

HYPOTHERMIA, DETECTION, PRESCRIPTION & PATHOPHYSIOLOGY

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DEFINITION

Inadvertent hypothermia is defined as a core temperature below 36o C (Bernard 2013; Mulry & Mooney 2012; National Institute for Health and Clinical Excellence (NICE) 2016; Winslow et al. 2012, ACORN 2023)

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Monday et al. 2023 remind us that despite an abundance of perioperative research on warming interventions (Munday et al., 2020) and implementation of warming bundles and pathways, hypothermia outcomes have not improved (Alfonsi et al., 2019; Duff et al., 2018).

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BACKGROUND

Over the past 30 years, there has been increasing awareness of the physiological mechanisms and effects of temperature on perioperative morbidity and mortality (Koh et al. 2021)

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INADVERTENT PERIOPERATIVE HYPOTHERMIA (IPH)

- Anaesthesia and surgery lead to impairments in central and peripheral thermoregulatory responses which are exacerbated by cool ambient operating room temperatures and exposed body cavities, resulting in inadvertent perioperative hypothermia (IPH) (Koh et al. 2021)
- Clinical guidelines recommend that active warming should be used perioperatively to prevent surgical complications that are associated with high costs and reduced quality of life such as surgical site infections and bleeding (Conway et al. 2019)

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QUIZ

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QUIZ

Please rate the importance of these vital signs 1-4

- Conscious state
- Respiratory rate
- Blood pressure
- Temperature

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QUIZ

Is there a connection between B/P and temperature?

In hypothermia there is _____

In hyperthermia there is _____

Thus, a patient does not have a stable B/P until they are normothermic

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SEQUELAE OF IPH

Older research

Inadvertent hypothermia has been associated with increased mortality rates (Billeter et al. 2014)

- in elective operations there was a 4-fold increase in mortality
- doubled complication rate (sepsis & stroke increased the most) (Billeter et al. 2014)

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NEWER RESEARCH

In a more recent meta-analysis 9 randomised control studies (RCT) and 11 observational studies were reviewed;

RCT-synthesized results showed that intraoperative hypothermia was associated with higher risks of bleeding (MD = 131.90, 95%CI: 117.42, 146.38)

- higher risk of surgical site infection (RD = 0.14, 95%CI: 0.06, 0.21)
- higher risks of shivering (RD = 0.32, 95%CI: 0.06, 0.58)
- there were no significant differences in duration of surgery, hospital stay or mortality
- Authors stated that it is still critical to normalize the hypothermia prevention (Xu et al. 2020)

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SALIENT AUSTRALIAN RESEARCH

Salient Australian research conducted in 2014 involving 4 major hospitals and 350 participants revealed;

- the incidence of Perioperative Inadvertent Hypothermia (PIH) was 32%
- 80% did not have a temperature documented intra-operatively
- only 8.8 had a temperature documented for each perioperative phase (pre-op intra-op & post-op)
- 45% of intra-op patients & 77% of post-operative patient did not receive active warming when required
- contrary to recommended practice 47% of patients were hypothermic at discharge from PACU (Duff et al. 2014)

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SALIENT AUSTRALIAN RESEARCH

The audit revealed poor compliance with evidence-based recommendations (Duff et al. 2014)

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THERMAL REGULATION

- Balance between heat production and heat loss
- Complex highly sensitive feedback system
- Sensing afferent → central integration with set-point → reflex efferent (Taylor, Tipton & Kenny 2014)

Normothermia 36o C - 37o C

Hyperthermia - Hyperpyrexia 41o

Hypothermia

- mild 34o C - 36o C
- moderate 30o C - 34o C
- severe < 30o C (Mulry & Mooney 2012)

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COSTINGS

Older costings suggest that a possible reduction of cost from between \$2500 and \$7000 per surgical patient may occur if normothermia was maintained (Burns 2001 as cited in Moola & Lockwood 2011)

Newer research suggests it is likely that increasing use of active warming by implementing the thermal care bundles would generate cost-savings and improve the quality of life for surgical patients (Conway et al. 2019)

Inadvertent hypothermia is defined as a core temperature below 36o C (Bernard 2013; Mulry & Mooney 2012; National Institute for Health and Clinical Excellence (NICE) 2016; Winslow et al. 2012)

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CONTRIBUTING FACTORS

- **Ambient operating room temperature (Moola & Lockwood 2011)**
- **Fasting reduces metabolic rate (Bernard 2013)**
- **Type of surgery**
- **Length of surgery**
- **Age**

(Mulry & Mooney 2012)

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GENERAL ANAESTHESIA

- Impaired thermoregulation/ depresses the hypothalamic thermoregulating centre (Moola & Lockwood 2011)
 - Skeletal muscle relaxants and central nervous system depressants
 - Abolish shivering
 - Eliminate motor activity
- Regional anaesthesia
- Cause vasodilation of the affected area
 - Abolish shivering and eliminate motor activity of the affected area

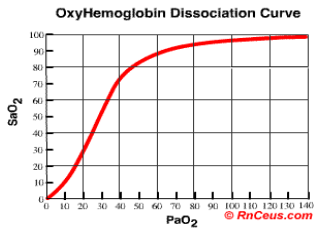
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PHYSIOLOGY

