Some Medical Aspects of Safety at Sea:

The Tools

The Killers

The Commonplace

Ken Fabert, MD

kenfabert@gmail.com

February 29, 2020

Why Safety Matters!

I. You can't know it all! How to approach medical problems.

II. Two things that CAN kill you on a sailboat: The boom and the (cold) brine.

III. Two problems you WILL encounter: seasickness and heat/dehydration.

Medical Basics. A few fundamental principles:

- it's not as complicated as you think
- you know a lot more than you think
- in an emergency, take a deep breath and you will be able to think
- most crises can be prevented

What you *Really* need to know medically:

- ✓ vital signs
- ✓ clinical thinking
- ✓ common sense
- ✓ effective use of references and support

Vital Signs Are Just that:

VITAL

The Four Classic Vital Signs:

- pulse (60-100 beats per minute)
- respirations (16-24 breaths per minute)
- blood pressure (110-140 systolic--the bottom # doesn't concern us here).
- temperature (degrees C or F)

7

8

In Addition: mental status
The "5th vital sign"

- orientation to person, place,& time.

Glasgow Coma Scale (GCS)

These 5 parameters will help you to decide if there is a significant medical problem or not.

If all 5 of the vital signs are normal after repeat assessments over time, the odds are great that a medical emergency does not exist.

There may still be a medical problem to deal with, but in all likelihood, there is no reason to activate the EPIRB.....

Organizing Your Thoughts: A "SOAP" note.

- **S**ubjective What is told by the patient or observers.
- **O**bjective What you can ascertain by observation.
- **A**ssessment What you think is going on.
- **P**lan What you plan to do.

Clinical Thinking:

- Remember: A medical situation is dynamic and always requires ongoing reassessment, reassessment, reassessment.
- Keep a running log of findings and changes.
- If all else fails: trust your gut. You know a lot more than you think.....

Two things that *can* kill you on a sailboat:

1. **Head injury** (boom contact, fall)
2. **Going overboard** (with subsequent cold water immersion).

Head Injury!

15

16

A Pivotal Symptom: Loss of Consciousness

- no LOC or disorientation, probably no serious head injury.
- LOC less than 1 minute with progressive improvement--probable concussion.
- LOC longer than several minutes--probable serious brain injury, usually associated with other findings.

Signs of Serious Head Injury

- headache
- altered mental status → loss of consciousness
- vomiting
- motor or vision deficits
- unequal pupils
- convulsions
- abnormal posturing (flexion, extension).

Glasgow coma scale

Eye opening	
Spontaneous	4
Response to verbal command	3
Response to pain	2
No eye opening	1
Best verbal response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1
Best motor response	
Obeys commands	6
Localizing response to pain	5
Withdrawal response to pain	4
Flexion to pain	3
Extension to pain	2
No motor response	1

The GCS is scored between 3 and 15, 3 being the worst, and 15 the best. It is composed of three parameters: best eye response (E), best verbal response (V), and best motor response (M). The components of the GCS should be recorded individually; for example, E2V3M4 results in a GCS score of 9. A score of 13 or higher correlates with mild brain injury; a score of 9 to 12 correlates with moderate injury; and a score of 8 or less represents severe brain injury.

GCS:

15-13 mild brain injury
12-9 moderate brain injury
<8 severe brain injury

19

NOTE:

Bleeding may not correlate to the severity of injury. While a scalp laceration will need to have pressure applied and the bleeding controlled, *far more important is brain function.* If the injured sailor is oriented (person,place,time) and remains that way, there is probably no significant brain injury.

20

21

Treatment of Head Injury at Sea

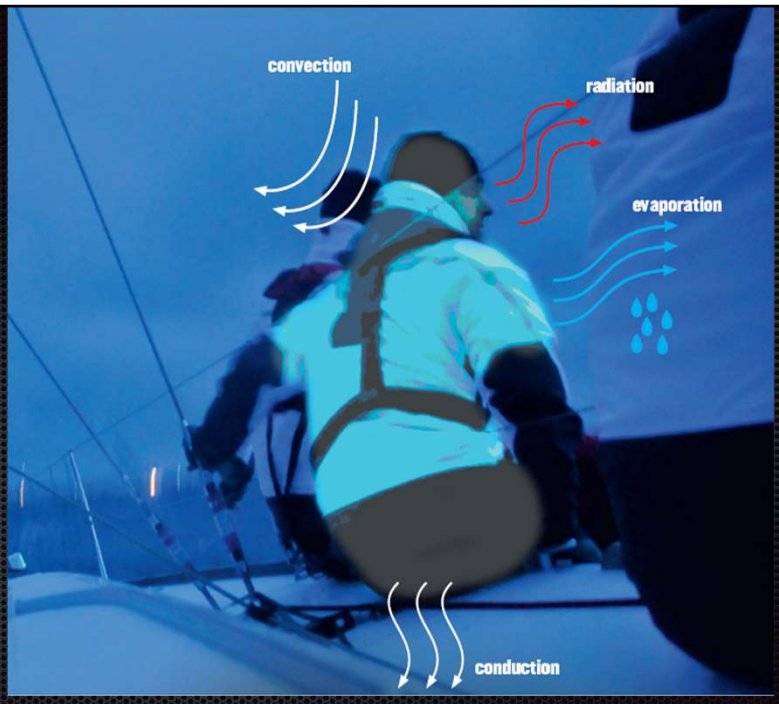
- assess and protect cervical spine (neck).
- immobilize neck if unsure. Monitor for pain (fractures hurt!).
- protect airway
- repeatedly assess neurological function and status.(orientation, Glasgow Coma Scale).
- control scalp bleeding with pressure, then closure.
- elevate head 30 degrees.
- initiate rescue plan if neurological function deteriorates.

