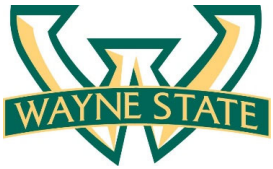
Emergency Medicine: On the Water Activities

Robert D. Welch, MD, MS, FACEP
Department of Emergency Medicine
Wayne State University School of Medicine
Detroit Receiving Hospital
Grosse Pointe Sail Club Member

Marc Rosenthal. DO, PhD, FACEP, FAEMS
Department of Emergency Medicine
Wayne State University School of Medicine
Sinai-Grace Hospital
BYC and GPSC



Objectives

- Describe the epidemiology of common injuries that may occur while sailing (cruising and racing)
- Review selected first-aid recommendations
- Discuss approach to selected medical symptoms and the approach while at sea
- Useful equipment and medications
- Possibility of telemedicine consults at sea

Sir WIlliam Osler

"Medicine is learned by the bedside and not in the classroom. Let not your conceptions of disease come from words heard in the lecture room or read from the book. See, and then reason and compare and control. But see first."

Training

- CPR
  - Red Cross
  - American Heart Association
  - Or really anyone
- First Aid
  - Red Cross
  - Companies, multiple
  - Read books, ask questions
  - Lectures

Before First Aid

Secure the Crew
and Boat

2019 Recreational Boating Statistics

COMDTPUB P16754.33
U.S. Department of Homeland Security
U.S. Coast Guard
Office of Auxiliary and Boating Safety

BOAT Responsibly

2019 USCG Statistics

U.S. Department of Homeland Security
United States Coast Guard

- 4,168 accidents
- 613 deaths (5.2 deaths per 100,000 registered recreational vessels)
  - 79% of fatal boating accident victims drowned
  - 86% of those drowned were not wearing a life jacket
  - 8/10 boaters who drowned were using vessels less than 21 feet in length
  - Alcohol use is the leading known contributing factor in fatal boating accidents
- 2,559 injuries
  - Operator inattention, improper lookout, operator inexperience, excessive speed, and alcohol use rank as the top five primary contributing factors in accidents
- $55 million dollars

Accident Reporting as Required by Federal Law

Under federal regulations (33 CFR Part 173; Subpart C – Casualty and Accident Reporting) the operator of any numbered vessel that was not required to be inspected or a vessel that was operated for recreational purposes is required to file a BAR when, as a result of an occurrence that involves the vessel or its equipment:

1. A person dies; or
2. A person disappears from the vessel under circumstances that indicate death or injury; or
3. A person is injured and requires medical treatment beyond first aid; or
4. Damage to vessels and other property totals $2,000 or more; or
5. There is a complete loss of any vessel.

Reporting and Statistic Underestimate

- Non-fatal accidents are severely under-reported (boaters are unaware of reporting requirements or are unwilling to report?)
- About 20% of hospital-admitted injuries not captured
- Upwards of 93% of non-fatal, non-hospital admitted injuries not captured

Temporary Insanity II **impaled on day-marker near Bay Bridge Marina on Kent Island (2002). A passenger suffered a broken arm and lacerations in the accident. The skipper claimed to have been "blinded by the lights of a sailboat" and was subsequently charged by Maryland DNR police with negligence, traveling at an unsafe speed, and failure to maintain a proper lookout. Story available from http://www.apg.army.mil/sibo/quotes1.htm#Q15. Photo available from http://safetycenter.navy.mil/photo/archive/archive_1-50/photo43.htm.**

Acute Sailing Injuries

- Performance of explosive and powerful moves
  - Physical actions on a sailboat are often awkward
  - Imbalances associated with changing forces on opposing muscle groups
  - Poor ergonomics
  - Unusual and unpredictable boat movements
  - Often not warmed-up
- Direct Impact

Chronic Sailing Injuries

Chronic repetitive movements

- Leveraging body (“hiking”)
- Grinding
- Steering

- Consider this possibility for each crew member prior to long cruise or race

Injuries Noted - 2007

- Abrasion
- Amputation
- ***Back Injury***
- ***Broken Bones***
- Burns
- Carbon Monoxide
- ***Contusion***
- Dislocation
- ***Head Injury***
- ***Hypothermia***
- ***Internal Injuries***
- ***Laceratio***n
- Neck Injury
- Shock
- Spinal Injury
- ***Sprain/Strain***
- Teeth and Jaw

Sailing Risks - Fatalities*

Riskier Than

- Walking to work (0.025)
- Riding the Bus (0.02)
- Riding a Ferry (0.01)
- Riding a Train (0.01)
- Riding a Horse (0.01)
- Cabin motorboats (0.0002)

