Chapter 12
Cardiovascular Emergencies

Learning Objectives
- Define role of EMT in emergency cardiac care system
- Predict relationship between basic life support (BLS) & patient experiencing cardiovascular compromise
- Explain rationale for early defibrillation
- Explain why cardiac arrest does not occur in all patients with chest pain & why all do not need to be attached to an automated external defibrillator (AED)

Learning Objectives
- Discuss role of the American Hospital Association (AHA) in use of AED
- Discuss fundamentals of early defibrillation
- Describe structure & function of the cardiovascular system
- Describe emergency medical care of the patient experiencing chest pain/discomfort

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Learning Objectives

- Discuss position of comfort for patients with various cardiac emergencies
- Establish the relationship between airway management & cardiovascular compromise
- Recognize need for medical direction of protocols to assist in emergency medical care of patient with chest pain
- List indications for use of nitroglycerin

Learning Objectives

- State contraindications & side effects for use of nitroglycerin
- Explain rationale for giving nitroglycerin to patient with chest pain/discomfort
- Discuss importance of cardiopulmonary resuscitation (CPR)
- Explain why changing EMTs every 2 minutes is important during CPR

Learning Objectives

- Discuss the importance of chest compressions that are hard, fast, & minimally interrupted
- List the steps for 1-rescuer & 2-rescuer CPR for adult, child, & infant victim of cardiac arrest
- Discuss various types of AEDs
- Discuss procedures that must be taken into consideration for standard operation of AEDs
Learning Objectives

- Discuss integration of CPR into other resuscitation procedures
- State reasons for ensuring patient is pulseless & apneic when using AED
- List indications & contraindications and advantages & disadvantages for AED
- Discuss circumstances that may result in inappropriate shocks

Learning Objectives

- Explain considerations for interruption of CPR when using an AED
- Summarize speed of operation of AED
- Discuss use of remote defibrillation through adhesive pads
- Discuss special considerations for rhythm monitoring
- List steps in operation of AED

Learning Objectives

- Explain impact of age & weight on defibrillation
- Differentiate 1-rescuer vs. multi-rescuer care with an AED
- Explain reason for pulses not being checked between shocks with an AED
- Discuss importance of coordinating advanced cardiac life support-trained (ACLS)-trained providers with personnel using AEDs
Learning Objectives

- Discuss importance & list components of postresuscitation care
- Define function of all controls of AED & describe event documentation & battery maintenance
- Discuss standard of care for patient with persistent/recurrent ventricular fibrillation (VF) & no available ACLS
- Explain importance of prehospital ACLS intervention, if available

Learning Objectives

- Explain importance of urgent transport to facility with ACLS if not available in prehospital setting
- Discuss need to complete “Automated defibrillator: operator’s shift” checklist
- Explain importance of frequent practice with AED
- Explain role medical direction plays in use of AED

Learning Objectives

- State why you should complete a case review after use of AED
- Discuss components to include in case review
- Discuss goal of quality improvement (QI) in AED
Introduction

- > 335,000 die in United States from sudden cardiac arrest (SCA) annually
  - Most occur outside hospital
  - SCA may be the first sign of heart disease
  - AHA promotes chain of survival

Chain of Survival

- Early recognition and activation of 9-1-1
- Early CPR
- Rapid defibrillation
- Early Advanced Life support
- Integrated post-resuscitation care

Chain of Survival

- Designed to:
  - Deliver CPR
  - Perfuse brain/heart
  - Provide early defibrillation
  - Prevent subsequent cardiac arrest
  - Provide therapeutic hypothermia and other post-resuscitation care
Chain of Survival

- Most patients with SCA have VF
- Early defibrillation
- Early access
- Early advanced cardiac care

Chain of Survival

- Patients with chest pain/SCA
  - Administer O₂
  - Assist with administration of prescribed nitroglycerine (NTG)
  - Defibrillate, if SCA occurs
  - Request ALS assistance
  - Provide prompt transport
  - Communicate findings to hospital personnel
Chain of Survival

- Major heart disease categories:
  - Ischemic chest pain
  - Heart failure
  - Sudden cardiac death

