New Approaches for Prehospital Cardiac Arrest Management
2010 NCEMSF Conference
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Paramedic Crew Chief
City of Pittsburgh EMS
Out of Hospital Cardiac Arrest

• Poor outcomes:
  – Arizona 2004: 3% Survival (Bobrow, 2008)
  – US and Canada: 6.4% average (AHA 2005)
  – US: 7.6% (Occupational Health & Safety, 2009)
  – Japan: 6.7% - 7.2% (Iwami, 2005)
  – 250,000 US prehospital deaths per year

***No national uniform reporting system
Resuscitation Outcomes Consortium (ROC)

Regional Variation in Out-of-Hospital Cardiac Arrest Incidence and Outcome

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Jerris Hodges, MD, MS
Judy L. Powell, BSN
Tom P. Aufderheide, MD
Tom Rea, MD
Robert Lowe, MD, MPH
Todd Brown, MD
John Dreyer, MD
Dan Davis, MD
Ahamed Idris, MD
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Context  The health and policy implications of regional variation in incidence and outcome of out-of-hospital cardiac arrest remain to be determined.

Objective  To evaluate whether cardiac arrest incidence and outcome differ across geographic regions.

Design, Setting, and Patients  Prospective observational study (the Resuscitation Outcomes Consortium) of all out-of-hospital cardiac arrests in 10 North American sites (8 US and 2 Canadian) from May 1, 2006, to April 30, 2007, followed up to hospital discharge, and including data available as of June 28, 2008. Cases (aged 0-108 years) were assessed by organized emergency medical services (EMS) personnel, did not have traumatic injury, and received attempts at external defibrillation or chest compressions or resuscitation was not attempted. Census data were used to determine rates adjusted for age and sex.

Main Outcome Measures  Incidence rate, mortality rate, case-fatality rate, and survival to discharge for patients assessed or treated by EMS personnel or with an initial rhythm of ventricular fibrillation.

Results  Among the 10 sites, the total catchment population was 21.4 million, and there were 14,826 cardiac arrests

Median Survival 8.4% (3.0% - 16.3%)
VF Median Survival 22% (7.7% - 39.9%)
2005 AHA Guidelines

• “push hard and push fast” compression rate of 100 per minute
• Change to 30:2 Compression:Ventilation Ratio
• Minimize any interruptions for procedures
  – Maximize cerebral and coronary perfusions pressures
  – Any interruptions will cause collapse of these pressures
Coronary Perfusion with CPR
Effective CPR

• Maximizes cerebral and coronary perfusion pressures

• Boosts myocardial ATP levels
  – Improves chances of ROSC
  – (Ornato, 2006)
Resuscitation Outcomes Consortium (ROC) Results: Survival by CPRF Category

<table>
<thead>
<tr>
<th>CPRF Category</th>
<th>Proportion Surviving to Discharge</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%-20%</td>
<td>0.13</td>
<td>0.00-0.22</td>
</tr>
<tr>
<td>20%-40%</td>
<td>0.22</td>
<td>0.20-0.24</td>
</tr>
<tr>
<td>40%-60%</td>
<td>0.23</td>
<td>0.22-0.24</td>
</tr>
<tr>
<td>60%-80%</td>
<td>0.30</td>
<td>0.28-0.32</td>
</tr>
<tr>
<td>80%-100%</td>
<td>0.28</td>
<td>0.26-0.30</td>
</tr>
</tbody>
</table>

n=97 n=73 n=115 n=132 n=67
ROC: Adjusted Odds Ratio of Survival

Adjusted for: bystander CPR, age, gender, time from 911 call to arrive at scene, chest compression rate, public location

<table>
<thead>
<tr>
<th>CPR Fraction</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>1</td>
<td>0.87, 5.22</td>
</tr>
<tr>
<td>21-40</td>
<td>2.13</td>
<td>1.00, 5.08</td>
</tr>
<tr>
<td>41-60</td>
<td>2.26</td>
<td>1.20, 6.88</td>
</tr>
<tr>
<td>61-80</td>
<td>2.88</td>
<td>1.50, 7.26</td>
</tr>
<tr>
<td>81-100</td>
<td>3.3</td>
<td></td>
</tr>
</tbody>
</table>
Pittsburgh EMS: Cardiac Arrest Management Strategies

