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Acute Management of Drowning in Children

Aim

This guideline aims to assist clinicians in the assessment, initial management and decision to admit or discharge children who have presented following a drowning incident.

Definition of terms

°C – Degrees Celsius
APLS – Advanced Paediatric Life Support
ATLS – Advanced Trauma Life Support
ECMO – Extracorporeal Membrane Oxygenation
ED – Emergency Department
ICTS – Irish Children's Triage System
PICU – Paediatric Intensive Care Unit
VF – Ventricular Fibrillation
VT – Ventricular Tachycardia

Target Patient Population

Paediatric patients presenting to the Emergency Department following a drowning event.

Target Users

Health-care professionals working in Paediatric Emergency Departments and Paediatric Intensive Care Units in Children's Health Ireland.

Definition

The definition of drowning has changed over recent decades. The most current and widely accepted definition was agreed by the WHO in 2005 and defines drowning as "the process of experiencing respiratory impairment from submersion or immersion in liquid". Other terms such as 'near-drowning' are considered obsolete in this newer definition which encompasses all drowning events and categorises outcomes as either fatal, non-fatal with morbidity or non-fatal without morbidity.¹

Assessment

Children who do not present in cardiorespiratory arrest should be rapidly assessed with emphasis placed on detection of cardiovascular instability, respiratory distress, hypothermia or altered level of consciousness.²

Investigations

Investigations are rarely indicated in well, asymptomatic children and should be guided by the child's presenting state.

In well-appearing children with normal vital signs and a normal examination, a chest x-ray is not routinely indicated.³



In patients with significant hypothermia (<32 °C), there should be consideration of cardiac arrhythmia, coagulopathy, deranged electrolytes and rhabdomyolysis as a result of shivering.

Special Considerations

In all patient groups, consideration of any ongoing safety concerns and referral to the Medical Social Worker on duty should be sent as necessary.

Thought should also be given to potential underlying causes of drowning in children, e.g. seizure, arrhythmia, non-accidental injury or ingestion of toxins, particularly alcohol.

Management

All children who present should be given the appropriate triage category as per ICTS.

Asymptomatic children

In children who are asymptomatic at presentation an 8 hour period of observation, from the time of the event is favoured.^{4,5,6} It is worth noting that if they are to become symptomatic, most children will develop symptoms within the first hour following a drowning incident.⁷

Symptomatic Children

All symptomatic children should have a primary survey performed as per APLS/ATLS protocols and action taken as issues are identified.

Associated Injuries

Overall, trauma associated with drowning occurs infrequently, however a focused clinical exam to assess for traumatic injuries should form part of the secondary survey. Injuries to the cervical spine have been observed to be the most common traumatic injury associated with drowning. As such, immobilisation should be considered until injury is ruled out either clinically or radiographically, particularly if the history is suggestive of concomitant trauma e.g. a diving related incident.⁸

Antibiotics and Tetanus Prophylaxis

Prophylactic antibiotics have not been shown to be beneficial to victims of drowning.²

The evidence for routine tetanus prophylaxis is poor. Unless there is a wound that may be heavily contaminated, routine tetanus prophylaxis is not indicated following a drowning incident.⁹

Management of Hypothermia

Hypothermia occurs commonly with drowning and should be effectively managed to prevent adverse effects such as ventricular arrhythmias.^{4,5}

Hypothermia can be classified as mild, moderate, or severe based on the child's core temperature.

Mild – 32 to 35°C
Moderate – 28 to 32°C
Severe – <28°C

Core temperature should be targeted to rise by no more than 0.25-0.5°C per hour.

All children with hypothermia should have active and passive external rewarming measures in place, i.e. removal of wet clothing, increasing room temperature, use of heat lamps, heat packs or Bair huggers.

Children who have moderate hypothermia as defined above, should have continuous monitoring during rewarming as cold, acidotic blood in the peripheries returning to the central circulation can cause a reduction in temperature and pH as well as hypotension due to peripheral vasodilatation.

In moderate to severely hypothermic patients, active internal rewarming measures may be necessary.

Simple initial techniques include administering IV fluids warmed to 39 °C and ventilation with gases warmed to 42 °C.

Other more invasive techniques include lavage of the bladder, stomach, pleura or peritoneum and should only be commenced under consultant guidance.

Cardiorespiratory Arrest Following Drowning

Children in cardiorespiratory arrest following drowning present a unique challenge and the standard protocol for management of cardiac arrest may need to be amended.¹⁰ (See below)

In the normothermic patient manage the arrest as per standard APLS protocols depending on initial rhythm-non shockable PEA/Asystole or shockable-VF/pulseless VT

In the hypothermic patient the notable changes to the standard APLS algorithms are:

Defibrillation – Below 30°C, limit defibrillation to only 3 shocks until core temperature is above 30°C.

Medication – Do not administer adrenaline or amiodarone if core temperature is below 30°C. When core temperature is between 30 and 34°C, the time interval between administration of medications is doubled.

Indications for PICU Referral

PICU referral should be considered where an ongoing requirement for airway management and/or cardiorespiratory support is anticipated and where neuroprotection and invasive temperature management is necessary.

When to Cease Resuscitation

Ultimately, the decision to cease resuscitation or to escalate care is unique to each case and should be made by the consultant in charge of the resuscitation.

It is worth noting that hypothermia in the setting of drowning in temperate climates has not been shown to have a neuroprotective effect and should not be used as a predictor of survival or an intact neurological outcome in these patients.¹¹

ECMO can be discussed on a case to case basis with the PICU team however it is worth noting that prolonged resuscitation/ECMO is likely to carry a poor outcome if the factors below exist.^{12,13,14,15}

- asystole as the presenting cardiac rhythm
- submersion time greater than 10 minutes
- severe hyperkalaemia

Links to useful websites

- Irish Water Safety - Steps to Safe Swimming Leaflet - https://watersafety.ie/wp-content/uploads/2017/12/12_steps_to_safe_swimming.pdf
- Irish Water Safety - Water Safety at Home Leaflet - https://watersafety.ie/wp-content/uploads/2017/12/irish_water_safety_at_home_a4_to_dl.pdf
- Irish Water Safety - Cold Shock Hypothermia Leaflet - <https://watersafety.ie/wp-content/uploads/2019/12/Hypothermia-Leaflet.pdf>

Companion documents

[Guideline Development Group signature sheet](#)

[Link to Reference List](#)