Cardiac Defibrilator

Definition

An electrical device used to counteract fibrillation of the heart muscle and restore normal heartbeat by applying a brief electric shock

Early defibrillation is critical to survival

- VF -frequent rhythm witnessed in SCA
- Rx for VF is electrical defibrillation
- Probability of successful defibrillation diminishes rapidly over time
- VF tends to deteriorate to asystole within a few minutes

For every minute that passes between collapse and defibrillation, survival rates from witnessed VF SCA decrease 7% to 10% if no CPR is provided

Ann Emerg Med. 1993;22:1652–1658

3 actions that must occur within the 1st moment of SCA

- Activation of the emergency medical services (EMS) system
- Provision of CPR, and
- Operation of an AED

When 2 or more rescuers are present, activation of EMS and initiation of CPR can occur simultaneously

2 critical questions about CPR+ defibrillation

- ? CPR should be provided before defibrillation is attempted
- Number of shocks to be delivered in a sequence before the rescuer resumes CPR

Shock First Vs CPR First

- Out-of-hospital witnessed arrest

- If AED is immediately available

- Use the AED as soon as possible.

Shock First Vs CPR First *contd..*

In hospital

CPR first

Out-of-hospital not witnessed SCA

↓

5 cycles of CPR

↓

Check the ECG rhythm

↓

Defibrillation (Class IIb)

- One cycle of CPR consists of 30 compressions and 2 breaths
- When compressions are delivered at a rate of about 100 per minute, 5 cycles of CPR should take roughly 2 minutes

This recommendation regarding CPR prior to attempted defibrillation is supported by 2 clinical studies

JAMA. 2003;289:1389 –1395

JAMA. 1999;281:1182–1188

1-shock Vs 3-shock sequence

- No published human studies
- Animal studies- 1 shock f/b CPR
- VF/ Pulseless VT- 1 shock f/b 5 # CPR
- Non shockable rhythm- CPR first
- 1st shock efficacy of Monophasic is lower than biphasic shock

Defibrillation waveforms and energy levels

- The energy settings are designed to provide the lowest effective energy needed to terminate VF
- Shock success -Termination of VF for at least 5 sec following the shock
- VF frequently recurs after successful shocks, but this recurrence should not be equated with shock failure

- Modern defibrillators are classified as
  - Monophasic
  - Biphasic
- Energy levels vary by type of device
- No specific waveform is associated with a higher rate of return of spontaneous circulation (ROSC) or rates of survival to hospital discharge after cardiac arrest

Monophasic waveform Defibrillators

- Deliver current of one polarity
- 2 types
- The monophasic damped sinusoidal waveform (MDS) returns to zero gradually
- Monophasic truncated exponential waveform (MTE) current is abruptly returned to baseline (truncated) to zero current flow

Biphasic waveform Defibrillators

- The optimal energy for termination rate for VF has not been determined
- 200 J is safe and has equivalent or higher efficacy for termination of VF than monophasic waveform shocks of equivalent or higher energy (Class IIa)

Automated external Defibrillators

- AEDs are sophisticated, reliable devices
- Use voice and visual prompts to guide lay rescuers and healthcare providers to safely defibrillate VF SCA

Lay Rescuer AED programs

- 1995 AHA recommended lay rescuer AED programs to improve survival rates from out-of-hospital SCA

- Studies of lay rescuer AED programs in airports, & casinos have shown a survival rate of 41-74% from out-of-hospital witnessed VF SCA when immediate bystander CPR is provided and defibrillation occurs within about 3 to 5 minutes of collapse

Electrode placement

- Right pad – Right Infraclavicular
- Left pad – Inf-lateral left chest, lateral to the left breast
- Position the pad at least 1 inch (2.5 cm) away from the implantable medical device

- Do not place pads directly on top of a transdermal medication patch
- If the victim's chest is covered with water or the victim is extremely diaphoretic, wipe the chest before attaching pads
- AEDs can be used when the victim is lying on snow or ice
- If the victim has a hairy chest, remove some hair

Manual Defibrillation

- Both low-energy and high-energy biphasic waveform shocks are effective
- Both escalating & non-escalating energy defibrillators are available
- Insufficient data to recommend one over another
- Use device specific dose