- Intra Arrest: 375E5 program
  - 375 Compression and Epinephrine in 5 minutes
- Post Arrest: Post Cardiac Management Guideline
375E5 Cardiac Arrest Management Program

- Retasks the first five (5) minutes of cardiac arrest management to:
  - Maximize hands on compression time and CPR %
    - **Defer advanced airway management unless clinically indicated to do earlier**
  - Early IV Access
  - Early IV Epinephrine

- **Support coronary and cerebral perfusion**
Coronary Perfusion Pressure and ROSC in Human Cardiac Arrest

Paradis (1990)
P < 0.001

Fig 5.—Percentage of patients with return of spontaneous circulation (ROSC) as a function of the maximal coronary perfusion pressure.
375E5 Program - Training

• CQI Training Initiative

• Started Pilot Training January 2008
  – Two (2) hour program
  – Small unit training 2-4 personnel per session

• Phased in regular bureau training cycles for all personnel Spring 2008
375E5 Program - Training

- 2 and 4 provider VF Cardiac Arrest Scenarios run for 5 minutes
  - Pretest
  - Performance Feedback
  - Post Test
- CPR Fraction and pause times measured via qCPR™ system in the Phillips Monitor
Training – CPR Feedback
Training – CPR Feedback
Training - CPR Fraction

270 s / 300 s
0.90

180 s / 300 s
0.60
## 375E5 - 2 Rescuer Scenario

<table>
<thead>
<tr>
<th>Problem</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay in initiating CCC</td>
<td>Rapid ABC assessment and initiation of CCC; one rescuer CCC while monitor placed</td>
</tr>
<tr>
<td>Pauses of CCC for rhythm analysis and defibrillation</td>
<td>Brief pause for rhythm analysis; continue CPR until ready for shock, clear and then resume CCC immediately</td>
</tr>
<tr>
<td>Pauses of CCC for advanced airway placement</td>
<td>Defer until later in the arrest unless clinically indicated to do earlier or placement with interruption of CCC</td>
</tr>
</tbody>
</table>
Pretest: 20 seconds to begin CCC
Post-test: 10 seconds to assess and start CCC; 7 second pause for rhythm analysis and defibrillation
Pretest: 30 second pause in CCC for rhythm analysis and defibrillation
CPR Pauses for Defibrillation

- Swine VF Arrest Model
- Mean Coronary Perfusion Pressure (CPP)
  - 23.4 mmHg after last compression
  - 7.6 mmHg after a 4.1 second compression pause for defibrillation
Post-test: 6 second pause for 2nd defibrillation
Pretest: Beginning of a 50 second pause in CCC for ETI

This program is intended to be used for quality assurance and research purposes. It is not intended to be used for the diagnosis, prevention, monitoring, treatment or alleviation of disease. It is the user's responsibility to ensure that the use of any data imported into this program complies with local data protection regulations.
Advanced airway placement in cardiac arrest

Median duration of CCC pause for 1st ETI in cardiac arrest = \(46.5 \text{ sec}\).

Total CCC pause for All ETI attempts = \(109.5 \text{ sec}\) (Wang, 2008)
## 375E5 - 2 Rescuer Scenario

<table>
<thead>
<tr>
<th>Problem</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay in initiating IV</td>
<td>One rescuer CPR while second rescuer starts IV; Defer advanced airway</td>
</tr>
<tr>
<td>Delay in administering epinephrine</td>
<td>One rescuer CPR while second rescuer administer epinephrine</td>
</tr>
<tr>
<td>Number of 1 mg epinephrine administered</td>
<td>2 mg epinephrine IVP first dose then 1 mg q 3 minutes</td>
</tr>
</tbody>
</table>
Figure 1. Peak coronary perfusion pressure as a function of time after cardiopulmonary resuscitation (CPR) was started. *Significant differences between the bupivacaine and saline groups. Epinephrine was given at 4, 6, 8, and 10 min after the beginning of CPR in the dose per kilogram indicated.
### 375E5 - 4 Rescue scenario

