Journal of Neonatal Nursing (2016) 22, 196—203

www.elsevier.com/jneo

Comparing the accuracy of skin sensor temperature at two placement sites to axillary temperature in term infants under radiant warmers

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Available online 21 January 2016

KEYWORDS
Infant warmer;
Probe placement;
Temperature measurement;
Thermoregulation

Abstract *Background:* The skin temperatures of the infants under radiant warmers can be monitored by a sensor probe attached on the abdomen, flanks, chest or back region.
Purpose: To compare the accuracy of temperature measurement with sensor probe placed at right hypochondrium of abdomen or middle of the chest to axillary temperature measurement with digital thermometer in term infants under radiant warmers.
Method: A total of 148 term infants with less than 2 weeks of age under radiant warmers were enrolled. One group of 73 infants was allocated to sensor probe placed at right hypochondrium of abdomen and another group of 75 infants was allocated to sensor probe placed at chest. The skin temperatures for both groups were measured on admission and subsequently at 15 min and 30 min times. The axillary temperatures for both groups were also measured concurrently using digital thermometer at the same interval. A total of 880 measurements were recorded.
Results: The findings from Bland—Altman tests indicate that the temperature measured with sensor probe at right hypochondrium of abdomen was more closely in agreement to digital axillary temperature in comparison to temperature measured with sensor probe placed at chest.

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http://dx.doi.org/10.1016/j.jnn.2016.01.003

Conclusion: Temperature measured with sensor probe placed at right hypochondrium of abdomen appears to be more accurate and reliable than temperature measured with sensor probe placed at chest.

Introduction

Management of thermal status is an important aspect of neonatal care for healthy term infants and high risk preterm infants in neonatal intensive care unit. The thermoregulation management is critical to the survival of infants because alteration in thermal stability can lead to adverse physiological effects including increases oxygen consumption, metabolic acidosis, hypoglycemia (Bissinger et al., 2010; Blackburn et al., 2001; Sherman et al., 2006) and risk of cold stress and hypothermia (Fic et al., 2014; Lyon and Freer, 2011). Since monitoring of thermal status requires estimation of core temperature, temperature measurements should be taken accurately to provide correct assessment on infants thermal status (Blackburn et al., 2001). Skin temperature has been used as the primary method to noninvasively monitor core temperature. Therefore, the placement of skin temperature sensor probe at suitable site in infants under radiant warmers for accurate measurement and monitoring of temperature is utmost important in neonatal care (Blackburn et al., 2001; Scopes, 1981).

It has been highlighted that the sites for probe placement among infants might be limited by their body size and body surface area especially for infants with low birth weight (<1,500 g) and prematurity (Blackburn et al., 2001). The frequent change of infant position; the restriction of probe placement to the torso over nonbony surface and the presence of emergency tubing or monitoring devices on infant body also contribute to less suitable site for probe placement (Altimier, 2012; Blackburn et al., 2001).

Radiant warmer has been used in neonatal setting to provide heat to the body of newborns. It helps to maintain the body temperature of the newborns and limit their metabolism rate (ECRI, 2014; Moen et al., 1987). Radiant warmer is used in many settings which include maternity, admissions, newborn nursery, neonatal intensive care, and infant surgical areas to maintain a small or premature infant at a desired temperature (Bell, 1983; Korones and Fitch, 1982; Whiteside, 1978). Studies showed that by keeping infants warm with radiant warmers would reduce morbidity (Knobel and Holdith-Davis, 2007; Lyon, 2006; Chadd and Gray, 1972; Gandy et al., 1964; Mann and Elliott, 1957) and mortality (Knobel and Holdith-Davis, 2007; Lyon, 2006; Buetow and Klein, 1964; Day et al., 1964; Silverman et al., 1958).

A conventional infant warmer has a heater element, a skin-mounted sensor and a control system. The heater element radiates heat to provide warmth to an infant. The sensor measures the infant's skin temperature. The control system regulates the heater element based on measured skin temperature (Altimier, 2012; Diab, 2009). The overall heat unit provides a warm environment while allowing for direct observation and free access to the infant (Whiteside, 1978). Radiant warmer with servo-control mode allows heater output determined automatically by infant's skin temperature. A skin probe is placed on the infant's skin using an insulated probe cover. This cover has reflective side to avoid falsely picking up the warmer temperature rather than the skin temperature. The warmer increases and decreases the heater output to maintain the set control temperature (Altimier, 2012; Leblanch, 1991).

Leblanch (1991) emphasizes the importance of the placement of sensor probe on appropriate site to avoid inaccurate temperature monitoring that might provide false reading on core temperature. Accurate temperature measurement by sensor probe is the one with reading very close to the axillary temperature obtained during vital signs monitoring. Measuring axillary temperature using digital thermometer is a standard practice in neonatal setting for well babies. Past studies conducted in neonatal units showed that digital thermometer is as effective as mercury thermometer in detecting hypothermia (Kara et al., 2009; Davies et al., 1986). Studies suggest the appropriate site of placement of sensor probe is on the skin of upper abdomen and emphasized that the probe should be attached firmly to the skin visible for inspection at all times (Leblanch, 1991; Leick-Rude and Bloom, 1998). So far, there is no study being done on sensor probe placement at anterior chest of infants under radiant warmers for temperature monitoring. In addition, there is lack