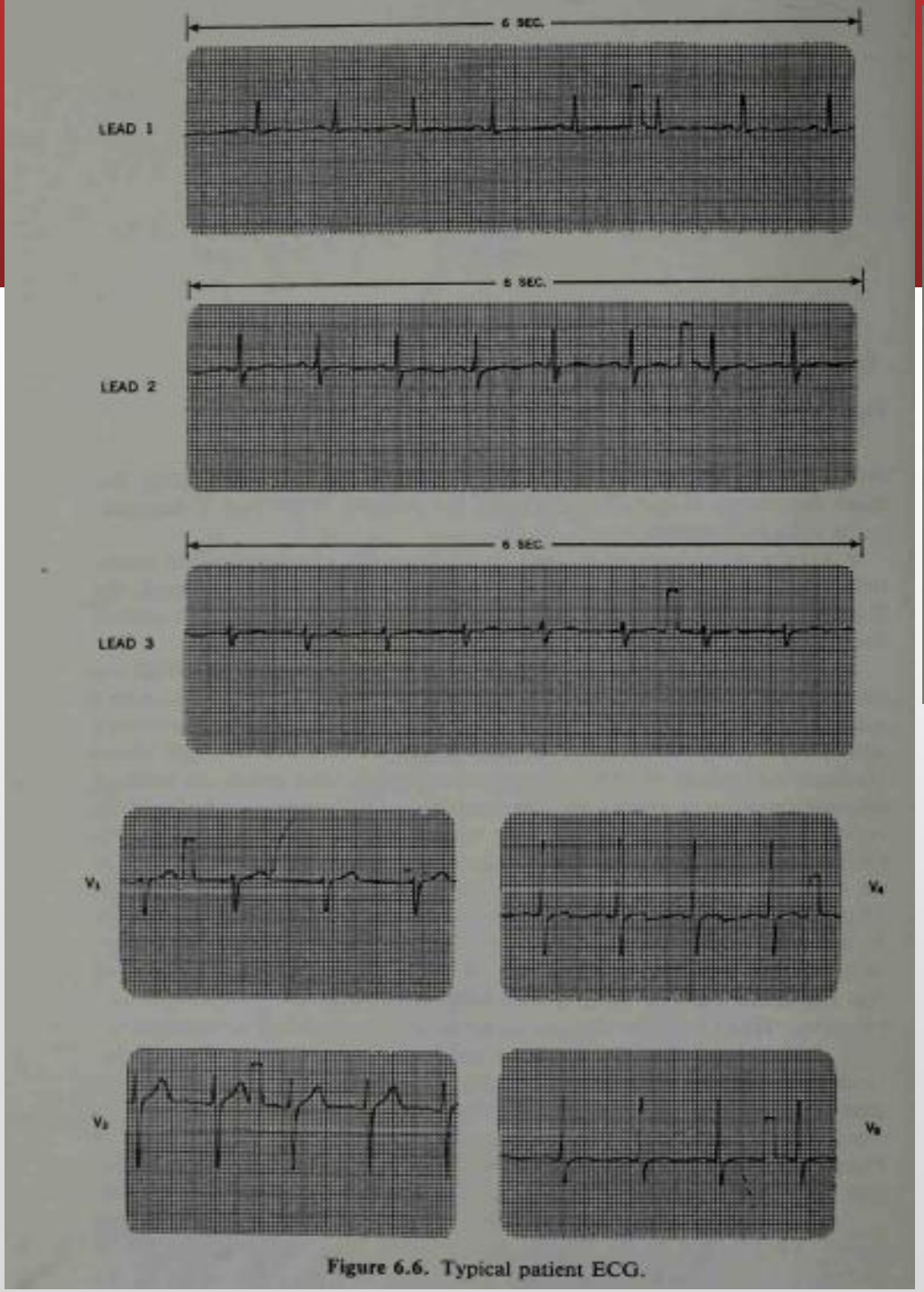