Less Risky Than

- Riding in a car (30)
- SCUBA diving (2)
- Flying in a small plane or commercial aviation (1 or 0.04)
- Cheerleading (0.4)
- Canoeing (0.12)
- Riding a bike (0.09)
- Riding a PWC (0.06)

* 0.03 fatalities per 100,000 participants normalized to average hours of participation per participant
(All types, as reported in CDC and USCG statistics (2001-2002)

Injuries to Fatalities Ratio

(requiring professional medical assistance)

- Football = 65,000 injuries/fatality
- Golf = 33,000
- Sailing = 200
- Caving/Rock Climbing = 16
- Aviation = 2


07.31.2010

Table I. Summary of injury rates, nature, site and risk factors of common injuries in each of the main sailing classes

Sailing class	Indicative injury rate	Common injuries		
		nature/type	site	risk factors
Olympic	0.2 injuries/athlete/year	Chronic strains and sprains	Lumbar spine Knee	Sustained hiking in a lordotic position Weakness of the abdominal muscles Shortness of the hip flexors Hiking foot placement (internal rotation) Low hamstrings/quadriceps strength ratio
Novice and recreational	0.3–0.4 injuries/person/year	Acute contusions, bruises, lacerations and abrasions	Upper limb and head	Collisions with the boom or other equipment during manoeuvres Slipping or falling on deck
Paralympic	100 injuries/1000 d sailing	Chronic strains and sprains	Upper extremity	Inadequate upper-limb conditioning and muscle strength
Windsurfing	1.1–2.0 injuries/person/year	Acute abrasions, sprains, lacerations and strains Chronic tendinopathies and neuropathies	Lower extremity Lumbar spine Upper limb	Impact with equipment Prolonged lordosis whilst pumping the sail Prolonged isometric contraction of the forearm during pronation
America's Cup	2.2 injuries/1000 h sailing	Joint/ligament sprains Chronic tendinopathies	Lower limb and spine Upper limb	Impact with boat hardware and lumbar flexion with rotation under load Sustained grinding, gripping and top handle winching
Offshore sailing	1.5–3.2 injuries/person/race	Acute contusions Chronic tendinopathies and neuropathies (helmsmen)	Upper limb Upper limb	Impact with boat hardware Prolonged repetitive steering

Neville V, Folland JP. The epidemiology and aetiology of injuries in sailing. *Sports Med.* 2009;39(2):129-145.

Survey of sailing Injuries

- Purpose: "to describe the relative frequency, patterns, and mechanisms of sailing-related injuries in dinghies and keelboats. Data were also collected on risky and risk-averse behaviors of sailors, as well as on sailing-related illnesses".

Andrew T. Nathanson, MD; Janette Baird, PhD; Michael Mello, MD, MPH **Sailing Injury and Illness: Results of an Online Survey**. *WILDERNESS & ENVIRONMENTAL MEDICINE*, 21, 291–297 (2010)

Sailing Injury Survey

- Survey done in 2006
- 1881 respondents completed the demographics
- 21 excluded (respondents < 18 years of age)
- 1 injury was reported by 1468 (79%) respondents
- 1353 (72%) provided complete data on 1 injury
- 362 provided complete data about a second injury
- Total 1715 injuries with data
- 559 illnesses

RESULTS

- Average age of the study population was 40.1 (SD 13.2; range 18–80) years
- Males (83%)
- North Americans (97%)
- Sailed an estimated 65 days (SD 50) over the previous 12 months

Table 1. Skill level and safety behaviors of respondents, N = 1860

Variable	*Percent*
Self-rated ability	
Beginner	2.3%
Intermediate/Experienced	73.9%
Professional/Pro Equivalent	23.8%
Life jacket use	Median 30%
0–25% of time	48%
26%–50% of time	16%
51%–75% of time	6%
76%–100% of time	30%
Sunscreen use	Median 80%
0–25% of time	19%
26%–50% of time	14%
51%–75% of time	14%
76%–100% of time	53%
Alcohol within 2 hours of injury[a]	7%

[a] n = 1715.

RESULTS (cont.)

