University Hospitals of Derby and Burton NHS Foundation Trust

PREVENTION OF PERIOPERATIVE HYPOTHERMIA STANDARD OPERATING PROCEDURE (SOP)- BURTON SITES ONLY

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PREVENTION OF PERIOPERATIVE HYPOTHERMIA

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Burton Hospitals NHS Foundation Trust

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1. INTRODUCTION

1.1 Inadvertent perioperative hypothermia (IPH) is a common and preventable complication of anaesthesia and surgery. Core temperature frequently drops between 1 and 3°C in patients undergoing surgery [1], and the greatest loss (1 to 1.5°C) occurs in the first hour [2]. Causative factors for its development include [3]:

- Loss of the normal behavioural response to cold
- Anaesthetic-induced peripheral vasodilatation
- Exposure of the body during preparation and surgery
- Perioperative fluid restriction
- Impaired heat distribution.

1.2 Perioperative hypothermia has been shown to increase the incidence of a number of complications, including surgical site infection [4], cardiac events [5] and length of hospital stay [3]. Studies have also demonstrated non-statistically significant trends towards increased risk of postoperative mechanical ventilation [5,6] and requirements for blood transfusion [3].

1.3 A strategy is clearly required, therefore, to prevent IPH and to reduce the incidence of these complications. This problem was addressed by the National Institute for Health and Clinical Excellence (NICE) in its clinical guideline entitled “inadvertent perioperative hypothermia: the management of inadvertent perioperative hypothermia in adults”, published in April 2008 and updated in 2016 [3]. This local SOP is based substantially on the work of NICE.

2. SOP OBJECTIVE

The objective of this SOP is to ensure that all appropriate steps are taken to prevent IPH in patients undergoing surgery at Burton Hospitals NHS Foundation Trust (the Trust).

3. DEFINITIONS

3.1 This SOP divides the perioperative period into three stages: pre-operative care, intra-operative care and post-operative care.

3.2 Pre-operative care is defined as the one hour period before induction of anaesthesia.

3.3 Intra-operative care is defined as the period from induction of anaesthesia to arrival of the patient in recovery.

3.4 Post-operative care is defined as the period from the arrival of the patient in recovery to the departure of the patient to the ward.

3.5 Where stated, core temperature measurement should be undertaken either by serial infrared temporal artery thermometer readings or continuously by pharyngeal probe.

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4. PRE-OPERATIVE CARE

4.1 All patients should undergo risk assessment for IPH on the ward or Elective Admissions Lounge (EAL). High risk for the development or consequences of hypothermia is defined as the presence of two or more of the following conditions:

- ASA grade II to V
- Pre-operative temperature below 36°C
- Plan for combined general and regional anaesthesia
- Major or intermediate surgery
- Risk of cardiovascular complications.

4.2 All patients should be kept comfortably warm while awaiting surgery.

4.3 All patients should have their core temperature recorded in the one hour period prior to leaving the ward for surgery. If this is below 36°C start active warming using a forced air warmer. A patient's temperature should be is at least 36°C before leaving the ward or EAL unless there is a need to expedite surgery due to clinical urgency. Active warming should be restarted as soon as feasible on arrival in the theatre suite.

4.5 Patients should be kept comfortably warm on transfer to the operating theatre and should be encouraged to walk when appropriate.

5. INTRA-OPERATIVE CARE

5.1 Patients should have their temperature recorded before induction of anaesthesia and every 30 minutes throughout the procedure.

5.2 Induction of anaesthesia should not occur until core temperature is above 36°C unless clinical urgency dictates. Patients should be warmed with a forced air warmer either on the ward or in the anaesthetic room if required to achieve this. This should be anticipated to take at least 30 minutes.

5.3 Patients should be kept covered throughout the intra-operative period, and should be exposed only for surgery and surgical preparation.

5.4 The ambient temperature in theatre should be at least 21°C whilst a patient is exposed. This may be reduced while forced air warming is in place.

