

Comparison of Forehead Infrared Thermometry and Tympanic Membrane Thermometry with Axillary Digital Thermometry in Term Neonates Admitted in NICU at Tertiary Care Centre Gujarat

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Abstract

Background: Neonates are more thermo-labile, so precise temperature recording relics a necessary part of the neonatal care. The greatest technique to calculate temperature should imitate the accurate body temperature and should not be exaggerated by outside factors.

Objectives: to evaluate the precision of digital axillary thermometer (DAT) with infrared tympanic thermometer (ITT) and infrared forehead skin thermometer (IFST) dimensions for term infants admitted in the NICU.

Material and Methods: Present research was performed among 625 term neonates admitted in NICU at Paediatrics department of tertiary care hospital at Visnagar, Gujarat, India during November 2021 to July 2022. Three temperature readings were executed from each newborn in NICU by the investigator at interval of 24 hours. Total 225 neonates enrolled in this study.

Results: In Axillary and tympanic temperature, maximum difference was 1.50C and minimum -1.20C where in forehead method; it was 1.80C & -1.30C respectively. The body temperature measurements by axillary and forehead techniques did not concur well. The body temperature dimensions by axillary and tympanic methods did not concur well.

Conclusion: Forehead infrared, tympanic infrared with axillary digital thermometer dimensions did not concur fine. Forehead infrared thermometry is not precise adequate and cannot substitute axillary thermometry for body temperature dimension in neonates.

Keywords: Axillary Digital, Body Temperature, Forehead Infrared, Neonate, Tympanic Infrared

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Introduction

Neonates are extra thermo-labile, so precise temperature recording relics a necessary part of the neonatal care. Measurement of temperature in neonates

can be attained by rectal, axillary, and tympanic thermometry [1].

The finest technique to calculate temperature should imitate the precise

body temperature and should not be exaggerated by external factors. 'Minimal contact' being the order of the day in neonatal intensive care unit (NICU) care, forehead non-contact infrared thermometry being a simple, fast, suitable technique appears to be capable. The forehead is an extremely superior region to calculate temperature as it is supplied by temporal artery which obtains high blood flow from the carotid artery [2,3].

Newborn infant's temperature inspection and its according management is a most chief prerequisite in good clinical neonatal management and carry out chief function in neonatal nursing care in NICU. Formative precise measurement of temperature is very significant since irregular temperature is powerfully connected with a severe condition [4,5].

Temperature measurement by the axillary technique has become the established neonatal nursing care [6,7]. As of the superior surface vasculature, augmented body fat and thermal consistency, temperature calculated in the axillary area is measured dependable and is utilized as a standard dimension site in newborns. No noteworthy dissimilarity has been recorded among left and right axillae [8]. Glass mercury thermometers are traditionally the most satisfactory typical techniques of temperature dimension. Nevertheless, glass mercury thermometers have some drawbacks such as danger of fracture, possible damage and noxious steam things to health workers and the subjects. As a result, glass mercury thermometers are now utilized infrequently in developed countries and researches are carry out to recognize the effectiveness of the different types of equipment accessible to measure temperature [9].

So, Current research was performed with the objectives to evaluate the precision of digital axillary thermometer (DAT) with infrared tympanic thermometer (ITT) and infrared forehead skin thermometer (IFST) measurements for term infants admitted in the NICU.

Material and Methods

Current prospective research was performed amid 225 term neonates admitted in NICU and post-natal ward at Paediatrics department of tertiary care hospital at Visnagar, Gujarat India during November 2021 to July 2022 after ethical permission of Institutional ethical committee. Three temperature impressions were carried out from each newborn in NICU by the researcher at interval of 24 hours. Entire 225 neonates included in the present research. An oral informed and written permission was acquired from the parents of the neonates. Temperature was measured by utilizing the following: Digital thermometer (for axillary), tympanic thermometer with disposable probe covers and Forehead infrared thermometer. Axillary and forehead region were dried utilizing a towel prior to the measurement. Right Axilla digital temperature was taken in supine position. Inclusion criteria was term neonates (>37 weeks) aged among 24 hours to 28 days of life, who will get admitted in NICU and post-natal ward of a tertiary hospital at Visnagar, Gujarat, the subject/guardian keen to provide a written informed consent. Exclusion criteria were: the neonates with maxillo facial congenital anomalies. The data were recorded in an Excel sheet and descriptive analysis was performed, of which data are presented in the tables.

