

Perioperative Hypothermia: An Old Nemesis Revisited

Terry C. Wicks, CRNA, MHS
Anesthesia Department Director
Catawba Valley Medical Center
Hickory, North Carolina





A Real Life Case...

- 74 year old female
- Self inflicted GSW
- S/P ex lap
- 7 units of blood products overnight in the ICU
- Hx hypothyroidism, depression, HTN
- Presents to OR at 0730 for emergent splenectomy
- Hypotensive, bradycardic, lethargic, early signs of DIC
- Verrrry sick...



After Induction...

- 8 mg etomidate & 50 mg rocuronium.
- Bp 74/42, hr 48, etco₂=12, BIS=7...
- Nasopharyngeal temperature = 83 degrees F.
- Splenectomy successful (25 min. skin to skin)
- Warmed with forced air blanket to 87 degrees
- Transported, intubated to ICU whereupon...

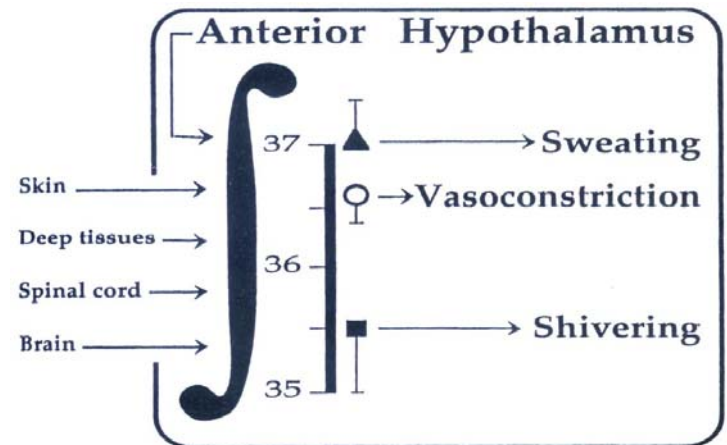


Presentation Outline

- Normal thermoregulation
- Effects of anesthesia
 - General
 - Neuroaxial
- Causes of hypothermia
- Consequences of mild hypothermia
- Preventing & managing hypothermia

Normal Thermoregulation

- Narrow presets...37 degrees C (+/- 0.2)
- Positive and negative feedback
- Three phase process:
 - Afferent thermal sensing
 - Central regulation
 - Efferent responses



Afferent Input

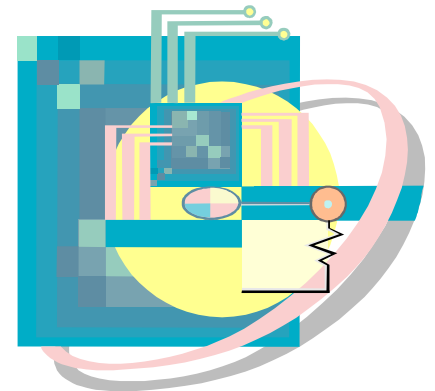
- Both “warm” and “cold” receptors
 - Brain
 - Spinal cord
 - Abdomen
 - Thorax
 - Skin
- Cold signals travel in A delta and unmyelinated C fibers
- Ascend to the brain in anterior spinothalamic tracts





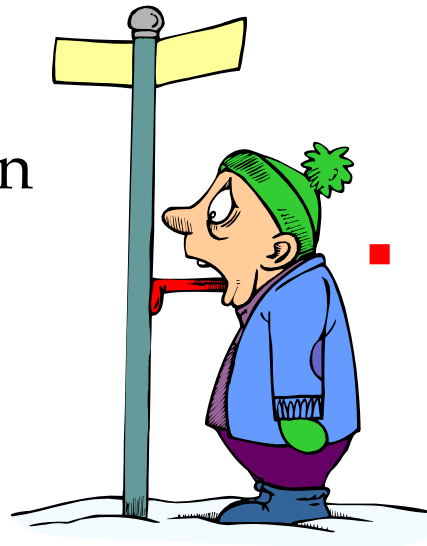
Central Control

- Hypothalamus integrates information from the CNS and periphery
- Autonomic responses determined by core input
- Behavioral responses primarily reflect skin surface input



Efferent Responses

- Increase heat production
 - Non shivering thermogenesis (minor in adults, major in infants)
 - Shivering (absent in infants, major in adults)
- Reduce heat loss
 - Cutaneous vasoconstriction
 - Closure of thermoregulatory arteriovenous shunts
 - Behavioral responses



Hypothermia During Anesthesia

- Heat is lost to the environment
- Presets are “re-set”
- Compensatory mechanisms are dampened or eliminated
- Winter sets in...



