

Over, Under, Hot and Cold



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Pulsecheck 2012

Reality EMS

- Under - Drowning
- Over - High Altitude Illness
- Hot - Hyperthermia
- Cold - Hypothermia (accidental/deliberate)

Reality EMS

- Reality
- Recognition
- Rescue
- Treatment and myths

Under - Drowning

- Tell me some things that you know about drowning.....

Definition

- Death secondary to asphyxia while immersed in a liquid (normally water) OR within 24 hours of submersion
- 2 types
 - Wet drowning - lungs take on water
 - Dry drowning - laryngospasm occurs

Mammalian Diving Reflex

- Seen in young children
 - Apnea
 - Bradycardia
 - Vasoconstriction
- Cold (Less than 70F water applied to face)

Aspiration

- Normally people aspirate less than 4mls/kg
- 1-3mls/kg can significantly impair gas transfer in the lungs
- Fresh water - Surfactant destroyed - Alveoli collapse - blood shunts thru the lungs
- Salt water - Surfactant washed out - Alveoli collapse - blood shunts thru the lungs

Shunt?

- What do I mean by shunt?

Incidence

- 8000 drowning deaths per year in the US
- 1500 are children
- In 2005 30% of deaths in 1-4 year olds was due to drowning
- 2 commonest cause of trauma death

Bimodal Distribution

- Peak drowning rates occur in toddlers and adolescents

Reality

- Between 1 month and 14 years, drowning is the 2nd most common cause of death
- In California, Arizona and Florida it is the most common cause of death
- For every 1 death, 4 are hospitalized and 14 will be evaluated in the ER

Bigger Problem

- 1200 boating deaths are due to drowning
- 500 MVC deaths are due to drowning
- 800 are during SCUBA diving
- 8% of child abuse deaths are due to drowning

Pools

- If you have a pool you are 14 times more likely to die from drowning than killed in an MVC

Bigger Problem

- 25,000 beach rescues in California every year
- It is the most under reported trauma worldwide
- Ideal target for EMS injury prevention

Recognition

- 5 volunteers needed

Orchard Beach, NY



Orchard Beach 1970



Frank Pia



What Drowning Looks Like

- Instinctive response
- Situations - Distress vs Drowning

Keys to Recognition

- Silent death
- Not much splashing
- Body almost completely submerged
- Hands up - Heads Down

Surface Phase

- 20-60 seconds
- Age dependent



















Rescue

- Never assume the patient is dead
- Direct or indirect rescue
- Golden Rule - *Illegitimi Non Carborundum*

ER Expectations

- Information
 - Time
 - Temperature
 - Type of water
 - Trauma
- Secondary causes

Management

- Rescue breathing - May need PEEP
- 100% NRB. Consider sugar
- C-spine control
- (Begin rewarming)

Prognosis

- If they require CPR - 35-60% die
- Survivors 35-100% have neurological damage
- If they go to the PICU - 30/30/30 rule

Over

- Can high altitude illness occur in low laying Suffern, NY?

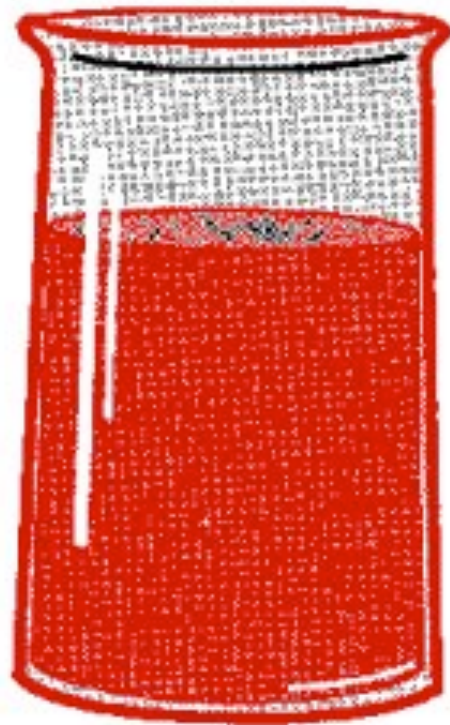
Case Link

- Beaches of Jamaica
- Fat guy goes SCUBA diving
- Now feels sick on the plane home

