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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].

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Is your graduate nurse suffering from transition shock?

Abstract

The term 'transition shock' is a relatively new concept used to describe the experience of moving from the comfortable and familiar role of the pre-registration nursing student to the professional registered nurse (RN)[1]. The initial and most dramatic stage in this theory of role adaption occurs over the first four months of professional practice[1].

Transition shock has foundational basis in Kramer's theory of 'reality shock,' which describes the phenomenon of studying for many years to practice a particular role, and then finding the professional reality is different than expected[2]. Reality shock has four phases – the honeymoon phase, the shock phase, recovery and resolution. Dr Judy Duchscher's theory of transition shock penetrates beyond the professional aspects of shock[1].

Duchscher, whose research into this issue in nursing spans over ten years, states that 'nurses often identify their initial professional adjustment in terms of the feelings of anxiety, insecurity, inadequacy and instability it produces[1].' Few would argue that the first few months of a graduate RN's career are the most stressful[3] – consolidating the theory outlined by Kramer.

This paper seeks to define transition shock and outline signs and symptoms which may be exhibited by the graduate nurse. Potential solutions to mitigate the effects of the shock phase on the perioperative graduate will be extrapolated. It is hoped that perioperative nurses will have an improved ability to recognise the issue and, with greater awareness and understanding, potentially be able to improve support for perioperative graduates to ensure a smooth path to successful transition and, in the long term, increase retention of graduates in the profession.

In offering solutions, the logistical issues affecting education and support in the operating theatre are highlighted and issues for potential research are recognised.

Key words: transition shock, graduate nurse, preceptor, stress

What is transition shock?

Over ten years of research, Duchscher proved that transition to professional practice has a significant emotional toll on the graduate nurse. She cites statements such as 'drowning' 'terrified' and 'scared to death' alongside feelings of exhaustion in trying to 'stabilise the emotional roller coaster' the new graduates find themselves on in those first months[1]. Her research showed that graduates nurses fear being 'exposed' as incompetent, fear providing unsafe care and causing harm inadvertently, and fear not being able to cope with their responsibilities. Ultimately they fear rejection by new colleagues[1]. These feelings relate directly to the new graduate's level of confidence and self-image as a professional[1].

Duchscher's theory elucidates how the graduate's role, responsibility, relationship and knowledge foundations impact on the intensity and extent of this transition period[1]. Jewel[3] further states that during this time feelings of self-doubt, inadequacy and exhaustion lead

to a high rate of burnout[3], job dissatisfaction and turnover[4].

According to Kramer, graduates commence in the 'honeymoon' phase. This is observable by traits such as being idealistic about their professional role, and optimistic[5]. Graduates are generally excited about having secured paid employment[6] and commencing in their chosen career[7]. Orientation and supernumary time occur during this phase. Not surprisingly, as the 'reality' of nursing work sets in, graduates find themselves with a disparity between what they have been taught and expect to do, and the reality of actual nursing practice in the workplace. The honeymoon phase ends, and transition shock[3] sets in.

At the commencement of the shock phase, Duchscher states that the graduate will display 'a deliberate withdrawal from the intensity of the shock period'[1]. 'Emotions such as withdrawal, rejection, hostility toward others, fatigue and illness are displayed'[5]. It is successful transition through this phase that this paper seeks to assure for the perioperative graduate.

Sparacino[6] states that 'new graduates equipped with the tools to successfully navigate through the shock phase progress to the recovery' phase. This is evidenced by decreased anxiety[6] and improved coping mechanisms. Kramer's final phase of resolution can be either positive or negative, as the graduate will either transition confidently and go on to become, as per Benner[7], a competent practitioner, or they may exhibit symptoms of burnout and potentially leave the profession altogether[6].

Honeymoon phase idealism excitement optimism		
Shock phase emotional withdrawal rejection, possible hostility fatigue, illness		
Recovery phase reduced anxiety increased coping ability		
Resolution phase		
successful transition to confident and competent practitioner	OR	burnout and possible decision to leave the profession

Solutions

Duchscher describes that maladaptive transitions occur due to lack of practical and emotional support, lack of confidence, uncertainty in relating to new colleagues, and unrealistic performance expectations[1]. Several solutions can be tentatively proposed.

