

Practical Aspects of Cooling (In Traumatic Brain Injury)



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characteristics of an ideal temperature control device can be identified.

- ◆ enable high speed of induction with little or no 'overshoot'
- ◆ enable reliable maintenance of temperature at the desired level within a narrow range
- ◆ Slow and controlled return to normothermia

Characteristics

- ◆ an acceptable amount of workload for the medical, nursing and technical staff
- ◆ purchase and maintenance costs of the cooling device and disposables should be acceptable
- ◆ IS THIS A REALITY??

What you need before cooling

- ◆ Team with ICU experience
- ◆ Training
- ◆ Written protocol
- ◆ Cardiovascular monitoring
- ◆ Temperature measurement from 2 independent areas.



Before cooling

- ◆ Intubation and ventilation
- ◆ Deep sedation – BIS
- ◆ ?Muscle relaxants (prevention of shivering)
- ◆ Device designed for cooling – no wet blankets or ice packs under arm pits!
- ◆ Base line bloods

Problems must be monitored

- ◆ Dysrhythmias are common.
- ◆ Cooling shifts potassium into the cells, causing hypokalaemia, while warming shifts potassium back into the serum.
- ◆ Hypothermia results in significant peripheral vasoconstriction and hypotension can occur on rewarming.
- ◆ potential for coagulopathy, thrombocytopenia and neutropenia.
- ◆ Skin breakdown can occur secondary to the intense vasoconstriction and frequent repositioning is required.
- ◆ Shivering impairs the ability to achieve and maintain the target temperature.

During Cooling

- ◆ Continual central temperature & peripheral
- ◆ U&E checks 4 hrly (K & gases more frequently – acid base balance especially if on propofol)
- ◆ Insulin release inhibited therefore glucose checks frequently
- ◆ Daily blood cultures
- ◆ Full haemodynamic monitoring
- ◆ Pulse oximetry may be unreliable due to peripheral shut down
- ◆ Assess bowel sounds – GIT absorption
- ◆ Increase skin inspection

HEAD TRAUMA

- ◆ Likely to be accompanied by cervical spine injury
- ◆ Difficult to roll onto some cooling systems
- ◆ Increases the risk of skin damage as skin cannot be inspected as often
- ◆ Cooling over days increases complications

CT – Trips off the ICU

- ◆ Regular trips to CT – cooling interrupted as systems are not mobile
- ◆ Reactive hyperthermia is a risk during interruptions to cooling
- ◆ Causing CVS instability and risk of increased brain metabolism and secondary brain injury
- ◆ Thiopentone to be considered to facilitate CT as interruption to cooling may cause rise in ICP

Replacing Potassium

- ◆ Cooling shifts potassium into the cells, causing hypokalaemia, while warming shifts potassium back into the serum
- ◆ IV only
- ◆ Gut motility will be reduced
- ◆ NG products sit in the gut
- ◆ Re warming and the patient begins to absorb
- ◆ K⁺ load absorbed
- ◆ This together with cell shifts can result in K in xs of 6

Re warming

- ◆ Do not stop core temp monitoring
- ◆ Elevate blanket temp gradually using a protocol
- ◆ Be aware of the hazards



Re warm

Slowly!