- Injuries requiring medical care = 4.6 per 1000 days of sailing
- 47% were minor injuries requiring no treatment
- 26% received first-aid onboard
- 33% sought medical care after injury

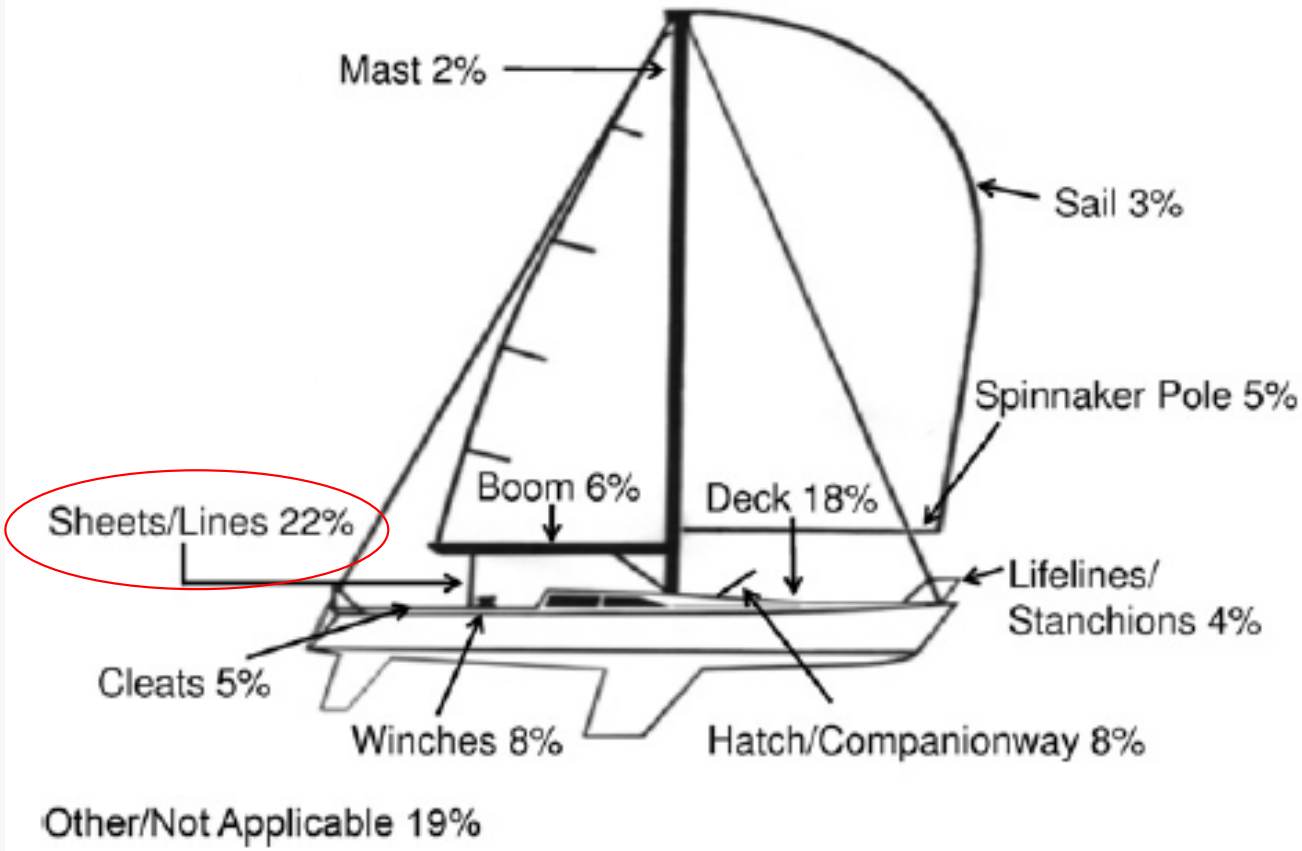


Figure 1. Part of keelboat associated with injury, n = 1226.

Severe Injuries

- Defined as “evacuation” from the vessel and/or “hospitalization.”
- Rate of severe injury was 0.56 per 1000 days
- Of the 70 (4%) severe injuries:
  - Fractures 25%
  - Torn tendons or cartilage 6%
  - Concussion 14%
  - Dislocations 8%
  - 36% heavy weather was a contributing factor
  - Crew inexperience and lack of communication


KIAORA
USA
444
Photo Boat
PHOTOGRAPHY

Patterns of Severe Injuries

- Planned and unplanned jibes in high winds
- Collisions with other boats
- Catastrophic rig failure
- Falls through open hatches or companionways
- Prolonged hiking in dinghies and small keelboats Three eye injuries resulted in permanent loss of vision
  - Struck by the boom
  - Hydraulic ram handle
  - Spinnaker pole during a jibe

Increased Risks

- Heavy Weather
- Crew (experience, familiarity with boat and each other, physical condition)
- Equipment (have it, it works, and the crew knows how to use it)
- Racing (pushing the limit)

Table 4. Common patterns of hand and head injuries for all types of sailboats combined

