Near Drowning

McHenry Western Lake County
EMS
Definition

- Near drowning means the person almost died from not being able to breathe under water.
Near Drownings

- Defined as: Survival of Victim for more than 24* following submission in a fluid medium.
- Leading cause of death in children 1-4 years of age.
- Second leading cause of death in children 1-14 years of age.
- 85 % are caused from falls into pools or natural bodies of water.
- Male/Female ratio is 4-1
Near Drowning

- Submersion injury occurs when a person is submerged in water, attempts to breathe, and either aspirates water (wet) or has laryngospasm (dry).
If a person has been rescued from a near drowning situation, quick first aid and medical attention are extremely important.
Statistics

- 6,000 to 8,000 people drown each year. Most of them are within a short distance of shore.
- A person who is drowning can not shout for help.
- Watch for uneven swimming motions that indicate swimmer is getting tired.
Statistics

• Children can drown in only a few inches of water.
• Suspect an accident if you see someone fully clothed.
• If the person is a cold water drowning, you may be able to revive them.
Near Drowning Risk Factor by Age

Ref: Paul A. Checchia, MD - Loma Linda University Children’s Hospital
Near Drowning

• “Tragically 90% of all fatal submersion incidents occur within ten yards of safety.”

Robinson, Ped Emer Care; 1987
Causes

• Leaving small children unattended around bath tubs and pools
• Drinking while boating or swimming
• Inability to swim or panic while swimming
• Falling through thin ice
• Blow to the head or seizure while swimming
• Attempted suicide
Symptoms

- Bluish skin to the face, especially around the lips
- Abdominal distention
- Confusion
- Cold skin and pale appearance
- Cough with pink frothy sputum
- Irritability
Symptoms

Symptoms may vary, but may include:

- Lethargy
- No breathing
- Shallow or gasping respirations
- Restlessness
- Unconsciousness
- Vomiting
- Chest pain
Near Drowning

• Pulmonary: As $\text{PCO}_2$ rises, diaphragm begins to have episodic contractions
  • Inspiration prevented only by voluntary closure of the glottis
  • Eventually, involuntary gasp occurs
• Hypoxia non-cardiogenic pulmonary edema in 5% of all cases
• Laryngospasm in 20% of cases – no water
• Pneumonia: Result of aspiration

Ref: Paul A. Checchia, MD - Loma Linda University Children’s Hospital
Near Drowning

- **Cardiovascular:** Dysrythmias due to hypoxemia and Cardiogenic Shock due to hypoxic damage to the myocardium.
- Development of acidosis also impairs function of the myocardium.
- Asystole (55%), Ventricular Tachycardia/Fibrillation (29%), Bradycardia (16%)
Near Drowning

- Neurologically: Altered mental status from Grand Mal Seizures to Comatose
  - GCS of 5 or less = Poor Outcome
  - GCS of 8 or more = Good Outcome
- Metabolically: Acidosis develops rapidly and can be profound. Resp, Metabolic or both.
Near Drowning

- Temperature Derangements: Mild hypothermia has a protective effect by causing decreased glucose usage and $O_2$ consumption.
- Hypothermia:
  - Core temp of 27c – 35c / 80.6f – 95.0f
Near Drowning

- Multi Organ Effects:
  - Hypoxic/ischemic cerebral injury
  - Fluid overload
  - Pulmonary injury
  - Hypothermia

- Cerebral hypoxia is the final common pathway in all drowning victims.
When someone is drowning

- Reach, throw, tow and then go.
  - Extend a pole, life jacket, throw rope etc.
- People that have fallen through the ice will not be able to grasp objects within their reach.
- Do not go onto the ice unless you are absolutely sure it is safe.
- If you have the proper equipment and training, you may rescue immediately when you are sure it will not cause you harm.
When someone is drowning

- If breathing has stopped, begin rescue breathing as soon as possible.
- Continue to breathe for the person every few seconds while moving to land. Once on land, give CPR if needed.
- Assume that the person has a neck or spinal cord injury.
Hypothermia

- Hypothermia is a lowered body temperature less than 95 degrees F.
- Cold water near drowning is in water temperatures 70 degrees F and below.
- A long time submersion is considered 4-6 minutes or greater.
Body heat loss

- **Conduction**
  - Lost due to nearby objects through touch

- **Convection**
  - Transfer of heat by air or water

- **Radiation**
  - Transfer of heat lost to nearby objects without touching them

- **Evaporation**
  - Body heat lost by evaporation of perspiration

- **Respiration**
  - Heat loss through normal exchange of gas in the lungs
Diving reflex

- On immersion to very cold water, reflex actions occur right away.

