WORKSHEET for PROPOSED Evidence-Based GUIDELINE RECOMMENDATIONS

Worksheet Author: David Szpilman, MD	**Home Subcommittee:** BLS
Author's Home Resuscitation Council: BRAZILIAN	**Date Submitted to Subcommittee:** March, 2004

STEP 1: STATE THE PROPOSAL. State if this is a proposed new guideline; revision to current guideline; or deletion of current guideline.
Existing guideline, practice or training activity:

Create a guideline

Step 1A: Refine the question; state the question as a positive (or negative) hypothesis. State proposed guideline recommendation as a specific, positive hypothesis. Use single sentence if possible. Include type of patients; setting (in- /out-of-hospital); specific interventions (dose, route); specific outcomes (ROSC vs. hospital discharge).

Recommended technique for transportation of drowning victim from water and positioning on a dry site varies according to level of consciousness.

Step 1B: Gather the Evidence; define your search strategy. Describe search results; describe best sources for evidence.

Cochrane database using word "drown" found 13 articles abstracts but none were related to the issue. Medline search using word "drowning" found 2,932 articles abstracts refined to 25 using words "drowning AND water rescue". After a review we exclude all articles which have nothing to add on this issue. At the end 11 were related (but two are in germany and one was a letter). Using Words "drowning AND transport from water" – 12 articles (only thre would be possibly related to the issue). Using Words "remove drowning from the water" – none found. Using Words "recover drowning from the water" 2 articles (but none of the issue).

List electronic databases searched (at least MEDLINE (http://igm.nlm.nih.gov/), Embase, Cochrane database for systematic reviews and Central Register of Controlled Trials, and hand searches of journals, review articles, and books. **Cochrane database (reviews and trials), Medline, Embase, AHA endnote database, references from previous articles and review articles and Books.**

- State major criteria you used to limit your search; state inclusion or exclusion criteria (e.g., only human studies with control group? no animal studies? N subjects > minimal number? type of methodology? peer-reviewed manuscripts only? no abstract-only studies?)

Excluded all ILCOR statements before 2000 and articles out of English language. Accept all studies based on "transport from the water and positioning on dry land". Case and personal reports included, but given low priority

- Number of articles/sources meeting criteria for further review: Create a citation marker for each study (use the author initials and date or Arabic numeral, e.g., "Cummins-1"). If possible, please supply file of best references; End Note 4+ preferred as reference manager, though other reference databases acceptable.

15 articles met criteria for more detailed review.

STEP 2: ASSESS THE QUALITY OF EACH STUDY

Step 2A: Determine the Level of Evidence. For each article/source from step 1, assign a level of evidence—based on study design and methodology.

Level of Evidence	Definitions (See manuscript for full details)
Level 1	Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects
Level 2	Randomized clinical trials with smaller or less significant treatment effects
Level 3	Prospective, controlled, non-randomized, cohort studies
Level 4	Historic, non-randomized, cohort or case-control studies
Level 5	Case series: patients compiled in serial fashion, lacking a control group
Level 6	Animal studies or mechanical model studies
Level 7	Extrapolations from existing data collected for other purposes, theoretical analyses
Level 8	Rational conjecture (common sense); common practices accepted before evidence-based guidelines

Step 2B: Critically assess each article/source in terms of research design and methods.

Was the study well executed? Suggested criteria appear in the table below. Assess design and methods and provide an overall rating. Ratings apply within each Level; a Level 1 study can be excellent or poor as a clinical trial, just as a Level 6 study could be excellent or poor as an animal study. Where applicable, please use a superscripted code (shown below) to categorize the primary endpoint of each study. For more detailed explanations please see attached assessment form.

Component of Study and Rating	Excellent	Good	Fair	*Poor*	*Unsatisfactory*
Design & Methods	Highly appropriate sample or model, randomized, proper controls **AND** Outstanding accuracy, precision, and data collection in its class	Highly appropriate sample or model, randomized, proper controls **OR** Outstanding accuracy, precision, and data collection in its class	Adequate, design, but possibly biased **OR** Adequate under the circumstances	*Small or clearly biased population or model* ***OR*** *Weakly defensible in its class, limited data or measures*	*Anecdotal, no controls, off target end-points* ***OR*** *Not defensible in its class, insufficient data or measures*

A = Return of spontaneous circulation　C = Survival to hospital discharge　E = Other endpoint
B = Survival of event　D = Intact neurological survival

Step 2C: Determine the <u>direction</u> of the results and the statistics: supportive? neutral? opposed?

DIRECTION of study by results & statistics:	SUPPORT the proposal	NEUTRAL	OPPOSE the proposal
Results	Outcome of proposed guideline superior, to a clinically important degree, to current approaches	Outcome of proposed guideline no different from current approach	Outcome of proposed guideline inferior to current approach

Step 2D: Cross-tabulate assessed studies by a) *level*, b) *quality* and c) *direction* (ie, supporting or neutral/ opposing)**; combine and summarize.** Exclude the *Poor* and *Unsatisfactory* studies. Sort the *Excellent, Good,* and *Fair* quality studies by both *Level and Quality of evidence,* and *Direction of support* in the summary grids below. Use citation marker (e.g. author/ date/source). In the *Neutral* or *Opposing* grid use bold font for *Opposing* studies to distinguish them from merely neutral studies. Where applicable, please use a superscripted code (shown below) to categorize the primary endpoint of each study.

Supporting Evidence

Recommended technique for transportation of drowning victim from water and positioning on a dry site varies according to level of consciousness.

Quality of Evidence	1	2	3	4	5	6	7	8
Excellent					**Watson2001** [D] **Handley1997** [E] **Szpilman1997** [C]	**Giesbrecht2000**[E]		
Good				**Szpilman2004** [C, D]	**Modell 1969**[E] **Manolios1988**[C, D, E]	**Werner1982**[E]	**Modell 1981**[E] **Rosen1995**[E]	**Orlowski2001** [E] **Cummings2003** [E]
Fair						**Golden1991** [A]	**Ruben1962**[E] **Orlowski 1987**[C,D]	

Level of Evidence

A = Return of spontaneous circulation　C = Survival to hospital discharge　E = Other endpoint
B = Survival of event　D = Intact neurological survival

Neutral or Opposing Evidence

Recommended technique for transportation of drowning victim from water and positioning on a dry site varies according to level of consciousness.

Quality									
	Excellent								
	Good								
	Fair								
		1	2	3	4	5	6	7	8
		Level of Evidence							

A = Return of spontaneous circulation
C = Survival to hospital discharge
E = Other endpoint
B = Survival of event
D = Intact neurological survival

STEP 3. DETERMINE THE CLASS OF RECOMMENDATION. Select from these summary definitions.

