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Measuring temperature of NICU patients — A comparison of three devices

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Mercury thermometer;
Electronic thermometer;
Infrared thermometer;
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Abstract *Background:* The provision of a thermoneutral environment is a cornerstone of neonatal care. An accurate method of temperature measurement is required in order that neonatal nurses can provide this care. Glass mercury thermometers, now rarely used in the developed world were once the gold standard. They have mainly been replaced by many different types of modern thermometers.
Methods: This study aims to compare the accuracy and user-acceptability of one electronic and one infrared thermometer (Lightouch Neonate, Exergen Corp, USA; Suretemp 678, Welch Allyn, Beaverton, USA) with traditional glass mercury thermometry for intermittent temperature measurement on the NICU, using the axilla as the measuring site.
Results: The results demonstrate a generally positive performance of the two devices tested. The mean (SD) difference between the readings from the Suretemp thermometer and the glass mercury thermometer was 0.1 ($\pm$0.25)°C. The mean difference between the readings from the Lightouch thermometer and the glass mercury thermometer is 0.07 °C.

Introduction

Maintaining the thermoneutral environment for sick and premature newborn infants is a key part of the nurse's role on the NICU, as abnormal temperature is strongly associated with adverse outcome (Bailey and Rose, 2000; CESDI, 2003; Silverman et al., 1958; WHO, 1997). Obtaining accurate measurement of temperature is an obligatory step in providing thermoneutrality. Temperature of NICU patients may be measured in a variety of sites, including rectum and axilla, and using a number of different tools, including glass mercury thermometers and electronic devices, which may in turn check temperature continuously, or as one-off readings.

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Mercury thermometry is now used rarely in the developed world, except as a comparison for evaluating new devices, as in this study. This is largely due to concerns about the hazards associated with mercury. Mercury emits a toxic vapour that can be inhaled or absorbed directly through the skin. This vapour may persist for months or years (Blumenthal, 1992). Very premature neonates with their increased skin permeability are a high-risk group for absorbing mercury vapour, especially as the warm environment required for their care facilitates mercury vapourisation (DoH, 1985). While mercury thermometers have been regarded as the gold standard for measurement of body temperature (Blumenthal, 1992; Pontious et al., 1994; Sheeran, 1996), numerous studies identify their inaccuracies (Abbey et al., 1978; Blumenthal, 1992; Leick-Rude and Bloom, 1998). Johnston and Shorten (1991) tested 48 mercury thermometers against a calibrated water bath, finding only five recording the same temperature. The remaining thermometers varied by as much as 0.8 °C.

In place of mercury thermometry, a profusion of devices for spot-check measurement have become available. These utilise electronic, infrared or chemical technology, for use in the tympanic membrane, axilla or rectum. In addition to providing spot-check measurements, some thermometers may be used in either monitoring or predictive modes. Monitoring mode gives a continuous readout, while predictive mode uses an algorithm to predict temperature based on rate of rise after probe introduction.

A number of these devices have been studied previously (Davis, 1993; Greenall et al., 1997; Johnson et al., 1991; Leick-Rude and Bloom, 1998; Ogren, 1990; Pontious et al., 1994; Rogers et al., 1991). Weiss and Richards (1994) studied 142 preterm and term infants. Using a single instrument (IVAC 2080) they measured temperature using different modes and in different sites in the same baby. They found statistically significant differences between measurements obtained in the axilla in predictive and monitoring modes, but concluded that the differences seen (0.1—0.2 °C) were not clinically significant. Seguin and Terry (1999) compared axillary temperatures obtained in 28 term and preterm infants using the Lightouch device (Exergen Corp, USA) in predictive mode with rectal temperature. They found preterm infants in incubators had the least difference between the two readings, mean (SD) 0.09 (0.16) °C. They concluded this was clinically acceptable.

The rectum is now rarely used as a temperature measuring site. The utility of the axilla as the measuring site, compared to the rectum, was assessed by Jirapaet and Jirapaet (2000). They measured the temperature of 109 preterm and term infants simultaneously using four different methods. When they compared rectal and axillary temperature measured using mercury thermometry they found a mean (95% CI) difference of 0.06 (0.03—0.09) °C and concluded that axillary temperature can be as accurate as rectal.

This study compares the accuracy and user-acceptability of one electronic and one infrared thermometer (Lightouch Neonate, Exergen Corp, USA; Suretemp 678, Welch Allyn, Beaverton, USA) with traditional glass mercury thermometry for intermittent temperature measurement on the NICU, using the axilla as the measuring site.

The Lightouch thermometer uses an optical device with a cup shaped probe, which detects infrared emissions from the surface of the skin. As there is no temperature device to heat up, it takes less than 1 s to produce a reading. The Suretemp 678 is an electronic thermistor thermometer, which takes 10 s to display a final reading in predictive mode.

The trial aim was to determine whether the Lightouch Neonate infrared thermometer or the Suretemp electronic thermometer set to predictive mode, would be accurate alternatives when compared to glass mercury thermometers.

Methods

A convenience sample consisting of the population resident on a large regional NICU, during a three-week trial period, was used to obtain the two separate data sets. These included babies requiring intensive care, high dependency care and low dependency care. The patient population consisted of term and preterm infants with a variety of medical and surgical conditions.

Readings were obtained at the same time, using glass mercury thermometry and one of the two trial devices. Temperature readings were taken as clinically indicated and all infants present on any area of the NICU were eligible for inclusion. Guidelines were developed so that the same method of temperature measurement would be undertaken by individual nurses, ensuring comparable sets of data would be produced, which differed only by which trial thermometer was used.

The mercury thermometer was held in place for five minutes, as recommended by Bliss-Holtz (1995). The Suretemp thermometer was set to the predictive mode. Either the Suretemp or the Lightouch was placed on the infant until a reading was obtained. The two readings were then recorded on a trial data sheet.