- Biphasic- 150-200 J
- Monophasic- 360 J
- Although operator selects the shock energy (in joules), it is the current flow (in amperes) that actually depolarizes the myocardium

Transthoracic Impedance

- Human impedance is 70 to 80 Ω
- To reduce use conductive materials
- In O_2 rich areas such as CCU's arcing has been known to cause fires

Electrode size

- Min of 50 cm^2
- 8-12 cm diameter
- Small electrode mat cause myocardial necrosis

Fire hazard

- In oxygen rich environment
- Self-adhesive minimize the risk of sparks
- Do not use medical gels or pastes with poor electrical conductivity, such as ultrasound gel

Synchronized cardioversion

- Shock delivery that is timed (synchronized) with the QRS complex
- Avoids shock delivery during the relative refractory portion of the cardiac cycle, when a shock could produce VF
- Energy (shock dose) used for a synchronized shock is lower than that used for unsynchronized shocks (defibrillation)

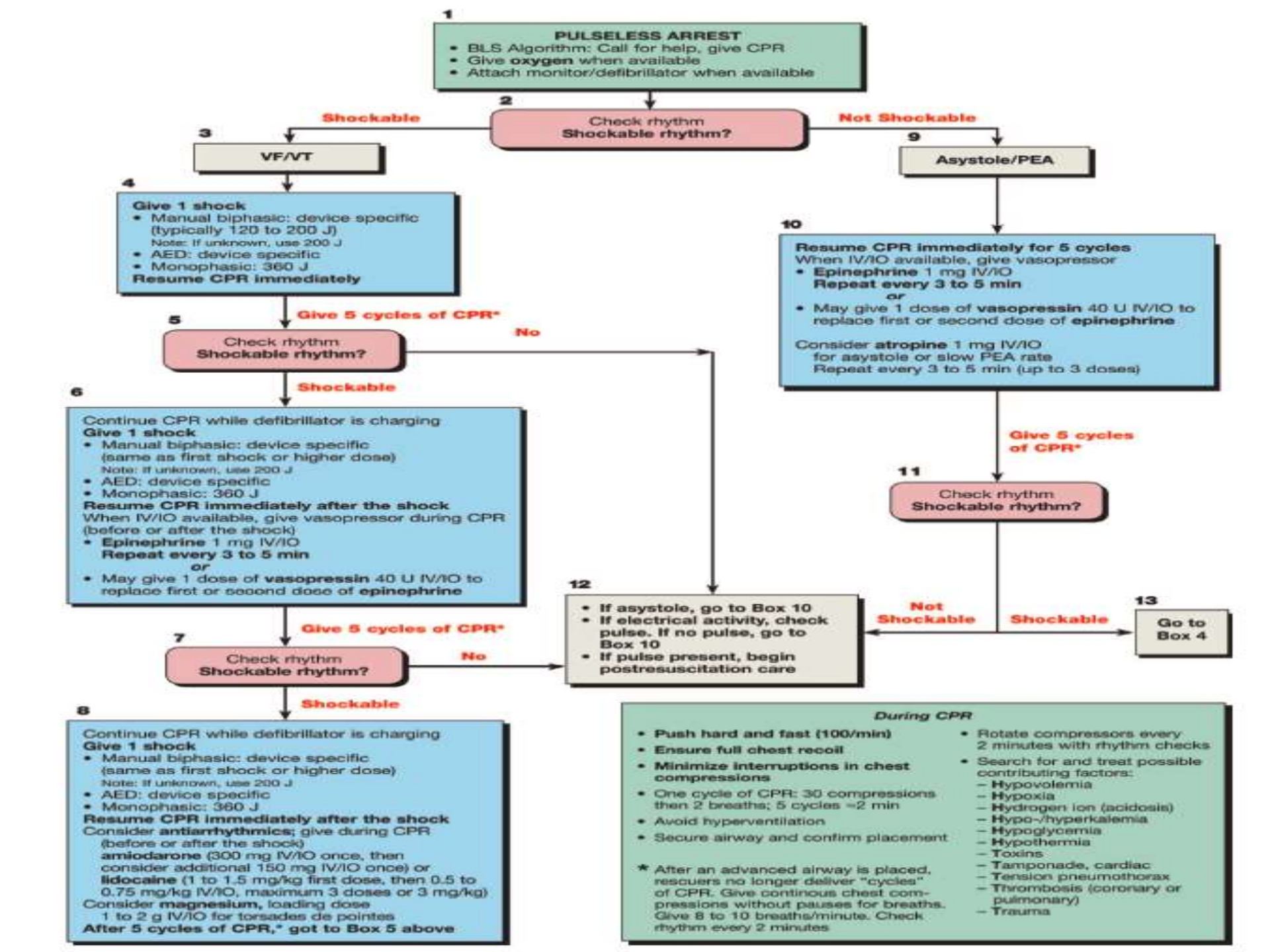
- Synchronized cardioversion is recommended to treat
- Unstable SVT
  - d/t reentry
  - atrial fibrillation
  - atrial flutter