22

Killer #2:
Cold Water Immersion

Mechanisms of heat loss:

- conduction
- convection
- radiation
- evaporation



Courtesy of Dr. Spike Biggs, Offshore Sailing Support,Ltd and Yachting World Magazine (UK)

4 Phases of Cold Water Immersion

The body's progression from initial Cold Shock Response through the onset of Hypothermia.

Adapted from slides by Dr. Gordon Giesbrecht, University of Manitoba

Question:

If you fall into very cold water, with layered clothing on, how long do you think it will take to become hypothermic?

Answer:

At 6 degrees C (43 F), at least ***30-60 minutes***.

Even at this temperature, if a drowning occurs in the first 15 minutes, it is NOT due to hypothermia.

4 Phases of Cold Water Immersion

1. **Cold Shock** (~ 1 min)

2. **Cold Incapacitation** (5-15 min)

3. **Hypothermia** (> 30 min)

4. **Circum-rescue Collapse**

= personal floatation device

1 – 10 – 1 Principle

Refers to first three phases of cold water immersion

after Dr. Gordon Giesbrecht

Lifesaving Message
1 Minute -10 Minutes - 1 Hour

If you fall into cold water you have:

1 MINUTE to get your breathing under control

10 MINUTES of meaningful movement, and

1 HOUR before you become unconscious due to hypothermia

1 - 10 - 1 Principle

Regarding the Cold Shock Response…

- DO NOT PANIC
- If possible,try to keep your head from being submerged.
- Focus on surviving the first minute by getting control of your breathing.

33

1 - 10 - 1 Principle

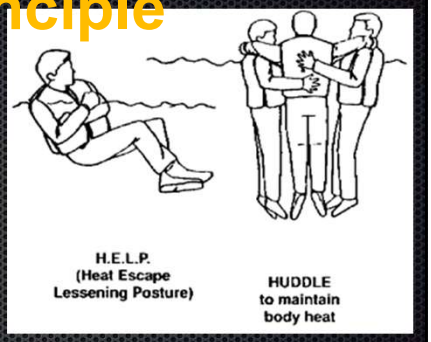
Regarding Cold Incapacitation…

- You have 10 minutes of meaningful movement for self rescue.
- Once you start becoming weaker, prepare to wait for rescue.

34

1 – 10 – 1 Principle

Regarding
Hypothermia
Consider the following:



- *Delay the Onset of Hypothermia:*
- HELP position
- Groups of individuals (HUDDLE)
- Exit water as soon as possible
- If exit is not possible, get as far out of the water as possible

35

FACT:

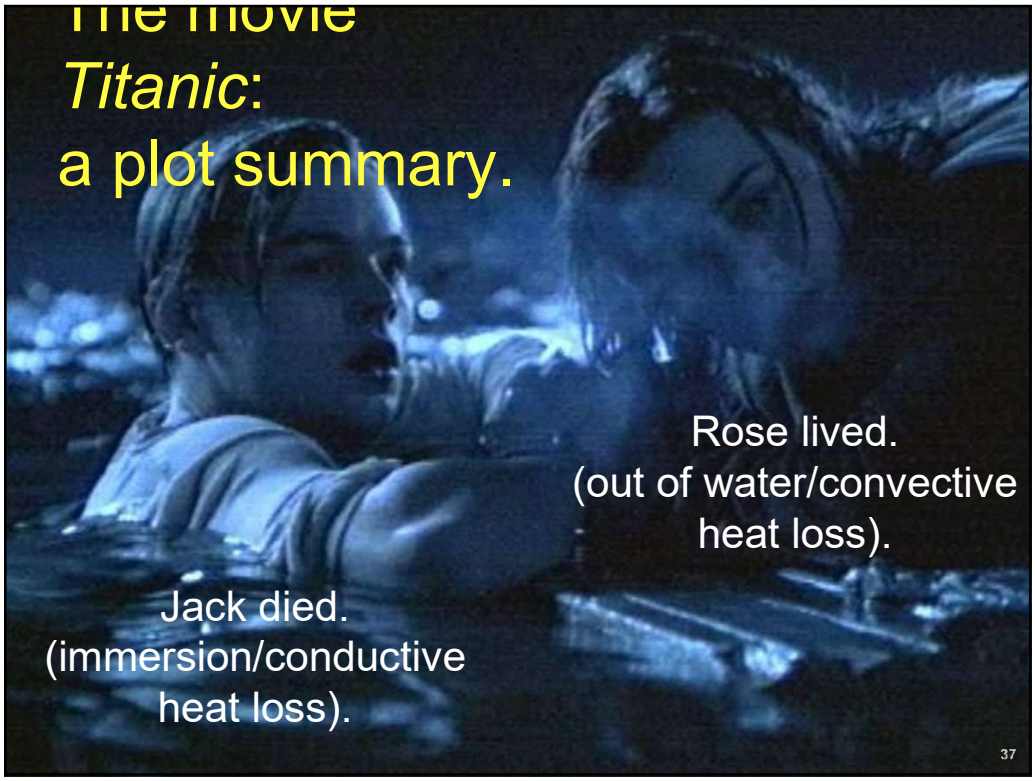
Heat loss with cold water immersion is almost exclusively through conduction.

