

Rectal, Axillary, and Tympanic Temperatures in Neonates and Infants with or without Fever

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Abstract

Objectives: To evaluate the agreement between temperature measured at the axilla or tympanic to rectum using standard techniques. **Patients and Methods:** We studied 50 neonates and 50 infants admitted to special care baby unit and Pediatric Gastroenterology Department with or without fever. Preterm, sick, malnourished neonates and uncooperative and crying infants were excluded from the study. Verbal consent from mothers was taken before the measurements. To adjust for rectal temperature, 0.55°C added to neonates and 0.65°C to infants' axillary temperature, 0.1°C to neonates, and 0.45°C to infants' tympanic membrane temperature. **Results:** There was a strong correlation (r) between 0.79 and 0.89 for axillary temperature with rectal temperature in neonates and infants, males and females, and for tympanic temperature with rectal in male infants. However, moderate correlation (r) was between 0.73 and 0.76 for tympanic temperature with rectal temperature in overall neonates and male and female infants. Axillary temperature missed 1% of pyrexia cases, whereas tympanic membrane measurements overestimate pyrexia in 5% of cases. **Conclusion:** It is safe reliable and convenient to use the axillary route for measurements of temperature in neonates and infants with or without fever.

Keywords: Axillary, fever, rectal, temperature, tympanic

INTRODUCTION

Body temperature is usually measured to confirm the presence or absence of fever.^[1] The presence of fever in infants and neonates affects the decision of both parents and clinicians.^[2,3] Parents may take vigorous steps to lower their children's temperature before and after seeking medical advice,^[2,3] and clinicians may carry out unnecessary investigations, may admit the child to the hospital,^[2-4] or just send him/her home with or without antibiotics.^[3] On the other hand, an incorrect temperature measurement could result in delayed detection of serious illness or an unnecessary septic workup.^[1] Despite the plethora of instruments that have become available in the past 30 years, these remain considerable controversy as the most appropriate thermometer and the most anatomical site for temperature measurement of neonates, infants, and children.^[1] An ideal thermometer should accurately reflect 40.41 core body temperature in all age groups, be convenient, easy, and comfortable to use by patient and practitioner, without causing embarrassment, and give a rapid result and does not result in cross-infection "safe," influenced by ambient

temperature, and cost-effective. We aimed to compare the temperature measured by axillary and tympanic with rectal routes in neonates and infants with or without fever.

SUBJECTS AND METHODS

This prospective study was carried out on 50 infants and 50 neonates admitted in the pediatric ward and special care baby unit, respectively, in Tripoli Medical Center for 3 months from June 1 to August 31, 2009. Children above 1 year and infants who were uncooperative or crying, preterm, or malnourished were excluded from the study. Each neonate and infant underwent simultaneous temperature measurement through the rectum, axilla, and external auditory canal "tympanic" for at least 3 min. The rectal and axillary measurements were performed using mercury in glass

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thermometer (IE. Medical-CE0123), using standard technique; for rectal measurement, a small amount of lubricant applied to the end of the probe which is gently slid into the rectum for about 2–2.5 cm.). The tympanic measurements were performed using digital auditory canal tympanic membrane thermometer (infrared ear thermometer, Braun ThermoScan. IRT 4520), calibrated before each measurement. Consent was obtained from the mothers after explaining the study. Statistical analysis was carried out using SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). Analysis of means (standard deviation), median (range), median difference, and correlation coefficient for measurements were calculated for each site for neonates and infants with or without fever in both genders.

RESULTS

A total of 100 patients (50 infants and 50 neonates) were included in the study. Measurements of rectal, axillary, and tympanic were taken at the same time. For neonates, 0.55°C added to axillary temperature with a strong correlation coefficient of 0.84 and 0.1°C added to tympanic temperature with a moderate correlation coefficient (0.74). Table 1 also shows that 0.65°C added to the axillary temperature of the infant to adjust for the rectal one and 0.45°C added to tympanic temperature. There was a strong correlation between rectal and axillary and between rectal and tympanic measurement in infants 0.88 and 0.83, respectively.

When gender is considered, we found that 0.6°C and 0.5°C added to axillary temperature of male and female neonates, respectively, to adjust for rectal ones with a strong correlation between axillary and rectal temperature ($r = 0.84, 0.90$) in both male and female neonates and 0.2°C added to tympanic temperature of male neonates to adjust for rectal one with a moderate correlation between tympanic and rectal temperature in male and female neonates ($r = 0.75, 0.74$) [Table 2].

For infants, 0.6 C added to the axillary temperature of male infants and 0.7°C to the axillary temperature of female infants to adjust for rectal ones with a strong correlation between the axillary and rectal temperature of male and female infants ($r = 0.89, 0.79$), respectively. Furthermore, 0.4°C added to male infants with a strong correlation of 0.84 and 0.5°C to female infants' tympanic membrane temperature to adjust for rectal ones, with a moderate correlation of 0.73 [Table 2].