<table>
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<tr>
<th>Problem</th>
<th>Mitigation</th>
</tr>
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<tbody>
<tr>
<td>Delay in initiating CCC</td>
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<td>Defer until later in the arrest unless clinically indicated to do earlier or placement with interruption of CCC</td>
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</table>
## 375E5 - 4 Rescuer Scenario

<table>
<thead>
<tr>
<th>Problem</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay in initiating IV</td>
<td>Defer advanced airway</td>
</tr>
<tr>
<td>Delay in administering epinephrine</td>
<td>Administer as soon as IV</td>
</tr>
<tr>
<td>Number of 1 mg epinephrine administered</td>
<td>2 mg epinephrine IVP first dose then 1 mg q 3 minutes</td>
</tr>
</tbody>
</table>
375E5 Program - Training

• Other performance parameters measured:
  – Pause Times
    • To start of compressions
    • For defibrillation
  – Time to IV
  – Time to first Epinephrine
  – Number of Epinephrine administered
## Training Results: 2 rescuer scenario

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pretest</th>
<th>Posttest</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR fraction</td>
<td>62.71%</td>
<td>71.33%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Start CCC</td>
<td>26.54 sec</td>
<td>10.42 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Defib pause time</td>
<td>21.39 sec</td>
<td>5.75 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to IV</td>
<td>207.33 sec</td>
<td>116.06 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to 1st EPI</td>
<td>245.83 sec</td>
<td>144.39 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Number epi given</td>
<td>0.29</td>
<td>2.13</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
# Training Results: 4 Rescuer Scenario

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pretest</th>
<th>Posttest</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR fraction</td>
<td>68.45%</td>
<td>81.45%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Start CCC</td>
<td>16.22 sec</td>
<td>9.50 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Defib pause time</td>
<td>15.29 sec</td>
<td>4.68 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to IV</td>
<td>132.43 sec</td>
<td>91.25 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to 1st EPI</td>
<td>210.70 sec</td>
<td>112.18 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Number epi given</td>
<td>1.41</td>
<td>2.45</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
### Training Results - Post Test: 2 Rescuer vs. 4 Rescuer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2 Rescuer</th>
<th>4 Rescuer</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPR fraction</td>
<td>71.33%</td>
<td>81.95%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Start CCC</td>
<td>10.42 sec</td>
<td>9.50 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Defib pause time</td>
<td>5.75 sec</td>
<td>4.68 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to IV</td>
<td>116.06 sec</td>
<td>91.25 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Time to 1st EPI</td>
<td>144.39 sec</td>
<td>112.18 sec</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Number epi given</td>
<td>2.12</td>
<td>2.45</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
375E5: Patient Outcomes in the Field

• Examined adult medical Out of Hospital Cardiac Arrest (OOHCA) 1 January 2007
• 11 December 2009
  – Pittsburgh EMS initiated ROC study protocols after 11 Dec 09
  – Any arrest that ALS was attempted on
  – Excludes trauma, burns, drowning, peds but includes hangings
• Defined a 375E5 arrest as any arrest that the first arriving unit had at least one 375E5 trained paramedic on it
### 375E5 Patient Outcomes: Pulse on ED Arrival

<table>
<thead>
<tr>
<th></th>
<th>Arrests</th>
<th>Pulse @ ED</th>
<th>% with pulse</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>375E5 Patients</td>
<td>149</td>
<td>51</td>
<td>34.29%</td>
<td>0.025</td>
</tr>
<tr>
<td>Standard Patients</td>
<td>225</td>
<td>69</td>
<td>23.47%</td>
<td></td>
</tr>
</tbody>
</table>
### 375E5 Patient Outcomes: Survival to Discharge