FACT:

Conduction heat loss in water is 25 X greater than convection heat loss through air.

This is why you are always better off OUT of the water than in.

36



Survival in Cold Water

- **PFD**
- Behavior:

Activity can increase the rate of heat loss.

HELP / Group HUDDLE

- Get out of water on to floatation
- Clothing
- Wet suits
- Extended wear “paddling” dry suits
- Low activity/short duration wear dry suits
- Survival suits / Rescue personnel

38

39

Swim??

a) Normal conditions
b) Cold decreases surface blood flow (heat loss)
c) Exercise increases surface blood flow (heat loss)

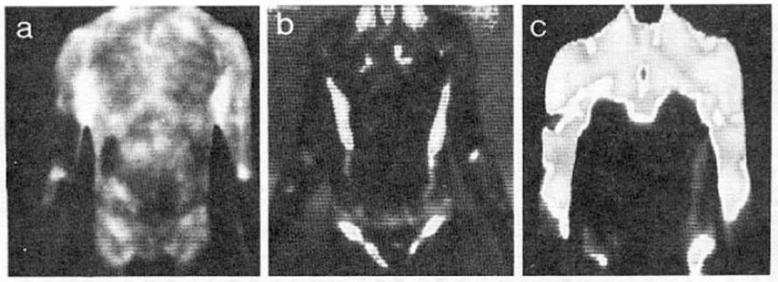


Figure 4. Thermograms indicating relative skin temperatures (and therefore relative heat loss): (a) before immersion in 45.5°F (7.5°C) water, (b) after holding still in the water for fifteen minutes, and (c) after swimming for fifteen minutes. Lighter areas are warmer.

40

Priorities and Techniques for Safe Rescue and Treatment:

- ☑ Rescue
- ☑ Rewarm

41

☑ Rescue (Extraction)

Care of the Victim:

- Be Gentle!
- Keep Them Horizontal… to prevent blood pooling in the legs causing a dangerous drop in blood pressure (“circum-rescue collapse”)
- Protect Them from Environment
- Dry / Insulate / Vapor Barrier

42

Rewarming

Main Priorities:

- Arrest fall in core temperature
- Maintain cardiovascular stability
- Establish steady safe warming

Symptoms of Hypothermia

35C (95F)	**Shivering** with normal mental status
32-35 (90-95)	Increasing physical impairment
	Increasing mental impairment
<32C (90F)	**SHIVERING STOPS**
<30C (86F)	Loss of Consciousness
<28C (82F)	Rigidity. Vital signs undetectable
<25C (77F)	Ventricular Fibrillation/ Cardiac Arrest

Shivering: A Pivotal Symptom

- shivering creates heat (thermogenesis)
- it begins as the core temperature drops from normal (37C) and ceases around 32 degrees C (90 F).
- if the victim stops shivering and is increasingly confused, they are getting COLDER.
- if the victim stops shivering and is oriented, they have probably warmed up!

Other signs of evolving hypothermia:

Deterioration of Mental status ("the umbles"):

- grumbles
- fumbles
- mumbles
- tumbles

Spontaneous Rewarming (passive external rewarming)

- remove wet clothing!
- insulation (fleece, sleeping bag, blankets, etc.)
- vapor barrier (space blanket, sails, plastic sheet)
- fluids and carbs (sugary drinks--doesn't necessarily have to be warm, although hot chocolate is great!)

47

Active External Rewarming

- warm air (diesel heater, hair dryer--but be careful!)
- warm moist air (steam from boiling water)
- hot water bottles (at armpits, groin, neck, chest)
- warm body in contact (eg. in a sleeping bag)

48

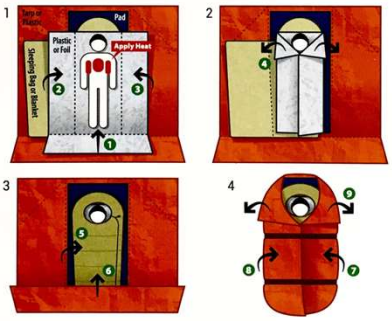
CARE FOR COLD PATIENT

SUGGESTED SUPPLIES FOR SEARCH/RESPONSE TEAMS IN COLD ENVIRONMENTS:

- 1 - Tarp or plastic sheet for vapour barrier outside sleeping bag
- 1 - Insulated ground pad
- 1 - Hooded sleeping bag (or equivalent)
- 1 - Plastic or foil sheet (2 x 3 m) for vapour barrier placed inside sleeping bag
- 1 - Source of heat ***for each team member*** *(e.g., chemical heating pads, or warm water in a bottle or hydration bladder),* or ***each team*** *(e.g., charcoal heater, chemical / electrical heating blanket, or military style Hypothermia Prevention and Management Kit [HPMK])*

INSTRUCTIONS FOR HYPOTHERMIA WRAP "The Burrito"

1. *Dry or damp clothing:* *Leave clothing on*
2. *Very wet clothing:*
   - ***IF*** Shelter / Transport is ***less than*** 30 minutes away, ***THEN*** *Wrap immediately*
   - ***IF*** Shelter / Transport is ***more than*** 30 minutes away, ***THEN*** *Protect patient from environment, remove wet clothing and wrap*



Sources: BICOrescue.com; Zafren, Giesbrecht, Danzl et al. *Wilderness Environ Med.* 2014, 25:S66-85.

Rewarming issues:

- can take *hours* (0.5-2 degrees Celcius/ hour)
- try to warm the core preferentially to minimize “afterdrop”.
- symptomatic improvement can fluctuate due to afterdrop.

CPR: for severe hypothermia

DANGER!

Chest compressions can cause fatal ventricular fibrillation in a cold but functioning heart.

CPR

NOTE: This is not a temporal emergency!

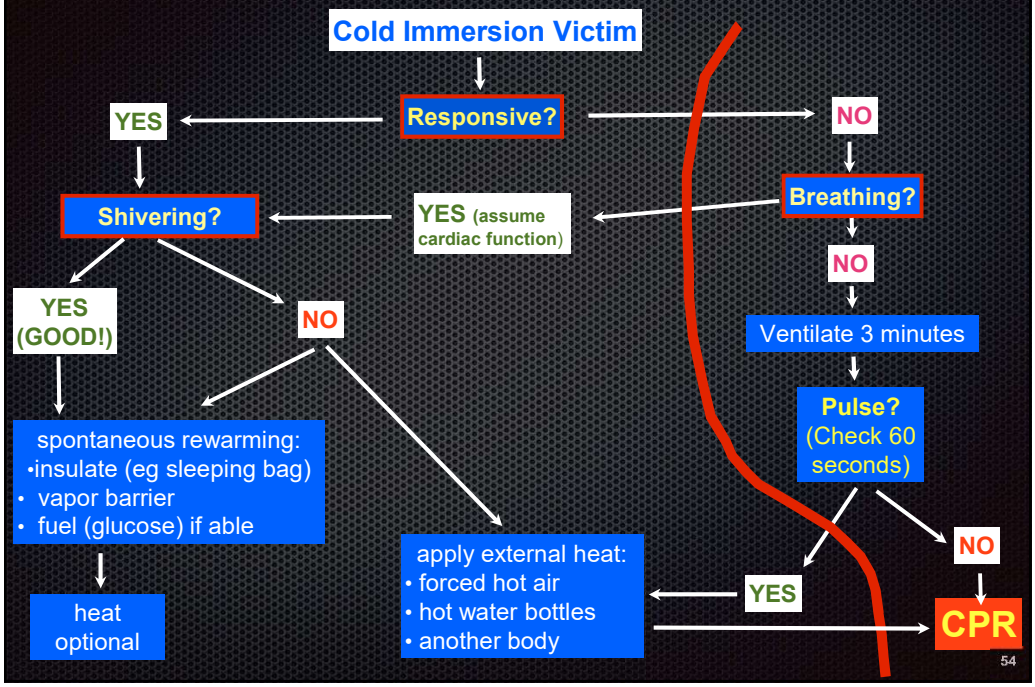
- It took time to become hypothermic
- Delaying CPR a few minutes will not compromise patient
- Rushing to start CPR may be fatal if victim is not already in full arrest