CLASS	CLINICAL DEFINITION	REQUIRED LEVEL OF EVIDENCE
Class I *Definitely recommended.* Definitive, **excellent** evidence provides support.	• Always acceptable, safe • Definitely useful • Proven in both efficacy & effectiveness • Must be used in the intended manner for proper clinical indications.	• One or more Level 1 studies are present (with rare exceptions) • Study results consistently positive and compelling
Class II: *Acceptable and useful*	• Safe, acceptable • Clinically useful • Not yet confirmed definitively	• Most evidence is positive • Level 1 studies are absent, or inconsistent, or lack power • No evidence of harm
• *Class IIa: Acceptable and useful* **Good** evidence provides support	• Safe, acceptable • Clinically useful • Considered treatments of choice	• Generally higher levels of evidence • Results are consistently positive
• ***Class IIb:** Acceptable and useful* **Fair** evidence provides support	• Safe, acceptable • Clinically useful • Considered optional or alternative treatments	• Generally lower or intermediate levels of evidence • Generally, but not consistently, positive results
Class III: *Not acceptable, not useful, may be harmful*	• Unacceptable • Not useful clinically • May be harmful.	• No positive high level data • Some studies suggest or confirm harm.
Indeterminate	• Research just getting started. • Continuing area of research • No recommendations until further research	• Minimal evidence is available • Higher studies in progress • Results inconsistent, contradictory • Results not compelling

STEP 3: DETERMINE THE CLASS OF RECOMMENDATION. State a **Class of Recommendation** for the Guideline Proposal. State either **a) the intervention**, and then the conditions under which the intervention is either Class I, Class IIA, IIB, etc.; or **b) the condition,** and then whether the intervention is Class I, Class IIA, IIB, etc.

Intervention: Recommended technique for transportation of drowning victim from water and positioning on a dry site varies according to level of consciousness.
Class of recommendation: variable. See guideline section below.

REVIEWER'S PERSPECTIVE AND POTENTIAL CONFLICTS OF INTEREST: Briefly summarize your professional background, clinical specialty, research training, AHA experience, or other relevant personal background that define your perspective on the guideline proposal. List any potential conflicts of interest involving consulting, compensation, or equity positions related to drugs, devices, or entities impacted by the guideline proposal. Disclose any research funding from involved companies or interest groups. State any relevant philosophical, religious, or cultural beliefs or longstanding disagreements with an individual.

Intensive Care & Internist Specialist. ILS Medical member Commission. Pre-hospital provider care on drowning for 14 years. Beginning PhD. No intellectual or commercial conflicts.

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK: Summarize your final evidence integration and the rationale for the class of recommendation. Describe any mismatches between the evidence and your final Class of Recommendation. "Mismatches" refer to selection of a class of recommendation that is heavily influenced by other factors than just the evidence. For example, the evidence is strong, but implementation is difficult or expensive; evidence weak, but future definitive evidence is unlikely to be obtained. Comment on contribution of animal or mechanical model studies to your final recommendation. Are results within animal studies homogeneous? Are animal results consistent with results from human studies? What is the frequency of adverse events? What is the possibility of harm? Describe any value or utility judgments you may have made, separate from the evidence. For example, you believe evidence-supported interventions should be limited to in-hospital use because you think proper use is too difficult for pre-hospital providers. Please include relevant key figures or tables to support your assessment

Summary

Recomendation: Recommended technique for transportation of drowning victim from water and positioning on a dry site varies according to level of consciousness.
There were only a very few limited number of human studies identified, and no Level 1, 2, or 3 studies were identified.
For centuries, people falsely believed that draining water from the lungs of drowning victims was an essential part of the resuscitation process. In the 18th Century, this was the main reason why victims were transported from the water and positioned hanging vertically head down (**Orlowski2001**).

Water in the lungs

Massive aspiration during the drowning process is seldom observed in humans **(Modell1969)**.
Placing the victim head down does result in the drainage of some aspirated fluid, mainly after salt water drowning, but the disadvantages outweigh the benefits. In particular, such action does not improve oxygenation of the patient during a resuscitation attempt (**Werner1982, Modell1981, Ruben1962**). Although It does not take long to drain water from the lungs (1-3 minutes), such delay before resuscitation can be significant as far as outcome is concerned (**Werner1982, Orlowski1987**).
During pre-hospital resuscitation, attempts at active drainage by placing the victim head down increases the risk of vomiting more than fivefold, and leads to a small (19%) but significant increase in mortality when compared with keeping the victim in a horizontal position (**Szpilman&Idris2002**).
The presence of vomit in the airway can result in further aspiration and impairment of oxygenation by obstruction of the airways; it can also discourage rescuers from attempting mouth-to-mouth resuscitation (**Manolios1988, Bierens1997**).
The abdominal thrust (Heimlich) maneuver should never be used as a means of expelling water from the lungs – it is ineffective and carries significant risks (**Rosen1995**)

In water rescue

If resuscitation is started whilst the drowning victim is still in the water the chances of survival without sequelae are increased 20 fold (**Szpilman2004**). Chest compression is not a practical option, but rescue breathing can be undertaken, preferably with support, in deep water (fig 1) or at the water's edge

RESCUE FROM THE WATER

Maintaining the victim in a head-up vertical position during rescue from the water reduces the incidence of vomiting and facilitates spontaneous respiration (**Manolios1988**) (fig 2). In the presence of hypotension or shock, the victim should be rescued in a near-horizontal position, but with the head still maintained above body level (**Szpilman1997, Szpilman2004**). Horizontal recovery is important after prolonged immersion, particularly in cold water, when a combination of the release of hydrostatic pressure and the effect of the cold may result in severe, sometimes irreversible, hypotension (**Golden1991, Giesbrecht2000**).

On-land resuscitation

All victims should initially be placed in a position parallel to the waterline as horizontal as possible, lying supine, far enough away from the water to avoid incoming waves. On sloping beaches or riverbanks, rescuers attending the victim should kneel with their backs towards the water so as to facilitate evaluation and CPR manoeuvers, if needed, without falling over the victim (fig 3) (**Szpilman2004**). During CPR, the brain is most effectively perfused with oxygenated blood if the victim is in a horizontal position **(Guidelines for cardiopulmonary Resuscitation and Emergency Cardiac Care, Part 4; Special Resuscitations; Near-Drowning; American Heart Association; JAMA, Oct 28, 1992 V268, P 2242 (9)**).

The unconscious breathing victim

On land, the airway of an unconscious victim who is breathing spontaneously is at risk of obstruction by the tongue and from inhalation of mucus and vomit. Placing the victim on the side (recovery position) helps to prevent these problems, and allows fluid to drain easily from the mouth.