Results

Table 1: Mean temperature difference between the axillary, ear and forehead temperature method (N=225)

Method	Mean Temperature Difference (°C)			
	Maximum	Minimum	Mean	SD
Axillary and Tympanic	1.5	-1.2	0.26	0.367
Axillary and Forehead	1.8	-1.3	0.54	0.586

Table 1 and figure 1 shows difference between axillary temperature with tympanic & forehead temperature. In Axillary and tympanic temperature, highest difference was 1.50C and minimum -1.20C where in forehead method; it was 1.80C & -1.30C respectively. Mean dissimilarity among axillary temperatures with tympanic & forehead temperature was 0.26⁰C with 0.367 SD & 0.54⁰C with 0.586 SD respectively.

Table 2 and figure 2 shows that mean temperature estimated by axillary method was 37.01(⁰C) with 0.47(⁰C) SD is lower than forehead method which was 37.55(⁰C) with 0.6(⁰C) SD. Dissimilarity among mean temperature anticipated by axillary method and mean temperature by forehead method was statistically significant (p<0.05). There was a statistically significant moderate correlation among higher than 2 techniques for temperature measurement (r=0.418, p<0.001). Mean temperature estimated by axillary method was 37.01(⁰C) with 0.47(⁰C) SD is lower than tympanic method which was 37.25(⁰C) with 0.69(⁰C) SD. Dissimilarity among mean temperature anticipated by axillary method and mean temperature by tympanic method was statistically significant (p<0.05). Also there was a significant strong correlation among over two techniques for temperature measurement (r=0.723, p<0.001).

Table 2: Correlation of forehead, ear temperature with axillary temperature (N=225)

Mean Temperature(⁰ C)		P value*	Correlation Coefficient
Forehead	Axillary		
37.55 ± 0.6	37.01 ± 0.47	<0.001	0.418**
Tympanic	Axillary		
37.25 ± 0.69	37.01 ± 0.47	<0.001	0.723**

Table 3 and figure 3 shows that forehead method of temperature method has 72.92% sensitivity to predict hyperthermia, 36.57% to predict normal and 14.0% to predict hypothermia. Overall sensitivity of forehead method to predict true temperature among neonates was 37.48%. Table 4 and figure 4 shows that tympanic method of temperature method has 89.58% sensitivity to predict hyperthermia, 69.5% to predict normal and 34.0% to predict hypothermia. Overall sensitivity of tympanic method to predict true temperature among neonates was 68.3%.

Table 3: Sensitivity of forehead temperature method to predict right temperature in study population (N=225)

Temperature	Axillary Temperature (Actual)	Detected right by Forehead method	Sensitivity of Forehead method (%)
<36.5	50	7	14.0
36.5-37.5	577	211	36.57
>37.5	48	35	72.92
Overall	675	253	37.48

Table 4: Sensitivity of tympanic temperature method to predict right temperature in study population (N=225)

Temperature	Axillary Temperature (Actual)	Detected right tympanic method	Sensitivity of tympanic method (%)
<36.5	50	17	34.0
36.5-37.5	577	401	69.5
>37.5	48	43	89.58
Overall	225	461	68.3

