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Maternal and Newborn Outcomes Related to Maternal Warming During Cesarean Delivery

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Objective: To compare two methods of maternal warming during cesarean delivery under spinal anesthesia on maternal and newborn outcomes.

Design: Randomized control trial.

Setting: Two acute care hospitals in central Canada.

Patients: 62 women (32 intervention, 30 control).

Interventions: Women received either a forced-air warming blanket (intervention) or usual care warmed cotton blankets (control).

Main Outcome Measures: For mothers: oral temperature, degree of shivering, thermal comfort, and pain scores. For newborns: rectal temperature at birth, 1- and 5-minute Apgar scores, and frequency of interventions for hypoglycemia within 3 hours of birth.

Results: With the exception of perceived thermal comfort, women in the two groups were not significantly different in terms of oral temperature, incidence of shivering, and pain scores. Similarly, newborns in both groups were not significantly different in terms of any of the measured variables. Although newborn rectal temperature was within the normal range, mothers in both groups showed a significant decline in body temperature to the mild hypothermic range (control 36.7 ± 0.4°C to 35.9 ± 0.5°C, $p < .001$; intervention 36.8 ± 0.4°C to 36.1 ± 0.4°C, $p < .001$).

Conclusion: The usual treatment of supplying warmed cotton blankets remains the treatment of choice for this population. *JOGNN, 35*, 324-331; 2006. DOI: 10.1111/J.1552-6909.2006.00052.x

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Body temperature is a tightly controlled physiological parameter, and small deviations in core temperature provoke aggressive thermoregulatory mechanisms in an effort to maintain normothermia. Since all anesthetic drugs profoundly impair these mechanisms, patients anesthetized for surgical procedures are at risk for hypothermia. Mild intraoperative hypothermia (core body temperature 35°C-36.5°C) has been associated with negative consequences for the surgical patient (Frank et al., 1997; Kurz, Sessler, & Lenhardt, 1996; Schmeid, Kurz, Sessler, Kozek, & Reiter, 1996; Winkler et al., 2000). In addition, anesthesia affects behavioral and physiological mechanisms of thermoregulation. As a result, shivering is a common postanesthetic complication (Buggy & Crossley, 2000).

Neuraxial (spinal or epidural) anesthesia is the method of choice for cesarean delivery. Despite the shorter duration of anesthesia associated with cesarean delivery, the potential for vasodilation, core-to-peripheral redistribution of body heat, and a resulting state of mild maternal hypothermia exists. In addition, shivering is a commonly reported side effect of regional anesthesia, with up to 60% of patients undergoing lower segment cesarean delivery reporting this disconcerting and untoward effect (Chan, Ng, Tong, & Jan, 1999; Lui & Luxton, 1991). Although pharmacologic agents are a popular method of treating and preventing postoperative shivering (Bugg & Crossley, 2000), maintaining normothermia with a forced-air warming blanket is an effective method of perioperative patient warming since 90% of metabolic heat is lost through the anterior surface of the skin (Feidler, 2001; Kurz et al., 1993; Sessler & Akca, 2002).

Research suggests that mild maternal hypothermia associated with neuraxial anesthesia precipitates mild

hypothermia in the newborn. Concomitant effects of newborn hypothermia may be seen in the physical and metabolic status of the infant at birth and in the immediate postbirth period (Horn et al., 2002; Larue, Labaille, Benhamou, Champagne, & Jullien, 1991). However, although a close correlation between maternal and neonatal temperature exists at birth, neonatal physiology takes over in the postbirth period, so that by 2 to 3 hours of age, maternal influence on newborn temperature disappears (Takayama, Teng, Uyemoto, Newman, & Pantell, 2000).

Horn et al. (2002) evaluated the efficacy of a forced-air warming blanket to prevent hypothermia of both mothers and newborns in a randomized control trial of 30 women undergoing cesarean delivery with epidural anesthesia. Patients received either passive warming (one warmed blanket) or active warming (forced-air blanket) throughout the surgery. Active warming patients received 15 minutes of prewarming prior to epidural anesthesia. Significantly less shivering, and significantly higher maternal core temperature, infant core temperature, and umbilical vein pH were noted in the active warming compared to the passive warming group. Thermal comfort and indices of pain were similar between groups.