The Basic Life Support Working Group of the International Liaison Committee on Resuscitation (ILCOR) agreed on six principles that should be followed when managing the unconscious, spontaneously breathing victim: 1. The victim should be in as near a true lateral position as possible with the head dependant to allow free drainage of fluid; 2. The position should be stable; 3. Any pressure on the chest that impairs breathing should be avoided; 4. It should be possible to turn the victim onto the side and return to the back easily and safely, having particular regard to the possibility of cervical spine injury; 5. Good observation of, and access to, the airway should be possible; and 6. The position itself should not give rise to any injury to the victim. (**Handley1997**).

DROWNING POSITIONING RECOMMENDATIONS ACCORDING TO THE SETTING AND LEVEL OF CONSCIOUSNESS

SETTING	**LEVEL OF CONSCIOUSNESS**	
	Conscious victim	Exhausted, confused or unconscious victim
In-water (during rescue)	Position according to the rescue technique chosen	Whenever possible keep the victim's face out of the water, extend the neck to open the airway and keep it clear during the rescue process (fig 1).
Recovery to dry land	Transport vertically with head up (fig 2) (Keep horizontal if prolonged immersion or cold water)	Transport in as near a horizontal position as possible but with the head still maintained above body level Keep airway open. (Keep horizontal if prolonged immersion or cold water)
Dry land	Maintain supine with head up.	<u>If CPR required</u>: Place victim supine, as horizontal as possible, and parallel with the waterline (fig 3). <u>Unconscious but breathing</u>: Place in recovery position (fig 4)

PHOTO 1

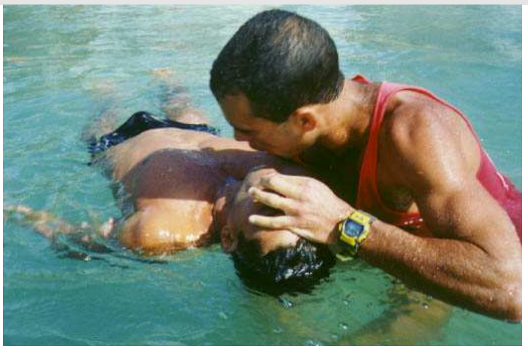
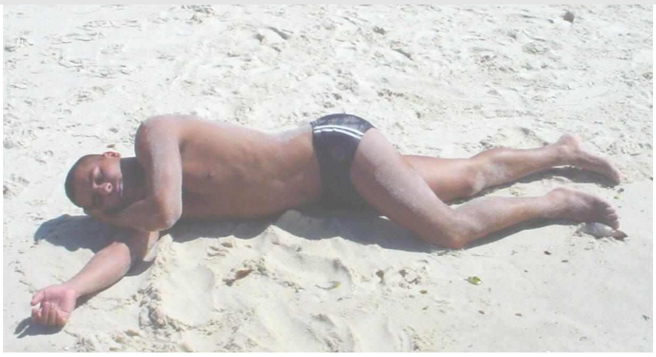


PHOTO 2

PHOTO 3

PHOTO 4



Preliminary draft/outline/bullet points of Guidelines revision: Include points you think are important for inclusion by the person assigned to write this section. Use extra pages if necessary.

Publication: ______ Chapter: _____ Pages: _____
Topic and subheading: _____

Final Class of recommendation: As follows:
Drowning victim transportation from water and positioning on dry site recommendations should be done according to the setting and level of consciousness.

SETTING and LEVEL OF CONSCIOUSNESS
In-water (during rescue)
Conscious victim - Keep the victim's face out of the water and rescue the victim in position according to the rescue technique chosen. (Class IIa – Level 4)
Exhausted, confused or unconscious victim - Whenever possible keep the victim's face out of the water, extend the neck to open the airway and keep it clear during the rescue process (fig 1). (Class IIa – Level 4)

Recovery to a dry place
Conscious victim - Transport victim vertically with head up (fig 2) (Keep horizontal if prolonged immersion or cold water) (Class IIb – Level 5)

Exhausted, confused or unconscious victim - Transport in as near a horizontal position as possible but with the head still maintained above body level. Keep airway open (Keep horizontal if prolonged immersion or cold water). (Class IIb – Level 5)

Dry land
Conscious victim - Maintain supine with head up. (Class IIb – Level 5)
Exhausted, confused or unconscious victim - If CPR required: Place victim supine, as horizontal as possible, and parallel with the waterline (fig 3). (Class IIb – Level 5)
Unconscious but breathing: Place in recovery position (fig 4) (Class IIa – Level 4)
NOTE: For cervical spine injury see other Statement.

See detailed comments, including Classes for recommendations in previous section.

Attachments:
- Bibliography in electronic form using Endnote. It is recommended that the bibliography be provided in annotated format. This will include the article abstract (if available) and any notes you would like to make providing specific comments on the quality, methodology and/or conclusions of the study.