Anatomy & Physiology

- Circulatory system delivers O₂ & nutrients to tissues; returns waste products to lungs & kidneys
  - Proper functioning depends on:
    - Heart
    - Blood
    - Blood vessels
Anatomy & Physiology

- Heart
  - Generates blood flow to all parts of body
  - Force must be sufficient to open vessels
  - Inner portion divided into:
    - Right atrium
    - Right ventricle
    - Left atrium
    - Left ventricle

Anatomy & Physiology

- Conduction system
  - Specialized tissues that depolarize and transmit impulses, creating rhythmic contraction & relaxation
Anatomy & Physiology

- Heart
  - Cardiac output

\[ \text{CO} = \text{SV} \times \text{HR} \]

- Blood vessels
  - Arteries
  - Veins
  - Capillaries

- Major arteries for palpation:
  - Carotid
  - Radial
  - Brachial
  - Femoral
  - Posterior tibial
  - Dorsalis pedis
Anatomy & Physiology

Blood pressure
- Force exerted by blood volume on walls of vessels
- Systole
  - Contraction
- Diastole
  - Relaxation

Microcirculation
- Capillaries
- Diffusion
Anatomy & Physiology

- Microcirculation
  - Capillary BP & osmosis
    - Microcirculation
    - Hydrostatic pressure
    - Osmosis
    - Plasma proteins
    - Oncotic pressure
    - Pushing & pulling forces create balance that ensures adequate fluid in both compartments
    - Fluid balance problems

- Shock (hypoperfusion)
  - Inadequate circulation
  - Vital body tissues poorly perfused
  - Vital body processes fail
  - Results in inadequate oxygenation of tissues; eventual cell death if prolonged
  - Can occur when any part of circulatory system fails
Anatomy & Physiology

- Shock (hypoperfusion)
  - Body releases epinephrine to compensate (elevates BP and shunts blood to more vital organs)
  - Patients with signs/symptoms of shock are high-priority patients
  - Prehospital care
    - Secure airway
    - Ensure patient can breathe
    - Ensure oxygenation

Cardiovascular Disease

- Cardiovascular disease and its complications - leading cause of death in United States
- Pathophysiology of ACS
  - Arteriosclerosis
    - Progressive artery disease
    - Coronary artery disease
  - Myocardial O₂ supply and demand
Cardiovascular Disease

- Myocardial ischemia, myocardial infarction
  - Ischemia
    - Decrease in blood flow to organ/tissue causing problems but not permanent damage
  - Infarction
    - Severe obstruction, resulting in heart cell necrosis
- Acute coronary syndromes
- Patients with ischemic chest pain - highest priority

Acute Coronary Syndromes

- Scene size-up
  - Ensure safe scene
  - BSI precautions
  - Identify MOI/NOI
  - Consider need for ALS
  - Notify dispatch early

- Initial/primary assessment
  - Form general impression
  - Identify:
    - Chief complaint
    - Age
    - Gender
  - Is this a life-threatening condition?
  - Assess mental status & ABCs
  - Manage airway/ventilation
  - Note patient’s pulse quality
  - Check for signs of poor perfusion
Acute Coronary Syndromes

Focused/secondary assessment

SAMPLE history

- Signs/symptoms
- Allergies, medications
- Pertinent past medical history
- Physical examination
- Baseline vital signs

SAMPLE history

- Signs/symptoms
  - Crushing
  - Pressing
  - Tight
  - Viselike
  - Heavy
- Usually located in anterior chest
- Radiates to neck, jaw, either arm/shoulder
- Associated complaints

SAMPLE history

- Signs/symptoms
  - Aching
  - Constricting
  - Burning
  - Discomfort in chest

SAMPLE history

- Check for JVD, accessory muscle use
- Baseline vital signs
  - Rapid, slow pulses
  - Variations in BP common
  - Skin - pale, cool, sweaty
  - Lungs: note presence of equal/abnormal sounds
Acute Coronary Syndromes

- Ongoing assessment/reassessment
  - Check:
    - Vital signs
    - Mental status
    - Response to therapy
    - Continuation of pain, dyspnea
    - Pulse rate, rhythm, quality
  - Have AED & mechanical aids for CPR readily available