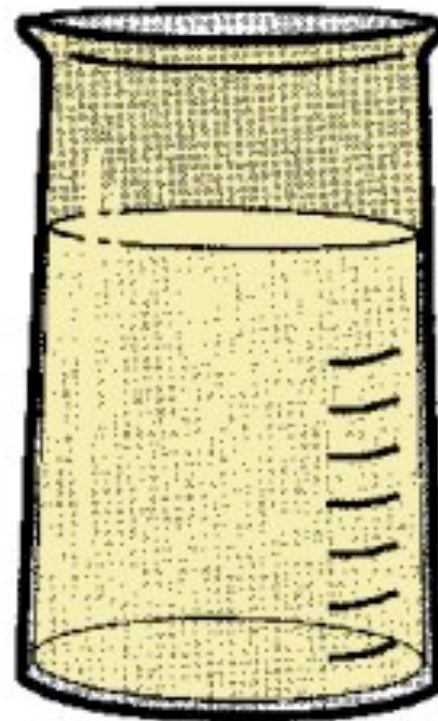
- “Can anyone help?”

Decompression Syndrome

- The body is primarily made up of water (non-compressible) and gas
- Gas is compressible
- Nitrogen dissolves in the blood and tissues and is compressed on descent in water
- Going to altitude can then allow the bubbles to dissolve out and embolize



Beaker 1
Blood (15 grams%
hemoglobin)



Beaker 2
Plasma only

Type I

- Mild pains - “The Niggles” - Resolve in 10 mins
- Itch - “The Skin Bends”
- Rash - Orange Peel Skin
- Pain - “The Bends” - Dull, throbbing, toothache pain. Starts mild and becomes intense. Focus on joints (esp shoulder)

Type 2

- Pulmonary - “The Chokes” - Starts at +12 and goes to +48hrs
- Shock
- CNS - Spinal trauma syndromes, blindness, dizziness
- Gas emboli in any artery (incl coronary)

Altitude Changes

- Decompression syndrome (DCS)
- High Altitude Pulmonary Edema (HAPE)
- Acute Mountain Syndrome (AMS)/High Altitude Cerebral Edema (HACE)

High Altitude

- High Altitude is regarded as $>1500\text{m}$ (4900ft)
- The majority of ski resorts are above this in the USA

Most Common

- Pressurized Planes run their atmosphere at 7000-8000 ft
- Average person
 - Increased heart rate/respiration rate
 - Sats average 94%

La Paz (Bolivia)

- Located at 13,000ft
- Equivalent to breathing 12% oxygen at sea level
- Sats can drop to 84%

Acclimatization

- Depends on rate and magnitude of ascent
- Acclimatization takes weeks
 - Quickest - Oxygen sensors in the neck increase the RR - Blow off CO₂ - Slows breathing (Resp center in brain). Also increase HR and BP
 - Later - Kidneys kick in to balance

Acclimatization

- Other things - Increase Hb
- Interestingly Cheyne-Stokes breathing will occur above 2700m. This is normal.

HAPE

- Pulmonary edema due to leaky capillaries
- In the US 1 per 10,000 skier days/year
- At some resorts the incidence PER DAY runs at 15%

HAPE

- Rapidly Fatal - Within 3 hours of onset
- Usually seen in 2-4 days after ascent
- Accounts for the majority of deaths due to altitude

Treatment

- Descent is the main treatment
- Usually 500-1000m is enough
- Garnow Bag is Emergency Alternative



AMS/HACE

- Essentially the same pathology but less severe
 - Brain gets leaky capillaries
 - AMS - Headaches, nausea, anorexia
 - HACE - Ataxia and ALOC
- Occurs within first 48 hours of ascent

Dysbarism

- Decompression - Recompress
- Altitude - Descent

Reality

- One thing we should remember
 - Transport of patients
 - Idea of closed pockets of air in the body