	Hand injuries, n = 398	*Head injuries, n = 190*
Type of injury	Laceration = 54% Contusion = 18% Sprain/strain = 10% Other = 10%	Contusion = 34% Laceration = 29% Concussion = 24% Fracture = 4%
Mechanism	Other = 38% Caught in lines = 28% Trip/fall = 19% Hit by object = 17%	Hit by object = 65% Trip/fall = 19% Other = 10% Caught in lines = 3%
Part of boat	Rope/line = 28% Deck = 16% Winch = 7% Cleat = 5%	Boom = 46% Spinnaker pole = 12% Other = 12% Hatch = 8%
Contributing factors	Heavy weather = 23% Tack = 16% Sail change = 13% Jibe = 12%	Jibe = 26% Heavy weather = 17% Tack = 14% Sail shange = 12%

Table 2. Type and location of sailing injuries for keelboats, n = 1226

Injury location	*Contusion*	*Laceration*	*Sprain/strain*	*Fracture*	*Concussion*	*Dislocation*	*Other*[a]	*Total*
Head/neck	3%	2.6%	0.6%	0.6%	2.5%	0.1%	1.3%	10.7%
Trunk	5%	0.6%	2.9%	1.6%	0.0%	0.0%	0.8%	10.9%
Upper extremity	13.7%	12.7%	7.3%	1.8%	0.0%	1.0%	3.5%	40.0%
Lower extremity	18.4%	10.3%	5.9%	1.7%	0.0%	0.5%	1.6%	38.4%
Total	40%	26.2%	16.7%	5.7%	2.5%	1.6%	7.2%	100.0%

[a] Other = thermal burn, rope burn, blisters, tendon rupture.

Table 3. Type and location of sailing injuries for dinghies, n = 397

Injury location	*Contusion*	*Laceration*	*Sprain/strain*	*Fracture*	*Concussion*	*Dislocation*	*Other*[a]	*Total*
Head/neck	3.9%	4.9%	0.4%	0.3%	2.3%	0%	0.3%	12.1%
Trunk	1.6%	0.4%	3%	0.3%	0%	0%	0.1%	5.4%
Upper extremity	13%	13.6%	6.4%	1%	0%	1.8%	2.6%	38.4%
Lower extremity	22.5%	12.2%	6.1%	0.8%	0%	0.3%	2.2%	44.1%
Total	41%	31.1%	15.9%	2.4%	2.3%	2.1%	5.2%	100%

[a] Other = rope burn, blisters, tendon rupture.

Medical Problems

- 559 sailing-related illnesses
  - Sunburn (53%)
  - Sea sickness (31%)
  - Dehydration (7%)
  - Hypothermia (2%).
- 4 cases of medical illnesses classified as severe
  - 2 cases of hypothermia (dinghy sailors who capsized in cold water)
  - 2 cases of sea sickness (dehydration)

