Lack of evidence blocks development of drowning resuscitation guidelines

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Content

- development of resuscitation guidelines
- pathophysiology of drowning
- consequence for drowning resucitation guidelines
- evidence of drowning resuscitation guidelines
- what evidence do we need

Resuscitation guidelines development method

- first standardised treatment recommendations 1966
- regular updates in well defined process
- AGREE: Apraissal for Guidelines for Research and Evaluation (AGREE)
- Consensus on Science and Treatment Recommendations (CoSTR)
- Level of Evidence (LOE)
  - from randomised controlled trial to expert opinion

At the same time

- "grandfathered" guidelines
- standardisation to increase teaching efficacy
- profiling researchers and research institutes
- personal hobbies and passions
- commercial interests
- not all questions asked, not all anwers given
- focused on the primarily cardiac arrest
- drowning guidelines did not follow this process

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ERC Guidelines drowning 2010

BLS – lay persons

- safe rescue
- abnormal respiration = cardiac arrest
- initial breathing: 5 -15 times
- continue compressions: 30:2
- use AED
- compression-only CPR is acceptable alternative

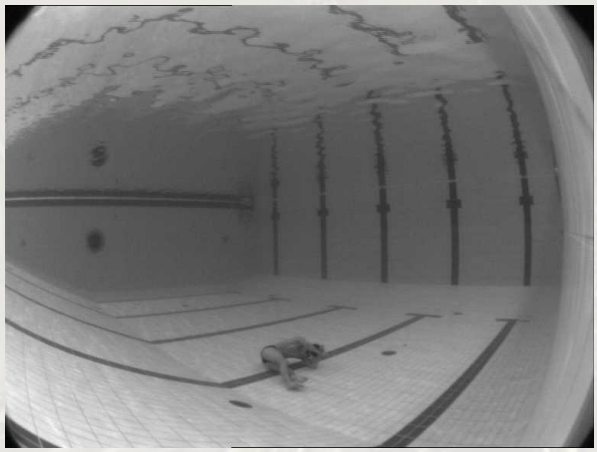
ALS – medical professionals

- high flow oxygen, non-invasive ventilation
- intubation, supraglottic devices

Is this the best way for drowning ?

- from the perspective of pathophysiology
- from the perspective of the lay person with a duty to respond
- from an educational point of view

Different drowning scenarios



Pathophysiology of drowning

- asphyxia
- laryngospasm
- aspiration (water and gastric content)
- alveolair-capillairy damage
- diving reflex
- hypothermia
- cervical spine injuries (CSI)

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The heart under water

- bradycardia occurs due to
  - hypoxia
  - diving reflex
  - hypothermia
- when cardiac arrest occurs the heart is
  - anoxic
  - acidotic
  - hypothermic

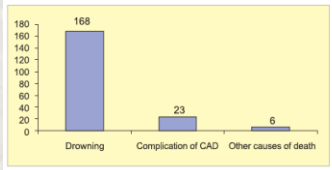

Figure 4. Causes of death in submersion cases (total 197). CAD – coronary artery disease.

very unlike a primarily cardiac arrest

Typical aspects of drowning CPR

- younger victim
- more frequent bystander CPR
- less frequent shockable rhythm
- better survival
- survival possible after unwitnessed arrest
- very prolonged resuscitation can be successful

Väyrynen et al. Resuscitation 2008; Claesson et al. Resuscitation 2008; Günther et al. Resuscitation 2009; Grmec et al. Int J Emerg Med 2009; Venema at al. Resuscitation 2010

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Typical aspects from organisational perspective

Life-savers are lay persons with a duty to respond

- organised
  - visible and traceable
  - expectations of public
  - dedicated to drowning
  - quality control
- trained
  - formal programs
  - informal education: sharing experiences
  - myths, rumors and devices (single loop learning)

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Which questions should be asked in drowning CPR

- when is resuscitation worthwhile
- when should resuscitation start
- how to overcome high inflation pressure during ventilation
- how to deal with risk of cervical injuries
- is there a place for titrated oxygen delivery
- is there a place for the AED

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When is resuscitation worthwhile

Most studies:

- 5 – 10 minutes under water

Case-reports:

- up to 66 minutes under water
- over 3 hours of BLS

Factors: cold water, child, car in water

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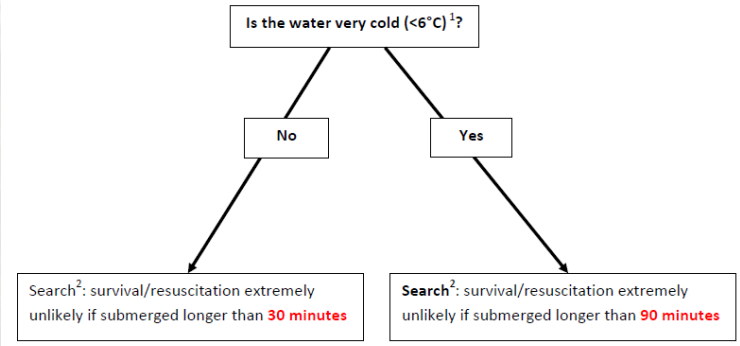