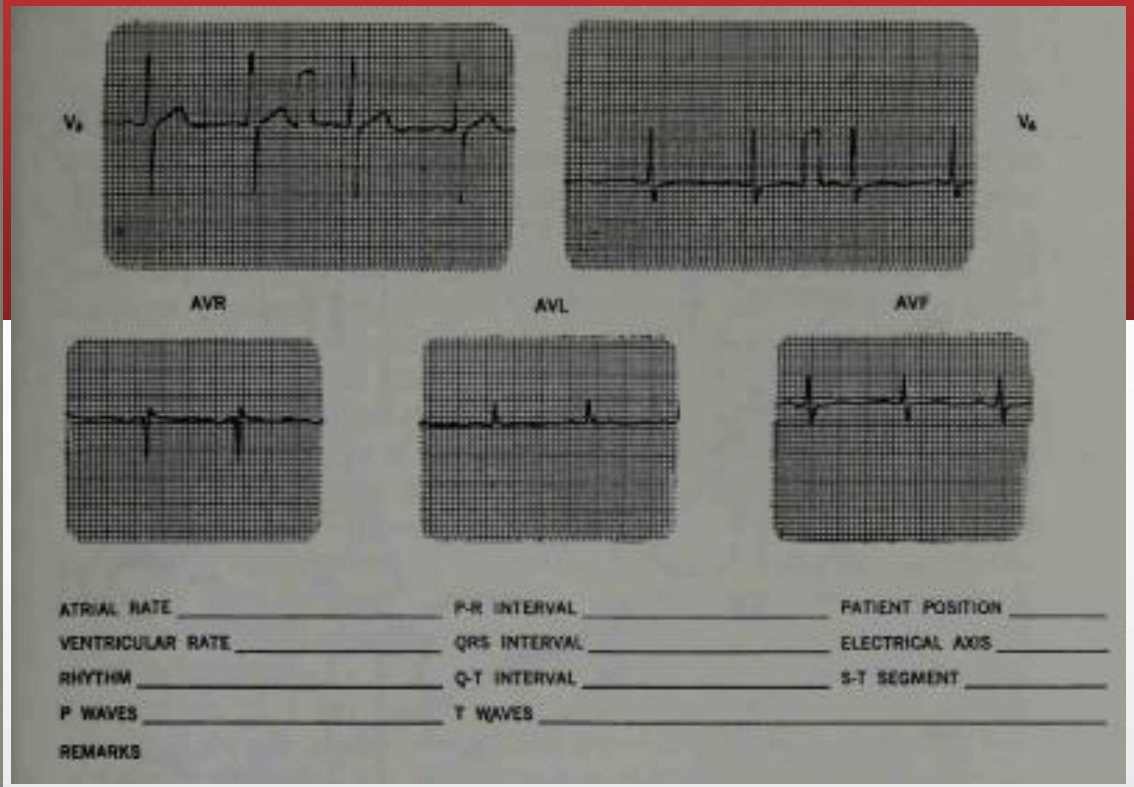