SVT

- Monophasic energy for A Fib = 100-200 J
- A Flutter = 50-100 J
- If initial shock fails then increase dose in step wise manner
- Optimal dose for biphasic waveforms not established
- Success of terminating A fib with initial dose = 85%

Ventricular Tachycardia

- Pulseless VT is treated as VF


1
PULSELESS ARREST
• BLS Algorithm: Call for help, give CPR
• Give oxygen when available
• Attach monitor/defibrillator when available
2
Check rhythm
Shockable rhythm?
Shockable
Not Shockable
3
VF/VT
9
Asystole/PEA
4
Give 1 shock
• Manual biphasic: device specific (typically 120 to 200 J)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately
10
Resume CPR immediately for 5 cycles
When IV/IO available, give vasopressor
• Epinephrine 1 mg IV/IO
Repeat every 3 to 5 min
or
• May give 1 dose of vasopressin 40 U IV/IO to replace first or second dose of epinephrine
Consider atropine 1 mg IV/IO
for asystole or slow PEA rate
Repeat every 3 to 5 min (up to 3 doses)
Give 5 cycles of CPR*
5
Check rhythm
Shockable rhythm?
No
Shockable
Give 5 cycles of CPR*
11
Check rhythm
Shockable rhythm?
6
Continue CPR while defibrillator is charging
Give 1 shock
• Manual biphasic: device specific (same as first shock or higher dose)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately after the shock
When IV/IO available, give vasopressor during CPR (before or after the shock)
• Epinephrine 1 mg IV/IO
Repeat every 3 to 5 min
or
• May give 1 dose of vasopressin 40 U IV/IO to replace first or second dose of epinephrine
12
• If asystole, go to Box 10
• If electrical activity, check pulse. If no pulse, go to Box 10
• If pulse present, begin postresuscitation care
Not Shockable
Shockable
13
Go to Box 4
Give 5 cycles of CPR*
7
Check rhythm
Shockable rhythm?
No
Shockable
8
Continue CPR while defibrillator is charging
Give 1 shock
• Manual biphasic: device specific (same as first shock or higher dose)
Note: If unknown, use 200 J
• AED: device specific
• Monophasic: 360 J
Resume CPR immediately after the shock
Consider antiarrhythmics; give during CPR (before or after the shock)
amiodarone (300 mg IV/IO once, then consider additional 150 mg IV/IO once) or
lidocaine (1 to 1.5 mg/kg first dose, then 0.5 to 0.75 mg/kg IV/IO, maximum 3 doses or 3 mg/kg)
Consider magnesium, loading dose
1 to 2 g IV/IO for torsades de pointes
After 5 cycles of CPR,* go to Box 5 above
During CPR
• Push hard and fast (100/min)
• Ensure full chest recoil
• Minimize interruptions in chest compressions
• One cycle of CPR: 30 compressions then 2 breaths; 5 cycles =2 min
• Avoid hyperventilation
• Secure airway and confirm placement
* After an advanced airway is placed, rescuers no longer deliver "cycles" of CPR. Give continous chest compressions without pauses for breaths. Give 8 to 10 breaths/minute. Check rhythm every 2 minutes
• Rotate compressors every 2 minutes with rhythm checks
• Search for and treat possible contributing factors:
– Hypovolemia
– Hypoxia
– Hydrogen ion (acidosis)
– Hypo-/hyperkalemia
– Hypoglycemia
– Hypothermia
– Toxins
– Tamponade, cardiac
– Tension pneumothorax
– Thrombosis (coronary or pulmonary)
– Trauma

Thank You