

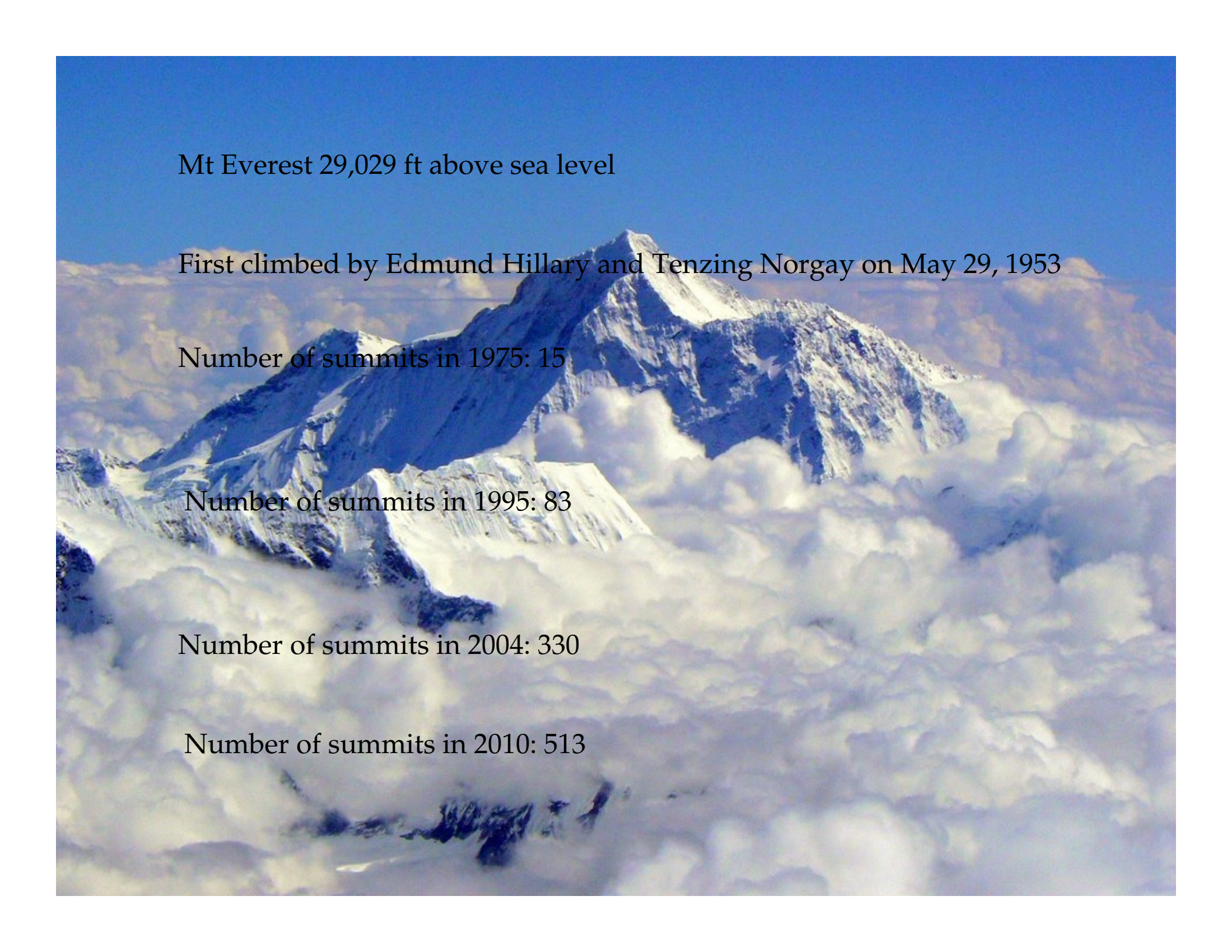


Environmental Issues in Sports Medicine

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Lecture Objectives

- Identify common environmental illnesses
- Describe prevention of environmental illness
- Describe treatment for life-threatening and non-emergent environmental illness



Mt Everest 29,029 ft above sea level

First climbed by Edmund Hillary and Tenzing Norgay on May 29, 1953

Number of summits in 1975: 15

Number of summits in 1995: 83

Number of summits in 2004: 330

Number of summits in 2010: 513

Introduction

- Outdoor sports are increasing in popularity
- Participants are becoming more “extreme”
- Family physicians need to be able to recognize and treat these problems in their patient population