In the perioperative environment, graduates need, first and foremost, a supportive and positive nurse unit manager (NUM). The NUM must provide, through leadership, a positive work environment[8] and culture of collaboration, while also fostering personal and professional growth[9]. A caring preceptorship team helps create positive working relationships with the graduates[8] enabling them to not only feel part of the team but also feel emotionally supported[2]. A committed educator is required to support the graduates through facilitation of theoretical, technical and non-technical knowledge, and provision of emotional support.

Graduate perioperative nurses need regular and timely access to educators who have a clear understanding of the learning needs of novices[8] and are able to provide targeted fulfilment of knowledge deficits[2]. This supportive role also needs to provide feedback and guide critical reflection in addition to that provided in situ by the preceptors. It is important to note that the feeling of isolation that many graduates feel is due to the sudden withdrawal of previous academic supports[10]. The preceptors and clinical educator can fulfil this role in the professional environment.

The important and often unrecognised role of the preceptorship team must be highlighted. Preceptors offer invaluable support in nurturing the graduate; in particular, the skill they provide in regards to 'challenge vs support' model of educational leadership with novice nurses must be recognised and celebrated. Sadly, preceptor burnout is an issue in the perioperative environment. Indeed, it is a concern across all fields of nursing, and necessitates further reflection and research into the cause and potential preventative strategies.

There may be multiple factors contributing to preceptor burnout – constant hypervigilance towards the novice's actions, time stressors from the surgical team whose demands often compete directly with the safe provision of a learning environment, emotional overload, lack of support and, perhaps, the inability of a department to match the skills of the graduate to the appropriate surgical specialty. Compassion fatigue (a cumulative condition where a nurse is 'desensitised' and their ability to care is reduced)[4] is well researched in the acute care sector but, again, little is known about this in the perioperative arena and how it may

stem from the preceptor–graduate relationship.

A generous preceptorship team – given many perioperative nurses are part-time workers – may reduce the burden, as perhaps may regular education about the principles of adult education, how to provide constructive negative feedback, Bloom's Taxonomy etc. These education sessions would have an added benefit of allowing the preceptor group time to debrief, reflect and consolidate individualised education plans.

Perioperative graduates need clear role expectations and a support network of peers with whom they can normalise their unique situation. They need to commence with solid anatomical and physiological knowledge, role and medico-legal perioperative knowledge, and also be inducted into the intricacies of the operating suite – the culture, the non-technical and communication skills they will be expected to display, and so on. This 'professional socialisation' is vital in the initial transition period, as graduates are, at this time, focussed on their own skill acquisition and the realities of their work[11].

The high level of physical exertion sustained by the graduates in Duchscher's study was essentially spent on fulfilling the tasks associated with their role and hiding the difficulties of this physical, emotional and intellectual exhaustion from colleagues[1]. This was often coupled with life changes such as altered living arrangements, new debt and the work–life challenges of shift work[1]. Participants detailed worrying about work before and after shifts, and also dreaming about work, so there was little respite[1].

For the graduate nurse in the perioperative arena, the cost of physical exhaustion can be potentially lessened again by a strong preceptor group who can discuss pre-emptively the physical symptoms of a long day of perioperative nursing and offer supportive measures as required.

The leadership team should encourage graduates to rest on their day off. Responsibility must lie with the network to disallow graduates to 'pick up' extra shifts during this time.

In order to assist a perioperative support team to prevent graduates from worrying about work at home, ideas such as debriefing regularly with an educator or preceptor may lessen this stress. Reflective tools, such as mandated reflective journalling during the transition process, and providing the time, support and space to share experiences with other graduate peers is invaluable[2].

Duchscher's research found that intellectually, graduates were initially excited, inspired and enthusiastic but once orientation was complete and they were no longer supernumerary, 'overwhelming fear, doubt and all-consuming stress' set in[1]. This was worsened by a lack of feedback, and a lack of awareness of the graduate role and responsibilities[1].