<table>
<thead>
<tr>
<th></th>
<th>Arrests</th>
<th>Survived to discharge</th>
<th>% survival</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>375E5 Patients</td>
<td>149</td>
<td>14</td>
<td>9.40%</td>
<td>0.592</td>
</tr>
<tr>
<td>Standard Patients</td>
<td>288</td>
<td>37</td>
<td>7.99%</td>
<td></td>
</tr>
</tbody>
</table>
375E5 Summary

• Resulted in improved performance parameters in simulated cardiac arrest

• Resulted in a statistically significant improvement in delivery of patients to the ED pulse to 34.29%

• No significant improvement in survival to discharge
Post Resuscitation Care
Post Resuscitation Care

• Poor outcomes for patients delivered to the ED with a pulse:

  – Ontario Prehospital Life Support Trial (2004) found 72% of patients with ROSC in the field died, including 65% of those who survived to hospital admission

  – 62% mortality for in hospital cardiac arrest with ROSC for > 20 minutes (Neumar, 2008)
Post Cardiac Arrest Syndrome: Epidemiology, Pathophysiology, Treatment, and Prognostication A Consensus Statement From the International Liaison Committee on Resuscitation (American Heart Association, Australian and New Zealand Council on Resuscitation, European Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Asia, and the Resuscitation Council of Southern Africa); the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiovascular Surgery and Anesthesia; the Council on Cardiopulmonary, Perioperative, and Critical Care; the Council on Clinical Cardiology; and the Stroke Council


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Post-Cardiac Arrest Syndrome

• High mortality of cardiac arrest patients after ROSC is due to multiple organ system dysfunction
  – Pre arrest pathology
  – Whole-body ischemia during arrest
    • Duration of cardiac arrest and no flow
  – Reperfusion injury after ROSC
Post-Cardiac Arrest Syndrome

• Post-cardiac arrest brain injury
  – Responsible for 68% of deaths of patients who survived to ICU admission (Lever, 2004)

• Post-cardiac arrest myocardial dysfunction
  – LV dysfunction, myocardial stunning, cardiogenic shock

• Systemic ischemia/reperfusion response
  – Inflammatory response, impaired vasoregulation, oxygen delivery and utilization, etc. resulting in hypotension and MSOF

• Persistent precipitating pathology
  – CHF, COPD, Toxic Ingestion, Hemorrhage, etc.
Management Strategies

• Post arrest brain injury
  – Hypothermia
  – Airway control, optimization of ventilation/oxygenation
  – Blood pressure optimization
  – Seizure control
  – Glycemic control
Management Strategies

- Post arrest myocardial dysfunction
  - Identify/revascularize AMI
  - Fluid and vasopressor support for BP
  - Mechanical support
Management Strategies

• Systemic ischemia/reperfusion response
  – Fluid/vasopressor support to maintain BP
  – Temperature control
  – Glycemic control
  – Antibiotics
Management Strategies

• Persistent precipitating pathology
  – Treat specific pathology
  – Supportive care
  – H’s & T’s
Field manageable interventions

• Airway control
• Optimization of ventilation/oxygenation
• Blood pressure optimization
  – Fluids & pressors
• Seizure control
• Correct hypoglycemia
• Hypothermia
• Identify AMI
  – Early cath lab activation
• Specific intervention for underlying pathology
  – Trauma, toxins, COPD, etc.
Pittsburgh EMS
Post Cardiac Arrest Care Guideline

1. Consult Command MD and notify that the Post Cardiac Arrest Care Guidelines is initiated

2. Secure and Confirm Airway
   a. Use Capnography
   b. King LT Acceptable

3. Maintain Normoventilation
   a. 10-12 BPM
   b. SpO2 > 95%
   c. ETCO2 35-40 mm/Hg

4. Stabilize Rhythm
   a. Electrical Therapy if unstable
   b. Antiarrhythmic medications as indicated
   c. If frequent ventricular ectopy post VF/VT arrest, administer Amiodarone 150mg over 10 minutes. May repeat if ectopy persists

