Defibrillation Plus CPR: A Critical Combination

- For every minute that passes between collapse and defibrillation, survival rates from witnessed VF SCA decrease 7% to 10% if no CPR is provided.
- If bystanders provide immediate CPR, many adults in VF can survive with intact neurologic function, especially if defibrillation is performed within 5 to 10 minutes after SCA.

New Recommendations to Integrate CPR and AED Use

**Shock First Versus CPR First:**
- When VF is present for more than a few minutes, the myocardium is depleted of oxygen and metabolic substrates.
- A brief period of chest compressions can deliver oxygen and energy substrates, increasing the likelihood that a shock may terminate VF.

New Recommendations to Integrate CPR and AED Use

- When an out-of-hospital cardiac arrest is not witnessed by EMS personnel, EMS may initiate CPR while checking the ECG rhythm and preparing for defibrillation.
- CPR should be performed while a defibrillator is being readied.

New Recommendations to Integrate CPR and AED Use

**1-Shock Protocol Versus 3-Shock Sequence**
- If 1 shock fails to eliminate VF, the incremental benefit of another shock is low, and resumption of CPR is likely to confer a greater value than another shock.
- The consensus was that rescuers using monophasic defibrillators should give an initial shock of 360 J.
New Recommendations to Integrate CPR and AED Use

- The rhythm analysis for a 3-shock sequence performed by commercially available AEDs can result in delays of up to 37 seconds between delivery of the first shock and delivery of the first postshock compression.
  - Shortening the interval between the last compression and the shock by even a few seconds can improve shock success.

Defibrillation Waveforms and Energy Levels

- Defibrillation (shock success) : typically defined as termination of VF for at least 5 seconds following the shock.
- Lower-energy biphasic waveform shocks have equivalent or higher success for termination of VF than monophasic waveform shocks.

Defibrillation Waveforms and Energy Levels

- For biphasic defibrillators, providers should use the manufacturer's recommended energy dose (120 to 200 J).
- If the manufacturer's recommended dose is not known, defibrillation at the maximal dose may be considered.

Electrodes

- Defibrillation With Implanted Cardioverter Defibrillator (ICD) :
  - Positioning the pads at least 8 cm away did not produce changes in pacing thresholds or sensing measurements.
  - Do not place AED electrode pads directly on top of a transdermal medication patch; it may cause small burns of the skin.

Automated External Defibrillators (AED)

- AED Use in Children :
  - 1 to 8 years of age : use a pediatric dose-attenuator if not available ; use standard AED
  - 1 year of age : prefer manual defibrillator
    - If not available : AED with pediatric attenuation
    - If neither is available : standard AED

Synchronized Cardioversion

- Supraventricular Tachycardias (Reentry Rhythms) :
  - Atrial fibrillation : 120 to 200 J (biphasic)
  - Atrial flutter and other supraventricular tachycardias : 50 J to 100 J

- Ventricular Tachycardia :
  - Monomorphic VT with a pulse : 100 J
  - Monomorphic or polymorphic VT in the unstable patient : defibrillation doses
Summary

- Rescuers must coordinate high-quality CPR with defibrillation to minimize interruptions in chest compressions and to ensure immediate resumption of chest compressions after shock delivery.
- The high first-shock efficacy of newer biphasic defibrillators led to the recommendation of single shocks plus immediate CPR instead of 3-shock sequences.

Post-Cardiac Arrest Care

- Subsequent objectives of post-cardiac arrest care are to:
  - Control body temperature to optimize survival and neurological recovery
  - Identify and treat acute coronary syndromes (ACS)
  - Optimize mechanical ventilation to minimize lung injury
  - Reduce the risk of multiorgan injury and support organ function if required
  - Objectively assess prognosis for recovery
  - Assist survivors with rehabilitation services when required

Overview of Post–Cardiac Arrest Care

- **Airway Management**: They should elevate the head of the bed 30° if tolerated to reduce the incidence of cerebral edema, aspiration, and ventilatory-associated pneumonia.
- Providers should titrate inspired oxygen to the lowest level required to achieve an arterial oxygen saturation of 94%, so as to avoid potential oxygen toxicity.

Overview of Post–Cardiac Arrest Care

- **Ventilation**: Hyperventilation increases intrathoracic pressure and inversely lowers cardiac output.
- The decrease in PaCO₂ seen with hyperventilation can also potentially decrease cerebral blood flow directly.

Overview of Post–Cardiac Arrest Care

- **Hemodynamics**: If the patient is hypotensive, fluid boluses can be considered.
- Titrated to achieve a minimum systolic blood pressure of 90 mm Hg or a mean arterial pressure of 65 mm Hg.
Therapeutic hypothermia is the only intervention demonstrated to improve neurological recovery. It should be considered for any patient who is unable to follow verbal commands after ROSC.