- ECG
- Arterial fibrillation < 30o C
 - Ventricular fibrillation < 28o C
- Respiratory
- Decrease and ceases at 24o C
 - Increase O2 requirement when shivering
- Metabolic
- Left oxyhaemoglobin shift
- Neurological
- Cerebral blood flow decreases 7% per o C
- Gastrointestinal
- Decrease to 34o C- ileus common

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OXYHAEMOGLOBIN DISSOCIATION CURVE



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INCREASED COMPLICATIONS SUCH AS:

- Infection (Koh et al. 2021)
- Impaired wound healing (Koh et al. 2021)
- Adverse cardiac events
- Impaired coagulation (Koh et al. 2021)
- delayed drug metabolism (Koh et al. 2021)
- Complication costs increased the cost of surgery (Conway et al. 2019; Winslow et al. 2012)
- Delayed wound healing and infection occurring in 40% of patients with hypothermia (Mulry & Mooney 2012)
- Stroke & sepsis (Billeter et al. 2014)

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It is preferable and easier to prevent IPH than to treat it (Australian College of Perioperative Nurses 2020)

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PREVENTION

Several risk factors for developing hypothermia were found to be amenable to treatment and were;

- anaemia
- unintended weight loss
- chronic renal impairment
- Severity of illness on admission
- >65
- Male

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RISK FACTORS CONTINUED

- Neurological disorders (Billeter et al. 2014)
- Identifying at risk patients for intraoperative warming
- ASA grade 11-V
- planned combined general and spinal anaesthesia major surgery
- known risk of cardiovascular complications
- age – infant and older adults (over 65)
- hypothyroidism
- general, regional, or neuraxial anaesthesia with a duration of longer than 30 minutes (Australian College of Perioperative Nurses 2020)

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WHEN SHOULD TEMPERATURES BE TAKEN?

- Temperature should be taken;
- within the hour prior to transfer to the perioperative suite,
 - on arrival to the holding bay,
 - immediately preceding induction of anaesthesia,
 - every 15 minutes when forced air warming is being instigated (I would do this every 10 minutes with the regular observations),
 - every 30 minutes for other patients,
 - on admission to PACU and every 15 minutes thereafter,
 - prior to making a decision on discharge from PACU (Australian College of Perioperative Nurses 2023).

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ACORN STANDARDS STATE THAT;

Healthcare providers have a duty to provide appropriate temperature monitoring devices which provide a core or near core reading however the choice of temperature device will depend on the several factors including, patient situation, acuity, surgical procedure and clinical context (Australian College of Perioperative Nurses 2020).

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MANAGEMENT OF HYPOTHERMIA

Take every patients' temperature in the P.A.C.U. on arrival

- remember "after-fall"
- administer O2 by mask
- remove wet coverings
- rewarm every hypothermic patient prior to discharge
- monitor the E.C.G. and B/P during rewarming
- 5 minutely B/P checks and provide fluids as needed
- inform anaesthetist (if not immediately after the list so as they may alter their management)
- forced air convective warming blanket

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WARM BLANKETS

NB warm blankets (passive warming) are a lovely 'caring' initiative but are not part of active temperature warming.

- The active warming method resulted in a shorter time to warming in hypothermia after surgery and an increase in the perception of thermal comfort and body temperature (€Ozsaban & Acaroglu 2020)

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PRE-WARMING

Preoperative warming methods need to be instigated if;

- patients who are experiencing discomfort prior to surgery,
- patients with a core preoperative temperature of less than 36o C, where a patient has two or more risk factors for hypothermia (Australian College of Perioperative Nurses 2020)

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BARRIERS TO COMPLIANCE

Compliance to international perioperative temperature management guidelines in Asia-Pacific remains poor, especially in small hospitals

- Barriers to compliance were limited temperature management equipment,
- lack of locally-relevant standard operating procedures and training (Koh et al. 2021)

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WHAT TO DO

It is likely that increasing use of active warming by implementing the thermal care bundles would generate cost-savings and improve the quality of life for surgical patients (Conway et al. 2019)

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WHAT IS A BUNDLE?

A care bundle is a set of evidence-based interventions (maybe 3 to 5) that when delivered together to improve outcomes more than if they were administered separately (Lavallée et al. 2017)

It is suggested to keep the care bundle elements simple, logical and easy (Oliver 2019)

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CASE STUDY

- 68 year old lady with a history of osteoarthritis
- Post total hip replacement
- Spinal anaesthesia with sedation
- Vital signs after 40 minutes in P.A.C.U.
- Conscious, drowsy – easily roused

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POSTOPERATIVE PATIENT

- H.R 84
- SaO2 97% on 6 litres
- B/P 100/68
- Resp. 18
- Discharge to ward at this time *
- In the ward the temperature is FINALLY taken
- It is 34.3

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POSTOPERATIVE PATIENT



- The ward rewarms the patient
- The patient has a sudden attack of chest pain
- The B/P at this time is 60/40

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QUIZ

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DISCUSSION

In what climate do you think hypothermia is worse, cold or hot????????????????????

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DISCUSSION



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