Objectives

1. Define key terms introduced in this chapter.
2. Explain the pathophysiology of shock (hypoperfusion), including the consequences of cellular hypoxia and death (slide 16).
3. Describe the physiology of maintaining adequate perfusion (slide 17).
4. Describe how inadequate vascular volume, inadequate heart function, and decreased peripheral vascular resistance can lead to shock (slide 18-22).
5. Give examples of conditions that can lead to (slides 18-22, 25-47):
   a. Loss of vascular volume
   b. Inadequate heart function
   c. Decreased peripheral vascular resistance
6. Explain the mechanisms and pathophysiology of each of the following categories and types of shock (slides 23-50):
   a. Hypovolemic (hemorrhagic and nonhemorrhagic)
   b. Distributive (anaphylactic, septic, neurogenic)
   c. Cardiogenic
   d. Obstructive
   e. Metabolic or respiratory
7. Explain how compensatory mechanisms to shock are maintained through (slides 53-56):
   a. Direct nerve stimulation
   b. Release of hormones
8. Explain the body’s compensatory responses to hypoperfusion and how they manifest in the early signs and symptoms of shock (slides 51-56).
Objectives

9. Differentiate between early (compensatory) and late (decompensatory/irreversible) signs of shock (slide 58).
10. Describe the progression of shock through the compensatory, decompensatory (progressive), and irreversible stages (slide 58).
11. Explain how to identify the patient who is in a shock state and demonstrate the assessment of patients to identify shock (slides 59-64).
12. Explain the influence of age on the assessment and management of patients with shock (slides 65-66).
13. Discuss the goals of prehospital management of patients with shock (slides 67-69).

Objectives

14. Describe the pathophysiology of cardiac arrest (slides 70-73).
15. Differentiate between the electrical, circulatory, and metabolic phases of cardiac arrest (slide 73).
16. Identify situations in which resuscitative attempts should be withheld (slides 76-77).
17. Explain each of the links in the Chain of Survival of cardiac arrest (slides 78-79).
18. Explain the importance of early defibrillation in cardiac arrest (slides 80-81).
19. Explain the rationale for the "push hard and push fast" approach to cardiopulmonary resuscitation (CPR) (slides 82-83).

Objectives

20. Describe the features, functions, advantages, disadvantages, use, and precautions in the use of automated external defibrillators (AEDs) (slides 84-87).
22. Given a series of cardiac arrest scenarios involving infants, children, and adults, demonstrate appropriate assessment and resuscitative techniques, including the integrated use of AEDs (automated and semiautomated), ventilation, and CPR, and explain the purpose and procedure for reassessment of the cardiac arrest patient (slides 94-101).
Objectives

24. Given a cardiac arrest scenario, make decisions regarding obtaining advanced cardiac life support (ACLS) (slide 105).
25. Describe the safety precautions to be taken to protect yourself, other EMS providers, the patient, and bystanders in resuscitation situations (slides 93, 107-108).

Objectives

26. Explain the importance of AED maintenance, EMT training and skills maintenance, and medical direction in the Chain of Survival of cardiac arrest (slides 109-115).
27. Discuss special considerations in the use of an AED in patients with cardiac pacemakers and automatic implanted cardioverter-defibrillators (slides 118-121).

Multimedia Directory

- Slide 22  Etiology of Shock Animation
- Slide 50  Types of Shock Animation
- Slide 69  Bleeding Control/Shock Management Video
Topics

- Shock
- Resuscitation in Cardiac Arrest
- Automated External Defibrillation and Cardiopulmonary Resuscitation
- Recognizing and Treating Cardiac Arrest
- Special Considerations for the AED

CASE STUDY

Dispatch

EMS Unit 102

Respond to 46 Hillman Street. You have a 26-year-old male patient who has been stabbed in the leg and is bleeding profusely. Law enforcement is en route.

Time out 2102
• A police officer leads you into the basement
• Patient is supine on the floor with a large pool of blood around his right thigh
• Patient is not alert, does not respond to voice, and appears extremely pale

Upon Arrival

How would you proceed with the assessment of this patient?