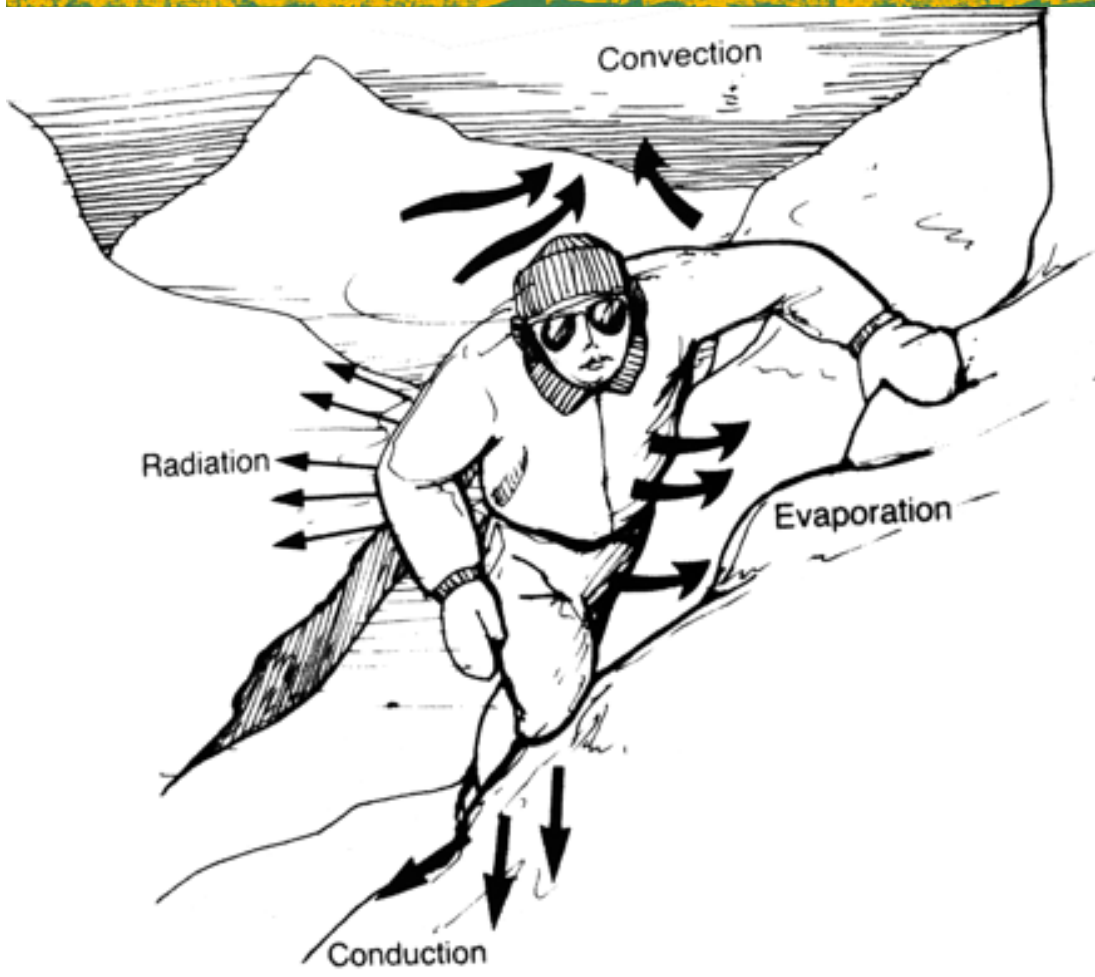
Environmental Illness

- Heat related Illness
- Cold injury
- Altitude
- UV Light
- Lightning

Heat related Illness

- Heat edema
- Heat rash
- Heat syncope
- Heat cramps
- Heat exhaustion
- Heat stroke

Human Heat Loss



- Convection
- Conduction
- Evaporation
- Radiation

Chicago Marathon 2007



Wet Bulb Globe Temperature

- Developed by USMC in 1956 at Parris Island, SC
- Takes into account temperature, humidity, wind speed, and solar radiation
- $WBGT = 0.7T_w + 0.2T_g + 0.1T_d$



Wet Bulb Globe Temperature

| Category | Temperature (°F) | Flag |
|----------|------------------|--------|
| 1 | <79.9 | None |
| 2 | 80 – 84.9 | Green |
| 3 | 85 – 87.9 | Yellow |
| 4 | 88 – 89.9 | Red |
| 5 | ≥90 | Black |

| ALERT LEVEL | EVENT CONDITIONS | RECOMMENDED ACTIONS |
|-----------------|--|--|
| EXTREME | EVENT CANCELLED/EXTREME AND DANGEROUS CONDITIONS | PARTICIPATION STOPPED/ FOLLOW EVENT OFFICIAL INSTRUCTION |
| HIGH | POTENTIALLY DANGEROUS CONDITIONS | SLOW DOWN/OBSERVE COURSE CHANGES/FOLLOW EVENT OFFICIAL INSTRUCTION/CONSIDER STOPPING |
| MODERATE | LESS THAN IDEAL CONDITIONS | SLOW DOWN/BE PREPARED FOR WORSENING CONDITIONS |
| LOW | GOOD CONDITIONS | ENJOY THE EVENT/ BE ALERT |