- There is hyperventilation, an involuntary gasp, and a varying amount of diving response follows.
Diving reflex

- It will slow the heart beat, decrease or cease respirations, and blood will circulate to the core (heart, lungs and brain)
- Cold water victims have been fully resuscitated when treated with rewarming techniques and CPR.
Signs and symptoms of hypothermia

- Shivering
- Lowered body temperatures
- Cold blue skin
- Slow heartbeat
- Slow respirations
- Slurred speech
- Confusion
- Muscle stiffness
- Cardiopulmonary arrest
Afterdrop

- During this period, the heart is very vulnerable to develop life threatening rhythm disturbances.
- The victim needs be moved as little as possible.
- “Field treatment” can worsen afterdrop such as a cigarette, hot cup of coffee, and alcohol all prolong the afterdrop and may not help them recover as fast from the hypothermia.
Factors to improve survival

- Age of the patient – the younger the better
- Length of submersion – shorter the better
- Water temperature – colder the better
- CPR – if appropriately applied, the better the survival
- Water quality – cleaner the better
- Struggle – more struggle, worse the outcome
- Other injuries – burn, blast, fractures all reduce survival.
Salt vs. Fresh water

• Salt water
  - Sea water = Salt, Potassium and Magnesium
    • Hypertonic
    • Pulmonary edema
    • Electrolyte changes

• Fresh water
  • Hypotonic
  • Surfactant changes in the lungs and ARDS
  • Electrolyte changes
# Relative Contribution of Various Submersion Media to Drowning Accidents

<table>
<thead>
<tr>
<th>Submersion Media</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt Water</td>
<td>1 - 2%</td>
</tr>
<tr>
<td>Fresh Water</td>
<td>98%</td>
</tr>
<tr>
<td>Swimming pools: public</td>
<td>50%</td>
</tr>
<tr>
<td>Swimming pools: private</td>
<td>3%</td>
</tr>
<tr>
<td>Lakes, rivers, streams, storm drains</td>
<td>20%</td>
</tr>
<tr>
<td>Bathtubs</td>
<td>15%</td>
</tr>
<tr>
<td>Buckets of water</td>
<td>4%</td>
</tr>
<tr>
<td>Fish tanks or pools</td>
<td>4%</td>
</tr>
<tr>
<td>Toilets</td>
<td>1%</td>
</tr>
<tr>
<td>Washing machines</td>
<td>1%</td>
</tr>
</tbody>
</table>

Ref: Paul A. Checchia, MD - Loma Linda University Children’s Hospital
Treatment Guidelines

• All victims of submersion who require any form of resuscitation (including rescue breathing alone) should be transported to the hospital for evaluation and monitoring, even if they appear to be alert and demonstrate effective cardiorespiratory function at the scene.

• All persons submerged $\leq$ 1 hour should be resuscitated unless there are signs of obvious death.
MWLCEMS Protocols

- **Rescue and removal**: Ensure EMS safety during the rescue process; only rescuers with appropriate training and equipment should enter moving or deep water to attempt rescue.
- Rescue personnel should wear protective garments if water temp is $< 70^\circ$.
- A safety line should be attached to the rescue swimmer.
MWLCEMS Protocols

- Patient should be kept in a horizontal position if at all possible. Cold-induced hypovolemia, cold myocardium, and impaired reflexes may result in significant hypotension. If hypothermic, appropriate rewarming should be done concurrent with resuscitation.
- Spine motion restriction only if circumstances suggest a spine injury
MWLCEMS Protocols

- **EMERGENT**: If awake with good respiratory effort, yet congested and increased work of breathing:
- **O₂ / C-PAP** mask to deliver 5-10 cm PEEP; use 15 L/NRM if CPAP unavailable or contraindicated
- If SBP falls < 90 (MAP < 65) or hypotensive for age: Titrate PEEP down to 5 cm; remove C-PAP if ↓ BP persists
• **CRITICAL:** If unresponsive and ineffective ventilations with a pulse:
  • Ventilate using BLS airways and BVM. Clear airway of aspirated water with suction.
  • Abdominal thrusts contraindicated.
  • Pts usually respond after a few ventilations. Consider need for advanced airway if patient does not respond to initial bag and mask ventilations.
MWLCEMS Protocols