Citation Marker	Full Citation*
Cummings2003	**Cummins RO, Szpilman D. Submersion. In: Cummins RO, Field JM, Hazinski MF, Editors. ACLS - The Reference Textbook. Volume II: ACLS for Experienced Providers. Dallas, Tx: American Heart Association; 2003:97-107.** **No abstract available** Level 8 – good
Giesbrecht2000	**Giesbrecht GG., Cold stress, near drowning and accidental hypothermia: a review. Aviat Space Environ Med. 2000 Jul;71(7):733-52. Review. Laboratory for Exercise and Environmental Medicine, Health, Leisure and Human Performance Research Institute, University of Manitoba, Winnipeg, Canada. giesbrec@ms.umanitoba.ca** This paper reviews literature on the topic of cold stress, near-drowning and hypothermia, written mainly since the last review of this type in this journal. The main effects of cold stress, especially in cold water immersion, include the "cold shock" response, local cooling causing decrements in physical and mental performance, and ultimately core cooling as hypothermia occurs. The section on cold-water submersion (near-drowning) includes discussion regarding the various mechanisms for brain and body cooling during submersion. The mechanisms for cold-induced protection of the anoxic brain are discussed with attention given to decreased brain temperature and the Q10 principle, the mammalian dive reflex and a newly considered mechanism; cold-induced changes in neurotransmitter release (i.e., glutamate and dopamine). The section on the post-cooling period includes the post-rescue collapse and subsequent rewarming strategies used in the field, during emergency transport or in medical facilities. Recent research on topics such as inhalation warming, body-to-body warming, radio wave therapy, warm water immersion, exercise, body cavity lavage, and cardiopulmonary bypass is reviewed. Information on new methods of warming, including arteriovenous anastomoses (AVA) warming (by application of heat- with or without negative pressure application-to distal extremities in an effort to increase AVA blood flow), forced-air warming, and peripheral vascular extracorporeal warming, are discussed. Publication Types: Review,Review, Academic PMID: 10902937 [PubMed - indexed for MEDLINE] Level 7 (review) – Excellent
Golden1991#	**Golden FS. Hervey GR. Tipton MJ. Circum-rescue collapse: collapse, sometimes fatal, associated with rescue of immersion victims. Journal of the Royal Naval Medical Service 1991;77:139-49.** **No abstract available** Level 5 (case reports) – Fair
Guidelines1992#	**Guidelines for cardiopulmonary Resuscitation and Emergency Cardiac Care, Part 4; Special Resuscitations; Near-Drowning; American Heart Association; JAMA, Oct 28, 1992 V268, P 2242 (9).** **No abstract available** Level 8 (guideline)
Handley1997#	**Handley, AJ, Becker LB, Allen M, van Drenth A, Kramer E B, Montgomery W H. Single rescuer adult basic life support: an advisory statement from the Basic Life Support Working Group of the International Liaison Committee on Resuscitation (ILCOR). 1997; 95, 2174-2179.** **No abstract available** Level 8 (guideline) – Excellent
Manolios1988#	**Manolios N, Mackie I. Drowning and near-drowning on Australian beaches patrolled by life-savers: a 10-year study, 1973-1983. Med J Aust. 1988 Feb 15;148(4):165-7, 170-1.** **Prince of Wales Hospital, Randwick, NSW.** Abstract: Resuscitation report-forms of the Surf Life-Saving Association of Australia, for the period 1973-1983, were analysed. During this period there were 262 immersion victims at beaches that were patrolled by life-savers. Of these, 162 victims survived, some of whom received expired-air resuscitation (n = 61) or cardiopulmonary resuscitation (n = 29). Among those who drowned, none was younger than five years of age. Vomiting and regurgitation were major problems during resuscitation. Respiratory and cardiopulmonary arrest occurred after apparently-successful rescue; this highlights the necessity for the close observation of victims and the early administration of oxygen to all immersion victims. Resuscitation in deep water has been shown to be effective, and instruction in these techniques is now standard teaching within the Surf Life-Saving Association of Australia.

	PMID: 3340043 [PubMed - indexed for MEDLINE] Level 5 – Good

Modell 1969#	**Modell JH, Davis JH (1969) Electrolytes changes in human drowning victims. Anesthesiology 30:414-420.** **No abstract available** Level 5 – Good
Modell 1981#	**Modell JH: Is the Heimlich maneuver appropriate as first treatment for drowning? Emerg Med Serv 10:63-66, 1981.** **No abstract available** Level 7 – good
Orlowski 1987#	**Orlowski JP: Adolescent Drowning: Swimming, Boating, Diving, and Scuba Accidents. Pediatric Annals 17: 2/Feb 1987.** **No abstract available** Level 7 – Fair
Orlowski2001#	**Orlowski JP, Szpilman D, "Drowning - Rescue, Resuscitation, and Reanimation" Pediatric Critical Care: A New Millennium, W. B. Saunders Company Pediatric Clinics Of North America - V48, N3, June 2001. Review.** **No Abstract available** Level 8 – good
Ruben 1962#	**Ruben A, Ruben H (1962); Artificial respiration. Flow of water from the lung and the stomach; Lancet 1:780-781.** **No abstract available** Level 7 – fair
Rosen1995#	**Rosen P, Stoto M, Harley J. The use of the Heimlich maneuver in near drowning: Institute of Medicine report. J Emerg Med *1995*;13:397-405)** **No abstract available** Level 7 – good
Szpilman1997#	**Szpilman D. Near-drowning and drowning classification: a proposal to stratify mortality based on the analysis of 1831 cases. Chest. 1997 Sep;112(3):660-5.** **ABSTRACT** Objective: To establish an updated classification for near-drowning and drowning(ND/D) according to severity, based on mortality rate of the subgroups. Materials and Methods: We reviewed 41,279 cases of predominantly sea water rescues from the coastal area of Rio de Janeiro City, Brazil, from 1972 to 1991. Of this total, 2,304 cases (5.5%) were referred to the Near-Drowning Recuperation Center, and this group was used as the study data base. At the accident site the following clinical parameters were recorded: presence of breathing, arterial pulse, pulmonary auscultation, and arterial blood pressure. Cases lacking records of clinical parameters were not studied. The ND/D were classified in 6 subgroups: Grade 1 - Normal pulmonary auscultation with coughing; Grade 2 - Abnormal pulmonary auscultation with rales in some pulmonary fields; Grade 3 - Pulmonary auscultation of acute pulmonary edema without arterial hypotension; Grade 4 - Pulmonary auscultation of acute pulmonary edema with arterial hypotension; Grade 5 - Isolated respiratory arrest; Grade 6 - Cardiopulmonary Arrest(CPA). Results: From 2,304 cases in the data base, 1,831 cases presented all clinical parameters recorded and were selected for classification. From these 1,831 cases, 1,189(65%) were classified as Grade 1 (mortality = 0%); 338(18.4%) as Grade 2 (mortality = 0.6%); 58(3.2%) as Grade 3 (mortality = 5.2%); 36(2%) as Grade 4 (mortality = 19.4%); 25(1.4%) as Grade 5 (mortality = 44%); and 185(10%) as Grade 6 (mortality = 93%)(P<0.000001). Conclusion: The study revealed that it is possible to establish 6 subgroups based on mortality rate by applying clinical criteria obtained from first-aid observations. These subgroups constitute the basis of a new classification. PMID: 9315798 [PubMed - indexed for MEDLINE] Level 5 – excellent
Szpilman2004#	**Szpilman D, Soares M, In-water resuscitation – Is it worthwhile?, Resuscitation, Accepted for publication in March 14th.** **Abstract:** Objectives: Until now, there is no solid information indicating the best option of rescuing a non-breathing drowning victim in the water. Our objectives were to compare the outcomes of performing immediate in-water resuscitation (IWR) or delaying resuscitation until the victim is brought shore.Material and Methods: A retrospective data analysis was conducted of non-breathing drowning victims rescued by lifeguards in the coastal area of Rio de Janeiro, Brazil. Patients were coded as IWR and no-IWR (NIWR) cases based on the lifeguard's decision whether to perform IWR. Death and development of severe neurological damage (SND) were considered poor outcome.Results: Forty-six patients were studied. Their median age was 17 (9-31) years. Nineteen (41.3%) patients received IWR and 27 (58.7%) did not. The mortality rate was lower for

[PTM1] Comentário: Please insert updated reference.