AHA/RED CROSS GUIDELINE FOCUSED UPDATE

2020 American Heart Association and American Red Cross Focused Update for First Aid

TOP TAKE-HOME MESSAGES

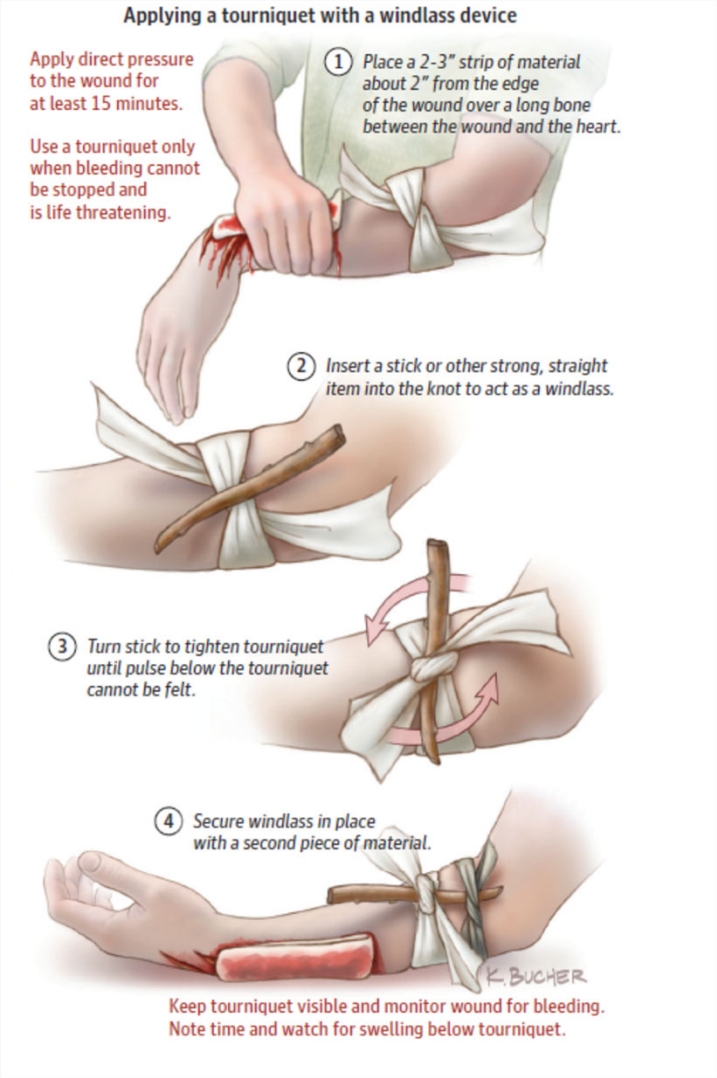
1. First aid providers can use the signs of weakness in the face (eg, droop), arm, or grip on one side of the body, or speech disturbance to identify individuals with a possible stroke and should activate emergency services when this occurs.
2. After activating emergency services, first aid providers may encourage alert adults experiencing nontraumatic chest pain to chew and swallow 162 to 324 mg of aspirin. This recommendation applies to all adults except for individuals who have an aspirin allergy or individuals who have been advised by a healthcare provider not to take aspirin.
3. Alert adults and children with suspected hypoglycemia should be given glucose to swallow. If symptoms worsen or do not resolve within 10 minutes, emergency services should be activated.
4. Tourniquets should be used as soon as available for the treatment of life-threatening extremity bleeding or bleeding that cannot be controlled with direct pressure.
5. Direct manual pressure, with the use of a hemostatic dressing if available, should be used for the treatment of injuries with life-threatening bleeding not amenable to the use of a tourniquet, or for extremity bleeding until a tourniquet is available.
6. Immediate replantation of an avulsed tooth is best, but if this is not an option, transporting the tooth in a solution like Hanks' Balanced Salt Solution or in plastic wrap to a dental provider increases chances of tooth survival. Tap water should not be used as a transport medium.
7. For people experiencing exertional hyperthermia or heatstroke, cold-water, whole-body immersion is the most effective technique for rapidly reducing core temperature and should be initiated as soon as possible and continued until a temperature of less than 39°C (102.2°F) is reached or resolution of signs and symptoms of heatstroke occurs. If cold-water, whole-body immersion is not available, other forms of cooling, such as commercially prepared ice packs, cold showers, and fanning, may be reasonable.

Direct Pressure

- Best controlled by applying pressure until bleeding stops
- The pressure must be firm and maintained for a long time
  - Manual pressure on gauze or other cloth placed over the bleeding source
  - If bleeding continues add more gauze on top and apply more pressure
  - If it is not possible to provide continuous manual pressure wrap an elastic bandage firmly over gauze to hold it in place with pressure

Tourniquets

- Battlefield use
- During surgery
- Paramedics
- Potential complications if used incorrectly or for prolonged periods of time