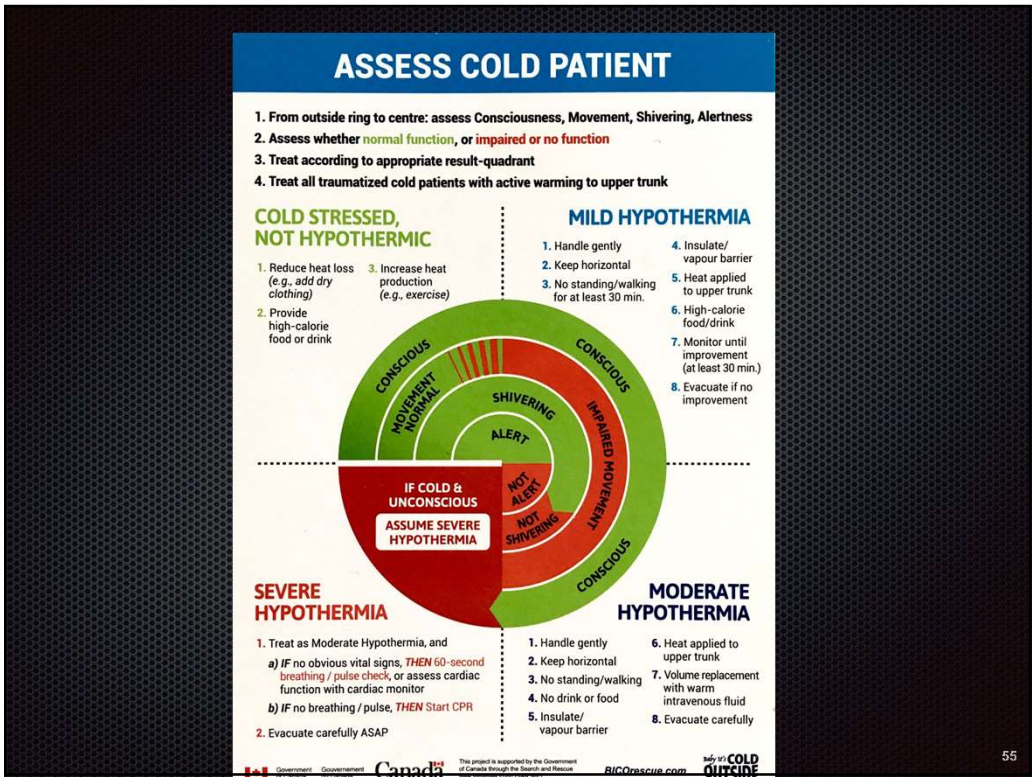
CPR

- Make an extended attempt to determine if a pulse exists.
- Look, listen and feel (60 seconds by the clock).
- Ventilate (3 min) to increase oxygenation of heart.
- Check for pulse again (60 sec).

Only then should you make a final judgment about cardiac activity and whether to start CPR.

Hypothermia Field Treatment Algorithm





55

When the victim is pulseless and CPR has been undertaken, when do you stop?

In the hospital setting, where internal warming methods are available, the watchword is “nobody is dead until they’re warm and dead”.

At sea, hours or days from rescue, this is not a reasonable standard, especially if the boat and crew are placed at risk.

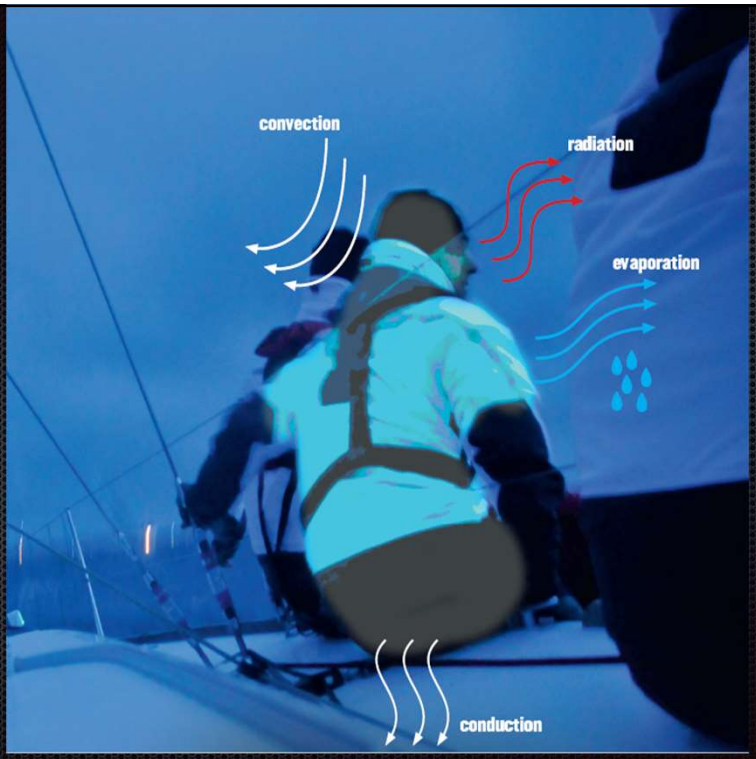
Prevention is by far the best approach.

56

Non-immersion (convection) hypothermia

scenario:

A crew member in the cockpit has cotton undergarments (jeans, t-shirt) damp from recent exertion. It is now raining and the wind has picked up. Foul weather gear has been donned. It is late in the day and ambient temperature is falling. He begins shivering.