	IWR cases (15.8% vs. 85.2%, p<0.001). However, among surviving IWR cases, 6 (31.6%) developed SND. In multivariate analysis, higher age [odds ratio (OR)=1.117 (95% confidence interval (CI)=1.006-1.240)] was associated with death, while IWR [OR=0.052 (95%CI=0.005-0.501)] was protective. When death and SND were set as the dependent variable, longer cardiopulmonary arrest (CPA) duration was the unique variable selected (OR=1.775 (95%CI=1.128-2.792). Every patient with CPA duration higher than 14 minutes had poor outcome. Conclusions: Delaying resuscitation efforts were associated with a worse outcome for non-breathing drowning victims. In the cases studied, IWR was associated with improvement of the likelihood of survival. An algorithm was developed for its indications and to avoid unnecessary risks to both victim and rescuer. Level 4 – retrospective, non-randomized, case-control study, where the authors identified for the first time, that attempting to conduct in-water resuscitation (IWR) (ventilation only) can result in a significant outcome improvement for severe drowning victims (unconscious victim). It further confirms that estimated cardio pulmonary arrest (CPA) duration is a crucial parameter to be taken into account when deciding to start any resuscitation efforts either in-water or not on drowning. Patients receiving IWR had lower scene and in-hospital mortality rates than those who did not receive IWR. They were less likely to require full CPR on the beach or pool deck and almost half of them did not need any additional resuscitation maneuver after IWR. They also had a higher probability of being successfully transferred to a hospital. In multivariate analysis, providing IWR reduced the probability of death almost 20-fold. Nonetheless, although most patients receiving IWR had good outcomes, about one third developed severe neurological damage (SND). A higher estimated CPA duration interval was the unique independent variable selected in the logistic regression. When a ROC curve was constructed, estimated CPA duration showed a very good accuracy in predicting these poor outcomes (AUROC=0.881). Of great concern, was the cutoff point found, in which every patient with CPA duration greater than only 14 minutes died or developed SND. The study has substantial limitations. First, it was based on a retrospective data assessment and, consequently, 28 (32.6%) patients were excluded due to missing data. Since the mortality rate for excluded cases was higher than for included ones, we cannot rule out the possibility that a selection bias caused to study cases that had been rescued more appropriately. Second, it was not possible to assess some variables related to patient characteristics (body mass, for example), beach conditions, rescue site, as well as factors such as lifeguard experience and self-confidence in the rescue, any of which could potentially affect the decision to offer IWR. Therefore, they cannot exclude a bias has occurred because lifeguards were given the prerogative of deciding whether to attempt IWR or not. Level 4 – good

Watson2001#	**Watson RS, Cummings P, Quan L, Bratton S, Weiss NS., Cervical spine injuries among submersion victims. J Trauma. 2001 Oct;51(4):658-62.** **PMID: 11586155 [PubMed - indexed for MEDLINE]** Department of Epidemiology, University of Washington School of Public Health and Community Medicine, Seattle, Washington, USA. watsonrs@anes.upmc.edu BACKGROUND: Submersion victims are frequently considered at high risk for cervical spine (C-spine) injury regardless of whether they sustain a traumatic injury. We hypothesized that C-spine injury is unlikely in submersion victims who do not sustain high-impact injuries. METHODS: The study was a cohort study of all people who submerged between January 1974 and July 1996 and received medical care or were seen by the medical examiner in King, Pierce, and Snohomish counties in Washington State. RESULTS: Eleven (0.5%) of 2,244 submersion victims had C-spine injuries. All 11 had submerged in open bodies of water; had clinical signs of serious injury; and had a history of diving, motorized vehicle crash, or fall from height. No C-spine injuries occurred in 880 low-impact submersions. CONCLUSION: Submersion victims are at risk for C-spine injury only if they have also sustained a traumatic injury. Routine C-spine immobilization does not appear to be warranted solely on the basis of a history of submersion. Publication Types: Multicenter Study PMID: 11586155 [PubMed - indexed for MEDLINE] Level 5 – excellent
Werner 1982#	**Werner JZ, Safar P, Bircher NG, Stezoski W, Siamion M, Stewart Rd. No improvement in pulmonary status by gravity drainage or abdominal thrust after seawater near-drowning in dogs. Anesthesiology; V57: No 3; Sept 1982.** **No abstract available** Level 6 – good
	ARTICLES EXCLUDED
Habib1996	**NOT RELATED** **Habib DM, Tecklenburg FW, Webb SA, Anas NG, Perkin RM. Prediction of childhood drowning and near-drowning morbidity and mortality. Pediatr Emerg Care. 1996 Aug;12(4):255-8. PMID: 8858647 [PubMed - indexed for MEDLINE]** Children's Hospital, Medical University of South Carolina, Charleston 29425-3305, USA. OBJECTIVES: (a) Evaluate the presenting hemodynamic status and neurologic function of a series of warm water submersion injuries. (b) To ascertain the importance of the timing of the neurologic examination. (c) To identify risk factors that predict which patients will not return to presubmersion status. DESIGN: Retrospective review of all patients with a diagnosis of drowning/near-drowning responded to by the Children's Hospital pediatric transport service. Data were collected over a 24-month period regarding patient characteristics, submersion medium, rescue efforts, time out of sight, elapsed times to emergency department (ED) and pediatric intensive care unit (PICU) arrival, neurologic and hemodynamic status on arrival at the ED and PICU, reconstructed Conn-Modell category, and neurologic outcome. SETTING: EDs of the referring hospitals and PICU of the Children's Hospital of Orange County (CHOC), California. PATIENTS: Ninety-three submersion victims at an average age of 31 months. All patients were provided intensive care support. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: Twenty-three percent (21/ 93) of patients died or survived vegetative. No patient arriving comatose and asystolic in the ED survived neurologically intact (n = 21, three patients expired in the ED). This group of patients had a mean duration of documented asystole = 41 minutes, range of 18 to 107 minutes, and time to ED arrival = 21 minutes. All patients with a detectable pulse and blood pressure (n = 72) on arrival to the ED, regardless of their neurologic status, recovered to their presubmersion status. Patients arriving comatose (decorticate, decerebrate, or flaccid posture) in the PICU (n = 18, mean arrival = 192 minutes) all died or were vegetative. All patients with non-coma (n = 72, Conn-Modell category A or B) on arrival to the PICU recovered normally. CONCLUSIONS: Hemodynamic status in the ED and neurologic status in the PICU are highly predictive of outcome. On arrival to the ED, the cardiovascular status is more predictive of abnormal outcome than neurologic status. Poor neurologic outcome appears inevitable for warm water submersion victims who are asystolic at ED arrival and remain comatose for more than 200 minutes.
Chochinov1998	**NOT IMPORTANT** **Chochinov AH, Baydock BM, Bristow GK, Giesbrecht GG., Recovery of a 62-year-old man from prolonged cold water submersion. Ann Emerg Med. 1998 Jan;31(1):127-**