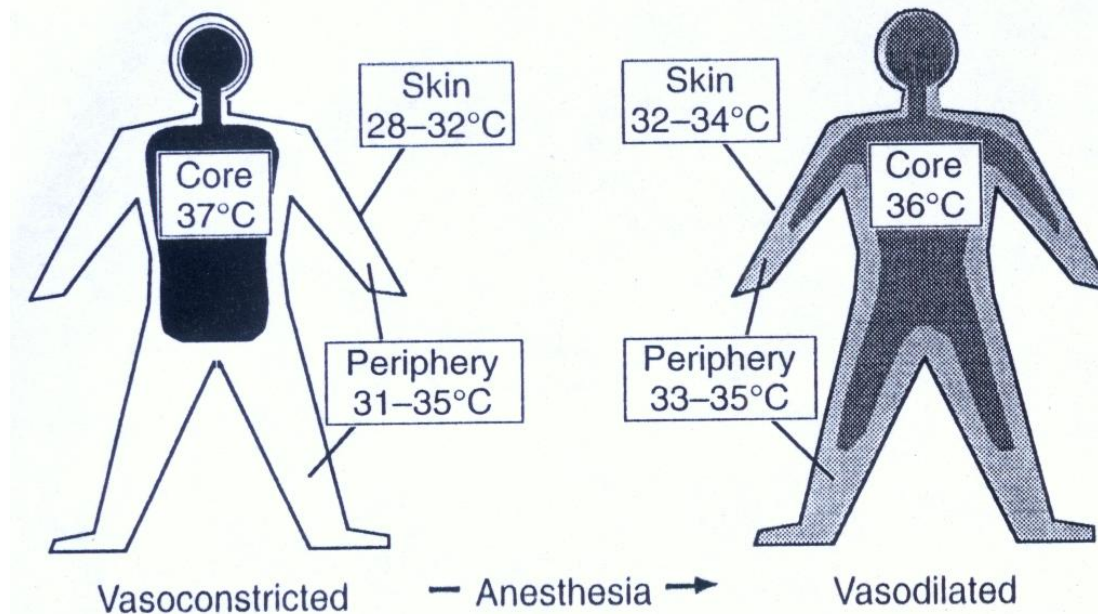


Causes and Patterns of Heat Loss

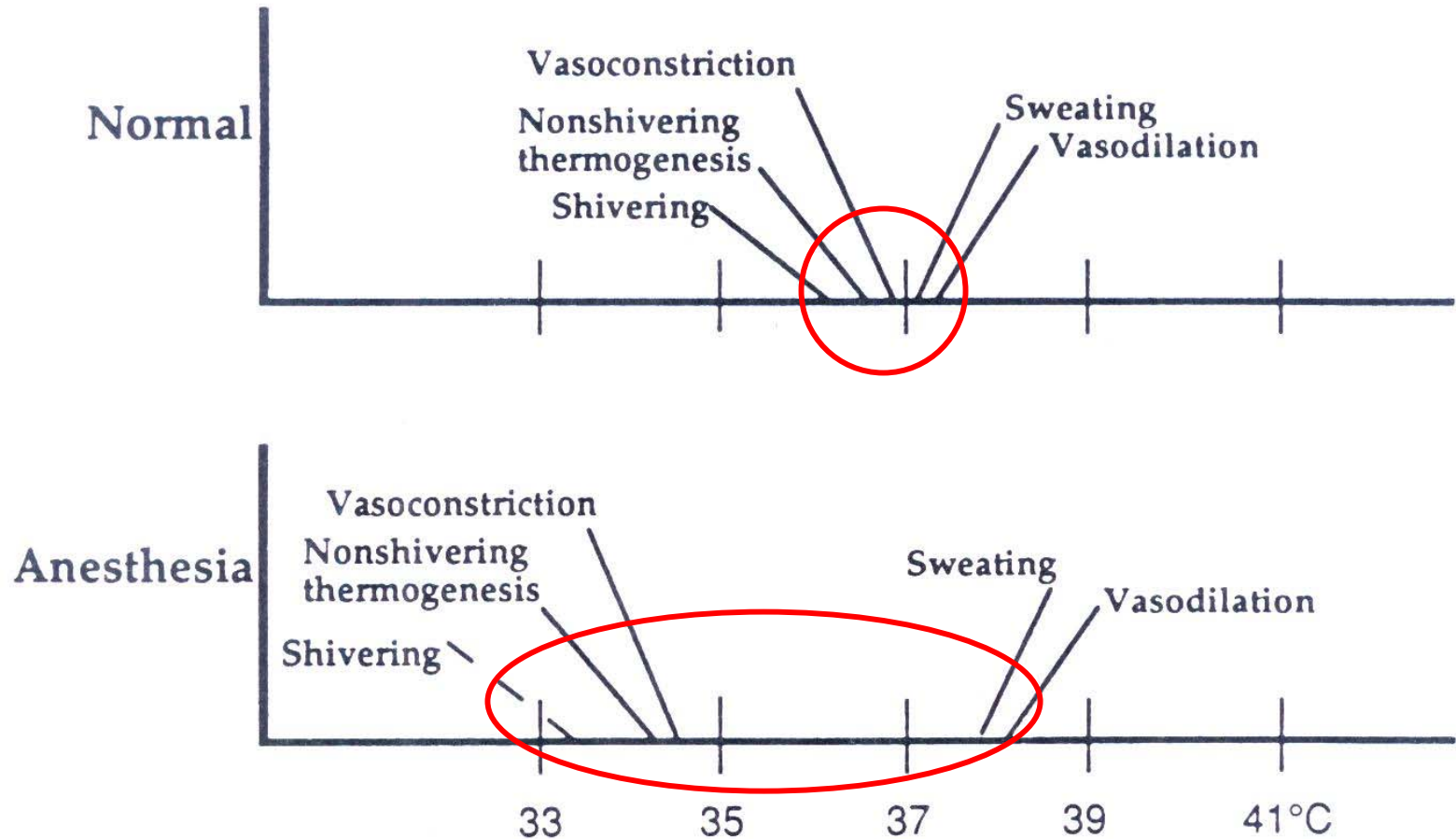
- **Radiation**: major source of heat loss, temperature gradient dependent
- **Conduction**: minor (adjacent surfaces)
- **Convection**: wind chill (moving conduction)