5.4 All intravenous fluids and blood products should be warmed to 37°C by pre-warming and / or with a fluid warming device.

5.5 All patients undergoing surgery for greater than 30 minutes should be warmed using a forced air warming device.

5.6 Patients at high risk (see paragraph 4.1) should be warmed with a forced air warming device, regardless of the duration of surgery.

5.7 The target temperature for all patients being warmed with a forced air warming device should be 36.5°C.

5.8 All irrigation fluids should be warmed in a cabinet to 38-40°C before use.

6. POST-OPERATIVE CARE

6.1 All patients should have their temperature recorded on arrival in the recovery room and every 15 minutes thereafter.

6.2 Patients should not be transferred back to ward areas until their core temperature is above 36°C.

6.3 All patients with a core temperature below 36°C should be warmed with a forced air warming device prior to transfer to the ward.

7. EVIDENCE TO SUPPORT SOP

7.1 Risk factors for IPH

7.1.1 ASA grade II to V

A meta-analysis of two cohort studies by NICE [7,8] for a total of 18,943 patients, demonstrated a statistically significant increased risk of perioperative hypothermia for an ASA grade of II and above compared with ASA I (Odds Ratio for hypothermia of 2.68; 95% Confidence Interval 1.4 - 5.12)

7.1.2 Pre-operative temperature below 36°C

A meta-analysis of two cohort studies with a combined total of 369 patients demonstrated a significant reduction in the risk of perioperative hypothermia when starting temperature was in the normothermic range (Odds Ratio 0.31, 95% Confidence Interval 0.17 - 0.55) [8,9]

7.1.3 Plan for combined general and regional anaesthesia

There is inconsistent evidence regarding the risk of IPH for general versus regional anaesthesia. However, meta-analysis of the two studies mentioned above [7,8] in 18,943 patients suggested a significant increased risk of hypothermia in cases where general and regional anaesthesia were combined compared with general or regional anaesthesia alone (Odds Ratio 2.86; 95% Confidence Interval 1.81-4.51)

7.1.4 Major or intermediate surgery

Major or intermediate surgery (defined as the exposure of body cavities and/or major vessels) was shown to be a risk factor for hypothermia in a meta-analysis of 3 individual cohort studies [8,9,10]. A NICE meta-analysis revealed odds ratios for hypothermia of 3.2 for major versus minor surgery and 4.31 for intermediate versus minor surgery [3]

7.1.5 Risk of cardiovascular complications

Patients at risk of cardiovascular complications do not present an increased risk for the development of hypothermia per se, though they are clearly at increased risk of the consequences. The NICE guideline does not present any specific evidence in support of this, though it seems a reasonable assumption

7.2 36°C as a minimum for safe anaesthesia

7.2.1 The principal justification for the selection of 36°C as the cut-off for safe anaesthesia is the evidence of adverse consequences of hypothermia from randomised controlled trials

7.2.2 A randomised controlled trial of 104 normothermic patients versus 96 hypothermic patients, where there was minimal overlap of groups above or below 36°C, demonstrated a relative risk of surgical wound infection of 4.0 (95% CI 1.57-10.19) for patients hypothermic during surgery [4]

7.2.3 A randomised controlled trial by Frank in 1997, of 300 patients undergoing abdominal, thoracic or peripheral vascular surgery, resulted in mean postoperative temperatures in the two groups of 35.4°C and 36.7°C respectively. The hypothermic group showed a relative risk for morbid cardiac events of 2.2 compared with the normothermic group [5]

7.2.4 These trials give reasonable support to the supposition that 36°C is an appropriate minimum for safe anaesthesia

7.3 Fluid warming devices

7.3.1 There is good evidence for the efficacy of active intravenous fluid warming versus room temperature intravenous fluids in the prevention of inadvertent perioperative hypothermia

7.3.2 Different studies have assessed different primary endpoints, namely the incidence of hypothermia at the end of surgery, core temperature intraoperatively, and core temperature at the end of surgery