	31. **PMID: 9437357 [PubMed - indexed for MEDLINE]** Department of Family Medicine, Faculty of Medicine, University of Manitoba, Winnipeg, Canada. Recovery from prolonged cold water submersion is well documented in children but rare in adults. In the few adult cases reported, significant body cooling occurred (rectal temperature ranging from 22 degrees to 32 degrees C) and the victims were relatively young (< 40 years). We report a case of a 62-year-old man who was submersed in 2 degrees to 3 degrees C water for 15 minutes (time from initial submersion to intubation = 22 minutes). At the time of rescue, he had no vital signs, received prehospital Advanced Life Support, and was transported to hospital. On arrival at hospital, the patient remained in full cardiopulmonary arrest with an agonal ECG rhythm and had an initial pH of 6.77. Initial rectal temperature was near normal (36 degrees C) but subsequently dropped to 33 degrees C. The patient was resuscitated, rewarmed by forced-air warming, and treated for acute myocardial infarction, pulmonary edema, and generalized seizures. He was discharged after 27 days with minor neurologic abnormalities. Given the near-normal initial rectal temperature, preferential brain cooling may have been at least partially responsible for the positive neurologic outcome. PMID: 9437357 [PubMed - indexed for MEDLINE]

Kizer 1982	**Kizer K., Aquatic rescue and in-water CPR. Ann Emerg Med. 1982 Mar;11(3):166-7**. No abstract available. PMID: 7065496 [PubMed - indexed for MEDLINE] Publication Types: Letter PMID: 7065496 [PubMed - indexed for MEDLINE]
Van Berkel966	**NOT RELATED** **Van Berkel M, Bierens JJ, Lie RL, de Rooy TP, Kool LJ, van de Velde EA, Meinders AE. Pulmonary oedema, pneumonia and mortality in submersion victims; a retrospective study in 125 patients. Intensive Care Med. 1996 Feb;22(2):101-7. PMID: 8857116 [PubMed - indexed for MEDLINE] Department of Medicine, Beatrixziekenhuis, Gorinchem, The Netherlands.** OBJECTIVE: The identification of risk factors contributing to the development of pulmonary oedema, pneumonia and late mortality in submersion victims. DESIGN: A retrospective study of 125 submersion victims. SETTING: The medical intensive care unit in a university hospital. METHODS: Baseline examination on admission consisted of history, physical examination, arterial blood gas analysis and a chest radiograph. Patients were then classified into four groups: class I, baseline examination negative; class II, baseline examination positive, but mechanical ventilation not needed on admission; class III, mechanical ventilation required on admission; class IV, patients suffering from cardiopulmonary arrest. All patients who were not successfully resuscitated or who had expired within 24 h after admission were excluded for determination of the risk of pulmonary oedema and pneumonia. RESULTS: Class I patients did not develop pulmonary complications; neither pulmonary oedema nor pneumonia occurred in this group. In the remaining classes the incidence of pulmonary oedema was 72% and that of pneumonia, 14.7%. Stepwise logistic regression showed that pulmonary oedema was related to the type of water (seawater, ditch water, swimming pool) victims were submerged in and to the neurological state both at the time of rescue and on admission. The development of pneumonia was related to the use of mechanical ventilation (the risk was 52%). Pneumonia was not related to neurological state at the time of rescue or on admission, to body temperature on admission, to the prophylactic administration of antibiotics or to the use of corticosteroids. Mortality was high in class IV patients, but low in all other patients. Early mortality was 18.4% while late mortality was 5.6%. CONCLUSIONS: There is no need to hospitalise submersion victims when there are no signs or symptoms of aspiration upon arrival in the emergency room. All other patients should be admitted to an intensive care unit. The risk of pneumonia is high when mechanical ventilation is necessary. Mortality is high in patients with circulatory arrest on admission, but low in all other patients. PMID: 8857116 [PubMed - indexed for MEDLINE]
Bierens JJ1990	**NOT RELATED** **Bierens JJ, van der Velde EA, van Berkel M, van Zanten JJ. Submersion in The Netherlands: prognostic indicators and results of resuscitation. Ann Emerg Med. 1990 Dec;19(12):1390-5**. PMID: 2240751 [PubMed - indexed for MEDLINE] Department of Internal Medicine, University Hospital Leiden, The Netherlands. STUDY OBJECTIVES: To analyze prognostic indicators and the outcome of resuscitation in submersion victims (drowning and near drowning). DESIGN: Retrospective study. SETTING: Intensive and Respiratory Care Unit. Between January 1, 1979, and December 31, 1985, 87 submersion victims were admitted. The files of 83 victims were available for statistical analysis. There were 66 male victims and 17 female victims; the average age was 31.4 +/- 25.8 years. There were ten salt water and 73 fresh water submersions. MEASUREMENTS AND MAIN RESULTS: Predictors for better survival potentials were a young age, submersion of less than ten minutes, no signs of aspiration, and a central body temperature of less than 35 C at admission. We did not detect factors that accelerated a decrease in core body temperature at admission and assume that lethal hypoxia had preceded protective hypothermia in our submersion victims. The Orlowski score had a predictive value but at the same time we found nonindependent indicators in this score. Neurologic outcome in our patients, who were not treated according to a brain protection protocol, was not worse than the outcome published by authors who have used such a protocol. Thirty-three percent of the victims with a cardioventilatory arrest (15) and all victims with a ventilatory arrest (11) survived resuscitation and were discharged. Five nonarrest victims died due to late complications. CONCLUSION: This study shows that no indicator at the rescue site and in the hospital is absolutely reliable with respect to death or survival.
Jungck1977	**INTERESTING BUT IN GERMAN~~¥~~** **Jungck E, Walther H. [Recovery from apparently hopeless fresh-water drowning (author's transl)] Prakt Anaesth. 1977 Dec;12(6):463-70. German. PMID: 339220**

	[PubMed - indexed for MEDLINE] (author's transl)] [Article in German] Report of 3 cases of drowning (children). 2 patients survived without severe injury, 1 patient died after 13 days. The protective action of hypothermia to the brain and heart in hypothermic drowning is emphasized. Even in apparently hopeless cases resuscitation should be started immediately and should not be discontinued too early. Especially in hypothermic drowning efforts can be successful after more than 60 min. of resuscitation. In cases of drowning an emergency physician should be called immediately (emergency-ambulance, rescue-helicopter). A short survey of pathologic physiology, emergency therapy and intensive care of drowning is given. PMID: 339220 [PubMed - indexed for MEDLINE]