Heat Index Chart

| | | Temperature (°F) | | | | | | | | | | | | | | | |
|-----------------------|----|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
| Relative Humidity (%) | 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| | 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| | 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| | 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| | 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| | 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| | 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| | 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| | 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| | 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| | 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| | 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | | |

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution
 Extreme Caution
 Danger
 Extreme Danger

Heat Edema

- Transient venodilation to facilitate core heat loss
- Normal body temperature
- Dependant edema
- Treat with hydration, elevation of lower extremities, and cooling

Heat Rash

- Also called prickly heat, miliaria rubra
- Profuse sweating saturates skin and clogs sweat ducts
- Pruritic rash, normal body temperature
- Treat with cooling, reduced clothing, antihistamines, lotions



Heat Syncope

- Occurs at end of activity in elevated temperatures
- Decrease in muscle contractions combined with peripheral vasodilation
- Normal body temperature
- Present with orthostasis, syncope, rapid mental status recovery when supine
- Treat with cool environment, supine position, elevated legs, fluid replacement, untie shoes

Heat Cramps

- Generally not acclimated to conditions
- Excess heat exposure with profuse sweating
- Generally inadequate fluid and electrolyte intake
- Temp <104 °F
- Painful muscle spasms, usually calves, quads, abdominal muscles
- Treat with stretching, cooling, fluid and electrolyte replacement
- Pickle juice, Gatorade with extra salt

Toe cramps! Toe cramps!



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Korey Stringer



May 8, 1974 – August 1, 2001

Heat Exhaustion

- May be initial presentation of heat illness
- Body temperature between 98.6 °F and 104 °F
- Malaise, fatigue, dizziness
- May have profuse sweating, nausea/vomiting, headache, fainting, weakness, cold/clammy skin, tachycardia
- Normal mental status
- Stable neurologic status
- May progress to heat stroke if not recognized and treated

Heat Stroke

- Symptoms of heat exhaustion along with the following
- Core temp $>104^{\circ}\text{F}$
- Hot skin with or without sweating
- CNS disturbance (Confusion, ataxia, irritability, coma)
- May have hypotension, seizure, hyperventilation
- Classic vs. Exertional

Risk Factors

- Age <15 o
- EtOH, me
- Dehydrati
- Prev. hea
- Poor accli
- Overmoti
- Sickle cell



level

clothing

water/shade

are

Medications

- Alpha adrenergic agents
- Amphetamines
- Anticholinergics
- Antihistamines
- Antihypertensives
- Benzodiazepines
- Illicit drugs
- Laxatives
- MAOIs
- Thyroid agonists
- TCAs
- Typical antipsychotics
- Dietary supplements
- EtOH

Prevention

- Education (athletes, coaches, trainers)
- Acclimatization (NCAA, ACSM guidelines)
- Daily weights to monitor for dehydration
- Proper uniforms
- Condition monitoring
- Adjusting practice times

Treatment

- Medical Emergency!
- Rectal Temp
- ABCs
- Cool first, then transport
 - Ice bath
 - Cool mist and fan
 - Ice at groin/axilla



Complications

- Seizures
 - benzodiazepines
- Hypotension
 - IV fluids, may need pressors
- Rhabdomyolysis
 - IV fluids, diuretics, alkalinize urine (pH > 7)
- Liver damage
 - Avoid acetaminophen
- Arrhythmias
 - Avoid cardioversion until myocardium has cooled

Return to Play

- Mild illness – 24 hours post event with proper rest and rehydration
- Heat stroke – at least one week
 - Monitor daily weights
 - Normalization of lab values
 - Graduated return to activity
 - Address all risk factors

Cold Injury

- Hypothermia
- Frostbite
- Trenchfoot



Hypothermia

- Normal core temperature 99.6 °F(+/- 4 °F)
- Thermoregulation through hypothalamus
 - Voluntary muscular activity
 - Involuntary shivering
 - Increased metabolic rate (higher epi and norepi)
 - Peripheral vasoconstriction

Hypothermia

- Risk factors
 - CNS depressants
 - Phenothiazines
 - Hypoglycemia, peripheral neuropathy, hypothyroidism, adrenal insufficiency
 - Ethanol
 - Age
 - Exhaustion
 - Malnutrition