This is mild hypothermia

Intervention:

- get out of the elements
- remove wet clothing
- don warm insulating layers (fleece,etc)
- drink sugary, warm drinks

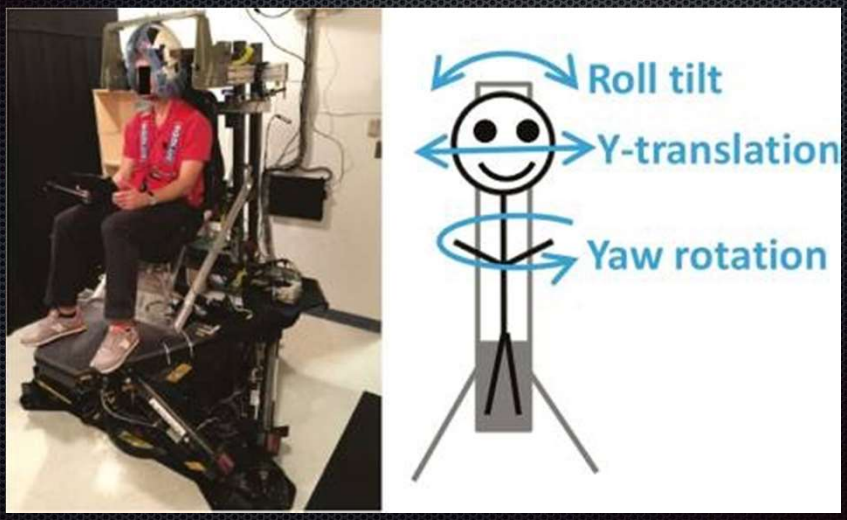
Coast Guard, CBP rescue 2 near Bellingham, Wash.
140628-G-ZZ999-001
Video by: U.S. Customs and Border Protection
Edited by: Petty Officer 2nd Class George Degener
Created: June 28, 2014
Released: July 1, 2014
Produced by: U.S. Customs and Border Protection
Released by: Coast Guard 13th District
Run time: 2:48

Two Common Problems you ***will*** encounter:

1. seasickness

2. sun, heat, and dehydration

Mal de Mer


Roll tilt
Y-translation
Yaw rotation


pfd!
harness!
(but attached to the
lifeline?)
leeward with low
center of gravity
36

Symptoms:

- yawning, sweating and salivation
- fatigue
- inability to concentrate on tasks
- apathy
- clumsiness
- vomiting

Susceptibility varies widely

- it is a common problem (48% of space shuttle astronauts experience it).
- people with a history of migraine more suseptible
- most people will develop motion sickness under extreme conditions
- although it can be worsened by anxiety, it is NOT primarily a psychological phenomenon.
- behavioral maneuvers can help

worst case scenarios:

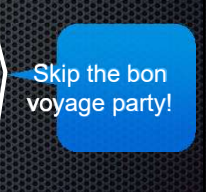
- protracted vomiting with dehydration and metabolic disturbances.
- inability of sick crewmember to take prescription meds for other medical problems.
- sedation and clumsiness due to seasickness and/or anti-seasickness meds resulting in trauma or MOB.

physiology:

- vestibular/sensory conflict in brain resulting in vertigo-like response.
- vestibular apparatus responds to conditioning after exposure (“sea legs”).
- pre-exposure conditioning can also reduce response.

Non-drug preventatives:

- avoid alcohol several days before the voyage
- stop smoking (good advice anytime!)
- get good sleep before departure
- push fluids prior to departure (“PRE-hydrate”)
- ginger (ginger beer, candies ginger, ginger extract applied to skin (!), etc)
- pressure or electric wrist bands?? No studies confirming benefit but if they work for you.....



Interventions underway:

- look at the horizon (for prolonged periods of time if needed)
- limit time below
- take the helm
- stay busy
- avoid strong odors (cooking, diesel fuel)
- limit reading or chartwork
- change point of sail (close-hauled often most provocative)

Drug Treatment: A few Thoughts:

- starting preventative treatment hours before the voyage appears to be advantageous
- belief in the treatment may be part of the equation (response rates to placebos in randomized controlled trials can be up to 30%) .

Drugs:

1. OTC antihistamines

--- meclizine (Bonine, Antivert)

--- dimenhydrinate (Dramamine, Gravol,etc.)

--- diphenhydramine (Benadryl)

--- chlorpheniramine (various)

--- cinnarazine (Stugeron)--available in UK, EU,Mexico but not US, Canada, NZ, Australia.

Has widespread following in many circles.

All are safe, and can be somewhat to moderately effective as a preventative. Not useful to treat vomiting.

All are sedating.

Drugs: Prescription antihistamine/antiemetics:

promethazine (Phenergan, Avomine,etc).

Available in tablets, suppositories. My favorite. The USN, USCG, Royal Navy (UK), NASA and most cruise lines agree.

prevention: 12.5 to 25 mg tabs every 6 hours

treatment: 25mg suppository every 6 hours

problems: sedation, worsens glaucoma and prostate obstruction.

Often given with caffeine or pseudoephedrine to counter

Drugs: Prescription antihistamine/antiemetics: (cont).

prochlorperazine (Compazine, Stematil,etc)

Similar dosing and side effect profile to promethazine, but it is in a different drug class: originally an antipsychotic.

Some sailing writers assert superiority but evidence is anecdotal.

dose: 5-10 mg orally every 6-8 hours or 25mg rectally every 12 hours.

anti-cholinergic preventatives:

scopolamine (Transderm Scop, etc.),

scopolamine (also known as hyoscine) tabs

tablets and transdermal patch. To be initated 8-12 hours before motion exposure.

side effects: very dry mouth, blurred vision, prostate obstruction, confusion, long half-life (takes time to clear the body if unacceptable side effects occur.)