- **CRITICAL:** If unresponsive, apneic and pulseless: CPR using traditional A-B-C approach due to hypoxic nature of arrest. Rx per appropriate SOP.
- Vomiting is common in those who require compressions & ventilations; prepare suction
- Remove wet clothing; dry patient as possible – especially the chest before applying pads and defibrillating pt
- If pt is cold: refer to HYPOTHERMIA SOP
MWLCEMS Protocols

• Evaluate for ↑ICP: (↑ SBP, widened PP; ↓ pulse, abnormal respiratory pattern, gaze palsies, HA, vomiting)

• If present; treat per Head Trauma SOP

• **Enroute:** Complete ITC: IV NS TKO [ALS]
Diving Related Emergencies

• Note: Consider decompression illness even if an apparently safe dive according to the tables or computer

• ITC special considerations:
  • Position supine or in recovery position
  • Consider transport to a hyperbaric chamber: See Carbon Monoxide Poisoning SOP for chamber locations.

• If assistance is needed: Divers Alert Network (DAN) (919) 684-8111
Environmental: SUBMERSION INCIDENT (adult & peds)

Notes:
- All victims of submersion who require any form of resuscitation (including rescue breathing alone) should be transported to the hospital for evaluation and monitoring, even if they appear to be alert and demonstrate effective cardiorespiratory function at the scene (Class I, LOE C).
- All persons submerged ≤ 1 hour should be resuscitated unless there are signs of obvious death.

1. ITC special considerations: [BLS]
   - Rescue and removal: Ensure EMS safety during the rescue process; only rescuers with appropriate training and equipment should enter moving or deep water to attempt rescue
     - Rescue personnel should wear protective garments if water temp is < 70°
     - A safety line should be attached to the rescue swimmer
     - Patient should be kept in a horizontal position if at all possible. Cold-induced hypovolemia, cold myocardium, and impaired reflexes may result in significant hypotension. If hypothermic, appropriate rewarming should be done concurrent with resuscitation.
   - Spine motion restriction only if circumstances suggest a spine injury
   - EMERGENT: If awake with good respiratory effort, yet congested and increased work of breathing:
     - O₂ / C-PAP mask to deliver 5-10 cm PEEP; use 15 L/NRM if CPAP unavailable or contraindicated
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   - CRITICAL: If unresponsive and ineffective ventilations with a pulse:
     - Ventilate using BLS airways and BVM. Clear airway of aspirated water with suction. Abdominal thrusts contraindicated.
     - Pts usually respond after a few ventilations. Consider need for advanced airway if patient does not respond to initial bag and mask ventilations.
   - CRITICAL: If unresponsive, apneic and pulseless: CPR using traditional A-B-C approach due to hypoxic nature of arrest. Rx per appropriate SOP.
     - Vomiting is common in those who require compressions & ventilations; prepare suction
     - Remove wet clothing; dry patient as possible – especially the chest before applying pads and defibrillating pt
     - If pt is cold: refer to HYPOOTHERMIA SOP (pg 31)
   - Evaluate for ↑ ICP: (↑ SBP, widened PP; ↓ pulse, abnormal respiratory pattern, gaze palsies, HA, vomiting)
     - If present; treat per Head Trauma SOP (pg. 51)

2. Enroute: Complete ITC: IV NS TKO [ALS]

Diving-related emergencies

Note: Consider decompression illness even if an apparently safe dive according to the tables or computer

ITC special considerations:
- Position supine or in recovery position
- Consider transport to a hyperbaric chamber: See Carbon Monoxide Poisoning SOP for chamber locations.
- If assistance is needed: Divers Alert Network (DAN) (319) 684-8111
Submersion Incident

All victims of submersion who require any form of resuscitation (including rescue breathing alone) should be transported to the hospital for evaluation and monitoring, even if they appear to be alert and demonstrate effective cardiorespiratory function at the scene (IC classifications I, II, or III).

All persons submerged 1 hour should be resuscitated unless there are signs of obvious death.

IFC (BLS)

Rescue and removal: Ensure EMS safety during the rescue process; only rescuers with appropriate training and equipment should enter moving or deep water to attempt rescue.