Hypothermia

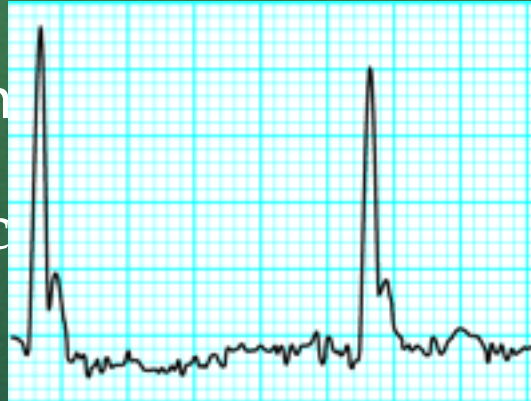
- Core temp <95 °F
- 1.8% increase in mortality rate with each 1.8 °F drop in core temperature
- Need a true core temperature (rectal temp with appropriate thermometer)

Mild Hypothermia

- Core temp 90° -95° F
- Cool, pale, core
- Uncontrolled shivering
- Dysarthria
- Ataxia
- Confusion
- Tachycardia
- Maximal peripheral vasoconstrictions

Moderate Hypothermia

- Core temp 82 ° - 90° F
- Loss of shivering
- Cardiac conduction
 - Afib
 - J waves



Severe Hypothermia

- Looks dead, core temp <82 °F
- No pulse or blood pressure
- Agonal or absent respirations
- Dilated pupils, areflexic
- Ventricular arrhythmia on EKG

Hypothermia

- Prevent further heat loss
- Passive external rewarming
- Active external rewarming
 - Warm blankets
 - hot water bottles
 - Warmed forced air
- Active Core rewarming
 - Warmed IV fluids
 - Warmed oxygen
 - NG, colonic, bladder irrigations
 - Peritoneal dialysis
 - Cardiopulmonary bypass
 - Hemodialysis

Hypothermia

- ABCs
- Limit movement
- Avoid chest compressions if any cardiac or respiratory activity
- A patient isn't dead until he's warm and dead



RULON

STARTING WEIGHT

474

Frostbite

- Direct freezing of tissues
- Ambient temp < 32° F
- Exposed areas and distal extremities most at risk
- Risk factors include
 - Raynauds, PAD, constrictive clothing, nicotine

Frostbite

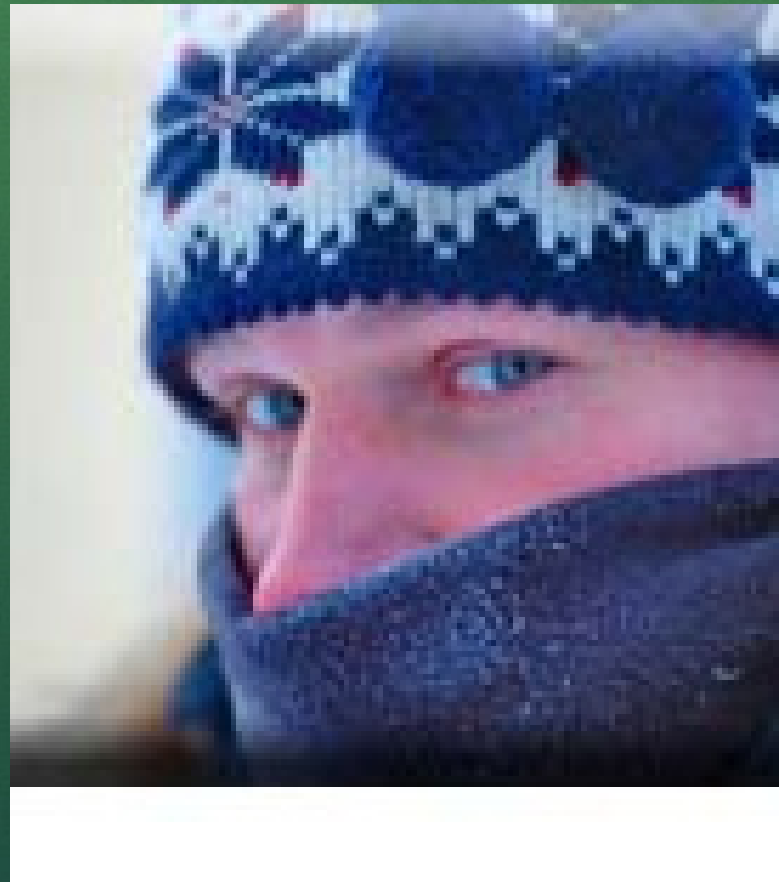
- Tissue cooling, vasoconstriction, hyperviscosity
- Extracellular ice formation
- Intracellular dehydration and hyperosmolality
- Cell membrane damage

- Microcirculatory stasis, sludging, thrombosis, leads to hypoxia
- Thawing leads to capillary leakage and tissue edema, causing more ischemia
- Usually several freeze thaw cycles in severe injuries