When rectal temperature of 38°C was taken as a cutoff point for fever, we found that only 6% of all neonates and infants had fever. Of these, the axillary measurement could detect 5%, i.e., axillary temperature missed 1% of the cases with pyrexia. On the other hand, tympanic measurements detect 11%, i.e., it overestimates core temperature by 5% [Table 3].

DISCUSSION

Rectal route is considered the gold standard for evaluations of temperature and to make clinical decisions. However, the temperature can be measured at more convenient sites

Table 1: Relationship of the rectal, axillary, and tympanic temperature of all 50 neonates and 50 infants

Stats	Age groups	Rectal	Axillary	Tympanic
Mean (SD)	Neonates	37.04 (0.55)	36.62 (0.59)	36.89 (0.57)
	Infants	37.19 (0.82)	36.56 (0.78)	36.8 (0.84)
Median (range)	Neonates	37.10 (35.5-38.4)	36.55 (35-38.1)	37.0 (35.5-37.9)
	Infants	37.25 (35-39.9)	36.6 (34.8-38.7)	37.8 (35-38.9)
Median difference	Neonates	-	+0.55	+0.10
	Infants	-	+0.65	+0.45
Correlation coefficient (<i>r</i>)	Neonates	-	0.84	0.74
	Infants	-	0.88	0.83

SD: Standard deviation

Table 2: The relationship of the rectal, axillary, and tympanic temperature by gender neonates (29 males and 21 females) and in infants (33 males and 17 females)

Statistics	Age group	Rectal		Axillary		Tympanic	
		Male	Female	Male	Female	Male	Female
Mean (SD)	Neonates	37.03 (0.51)	37.06 (0.69)	36.51 (0.69)	36.55 (0.55)	36.89 (0.56)	36.89 (0.51)
	Infants	37.19 (0.91)	37.19 (0.43)	36.57 (0.94)	36.53 (0.51)	36.79 (+0.93)	36.83 (0.50)
Median (range)	Neonates	37.2 (35.6-37.7)	36.9 (35.5-37.9)	36.6 (35-38.1)	36.4 (35.3-37.6)	37.0 (35.8-38.2)	36.9 (36-38.4)
	Infants	37.2 (34.8-38.7)	37.3 (36.1-37.4)	36.6 (35-38.9)	36.6 (35.5-37.2)	36.8 (35-39.9)	36.8 (36.2-37.9)
Median difference	Neonates	-	-	+0.6	+0.5	+0.20	+0.0
	Infants	-	-	+0.6	+0.70	+0.4	+0.5
Correlation coefficient (<i>r</i>)	Neonates	-	-	0.814	0.9	0.757	0.74
	Infants	-	-	0.89	0.79	0.84	0.73

SD: Standard deviation

Table 3: Relation of fever to rectal, axillary, and tympanic measurements

Measurement site	Cutoff point for fever	Percentage without fever	Percentage with fever
Rectal	38.0	94	6
Axillary	37.5	95	5
Tympanic	37.6	89	11

including tympanic membrane, skin, oral, and axilla, with a conversion factor adjusted to estimate rectal temperature.

The accurate temperature measured is critical in infants, especially under the age of 3 months; in this age group, a temperature over 38°C has been associated with serious bacterial infection in 3%–15% of patients.^[5]

In the present study, tympanic measurements in neonates were not sufficiently accurate with low sensitivity in agreement with several previous studies.^[6-8] This is in contrast with other workers who concluded that tympanic thermometry is a very promising, acceptable, and practical methods and seems to be sufficient for mothers.^[9-11] Tympanic thermometry in infancy does not show sufficient agreement with a rectal one,^[2] supported by a recent meta-analysis and systematic review study by Zhen *et al.* 2014.^[12] They concluded that the accuracy of ear thermometer in children is poor and cannot replace rectal in agreement with our findings but at variance with other studies.^[1,13-17]

Several studies showed that axillary measurements in the newborn are interchangeable with rectal temperature^[3,7,18-21] which in agreement with our results, but Hissink Muller, in 2008,^[22] concluded that axillary and rectal temperature measurements poorly agree in newborn infants and cannot be used interchangeably.

The axillary temperature in infancy is safe; the corrected axillary temperature is a good guide to the rectal temperature in patients older than 1 month,^[23] which is in favor of our results. Other studies^[2,14,16] concluded that axillary temperature does not reflect rectal temperature, and there was a wide variation between axillary and rectal readings. In our study, only 6% were feverish by rectal route; further studies are required to assess the relationship between the axillary and rectal temperature in feverish neonates and infants of different pathologies. Our study also showed some gender variation, which requires further elucidation in large scale to confirm it and to find an explanation.

CONCLUSION

It is safe reliable and convenient to use the axillary route for measurements of temperature in neonates and infants with or without fever.

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Authors' contribution

All authors contributed to the conception and conduct of the study, preparation, revision, and approval of the final version of the manuscript.

Compliance with ethical principles

The study was approved by the Ethical Committee at the Tripoli Medical Center, Tripoli, Libya. Parents of all participants gave a verbal informed consent before participation.

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Conflicts of interest

There are no conflicts of interest.

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