Figure 1. Decision-making guide for immersion incidents involving total (head under) submersion

Tipton M. Resuscitation 2011; in press

Is a pulse check needed

- gasping as sign to start CPR seems not reliable as sign for cardiac arrest
- hypoxic bradycardia or cardiac arrest, VF is rare
- injuries due to CPR
  - 25-75% potentially harmful injuries
  - 5-10% lethal injuries
- induction VF

Is a pulse check possible

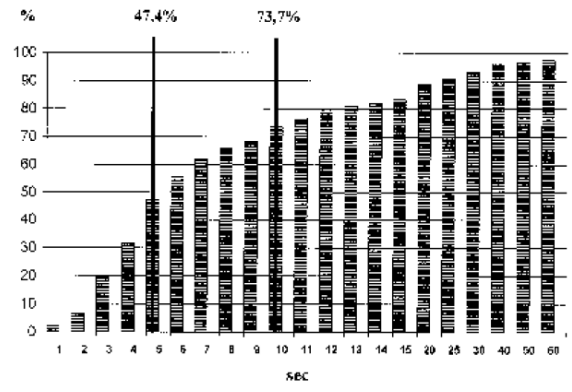

Fig. 1. Time needed (cumulating percentages; $n = 449$).

Bahr e.a. Resuscitation 1997;35:23-26

Is a pulse check indicated in drowning

- During team CPR a pulse check during rescue breathing provides important information without losing time
- Less implications of “Type II error” (false positive)

Technique

- carotid artery one side, neutral position
- 5 breaths: 30 – 60 seconds
- double check

High inflation pressure during ventilation

- increased airway resistance
  - loss of surfactant
  - ARDS
  - brochoconstriction
- gastric inflation

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What to when a lifeguard is in this situation

- adequate open airway
- good mouth-to-mouth seal
- stomach is rising with each inflation
- the chest is not going up and down
- the arrival of the ambulance will take 15 minutes
- the people around have the perception that you are not doing a good job

How to overcome high inflation pressure during ventilation

- prolonged inspiration period
- Guedel or Mayo tube
- bag-mask ventilation
- subglottic devices
- intubation

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How to overcome high inflation pressure during ventilation

- cricoid pressure
  - 1774 Monroi: drowning
  - 1961 Sellick: prevent aspiration during intubation
  - 2000 highly controversial in anesthesia
- technique
  - compression post-cricoid hypopharynx
  - needed pressure 30 kilo
  - easy to learn; simple learning devices
  - no complications

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How to overcome high inflation pressure during ventilation

Table 2. Studies showing effect of cricoid pressure on gastric insufflation.

First Author	Study Group/Details	Study Type	Outcome Measures	Key Results	Comments
Salem,[78] 1974	10 children, ventilated with 150% of normal minute volume by facemask	Nonrandomized	Effects of CP on gastric insufflation assessed by mL of air in stomach	Reduction in stomach gas volumes when CP applied	Peak airway pressures 19-25 cm H_2O Orogastric endotracheal tube in situ CP applied variably and "gently" No statistical analysis
Lawes,[79] 1987	20 patients ventilated by facemask with variable airway pressures	Observational	Effects of CP on gastric insufflation, assessed by stethoscope over stomach	No gastric insufflation with CP at peak airway pressures up to 45 cm H_2O	Tidal volume not measured Assessment of adequate ventilation subjective No gastric insufflation detected at 17 cm H_2O with or without CP
Petito,[80] 1988	50 patients ventilated by facemask with tidal volumes of 15 mL/kg and a respiratory rate of 10 breaths/min	Randomized study	Effects of CP on gastric insufflation assessed by mL of air in the stomach	Patients with CP applied had less gas in the stomach ($P<.001$)	High tidal volumes Nasogastric endotracheal tube in situ
Moynihan,[81] 1993	59 children ventilated by facemask. Airway pressures increased by gradual closure of pressure-release valve.	Part randomized, crossover	Effects of CP on gastric insufflation, assessed by stethoscope over stomach	CP prevented gastric insufflation up to an airway pressure of 40 cm H_2O	No gastric insufflation detected at 16 cm H_2O with or without CP Force of CP highly variable Orogastric endotracheal tube in situ

Elis et al. Ann Emerg Med 2007;50;853-665

Conclusion

- immediate resuscitation has the highest impact on survival
- a better resuscitation guideline may lead to better survival
- a best method of resuscitation in drowning, by a team of lifesavers, is still unknown
- many reasons to believe that the standard resuscitation guidelines are suboptimal for drowning
- evidence is needed if we think that we should do better

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