ACORN AUSTRALIAN COLLEGE OF PERIOPERATIVE NURSES | JOURNAL OF PERIOPERATIVE NURSING

Volume 31 | Issue 1 Article 4

3-1-2018

Inadvertent postoperative hypothermia prevention: Passive versus active warming methods

Jessica Watson
Jessica.watson2@svha.org.au

Recommended Citation

Watson, Jessica (2018) "Inadvertent postoperative hypothermia prevention: Passive versus active warming methods," *Journal of Perioperative Nursing*: Vol. 31 : Iss. 1 , Article 4.
Available at: https://doi.org/10.26550/2209-1092.1025

https://www.journal.acorn.org.au/jpn/vol31/iss1/4

Peer-reviewed article

Author

Jessica Watson
GradCert (Anaesthetics and recovery)
St Vincent's Hospital
390 Victoria St
Darlinghurst, Sydney
E: Jessica.watson2@svha.org.au

Inadvertent postoperative hypothermia prevention: Passive versus active warming methods

Temperature management within the perioperative environment is an imperative component of and a standard of practice in providing effective patient safety and comfort. This literature review will explore the evidence surrounding the use of active and passive warming mechanisms in the prevention of postoperative hypothermia. Many studies have recognised the adverse consequences of inadvertent postoperative hypothermia, hence the rapid advancement in education about and use of equipment and devices for its prevention. Evidence-based literature was reviewed to provide rationales and recommendations for strategies to prevent postoperative hypothermia. This literature review will potentially guide clinicians through the use of effective devices to allow for informed choices to provide appropriate patient care.

Inadvertent postoperative hypothermia (IPH) is defined as a core body temperature lower than 36˚ C. IPH usually occurs in response to general or regional anaesthesia and transpires due to the vasoconstriction mechanism responsible for maintaining temperature becoming inhibited on administration of anaesthetic agents. Not only is anaesthesia responsible for a 20 per cent reduction in metabolic heat production but also environmental factors such as the cold operating theatre, body exposure and lack of pre-warming for flushing solutions affect the incidence of IPH[1]. Some authors have reported that the incidence of postoperative hypothermia morbidity can be as high as 50 to 90 per cent[2–4]. Perioperative nurses have a primary role in caring for and monitoring patients within the Post Anaesthesia Care Unit (PACU) and it is imperative that they gain increased knowledge of and understanding about the management of IPH to improve patient outcomes.

Background

Various studies have proven that IPH can lead to patients experiencing a variety of physiological changes. These changes can include cardiac arrhythmias leading to cardiac arrest, increased mortality[5], infection and complications of the surgical wound[6], prolonged bleeding[7], and increased discomfort and shivering[8]. According to Giuliano and Hendricks[5] around 70 per cent of surgical patients will experience IPH. As a consequence of complications related to IPH, hospital stays may be prolonged resulting in increased treatment costs for surgical site infections (SSI), increased transfusion needs and extended PACU stays[9]. Temperature management therefore can be cost efficient; however, it is the PACU nurse's role to correctly identify and utilise appropriate warming strategies to provide the patient with a safe and effective perioperative journey[10].

This literature review extensively critiqued and analysed the different ways of managing inadvertent postoperative hypothermia in the postoperative area. This review will help to identify the most cost-

effective and efficient strategies that ultimately will prevent and treat this common surgical complication while providing comfort to patients within the PACU.

Terms

Terms used within this literature review include:

- core temperature – the temperature of the blood and internal organs
- normothermia – a temperature range between 36.5 ˚C and 37.5 ˚C
- hypothermia – core temperature below 36 ˚C
- active warming – a process that transfers heat to a patient
- passive warming – method used to avoid heat loss.

Method

Literature for this review was obtained through the library database from both the University of Tasmania and Walter McGrath library of St Vincent's Hospital. Databases included EBSCO, CINAHL, PubMed, MEDLINE complete, Ovid and Health source: Nursing/academic edition. The initial search terms included 'hypothermia', 'postoperative hypothermia, 'inadvertent hypothermia'; the results were then further refined using the search terms 'nursing hypothermia', 'perioperative hypothermia', 'active warming', 'passive warming' and 'hypothermia in recovery'. The results were limited to adult studies, in full text with English language only, narrowed down to between the years of 2013 and 2017. The literature comprised meta-analyses, systematic reviews, email surveys and randomised control trials.