Case Study

- Patient is involved in MVC en route to the airport to fly home
- Some bruising but feels fine
- Some chest wall pain

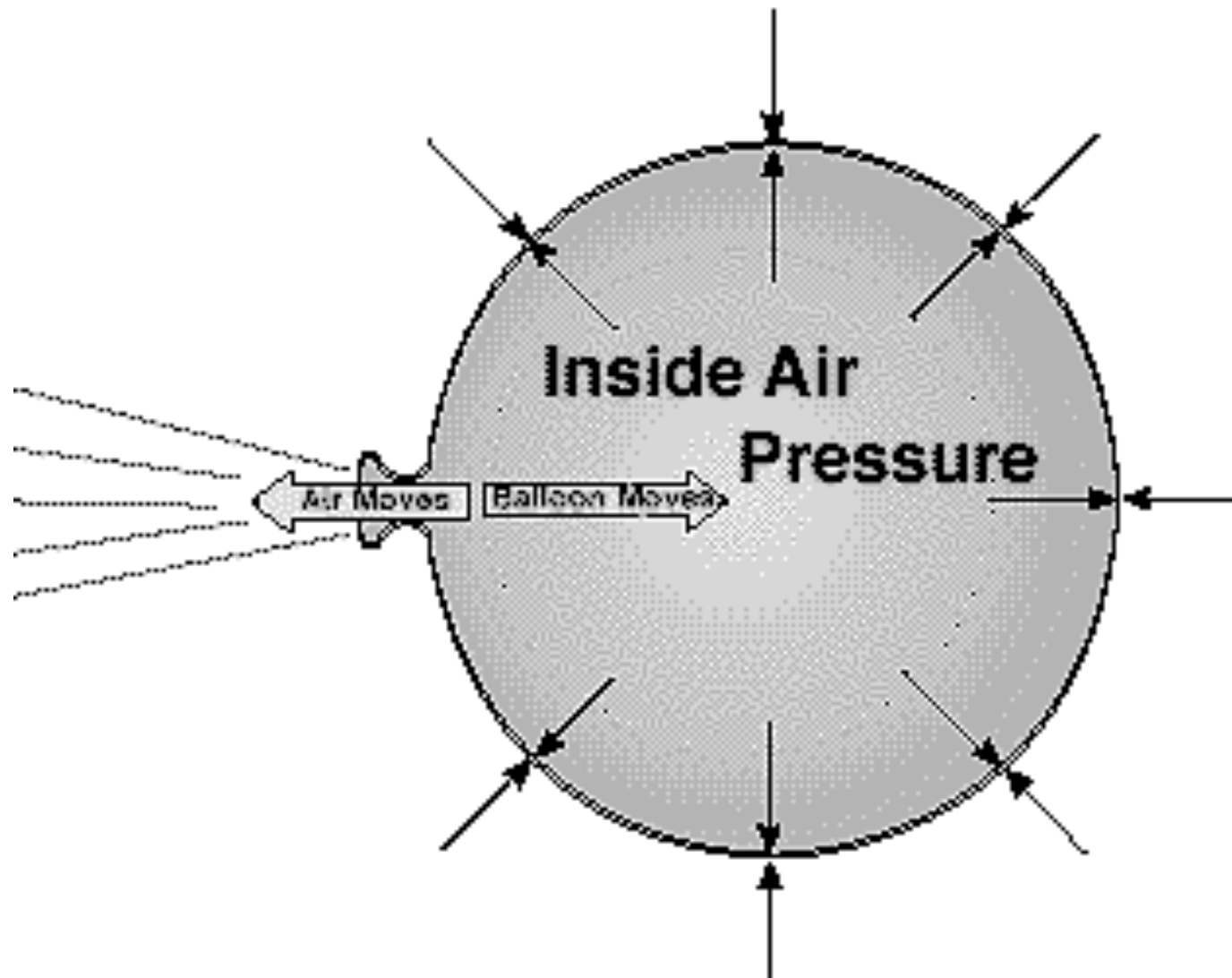
Paula Dixon 1995

- Drs Wallace and Wong
- Noted trachea was deviated

I advised the patient that she had a serious condition and that an operation was required, but she was too ill to give written consent. With the patient seated in her aircraft seat, the operation—the insertion of a chest drain under local anaesthetic—was performed. I planned to insert the chest drain into the left second intercostal space in the mid-clavicular line because this was the most accessible area and would control a tension pneumothorax. As soon as the drain was connected, air was released from the pleural cavity and within five minutes the patient had almost fully recovered. The patient was left sitting in her passenger seat and settled down to enjoy her meal and the inflight entertainment.