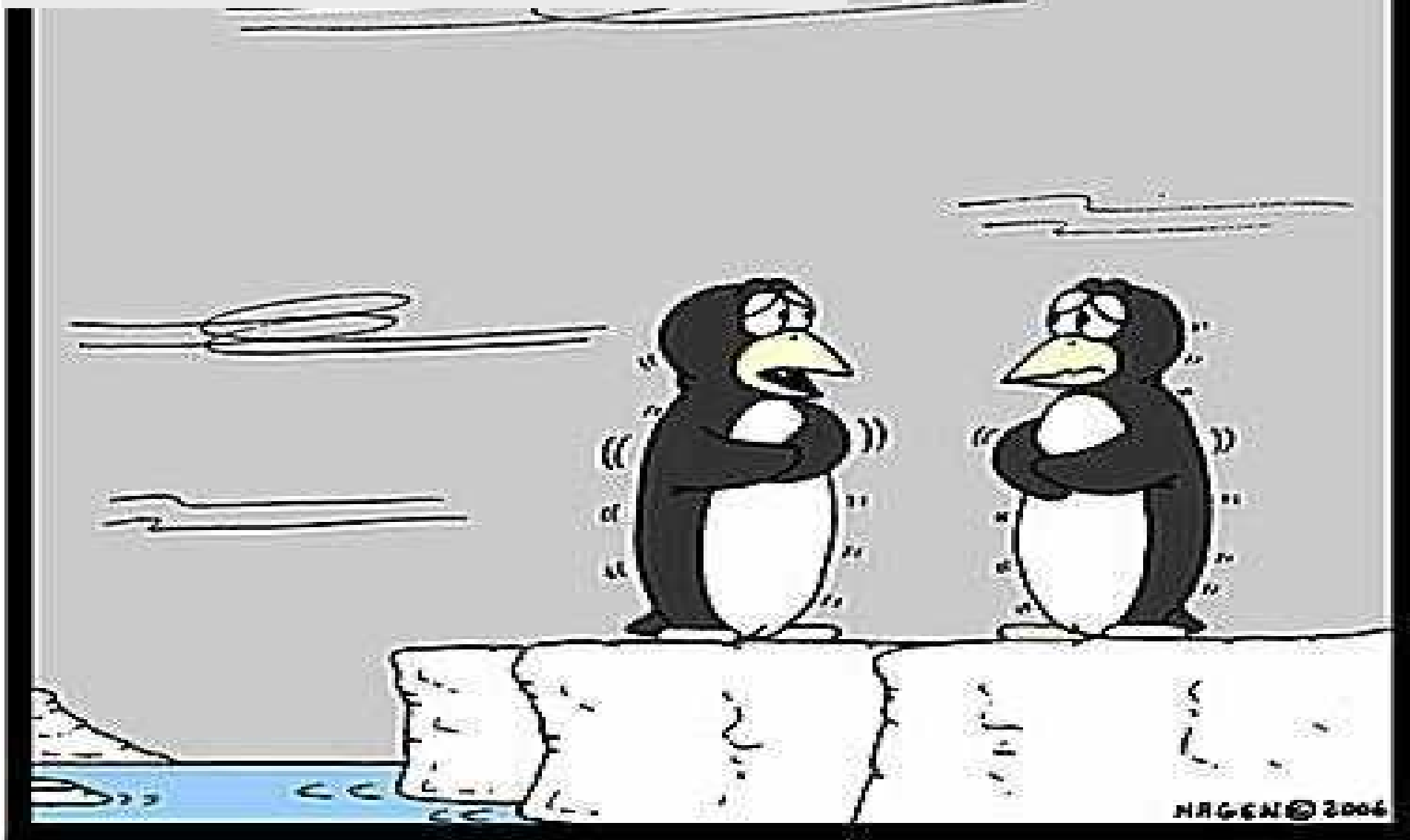
**NOT RECOMMENDED
FOR**

**PYREXIA CONTROL IN
NON ACUTE PATIENTS**

Cooling in non acute situations

- ◆ May be possible if control of the water temp circulating into the system can be achieved
- ◆ Only highly efficient systems can be used in this situation as others will struggle to bring high temps down
- ◆ Surface temp of most products = 10 degrees, sometimes as low as 4 deg
- ◆ Culture everything
- ◆ Treat the cause
- ◆ Can be difficult to manage if brain stem causes for high temp in TBI

This is torture – give me a shot of sedation and wake me up after global warming!



