AUTOMATED EXTERNAL DEFIBRILLATORS

Presented by MedicEd.com, Inc.
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1 Credit Hour Course Approved for the Following Levels:
» First Responder
» EMT Basic
» EMT Intermediate
» EMT Paramedic

INTRODUCTION
• Early defibrillation saves lives. Learn how since their introduction into the prehospital environment AED’s have been a strong link in the chain of survival.

*This lecture does not grant permission for the reader to own/operate an AED. Follow your local protocols/guidelines about medical control and operation of an AED.

SCENARIO
You are called to the scene of a 58 year-old male who was complaining of chest pain. His wife states that he just collapsed to the floor and she cannot wake him up. You enter to find your patient prone on the living room floor. You begin your assessment and find the patient pulseless and apneic. Your partner initiates CPR while you open and turn on the AED.

OBJECTIVES
By the end of this lecture, the participant should be able to...
• Describe the scientific evidence behind the operation of automated external defibrillators (AEDs) according to the 2005 AHA Guidelines
• Explain the history of AEDs
• Describe the types of AEDs and basic operation
• Understand basic cardiac anatomy & physiology
• Describe the AED Assessment in regards to the AHA Primary Survey
• Explain the special situations for AED usage
• Explain reasoning behind manufacturers recommendations for energy settings
• Manage a scenario of a patient in cardiac arrest
HISTORY OF AEDs

- Out of hospital cardiac arrest remains a leading cause of death in the United States.
- Cardiovascular disease claims the lives of more than 600,000 Americans each year. Half of these deaths occur outside the hospital. In nearly 50% of these cases, a patient had no knowledge of a heart disorder until he or she collapsed.
- Most of these cases are sudden death caused by cardiac arrest; usually a result of ventricular fibrillation.
- It is for this reason that the American Heart Association in the early 1990's initiated a program to ensure public access to defibrillation and decrease delays to shock.
- Automatic external defibrillators were first introduced in the late 1970's when technology allowed for a device to accurately analyze a cardiac rhythm and if appropriate deliver an electric countershock.
- While widely used by first responders and emergency medical technicians, AEDs have now been moved into the public eye in areas such as schools, airports, playgrounds and casinos.
- Each year, about 1.1 million Americans suffer a heart attack. About 460,000 of those heart attacks are fatal. About half of those deaths occur within 1 hour of the start of symptoms and before the person reaches the hospital.

References:
* http://www.nhlbi.nih.gov/actintime/aha/aha.htm
* ©2009 Pearson Education, Inc.; Emergency Care, 11th Ed.

PUBLIC ACCESS DEFIBRILLATION STUDY

- Over a two year period ending January 2002, 993 public facilities participated in a PAD study
- All participants were trained in CPR
- Half of the volunteers received training on the usage of an AED
- Approximately 20,000 volunteers were initially trained
- Of these, 48% were retrained after an average of 5.5 months, and 20% received a second retraining at an average of 9.8 months from the first retraining.
- Preliminary results are based on a total of 292 attempted resuscitations
- There were 44 survivors from among these cardiac arrest patients, 15 in the CPR arm and 29 in the CPR+AED arm.
- No volunteers received inadvertent shocks, and no patients were shocked unnecessarily.

http://depts.washington.edu/padctc/
NHLBI Sponsored Public Access Defibrillation Trial
Presented November 11th, 2003
Studies

• There were two interesting studies were reported in the New England Journal of Medicine that looked at the use of AEDs (Automated External Defibrillators) by non medical personal and reviewed rates of survival to hospital discharge.

Uses of AEDs in Casinos

• The first study by Valenzuela et al. Outcomes of rapid defibrillation by security officers after cardiac arrest in casinos, is a prospective study of cases of sudden cardiac arrest that occur in casinos.
• Security officers were first trained in the uses of AEDs.

References:

Methods of Casino Study

• The subjects included in the study had a cardiac arrest on the casino property. Either in common area where gambling or in a hotel room.
• Patients were unconscious, unresponsive, without pulse or respirations.
• Security officers had basic cardiopulmonary resuscitation training.
• AEDs were placed in casinos to meet a goal of no more then 3 minutes to defibrillation.
• The outcome measure of the study was survival to hospital discharge.

Results of Casino Study

• 148 patients were studied
• 105 had ventricular fibrillation (VF) as the initial rhythm (71%)
• 17 had pulseless electrical activity (PEA)
• 26 asystole

Results

• Of the 148 total group:
  o 17 were pronounced dead at the scene
  o 60 were pronounced dead in the hospital emergency department
  o 15 were admitted to the hospital and died before discharge
  o 56 survived to discharge from the hospital (38%)

Subgroup Analysis

• Of those patients whose collapse was witnessed, survival rates were:
  o 74% (26 of 35) if response was 3 minutes or less
  o 49% (27 of 55) if response was greater than 3 minutes

High rates of survival

• Notice that survival rates are extremely high for out-of-hospital cardiac arrest.
• Casinos have the obvious advantages of increased witnesses and decreased response times.
Time to shock still critical
• The high survival rates of witnessed collapses shows that time between collapse and first defibrillation is paramount.
• The study also shows that AEDs can be operated by non medical personnel with minimal training

Airline Study
• A second study on the use of AEDs followed the Casino study in the October 2000 issue of the New England Journal of Medicine.
• This study looked at the use of AEDs on airplanes and in the terminal.
• Airplanes provide a unique problem, as it is a significant length of time before medical care is available.
• In 1997 American Airlines began placing AEDs aboard selected aircraft’s. Flight attendants were trained 4 hours followed by a 1-½ hour annual refresher.

References:

Methods
• The study looked at use of the AED from June 1, 1997 to July 15, 1999.
• AED was used in cases of cardiac arrest for monitoring and defibrillation. This was usually at the request of a passenger that was a physician.