Outside Air Pressure



Inside Air Pressure

Air Moves Balloon Moves

Options for treatment

- Drain the pocket
- Change the environment

Hot

- Normal body temperature is about 37C
- Change to that can be extrinsic or intrinsic
- Body generates heat at 1.1 C/hr (goes to 15x that when exercising)
- Post marathon temperatures **AVERAGE** 40C (105.8F) in survivors and 43C (109) in those that collapse

Regulation

- Conduct (2%) - Direct contact
- Convection (10%) - Heat dissipates
- Radiate (65%) - Thru electromagnetic waves
- Evaporate (30%) - Sweat and breathing

Problems

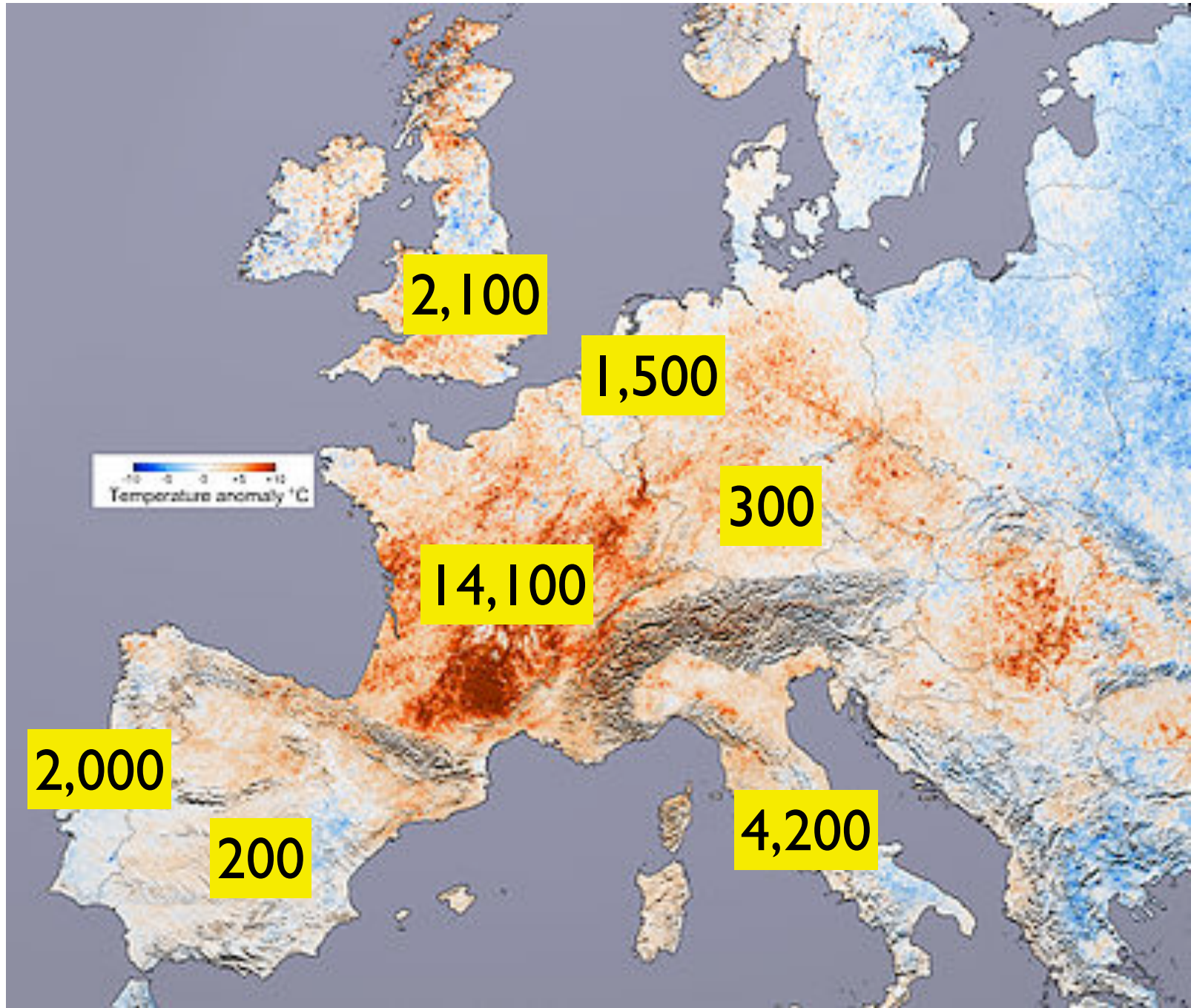
- If the ambient temperature goes to 35C
 - Conduction - NO
 - Convection - NO
 - Radiation - NO
 - Evaporation - YES