Shock
Etiologies of Shock
Inadequate Volume

Inadequate Pump Function

Inadequate Vessel Tone

Normalized vessel full of blood.

Dilated vessel only partially filled with blood.
Etiology of Shock

Click here to view an animation on the etiology of shock

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Categories of Shock

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Categories of Shock

**Hypovolemic Shock**

- Hemorrhagic hypovolemic: loss of whole blood, plasma, and formed elements.
- Nonhemorrhagic hypovolemic: loss of plasma.

**Distributive Shock**
Categories of Shock

Cardiogenic Shock

- Heart muscle damaged from myocardial infarction.
- Contractile force reduced.
- Stroke volume reduced.
- Cardiac output reduced.
Categories of Shock

Obstructive Shock

Metabolic or Respiratory Shock
Inability of the body to use, transport, and/or offload oxygen

Specific Types of Shock

Hemorrhagic
Hypovolemic Shock
Specific Types of Shock

Nonhemorrhagic Hypovolemic Shock
Specific Types of Shock

Burn Shock

Fluid is pulled from the vascular space to the interstitial space, causing hypovolemia.

Specific Types of Shock

Anaphylactic Shock
Vasodilation moves blood from the central core to the periphery, causing distributive shock.

Specific Types of Shock

Septic Shock

Bacteria or toxins throughout the body cause the blood vessels to dilate and to become permeable.
Specific Types of Shock

Neurogenic Shock

Spinal cord trauma causes a loss of blood vessel tone and results in widespread vasodilation.

Specific Types of Shock

Cardiogenic Shock
Depressed pump function reduces the force of the left ventricular contraction, stroke volume, cardiac output, systolic blood pressure, and perfusion.

Types of Shock

Click here to view an animation on types of shock.

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The Body’s Response to Shock

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The Body’s Response to Shock

Direct Nerve Stimulation

- Increased heart rate
- Increased contractile force
- Vasoconstriction
- Release of epinephrine and norepinephrine
The Body’s Response to Shock

Release of Hormones

Hormones released stimulate alpha receptors in peripheral blood vessels, returning blood to the central core.

Stages of Shock
Shock Assessment

History
Pay particular attention to chief complaint and SAMPLE
Some medications may prevent compensation

Shock Assessment

Physical Exam

• Altered mental status
• Pale, cool, and clammy skin
• Delayed capillary refill
• Decreased urine output
• Weak or absent peripheral pulses
Age Considerations in Shock

Children compensate well and then suddenly decompensate.

Medications and advanced age decrease compensation ability.
General Goals of Prehospital Management of Shock

Back to Objectives

• Secure and maintain an airway
• Assure adequate ventilation
• Provide high-flow, high-concentration oxygen
• Avoid hyperventilation
• Stop any external bleeding
• Splint fractures to reduce bleeding
• Leave impaled objects in place
• Keep the patient warm
• Apply PASG if indicated and local protocol allows
• Provide rapid transport and perform other interventions en route
• Consider an ALS intercept

Bleeding Control/ Shock Management

Click here to view a video on the topic of bleeding control and shock management
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Resuscitation in Cardiac Arrest

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Sudden Death: the patient dies within one hour of the onset of symptoms

Cardiac Arrest: cardiac output is completely ineffective and no pulse can be felt

Resuscitation: bringing the patient back from a potential or apparent death

Back to Objectives

Pathophysiology of Cardiac Arrest

Pathophysiology of Cardiac Arrest
Electrical Phase
Less than four minutes following arrest, the cardiac muscle uses its sugar/oxygen stores.

Circulatory Phase
From four to ten minutes following arrest, the cardiac muscle switches to anaerobic metabolism.

Metabolic Phase
Greater than ten minutes following arrest, cardiac cells swell, rupture, and die.

Terms Related to Resuscitation

Survival
A patient who survives to be discharged from the hospital.