- Transportation
  - Priority transportation decision for chest pain
  - Rapid, quiet
  - Avoid siren use
  - Notify hospital of imminent arrival

- Emergency medical care
  - Reduce work of heart
  - Enhance $O_2$ delivery to cells guided by oxygen saturation
Acute Coronary Syndromes

- Decreasing body O₂ requirements
  - Limit anxiety & activity
  - Stress & fear can cause epinephrine release
  - Reduce energy requirements
  - ↑ Oxygenation if saturation is below 95%
  - Patient denial
  - Compromised respiratory/circulatory systems

Nitroglycerin

- Used to treat ischemic heart disease
- Dilates larger veins
  - Allows more blood to pool in dependent areas
  - Reduces blood returning to heart
- Dilates arteries
  - Decreases resistance to blood moving out of heart
- Contraindicated if systolic BP lower than 100 mm Hg

Nitroglycerin

- Nitroglycerin available as patch
  - Absorbed slowly over several hours
  - Not useful for acute attacks
- Contraindicated if systolic BP lower than 100 mm Hg
- Should be avoided if patient has recently taken Viagra or similar drug
Administering Nitroglycerin

- Perform focused assessment
- Take BP reading
- Question administration of last dose & effects of medication
- Obtain an order

Administering Nitroglycerin

- Ensure right medication, dose, route & patient is alert
- Place tablet/spray under tongue

Administering Nitroglycerin

- Recheck BP
- Record activity, times
- Perform reassessment
Aspirin

- Decreases formation of clots during ACS
- Before administering, assess following contraindications:
  - Is patient allergic to aspirin?
  - Has patient recently taken aspirin?
  - Does patient have recent history of GI bleeding?

Heart Failure

- Destruction of heart muscle reduces heart's power to contract
- History
  - History of hypertension or signs of recent MI
  - Shortness of breath, weakness, limited activity
  - Weakened heart inadequately pumps blood from ventricles

Heart Failure

Physical examination
- Signs
  - Noisy respirations
  - Crackles sounds at base of lung fields
  - Accessory muscle use
  - Cyanosis
  - Edema – ankle/lower legs
  - Massive tissue swelling
  - Distended neck veins
Heart Failure

- Treatment
  - Difficulty breathing
    - High-concentration O₂ via nonrebreather mask
  - Inadequate breathing
    - Positive-pressure ventilation (PPV) with bag-mask or other ventilation device
  - Upright position allowing legs to hang down
  - ALS medications

Thoracic Aortic Dissection

- Frequently occurs in men/persons over 50 y/o
- Tear in aortic wall; blood enters vessel inner lining
  - Forms false passage
  - Dissections
    - Proximal dissections
    - Distal dissections
Heart Failure

Thoracic Aortic Dissection

- Pericardial tamponade
  - Blood around heart & aorta can result in:
    - Poor venous return
    - Profound shock
    - Death

Thoracic Aortic Dissection

- History
  - Thoracic aortic dissection presents tearing, ripping, searing chest pain
  - Patient may:
    - Faint
    - Show signs of stroke
    - Experience arm numbness
Slide title correct?
Reed Elsevier, 8/2/2011
Thoracic Aortic Dissection

- Physical examination
  - Findings related to MOI
    - Occlusion of vessels
    - Hemorrhage
    - Pericardial tamponade

Thoracic Aortic Dissection

- Treatment
  - Immediate surgical intervention at hospital
  - Rapid transport
  - Supportive care
    - High-concentration O₂
    - PPV, if needed
    - Treat for shock

Abdominal Aortic Aneurysm

- Aneurysm
  - Localized abnormal dilation of blood vessel/heart
  - Abdominal aortic aneurysms (AAAs)
  - Exsanguination
Abdominal Aortic Aneurysm

- History
  - AAA typically presents with abdominal/back pain
  - Patient usually older
  - Hypertension/aneurysm history possible

- Physical examination
  - Poor perfusion
  - Elevated HR
  - Adrenaline release
    - Pale, cool, sweaty skin
  - Rigid and distended abdomen; tenderness
  - May occlude one or both femoral arteries
Abdominal Aortic Aneurysm