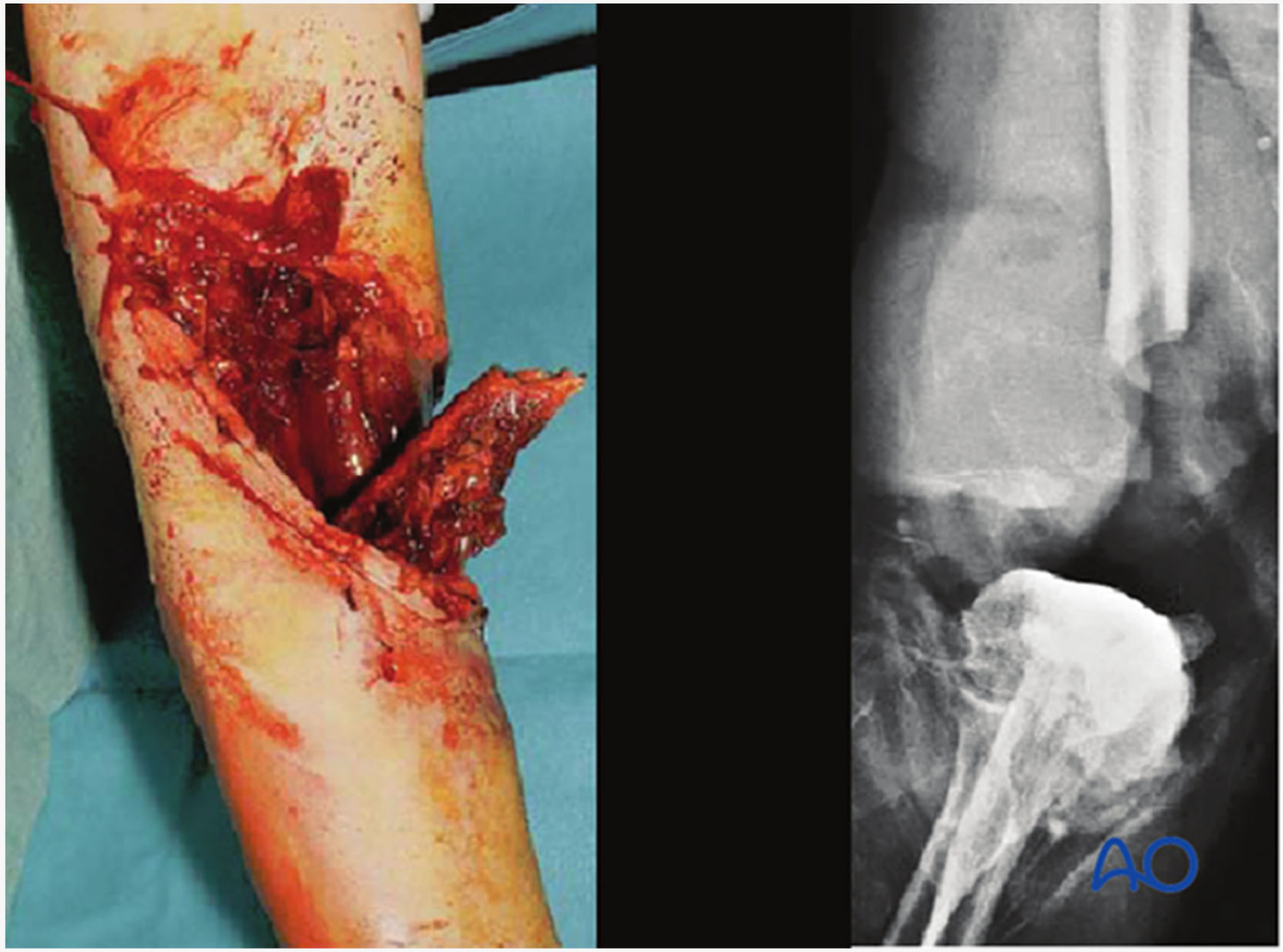

Applying a tourniquet with a windlass device
Apply direct pressure to the wound for at least 15 minutes.
Use a tourniquet only when bleeding cannot be stopped and is life threatening.
1 Place a 2-3" strip of material about 2" from the edge of the wound over a long bone between the wound and the heart.
2 Insert a stick or other strong, straight item into the knot to act as a windlass.
3 Turn stick to tighten tourniquet until pulse below the tourniquet cannot be felt.
4 Secure windlass in place with a second piece of material.
K. BUCHER
Keep tourniquet visible and monitor wound for bleeding.
Note time and watch for swelling below tourniquet.

Myth – Wounds and Lacerations

- **Do you need sterile technique for simple wound closure?**
  - Sterile gloves
  - Sterile saline
- Do not need all the “sterile” equipment recommended by many of the medical kit manufacturers
- Glues, strips, and sutures
- STAPLES may be a good idea