BUT

- Then if humidity goes to almost 100%
 - Conduction - NO
 - Convection - NO
 - Radiation - NO
 - Evaporation - NO

Does this happen

- Ambient temperature 35C
- Humidity >95%
- France 2003 - 14,300 heat related deaths



Reality

- Risk of death is related to peak temperature, duration of exposure and acclimatization period

Types of Heat Injury

- Heat exhaustion
 - Dizzy, cramps, tired, headaches, nausea, irritability

Heat Stroke

- Hyperthermia above 40F
- CNS dysfunction
- 50% sweat, 50% don't
- Guess the 2 hour mortality

Mortality

- From heat stroke
 - 70% at two hours!

Treatment

- Cool rapidly - but avoid shivering!
- Alcohol baths/fans/sprays/wet blankets
- “Ice the family jewels”

Are we going to see this in NY?

- Yes
 - Ecstasy/PCP/Cocaine
 - Delerium tremens
 - Overdoses

Cold

- Hypothermia may complicate drowning
- May be bad, may be good
- May be accidental, may be induced

Hypothermia

- Body movement induces heat production
- The body will shiver down to 30C
- Below 20C there is no activity on an EEG and the patient is “Brain Dead”

Location of Patients

- Most cases of hypothermia occur in an URBAN setting
- 21% of people die if they reach 30C
- 40% of people die if they reach 28C

Hypothermia

- Mild (32-35C) - Confusion, shivering, poor motor control, diuresis
- Moderate (28-32C) - Delerium, slow reflexes
- Severe (<28C) - Unresponsive, coma, abnormal ECGs

Reality

- Hypothermia often reflects some other pathology and treatment must be directed at both the cause and the effect

Treatment

- ???Warmed fluids???
- Ambient heat
- Active rewarming

How things have changed!

- 1999 - You have to be warm to be dead

2012

- You have to be cooled **AFTER** being warmed **AFTER** being cooled to be dead!

Induced Hypothermia

- Been used in cardiac surgery for years
- Then came to Emergency Department Care
- Now being done in EMS

Wake County EMS

- In ROSC patients - Now apply cold saline via IV and apply ice packs to the armpits and groin. If they shiver they paralyze them
- Reported results May 2008

Results

- Odds ratio of restoration of complete neurological function
 - Age - 0.97
 - Bystander CPR - 2.65
 - New CPR - 3.19

Induced Hypothermia

6.21

Closing the loop

- The earliest studies for hypothermia and survival from cardiac arrest came from drowning victims

Closing Points

- Remember the video of a drowning victim
- Don't be surprised now you know to look for it