- Treatment
  - Immediate surgical intervention at hospital
  - Rapid transport
  - Supportive care
    - High-concentration O₂
    - PPV, if needed
    - Treatment for shock

Pulmonary Embolism

- Blood clots released from leg veins, lodged in pulmonary artery
- Can occur after surgery; patients taking birth control
- Large artery involved, shock may result
- Changes in lung circulation

Pulmonary Embolism

- History
  - Difficulty breathing
  - Chest pain increases with breathing
  - Cough up bloody sputum
  - Possibly history of:
    - Calf tenderness
    - Recent surgery
    - Prolonged bed rest
    - Recent travel
    - Use of oral contraceptives
    - Phlebitis
Pulmonary Embolism

- Physical examination
  - Findings often normal
  - ↑ HR
  - Shock present in worst cases
  - Significant obstruction, signs of right-sided heart failure
  - Possible hypoxia – cyanosis, AMS

Pulmonary Embolism

- Treatment
  - High-concentration O₂
  - Treatment for shock, as needed
  - Rapid transport crucial

Cardiac Arrest

- Heart rhythm does not generate blood flow

- Asystole
  - “Flatline”
  - No electrical activity

- Pulseless electrical activity
  - Organized electrical heart rhythm
  - No palpable pulse/ventricular fibrillation
Cardiac Arrest

- Causes
  - Adults - ventricular fibrillation likely cause
    - Time to defibrillation critical
    - EMS, CPR, AED use most important
  - Children - respiratory problems likely cause
    - Focus on providing ventilation
    - Possible ventricular fibrillation, but not as likely
    - Check EMS local treatment protocols for cardiac arrest victims younger than 8 y/o

Cardiac Arrest

- Relationship to BLS
  - 2-rescuer CPR - most common technique at scene
    - 1-rescuer CPR may be needed if partner is preparing an AED or during transport
  - Maintain secure position
  - Consider important modalities/factors when performing CPR

Cardiopulmonary Resuscitation

- Chest compressions with PPV
- Provides temporary perfusion to vital organs until circulation is restored
- May resuscitate short-term cardiac arrest victims caused by respiratory failure/arrest
Cardiopulmonary Resuscitation

- Optimal CPR benefits
  - Activate 9-1-1 system quickly
  - CPR provided early
  - Quality compressions
    - 2 inch (5 cm) compressions
    - Complete recoil of the chest
    - At least 100 compressions/minute
    - Minimal interruption

Cardiopulmonary Resuscitation

- Adult CPR
  - AHA 2010 guidelines
    - Encourage 2 inch compressions
    - Minimal interruption of compressions
    - Avoid hyperventilation
  - New sequence CAB
    - Check unresponsiveness and breathing
    - Activate response
    - Check carotid pulse
    - Start compressions
    - Compressions-to-ventilations ratio 30:2

Cardiopulmonary Resuscitation

- Adult CPR
  - Assess responsiveness and breathing, activate EMSS
    - First person at scene - check responsiveness and breathing
    - Time to defibrillation, most important variable
    - If alone, activate EMSS and retrieve AED
    - 2 people
      - 1 performs CPR
      - 1 prepares AED
    - Only exception – asphyxia
      - Ventilations first
In last note, please clarify “way” in “complete release of the chest way, critical”

In notes section--change 2005 to 2010?
Cardiopulmonary Resuscitation

- Adult CPR
  - Circulation
    - Chest compressions create blood flow
    - Recognize cardiac arrest – most important step
    - Assess pulse
      - Palpate carotid artery for 5 to 10 seconds
      - If no breathing and pulse is present
        - Perform rescue breathing 10 to 12 breaths/min
      - If no pulse, begin chest compressions
  - Chest compressions
    - Relatively rapid compression rate
    - Critical to maintain at least 100 compressions/minute
    - Guideline ratio 30:2
    - Ventilations: 8 to 10 breaths/min when advanced airway placed
    - Compress sternum 2 inches for adult