- **Evaporation**: heat lost through wounds, can be significant

Causes and Patterns of Heat Loss

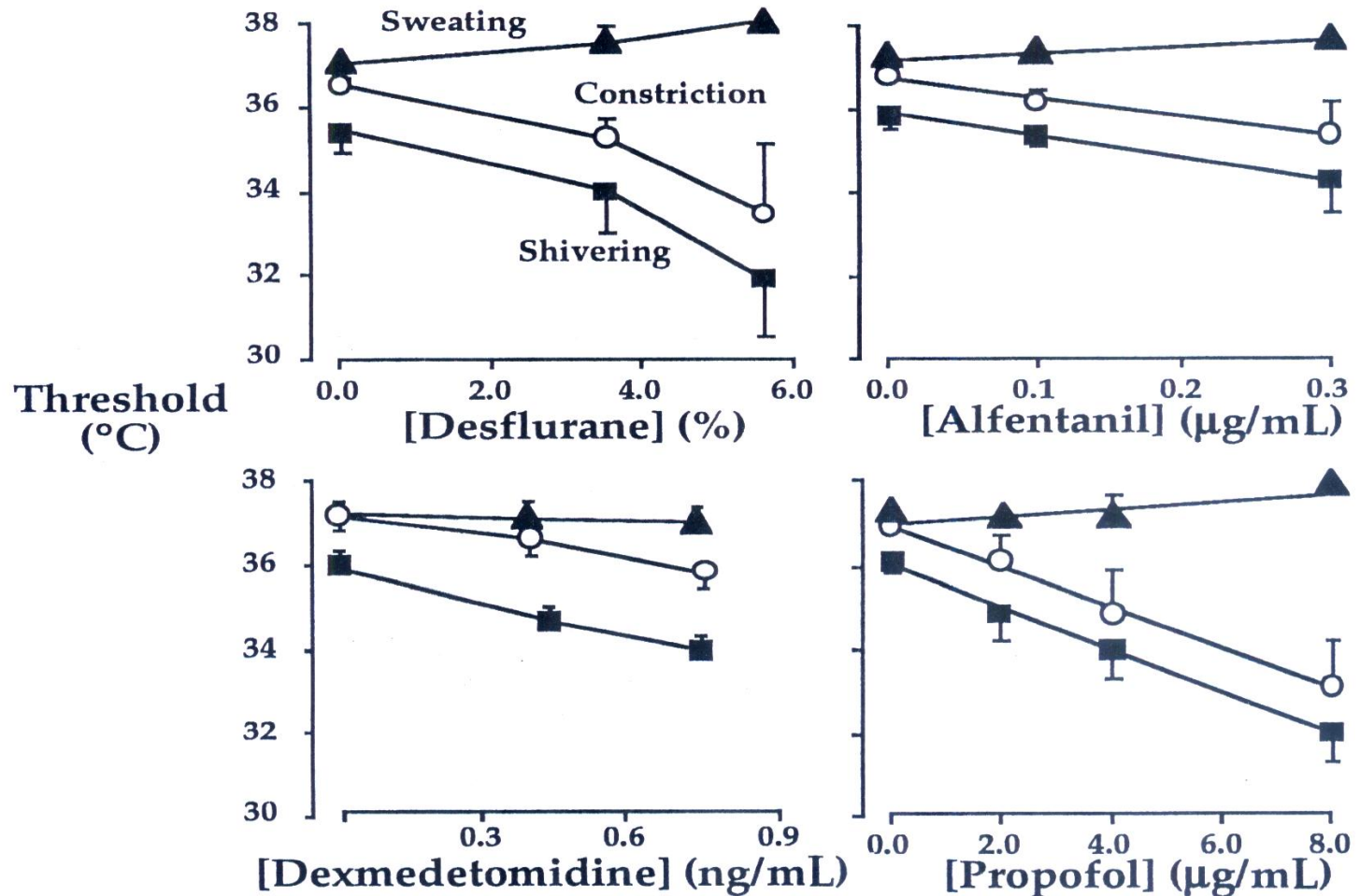
- Initial rapid decrease in core temperature
- Slow reduction in core temperature
- Core temperature stabilizes



