

INTRODUCTION

There are about 700 deaths by drowning a year in the UK, and many more times that number of near-drowning. A high percentage of these deaths involve children. In the majority of drowning, water enters the lungs, but 10–15% of cases involve intense laryngeal spasm with death resulting from asphyxia (so called dry-drowning).

The term **near drowning** applies to survivors of drowning including those resuscitated from cardiac or respiratory arrest resulting from an immersion incident.

It is customary to refer to incidents of near drowning as **IMMERSION** or **SUBMERSION**. In submersion incidents the head is below water and the main problems are **asphyxia** and **hypoxia**. With immersion the head usually remains above the water and the main problems will be **hypothermia** and cardiovascular instability from the hydrostatic pressure of the surrounding water on the lower limbs.

Trauma is often a major accompanying factor in the immersion incident. In particular, dives into shallow pools are often associated with **neck** and/or **head injury**.

In addition, **intoxication** from alcohol or drugs may often accompany immersion incidents. Occasionally an immersion incident may be precipitated by a medical cause such as **seizure**.

NOTE: as survival has been recorded after prolonged submersion, resuscitation and transport to hospital should be undertaken in all recent cases of near drowning. Only if the victim is discovered in cardiac arrest 1.5 hours or more after having entered the water should the fact of death be presumed.

HISTORY

History is often incomplete at the incident scene, both relating to the incident and the casualty.

Establish the number of patients involved.

Note the environment: swimming pools, hot tubs, fresh or sea water. Increasingly, immersion may occur because long hair becomes entangled in a drain or filter outlet, for example in a hot tub.¹

Try to obtain the time of accident, time of rescue, time of first effective cardio-pulmonary resuscitation (CPR).

Note the duration of any **SUBMERSION** and the water temperature and type (salt, fresh, contaminated).

RESCUE

NOTE: NEVER PUT YOURSELF AT RISK – Preserve your own safety and that of other rescuers.

Changes in haemodynamics after water immersion (the “hydrostatic squeeze effect”) make positional hypotension likely and the blood pressure will fall if the patient is raised vertically from the water. Rescuers must always attempt to maintain the victim flat and avoid vertical removal from water.

If the history suggests a neck injury take special care of cervical spine immobilisation during rescue and resuscitation.

Aspiration of water during drowning is common (around 80%). Tilting to drain aspirated water simply empties water from the stomach into the pharynx, risking further airway contamination. **Mechanical drainage of water from the lungs should not be carried out.** The lungs can be ventilated even with large volumes of water inside them.

ASSESSMENT

Primary Survey and Resuscitation

Assess and manage **ABCD**’s as per resuscitation guidelines.

Airway clearance and ventilation are the first priorities. Adequate ventilation and oxygenation may restore cardiac activity in drowning, so are worthy of major effort.²

The recovered patient is in great danger of vomiting. Alcohol/drugs are particularly likely to induce vomiting. Suction equipment and/or postural draining may be necessary if appropriate.

Administer high concentration oxygen (O₂) via a non-re-breathing mask, using the stoma in laryngectomy and other neck breathing patients, to ensure an oxygen saturation (SpO₂) of >95%, except in patients with chronic obstructive pulmonary disease (COPD) (**refer to COPD guideline**)

Consider assisted ventilation at a rate of 12–20 respirations per minute if:

- SpO₂ is >90% on high concentration O₂
- respiratory rate is <10 or >30
- expansion is inadequate

Ventilation in a near drowned casualty may be difficult as lung compliance is reduced if water has been inhaled.

Endotracheal intubation may be required and is

desirable in order to secure an impaired airway and provide adequate ventilation.

The **pulse** may be extremely slow if hypothermia is present, and external cardiac compression may be required. Bradycardia often responds to improved ventilation and oxygenation. **Drugs such as adrenaline and atropine are less effective in HYPOTHERMIA, and must not be repeatedly used.** These drugs may pool in the static circulation of the drowned casualty, and then, after re-warming and circulation has been restored, act as a dangerous bolus of drug as they are circulated.

In hypothermic cardiac arrest, **defibrillation** will be unsuccessful where the core temperature remains low. At 28°C the ventricle may spontaneously fibrillate. Defibrillation may not succeed until the core temperature rises above 30-32°C.

Therefore:

- in ventricular fibrillation give three DC shocks according to current resuscitation guidelines
- if unsuccessful check the core temperature. If below 30°C, commence active re-warming and consider urgent transport to a facility where active re-warming can be provided (ideally an extracorporeal circulation). Meanwhile continue with CPR, postponing further DC shocks until the patient is warmed.
- attach ECG and pulse oximeter.

Secondary survey and transfer to further care

In the presence of time-critical conditions e.g. cardiac arrest, difficulties in airway and ventilation maintenance, and/or major life-threatening trauma, do not waste further time in resuscitation at the scene but transport rapidly to hospital.

If non-time-critical features are present perform a more thorough patient assessment and a brief secondary survey.

If C-spine injury is not an issue, immersion victims should be transported in the recovery position with suction at hand. If C-spine injury cannot be excluded, immobilise on a long board and prepare for side-tilt and suction as required (**refer to neck and back trauma guideline**).

Cover to prevent further heat loss.

Establish IV access en route to hospital where possible.

Provide a Hospital Alert Message/Information call.

Secondary Drowning

Secondary drowning occurs usually within 4 hours of near-drowning and can also prove fatal. These cases can present up to 24 hours following immersion. Hence, anyone who is remotely suspected of having nearly drowned, or been rescued from water MUST BE TRANSFERRED TO HOSPITAL, however well they appear.

The common problems of secondary drowning are:

- acute respiratory distress syndrome (ARDS)
- cerebral oedema
- renal failure
- infection
- disturbance of electrolytes, acid-base balance, and lung function, along with hypothermia, are the main problems, and there is little to separate sea from fresh water exposure as a particular issue.

Treatment is aimed at preventing cardiac arrest. If this occurs, survival rate decreases from approximately 70-90% to approximately 15%.

Key Points – submersion/immersion

- Ensure own personal safety.
- Successful resuscitations have occurred after prolonged submersion/immersion.
- Near drowning is often associated with hypothermia.
- Special considerations in cardiac arrest treatment in the presence of hypothermia.
- Severe complications may develop several hours after submersion/immersion.

REFERENCES

- ¹ Press E. The health hazards of saunas and spas and how to minimise them. *American Journal of Public Health* 1991;8:1034-7.
- ² Goh SH, Low BY. Drowning and Near Drowning-some lessons learnt. *Annals of the Academy of Medicine, Singapore* 1999;28(2):183-8.

METHODOLOGY

Refer to methodology section.