Concurrent PCI and hypothermia are safe, with good outcomes reported for some comatose patients who undergo PCI.

Targeted Temperature Management

Induced Hypothermia

- For patients with out-of-hospital ventricular fibrillation (VF) cardiac arrest. (Class I, LOEB)
- Cooled to 32°C to 34°C for 12 or 24 hours beginning minutes to hours after ROSC.
- No randomized controlled trials have compared outcome between hypothermia and normothermia for non-VF arrest. (for PEA or asystole→ Class IIb, LOEB)

Timing of initiating hypothermia:

- Current studies showed time to target temperature was not an independent predictor of neurological outcome.

Duration of induced hypothermia:

- At least 12 hours and may be 24 hours.
- The effect of a longer duration of cooling on outcome has not been studied in adults.

Method of inducing hypothermia:

- Feedback-controlled endovascular catheters
- Surface cooling devices
- Cooling blankets and frequent application of ice bags
Targeted Temperature Management

- **monitor core temperature**: using an esophageal thermometer, bladder catheter in nonanuric patients, or pulmonary artery catheter if other indicated.
- Axillary and oral temperatures are inadequate for measurement of core temperature changes.
- Bladder temperatures in anuric patients and rectal temperatures may differ from brain or core temperature.

Possible Complication of induced hypothermia:
- Coagulopathy
- Arrhythmias
- Hyperglycemia
- Sepsis and pneumonia

Organ-Specific Evaluation and Support

**Pulmonary System**
- The beneficial effect of high FIO2 on systemic oxygen delivery should be balanced with the deleterious effect of generating oxygen-derived free radicals during the reperfusion phase.
- Adjust the FIO2 to the minimum concentration needed to achieve arterial oxyhemoglobin saturation 94%, with the goal of avoiding hyperoxia while ensuring adequate oxygen delivery. (Class I, LOEC)

**Cardiovascular System**
- A 12-lead ECG should be obtained as soon as possible after ROSC to determine whether acute ST elevation is present (Class I, LOE B).
- Therapeutic hypothermia can be safely combined with primary PCI after cardiac arrest caused by AMI.

Vasoactive Drugs for Use in Post–Cardiac Arrest

**Vasopressors**
- Specific drug infusion rates cannot be recommended because of variations in pharmacokinetics and pharmacodynamics in critically ill patients.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Specific Action</th>
<th>Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td>10-50 μg/mg</td>
<td>IV</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>1-5 μg/mg</td>
<td>IV</td>
</tr>
</tbody>
</table>

Vasoactive Drugs for Use in Post–Cardiac Arrest

Adrenergic drugs should not be mixed with sodium bicarbonate or other alkaline solutions in the IV line because there is evidence that adrenergic agents are inactivated in alkaline solutions.
Modifying Outcomes From Critical Illness

Glucose Control
- Strategies to target moderate glycemic control (144 to 180 mg/dL) may be considered in adult patients with ROSC after cardiac arrest (Class IIb, LOE B).
- Attempts to control glucose concentration within a lower range (80 to 110 mg/dL) should not be implemented after cardiac arrest due to the increased risk of hypoglycemia (Class III, LOE B).

Steroids
- The post-cardiac arrest syndrome has similarities to septic shock, but the efficacy of corticosteroids remains controversial in patients with sepsis as well.
- The value of the routine use of corticosteroids for patients with ROSC following cardiac arrest is uncertain.

Central Nervous System

Seizure Management
- An EEG should be performed with prompt interpretation as soon as possible and should be monitored frequently or continuously in comatose patients after ROSC (Class I, LOE C).
- The anticonvulsant regimens for the treatment of seizures used for status epilepticus caused by other etiologies may be considered after cardiac arrest. (Class IIb, LOE C).

Prognostication of Neurological Outcome in Comatose Cardiac Arrest Survivors

Poor outcome is defined as death, persistent unresponsiveness, or the inability to undertake independent activities after 6 months.
- Among adult patients who have not been treated with hypothermia, the absence of both pupillary light and corneal reflexes at 72 hours after cardiac arrest predicted poor outcome with high reliability.

Changes in Prognostication With Hypothermia

- Physical examination (motor response, pupillary light and corneal reflexes), EEG, SSEP, and imaging studies are less reliable for predicting poor outcome in patients treated with hypothermia.
- Durations of observation greater than 72 hours after ROSC should be considered before predicting poor outcome in patients treated with hypothermia (Class I, Level C).

Summary

- The post-cardiac arrest period is often marked by hemodynamic instability as well as metabolic abnormalities.
- Support and treatment of acute myocardial dysfunction and acute myocardial ischemia can increase the probability of survival.
- Interventions to reduce secondary brain injury, such as therapeutic hypothermia, can improve survival and neurological recovery.

Thanks for your attention!