Objectives

Review ACLS algorithms with specific focus on medications

Review pharmacodynamics of these medications

Discuss updated information and evidence cited by ILCOR/AHA
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.</td>
</tr>
<tr>
<td>II</td>
<td>Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.</td>
</tr>
<tr>
<td>IIa</td>
<td>Weight of evidence/opinion is in favour of usefulness/efficacy.</td>
</tr>
<tr>
<td>IIb</td>
<td>Usefulness/efficacy is less well established by evidence/opinion.</td>
</tr>
<tr>
<td>III</td>
<td>Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.</td>
</tr>
</tbody>
</table>
| Level A | High-quality evidence\(^*\) from more than 1 RCTs  
Meta-analyses of high-quality RCTs  
One or more RCTs corroborated by high-quality registry studies |
| Level B-R | Moderate-quality evidence\(^*\) from 1 or more RCTs  
Meta-analyses of moderate-quality RCTs |
| Level B-NR | Moderate-quality evidence\(^*\) from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies  
Meta-analyses of such studies |
| Level C-LD | Randomized or nonrandomized observational or registry studies with limitations of design or execution  
Meta-analyses of such studies  
Physiological or mechanistic studies in human subjects |
| Level C-EO | Consensus of expert opinion based on clinical experience |
Cardiac Arrest
Chain of Survival

Early Access and Cardiac Arrest Recognition

Early, High-Quality CPR

- Lay-rescuer should provide compression only CPR (I,C-LD)
- EMS may delay PPV in witnessed OHCA (IIb, C-LD)

Early defibrillation

Advanced Life Support

Integrated postarrest care
When the links in the Chain of Survival are implemented in an effective way, survival can approach 50% in EMS-treated patients after witnessed out-of-hospital ventricular fibrillation arrest.”

1. Start CPR
   - Give oxygen
   - Attach monitor/defibrillator

2. Yes → Rhythm shockable?

3. No → Asystole/PEA

4. CPR 2 min
   - IV/IO access

5. Yes → Shock

6. CPR 2 min
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography

9. No → Rhythm shockable?

10. Yes → Shock

   CPR 2 min
   - IV/IO access
   - Epinephrine every 3-5 min
   - Consider advanced airway, capnography
SDE good...?

Standard Dose Epinephrine (SDE)
- 1 mg IV/IO every 3-5 minutes

Vasopressin
Epinephrine
Epinephrine

Classification
Epinephrine

Classification

When?
Epinephrine

The ‘circular algorithm’ introduced in 2010 to emphasize the importance of CPR

“There is insufficient evidence to recommend a specific timing or sequence of drug administration and advanced airway placement during cardiac arrest.”

Epinephrine

Classification

When?

What is the significance of 3-5 minutes?

Time to administration
- < 9 min improved 1 month survival in non-shockable rhythms
- Dumas et al. – delayed administration associated with worse outcome
Evidence

SDE (IIb, B-R)

- Jacobs et al. mentioned with explanation
- Observational Studies with conflicting results?
  - Hagihara et al.
  - Machida et al.

Dumas et al. (2014)
Evidence

Vasopressin (IIb, B-R)
- No benefit with Epi/vaso for survival to hospital admission or discharge

Steroids, Vaso, Epi
- IHCA – SVE bundling significant improvement in survival to discharge vs. Epi and placebo
- Conclusion – IHCA may be considered, OHCA – uncertain benefit
OHCA vs. IHCA

Why the distinctions? Do the data exist to make this legitimate?

Targeted Temperature Management (I, B-R)

- Mild Therapeutic Hypothermia to Improve the Neurologic Outcome after Cardiac Arrest – NEJM
- Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia – Bernard et al.
Antiarrhythmics

Amiodarone 300 mg
- Second dose of 150 mg

Or

Lidocaine 1-1.5 mg/kg
- Additional dosing 0.5 – 0.75 mg/kg every 5-10 min. to a max of 3 mg/kg
Antiarrhythmics

Miodarone

Class III antiarrhythmic agent
- Potassium Channel Blocker
  - Prolongs phase 3 (repolarization) of the cardiac action potential
Antiarrhythmics

iodarone

Class III antiarrhythmic agent
- Potassium Channel Blocker
  - Prolongs phase 3 (repolarization) of the cardiac action potential

  And…

- It has effects similar to class Ia
- II
- IV
Class IV drugs (verapamil, diltiazem)
Amiodarone
Flecainide
Digoxin

Superior vena cava
SA node
Right atrium
Foramen ovale
Coronary sinus
AV node
Aorta
Atrium
Bundle of His
Accessory pathway
Posterior
Anterior
Left bundle branch
Right bundle branch
Fibrous septum
Ventricle

β-Blockers
Verapamil
Digoxin
Adenosine

Amiodarone
Lidocaine
β-Blockers
Antiarrhythmics

Tocaine

How does it ‘anti’ the arrhythmia?
Antiarrhythmics

docaine

How does it ‘anti’ the arrhythmia?