- Airway
  - Open airway with head-tilt–chin lift method
  - If trauma suspected, use jaw thrust
- Breathing
  - Do not breathe too forcefully or rapidly
  - Two breaths with each breath delivered over 1-second with visible chest rise
  - Mouth-to-mask and bag-mask can be used
RE5  Is "Two breaths with each breath delivered" clear to reader?
Reed Elsevier, 8/2/2011
Cardiopulmonary Resuscitation

- Adult CPR
  - 1-rescuer CPR
    - If only 2 rescuers available
      - 1-rescuer CPR
        - Other applies AED, evaluates quality of chest compressions
  - 2-rescuer CPR
    - 1 rescuer at victim's side
    - 1 rescuer at victim's head
    - Compression rate 100/min
    - Compression-to-ventilation ratio 30:2
    - Change compressors every 2 minutes

Adult 1-Rescuer CPR

- Check unresponsiveness
- Check for breathing

Adult 1-Rescuer CPR

- Check carotid pulse (for 5-10 seconds)
- If no pulse, begin chest compressions
**Adult 1-Rescuer CPR**

- Place hand in the center of the chest on the lower half off the breastbone
- Place the hand directly over the first
- Perform external chest compressions at rate of 100/min with 30:2 compression-to-ventilation ratio

**Adult 1-Rescuer CPR**

- Depress chest 2 inches
- Provide 2 breaths
- Perform complete cycles of 30 compressions to 2 ventilations
- Reevaluate after 5 cycles

**Adult 2-Rescuer Cardiopulmonary Resuscitation**
Infant and Child Cardiopulmonary Resuscitation

- Infant/child CPR
  - Infant younger than 1 year old
  - Child – from 1 year old to puberty
  - Cardiac arrest usually caused by respiratory failure/arrest, trauma
  - Assess responsiveness and breathing, activate EMSS

Child 1-Rescuer Cardiopulmonary Resuscitation

- Check unresponsiveness
- Check for breathing

- Check carotid pulse (for 5-10 seconds)
- If no pulse, begin chest compressions
- Compress chest 1/3 to 1/2 half the diameter of the chest
- At least 100 compressions per minute
See Notes section--appropriate for slides 92-99?
Child 1-Rescuer
Cardiopulmonary Resuscitation

- For smaller children use 1 arm for compressions

Child 1-Rescuer
Cardiopulmonary Resuscitation

- Deliver 2 breaths
- Continue 30:2 cycle

Child 2-Rescuer
Cardiopulmonary Resuscitation

- Perform 15:2 cycles when performing 2-rescuer child CPR
Infant 1-Rescuer
Cardiopulmonary Resuscitation

- Check unresponsiveness
- Check for breathing

Infant 1-Rescuer
Cardiopulmonary Resuscitation

- Check brachial pulse (for 5-10 seconds)
- If no pulse, begin chest compressions
- Compress chest 1/3 to 1/2 the diameter of the chest
- At least 100 compressions per minute

Infant 1-Rescuer
Cardiopulmonary Resuscitation

- Provide 2 breaths
- Continue cycles of 30 compressions to 2 breaths
Infant 2-Rescuer CPR

- Perform 15:2 cycles when performing 2-rescuer child CPR
- Use 2-thumb-encircling technique for compressions

Automated External Defibrillators

- Goals
  - Monitor patient’s heart rhythm
  - Identify shockable vs. nonshockable heart rhythms
  - Advise AED operator to initiate defibrillation

- Ventricular fibrillation from ischemic heart disease is the most common and treatable cause of sudden death
Automated External Defibrillators

- Evolution of defibrillation concept
  - Hospital experience showed early CPR and ALS application leads to higher patient survival rate
  - Portable defibrillators – 1960s
  - Time elapsed between onset and CPR and defibrillation determined to be most important

Operating an AED

- BSI
- Check responsiveness, breathing
- Check pulse for 5 to 10 seconds
- Begin CPR until AED attached
- Position AED close to victim
- Turn on AED

- Prepare to place AED on pads on patient’s chest
- Attach electrode pads to patient at right sternal border
  - Below clavicle
  - 2 to 3 inches below left arm pit
Operating an AED

- Clear patient
  - Press analyze button/allow machine to analyze
- If shock advised
  - Confirm everyone clear
  - Press shock button
  - Immediately resume CPR, starting with chest compressions