1st Degree Frostbite

- Partial skin freezing
- Erythema, edema, hyperemia, no blisters
- No necrosis
- Skin may peel a week or two later
- Stings, throbs, aches, burns, hyperhidrosis



2nd Degree Frostbite

- Full thickness injury
- Erythema, edema
- Vesicles with clear fluid
- May form blackened eschar
- Numbness, vasomotor dysfunction if severe



3rd Degree Frostbite

- Full thickness skin and subQ freezing
- Hemorrhagic blisters
- Skin necrosis
- Blue-gray discolorations



4th Degree Frostbite

- Full thickness, skin, subQ, muscle, tendon, and bone freezing
- Little edema
- Mottled, deep red, or cyanotic
- Becomes dry, black, and mummified



Frostbite

- Rewarm in 104 -108 F water bath
- Ensure no refreezing
- Very painful process (narcotics and NSAIDs)
- Tetanus immunization
- After rewarming, separate digits and splint

Frostbite

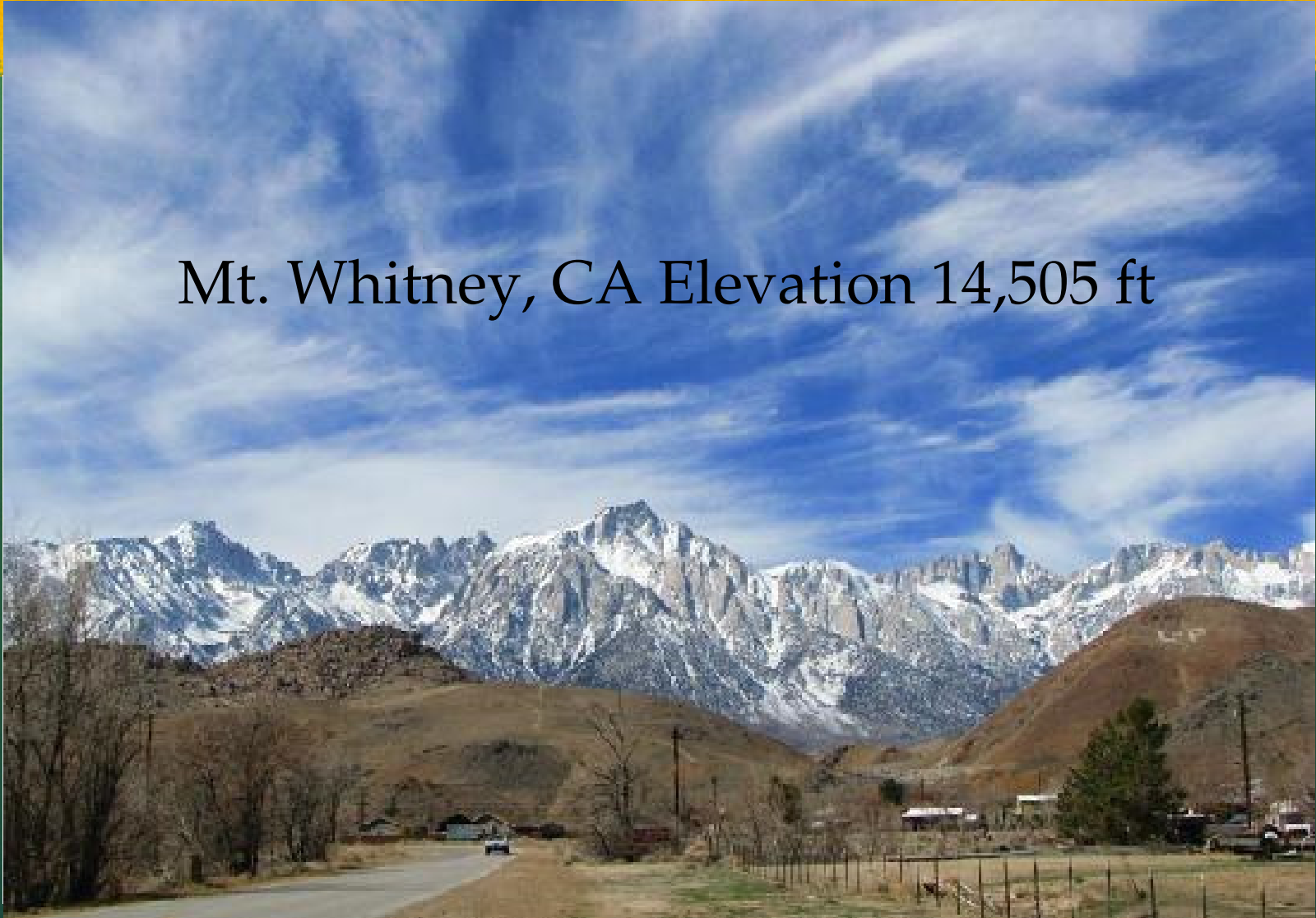
- Debride clear blisters but not hemorrhagic ones
- Early surgery for compartment syndrome or escharotomy
- Amputation after tissue injury demarcates unless infected (may take several weeks)
- Physeal injury may develop in children with frostbite