Figure 6.6. Typical patient ECG.



ECG Recorders

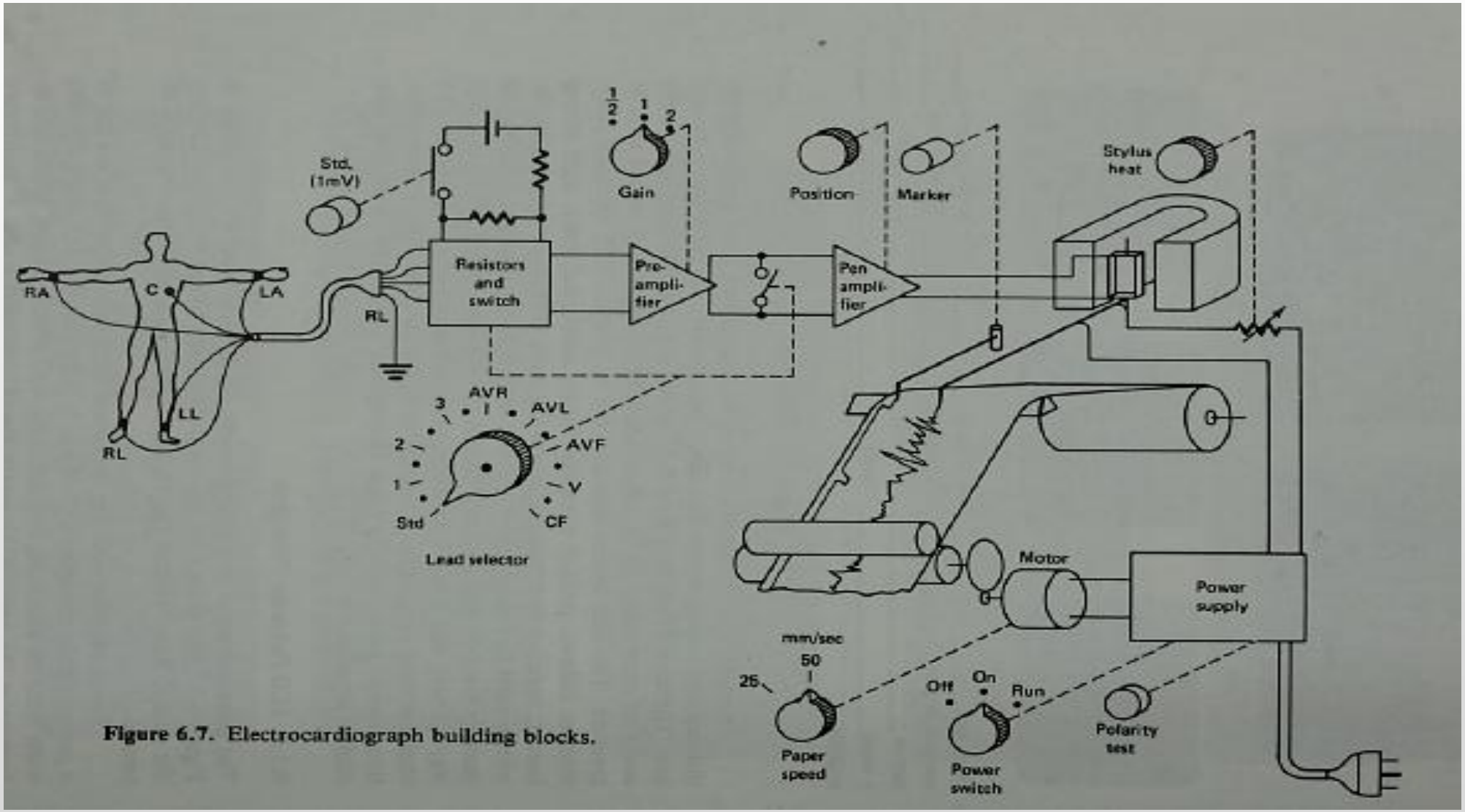
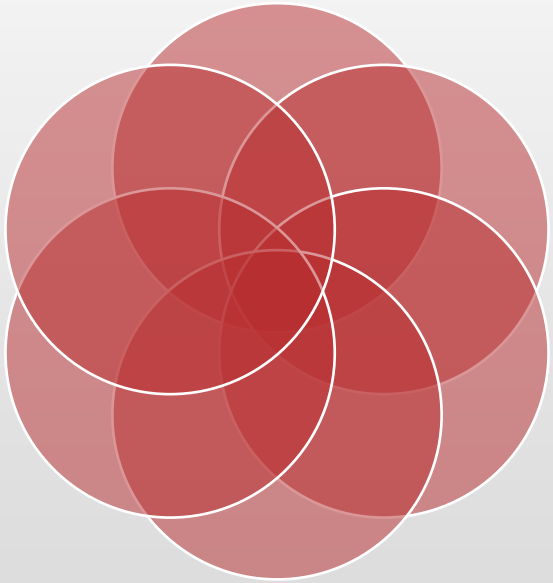


Figure 6.7. Electrocardiograph building blocks.

Types of ECG Recorders

Single-channel recorders

Continuous ECG recording (Hotter recording).