Return of Spontaneous Circulation (ROSC)
The patient regains a spontaneous pulse during the resuscitation effort.

Downtime
The time the patient goes into cardiac arrest until CPR is effectively being performed.

Total Downtime
The total time from when the patient goes into cardiac arrest until you deliver the patient to the emergency department.
Withholding a Resuscitation Attempt

You may also withhold resuscitation in cases of obvious death, such as decapitation.

The Chain of Survival
Early Advanced Care: Advanced life support (ALS) is delivered most often by paramedics who can provide advanced cardiac life support (ACLS).

Automated External Defibrillation and Cardiopulmonary Resuscitation

AHA Rationale for Early Defibrillation

• The most frequent initial rhythm in sudden cardiac arrest is ventricular fibrillation
• The most effective treatment for terminating ventricular fibrillation is electrical defibrillation
• The probability of successful defibrillation is directly related to the time from fibrillation to defibrillation
• Ventricular fibrillation will, without prompt or appropriate treatment, degenerate into asystole
• “Push hard and push fast”
• 100 compressions per minute
• 30:2 compression to Pulse checks should NOT follow a defibrillation attempt. Always resume CPR after shocking a patient with an AED.
• Start with CPR if the downtime is unknown or greater than four to five minutes
• If the downtime is less than four to five minutes, use the AED

AHA Rationale for Current AED and CPR Standards

• “Push hard and push fast” will help avoid compressions that are delivered either too slow or too shallow
• The ratio of 30:2 minimizes interruptions to compressions for pulse checks and ventilations
• Compressions prior to defibrillation in unwitnessed arrests will make defibrillation more successful
• Rarely will a perfusing rhythm be evident by a pulse check immediately after defibrillation
• CPR as just described can double or triple the chance of survival

Types of Defibrillators
Manual defibrillators require extensive training prior to use.

An automated external defibrillator (AED) is much simpler to operate.

Advantages of AEDs:
- Speed of operation
- Safer, more effective delivery
- More efficient monitoring

Types of AEDs:
- Fully automated AED
- Semiautomated AED
- Semi-automated AED

Biphasic versus Monophasic
- Biphasic: more effective with less energy
- Monophasic: less effective with more energy

150 to 200 J

200, 300, 360 J
Analysis of Cardiac Rhythms

Ventricular Fibrillation: Shockable!

Chaotic electrical discharge as seen on an ECG tracing.

Ventricular Tachycardia: Shockable!

ECG tracing of ventricular tachycardia.
Asystole: NOT Shockable!

ECG tracing of asystole

Pulseless Electrical Activity: NOT Shockable!

Organized electrical activity with no pulse

NEVER touch the patient, AED, or cables when the AED is analyzing a rhythm.
When and When Not to Use the AED

Apply an AED if:

• The patient is in nontraumatic cardiac arrest
• For children one to eight years of age, an adult AED may be used, preferably with a pediatric dose attenuating system
• The downtime is less than four to five minutes, or two minutes of CPR has been performed

Do not apply an AED if:

• The patient is in cardiac arrest as a result of trauma
• The downtime is greater than four to five minutes, and two minutes of CPR has not been performed
Assessment-Based Approach: Cardiac Arrest

Assessment Summary

CARDIAC ARREST
The following are findings that indicate cardiac arrest. These findings are obtained during the primary assessment:
- Unresponsive
- Apneic (not breathing)
- Pulseless
Performing Defibrillation

Fig 15 - 16b and/or 15 - 17 I cannot determine without seeing content - WDS

Transporting the Cardiac Arrest Patient
Providing for Advanced Cardiac Life Support

- When to transport
- Transporting a patient with a pulse
- Transporting a patient without a pulse

Request advance life support (ALS) providers as soon as possible.
Special Considerations for the AED

Remember the following safety guidelines:

• Clear the patient before shocking
• Water and metal conduct electricity well
• Never place an electrode over a medication patch or implanted pacemaker

If the patient has an extremely hairy chest and firmly pressing the pad on the chest does not work, then consider shaving the area with an electric clippers or disposable razor.
AED Maintenance

Always inspect your AED for function and proper stock. The most common cause of AED failure is battery failure.