Trenchfoot



Altitude Illness

Mt. Whitney, CA Elevation 14,505 ft



Altitude Illness

- Exponential drop in partial pressure of oxygen
- At 10,000 ft, 42% of people with experience altitude illness
- Risk factors include increasing altitude, rate of ascent, sleeping altitude, previous hx of altitude illness, permanent residence at low altitude, level of exertion at high altitude

Altitude Illness

- High Altitude Headache
- Acute Mountain Sickness
- High Altitude Cerebral Edema
- High Altitude Pulmonary Edema

HAH / AMS

- High altitude headache – usually attributed to lack of sleep, poor nutrition, or dehydration
 - Treat with NSAIDs or acetaminophen
- Acute mountain sickness – HAH plus 1 of the following: GI irritation, dizziness, fatigue, or sleep disturbance
 - Treat with stopping ascent (rare), descent, oxygen, dexamethasone, acetazolamide

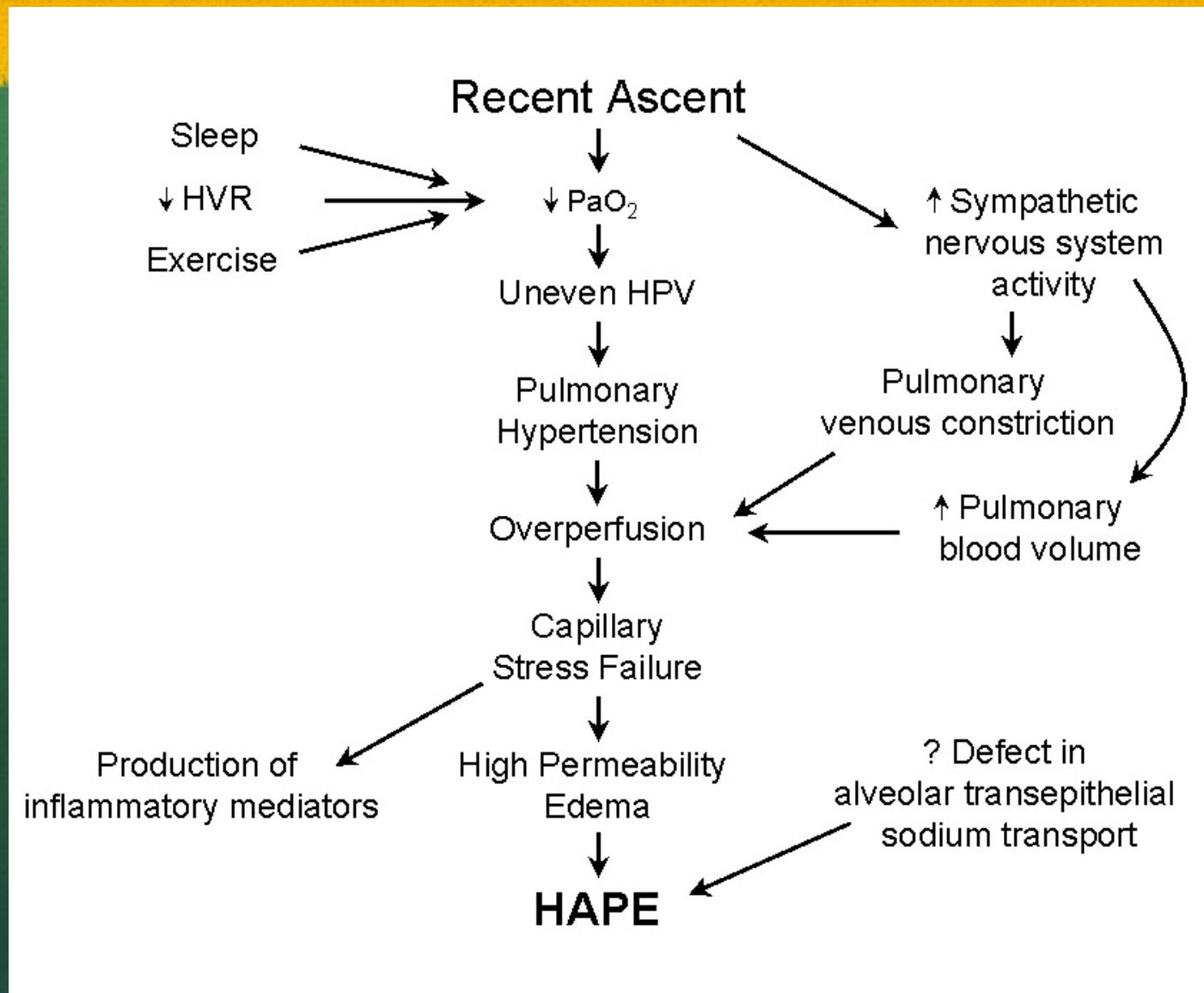
High Altitude Cerebral Edema

- Defined as altered consciousness or ataxia in someone with AMS or HAPE
- Drowsiness, poor decision making, psychomotor slowing, stupor
- Exam may reveal papilledema, retinal hemorrhages, global encephalopathy
- Untreated, leads to death via cerebral herniation

High Altitude Pulmonary Edema

- Most common cause of death from altitude related illness
- Dry cough and decreased exercise tolerance