5. Stabilize Blood Pressure to SBP 110-140
   a. 500cc NSS boluses (cold NSS if hypothermia is being initiated) up to 2L
   b. If SBP < 140 start Epinephrine Drip 4 mcg/min
   c. May add or switch to Dopamine Drip starting at 10 mcg/kg/min per command MD

6. Initiate Hypothermia per Hypothermia Guideline
   a. Pressure Infuse 2000cc Cold NSS

7. Obtain and Transmit 12 Lead ECG
8. Check Blood Glucose
   a. 1 amp D50W if < 60 mg/dl
9. Diazepam 10mg IVP prn for Seizure Activity or Shivering

10. Transport to PCI and Hypothermia Capable Hospital
POSTRESUSCITATION CARE
STATEWIDE ALS PROTOCOL

ROSC after cardiac arrest

Manage Airway/ Ventilate if needed
- Monitor ETCO₂ if available
- Avoid hyperventilation
- Consider sedation, initial dose, (see box) if agitated
- Administer oxygen
- Assure/Initiate IV/IO NSS
- Monitor ECG/pulse oximetry
- Consider/ treat associated factors (see box)

Reassess Patient and Check Vital Signs.
(Follow multiple treatment paths, if applicable)

Hypotension?
SBP < 100 mmHg
[Ped's: SBP < 70 + (age x 2)]

Treat/titrater to target perfusion pressure of
SBP ≥ 110 mmHg
[Ped's: 80 + (age x 2)]
If no signs of CHF
Administer 20 ml/kg NSS
wide open
(up to 2000 ml total)

Dopamine infusion
AND Dobutamine (if available)

Altered Level of Consciousness?
GCS < 16

If patient does not follow commands, avoid warming:
- Remove excess clothing
- Cover only with light sheet
- Avoid heat packs or warm IV fluids

Check blood glucose. If ≤80,
Dextrose 50% 25 gm IV/IO
[Ped's: Dextrose 25% 2 ml/kg IV/IO]

Dysrhythmia? 8
Bradydysrhythmia or Tachycardia (not-sinus)

Follow appropriate dysrhythmia protocol
(Bradycardia, Wide-complex tachycardia, Narrow-complex tachycardia)

Contact Medical Command

If post-VF/VT arrest, consider antidyssrhythmic infusion:
Lidocaine 2-4 mg/min IV/IO
OR
Amiodarone 1 mg/min IV/IO

Additional dose(s) of sedation if patient is agitated
Consider transport to center capable of PCI or therapeutic hypothermia
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

• Exceeds scope of state protocol so must consult command MD to initiate
• Team approach focusing on supporting
  – Airway and ventilation
  – Cardiac function
  – Blood pressure
  – Neuroprotection
The first 20 minutes after return of pulses is the **Immediate Phase** of Post Cardiac Arrest Syndrome, after this until six hours is the **Early Phase**

Patients in these phases may be critically ill and will be affected by immediate interventions and must have aggressive ALS interventions AT SCENE

- This is a better strategy for patient survival than rapid movement to the vehicle and rapid transport delaying or deferring key interventions

- Failure to initiate immediate aggressive treatment may result in re-arrest of patient or increased morbidity
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

• Designed as a four paramedic team based approach for management of key treatment items for post cardiac arrest syndrome in **10 minutes**
  – Fewer medics necessitates doubling up of roles and increased scene time

• Patient must be treated immediately at scene for benefit
**Airway Manager:**
- Secure airway
- Manage ventilation
- Monitor SpO2 and EtCO2

**Monitor Manager/Resuscitation Leader**
- Oversee resuscitation effort/monitor times
- Monitor rhythm
- Obtain and transmit 12 lead EKG
- Electrical Therapy
- Monitor Vitals
- Confirm advanced airway placement

**Vascular Access/Medical Manager 1**
- IV access – 2 lines
- Fluid resuscitation
- Initiate hypothermia
- Initiate pressors
- Administer other medications

**Vascular Access/Medical Manager 2**
- Assist Manager 1 as needed with IV access and fluids
- Draw up and prepare meds
- Check blood glucose
Resuscitation Roles

1. **Airway Manager**
   - Secure airway
   - Manage ventilation
   - Monitor SpO2 and EtCO2

