

Hypothermia

- The human thermoregulatory system usually maintains core body temperature within 0.2°C of 37°C
- Perioperative hypothermia is common because of the inhibition of thermoregulation induced by anesthesia and the patient's exposure to a cool environment
- Up to 60% of patients have temperatures less than 36°C upon admission to PACU

Normal Thermoregulation

- Major autonomic defenses against heat:
 1. Sweating
 2. Cutaneous vasodilation
- Major autonomic defenses against cold:
 1. Cutaneous vasoconstriction
 2. Nonshivering thermogenesis
 3. Shivering

Normal Thermoregulation

- Vasoconstriction occurs in AV shunts located primarily in fingers and toes, mediated by α -adrenergic sympathetic nerves
- Nonshivering thermogenesis is important in infants, but not in adults (brown fat)
- Shivering is an involuntary muscle activity that increase metabolic rate 2-3 times

Factors Contributing To Hypothermia

1. Cold OR suites
2. IV fluids (unless warmed)
3. Exposed viscera and cold irrigating solutions
4. Dry non-humidified inspired anesthetic gases
5. Reduced body metabolism (heat production)
6. Vasodilation
7. Anesthesia interferes with regulatory mechanisms

Mechanisms of Heat Loss

- Radiation: Contributes to most of heat loss – up to 60%
- Convection: Due to loss of heat to air immediately surrounding the body – up to 30%
- Evaporation: Occurs from cleaning fluids, skin, respiratory, bowel and wound surfaces
- Conduction: Du to heating surfaces in contact with the body such as OR table or cold fluids

Phases of Heat Loss under Anesthesia

- Redistribution: Typically in the first hour after induction due to vasodilation causing redistribution of heat from the core to periphery
- Linear Phase: Core temperature decreases linearly over the next 2-3 hours
- Plateau Phase: When patients become sufficiently hypothermic they restrict core-to-peripheral flow of heat by thermoregulatory vasoconstriction – may be impaired in autonomic neuropathy and combined regional/general anesthesia

Consequences Of Hypothermia

Advantages

- Provides substantial protection against cerebral ischemia and hypoxia – $CMRO_2$ decreases by 8% per degree Celsius decrease
- Slows the triggering of Malignant Hyperthermia and reduce its severity

Consequences Of Hypothermia

Disadvantages

1. Wound infection---the most common serious complication due to:
 - Impaired immune function
 - Decreased cutaneous blood flow
 - Protein wasting
 - Decreased synthesis of collagen

Consequences Of Hypothermia

2. Coagulopathy

- Hypothermia reduces platelet function and decreases the activation of the coagulation cascade
- Increases blood loss and the need for transfusion

Consequences Of Hypothermia

3. Cardiac – just 1.5 °C of core hypothermia triples the incidence of VT and morbid cardiac events
4. Drug Metabolism – drugs relying on liver metabolism and / or renal excretion have prolonged half-lives

Treatment And Prevention

1. Forced air warming blanket (most effective)
2. Heated humidifiers and lower fresh gas flows
3. Warmed IV fluids
4. Warm room temperature
5. Radiant heat lamps

Hypothermia Conclusions

- The combination of anesthetic-induced thermoregulatory impairment and exposure to cold operating rooms makes most surgical patients hypothermic
- Perioperative hypothermia is associated with adverse outcomes, including: cardiac events, coagulopathy, and wound infections
- Unless hypothermia is specially indicated, the intraoperative core temperature should be kept above 36 °C (36-38 °C)