Department of Anesthesia Techniques

Defibrillators

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Principles of Defibrillators

- An early “medical” use of electricity **was not to augment life but to document the end of it** with patients receiving an electrical shock to prove they were dead.
- In 1899, Prevost discovered that small electric shocks could induce ventricular fibrillation in dogs and that larger charges would reverse the condition.
- In 1956 when alternating current was first used for transthoracic defibrillation to treat ventricular fibrillation in humans
- 1962 direct current defibrillators were introduced into clinical practice
- when it was demonstrated that electrical countershock or cardioversion across the closed chest could abolish other cardiac arrhythmias in addition to ventricular fibrillation

Defibrillators

Defibrillator: is a device that deliver a therapeutic dose of electrical energy (electric shock) to the affected heart (heart with fibrillation) to force the heart to produce normal cardiac rhythm.

There are three modes:

- **Defibrillation**
- **Cardioversion**
- **Pacing**

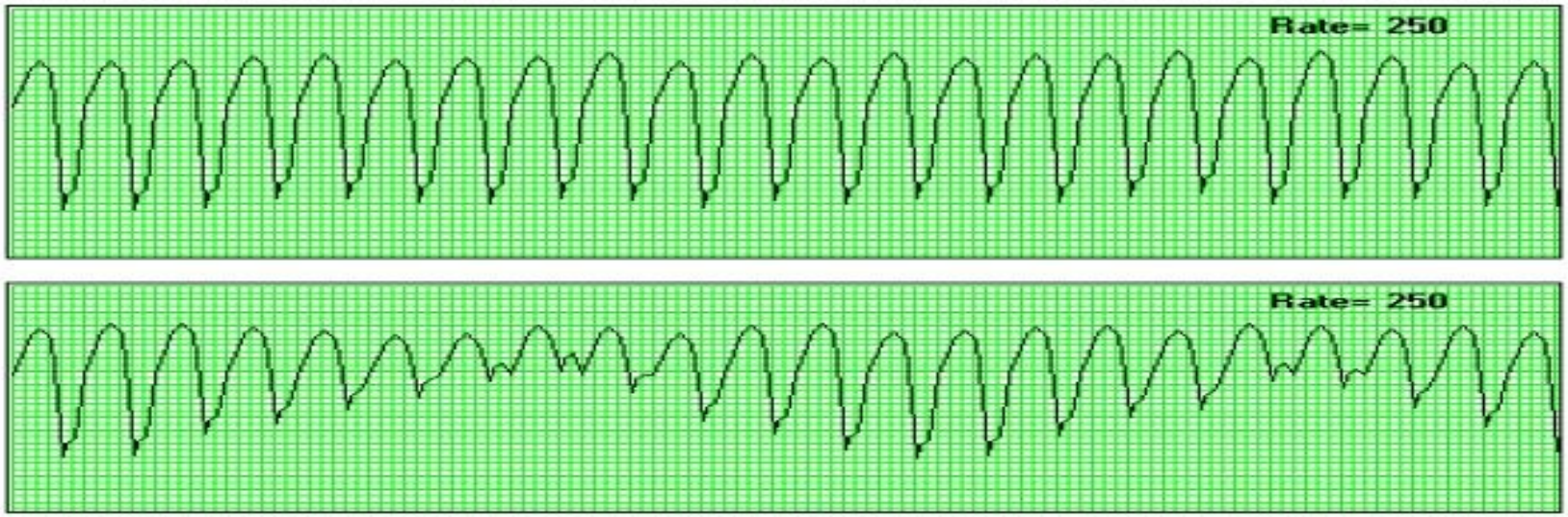
Defibrillation

Defibrillation is **non-synchronized** random administration of shock during a cardiac cycle

Indication:

- Pulseless VT
- VF

Ventricular Tachycardias



Monomorphic, Polymorphic, Torsades de Pointes

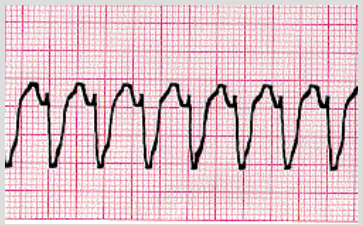
Ventricular Fibrillation (V-fib)

Rhythm: Chaotic
Rate: Chaotic
P Waves: Absent
P-R Interval: Absent
QRS: Absent

Clinical Significance: Ventricular fibrillation is lethal with no cardiac output. Defibrillate with an initial unsynchronized dose of 360 joules monophasic or 120-200 joules biphasic. 1mg Ephinephrine 1:10,000 is the drug of choice given every 3-5 minutes.