Management strategies

A combined total of 2594 participants accumulated from 17 studies were included. Recommended prevention strategies to maintain or restore normothermia that have been identified in this review include:

- passive warming aimed at reducing heat loss via cotton blankets and surgical drapes
- administration of warm fluids both intravenously (IV) and via irrigation
- active warming devices to transfer heat to the patient via forced air-warming
- limiting skin exposure within low temperature operating theatres.

The interventions were then narrowed to studies that included:

- patients over the age of 18 years old that where given a general/deep sedation or regional anaesthetic
- PACU or perioperative care
- strategies/interventions applied until normothermia was maintained or restored.

Exclusion criteria for studies were:

- studies of individuals under the age of 18 years old
- non-clinical or non–human trials
- studies of neurocritical patients
- studies of procedures under local anaesthetic
- ongoing studies
- protocols.

Treatment of IPH can be categorised into active and passive measurements. Active warming measurements are aimed at transferring heat to a patient. These can include forced air warming systems (FAW), warming of IV or irrigation fluids, electric blankets, circulating water garments (CWG) and circulating water mattresses (CWM), radiant warming systems and many more[11]. Passive warming is aimed at reducing heat loss and can include warm cotton blankets or surgical drapes, maintaining warm environmental temperatures and ensuring exposed body surface is adequately covered[12]. The primary outcomes for this study were rate of rewarming and time taken to reach normothermia and severe cardiac complications such as myocardial infarction or cardiovascular death. The secondary outcomes evaluated from the studies include postoperative SSI, blood loss, length of PACU stay or other cardiac complications such as arrhythmias.

It should be noted that throughout this literature review reliability and accuracy of temperature measurement was questioned due to the wide range of measurement devices and routes used, along with variations in hypothermia definitions. Urrútia et al.[13] state that temperature should be measured at the same site as there is a difference between sites. National Institute for Health and Care Excellence (NICE) guidelines[14] suggest patient temperature should be measured from a direct measurement of core temperature using axilla, rectal, pulmonary artery catheter, urinary bladder or sublingual sites. In the postoperative phase the temperature should be taken on arrival to the PACU and every 15 minutes following until discharge to the ward. If the patient's temperature is below 36 ˚C, warming methods must be commenced until the patient is comfortable[14].

Active warming methods

According to literature from Nieh and Su[7] there is a long history of using warming devices to prevent perioperative hypothermia. Among the studies reviewed there was great diversity in results as patients

sometimes received more than one warming intervention. FAW devices recommended by NICE guidelines[14] had favorable results in terms of reaching normothermia. Unsurprisingly FAW systems are the most commonly tested warming modality as they have a significantly greater association with reaching higher PACU core temperatures compared to non-warming systems[15]. Other benefits associated with FAW systems include reduced cardiovascular complications, increased patient comfort, reduction of postoperative shivering and reduced incidence of bleeding complications and SSI[16].

While FAW systems have been used in hospitals for more than 20 years and are proven to be provide significantly better outcomes, they still pose a risk to patients and staff through burn injuries, fire, monitor interference and surgical site contamination[17]. The most common misuse of FAW systems, according to Wu[17], is blowing warm air directly onto patients without using the blanket (known as 'hosing'). However, the statistical risk of complications arising from FAW is unclear. John et al.[15] highlight the low risk of thermal injuries due to incorrect assembly or uneven temperature distribution within the blanket. The incidence of surgical site contamination was contested but not apparent and, following trials during colorectal and clean site surgery, John et al. concluded that FAW significantly reduces surgical site infection[15].

Examining rewarming rates, John et al.[15] compared FAW to polyester-filled blankets (passive system) in hypothermic patients. While the sample size was low and consisted of healthy volunteers, forced warming was the more effective method with patients reaching normothermia within 30 minutes[15]. Using a meta-analysis Nieh and Su[7] revealed the effectiveness and efficiency of FAW, CWM and CWG. FAW was proven to be superior to CWM as it allows for selection of appropriate warming sites and better thermal comfort. However, there was no statistical difference between FAW and CWG in preventing perioperative hypothermia[7]. These results are also inconsistent with those of Lopes et al.[1] who concluded in their meta-analysis that CWG was more effective in maintaining core body temperature compared to FAW or carbon-fibre warming systems.