Shivering

- ◆ Negates benefits of cooling
- ◆ Noxious stimulus
- ◆ Increases O₂ consumption in Organs
- ◆ Increases lactate build up
- ◆ Must be controlled
- ◆ Deep sedation
- ◆ Muscle relaxants / BIS

Skin Damage

Increased risk over days

SKIN

- ◆ Temperature of the cooling wrap/blanket
- ◆ Can be as low as 4 deg! (usually 10)
- ◆ Frost bite may result
- ◆ Wrap peripheries to protect them
- ◆ Patterned surface wraps can severely mark the skin

SKIN

- ◆ Bony prominences are vulnerable
- ◆ Wraps can cause skin marking and damage
- ◆ Regular inspection of the skin and peripheries essential
- ◆ Beware cooling + inotropes can increase the risk of organ damage and peripheral shut down

BOWELS

- Adhere to bowel regimes
- Increased risk of bowel obstruction
- General surgeons not amused when referred a patient with a distended abdo full of frozen faeces
- Expensive body wraps need to be replaced when the patient is incontinent

Systems in use at WCNN ICU

Practical problems
encountered

Used on ICU WCNN

- ◆ Body wrap system
- ◆ Expensive disposables £180 per wrap
- ◆ Wrap can be used for 72 hours
- ◆ Costs can rack up when soiled
- ◆ Wrap to be filled with fluid prior to placing on the patient – very difficult to log roll on to it – very heavy
- ◆ Water tank often over filled due to misleading markings flooding the floor!
- ◆ Floods when put on standby if unit over filled and clips not applied
- ◆ Skin marking with use beyond 24 hours
- ◆ One size fits all – difficult so assess chest movement

Risks

- ◆ Temperature de-fault after being switched off to 33 deg
- ◆ Cleaning difficult therefore contamination risk – legionella
- ◆ Technical support
- ◆ Flooding = hazard with wires and slips, especially if you haven't noticed

Over/underlay blankets

- ◆ under sheet and over sheet
- ◆ Water circulates through them
- ◆ Because of the ridged nature of the sheet it tends to rest on bony prominences eg, knees and toes resulting in local skin damage
- ◆ Poor surface area contact therefore not efficient

Overlay

- ◆ Problems with overshoot
- ◆ Struggles to cool if patient has an underlying pyrexia
- ◆ If struggling – blanket temp plummets to 4 deg
- ◆ Condensing water on blanket top pools and drips
- ◆ There is an updated model which uses wraps –
- ◆ we have problems sourcing components for the old model

Surface pads – adhere to skin

- ◆ Expensive disposables (as with all!)
- ◆ Can be wiped down when soiled
- ◆ Problem with application if there is skin trauma?
- ◆ Good temperature control.
- ◆ Easy application of skin pads.
- ◆ 40% body surface area coverage
- ◆ Efficient and no overshoot



All systems are probably
hard to control to any fine
point

Choosing the least
troublesome is key!

Intravascular cooling

- ◆ Most reliable method
- ◆ May need a second line for certain drugs?
- ◆ Risks associated with line changes
- ◆ Line may be left in after therapy and used as a regular central line
- ◆ Triple lumen
- ◆ Subclavian and femoral

Intravascular Cooling



Financial aspects

- ◆ Wraps etc average at £200 each
- ◆ Should be disposable
- ◆ Beware – advances in machinery mean *your* model may become obsolete
- ◆ Unable to source components & disposables
- ◆ Intravascular disposables around £600 but may work out the cheaper option as soiled wraps are changed

A rep is not just for Xmas – friend for life

- ◆ Training for staff
- ◆ Literature & research materials
- ◆ Can link you in with others using the system
- ◆ Help you share information & protocols
- ◆ Road test the system thoroughly before committing to purchase
- ◆ Look at as many models as possible
- ◆ Speak to ICUs using the system for an unbiased appraisal
- ◆ Make sure you know the level of technical support you will get once money has changed hands

Therapeutic hypothermia

- ◆ Hazardous
- ◆ Needs strict control
- ◆ Highly trained staff
- ◆ Risk of secondary problems
- ◆ Level III evidence in head injury
(Outcome) Level I evidence for ICP control
- ◆ Work intensive
- ◆ Expensive

Any Questions?

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