Pediatric Submersion
Pediatric Submersion
Pediatric Submersion
Pediatric Submersion

Prevention

Drowning

Hospital/Home
A Similar Story

Pregnancy
A Similar Story

Pregnancy  Delivery
A Similar Story

Pregnancy  Delivery  Life
Pediatric Drowning
Allan’s Story
Pediatric Drowning
ED Management

- Placed on a ventilator
- Labs suggest significant illness
  - Oxygen starvation
  - Elevated Acid levels
- IV medications & fluid
- Transferred to PICU
Pediatric Drowning
PICU Course
• Initial explanation did not sink in
• I was told he didn’t drown, so I thought he’d be okay
• They asked if I want to disconnect the ventilator at 48 hours
• Things sunk in at 3 weeks
Pediatric Drowning

Allan
Pediatric Drowning
Submersion Time

Graph showing the risk of bad outcome based on submersion time in minutes. The risk increases as the duration increases:
- 0–5 minutes: 67%
- 6–10 minutes: 18%
- 11–15 minutes: 6%
- 16–25 minutes: 9%
- > 25 minutes: 4%
Pediatric Drowning
CPR Duration

- Risk death/severe damage:
  - 0-5 minutes: 14%
  - 6-10 minutes: 7%
  - 11-15 minutes: 3%
  - 16-25 minutes: 9%
  - >25 minutes: 20%

Duration in Minutes:
0-5  6-10  11-15  16-25  >25
<table>
<thead>
<tr>
<th>Signs and Sx</th>
<th>Mortality</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough NO Foam (mouth/nose)</td>
<td>0%</td>
<td>Educate</td>
</tr>
<tr>
<td>Small Foam +Rales</td>
<td>0.6%</td>
<td>Nasal cannula Hospital</td>
</tr>
<tr>
<td>Large Foam Normal BP (+radial)</td>
<td>5.2%</td>
<td>SGA/ETT Hospital</td>
</tr>
<tr>
<td>Large Foam Low BP (-radial)</td>
<td>19.4%</td>
<td>SGA/ETT/IVF Hospital</td>
</tr>
<tr>
<td>Respiratory Arrest</td>
<td>44%</td>
<td>SGA/ETT/IVF Hospital</td>
</tr>
<tr>
<td>Cardiopulmonary Arrest</td>
<td>93%</td>
<td>SGA/ETT/IVF Hospital</td>
</tr>
</tbody>
</table>
A Prospective, Population-Based Study of the Demographics, Epidemiology, Management, and Outcome of Out-of-Hospital Pediatric Cardiopulmonary Arrest

Sirbaugh et al, Annals Emerg 1999

Study objectives: To perform a population-based study addressing the demography, epidemiology, management, and outcome of out-of-hospital pediatric cardiopulmonary arrest (PCPA).

Methods: Prospective, population-based study of all children (17

Pediatric Out-of-Hospital Cardiac Arrest

Houston, TX  1992-1995
A Prospective, Population-Based Study of the Demographics, Epidemiology, Management, and Outcome of Out-of-Hospital Pediatric Cardiopulmonary Arrest

Sirbaugh et al, Annals Emerg 1999

Study objectives: To perform a population-based study addressing the demography, epidemiology, management, and outcome of out-of-hospital pediatric cardiopulmonary arrest (PCPA).

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A Prospective, Population-Based Study of the Demographics, Epidemiology, Management, and Outcome of Out-of-Hospital Pediatric Cardiopulmonary Arrest

Sirbaugh et al, Annals Emerg 1999

Effect of Bystander CPR

65 Submersions + Bystander CPR

EMS arrival

Breathing + Pulse

41

24

Arrest

Neuro Intact

41

0

Neuro Intact

Tuesday, June 3, 14
Predictors of Survival
Short EMS Response
Shockable Rhythm
Non-Salt Water
Pediatric Drowning
The 911 Call
Pediatric Drowning
The 911 Call
Pediatric Drowning
The 911 Call
Pediatric Drowning
The 911 Call

“REMOVE THE PILLOWS”
1. CALL 911
   What is your emergency?
   What is the address?
   What is the phone number?
   What is your name?
   How old is the child?
   Is it a male or female?
   Where is the child now?
   Are there any injuries?
   Can you repeat that?

