

Cardioversion and Defibrillation

Objectives

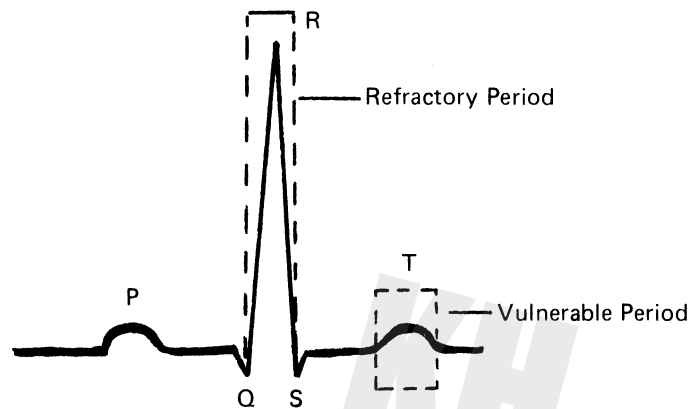
When you have completed Section 7, you will be able to describe or identify

1. refractory and vulnerable phases of the cardiac cycle
2. synchronized precordial shock or cardioversion
3. nonsynchronized precordial shock or defibrillation
4. automatic external defibrillator (AED) functioning

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7.1: Refractory and Vulnerable Phases of the Cardiac Cycle

In previous sections, reference was made to *precordial shock* as a treatment option for uncontrolled rapid dysrhythmias producing hemodynamic imbalance. To appreciate precordial shock treatment, one must have an understanding of the cardiac cycle.

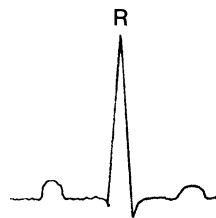


Each cardiac cycle has an **absolute refractory period** during which time the tissues are immune or resistant to further electrical stimulation. A brief **vulnerable period**, essentially encompassing the T wave, follows the refractory period. It is during the vulnerable period that an electrical stimulus (a shock from a live electrical source, lightning, a P.V.C. occurring in an ischemic heart, etc.) can induce ventricular fibrillation.

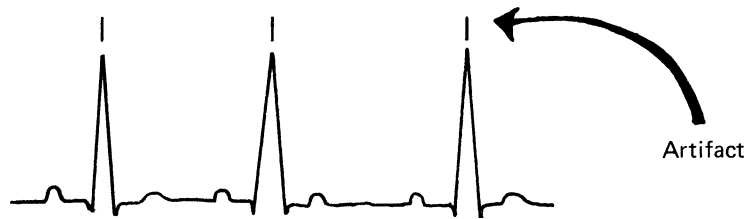
The vulnerable period, the T wave, can actually be thought of as having two parts. The first half of the T wave is relatively refractory to electrical stimulation, meaning that a sufficiently strong electrical current would be necessary to stimulate action. The middle and latter half of the T wave is truly the vulnerable period, requiring only a minimal electrical stimulus to initiate a response.

Thus, when electrical stimulation (precordial shock) is used as a therapeutic intervention to disrupt rapid dysrhythmias, a method of delivery must prevent the shock from occurring during the vulnerable period (the T wave) to avoid the risk of ventricular fibrillation. Avoiding the vulnerable period is achieved by synchronizing the timing of the electrical shock to the patient's rhythm, specifically to the R wave of the QRS (the refractory period). Precordial shock introduced during the refractory period will avoid the risk of ventricular fibrillation.

Synchronization of the defibrillator unit to the patient's rhythm is achieved by connecting a cable from the patient's EKG recording device (EKG machine or monitor) to the defibrillator unit. Once connected, a *synchronization option* (or button) is selected on the defibrillator unit. The defibrillator unit is then able to *sense* the tall R wave of the QRS cycle. Occasionally, the gain or amplitude setting will need to be increased for the R waves to be sensed.



The defibrillator unit will have an indicator (usually a blinking light) that signals the sensing of R waves. Each time the light blinks, it's saying "I see an R wave, I see an R wave" . . . etc.