7.3.3 Studies by Muth [11] and Smith [12] assessed the incidence of hypothermia at the end of surgery (defined as a postoperative temperature less than 35.5°C). A NICE meta-analysis of these randomised trials, with a total of 88 patients, gave an odds ratio for hypothermia of 0.1 with active fluid warming (95% confidence interval 0.04-0.24) [3]. This corresponds to a number needed to treat (NNT) of only 3

7.3.4 A number of RCTs have demonstrated higher core temperatures at various points during surgery when warmed fluids are used [12,13,14,15]. A NICE meta-analysis of these four studies, with a total of 172 patients, demonstrated a significant increase in core temperature after 60 minutes of surgery in groups receiving warmed fluids (mean temperature difference 0.38°C, 95% confidence interval 0.21 - 0.54°C) [3]

7.3.5 At the end of surgery, this core temperature difference appears to be even more marked. A meta-analysis of four RCTs [11, 12, 13, and 15] demonstrated a mean temperature increase of 0.66°C by the end of surgery in groups receiving warmed fluids [3]

7.4 Type of fluid warming device

7.4.1 The five randomised controlled trials considered above (7.3) used either dry plate fluid warmers or countercurrent heat exchange warmers. No attempt was made to ascertain the superiority of one method over the other

7.4.2 One study looked at the comparison between prewarmed intravenous fluids and continuously warmed intravenous fluids, and found no significant difference in perioperative temperature between the two groups [16]

7.5 Forced air warmers

A number of studies have evaluated the efficacy of forced air warming devices in the prevention of perioperative hypothermia. A meta-analysis of five studies by NICE [17,18,19,20,21], which compared forced air warming with usual care, demonstrated that at 60 minutes, mean core temperature was 0.35°C higher in the treatment group compared with the control group (95% CI 0.21-0.49) [3]. The devices used in these studies were either the Bair Hugger® or Warm Touch® at a variety of temperature settings. There is also good evidence that this difference is maintained throughout the intraoperative period. However, there is weak or insufficient evidence for the superiority of one active warming technique over another, for example of forced air warming over electrical insulation blankets and mattresses [3].

7.6 Use of warmed irrigation fluids

There is weak evidence for the benefit of warmed irrigation fluids in the prevention of inadvertent perioperative hypothermia. Most studies in this area have failed to demonstrate significant differences between room temperature and warmed irrigation [3]. However, it is recommended as a perioperative intervention in the NICE guideline on the basis that it is standard practice in most organisations, and is unlikely to be associated with significant cost or harm.

8. EXCLUSIONS FROM SOP

8.1 A small number of NICE recommendations have been omitted from this SOP or have been subject to alteration. The principal changes are considered below:

8.2 Use of in-line fluid warmers

8.2.1 The NICE guideline states that all intravenous fluids over 500 millitres in volume should be warmed prior to infusion. The guideline itself does not specify that in-line fluid warming is necessary, but Chapter 4 states that the review group considered fluids from a warming cabinet to be insufficient. However, as described in paragraph 7.4.2, there is no evidence that in-line warming devices are superior to prewarmed fluids; indeed, the one study examining this failed to demonstrate a significant difference between the two in terms of efficacy in preventing

perioperative hypothermia. For this reason the specific requirement to use an in-line fluid warming device has been omitted from the SOP, and the use of prewarmed fluids fulfils element 5.4

8.2.2 Furthermore, because it is standard practice at the Trust to use prewarmed intravenous fluids in all patients, the distinction between less than or greater than 500 millilitres of fluid has not been made. Clearly all blood products must be administered via an in-line warming device as they cannot be prewarmed

8.3 Forced air warming from commencement of anaesthesia

The NICE guideline recommends that patients at high risk are actively warmed from induction of anaesthesia. However, there is no evidence provided to support this assertion. The risk factors as cited (i.e. ASA II and above) would label a large proportion of patients as high risk, and active warming in the anaesthetic room would have significant logistical implications. For this reason it has been recommended that high risk patients are warmed from the start of surgery (not anaesthesia) regardless of duration.

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