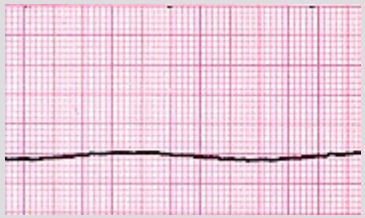
Cardiac arrest heart rhythms summary

ventricular fibrillation



ventricular tachycardia

pulseless electrical activity



asystole

Shockable rhythms; need to defibrillate

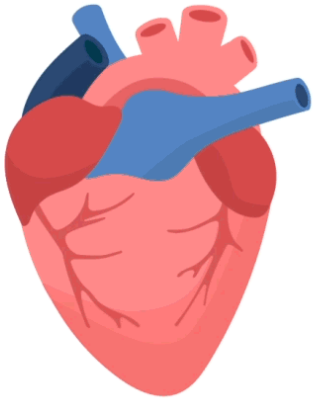
VF and VT are very common for cardiac arrest in the home or in public places

Non-shockable rhythms; do not defibrillate

PEA and asystole are more for cardiac arrest among hospitalized patients

Mechanism

- Current depolarized the myocardium
- Induces asystole temporarily
- Allows SA node to take over because it's the first to repolarize



Types of defibrillators

1- Automated external defibrillators (AEDs):

- These are portable , their use does not require special medical training.
- They are found in public places - e.g., offices, airports, train stations, shopping centers.
- They analyze the heart rhythm and then charge and deliver a shock in case of VF

- AED is provided with self-adhesive electrodes instead of hand held paddles


ZOLL
GOOD COMPRESSIONS
AED

Types of defibrillators

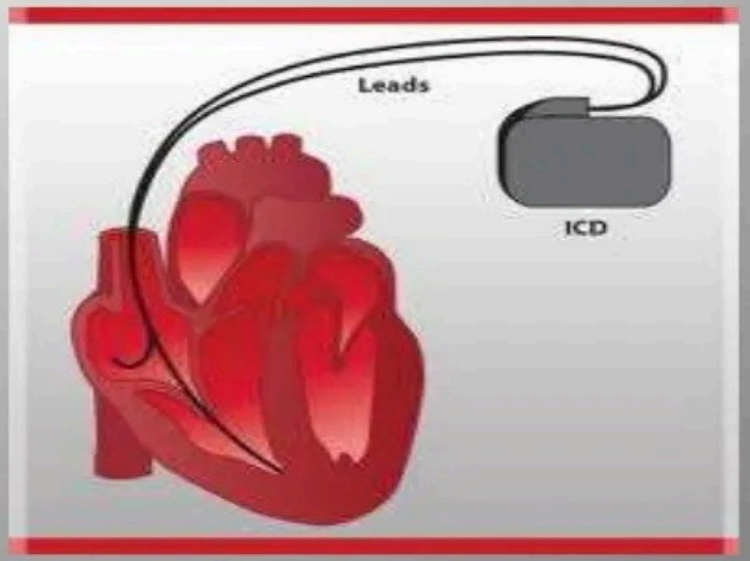
2- Semi-automated AEDs:

- These are similar to AEDs but can be overridden and usually have an ECG display.
- They tend to be used by paramedics.
- They also have the ability to pace.

3- Implantable cardioverter-defibrillators

Implantable cardioverter-defibrillator (ICD)
{automatic internal cardiac defibrillator (AICD)}

A implanted device that detacts and terminats life threatning episodes of VF / VT in high risk patients.



4- Manual External Defibrillators

Energy delivery and dose

Transthoracic **impedance** and defibrillation **efficiency**.

