Clinical Guidance

Paediatric Critical Care: Drowning

Summary
This guideline is for staff to use when caring for a child following a drowning. It looks at resuscitation, management, investigations and prognostics.

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This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.

This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.

Change History		
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Paediatric Critical Care

Drowning

Drowning: Respiratory impairment following submersion/ immersion in a liquid medium.[1]

"Near drowning" and "wet/dry drowning" terms are no longer used.

PRE-HOSPITAL & CARDIAC ARREST MANAGEMENT

Early bystander CPR dramatically affects chances of survival.[4,5,6]

Emergency medical services (EMS) initiate A, B, C approach

A: Immobilise C-Spine. Ensure airway is clear. Administer 100% O2.

B. Bag mask ventilation/ intubation by skilled personnel if required

C. Cardiac compressions 15:2. Obtain IV/IO access if possible.

If cardiac arrest: use APLS algorithm and adjust if hypothermic[12]:

- **<30°C**: aggressively rewarm (see right), avoid adrenaline/amiodarone and max 3 defibrillation attempts until >30°C
- **30-35°C**: Defibrillate as usual, double dose interval for resus. drugs

MANAGEMENT: Discuss with PICU early

Protect airway

- Assume cervical injury until proven otherwise
- High flow O2 (trauma mask).[1,6]
- Intubation with cuffed endotracheal tube.

Protective lung strategy

- Target tidal volumes 6-8mls/kg. Limit PIP to 30cmH_20
- Permissive hypercapnia. (Caution with head injury see below)
- Permissive hypoxia SaO2 90-94%
- Recruitment manoeuvres to establish open lung strategy
- Optimise PEEP to achieve oxygenation, may need 10-15cmH_20 [10]

Circulation [4,6]

- Treat hypothermia to optimise resuscitation process
- (See rewarming methods.)
- Target core temp >35^{0}C
- Central / IO access and arterial access
- Restrict fluids to 50% maintenance (0.9%Sodium Chloride +/- Glucose).
- Age appropriate MAP(inotropes): cerebral perfusion pressure)
- Arrhythmias common and may require treatment. Discuss with STRS

Neuroprotection [4,6,8]

- 30 degree head up tilt
- Normoglycaemic
- 2.7% sodium chloride (2 - 5ml/kg over 30mins) target sodium 145- 150mmol/l
- Ventilate to $ETCO_2$ target 4-5 kPa
- If haemodynamically stable: slow rewarming to 35°C advised [10]
- May need seizure control: load phenytoin

Full secondary survey

Early referral to tertiary centre for definitive care

PROGNOSTICATORS OF OUTCOME

GOOD

Short submersion time. GCS>5, cardiac output and spontaneous respiration in A&E

BAD

Age<3yrs [2,3,5] Submersion> 5 min No CPR>10 mins, asystole at the scene, resuscitation of cardiac arrest > 30mins[9] Multiorgan dysfunction[11]

REWARMING METHODS

Warm patient with core temp< 28°C[7,8]

If CVS stable aim to rewarm at 0.5°C per hr to 35°C

- Warm IV fluids (38-40°C)
- Heated humidified ventilator gases
- Radiant heaters/ Warming blanket
- Intravascular temperature control devices

If cardiovascularly unstable/in cardiac arrest:

Aggressive rewarming

- Bladder irrigation/ pleural lavage warm fluids
- Intravascular temperature control devices
- CVVH
- CPB/ECMO if available.

Prolonged, profound hypothermia may make resuscitation and rewarming impossible.

INVESTIGATIONS

Blood gas and glucose

FBC, Coagulation

U&E's: Correct any electrolyte abnormalities

CK may be ↑↑ if child has struggled in hypoxic conditions

LFT's & C-reactive protein. Serum osmolality

Consider drug and alcohol screen

Chest x-ray, Trauma panel if indicated

CT Scan/MRI brain if warranted.

ONGOING MANAGEMENT

- Multi organ dysfunction common in paediatric drowning victims who require PICU (54%).[11]
  - Respiratory>neurologic> cardiovascular
- Maintain normothermia if post cardiac arrest
- Antibiotics not started routinely
  - Send BAL and treat if concerns
- No evidence for the use of corticosteroids [1,2,710]
- Minimal data to support the use of surfactant.[1]

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