Nevertheless Lopes et al. did agree and confirm that FAW was more effective than passive warming systems[1]. This makes FAW more cost-effective than passive warming; however, there is not enough conclusive evidence to demonstrate the advantage of CWG. This study is useful for nurses to improve patient care and diminish their postoperative discomfort[7]. However, the use of FAW should take into account patient comfort and comorbidities such as diabetes, peripheral vascular disease or thyroid dysfunctions. One study showed that the cost of CWG was significantly higher than FAW, with CWG costing $2500 to $4000 and requiring a process of sterilisation to prevent contamination between each use. FAW costs between $2000 and $2500, however uses a disposable blanket[7]. Wu[17] also stated that FAW can reduce hypothermia costs by between $3000 and $8000 per patient.

In relation to minimising patients haemodynamic changes, reducing postoperative shivering and maintaining core temperature, warm IV fluids is another favoured warming technique evaluated in multiple studies[1,15,18]. Lopes et al.[1] state that all IV fluids greater then 500ml should be warmed to minimise perioperative hypothermia incidence as per NICE guidelines[14]. On the other hand, John et al.[15] state that with many of the studies analysed, FAW devices were also used in association with warmed IV fluids, highlighting the fact that warmed fluids do not actively warm patients and infusions below normal body temperature can be deemed as active cooling. It is not surprising that Johns et al. showed that IPH was less apparent when fluid warming and FAW where combined[15].

Passive warming methods

In combination with various environmental or individual risk factors Intraoperative hypothermia can be a serious complication for patients. However, IPH is commonly not diagnosed due to lack of appropriate temperature monitoring. While active warming methods have so far proven beneficial, they require long procedural exposure times. Passive warming methods can include cotton blankets, heated drapes, space blankets, increasing the operating theatre temperature or ensuring body exposure during surgery is limited. Fatima et al.[19] established that passive heating methods such as the examples listed above are not efficient in maintaining temperature or preventing postoperative hypothermia. This is because they are unable to prevent heat loss compared to the active methods that inhibit heat loss or provide heat to the body[19].

Koenan, Passey and Rolfe[20] conducted a randomised control trial to determine if reflective blankets were more effective than cotton blankets in reducing perioperative hypothermia. Cotton blankets are usually provided to patients preoperatively and postoperatively for warmth and comfort; however Koenan, Passey and Rolfe state that heat from warm blankets was shown to dissipate within ten minutes with blankets frequently being changed. Metalised plastic sheeting, otherwise

known as reflective blankets, acts primarily as an insulator, reducing heat loss, and has been proven to be significantly more efficient and cost-effective in perioperative temperature management[20].

Adequate information regarding maintenance of patient temperature within the PACU is limited. NICE guidelines[14] suggest the use of cotton blankets, maintaining a room temperature of 20 ˚C to 23.8 ˚C and recording patient's temperature every 15 minutes. A study by Jardaleza et al.[21] was conducted in response to the lack of research available comparing the effectiveness of these passive methods. A warmed blanket was given to the treatment group versus an unwarmed cotton sheet to the control group. It is not surprising that there was a significant difference between the two groups after 30 minutes – the treatment group had higher temperatures and stated via a survey that they were more comfortable in PACU[21].

Conclusion

Inadvertent postoperative hypothermia is a totally preventable complication. To inhibit its occurrence and consequences it is imperative that the perioperative nurse and other professionals have the correct knowledge and skills for prevention and treatment. The findings from the studies reviewed show that appropriate intervention has significant positive effects in maintaining normothermia, reducing shivering and increasing overall patient comfort, and that active warming methods are more effective than passive warming methods. Unfortunately there is a lack of evidence available to clinically assess the reduction in clinical complications. The integrative literature shows that some active warming methods are more effective than others, and the combination of multiple active warming systems are more beneficial than the use of just one. Like other aspects of perioperative management choosing the most appropriate warming method should be based on the individual patient. With an ageing population and an increase in surgeries that expose greater skin area, perioperative hypothermia is a challenge greater then ever before and one which can only be overcome by greater awareness and better understanding of the research and relative effectiveness of specific warming methods[22].