Effects of General Anesthesia



Effects of General Anesthesia





Effects of Neuroaxial Anesthesia

- Vasoconstrictive and shivering thresholds are lowered.
- Thermal inputs from blocked segments are altered.
- Sedatives impair thermoregulatory control.
- Patients may not “feel” cold.



Benefits of Mild Hypothermia

- Substantial protection against ischemia and hypoxia (1-3 degrees).
- May be indicated for carotid endarterectomy or neurosurgery.
- Malignant hyperthermia is more difficult to trigger and is less severe.



Complications of Hypothermia

- Coagulation defects
 - Impaired platelet aggregation
 - Impaired coagulation enzyme activity
- Increased wound infections
- Postop thermal discomfort
- Increased myocardial events
- Altered drug kinetics and dynamics



Complications of Hypothermia

Wound infections	6%	19%
Blood loss	1.7 +/- 0.3 L	2.2 +/- 0.5 L
Cardiac events	1%	6%
Duration of vecuronium	28 +/- 4 min	62 +/- 8 min
Time in PACU	53 +/- 36 min	94 +/- 65 min

Challenges in Management

- Initial reduction in core temperature is difficult to prevent (thermoregulatory effect). *Hint: try pre-warming.*
- Surgeons resist raising ambient temperatures.
- Vasoconstriction goes both ways.