For those with a history of migraine:

New evidence indicates that the “triptan” class of drugs like:

sumatriptan (Imitrex, et al)-- oral or injectable

rizatriptan (Maxalt,etc)--oral or sublingual

may be effective in treating seasickness.

Treatment: Putting it all together.

If the sailor is actively vomiting and incapacitated, treat aggressively (sooner than later) with anti-emetic suppositories, relieve them of all duties and get them horizontal. Exploit the sedating properties of the anti-emetics and in a few hours you may have a rejuvinated crewmember on your team....

A parting thought:

Remember: Seasickness is not a sign of constitutional or psychological weakness. It is a neurological response to conflicting sensory inputs. Have some compassion for your seasick crewmember, stay flexible, and be thankful it's not you!

Sun and Heat Exposure

79

Protection = Prevention

80

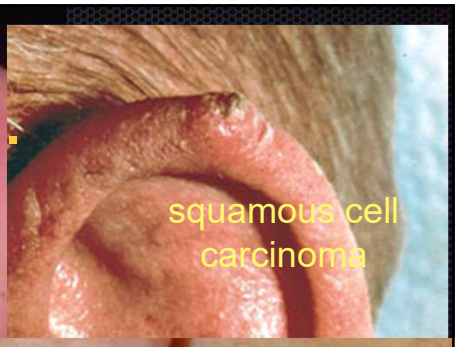
More sun protection:

- light-weight, tight-weave garments--usually synthetics. Cotton often VERY UV permeable
- dark colors preferable to light (less UV transmission)
- new standard is UPF (not SPF)
- may be better than applying chemicals to the skin
- long sleeve shirts, hats, long pants

81

Prevention of.....

sunburn

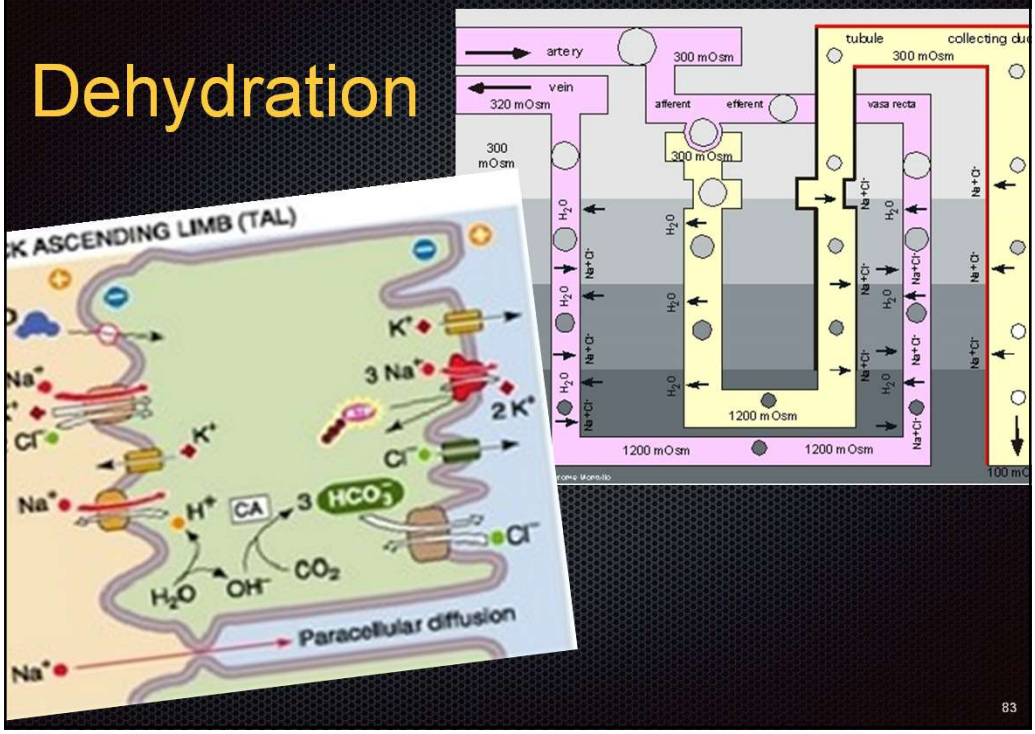


squamous cell carcinoma

melanoma

82

Dehydration



Fluids that *promote* dehydration:

How to tell how well hydrated you are:

- history of fluid intake ---a few cups of coffee or tea off and on are NOT enough.
- thirst ---not always reliable, but if you wake up thirsty, that's a sure sign you're dry.
- urine color ---reflects dilution: dark = concentrated and need to drink more. Watery ("straw colored") is dilute=good.
- urine output ---trips to the head are good...be careful whizzing overboard! (women,too!)

85

86

Rehydration:

- probable scenario is seasickness--treat as discussed
- IVs not realistic (high skill level, moving boat, etc)
- You need water, salt, sugar. WHO rehydration salts, electrolyte drinks OK.
- frequent small sips--spoon it in if need be.