In addition, the monitoring device will show an artifact above each R wave. The artifact also indicates that the defibrillator unit is reading or sensing the R wave of each QRS complex. Now, no matter when in the cardiac cycle the buttons for releasing the electrical energy are pressed, the defibrillator unit will not deliver the energy until it senses the R wave! The synchronized defibrillator does *all* the work. 😊

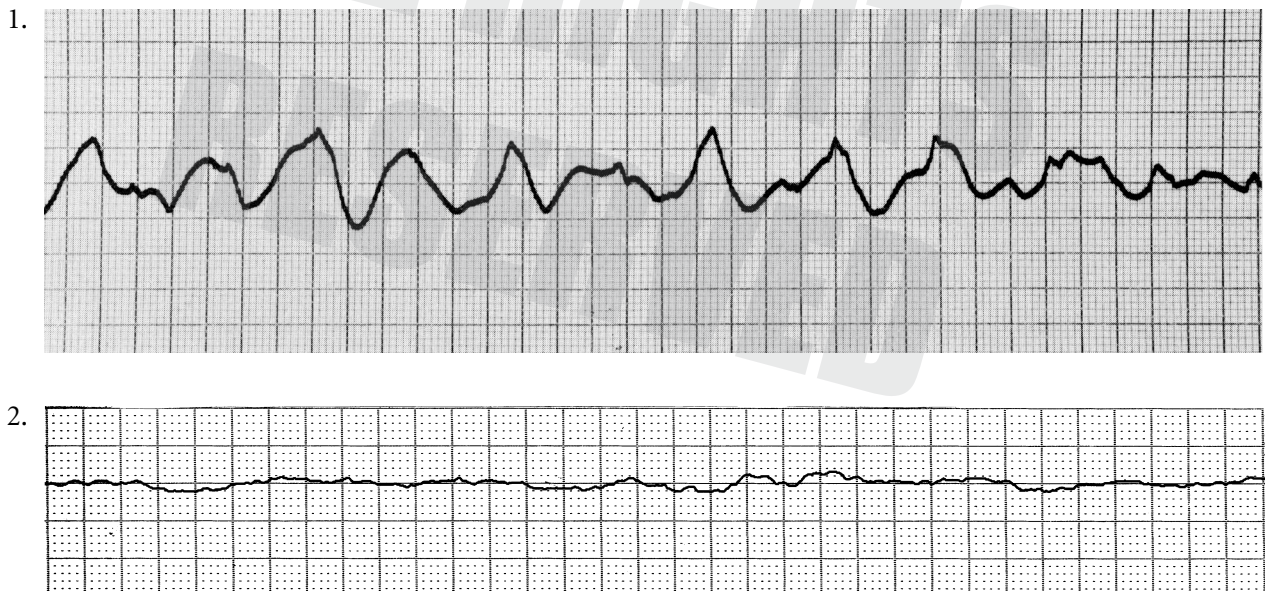
In essence then, this synchronization prevents the electrical shock from occurring during the vulnerable period (T wave).

There are two types of precordial shock, *synchronized* and *unsynchronized*. Synchronized precordial shock is most usually referred to as **cardioversion**. Unsynchronized precordial shock is referred to as **defibrillation**.

Defibrillation is the treatment of choice for ventricular fibrillation, the chaotic, uncoordinated, ineffective depolarization of the ventricles and for pulseless ventricular tachycardia. Remember, CPR must be instituted immediately upon the recognition of ventricular fibrillation or the determination of pulselessness unless an automatic external defibrillator (AED) is immediately available.

Both synchronized cardioversion and defibrillation work on the same principle. Electrical energy of brief duration is delivered through the chest wall. This shock causes depolarization (release of energy) of a critical mass of myocardial cells, thus halting or disrupting the chaotic or ectopic activity, and hopefully allowing the sinus pacemaker to resume control of the rhythm.

Review the following rhythm strips demonstrating ventricular fibrillation.



The first strip depicts a *coarse* ventricular fibrillation; the second strip displays a *fine* ventricular fibrillation. To interrupt the chaotic ectopic activity, precordial shock must be instituted. . . .

. . . but which kind?

synchronized, or unsynchronized?
cardioversion, or defibrillation?