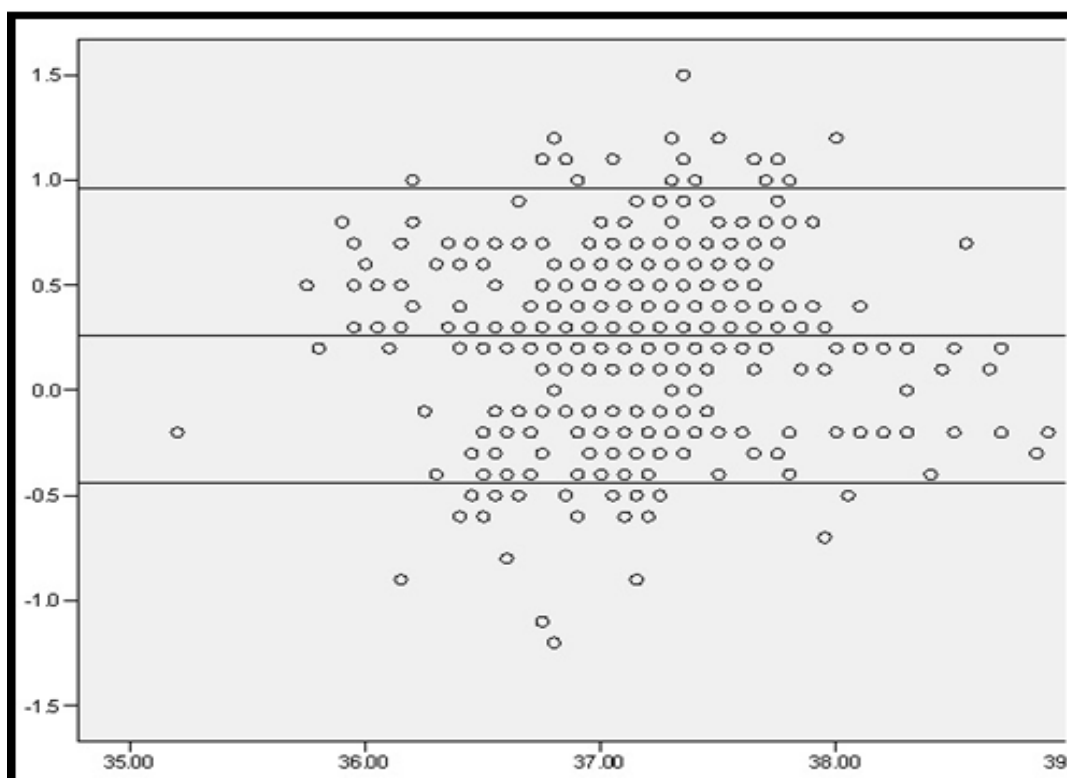


Figure 1: Bland–Altman plot showing comparison of body temperature: Average of Axillary Celsius and Forehead Celsius (X-axis) Vs Forehead Celsius – Axillary Celsius

Figure 1 shows that the body temperature dimensions by axillary and forehead techniques did not concur fine. Figure 2 shows that the body temperature dimensions by axillary and tympanic methods did not concur fine.