Training and Skills Maintenance
• Be prepared to use the AED at any time

• Practice your skills with the AED at least every 90 days

• Review incidents for quality improvement

• Keep up to date on new research on AED procedures

Medical Direction and the AED

Responsible for the following:

• Making sure that the EMS system has all necessary links in the AHA Chain of Survival

• Overseeing all levels of EMTs

• Reviewing the continual competency skill review program

• Engaging in an audit and/or quality improvement program
Incident review may be accomplished by:

- Written reports
- Review of the voice and/or ECG tapes if the system’s AED is equipped with that feature
- Review of solid-state memory modules and magnetic tapes if the system’s AED is so equipped

Energy Levels of Defibrillators

Typical Energy Levels

- Manual defibrillators typically range from five joules to 360 joules
- Most AEDs have two preset values of 200 joules and 360 joules
Some patients require a pacemaker to maintain an adequate heart rate. They are usually placed under a clavicle.

Automatic Implantable Cardioverter Defibrillators
Automatic Implantable Cardioverter Defibrillators (AICD)

• Implanted device that monitors the heart’s activity
• Capable of delivering shocks directly to the heart to correct lethal dysrhythmias
• A conscious patient can tell you when a shock is delivered
• The shock from an AICD does not pose a risk to EMS providers

Automated Chest Compression Devices

Mechanical Piston Device

A mechanical piston device in place on a patient
Automated Chest Compression Devices

Load-Distributing-Band CPR or Vest CPR

A load-distributing-band CPR device

Automated Chest Compression Devices

Impedance Threshold Device
An impedance threshold device

Automated Chest Compression Devices

Other Circulation Enhancing Devices

Other devices, like the LUCAS, may also actively decompress the chest.
CASE STUDY

Primary Assessment
- Patient not alert and doesn't respond when name is called
- Pale color; apply in-line stabilization
- Patient moans to painful stimuli
- Respirations are adequate; place nonrebreather mask at 15 lpm
- Find blood coming from right leg wound; expose leg and apply direct pressure

CASE STUDY

Secondary Assessment
- You expose the patient's body to look for other injuries while rolling onto backboard
- No other injuries found
- BP: 72/58mmHg; HR: 132; RR: 26; skin pale, cool, and clammy
- Patient still responsive only to pain
- No history or medical information obtainable

Follow-Up
**CASE STUDY**

Reassessment

- Monitor mental status, ABCs, and bleeding en route
- No change en route
- Upon arrival, trauma surgeon meets you and brings the patient to the trauma bay
- Prepare written report and return to service

**Critical Thinking Scenario**

- Dispatch advises you are responding to a man down; CPR in progress
- You arrive four minutes after the call came in and within moments of fire and PD
- You see a small crowd gathered around a male patient; two people are in fact performing CPR

**Critical Thinking Scenario**

- You’ve already donned gloves and eye protection while en route
- You grab your AED as you exit the ambulance
- Your primary assessment reveals an unresponsive man, mid-50s, supine on the ground with effective bystander CPR in progress
Bystanders state that they began CPR immediately upon his collapse and then called 911.
The patient’s skin is slightly cyanotic.
You request that CPR be stopped temporarily while you assess pulse and breathing.
Your partner is setting up the AED.

You find no carotid pulse and detect no breathing.
This is a priority patient for whom defibrillation is appropriate.
You direct a firefighter to resume compressions while you ventilate with a bag-valve mask and high-flow, high-concentration oxygen.

1. What assessment findings indicate that this patient is indeed in cardiac arrest?
2. Which components of the Chain of Survival have already been met?
3. Why is this patient a candidate for immediate versus delayed AED use?
4. What cardiac rhythm is this patient most likely going to show?
Critical Thinking Questions

5. What is the compression to ventilation ratio going to be for this patient?
6. If the AED indicates that no shock is warranted, what should your next action be?

Reinforce and Review

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