Ah-ha! Since no QRSs are present, it is *impossible* to use synchronized precordial shock! As a matter of fact, if one set or programmed the defibrillator unit to deliver synchronized shock, the machine would **never** release the energy through the paddles. It would hold the energy until it “sensed” an *R wave* . . . which would never appear! Thus, because QRS complexes are absent, non-synchronized precordial shock or defibrillation would be used.

With non-synchronized precordial shock or defibrillation, the energy is delivered through the paddles at any point during the chaotic rhythm, as soon as the “energy delivery” button(s) is pressed. Usually, a high energy shock is used—between 200 and 400 watt/seconds or joules of energy (depending upon the patient’s size and chest wall thickness).

It should be noted that there are two *general* types of defibrillators. Hospital defibrillator units have three capabilities: defibrillation; synchronized cardioversion; and, external pacing.

A second type of defibrillator unit, an **automatic external defibrillator (AED)** is a “grab and go” unit used by fire departments, airlines, rescue squads and certain large businesses for the treatment of cardiac emergencies. An AED is a battery-powered portable unit equipped with adhesive electrodes, electrical circuitry, and an internal microprocessor for interpreting rhythms. The AED unit includes diagrams for guiding the placement of electrodes and usually has both visual and audio prompts. Essentially, the AED senses and analyzes the underlying cardiac rhythm, then advises (prompts) the operator whether electric shock is needed (shock/no shock). When electrical shock is needed (ventricular fibrillation/ventricular tachycardia), the AED automatically calculates and delivers a pre-determined amount of energy (joules), though most units allow a manual override for alternate current settings. In the presence of ventricular tachycardia, the AED senses the QRS configuration and synchronizes the timing of energy release to avoid current delivery during the vulnerable phase of a cardiac cycle. AED units come with treatment algorithms and can both record and print monitor tracings.



As this text goes to press, the FDA is evaluating a foreign AED (FRED easyport) that is small enough to be worn on the belt. The unit is light weight and uses a pulsed biphasic waveform, allowing the same efficiency using less energy.

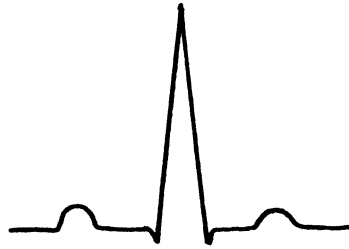
Additionally, the FDA approved *over-the-counter* sales of an in-home defibrillator with programmed audio directions.

CRITICAL NOTE: Owing to variation in defibrillator equipment, the practitioner is strongly cautioned to become familiar with devices available for use. Initial training and periodic “hands-on” reviews are required to maintain competency. In cardiac emergencies, speed is critical. In the face of ventricular fibrillation (pulselessness), chances of survival decrease approximately 7–10% each passing minute. Defibrillation within the first 3–4 minutes affords the best chance for survival. Immediate CPR is required for any pulseless event and should be continued until the “all standback for defibrillation” command is given. If defibrillation is unsuccessful, CPR should be reinstituted immediately. Clinicians and *field-warriors*, alike, should stay abreast of current resuscitation guidelines published by the American Heart Association (ACLS and PALS Guidelines).

Practice Exercise 1

Let's see how much you remember!

- A. Here is a QRS complex. Draw and label the refractory and vulnerable periods.



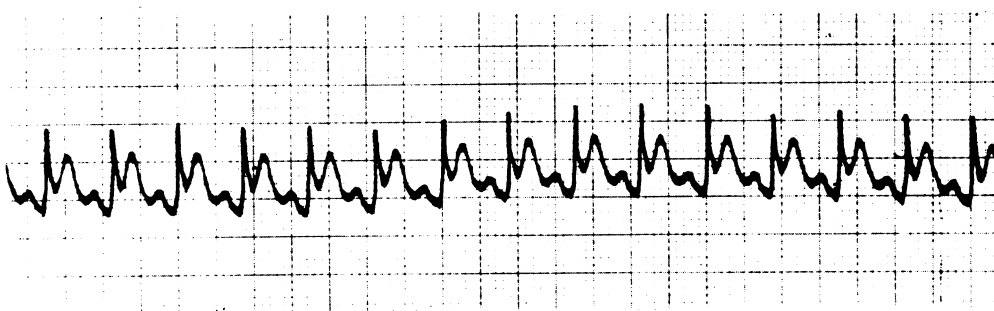
- B. Refractory means that _____

- C. Vulnerable implies that _____

- D. In synchronized precordial shock, or _____ the defibrillator unit will deliver its energy *only* on _____ of the EKG cycle.