The construct of resilience has been researched[12] and is cited as one factor that facilitates a successful transition, job satisfaction and career longevity. Are nursing graduates being educated that resilience is an important skill they must have in order to transition successfully? How can it be taught and measured? More research is required in this field, particularly for the perioperative specialty.

Feelings of stress could potentially be decreased for new graduates with a comprehensive pre-reading package prior to introductory orientation. This would also require educator-facilitated reflection and discussion. Specific study days for the unique areas of perioperative nursing would also be of benefit.

Principles of asepsis and surgical specialty, specific academic tasks and documentation, and medico-legal requirements could be discussed, and a hands-on instrumentation session for the perioperative graduate provided. For the perianaesthetic graduate, further training in principles of anaesthesia, drugs and common complications with their management, pain management and airway practice could be provided. Key to this theoretical foundational knowledge would be active learning and simulation, both task–trainer and immersive in approach. Furthermore, vital to this foundation would be adequate supernumerary time.

Research[13] shows that consideration also needs to be given to the workload, which can be expanded as confidence and competence grows. This may be possible in the perioperative environment through careful allocation of lists, careful skill mix and similar methods but of course does pose practical challenges. In a perfect world, the graduate perioperative nurse would spend sufficient time in one specialty before moving to the next (following through with the 'mastery theory' of adult learning), be kept away from emergency cases initially, work only 'in hours', and commence with less instrumentation-intensive cases or, in the peri-anaesthetic arena, less complex patients.

The main socio-developmental issues in those first months pertained to the graduate nurses 'finding and trusting their professional selves, distinguishing those selves from others around them, being accepted by the larger professional nursing culture, balancing their personal

lives with their professional work and finding a way to meld what they had learned during their undergraduate education with what they were seeing and doing in the 'real' world[1]. Thus, it is not surprising that graduates were hypersensitive and self-critical[1].

In these initial first months, graduates were focussed primarily on 'getting the work done on time' rather than other higher order tasks such as patient advocacy. In this instance, it could be argued that the challenges associated with the graduate nurse in the ward environment differ significantly to those in the operating theatre. It could be presumed that graduate nurses moving into the acute sector would have previous experience in the ward environment, and thus a clearer idea of the role expectation, if not the reality.

Graduate nurses in the perioperative environment are often very self-critical; however, this may stem from an intrinsic need to succeed, please their support team and be accepted as a part of the team rather than a disparity between what they are currently experiencing and what they have learned at university or on a clinical placement. How many graduates who have a perioperative rotation as a preregistration student actually have the chance to work in the operating theatre as a graduate nurse? More research is required into this correlation but regardless of prior exposure it is vital to have the right preceptor matched to the graduate, clear expectations and clinical hurdles to achieve, and regular facilitated self-reflection.

Conclusion

Despite the potential solutions outlined in this paper for mitigating transition shock for graduates, the practical and logistical challenges of running an operating theatre remain. Lists need to be completed, emergencies dealt with, staff shortfalls coped with. Skill mix is often not ideal and in some cases it is impossible for a graduate to work alongside one of their preceptors. Time for education is limited, as is allowable time off the floor for debrief. In this current climate, time appears to still be granted generously for medical colleagues but is still largely absent for the nursing profession. In this fiscally challenged environment, who will lead the change to promote education as the solution to not only transition shock amongst graduates but also as a potential way to maximise staff retention in the long term?

Research has shown that all graduate nurses will go through transition shock to a degree, and this is replicated when they rotate to a new ward or environment[13]. It can be surmised that a graduate nurse commencing in the perioperative environment is particularly at risk. Duchscher suggests incorporating formal transition shock theory into orientation and transition programs[1]. It is hoped that by highlighting the phenomena of transition shock, awareness will be raised and some practical solutions implemented to make the transition process smoother for graduate perioperative nurses. Transition shock and its effects on the graduate perioperative nurse is an area that warrants further research.

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