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Original Research Article

Comparison of the accuracy of digital axillary thermometer (DAT) with infrared forehead skin thermometer (IFST) measurements in healthy newborns

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ABSTRACT

Introduction: Temperature is an important vital sign. Body temperature is generally measured whenever there is suspicion of fever, but in neonates' hypothermia is considered even more serious than fever. There are studies in pediatric intensive care units comparing various invasive methods of temperature measurement.

Materials and Methods: This was a cross sectional comparative study conducted in postnatal wards and outpatient department of a teaching hospital. All consecutive 348 healthy term neonates between 0-28 days of life whose parents consented for participation in the study were included. The axillary temp was taken with digital thermometer and forehead temperature were measured by temporal scanner device simultaneously. Doctor and caretaker both took the temperature measurement.

Results: Out of total 348 patients 114 (32.7%) were males and 234(67.2%) were females. Mean birth weight was 2800±400 grams. Mean axillary temperature was 98.34±0.81°F, and forehead temperature was 97.81±0.89°F (p=0.44). There was a positive correlation between temperature measured using digital and infrared thermometer (r=0.914, p=0.00). The mean difference was −0.07 with limits of agreement −0.71 to 0.57.

Conclusion: Digital axillary temperature was higher and closer to normal than infrared forehead temperature. Temperature readings by forehead infrared thermometry agree well with those by axillary digital thermometry in neonates. Hence both methods of temperature measurement can be used in neonates although Infra-red temporal touch is much easier technique than digital axilla temperature measurement

1. Introduction

Neonatal hypothermia after delivery is a worldwide issue, occurs in all climates and if prolonged can cause harm and affect survival. It is defined by the World Health Organization as an axillary temperature below 36.5∘C and is estimated to affect 11–92% of neonates. Risk factors include prematurity (birth prior to 37 weeks completed gestation), low birth weight (birth weight <2500 g), low maternal socioeconomic status, younger maternal age and birth outside of the hospital. The occurrence of hypoxemia, bradycardia, hypoglycemia and metabolic acidosis as a result of hypothermia contribute towards increased mortality.

Temperature is an important vital sign. Body temperature is generally measured whenever there is suspicion of fever, but in neonates' hypothermia is considered even more serious than fever. There are studies in pediatric intensive care units comparing various invasive methods of temperature measurement.[1] American Academy of Pediatrics (AAP) and National Institute for Health and Care Excellence, United Kingdom (NICE) guidelines recommend the use of axillary temperature in neonates.[2,3] Temperature charting in preterm low birth weight babies

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is done cautiously till he is able to maintain his body temperature at desirable level.[4] There are many different methods for measuring body temperature in children like Intra aural (Tympanic), temporal artery and axillary measurements.[5] The old and outdated method is Mercury thermometers which were abandoned due to the serious health consequences of mercury.[6,7] Today, after covid era, focus has shifted once again towards infra-red skin thermometers as their use with no contact technique avoid spread of infection.[8,9] The forehead is supplied by superficial temporal artery which is superficial accessible artery & it is an excellent area to measure temperature. It has unique property as compared to other accessible cutaneous blood vessels that it has no or very few arteriovenous anastomoses (AVA). Due to lack of AVA, perfusion rate is reliable under essentially all conditions, and blood flow is relatively free of vasomotor control in response to thermoregulatory stimuli.[8] There are few studies in past comparing non-contact methods for measuring body temperature regarding ease of the parents, comfort of the neonate vs efficacy and accuracy of reading.[10,11]

Infrared forehead skin thermometers (IFST) are among the many new available methods of temperature measurement, and their use have become quite popular in all age groups and all settings like in health care facilities and at home .However, there are some studies with conflicting results have raised doubts regarding the accuracy and reliability of IRST.[11,12] Uslu et al.,[13] noted a bias of -0.55 C and Can et al[14] found the limits as being -0.4,+1.54. They all concluded that infrared non-contact thermometers cannot be recommended for the measurement of body temperature in neonates in an intensive care setting where accurate temperature measurement is required. Oncel et al[4] reported that while infrared thermometers were not accurate enough to be recommended for use in hospitalized neonates, they could be used for determining body temperature of newborns at home by caretakers because they are safe, time efficient, noninvasive and easy to use.

The aim of the present study was to investigate any differences between measurements performed using two different thermometers IFST on forehead and digital axillary thermometers (DAT)used in axilla in healthy term neonates in non NICU setting. The another important aim was to compare the measurements taken by the mothers and physicians in newborns.

