

Drowning

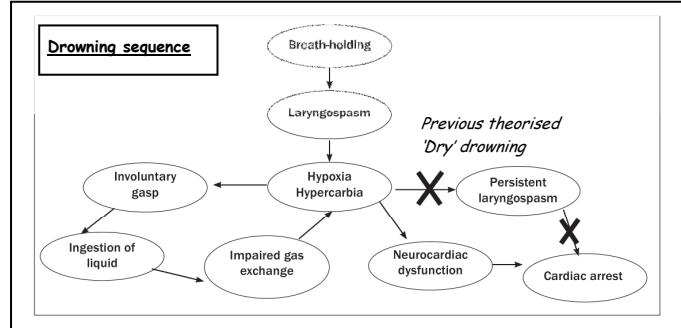
Definitions

2002 World Congress on Drowning consensus definition: "Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid."

Outcomes: death, morbidity (mod disabled, sev disabled, vegetative state/coma, & brain death), and no morbidity.

The terms *wet, dry, active, passive, secondary, and silent* are now obsolete.

Pathophysiology



Young children: cold water ($<10^{\circ}\text{C}$) immersion → diving reflex → apnoea, bradycardia, & shunting of blood to the coronary & cerebral circulation → improves chances of survival.

Pulmonary oedema: Common. Related more to vol. rather than type of liquid. Surfactant loss → atelectasis, bronchospasm, non-cardiogenic pulmonary edema, shunting, and V/Q mismatches. Pulmonary vasoconstriction from hypoxia → ↑pulm pressures → further oedema. May take minutes to days. FB aspiration may worsen hypoxia.

Other: Hypothermia may slow metabolic rate but usually less than respiration → hypoxia.

Epidemiology

- 2nd commonest form of accidental death (1st = MVA)
- Incidence peaks for toddlers and teenage boys.

Risk factors

- Unattended buckets of water, baths, swimming pools (unfenced), abuse in <5y
- EtOH, water sports and unsupervised swimming in open water in adolescents/adults.
- Cold water - hypothermia

Assessment

History: Mechanism and duration of submersion, type and temperature of water, time to CPR, ROSC & first breath, any vomiting, ?trauma, other precipitants (arrhythmia, MI, seizure, NAI)

Examination: TPR, BP, SaO_2 , Cardiac rhythm, Respiratory pattern, HI, APO, #'s, Neurological status (Conn & Modell classification at 2hr post immersion: Cat A - awake, Cat B- conscious but obtunded, Cat C - comatose, C1=flex to pain, C2=ext to pain, C3=flaccid)

Investigations

Bloods: ABG, electrolytes, renal function, glucose, osmolarity, alcohol level, FBC, LFTs, coags.

ECG: Note rate, rhythm, evidence of ischaemia, J waves of hypothermia.

Imaging: CXR (often normal initially), also C-Spine and possibly CT head if indicated.

Treatment

Cat A: Symptomatic Rx. Obs for 6h. NBM. O_2 PRN.

Cat B & C: Aggressive resus at scene. Resp. arrest before cardiac arrest.

Resus:

- A&B: O_2 . Consider early intubation +↑PEEP. If spont. breathing CPAP may help. Salbutamol for bronchospasm.
- C: CPR if req. Treat hypovolaemia, or hypotension if occur (consider CVL if persistent).

- D: Treat hypoglycaemia, seizures. ?Therapeutic cooling.
- E: Treat hypothermia (see separate article).

Supportive:

- NG tube +/- urinary catheter.
- Dialysis for renal failure.
- Prophylactic antibiotics unproven benefit. Use if febrile or grossly contaminated water.
- Artificial surfactant, hyperbaric O₂ and inhaled NO unproven therapies.

Complications

There are many possible complications:

- Cardiac (cardiac arrest, bradycardia, myocardial infarction)
- Pulmonary (pulmonary oedema, pneumonia)
- Neurological (stroke, cerebral hypoxia, cerebral oedema)
- Renal (renal failure)
- Haematological (haemolysis)
- Metabolic (hyperkalaemia, acidosis)
- Infective (pneumonia, septicaemia)

Prognosis

Generally the shorter the submersion time and delay to CPR, the better the outcome.

Prognosis is ultimately related directly to the duration and magnitude of hypoxia.

Poor survival is associated with the need for continued hospital CPR

The neuroprotective effects of cold-water drowning are poorly understood.

Orlowski Scale for paediatric drowning and near drowning.

- Age <3y
- Submersion >5min
- CPR delayed >10min after rescue
- Coma on arrival in ED
- pH<7.10 on arrival in ED

If 1 or 2 criteria are present, then 90% achieve a good recovery

If 3 or more criteria are present, only 5% recover.

GCS

- M1-3 score @ 2-6hr post-rescue = death/severe deficit
- Total score of 5 = 80% risk of death/severe deficit

Prevention

- Fences around swimming pools. This is a legal requirement in some countries.
- Teach children to swim.
- Adult supervision of children swimming, in bath.
- Wearing of life jackets in water sports including yachting, water skiing and jet skiing.
- Alcohol and swimming do not mix.

Notes:

Immersion Syndrome = sudden cardiac arrest on cold immersion. Vagal response + vasoconstriction.

Recovery syncope = syncope immediately following removal from cold water. May be due to cold diuresis and loss of external water pressure leading to reduced central perfusion.