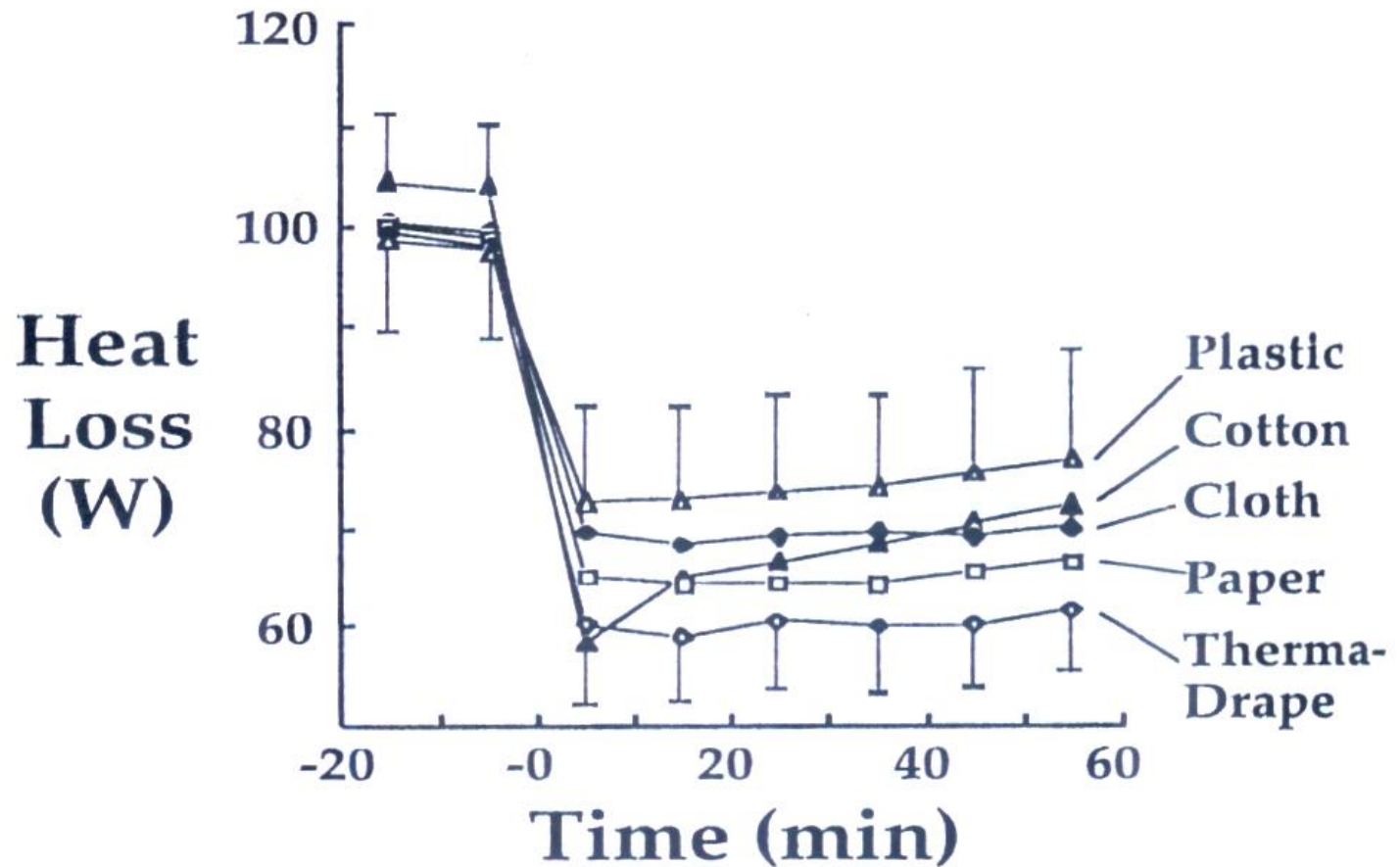




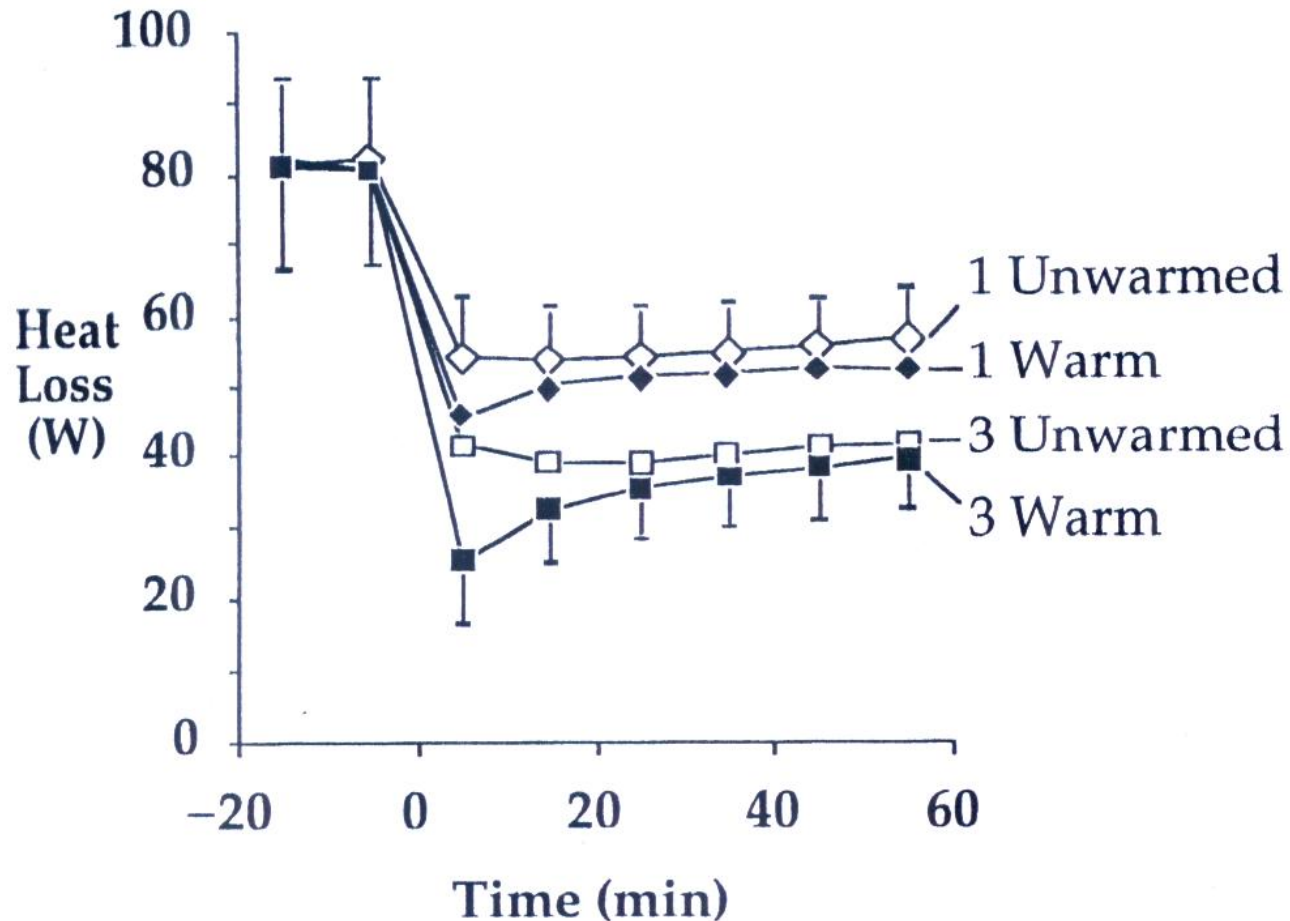
Interventions to Preserve Heat

- Airway warming
 - Passive: HMEs
 - Active: heaters
- Fluid warmers...it's all about the same
- Cutaneous warming
 - Room temperature
 - Passive insulation
- Forced air, the undisputed champion...