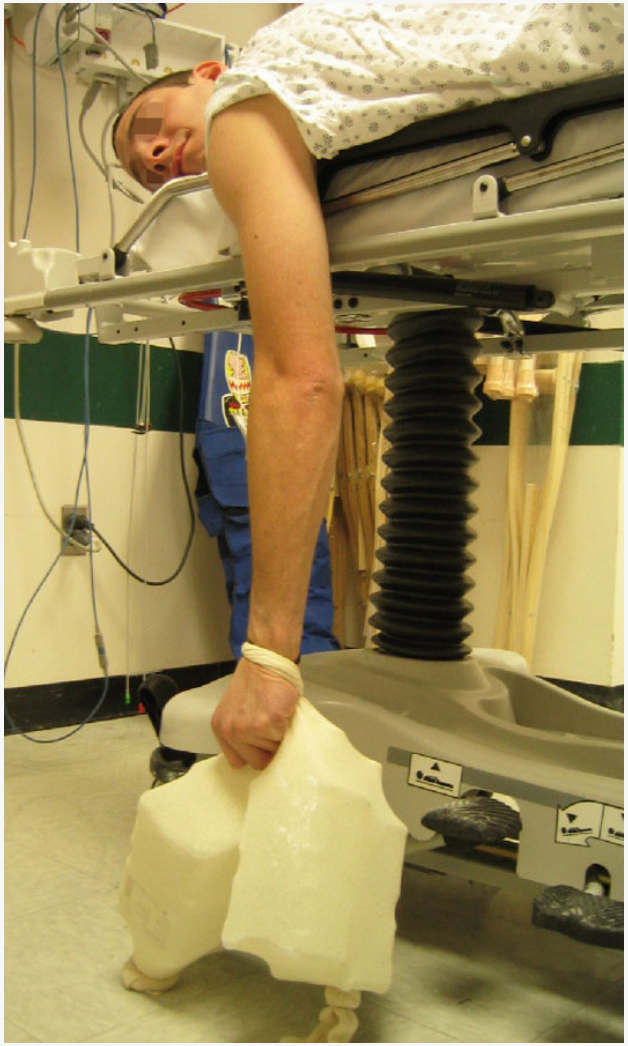
Fractures

- Assume that any injury to an extremity may include a fracture. Do not move or try to straighten an injured extremity
- No evidence that straightening a long bone fracture shortens healing time or reduces pain prior to permanent care. Expert opinion suggests that splinting may reduce pain and prevent further injury. If far from care, then stabilize the extremity with a splint in its current position



Dislocations

- This may be the exception to the rule of do not try to straightened (if you feel comfortable)
- Fingers
- Shoulder
- Examples



Head Injuries

- Not in First Aid recommendations
- Any symptoms suggesting possible intracranial pathology should be taken seriously - Evacuate
  - Confusion must be carefully evaluated
  - LOC (lucid interval) or Amnesia
  - Age
  - Seizures
  - Severe headache
  - Vomiting

Hypothermia

- Begin re-warming a victim of hypothermia immediately
- Move the victim to a warm environment
- Removing wet clothing
- Wrapping all exposed body surfaces with anything at hand
- If the hypothermia victim is far from definitive health care, begin active re-warming (heat source)
- I also recommend paying close attention to:
  - Mental status
  - Shivering

Summary of Injuries

- Common minor injuries
- Predictable patterns and causes
- Plan for the known
- Need to be even more ready for rare and unknown problems

MARK TWAIN

“It is amazing what little harm doctors do when one considers all the opportunity they have”.

Minor Problems

- Self limited motion sickness
- Rashes
- Minor lacerations, abrasions
- Vomiting minor
- “gastritis pain”
- Minor bone fractures
- Minor allergic reactions
- “Feeling poor”
- Usually can help, monitor, and finish the race

Sea Sickness

- Sea Sick Bands – any experience?
- Ginger
- Dramamine (dimenhydrinate)
- Scopolamine (levo-duboisine)
- Promethazine 25mg

Skin

- Skin abrasions and wounds
  - Clean with water (don't need betadine – iodine)
  - Soap intact skin
  - Antibiotic ointments more for comfort
  - Oral antibiotics usually not needed
    - Consider underlying conditions (DM, immune)
    - Keflex, bactrim, clindamycin
- Sunburns
  - Prevent
  - Topic Vitamin A, E may help
  - Aloe
  - Oral steroids for severe sunburns but be careful

Allergic Reactions

- Epinephrine auto-injectors
- Prednisone (multi-uses)
- Antihistamines (diphenhydramine) may be useful
- Albuterol inhaler

Dental ****

- Oil of Cloves
- Dental cements or temporary fillings
- Pain medication

Urgent Problems

- Fracture
- Minor to moderate lacerations
- Somewhat Controlled vomiting (seasickness)
- Abdominal pain, but not associated with vomiting or getting worse
- Allergic Reactions

- Have to determine when need to be seen, if can wait 2 days sail on, if not motor in to harbor for treatment and evaluation.

Serious Problems

- End of Race
- Crew must be evacuated
- Methods:
  - Sail/motor into harbor
  - Request assistance from USCG, Sherriff office for motorboat transport
  - Request Air Evacuation by USCG

- Method to be determined by risk to crew member medically and by rescue crews

Serious Problems

- Stroke
- Chest Pain, concerning, new
- Shortness of breath, concerning, new
- Constant vomiting causing dehydration
- High fever
- Altered Mental Status
- Cardiac Arrest
- Open Fracture
- Severe abdominal pain
- Severe lacerations
- Anaphylaxis

TELEMEDICINE

- Definition - Code of Federal Regulations - 410.78 Telehealth services

- Asynchronous store and forward technologies means the transmission of a patient's medical information from an originating site to the physician or practitioner at the distant site. The physician or practitioner at the distant site can review the medical case without the patient being present. An asynchronous telecommunications system in single media format does not include telephone calls, images transmitted via facsimile machines and text messages without visualization of the patient (electronic mail). Photographs visualized by a telecommunications system must be specific to the patient's medical condition and adequate for furnishing or confirming a diagnosis and or treatment plan. Dermatological photographs, for example, a photograph of a skin lesion, may be considered to meet the requirement of a single media format under this provision.