- Progresses to tachycardia, resting tachypnea, hemoptysis, respiratory distress and fever
- Treat with descent, supplemental oxygen, nifedipine, nitric oxide

HAPE



Altitude Illness



Credit: VMcKiel



UV Light

- Outdoor competition increases UV exposure
- Short term consequences of sunburn
- Long term consequences of melanoma, basal cell cancer and squamous cell cancer

UV Light

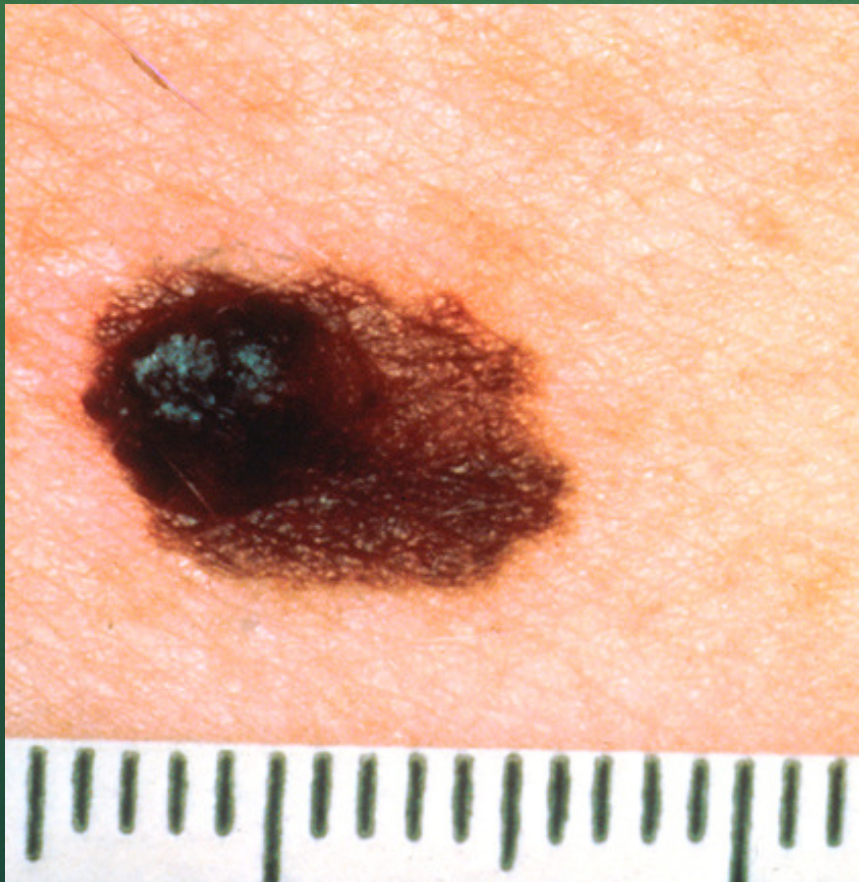
- UVA - makes up 90% of UV light, wavelength of 320-400 nm, penetrates to deep cutaneous tissue, damages DNA through free radical formation
- UVB – wavelength of 290 to 320 nm, primary cause of sunburn
- UVC – wavelength of 200-290 nm, blocked by ozone

Sunburn



- Direct injury from UV radiation
- Vasodilation leading to erythema, edema, vesicles, and bullae
- Initial symptoms at 3-5 hours post exposure, peaking at 24 hours

Skin Cancer



- Frequent severe sunburns as a youth increase risk of melanoma and basal cell cancer
- Prolonged exposure at lower levels increases risk of squamous cell CA

UV Light

- Treat sunburns with moisturizers and pain medications
- Options include topical and systemic steroids, NSAIDS, antihistamines, antioxidants, emollients
- Prevent sun damage with UVA/UVB sunscreen with SPF between 15-30
- SPF 15 filters 92% of UVB exposure
- Participate at low sun times and wear protective clothing

