

Risk

- Greater in infants and children
- Greater in longer, larger operations
- Similar in RA and GA

Perioperative Risks

- Surgical wound infections
- Coagulopathy
- Reduced drug metabolism
- Prolonged recovery and hospitalization
- Shivering and thermal discomfort

Overview

- Benefits:
 - Improved neurologic recovery in asphyxiated neonates
 - Decreases triggering and severity of malignant hyperthermia.

- Core temperature normally protected by responses that include sweating, vasoconstriction, and shivering.
- Typical doses of GA have little effect on the sweating threshold but decrease vasoconstriction and shivering thresholds 2–4° C, thus increasing the range of temperatures not triggering protective responses 10-fold from approximately 0.4–4° C.
- RA inhibits thermoregulatory control by preventing peripheral responses (such as vasoconstriction) and centrally by reducing afferent input.

Etiology

- Initial 0.5–1.5° C decrease in core temperature from core-to-peripheral redistribution of body heat.
- Subsequently, slow, linear decrease in core temperature from heat loss exceeding heat production.

- Finally, a core-temperature plateau results when thermoregulatory vasoconstriction decreases cutaneous heat loss and constrains metabolic heat to core thermal compartment.

Usual Treatment

- Forced-air is by far the most commonly used warming method, typically increasing mean body temperature 1° C/h.
- 1 L of crystalloid at 20°C or 1 U of blood at 4° C decreases mean body temperature approximately 0.25° C in adults. Fluid warming should be restricted to pts given large volumes of fluid (i.e., ≥2 L/h).
- Passive insulation (e.g., surgical drapes, cotton blankets) decreases heat loss 30%, which is usually insufficient to maintain periop normothermia.
- Airway heating and humidification is ineffective.

Assessment Points

System	Effect	Dx	Treatment
CNS	Ischemia protection Thermal discomfort	None Visual analogue scale	Induce and maintain hypothermia Active cutaneous warming
VASC	Precapillary dilation; reduced SVR Arteriovenous shunt constriction, increased BP, decreased HR	Associated with sweating Fingers feel cold, approximately 10 mm Hg increase in mean arterial pressure	Active or passive cooling Active cutaneous warming
MS (shivering)	Two-fold to three-fold increase in metabolic rate Pt discomfort Interference with monitoring	Visual inspection O ₂ consumption	Prevent hypothermia Meperidine 10–25 mg IV Clonidine 75 mcg IV Active cutaneous warming
IMMUNE	Increased risk of surgical site infection	Clinical infections	Prevent hypothermia
HEME	10% increase/° C in blood loss	Bleeding time PT/PTT falsely normal	Prevent hypothermia Defect probably not reversed by FFP and platelet transfusions
METAB (increased drug action)	MAC decreases approximately 5%/° C Decreased drug metabolism	Monitor drug action (rather than dose)	Titrate drug administration to desired endpoint Monitor twitch depression

Key Reference: Sessler DI: Perioperative thermoregulation and heat balance, *Lancet* 387: 2655–2664, 2016.

Perioperative Implications

Preoperative Preparation

- Active prewarming for 30–60 min helps prevent redistribution hypothermia.

Monitoring

- Four core temperature sites are accurate: pulm artery, distal esophagus, tympanic membrane (with a contact thermometer), nasopharynx.
- Three additional sites suitable except during cardiopulmonary bypass: mouth, axilla, bladder.
- Best site for postop temperature monitoring is the mouth.

Intraoperative Period

- Maintain normothermia (core temperature >36° C) unless otherwise indicated.
- Sufficient passive or active reduction of heat loss will prevent hypothermia; however, active warming is usually required.
- Once triggered, thermoregulatory vasoconstriction effective in preventing further core hypothermia.
- Community standard of care is to monitor core temperature in pts having general anesthesia lasting more than 30 min and to keep core temperature ≥36°C.

Postoperative Period

- Hypothermic pts should be rewarmed with forced air.
- Shivering and thermal discomfort can be specifically treated.
- Postop warming not a substitute for maintaining intraop normothermia.

Anticipated Problems/Concerns

- Hypothermia has been proven to cause numerous life-threatening complications and should be actively prevented unless therapeutic hypothermia is specifically indicated.

Hypothyroidism

John F. Butterworth

Risk

- Hypothyroidism may be present in 2–5% of the general population and is more common in women and the elderly.
- Approximately 3% of adults receive chronic thyroid replacement.

Perioperative Risks

- If inadequately treated, increased risk for hypothermia, hypotension, cardiac failure, and GI dysfunction.
- Periop mortality rate not increased unless overtly hypothyroid.

- Inadequate thyroid replacement associates with adverse obstetric outcomes and developmental delays in the offspring, but screening for hypothyroidism during pregnancy remains controversial.

Worry About

- Predisposition to hypothermia.
- Neuromuscular weakness may impair weaning from mechanical ventilation.

Overview

- Common condition, particularly in adult women.
- Elevated TSH concentration in blood is hallmark lab finding.

- Subclinical hypothyroidism (persistent increase in TSH despite normal T₄) sometimes present month to year before decreased T₄ concentration.
- Adequacy of T₄ replacement defined by TSH concentrations in the low-normal range.
- Total and free T₄ (and usually T₃) concentrations typically reduced.
- Symptomatic pts with TSH >10 mU/L should receive maintenance thyroid hormone replacement (T₄ 0.8–2 mcg/kg daily).
- Pts presenting with severe, untreated hypothyroidism or myxedema coma may also demonstrate hypothermia, hypoventilation, hyponatremia, hypotension, heart failure, bowel obstruction, and hypoglycemia.