- E. When defibrillation or non-synchronized precordial shock is used, the defibrillator unit will deliver its energy _____

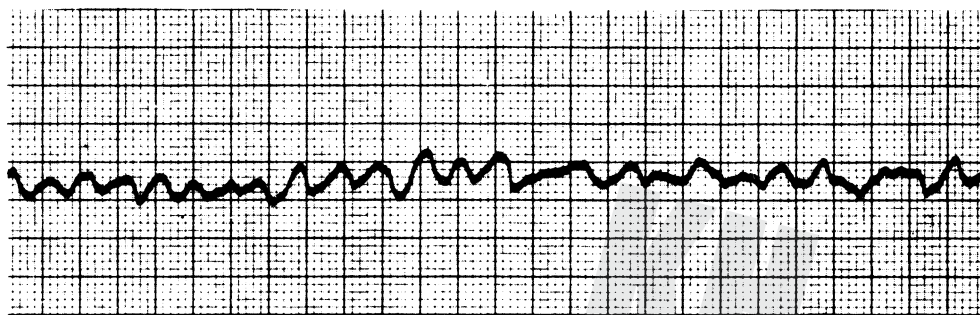
- F. Following is a rhythm strip of a patient experiencing severe chest pain and a falling blood pressure.



This rhythm is an _____. Because the clinical condition is deteriorating rapidly, it has been decided to administer precordial shock to terminate the ectopic rhythm.

Cardioversion / defibrillation (circle one) would be used because _____

G.

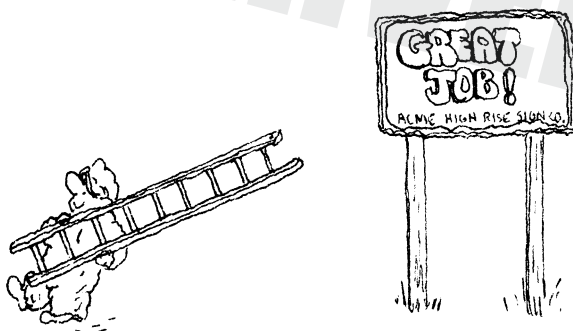


The rhythm strip above is that of a code arrest victim. _____ precordial shock would be administered because there are no _____ complexes present!

H. The abbreviation AED stands for _____.



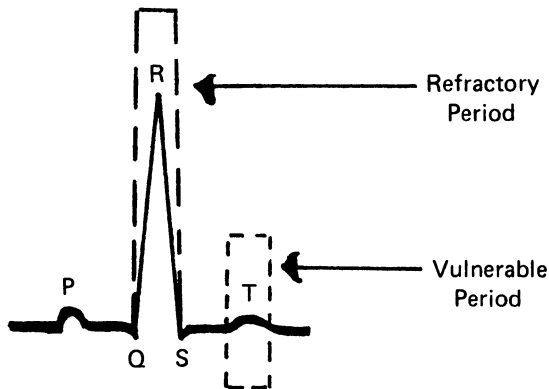
For Feedback 1, see page 197.





Feedback 1

A.



Nice work



- B. Refractory means that this phase in the cardiac cycle (the QRS) is immune to any additional electrical stimulation.
- C. Vulnerable implies that this phase in the cardiac cycle (the T wave) is sensitive to electrical stimulation. Electrical stimulation during the vulnerable period may induce ventricular fibrillation.
- D. In synchronized precordial shock, or **cardioversion**, the defibrillator unit will deliver its energy only on the **R Wave** of the EKG cycle.
- E. When defibrillation or non-synchronized precordial shock is used, the defibrillator unit will deliver its energy as soon as the energy delivery buttons are pressed anywhere in the chaotic rhythm.
- F. This rhythm is supra-ventricular tachycardia.
Cardioversion would be used because QRS complexes are present and principally to avoid the risk of inducing ventricular fibrillation.
- G. Unsynchronized precordial shock or defibrillation would be administered because there are no QRS complexes present!
- H. The abbreviation AED stands for automatic external defibrillator.

KH
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