The potentially positive clinical practice of using forced-air warming devices warrants additional study in this vulnerable population. Therefore, the primary purpose of this randomized control trial was to determine whether there are differences in maternal oral body temperature related to active warming using a forced-air warming blanket compared with usual treatment of warmed cotton blankets during a shorter operative delivery using spinal anesthesia. It was hypothesized that there was no significant difference between the two groups in maternal oral temperature, incidence of shivering, thermal comfort, and level of pain, or in newborn rectal temperature at birth, umbilical vein pH, Apgar scores immediately postdelivery, and interventions for hypoglycemia within 3 hours postdelivery.

Methods

Following research ethics board and site approvals, the study took place at two acute care sites in Winnipeg, Canada. Power analysis revealed that a sample size of 56 was required to detect a 0.5°C difference, assuming a two-sided alpha of .05, power of 90%, and standard deviation of 0.5°C in body temperature, where the estimate of standard deviation was based on a study of maternal temperature using external warming techniques (Horn et al., 2002). Low-risk pregnant women who were 18 years or older, 37 weeks or greater gestation, and undergoing elective scheduled cesarean delivery were eligible for enrollment. Pregnant women who were on any medications other than prenatal vitamins or deemed as high-risk pregnancy were excluded.

Following written informed consent, eligible participants were assigned to the control or intervention group based on block randomization. Results of randomization were placed in sealed opaque envelopes by a statistician with only the participant number identifier on the envelope front. The research nurse selected the envelope that matched the participant number prior to the beginning of data collection on the day of surgery.

Mothers walked into the operating room (OR) theater, were followed throughout their scheduled surgical procedure in the OR, and did not receive a period of prewarming prior to spinal anesthesia. Research nurses, trained by the investigators in the procedure, instruments, and scales, collected the data.

Two IVAC TempPLUS II electronic thermometers (Alaris Medical Systems, San Diego, CA) were used throughout the study, and testing of these instruments occurred prior to and following data collection. Testing of thermometers occurred in a constantly stirred temperature controlled water bath at 1°C intervals between 35°C and 39 °C. Accuracy was tested against a highly accurate water bath thermometer traceable to National Institute of Standards and Technology. Both thermometers remained within 0.1°C of the reference thermometer throughout the testing. Daily testing of the thermometers also occurred using a calibration (test) plug at various temperatures between 26.8°C and 42.1°C. Again both instruments remained within 0.1°C of the reference temperatures.

Baseline data collection began at the time of the mother's entrance into the OR and then every 15 minutes thereafter until she exited the OR. Once settled on the OR table in preparation for spinal anesthesia, oral temperature was measured. The left or right posterior sublingual cavity (Kung, Ochs, & Goodson, 1990) was used for all measurements on the same individual. Oral temperature was selected as the site for body temperature measurement because of the difficulties and hazards associated with direct tympanic temperature measurement (Tabor, Blaho, Schriver, & Gordon, 1981; Wallace, Marks, Adkins, & Mahaffey, 1974) and because of the concerns and variability associated with ear-based temperatures (Christensen & Boysen, 2002; Erickson & Kirklin, 1993; Erickson & Meyer, 1994; Staven, Saxholm, & Smith-Erichsen, 1997). Further, because of the close proximity to lingual and external carotid arteries, oral temperature is considered a fairly accurate representation of body temperature (Lasater, 2005) and in critically ill patients has been noted as the best method of temperature monitoring when a pulmonary artery catheter, the usual gold standard, is not available (Giuliano, Giuliano, & Scott, 2000). Differences between oral and pulmonary artery temperatures of less than 0.2°C have been reported (Henker & Coyne, 1995; Schmitz, Blair, Falk, & Levine, 1995).