This may take up to 4 minutes

2. START CPR
   Child
   CPR
   30:2 One Person
   15:2 Two Person

This can’t afford to wait

Know How to Perform CPR On Your Child
Before you call 911

Tuesday, June 3, 14
Pediatric Drowning
Timeline

Child falls into pool
Child poolside No Pulse
EMS Arrival
ED Arrival

The Variables
- CPR on Scene
- Resus location
- Epinephrine
  - when & where

0  5 min  13 min  22 min

Tuesday, June 3, 14
Pediatric Drowning
Timeline

Child falls into pool
Child poolside No Pulse
EMS Arrival
ED Arrival

The Variables
- CPR on Scene
- Resus location
- Epinephrine
  - when & where

Where is care provided?

Tuesday, June 3, 14
Prolonged resuscitation (ACLS >25 min) of warm water pediatric drowning victims is \textbf{NOT indicated}.

The longest ED CPR with a good neurologic outcome was \textbf{12 minutes} (warm water).
Pediatric Drowning
Hypothermia
Pediatric Drowning
Hypothermia
Effect of Hypothermia and Cardiac Arrest on Outcome of Near-Drowning Accidents in Children


55 Drownings

32 Intact

37 Survivors

18 Deaths

5 PVS

Cold

All intact survivors were submerged in cold water and had prolonged resuscitations
Pediatric Drowning Victims - Canada 1986 - PICU

- Hypothermia: 24
  - Brain Swelling: 10
  - Sepsis: 7
  - *Greater intact neurologic survival: 7*

- Normothermia: 16
  - Brain Swelling: 3
  - Sepsis: 13

Tuesday, June 3, 14
43 Arrests

Hypothermia
35%
n=14

Survival

Normothermia
65%
n=28

9/14 Neuro Intact

6/28 Neuro Intact

Pediatric Neurology 2012
Therapeutic Hypothermia Associated With Increased Survival After Resuscitation in Children

Jainn-Jim Lin MD\textsuperscript{a,b,c}, Shao-Hsuan Hsia MD\textsuperscript{a}, Huei-Shyong Wang MD\textsuperscript{c}, Ming-Chou Chiang MD\textsuperscript{b,d}, Kuang-Lin Lin MD\textsuperscript{c,*}

Pediatric Neurology 2012

43 Arrests

Hypothermia
35%  
n=14

Normothermia
65%  
n=28

9/14 Neuro Intact 78%  
6/28 Neuro Intact  

Survival
43 Arrests

Hypothermia
35%
n=14

Normothermia
65%
n=28

9/14 Neuro Intact 78% Survival 46%
6/28 Neuro Intact
Submersion Accidents:
Highly trained Emergency Medicine and specialized and sophisticated Intensiv Care can not replace Prevention
Targeted Temperature Management
Targeted Temperature Management
Targeted Temperature Management

![Graph showing percent mortality or discharge to hospice by fever burden category. No fever: 4.2%, Low (0.1-2.0): 9.2%, Medium (2.1-4.0): 24.7%, High (>4.0): 44.3%.]
Therapeutic Hypothermia

900 children / 34 Hospitals / Sept 2015
www.THAPCA.org
Future Concepts

Initial BVM

SGA
On Scene
Resuscitation
On Scene Resuscitation
The Future

Portable ECMO
The Future
Portable ECMO
Pediatric Drowning

Outcome of 12 drowned children with attempted resuscitation on cardiopulmonary bypass: An analysis of variables based on the "Utstein Style for Drowning"

Christoph Eich, Anselm Bräuer, Arnd Timmermann, Stephan K.W. Schwarz, Sebastian G. Russo, Karin Neubert, Bernhard M. Graf, Ivan Aleksic

Department of Anaesthesiology, Emergency and Intensive Care Medicine, Georg-August University, Göttingen, Germany

Results: Out of 12 children (aged 22 months to 7.5 years), 5 survived to hospital discharge and 7 died in hospital. Two survivors recovered fully and three remained in a vegetative state. In two patients, resuscitation on CPB failed. Both children who fully recovered, compared to the 10 others, had relatively low serum K⁺ concentrations.
Pediatric Drowning
Take Home Points

- Look at Every Step With a Microscope
  - 911 Call (Not for CPR instructions)
  - CPR Early (Family and EMS)
  - Resuscitation ON SCENE (2 minutes then move)
- Waiting on Hypothermia Data
- BVM (5 breaths initially)
- Supraglottic Airway (Lifeguards)
Thank You!
Submersion Injuries

Peter Antevy MD
JDCH, Pediatric Emergency Medicine
Davie Fire Rescue, Medical Director
American Ambulance, Medical Director
Broward College EMS, Medical Director
Miramar, Coral Springs, N.Lauderdale, Seminole Tribe, Plantation, Margate & Sunrise - Asst. Medical Director

Tuesday, June 3, 14