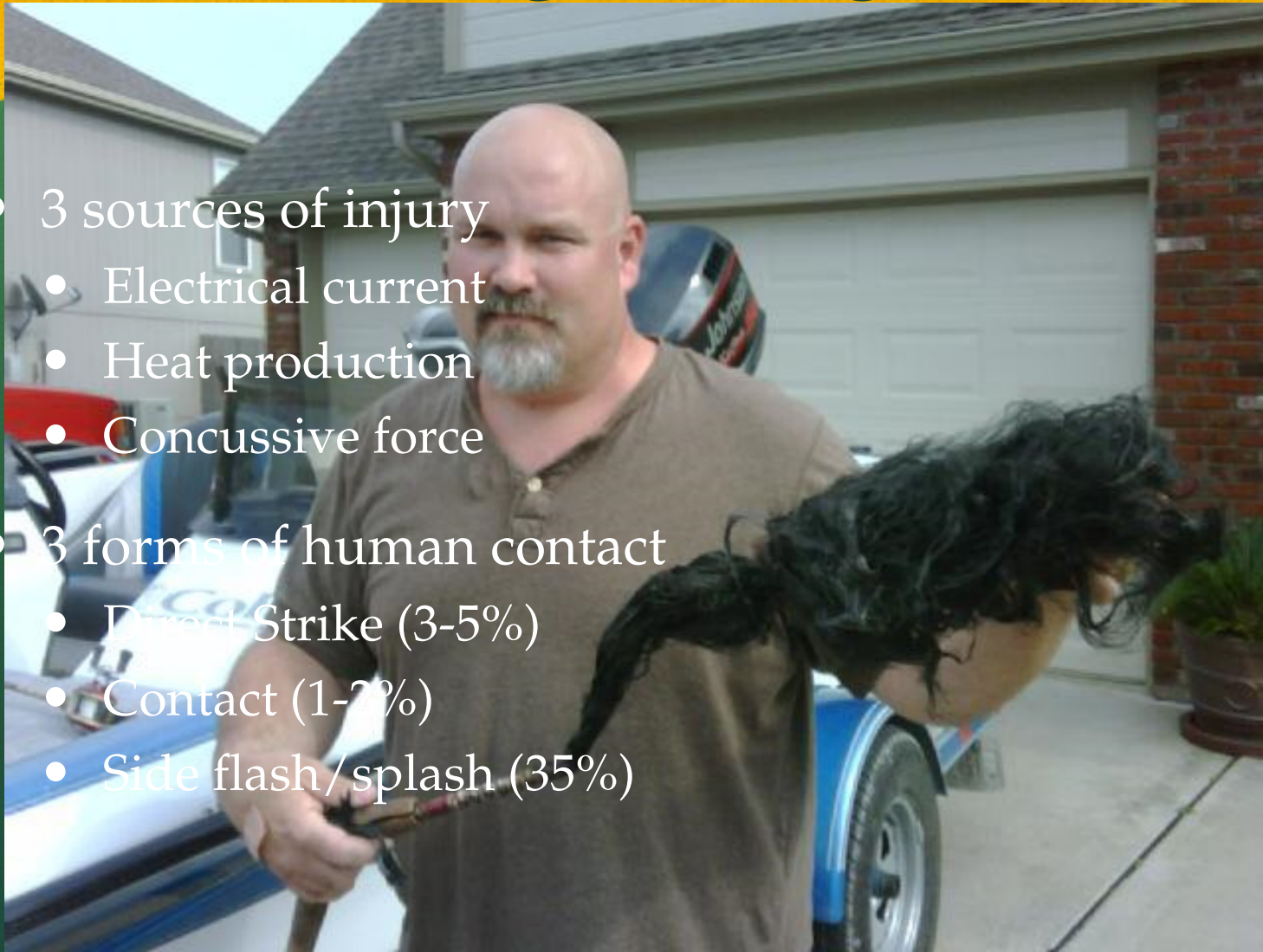
Lightning

- About 300 injuries per year in the US
- 70-90 % of victims survive but 75% have permanent injuries
- Highest incidence of injury in areas of highest lightning flashes (Central Florida in US)



Lightning

- 3 sources of injury
 - Electrical current
 - Heat production
 - Concussive force
- 3 forms of human contact
 - Direct Strike (3-5%)
 - Contact (1-2%)
 - Side flash/splash (35%)



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Lightning

- ATLS protocol
- EKG, C-spine films
- UA, chem 14, cardiac profile
- Burn treatment/referral
- Post-injury support network

Lightning

- 30 seconds - 30 minutes rule
- Shelter in substantial building or metal roofed automobile
- Increased storm activity on summer afternoons, also peak time for sporting events

Thank You