2. **Monitor Manager/Resuscitation Leader**
   - Oversee resuscitation effort/monitor times
   - Monitor rhythm
   - Obtain and transmit 12 lead EKG
   - Electrical Therapy
   - Monitor Vitals
   - Confirm advanced airway placement
Resuscitation Roles

• 3. Vascular Access/Medical Manager 1
  – IV access – 2 lines
  – Fluid resuscitation
  – Initiate hypothermia
  – Initiate pressors
  – Administer other medications

• 4. Vascular Access/Medical Manager 2
  – Assist Manager 1 as needed with IV access and fluids
  – Draw up and prepare meds
  – Check blood glucose
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

1. Secure/confirm Airway if not already done
   a. ETI
   b. King Airway
   c. 2 person BVM + adjunct

2. Normoventilation with O2 15-25 lpm via BVM
   a. Rate 10-12/m
   b. SpO2 > 95%
   c. EtCO2 35-45 mm/hg
3. **Stabilize cardiac rhythm**
   a. Unstable tachycardia: synchronized cardioversion
   b. Unstable bradycardia: TCP
   c. Stable tachycardia/bradycardia: Treat per protocol
   d. Post VF/VT arrest: Amiodarone 150mg/10 minutes or Lidocaine 1.5 mg/kg if not already administered, then 0.75 mg/kg q 10 minutes to 3 mg/kg if not contraindicated
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

4. Stabilize blood pressure to > 110 systolic
   a. 500cc NSS bolus prn if no pulmonary edema
   b. May use cold NSS to concurrently induce hypothermia
   c. If SBP < 140 start Epinephrine Drip @ 4 mcg/min
   d. MD may change to Dopamine @ 10 mcg/kg/min if on scene if needed
Why early pressors??

- Most patients will be catecholamine dependent post arrest (Epi given during resuscitation)
- Initially “good” BP’s may drop shortly after ROSC
- Myocardial stunning
- LV dysfunction
- If RVMI suspected that fluids should be emphasized instead of pressors
After more than a few minutes of circulatory arrest, ROSC is followed by CRUMP.

Rittenburger (2008)
Suspect RVMI if inferior wall MI and anterior ST depressions

Need to take a look at Vr3 and Vr4
Why Epinephrine???

- We’re giving it during the arrest
- Easy to mix
- Easy to drip
- Non weight based calculation
- Epinephrine is the pharmacological end product of giving Dopamine
  - Dopamine > Norepinephrine > Epinephrine
EPINEPHRINE Injection, USP
1:10,000
1 mg (0.1 mg/mL)

PROTECT FROM LIGHT

Glass
ABBOJECT®
Unit of Use Syringe

with male luer lock adapter and 20-Gauge protected needle

Rx only
Epinephrine Drip

- 1 mg Epinephrine/250 cc NSS = 4 mcg/cc
  - Can mix 2mg/500cc or 4 mg/1000cc for same concentration

- 1cc/min = 4 mcg/min

- 60 drops = 1 cc

- 1 drop/second
Epinephrine Drip

- Start at 4 mcg/m

- If BP > 140 systolic decrease to 2 mcg/min which will be 1 drop every 2 seconds

- If BP < 110 systolic increase to 8 mcg/min which will be 2 drops per second

- Consult the MD from there
Pittsburgh EMS
Post Cardiac Arrest Hypothermia Guidline

Inclusions:
1. All patients with sustained ROSC > 5 minutes post cardiac arrest (defined as chest compressions or defibrillation performed) and:
   a. Unable to follow verbal commands if intubated
   b. Unable to open eyes and verbalize if not intubated
   c. SBP > 100
      i. If initial SBP is < 100 but responds to fluids/vasopressors and becomes > 100 then the protocol may be executed

Exclusions:
1. Age < 18 y/o
2. Traumatic cardiac arrest
3. Significant head trauma
4. Actual or suspected significant hemorrhage (GI bleeding, AAA, etc.)
5. Suspected significant hypothermia already present
6. Frank pulmonary edema

Procedure:
1. Notify command MD and request to initiate the post ROSC hypothermia.