References

1. Lopes I, Magalhaes A, De Sousa A, Araujo I. Preventing perioperative hypothermia: An integrative literature review. J Nurs 2015;4(4):147–155,
2. Singh A. Strategies for the management and avoidance of hypothermia in the peri-operative environment. J Perioper Pract 2014;24(4):75–78.
3. Duff J, Walker K, Edward KL, Williams R, Sutherland-Fraser S. Incidence of perioperative inadvertent hypothermia and compliance with evidence-based recommendations at four Australian hospitals: A retrospective chart audit. ACORN 2014;27(3):16.
4. Duff J, Walker K, Edward KL, Ralph N, Giandinoto JA, Alexander K et al. Effect of a thermal care bundle on the prevention, detection, and treatment of perioperative inadvertent hypothermia. J Clin Nurs 2017. doi:10.1111/jocn.14171.
5. Guiliano K, Hendricks J. Inadvertent perioperative hypothermia: Current nursing knowledge. AORN J 2017;105(5):453–462.
6. Du Plessis. Interventions for treating inadvertent postoperative hypothermia. Cochrane Review 2016;26(8):158–159.
7. Nieh H, Su S. Meta-analysis: Effectiveness of forced-air warming for prevention of perioperative hypothermia in surgical patients. J Adv Nurs 2016;72(10):2294–2314.
8. Robertson M, Dieckmann L, Rodriguez R, Austin, P. A review of the evidence for active preoperative warming of adults undergoing general anesthesia. AANA J 2013;81(5)351–355.
9. Hart S, Bordes B, Hart J, Corsino D, Harmon D. Unintended perioperative hypothermia. Oschner J 2011;11(3):259–270.
10. Australian College of Perioperative Nurses (ACORN). Standards for Perioperative Nursing in Australia 14th ed. Adelaide, South Australia: ACORN; 2016.
11. Fadzlina W, Nazaruddin W, Hardy M. Passive warming using a heat band versus a resistive heating blanket for the prevention of inadvertent perioperative hypothermia during laparotomy for gynaecological surgery. Malays J Med Sci 2016;23(2):28–37.
12. Bernard H. Patient warming in surgery and the enhanced recovery. Br J Nurs 2013;22(6):319–325.
13. Urrútia G, Roqué M, Campos JM, Paniagua P, Cibrian Sánchez S, Maestre L. Active warming systems for preventing inadvertent perioperative hypothermia in adults. Cochrane Database Syst Rev 2013;3(9).
14. National Institute for Health and Care Excellence (NICE). Clinical Practice Guideline CG65. Hypothermia: Prevention and management in adults having surgery [Internet]. London: NICE; 2008 [updated 2016 December, cited 2017 October 8]. Available from: www.nice.org.uk/guidance/cg65.
15. John M, Ford J, Harper M. Peri-operative warming devices: Performance and clinical application. Anaesthesia 2014;69(6):623–634.
16. Dan M, Martos SM, Beller E, Jones P, Randle R, Liu D. Blood loss in primary total knee arthroplasty – Body temperature is not a significant risk factor – A prospective, consecutive, observational cohort study. J Orthop Surg Res 2015;10:97
17. Wu X. The safe and efficient use of forced air warming systems. AORN J 2013;97(3):302–306.
18. Munday J, Hines S, Wallace K, Chang A, Gibbons K, Yates P. A systematic review of the effectiveness of warming interventions for women undergoing cesarean section. Worldviews Evid Based Nurs 2014;11:(6):383–393.
19. Fatima R, Nasciment E, Silveira N, Hermida P, Rasia M. Heating methods in the prevention of intraoperative hypothermia of elective abdominal surgery, Anna Nery School Nursing Magazine 2015;19(4).
20. Koenen M, Passey M, Rolfe M. 'Keeping them warm'—A randomized controlled trial of two passive perioperative warming methods. J Perianesth Nurs 2016;32(3):188–198.
21. Jardeleza A, Fleig D, Davis N, Spreen-Parker R. The effectiveness and cost of passive warming in adult ambulatory surgery patients. AORN J 2011;94(4):363–369.
22. Ralph N. Editorial. ACORN 2017;30(3);3–4.