- After 5 CPR cycles:
  - Check pulse
  - Allow AED reanalyze
  - If second shock recommended, follow previous instructions
- If "no shock advised":
  - Perform 5 CPR cycles
  - Check pulse
  - Reanalyze

- Persistent ventricular fibrillation
  - After defibrillation:
    - Monitor for recurrent VF
    - If unresponsive, attend to breathing, checking circulation
  - Circulation lost en route:
    - Stop vehicle
    - Analyze rhythm
    - Deliver shock
  - If conscious patient collapses with no signs of breathing & circulation
    - Stop vehicle
    - Apply AED
    - Have AED readily available
Special Situations

- Hairy chest
- Water
- Transdermal medication
- Pacemaker/cardioverter-defibrillator

Coordination with ALS Personnel

- Coordination with ALS personnel
  - Local protocols cover interaction of ALS personnel with BLS providers
    - ALS have medical authority
  - EMT can assist paramedics
  - If ALS not possible
    - Rapid transport

Postresuscitation Care

- Postresuscitation care
  - Patients who regain spontaneous circulation after cardiac arrest show varying responses, vital signs
  - Monitor ventilations
  - Administer PPV
Maintenance

- Maintenance
  - AED must be maintained
  - Record maintenance functions
  - "Automated defibrillator: operator’s shift" checklist
  - Maintain batteries properly
  - Ensure backup batteries are available

Training, Sources of Information

- Practice frequently to maintain skill proficiency
  - Most systems require evaluation to ensure competency in AED use

Medical Direction, Quality Improvement

- Essential components
  - Education
  - Protocol development
  - Continuing education
  - Case, call review
  - Evaluation of prehospital outcomes
Summary

Arteriosclerosis is a progressive narrowing of arteries that results in development of acute coronary syndrome including:
- Angina pectoris
- Myocardial infarction

Ischemic chest pain typically occurs in center of chest and may radiate to:
- Neck, jaw, arms

Summary

Angina pectoris is chest pain that is usually caused by increased oxygen demands on heart

Myocardial infarction (MI) - death of heart muscle caused by blockage/occlusion of coronary artery

Summary

Signs, symptoms of MI include:
- Ischemic chest pain
- Sweating, pale
- Cool skin
- Shortness of breath
- Nausea
- Vomiting
- Dizziness
- Fainting
Summary

- Place patients with chest pain/shortness of breath in position of comfort
- EMTs may assist patients with prescribed nitroglycerin with administration of tablets/spray
- Nitroglycerin administration may be repeated every 3 to 5 minutes, up to 3 doses

Summary

- Heart failure - condition resulting from damaged/weak heart muscle - caused by:
  - Severe MI
  - Chronic hypertension
  - Other causes
- Patients with heart failure may exhibit shortness of breath; noisy breath sounds; swelling of ankles, lower back, abdomen; distended neck veins

Summary

- Cardiac arrest caused by heart rhythms that result in no blood flow, including:
  - Asystole
  - Pulseless electrical activity
  - Ventricular fibrillation/ventricular tachycardia
- Effective, early cardiopulmonary resuscitation (CPR) with compression-to-ventilation ratio of 30:2 increases survivability of cardiac arrest event
- CPR is most effectively performed by 2 rescuers
  - Interruptions should be limited
Summary

- Ventricular fibrillation, useless quivering of heart, results in no blood flow.

- Only effective treatment for ventricular fibrillation is electric shock with defibrillator.

- Automated external defibrillator (AED) is computerized device that recognizes shockable versus nonshockable heart rhythms, advises operator to deliver electric shock.

Summary

- AED electrode pads are placed on right upper chest, below clavicle on right border of sternum; left chest 2 to 3 inches below armpit.

- Operation of AED involves 4 distinct steps:
  - Turning device on
  - Attaching electrode pads
  - Clearing patient, allowing device to analyze
  - When advised, clearing patient, pushing shock button.

Summary

- Most AEDs can safely be used on persons older than 8 years.

- Continual training on CPR, AED use is crucial.

- Smooth, coordinated interaction with EMTs, ALS personnel increases patient’s chance of survival in all cardiac events.