Three-channel recorders.

Electrocardiographs for computer processing

Vector electrocardiographs (vectorcardiographs)

Electrocardiograph systems for stress testing

Single Channel Recorder

- The most frequently used type of portable EGG recorder
- usually mounted on a cart so that it can be wheeled to the bedside of a patient with relative ease

Three Channel Recorder

- Substantial savings in personnel can be achieved by the use of automatic three-channel recorders.
- This not only record three leads simultaneously on a three-channel recorder, but they also switch automatically to the next group of three leads.
- An electrocardiogram with the 12 standard leads, therefore, can be recorded automatically as a sequence of four groups of three traces with overall time of 10 seconds
- The groups of leads recorded and the time at which the switching occurs are automatically identified by code markings at the margin of the recording paper.
- Mounting of the recorder is easy also time of the recording is substantially reduced but more time is required to connect electrode to patient

Vector electrocardiographs (vectorcardiographs)

- The voltage generated by the activity of the heart can be described as a vector whose magnitude and spatial orientation change with time.
- In the type of electrocardiography only the magnitude of the voltage is recorded.
- Vectorcardiography presents an image of both the magnitude and the spatial orientation of the heart vector.
- The heart vector, however, is a three-dimensional variable, and three “views” or projections on orthogonal planes are necessary to describe the variable fully in two-dimensional figures
- Special lead placement systems must be used to pick up the ECG signals for vector electrocardiograms
- The vectorcardiogram is usually displayed on a cathode-ray tube.

Electrocardiograph systems for stress testing

Coronary insufficiency frequently does not manifest itself in the electrocardiogram if the recording is taken during rest.

In the Masters test or two-step exercise test, sl physiological stress is imposed on the cardiovascular system by letting the patient repeatedly walk up and down.

special systems are available for the exercise stress test. These systems, however, are usually made up of a number of individual instruments.

An exercise stress test system consists of the following parts

- A treadmill which may incorporate an automatic programmer to change the speed and inclination in order to apply a specific physiological stress.
- An ECG radio telemetry system to allow recording of the ECG without artifacts while the patient is on the treadmill.
- An ECG monitor with a cathode-ray-tube display and heart rate meter.
- An ECG recorder.
- An automatic or semiautomatic sphygmomanometer for the indirect measurement of blood pressure.

Electrocardiographs for computer processing.

The automatic analysis of electrocardiograms by computers is used increasingly

Technique requires that the ECG signal from the standard leads be transmitted sequentially to the computer by some suitable means, together with additional information on the patient.

The automatic three-channel recorders can frequently be adapted for this purpose.

The ECG signals can either be recorded on a tape for later computer entry or can be directly transmitted to the computer through special lines or regular telephone lines using a special acoustical coupler

Information regarding the patient is entered with thumbwheel switches or from a keyboard and is transmitted along with the ECG signal.

During the transmission of the signal, the electrocardiogram is simultaneously recorded to verify that the transmitted signals are free of artifacts.

Continuous ECG recording (Hotter recording).

Because a normal electrocardiogram represents only a brief sample of cardiac activity, arrhythmias which occur intermittently or only under certain conditions, such as emotional stress, are frequently missed.

The technique of continuous ECG recording, which was introduced by Norman Holter, makes it possible to capture these kinds of arrhythmias.

To obtain a continuous ECG, the electrocardiogram of a patient is recorded during his normal daily activity by means of a special magnetic tape recorder.

The smallest device of this type can actually be worn in a shirt pocket and allows recordings of the ECG for four hours.

Other recorders, about the size of a camera case, are worn over the shoulder and can record the electrocardiogram for up to 24 hours.

The recorded tape is analyzed using a special scanning device which plays back the tape at a higher speed than that used for recording.

By this method a 24-hour tape can be reviewed in as little as 12 minutes.

During the playback, the beat-to-beat interval of the electrocardiogram is displayed on a cathode-ray tube as a picket-fence-like pattern in which arrhythmia epsiodes are clearly visible.

THANKYOU

BEST WISHES