2. Obtain 2nd large bore IV or IO access if feasible
   a. If not possible to obtain a 2nd IV, use of primary IV is acceptable unless it is being used for infused medications.

3. Pressure infuse two (2) liters of chilled NSS at maximum feasible rate
   a. Label bag with hypothermia protocol label
   b. If SBP > 100 administer 10 mg Diazepam IVP, give an additional 5 mg if SBP > 100 and 5 mg if SBP > 200 (max 15mg) as needed to suppress
5. Initiate Hypothermia Guideline for neuroprotection

• Inclusions
  – Patients with sustained ROSC post cardiac arrest (defined as chest compressions or defibrillation perfumed) and
    • Unable to follow verbal commands if intubated
    • Unable to open eyes and verbalize if not intubated
    • SBP > 100 (Relative contraindication if hypotensive volume treats BP any hypothermia works like an inotrope)
Pittsburgh EMS Hypothermia Guideline

- **Exclusions:**
  - Age < 18
  - Trauma cardiac arrest
  - Significant head trauma
  - Actual or suspected significant bleeding
  - Suspected significant hypothermia already present
  - Frank pulmonary edema
Hypothermia Guideline

1. Contact Command MD and request permission to initiate

2. Obtain 2\textsuperscript{nd} Large Bore IV/IO Access

3. Pressure infuse up to 2L cold NSS
Hypothermia Guideline

4. If shivering and SBP > 100
   - 10 mg Diazepam IVP
   - Repeat at 5 mg increments as needed to 20 mg total

5. Notify receiving facility that the therapeutic hypothermia has been initiated

6. Document on PCR that hypothermia was initiated
6. Obtain and Transmit 12 Lead EKG

- Screen for STEMI or ischemia
  - Up to 80% of post arrest patients will need a cardiac cath
- Transmission to the ED allows for early Cath Lab activation
- Decreased door to balloon time result in more LV salvage and improves cardiac output and outcome
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

7. Check Blood Glucose
   a. 1 amp D50W IVP if < 60 mg/dl

8. Diazepam 10 mg IVP if seizures or shivering
   a. SBP > 100
Pittsburgh EMS
Post Cardiac Arrest Care “Guideline”

• Patients should be transported to facilities that:
  – Will continue hypothermia for 24 hours
  – Have emergent cardiac cath capability
  – Comprehensive post cardiac arrest care critical care capability
Case Review

• PGH EMS Medics 6 and 11 respond to a public venue for a 64 y/o male with a witnessed collapse
  – Bystander CPR performed
• CPR continued following the 375E5 guidelines
• ECG shows VF
• Defibrillated @ 150J > NSR
Case Progression

• Patient assessment
  – Pulse: 80
  – Respirations: 10
  – Blood Pressure: 140/100
  – ECG: NSR
  – Unresponsive, GCS 3
Post Resuscitation Care Initiated

- Two (2) IV’s initiated
- 100mg Lidocaine IVP
- Command MD Consulted
- Hypothermia initiated with cold NSS infusion pressure infused
- Crew elected to hold on Epi drip due to BP 140/100
- ETI Sx1
  - EtCO2 initially 25mm/Hg; pt normoventilated and EtCO2 rises to 35 mm/Hg
12 Lead EKG obtained

Digitally Transmitted to Receiving Facility
Case progression

- Blood glucose 92 mg/dl
- No seizure activity or shivering
- Pt arrives at receiving facility with:
  - NSR 80/m
  - BP: 130/90
  - Resps: 15/m
  - EtCO2: 35 mm/Hg
  - SpO2: 100%
Case Conclusion

- Patient emergently goes to the cath lab for PCI and stent placement
- Hypothermia maintained for 24 hours after which the pt is passively warmed
- Pt wakes up
- Discharged home on Hospital Day 11 with normal mental status and cardiac (LV) function
Summary

• Bystander CPR & AED Programs
• 375E5
• Post Arrest care
Questions??