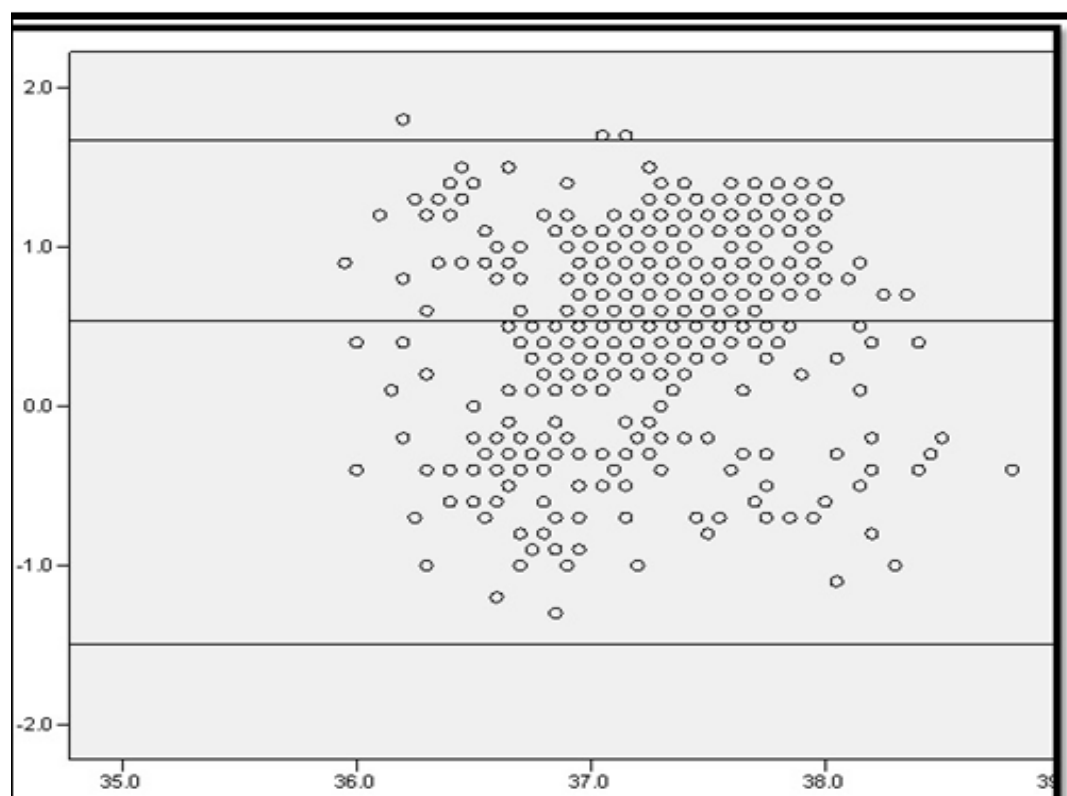


Figure 2: Bland–Altman plot showing comparison of body temperature: Average of Axillary Celsius and Tympanic Celsius (X-axis) Vs Tympanic Celsius – Axillary Celsius

Discussion

Supervising the body temperature in neonates is a clinical process utilized to evaluate the overall patient position. The present study was conducted to compare forehead infrared thermometry and tympanic thermometry with axillary digital thermometry for temperature measurement in term neonates admitted in NICU.

Current research found that the difference in mean, maximum and minimum temperature of axillary & tympanic was lower compare to axillary & forehead. Mean temperature measured by tympanic method was very close to observation of axillary method as compared to temperature measured by forehead method. Strong Correlation observed between tympanic & axillary method as compared to moderate association between forehead & axillary method. Chiappini E *et al* [10] accounted good harmony among forehead infrared thermometry and axillary thermometry utilizing mercury in glass thermometer. Alternatively, Apa H *et al* [11] recorded a superior mean difference of -0.38 C among axillary and infrared temperatures in children. Teran CG *et al* [12] illustrated a mean difference of only 0.029 C and so establish infrared thermometry dependable whereas Teller J *et al* [13] described broad limits of agreement and thus accomplished that it was not precise adequate for utilization in children. Fortuna *et al* [14] and Allegaert Ket *al* [15] described that contrast with rectal thermometers, forehead infrared thermometers overvalued the temperature at lower body temperatures and undervalue the temperature at higher body temperatures. De Curtis M *et al* [16] evaluated infrared thermometry with rectal thermometry in 107 newborns and establish a mean difference of -0.052 C. Researches performed by Placidi G *et al* [17], Sethi A *et al* [18], Patel MS *et al* [19] and Uslu S *et al* [20] too examined comparable outcome.

Sensitivity of tympanic method to examined temperature in neonate was

almost double than the sensitivity of forehead method.

In the present research, a elevated assessment of bias and wide limits of concurrence were recorded. The mean dissimilarity was -0.54 C which was superior to the set clinically satisfactory perimeter. Oncel MY *et al* [21] reported that as infrared thermometers were not precise sufficient to be suggested for utilization in hospitalized neonates, they could be utilized for formative body temperature of newborns at home by caretakers since they are protected, time competent, noninvasive and simple to employ. We found a mean temperature dissimilarity between axillary and tympanic methods to be of 0.26 C. Bland-Altman plot showed that body temperature dimensions by axillary and forehead techniques did not concur fine. Weiss ME *et al* [22] and Weiss ME *et al* [23] found that mean ear and axillary temperatures were extremely connected in newborns. On the other hand, its accurateness has been questioned for newborns renowned in research performed by Yetman RJ *et al*. [24].

Conclusion

Fever is a significant sign of infection in children. The stature of the fever associates with the probability of severe bacterial infection and occult bacteremia. Among the technology of nowadays, outline of fever are rarely utilized to narrow a discrepancy analysis. It is significant to be competent to notice and file fever precisely. Ear and forehead are potentially suitable sites for paediatric temperature measurement. Ear thermometry has benefits that include ease of utilization, quickness of outcome, security, subject and health care provider ease, lack of authority by things known to spuriously influence oral temperature and dependability over a wide choice of temperatures. Forehead infrared, tympanic infrared with axillary digital thermometer

measurements did not concur fine. Forehead infrared thermometry is not precise and cannot substitute axillary thermometry for body temperature measurement in neonates.

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