

An Evidence-based Warming Protocol Compliant with the ERAS[®] Society Guidelines Recommendation for Perioperative Normothermia

Solventum Perioperative Normothermia Protocol

An evidence-based protocol, based on global guidelines: ERAS, WHO, CDC, ACORN (Australia), ANZCA, ACPAN, ACS, AORN, ASA (US), DGAI (Germany), NICE (UK), ORNAC (Canada), SEDAR (Spain), SFAR (France), and SIAARTI (Italy).

Prewarm, Monitor, Maintain.

Pre-op



Prewarm

with forced-air warming for at least 10 minutes on highest setting.²⁹



Monitor

patient's core body temperature.



Prewarming prior to the induction of anaesthesia helps to maintain normothermia and mitigate the effects of heat redistribution caused by anaesthesia.

Intra-op



Warm

with forced-air warming prior to anaesthesia administration and continue to warm throughout the procedure. The gap from prewarming to IntraOp warming should be less than 10 minutes.³⁷



Monitor

patient's core body temperature continuously during surgery.³⁸



Maintain

patient's core body temperature near 36.5°C (36.6 + or - 0.5°C).³⁹

Every minute in delay of active warming increases odds of hypothermia by 5%.³⁷

Fluid warming should be used if more than 1L of IV fluid will be administered.³⁴

Post-op



Warm

with forced-air warming until patient is thermally comfortable and not shivering.¹³



Monitor

patient's temperature on admission to recovery room and then every 15 minutes until 36.0°C or above.



Maintain

patient's core body temperature near 36.5°C (36.6 + or - 0.5°C).³⁹

By maintaining a patient's core body temperature near 36.5°C (36.6 + or - 0.5°C), patient length of stay has been shown to be reduced by 2.6 days.³⁹

Introduction

With the sole exception of the bariatric guidelines, all other ERAS Society guidelines recommend the prevention of perioperative hypothermia.¹⁻¹⁸ Table 1 summarises the individual recommendations and evidence assessment in each guideline. The “NO” labels in the table simply mean there is no recommendation, not that the practice is prohibited.

Table 1:
Warming and temperature monitoring recommendations in each ERAS Society Guideline.

Primary	Temperature Monitoring	Prevent Perioperative Hypothermia	Forced-Air Warming	Other Warming Methods	Fluid warming	Prewarming	Intraoperative warming	Postop warming	Evidence Level	Recommendation Grade
Gynecologic/Oncology	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High	Strong
Gastrointestinal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	NA	Strong
Gastrectomy Surgery	No	Yes	Yes	Yes	No	Yes	Yes	Yes	High	Strong
Radical Cystectomy	No	Yes	No	No	No	No	No	No	NA	Strong
Pancreaticoduodenectomy	No	Yes	Yes	Yes	No	Yes	No	Yes	High	Strong
Elective Colon	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High	Strong
Elective Rectal/Pelvic	Yes	Yes	No	No	No	Yes	No	No	High	Strong
Bariatric	No	No	No	No	No	No	No	No	NA	Strong
Hepatic	No	Yes	No	Yes	No	No	No	No	Moderate	NA
Head/Neck	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High	Strong
Breast	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Moderate	Strong
Caesarean Delivery	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Moderate	Strong
Cardiac Surgery	No	Yes*	Yes	Yes	Yes	No	Yes	Yes	High	Strong

*Avoidance of early postoperative hypothermia

The purpose of patient warming is the maintenance of intraoperative core temperature within a normothermic temperature zone, which is clinically defined as core temperatures between 36.0°C and 37.5°C.¹⁹⁻²¹ The highly predictable post-induction decrease in core temperature is dominated by a redistribution of heat within the body that is caused by an anaesthesia-mediated decrease in systemic vascular resistance.^{22, 23} In adults, heat loss is usually not a substantial cause of intraoperative hypothermia, although it can be an important contributor during long surgeries. However, because children have substantially greater body-surface-area-to-mass (BSA:M) ratios than adults, intraoperative heat loss can be a substantial cause of intraoperative hypothermia.²⁴ The large BSA:M ratio also makes it very easy to maintain paediatric normothermia with intraoperative warming and heat preservation techniques.²⁵

In adults, patient-warming efforts are made to minimise the effect of postinduction redistribution, minimise cutaneous heat loss, and restore normothermia; however, the therapeutic strategy differs depending on whether hypothermia is being prevented or treated. This means that each of the three perioperative warming phases has a distinct purpose and must be handled differently.