Potential for Telemedicine at Sea

- Equipment needs
  - Some internet or high-speed data connection
  - Video or photographs
  - We use real-time video for stroke patients
- Practicality
- Best may be simple phone and text consultation
- Satellite connection

VIA MEDICA

REVIEW ARTICLE

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A Medical Support in Offshore Racing — Workshop on Medical Support for Offshore Yacht Races, Telemedical Advice Service (TMAS), 1–2 December 2018, London, United Kingdom

Nebojša Nikolić[1], Roger Nilson[2], Spike Briggs[3], Arne J. Ulven[4], Agnar Tveten[5], Simon Forbes[6], Carmen Vaz Pardal[7], Lucas Viruly[8], Rob Verbist[9]

[1]Workshop Chairman, WS Medical Commission/IMHA, Croatia
[2]Volvo Ocean Race and Trophy Jules Verne, Sweden
[3]WS Medical Commission, Volvo RWR, United Kingdom
[4]Norwegian Centre for Maritime and Diving Medicine, Haukeland University Hospital, Norway
[5]Radio-medico Norway, Norway
[6]World Sailing Offshore Technical Manager, United Kingdom
[7]Andalusian Sport Medicine Centre, Andalucia, Spain
[8]Radio Medico Netherlands, Netherlands
[9]Maritime Academy Antwerp, Belgium

Recommendations

- Trained medical help on board
- Total 135 medicines and equipment of which 57 are medications
- Telemedical advice services integrated into care

Nikolic N, Nilson R, Briggs S, et al. A Medical Support in Offshore Racing - Workshop on Medical Support for Offshore Yacht Races, Telemedical Advice Service (TMAS), 1-2 December 2018, London, United Kingdom. *Int Marit Health.* 2019;70:27-41.

Kits – Practical and for Our Purposes

- Many things to consider, no one kit is right.
- Make your own
- Waterproof
- Consider purchase of AED
- Consider supplies for minor issues, e.g., band aids, ace wraps
- Consider Major Trauma supplies, Tourniquet, Israeli Bandage, clotting bandages
- Consider medications: Motrin, Tylenol, Aspirin, anti-emetic, Pepcid, anti-histamine,

Preparation

- Know yourself, are you safe for the race/trip
- Have enough medication for 2x time of the trip
- Do you feel well before the trip
- Medical form for each crew member
- As skipper, do you know who on your trip has significant medical issues, allergies, etc.
- What about Covid-19

Situational Awareness

- Know who might be having problems, address immediately
  - Prevent worsening of problem
    - E.g., sea sickness, ensure early hydration of crew, problem crew, put on the helm
    - Consider medications early, etc.
  - For chest pain, shortness of breath, etc. Is it typical for the crew member or not
  - Do they have medication for the problem

USCG

- Motorvessels
  - No first aid training, they do have CPR training, they do have Narcan
- Rotor Aircraft
  - AST (Aviation Survival Technicians) EMT-Basic
  - They have airways, bleeding and splinting supplies, an AED, Glucometer with
    - Oral Glucose
  - They can do CPR, manage an airway

Helicopter Rescue

- On Dec. 18, 2008, the French sailor Yann Eliès fell on deck fracturing his femur in Vendée Globe. He was alone in the southern Indian Ocean but managed to get below deck and into his berth where he spent the next three days awaiting rescue.
- Eliès was incapacitated and unable to reach the pain medication in his medical kit.
- “A comprehensive medical kit, like a life raft, is just expensive ballast if you and your crew can’t find it”.
- Eliès must have had a survivor’s instinct and will
- These qualities are more useful than medical skill, equipment, or any amount of medical advice.
- Maybe his most important medical equipment he had was his satellite radio and GPS!

My Final Thoughts

- Blind obedience to protocol is not always warranted, particularly in the unconventional setting.
- You are not practicing medicine in an ambulance or emergency department.
- Even if partially disabled, the patient will have a much better chance of survival with some freedom of movement.
- Know and plan for potential complications of pre-existing medical disorders!
- Radio, Phone and Motor are your best friends


Thanks for your attention!