- Class Ib
- Na+ Channel Blocking
- Ventricular arrhythmias
Antiarrhythmics

Amio vs. Lido

- Is anyone using Lidocaine?
- Evidence of a superior choice?
More arrest pharm

Magnesium Sulfate

Electrolyte

Indications

Mechanism of Action

Evidence?
Post-arrest
What to do with the patient that comes back to life
Adult Immediate Post-Cardiac Arrest Care

1. Return of Spontaneous Circulation (ROSC)

2. Optimize ventilation and oxygenation
   - Maintain oxygen saturation ≥94%
   - Consider advanced airway and waveform capnography
   - Do not hyperventilate

3. Treat hypotension (SBP <90 mm Hg)
   - IV/IO bolus
   - Vasopressor infusion
   - Consider treatable causes
   - 12-Lead ECG

4. Follow commands?
   - Yes
   - STEMI OR high suspicion of AMI

5. Consider induced hypothermia

6. Coronary reperfusion
   - Yes
   - Advanced critical care

7. No

Doses/Details

Ventilation/Oxygenation
Avoid excessive ventilation. Start at 10-12 breaths/min and titrate to target PETCO₂ of 35-40 mm Hg. When feasible, titrate FiO₂ to minimum necessary to achieve Spo₂ ≥94%.

IV Bolus
1-2 L normal saline or lactated Ringer's. If inducing hypothermia, may use 4°C fluid.

Epinephrine IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Dopamine IV Infusion:
5-10 mcg/kg per minute

Norepinephrine
IV Infusion:
0.1-0.5 mcg/kg per minute (in 70-kg adult: 7-35 mcg per minute)

Reversible Causes
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary
We do this perfectly.
Always.
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Gone with 2015
Norepi? There’s a rhyme about that.
Norepinephrine

Alpha and Beta adrenergic actions

- Specificity can be a good thing

Dose

- 0.1-0.5 mcg/kg/min (common 2-10 mcg/min)

More familiar thanks to shortages

Why the bad rep?

- Previous use a secondary vasopressor for hypotension refractory to dopamine
Pharmacology with the living

Mistakes may be more readily evident...
ACS

- Define hyperoxia
- Pullalarevu et al. Association Between Duration of Hyperoxia, Organ Failure and Survival After Cardiac Arrest

SA
- MoA
- Daily ASA concerns
ACS Pharm

Nitrates
• Concerns?

Pain management
• What medication

Beta-Blockers
• Reasonable in severe hypertension or tachyarrhythmias (IIa, B)
• Absent contraindications, administer PO within first 24 hours (I, A)
Bradycardia

- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IV access
- 12-Lead ECG if available; don’t delay therapy

3

Persistent bradyarrhythmia causing:
- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

No

5

Yes

Atropine
If atropine ineffective:
- Transcutaneous pacing
  OR
- Dopamine infusion
  OR

Doses/Details
Atropine IV Dose:
First dose: 0.5 mg bolus
Repeat every 3-5 minutes
Maximum: 3 mg
Dopamine IV Infusion:
2-10 mcg/kg per minute
Bradycardia

Identify and treat underlying cause:
- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- Access 2-Lead ECG if available; don’t delay therapy

Persistent bradyarrhythmia causing:
- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

Atropine
If atropine ineffective:
- Transcutaneous pacing
  OR
- Dopamine infusion
  OR
- Epinephrine infusion
Bradycardia

tropine

Nonselective muscarinic acetylcholinergic antagonist (AKA Anticholinergic)

MoA - Parasympathetic NS guerilla warfare
Bradycardia

tropine

Nonselective muscarinic acetylcholinergic antagonist (AKA Anticholinergic)

MoA - Parasympathetic NS guerilla warfare

Caution/considerations

What about ‘high blocks’?
Bradycardia

Vasopressors haven’t changed, just more emphasis

- Dopamine
- Epinephrine
- Norepinephrine
Bradycardia

Dopamine
Chronotropic and Inotropic effects
Dose Specificity
- 0.5 – 2.0 – Low (aka renal dosing)
- 2.0-10.0 – Intermediate
- 10.0-20.0 - High

Epinephrine
- Chronotropic and Inotropic effects
Review

Inotrope
• Force of contraction

Chronotrope
• Speed of contraction

Dromotrope
• AV node conduction speed
Tachycardia

The Good

The Bad

The Ugly
Adenosine

Doses/Details

**Synchronized Cardioversion**
Initial recommended doses:
- Narrow regular: 50-100 J
- Narrow irregular: 120-200 J biphasic or 200 J monophasic
- Wide regular: 100 J
- Wide irregular: defibrillation dose (NOT synchronized)

**Adenosine IV Dose:**
First dose: 6 mg rapid IV push; follow with NS flush.
Second dose: 12 mg if required.

**Antiarrhythmic Infusions for Stable Wide-QRS Tachycardia**

- **Procainamide IV Dose:**
  20-50 mg/min until arrhythmia suppressed, hypotension ensues, QRS duration increases >50%, or maximum dose 17 mg/kg given. Maintenance infusion: 1-4 mg/min. Avoid if prolonged QT or CHF.

- **Amiodarone IV Dose:**
  First dose: 150 mg over 10 minutes.
Adenosine

Classification – antiarrhythmic (V)

MoA

Limitations

Dose

Why consideration for wide, regular, monomorphic tachycardia
Rate Control

Cardiazem

- Prolongs AH conduction time and AV node EFR
- 0.25-0.35 mg/kg bolus with 10 mg/hr infusion

Metoprolol

- Blocks response to beta adrenergic stimulation
- 5 mg IV, repeated in 5 min to max of 15 mg
Procainamide

Class – Antiarrhythmic – (Ia)

Effects
- Increased atrial effective refractory period (decreased impulse conduction)
- Variable A-V node effects (direct slowing with weak vagolytic)
- Decreased myocardial excitability – from atria to ventricle
- Decreased CO (profound in myocardial damage)

Dosing – 20-50 mg/min loading dose
Procainamide

ECG Changes

- Sinus Tach
- Widened QRS
- Lengthened QTI and PRI
- Decreased amplitude of QRS and T wave

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Questions, Concerns, Discussion?