Preoperative phase:

Prewarming increases the energy content of the body by elevating the mean body temperature (MBT), not the core temperature. The goal of pre-induction warming is to transfer enough energy (200-300 KJ) to prevent post-induction hypothermia without causing significant thermal discomfort or sweating.^{26, 27} As nearly all these patients have an intact thermoregulatory system, which actively resists a heat imbalance, an effective method to increase MBT is to rapidly and aggressively warm the patient for only a brief period due to the inevitable thermal discomfort that occurs during an intentional heat imbalance.^{28, 29} From a nursing perspective, the prewarming phase may be the most challenging because it requires anticipation of an unseen event (redistribution), lacks an effective assay, and can produce thermal discomfort.

It is not practically possible to prewarm patients solely by minimising heat loss from the skin; prewarming requires the transfer of heat into the body by an active warming device. Forced-air warming is a very effective method for transferring heat into the body primarily because it can easily recruit substantial amounts of skin surface. Forced-air prewarming is effective in patients undergoing neuraxial, general, or combination anaesthesia. All adult patients scheduled for any type of anaesthesia of duration greater than 30 minutes should be considered candidates for prewarming.³⁰

Intraoperative phase:

Most of the temperature decrease that occurs intraoperatively is caused by redistribution, which cannot be rapidly reversed by any type of cutaneous warming.³¹ Heat loss during the intraoperative phase contributes approximately 20% to the immediate post-induction decrease in core temperature.^{22, 23} Intraoperative warming transfers a small amount of heat into the body, but it can also reverse approximately 100 W of heat loss.³² Intraoperative core temperature monitoring is essential because it helps detect hypothermia and malignant hyperthermia.³³ Intravenous fluid warming is an adjunct therapy that cannot increase core temperature; however, if more than 1 L of fluid will be administered during the procedure, it should be warmed to prevent further decreasing core temperature.³⁴

Postoperative phase:

The purposes of postoperative warming are to reverse existing hypothermia and produce a sensation of thermal comfort, which is the one anaesthesia-related outcome for which patients are willing to pay.³⁵ These two purposes are interrelated since thermal comfort depends largely on the existence of normothermia; however, stimulation by heat of the peripheral thermoreceptors can produce thermal comfort even in the context of hypothermia.³⁶

Infants and Children:

As discussed above, rewarming rates in infants and children are much greater than those in adults because of the substantial differences in body-surface-area-to-mass ratios.²⁴ Children may be at increased risk from the complications of hypothermia, so it is very important to maintain intraoperative normothermia in children.²⁴ At present, it is not known from experimental data at what BSA:M threshold prewarming is beneficial; however, a comparison of cooling and rewarming rates in infants and children can provide some guidance.²⁵ At a body mass of 15 kg or less, cooling and rewarming rates are nearly identical; however, as body mass increases beyond 15 kg, rewarming rates are slower than cooling rates, suggesting that some benefit may attach to prewarming children who weigh more than 15 kg.²⁵

With respect to the use of fluid warming in children, continuous infusions of blood or fluids up to 30 mL/kg do not require warming as the decrease in core temperature associated with the infusion can be easily reversed by forced-air warming.³⁴

Protocol Recommendations

1. All surgical patients, and especially all infants and children, should have their core temperature monitored continuously during the entire perioperative period. If continuous measurements are not possible, core temperature should be measured at least every ten minutes.
2. Prior to surgery, all adult patients scheduled for neuraxial, general, or combined anaesthesia should be prewarmed with a forced-air warming device on its high-temperature setting for at least ten minutes. Longer periods of prewarming can be accomplished by adjusting the warming unit setpoint temperature to the highest setting that does not cause sweating or excessive thermal discomfort. Prewarming should be considered for children who weigh more than 15 kg.
3. The amount of time between the end of prewarming and induction of anaesthesia should be as brief as possible, but ideally fewer than 10 minutes.²⁷
4. If more than 1L of intravenous fluid will be administered during the procedure, a fluid warmer should be used. In children, fluid warming should be considered when continuous infusions of more than 30 mL/kg are anticipated.
5. During surgery, all patients with anticipated anaesthesia durations ≥ 30 minutes should receive intraoperative forced-air warming with a blanket that can cover the largest possible amount of skin surface. The warming unit should be operated on the lowest temperature and blower settings that maintain the core temperature within the normothermic range. Infants and children should be warmed unless contraindicated.
6. After surgery, all surgical patients should be warmed until they are thermally comfortable and have a core temperature within the normal range.

This protocol is compliant with ERAS® Society recommendations for perioperative normothermia. On the next page you will find a helpful tool which summarises and visualises this evidence-based warming protocol.

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KCI Medical Australia Pty Ltd | Level 3, Building A, 1 Rivett Road, North Ryde, NSW 2113 | 1300 363 878

KCI New Zealand Unlimited | Suite 1701, Level 17, PwC Tower, 15 Customs Street West, Auckland 1010 | 0800 808 182

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