Impedance consists of resistance It is determined by:

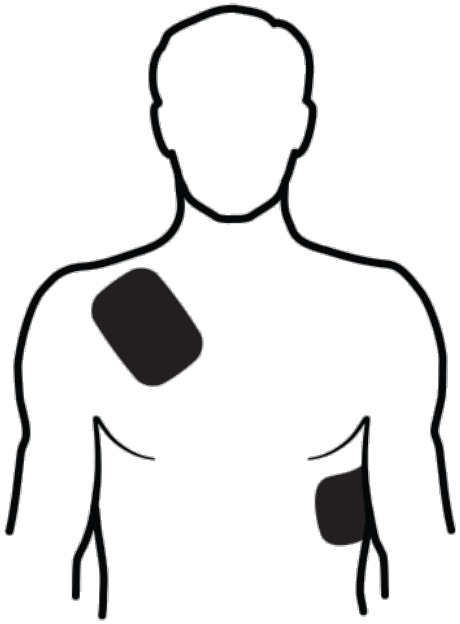
- the shape of the thorax
- water and fat content
- type of conductor used
- pulmonary volume

- **Surface area of paddles or pads**
- **Physical force used in application**
- **Position of paddles or pads**

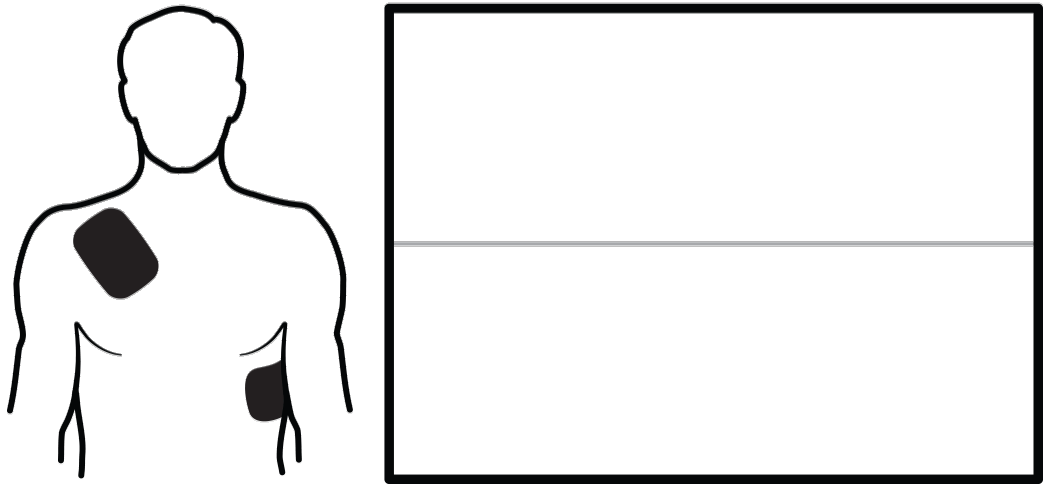
Differences between monophasic and biphasic systems

- In monophasic systems, the current travels only in one direction - from one paddle to the other.
- In biphasic systems, the current travels towards the positive paddle and then reverses and goes back; this occurs several times.
- Biphasic shocks deliver one cycle every 10 milliseconds and they are associated with fewer burns and less myocardial damage.

Monophasic



Biphasic



Differences between monophasic and biphasic systems

- With monophasic shocks, the rate of first shock success in cardiac arrests due to a shockable rhythm is only 60%, whereas with biphasic shocks, this increases to 90%.

Paddles versus adhesive patches

- Paddles were originally used but their use is being superseded by adhesive patches.
- Adhesive patches are placed most commonly antero-apically –
  - the anterior patch goes under the right clavicle and the apical patch is placed at the apex.
- Adhesive electrodes are better, as they stick to the chest wall, so there is no mess with gels.

Paddles versus adhesive patches

- Paddles require a significant level of force, which is not needed with adhesive electrodes.
- Adhesive electrodes also allow good ECG trace without interference.
- They are also safer, as no operator is required - although, before discharging a shock, it is important to ensure everyone is clear of the patient

Energy levels for defibrillation

- Monophasic - the cardiopulmonary resuscitation (CPR) algorithm recommends single shocks started at and repeated at 360 J.
- Biphasic - the CPR algorithm recommends shocks initially of 150-200 J and subsequent shocks of 150-360 J.