One More Thing

- The next hypothermia treatment
 - EPR

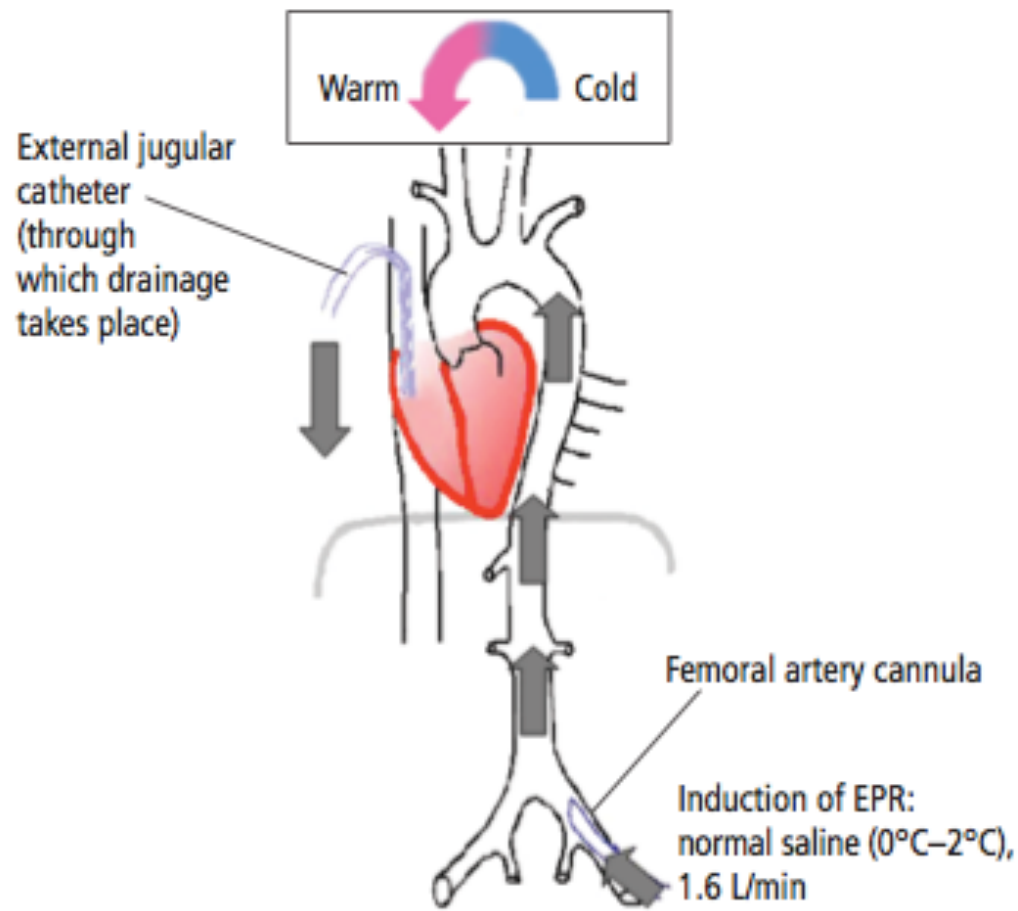


FIGURE 2. Schematic of aortic cold flush for the induction of emergency preservation and resuscitation (EPR) to rapidly create a transient state of hypothermic preservation in otherwise lethally injured victims of exsanguination cardiac arrest. After damage-control surgery, resuscitation is performed via cardiopulmonary bypass (see text for details).

Scientists Will Test Extreme Hypothermia on Pittsburgh Trauma Patients



ABCNews Nov2011.

Emergency preservation and resuscitation with profound hypothermia, oxygen, and glucose allows reliable neurological recovery after 3 h of cardiac arrest from rapid exsanguination in dogs

Xianren Wu^{1,2}, Tomas Drabek^{1,2}, Samuel A Tisherman^{1,3,4}, Jeremy Henchir¹, S William Stezoski¹, Sherman Culver¹, Jason Stezoski¹, Edwin K Jackson⁵, Robert Garman⁶ and Patrick M Kochanek^{1,3}

Journal of Cerebral Blood Flow & Metabolism (2008) 28, 302–311

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