2. Materials and Methods

This was a cross sectional comparative study conducted in postnatal wards and outpatient department of a teaching hospital situated in urban area in western Uttar Pradesh. Study period was between January 2021 and March June 2022. All consecutive 348 healthy term neonates between 0-28 days of life whose parents consented for participation in the study were included. The axillary temp was taken with digital thermometer (cipla) and forehead temperature were measured by temporal scanner device (Exergen Corporation, Model 2000C) simultaneously. The infra-red thermometer was kept on the skin of forehead & pressed & moved laterally along the hair line while remaining in contact with the skin. For axillary temperature measurement, axilla was wiped with a dry towel and digital thermometer tip was placed in contact with the skin in armpit and temperature displayed after the beep sound was recorded. Sample size was 348. Babies who had fever or were sick, required admission in Neonatal Intensive Care Unit (NICU) due to any reason were excluded from the study. The study protocol was approved by Institutional Ethical Committee. Principal investigator recorded temperature of all newborns using both measuring devices.

Results were analyzed using Microsoft excel and strata software, Linear correlations were made between forehead and axillary temperatures. Differences between sets of data were plotted as described by Bland and Altman.[15] Based on previously predefined clinically acceptable limits, the agreement between forehead and axillary measurement methods was accepted when the mean ± 2 standard deviations was within ± 0.5°F.[16]

3. Results

The body temperature was measured in total 348 patients including 114 (32.7%) males and 234(67.2%) females. Mean birth weight was 2800±400 grams. Mean axillary temperature was 98.34±0.81°F, and forehead temperature was 97.81±0.89°F (p=0.44). There was a positive correlation between temperature measured using digital and infrared thermometer (r=0.914, p=0.00). The mean difference was −0.07 with limits of agreement −0.71 to 0.57. Bland – Altman plot showing the differences between temperatures is given in Figure 1.

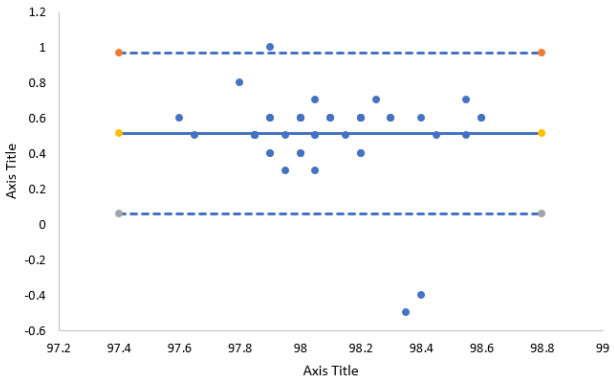

Fig. 1: Bland and altman plot of the differences between infrared forehead skin thermometry and digital axillary.

The means, standard deviations and range of temperature measurements made by mothers and physicians using each thermometer are summarized in Table I. Initial analysis revealed measurements made by mothers to be lower than those made by the physician by 0.01 and 0.02 °C, respectively for IFST and DAT. This difference was deemed statistically insignificant (Table 1).

Table 1: Thermometry measurements by DAT & IFST by mother and physician

Type of thermometry	mean(+/-SD)	range
DAT by Mothers	98.944 ± 0.248	97.4 to 98.8
DAT by Physician	98.344 ± 0.245	97.6 to 98.8
IFST by Mothers	97.924 ± 0.329	97.4 to 98.8
IFST by Physician	97.83 ± 0.280	97.4 to 98.9

4. Discussion

Forehead infrared thermometry is a new method which is rapid and easy to use compared to conventional methods of temperature measurement. Due to its non-contact or minimal (but not disturbing) contact technique and negligible risk of cross infections it appears to be very suitable for use in neonates. Since its introduction various studies have been conducted to compare its accuracy with other methods of temperature measurement. Most of the studies have been conducted in children and adults.[17,18] Some reported good agreement[17,19] between IFST and conventional method measurement values while some gave contradictory conclusion.[18,20] De Curtis et al[11] compared infrared thermometry with rectal thermometry in 107 newborns and found a mean difference of -0.052 C and 95% limits of agreement as -0.682, 0.578. They concluded that the difference between the two methods being modest and limits of agreement acceptable, infrared thermometry could be used in neonates.

Present study demonstrated negligible difference in the temperature readings recorded by mother and physician, so both the devices can be used at hospital and at home for measuring temperature. Limitations of present study were-use of a single brand of infrared and digital thermometer although many thermometer models are available in market. Present study included only term healthy neonates, but results may vary with preterm, low birth weight baby, or kept under radiant warmer.

5. Conclusion

Digital axillary temperature was higher and closer to normal than infrared forehead temperature. Temperature readings by forehead infrared thermometry agree well with those by axillary digital thermometry in neonates. Hence, both methods of temperature measurement can be used in neonates although Infra-red temporal touch is much easier technique than digital axilla temperature measurement.

6. Source of Funding

None.

7. Conflicts of interest

There are no conflicts of interest.

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