Rescue personnel should wear protective garments if water temp is < 70°F.

A safety line should be attached to the rescue swimmer.

Patient should be kept in a horizontal position if at all possible. Cold-induced hypoxia, cold myocardium, and impaired reflexes may result in significant hypotension. If hypothermic, appropriate rewarming should be done concurrent with resuscitation.

Selecive spine precautions only if circumstances suggest a spine injury.

Emergent

Awake with good respiratory effort, yet congested with increased work of breathing.

C-PAP mask to deliver 5-10 cm PEEP.

If SBP falls < 90 (MAP < 65) Titrate down to 5 cm, remove C-PAP if hypotension persists.

Critical

Unresponsive and ineffective ventilations with a pulse.

Ventilate using BLS Airways and BVM.

Consider need for advanced airway.

Critical

Unresponsive, apneic and pulseless.

CPR using traditional ABC approach due to hypoxic nature of arrest.

Vomting is common in those who require compressions & ventilations; prepare suction.

Remove wet clothing; dry patient as possible – especially the chest before applying pads and debrilating pt.

If pt is cold, refer to HYPTHERMIA SOP.

Evaluate for increased ICP. If present treat per Head Trauma SOP.

Enroute complete IFC and start IV NS TKO.

For Diving Related Emergencies please refer to your full SOP.
Adult Respiratory Distress Syndrome

- ARDS is one of the most severe post-resuscitative complications, with a high mortality rate.
- The lungs will leak fluid into the alveoli which cause a severe inflammation to the tissues and the respiratory system will fail.
Respiratory problems

- Although they may survive the near drowning, they may also develop:
  - Pulmonary parenchymal injury
  - Destruction of surfactant in the lung
  - Aspiration pneumonia
  - Pneumothorax
  - Renal failure
  - Metabolic and respiratory acidosis
Resuscitative efforts

- All persons submerged ≤ 1 hour should be resuscitated despite apparent "rigor mortis".
- "They are not dead, unless they are warm and dead"
Remember!

Even Meredith Gray survived after drowning in the Puget Sound!
Question

- You have been called to the scene of a child that has been found unresponsive in a pool. What should be one of your first priorities in managing this child?
Answer

- Cervical spine immobilization must be considered in any pool drowning. You cannot be sure that the victim did not jump into the pool and cause a spinal injury.
References

- Medline Plus Medical Encyclopedia
- Immersion Hypothermia and Near Drowning from scuba-doc.com
- McHenry Western Lake County EMS System Protocols
Near Drowning

NAME: ______________________________________   DEPT: __________________________
(PRINT CLEARLY)

DATE: _____________________________

1) When someone is drowning, we want to do these 4 things. Reach, Throw, Tow and then Go.
   True       False

2) List the 5 ways we can have body heat loss.

   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________
   ______________________________________

3) Hypothermia is defined as a body temperature below _______________ degrees.

4) A victim has been under water for 20 minutes in cold water. By our protocols we should not initiate CPR and resuscitative measures.
   True       False

5) Spine Motion Restriction must be done on all near drowning victims.
   True       False
6) If awake and with good respiratory effort, yet congested and increased work of breathing following a near drowning or submersion incident, You should apply:
   a. CPAP at 12-15cm of PEEP
   b. NRB at 8-10 lpm
   c. CPAP at 5-10cm of PEEP
   d. NC at 2-6 lpm

7) Who is more likely to have a near drowning incident?
   Boys               Girls

8) Statistically a child that has a GCS of _________ or less will have a poor outcome.

9) List 4 signs and symptoms of hypothermia.
   ________________________________
   ________________________________
   ________________________________
   ________________________________

10) You have a much better chance of survival in cold water than you do in a warm water due to the Diving Reflex?
   True                 False

If you are NOT a member of the McHenry Western Lake County EMS System, Please include your address on each optional quiz turned into our office. Our mailing address is: Northwestern Medicine – McHenry Hospital EMS, 4201 Medical Center Drive, McHenry, Illinois 60050. We will forward to your home address verification of your continuing education hours.

If you ARE a member of our EMS System, your credit will be added to your Image Trend record. Please refer to Image Trend to see your current list of continuing education credits. Any questions regarding this can be addressed to Cindy Tabert at 224-654-0160. Please fax your quiz to Cindy Tabert at 224-654-0165 or send by email to cynthia.tabert@nm.org