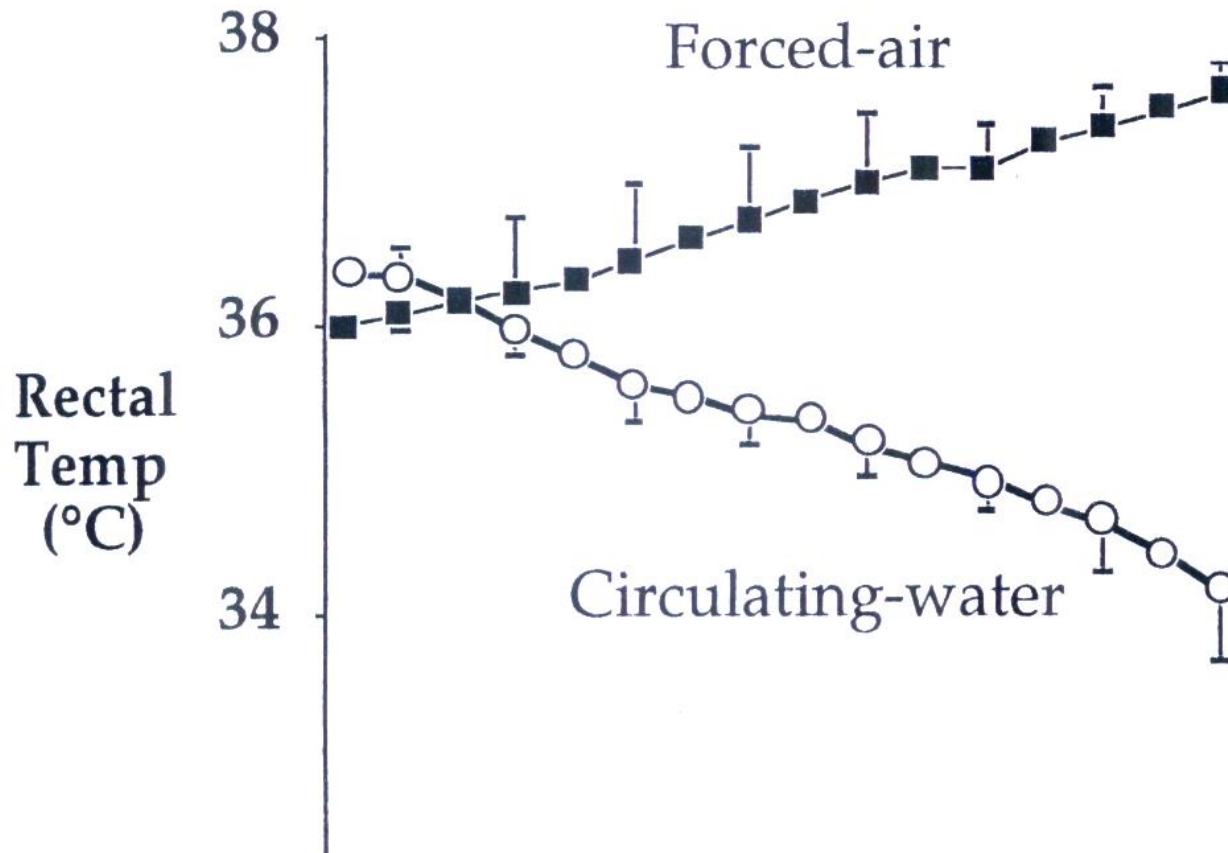
Passive Insulation I



Passive Insulation II

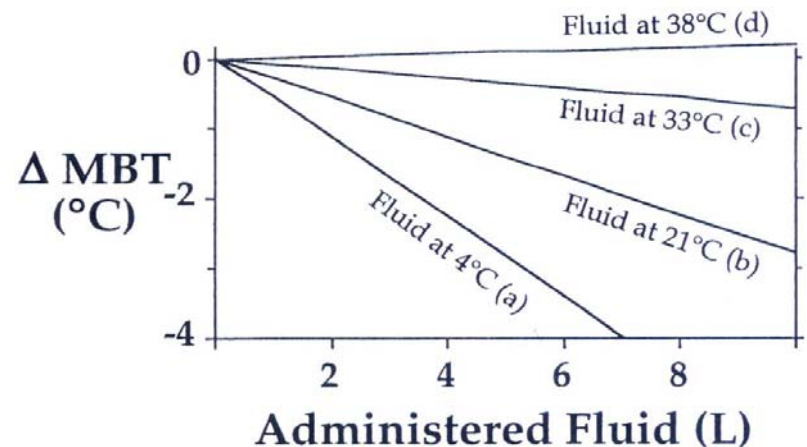
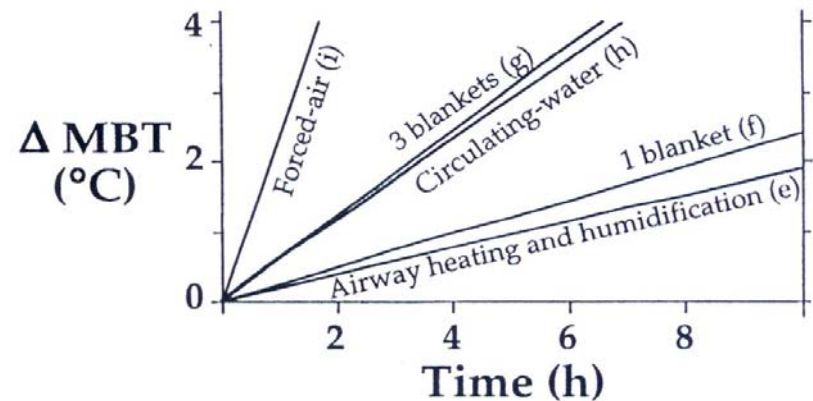


Stuff That Really Works...



Looking at the Big Picture...

- Fluid warmer can make a difference.
- Force air blankets are the most effective at putting heat into the system.





Conclusions...

- Heat loss during surgery is nearly unavoidable.
- Prevention of hypothermia is preferable to treatment, and is cheaper.
- Use the things that work.
- Discourage those that don't.



Questions?