Schmidt1995	**VERY INTERESTING BUT NOT RELATED** **Schmidt U, Fritz KW, Kasperczyk W, Tscherne H. Successful resuscitation of a child with severe hypothermia after cardiac arrest of 88 minutes. Prehospital Disaster Med. 1995 Jan-Mar;10(1):60-2. PMID: 10155409 [PubMed - indexed for MEDLINE]** Medizinische Hochschule Hannover, Unfallchirurgische Klinik, Germany. A 4-year-old boy broke through the ice of a frozen lake and drowned. The boy was extricated from the icy water by a rescue helicopter that was dispatched shortly after the incident. Although the boy was severely hypothermic, no cardiac response could be induced with field resuscitation measures, including intubation, ventilation, suction, and cardiopulmonary resuscitation. On admission, the primary findings included fixed, nonreacting pupils and asystole. The first core temperature measured was 19.8 degrees C (67.6 degrees F). During active, external warming, the first ventricular beats were observed 20 minutes after admission, and changed 10 minutes later to a sinus rhythm. Continuous monitoring included repeated arterial blood gas and electrolyte tests; prophylaxis for cerebral edema was performed with hyperventilation and administration of sodium Brevimytal and dexamethasone. Seventy minutes after admission, hemodynamics stabilized and the boy was transferred to the pediatric intensive care unit (PICU), where active external warming was continued to raise the core temperature at a rate of 1 degree C/hour. Adult respiratory distress syndrome developed, and the boy had to be ventilated in the PICU for 10 days. He was discharged home after another two weeks. He recovered fully. The rapid heat loss with the induction of severe hypothermia (< 20 degrees C; 68 degrees F) was the main reason for survival in this rare event of a patient with cardiac arrest lasting 88 minutes after accidental hypothermia. PMID: 10155409 [PubMed - indexed for MEDLINE]
Szpilman2002	**Szpilman D, Orlowski J, Brewster C, Mackie I; In-water resuscitation - is it worthwhile? World Congress on Drowning, Amsterdam 2002, Book of Abstracts, pg 60.** ABSTRACT Purpose: Whenever an unconscious, apparently non-breathing victim is found in water, the rescuer is confronted with a dilemma. Should in-water resuscitation be attempted or should the victim first be brought to shore? Hypoxia caused by submersion results first in cessation of breathing. This leads to cardiac arrest within a variable but short time interval if not corrected. Our objective was to test the value of attempting resuscitation in-water versus delaying resuscitation attempts until rescue to shore is accomplished. Method: We retrospectively selected(January-1995 to December-2000) all in-water cases found unconscious(no-movement) by lifeguards, referred to DRC. We excluded those in which no resuscitation attempt was made and with missing data and divided the rest into two groups: no-in-water-resuscitation(NWR) and in-water-resuscitation(WR). Each group was analyzed using "Mantel-Haenszel' method and considered significant if P<0.05(CI-95%). Results: From 86 cases, 46 were selected. Of these, 27 were NWR(58.7%) and 19 were WR(41.3%). Average age was 21.3(SD+/-13.7) and males were more frequent(87%). There were 10(27.8%) fresh and 36(78.3%) seawater cases. The NWR and WR groups presented no significant difference in gender, time-of-attendance, age, and type and depth of water (P>0.05). There was a significant difference(P<0.05) when considering, mean time of cardiopulmonary arrest(NWR-21.6min/WR-8.7min) and cardiopulmonary resuscitation (NWR-39.3/WR-15.53min). The WR group had in-water circulation check in 26.3% of cases. They were rescued by more than 2 lifeguards in 58% of cases and were assisted by equipment in 79% of cases(58%using swim fins). They also needed no other procedures in 47.4% of cases and ventilation only in 10.5% of cases on-shore. Vomiting was present in 30.4% of cases, mainly in NWR group(64.3%). From pre-hospital attendance(NWR/WR), 39.1% died(NWR-17/WR-1), 52.2% were referred to hospital(NWR-8/WR-16) and 8.7% were released home(NWR-2/WR-2). Final mortality was: NWR-85.2%(23) and WR-15.8% (3)(P<0.00001,X2=21.38,RR=4.42). Final outcome: POOR(death or neurological sequelae) vs. GOOD(survival without sequelae) was NWR-25-to-2 and WR-9-to-10 (P<0.001,X2=11.57,RR=4.41).Conclusions: In-water resuscitation provides the victim a 4.4 times better chance of survival without sequelae. Lifeguards should be fully trained in this difficult procedure though it is not always possible. They should check ventilation of victims being rescued and, whenever possible and if indicated, attempt to provide mouth-to-mouth while still in-water.
Szpilman&Brewster2002#	**Szpilman D, Brewster C, Cruz-Filho FES, Aquatic Cervical Spine Injury – How often do we have to worry? World Congress on Drowning, Amsterdam 2002, oral presentation.** **ABSTRACT** Purpose: During in-water shoreline rescue, lifeguards usually need to decide if it's important to proceed with cervical spine (CS) immobilization or not. This could mean the difference between a normal or a severe, lifelong disability. Immobilization of CS is clearly indicated in a conscious victim who is either witnessed to be or highly suspected of trauma, or is in trouble in shallow water for unknown reasons. On the other hand, for unconscious victims the time

	spent on immobilizing the CS could lead to cardiopulmonary deterioration and even death. Some factors need to be considered in this decision. One of them is how often CSI occurs among beach-line water incidents ? Method: We retrospectively analyzed all rescues and medical emergencies at the Drowning Resuscitation Center(DRC), dispatched between 1991 and 2000 which were suspected or confirmed to have CSI by clinical(pre-hospital) or radiological methods(hospital). Results: There were 46,060 rescues made by lifeguards. From these, 930(2%) were referred to the DRC. The remaining 45,130 cases were released directly from the beach with no clinical complaints. From the total of 930 immersion/submersion incidents, 13 cases had associated trauma with head or cervical spine injury. Two cases had missing data. The other 11 cases had a mean age of 23,9(SD+/-9,45) and nine were males. From these suspected CSI cases(0,02% of rescues), only 4 had confirmed CSI(0,009%). All were released home (2-normal, 1-light disability and 1-tetraplegic). Conclusions: Rio de Janeiro beaches have a very low incidence(0,009%) of CSI among bathers rescued by lifeguards. Other water locations may have different rates depending on a wide variety of elements which require individual evaluation. On Rio de Janeiro beaches we recommend that lifeguards carry out the CS immobilization only in conscious cases where trauma is evident. All unconscious cases should first have their breathing checked and only if they are alive and CSI is suspected should the lifeguard worry about immobilizing it.