Adventure Medical Kits Oral Rehydration Salts
1. $9.00

(3)
Item # 407272
REI Members get back an estimated **10% on this item** as part of their annual member refund.

4072720016 $9.00
1Quantity
add to cart

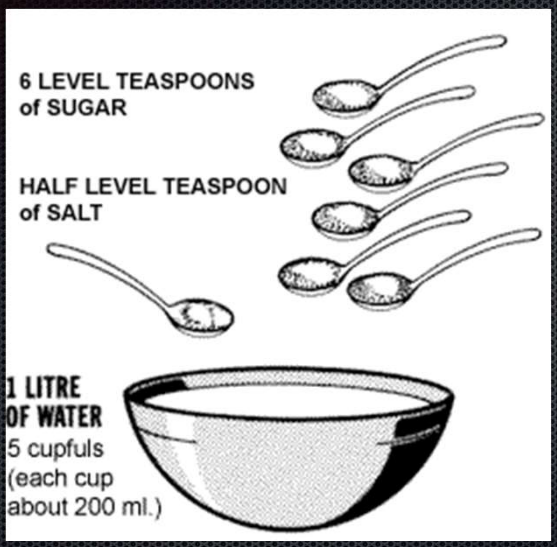
1. add to wish list

3. 100% Satisfaction Guaranteed
4. Gear and Advice You Can Trust

This item may be available in your local REI store.
find in store

Free U.S. standard shipping through February 20.
No minimum purchase! Learn more

Or, a bit cheaper than $9.00 per liter....



The "Simple Solution" - Home made Oral Rehydration Salts (ORS) Recipe

Preparing 1 (one) Litre solution using Salt, Sugar and Water at Home

Mix an oral rehydration solution using the following recipe.

Ingredients:

- **Six (6) level teaspoons of Sugar**
- **Half (1/2) level teaspoon of Salt**
- **One Litre of clean drinking or boiled water and then cooled -** 5 cupfuls (each cup about 200 ml.)

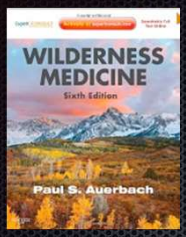
Preparation Method:

- Stir the mixture till the salt and sugar dissolve.

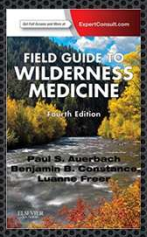
Add flavoring to taste.

Or improvise:
Remember: water, sugar, salt!

Have a reference book (or two) on board. Become familiar with its layout for quick access to information in a crunch. Some suggestions:



Wilderness Medicine, 6th Edition
Pual Auerbach, MD
Mosby, 2012
The "Bible". Encyclopedic, detailed, definitive professional reference, clear enough for intelligent lay use. Even at many Kgs and $167.00, it's worth it's weight.



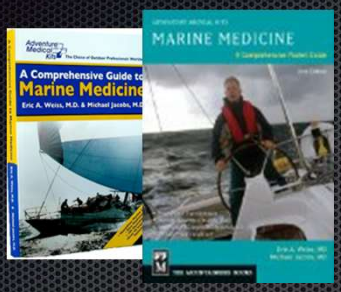
Field Guide to Wilderness Medicine
Paul Auerbach, MD
Mosby, 2011
A detailed , outline-format distillation of the "Bible"--more affordable at $34.08

Wildeness Medicine,6th Edition
Tod Schimelpfenig,et al
Stackpole Press, 2016
A wealth of field advice.

Wilderness First Aid, 3rd Edition
Tod Schimelpfenig
Stackpole Press, 2000
Good companion to NOLS Wilderness Medicine. Great summaries for various problems.

Medicine for Mountaineers
Wilkerson,et al,
The Mountaineers, 2010
Another encyclopedic survey of the topic.

Specific Marine Medicine Books:



Marine Medicine
Eric Weiss, Michael Jacobs
Mountaineers, 2012
Small format, portable, marine-specific reference. Not as much detail as the references, but lots of tips.

Doctor on Board
Dr. Jurgen Hauert, University of Hamburg
Sheridan House 2010:
Lay-oriented, sailing specific with lots of easy-to-understand photos. Some errors in medication discussion. Adjunct to the reference texts. No German necessary.

Whatever you do:

Get medical evacuation insurance!!!

It's relatively inexpensive and it can save you a bundle if you need to be rescued or transported to an appropriate care facility.

But the best insurance policy of all?


er 100 Ton
V - Operator of Uninspected Passenger Vessels
s of the Road
HEARTSTART
DEFIBRILLATOR
PHILIPS
PHILIPS OnSite AED Package Options
A1

95

96

Slide 95

A1

??????
Author, 2/28/2020

kenfabert@gmail.com

topics for small group sessions tomorrow:

- crew responsibilities and creating a culture of safety and care.
- real-world scenarios: *Apply what you now know!*
- the medical kit.
- thoughts about AEDs (automated external defibrillators) and other advanced medical technologies on board.