Energy levels for defibrillation

- The COACHED mnemonic is used to help safe defibrillation and stands for:
    - Continue Chest Compressions
    - Oxygen Away
    - All Else Clear
    - Charging
    - Hands Off
    - Evaluate the Rhythm - Shockable vs Non-shockable
    - Defibrillate or Disarm

Power source

Most defibrillators have a rechargeable battery that allows them to be portable.

They can be categorized by the chemical reaction used and include lead acid, lithium and nickele cadmium systems.

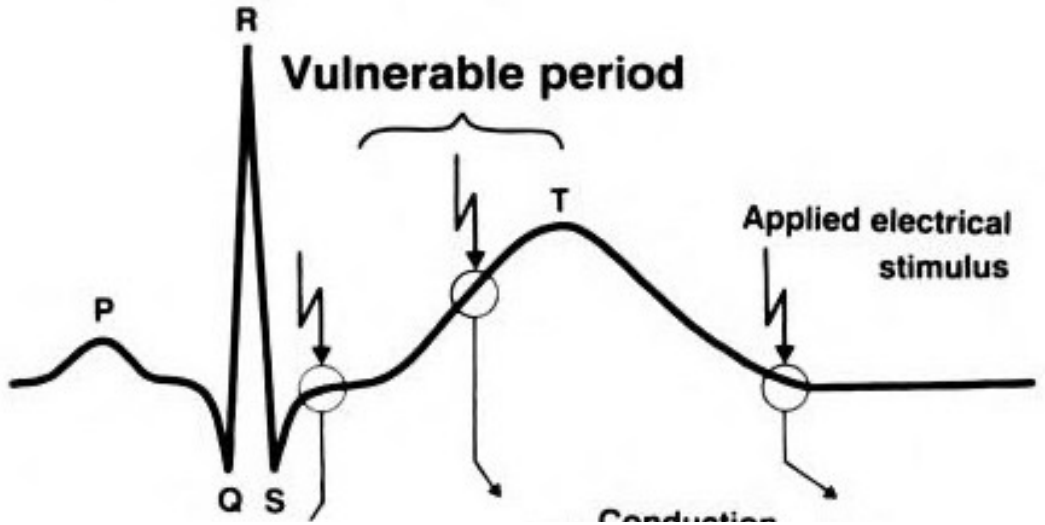
Implantable defibrillators usually use lithium/silver vanadium batteries.

Cardioversion

- process that aims to convert an arrhythmia back to sinus rhythm.
- Electrical cardioversion is used when the patient has a **pulse but is either unstable**, or **chemical cardioversion has failed** or is unlikely to be successful.

Cardioversion

- cardioversion delivery of electrical shocks synchronized to the R-wave of the ECG.
- atrial fibrillation, atrial flutter, ventricular tachycardia
- The shock is delivered immediately after recognition of the R-wave to avoid delivery during the vulnerable period which can precipitate ventricular fibrillation.
- The vulnerable period extends from 70msec before, to 25msec after the apex of the T-wave



Pharmacological Cardioversion

- in patients who are hemodynamically stable .

Several agents are available :

- Amiodarone most preferred in ICU setting.
- Amiodarone is the most widely used agent in ICU setting especially in patients with depressed ejection fraction. It is also useful in controlling ventricular rate in patients with heart failure and for long-term control of rhythm.

Cardioversion

➢Uses

1- **Decompensated** rapid AF with a rapid ventricular response, a hypotensive patient, not responding to medical therapy.

2- VT with a pulse.