Results
• The AED was used on 200 patients.
• Use was for cardiac arrest, chest pain, nausea or malaise, light-headedness, palpitations, stroke or for unclear reasons.
• 14 patients had documented VF. In each case the arrhythmia was recognized and shock recommended. (Sensitivity of 100%)
• 13 of the 14 were successfully defibrillated. One patient was not resuscitated due to family request.
• Rate of survival after defibrillation to hospital discharge was 40%. This again is high compared to those patients who receive defibrillation in other out-of-hospital settings.

Devices Use As Monitor
• In 101 out of 200 cases the device was placed on a conscious passenger for use as a monitor. This was usually at the request of a passenger that was a physician.
• In no case was an inappropriate shock given.
• So even though the AED was used as a monitor half the time, it was safe for patients.
Unique Problems
- One interesting dilemma unique to the airline is that passengers in cardiac arrest were often unrecognized for long periods of time.
- These passengers were assumed to be sleeping and therefore their treatment was delayed.
- Perhaps additional training in recognizing cardiac arrest is needed as well.

Training
- In the two pervious studies casino security officers and flight attendants were successfully trained to use an automated external defibrillator.
- However, can AEDs be operated by the general public with little or no training?

Yes
- In a study by Gundry et al. sixth-grade children were able to follow defibrillator diagrams and "voice prompts" in a simulated cardiac arrest and deliver a shock safely.
- The sixth-graders only took 27 seconds longer to accomplish defibrillation than trained EMTs or paramedics!

References:

Key points from these studies
- Critical element for survival is early defibrillation
- The differences between devices is not as important as time from collapse to application of the device.
- AED can be used to save lives by non medical personnel with minimal training

TYPES OF AEDs
- Fully Automated
  - Operators have to turn the machine on and follow voice prompts
- Semi-Automated
  - Operators will be required to re-analyze after a sequence of CPR

HOW THEY WORK
- AEDs are battery-operated devices that are capable of detecting ventricular fibrillation or rapid ventricular tachycardia with a high sensitivity (approx.90%) and specificity near 100%.
- A microprocessor builds a charge within seconds
- They then guide the user and allow for delivery of a shock.
- AEDs have the capability for built in memory so the rhythm and operation can be reviewed later for quality assurance
  - With the implementation of advanced technology, a variety of information stored on the AED is capable of being sent to hospitals prior to ambulance arrival or used for quality assurance.
  - Once defibrillation occurs the AED prompts the user to resume/initiate CPR

References:
Cardiac Anatomy and Physiology Overview

- Flow of blood through the chambers of the heart
- Cardiac conductive system
- The names and positions of major blood vessels

In the event the cardiac conduction system is compromised, the patient may experience Ventricular Fibrillation.

- The AED searches for Ventricular Fibrillation and Ventricular Tachycardia (pulseless, which you’ve already determined)

- The main purpose of the AED is to quiet the chaotic electrical activity within the heart by providing an unsynchronized shock.

- Once defibrillation has occurred immediate CPR is initiated/resumed to ensure adequate blood flow is being pushed throughout the body. Hopefully, the normal electrical activity in the heart will resume.

2005 AHA GUIDELINES for CPR

- Push harder Push Faster
- Minimize interruptions in chest compressions
- Full chest recoil

2005 AHA GUIDELINES for AED

- Witnessed collapse vs. un-witnessed
- Single shocks, followed by immediate CPR, be used to attempt defibrillation for VF cardiac arrest.
- Rhythm checks should be performed every 2 minutes.
- Endorsement of the 2003 ILCOR recommendation for use of AEDs in children 1 to 8 years old (and older); use a child dose-reduction system if available.

AED ASSESSMENT

- Scene Size-up / Initial Assessment
- Call for ALS Paramedics
- AHA Primary Assessment
- Airway Breathing Circulation & Defibrillation
- AEDs are only applied to patients who are determined to be pulseless by the EMS provider or AED operator
SPECIAL SITUATIONS
- Age / weight
- Hairy
- Wet
- Automated Internal Pacemakers/Defibrillators
- Medication patches
- Problematic jewelry

MANUFACTURER RECOMMENDATIONS
- There are a variety of AEDs in use today all serving the same function reversal of VF arrests
- Each defibrillator has an energy setting that has been proven effective by the manufacturer
- One reason behind the concept of lower energy defibrillation is to minimize damage and dysfunction to the heart.
- In certain models of AEDs, advanced software allows the AED to analyze cardiac rhythms while the rescuer performs continuous compressions. This technology minimizes the interruptions in CPR.

How machines differ
- The minimally trained may require a simple easily portable machine while those with more advanced training may desire a manual operation mode or optional ECG display.

References:

- There are a variety of AED manufacturers that supply the machines with differences for each model
- AEDs vary in size, weight, cost, voice prompts and energy settings
- Certain AEDs may provide voice prompts in regards to quality and quantity of compressions.

Biphasic waveform vs. monophasic
- Biphasic waveform defibrillators can use lower energy shocks and are just as effective.
- Research has failed to show any clinical benefit from biphasic waveforms delivering more than 200 J of energy.

References:

Cost
- There are approximately 8 major manufacturers of AED all providing varying models and features
- The average cost for an AED unit is between $1,200 to $3,000 depending on the built-in technologies and accessories that accompany the AED
SCENARIO
While providing continuous compressions to the 58 year-old male in a witnessed cardiac arrest you attach the AED. The fully automated AED advises you to stand clear during analysis of the initial rhythm. The AED voice prompt states “shock advised” and you hear the AED charge. You ensure that everyone is clear from the patient and depress the shock button. You instruct your partner to immediately resume quality chest compressions for 2 minutes while you ensure ALS has been initiated.