Wulf H1988	**INTERESTING BUT CASE REPORT AND IN GERMANY** **Wulf H., [Successful resuscitation in near-drowning with reference to special complications in recovery from great depth] Anasth Intensivther Notfallmed. 1988** Feb;23(1):36-8. German. PMID: 3364631 [PubMed - indexed for MEDLINE] [Article in German] Zentrale Abteilung fur Anasthesiologie des Klinikums der Christian-Albrechts-Universitat Kiel. A case of near drowning of a 37-year-old female in cold sea water is reported. She was rescued after 30 minutes from a depth of 11 meters and resuscitation was successful. The case is to demonstrate that successful resuscitation is possible in adults even after such a long period of cold water immersion adequate rescue and treatment assumed. But if fast decompression during rescue from great depths occurs, one has to be aware of typical complications (air embolism, barotrauma). PMID: 3364631 [PubMed - indexed for MEDLINE]
Szpilman&Idris2002#	**Szpilman D, Idris A & Cruz-Filho FES; Position of Drowning Resuscitation victim on Sloping Beaches; World Congress on Drowning, Amsterdam 2002, Book of Abstracts, pg 168.** ABSTRACT Purpose: For centuries, people have thought that water should be drained from the lungs of a drowning victim. In the 18th century, this was the main reason for setting the victim's head down(HD) on sloping beaches. This position was used by the Rio de Janeiro-Lifeguard-Service (Brazil) until 1992. However, such risks as regurgitation and increased difficulty to ventilate a patient in the HD position were not considered. Based on these considerations, lifeguards started to place the head at the same level as the trunk (HT). The objective of this study was to determine which position is best for initial resuscitation on sloping beaches. Method: We conducted a prospective study from January 1993 to December 2000, comparing cases of HD with HT position, randomly chosen by lifeguards. All rescues were evaluated, but only patients with cardiopulmonary arrest(CPA) were included. We excluded all those in which no attempt of resuscitation was made and those with missing data. Each group was analyzed considering, sex, age, type of water, time of attendance, vomiting, estimated time-of-CPA and cardiopulmonary resuscitation(CPR), and mortality. Using 'Mantel-Haenszel' method, X2, relative risk and the P value were evaluated. P<0.05(95% confidence limit) was considered statistically significant. Results: From 126 cases, 84 were selected. The average age was 25.7(SD+/-12.6), and males appeared 9 times more often. There were 11(13.1%) fresh and 73(86.9%) seawater cases. From pre-hospital attendance, 66.7% died, 29.8% were referred to the hospital and 3.5% were released home. At the final follow up, there were 73(87%) deaths. The two groups, HD (N=39)(46%) and HT (N=45)(64%) had no significant differences in, sex, time-of-attendance, age, mean time-of-CPA (18/21min), mean time of CPR(37/40 min), and sea water drowning(38/35)(P>0.05). Regurgitation was present in 87% of HD compared with 16% of HT patients (P<0.00001,X2=42.39,RR=5.60(2.81-11.19)). Final mortality was: HD-95%(37) and HT-80%(36)(P<0.05,X2=4.01,RR=1.19). Conclusions: Regurgitation is much more likely to occur when the HD position is used and the risks of aspiration and impaired ventilation and oxygenation are also increased. On sloping beaches drowning victims should be placed parallel to the waterline. This position decreases the incidence of vomiting and mortality.
Szpilman1996#	Szpilman – 1996 - personal observation – expert opinion
Conn AW1995	**NOT RELATED** **Conn AW, Miyasaka K, Katayama M, Fujita M, Orima H, Barker G, Bohn D. A canine study of cold water drowning in fresh versus salt water.Crit Care Med. 1995 Dec;23(12):2029-37. PMID: 7497726 [PubMed - indexed for MEDLINE]** Department of Anesthesia, National Children's Medical Research Centre, Tokyo, Japan. OBJECTIVE: To compare the pathophysiologic changes occurring during drowning in cold fresh water and cold salt water with reference to viability. DESIGN: Randomized, prospective, controlled submersion experiments in two contrasting cold liquids. SETTING: A laboratory at a large university-affiliated medical institution. SUBJECTS: Thirteen healthy, anesthetized mongrel dogs. Three dogs served as controls and were immersed but not submerged. The remainder were submerged in cold fresh water or cold salt water (4 degrees C). INTERVENTIONS: Catheters were placed in the femoral artery, right carotid artery and right internal jugular vein. Electrocardiogram, pneumogram, and rectal temperatures were measured continuously during submersion/immersion. MEASUREMENTS AND MAIN RESULTS: Cold water submersion with drowning produced a large initial decrease in carotid artery temperature (approximately 7.5 degrees C in the first 2 mins) compared with a minor decrease (approximately 0.8 degrees C with immersion). No significant differences were noted in the rate of decrease of temperature between drowning in fresh water and salt water. During cold fresh water drowning, aspiration produced gross hemodilution with an

	average increase in body weight of 16.5%. Hematocrit values, serum sodium concentrations, and osmolality decreased while serum potassium concentrations, catecholamines, and free hemoglobin increased. All measured biochemical data (except PaO2) remained at viable levels. By contrast, during cold salt water drowning, average body weight increased by only 6%, with hemoconcentration and a shrinkage of vascular volume. Hematocrit and hemoglobin values increased by 30%, but initial plasma free hemoglobin values remained unchanged. Serum sodium concentrations, osmolality, and potassium concentrations increased rapidly to critical levels. CONCLUSIONS: On submersion in cold water, all of the experimental animals developed tachypnea immediately, followed by aspiration with predictable effects. The biochemical and pathophysiologic changes in cold water drowning approximated those changes reported for warm water drowning for both fresh and salt water with one exception and continued aspiration of cold water produced extremely rapid core cooling as long as the circulation remained intact. This process of acute submersion hypothermia may protect the brain temporarily from lethal damage, as reported in cases of cold fresh water drowning. Concentrations of circulating catecholamines increased exponentially in both groups of test animals. Clinically, their acute effects on the circulation, compounded by significant hypothermia and extreme anoxia, must hamper the detection of residual circulation at rescue and may play a role in sudden death from cold water in the absence of drowning. PMID: 7497726 [PubMed - indexed for MEDLINE]

*Type the citation marker in the first field and then paste the full citation into the second field. You can copy the full citation from EndNote by selecting the citation, then copying the FORMATTED citation using the short cut, Ctrl-K. After you copy the citation, go back to this document and position the cursor in the field, then paste the citation into the document (use Ctrl-V). For each new citation press Enter to move down to start a new paragraph.