3- Supraventricular tachycardias

- In cardioversion the shock has to be properly timed, so that it does not occur during the vulnerable period, i.e**. during the T wave**. If this occurs then VT can be triggered.
- Sedation usually needed as most patient are conscious and shock is painful

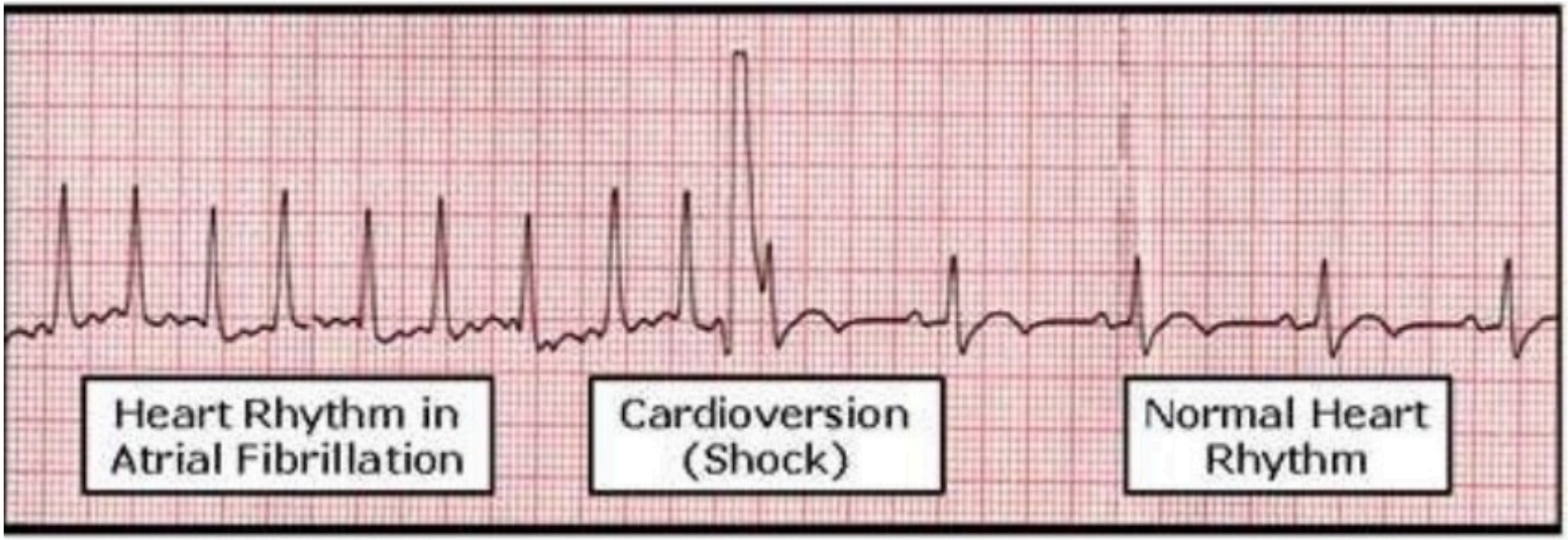
Contraindications

1- Presence of left atrial thrombus

2- Digitalis toxicity or hypokalemia

3- Sinus tachycardia caused by various clinical condition and catecholamine-induced arrhythmia

4- Multifocal atrial tachycardia


Heart Rhythm in Atrial Fibrillation
Cardioversion (Shock)
Normal Heart Rhythm

Post procedure monitoring

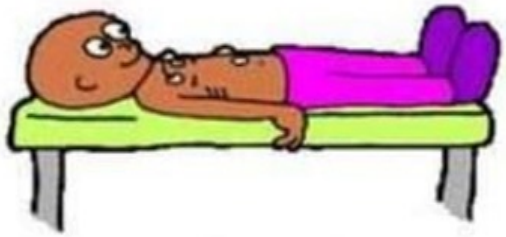
- Record delivery energy and result
- Continuous ECG monitoring
- 12 lead ECG
- If successful response
    - Check for peripheral pulses, BP, Airway patency and LOC
- Inspect skin under the pads
- If not successful, check and reassess

Doses/Details

Initial recommended doses:

- Narrow QRS regular: 50–100 J
- Narrow QRS irregular: 120–200 J
- Wide regular: 100 J
- Wide irregular: Defibrillation dose (notsynchronized)200-360 joules

CARDIOVERSION



- Elective Procedure
- Client Awake & Frequently Sedated
- Synchronized With "QRS"
- 50 - 200 Joules
- Consent Form
- EKG Monitor

DEFIBRILLATION

- Emergency
- V-Fib / V-Tach
- No Cardiac Output
- Begin With 200 Joules
  Up to 360
- Client Unconscious
- EKG Monitor