Tympanic Membrane or Temporal Artery Thermometry: Which is More Reliable for Children?

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Abstract: _Background: Evaluation of body temperature is one of the oldest known diagnostic methods and is still an important sign of health and disease, both in everyday life and in medical care._ _Objective: To assess and compare the accuracy of temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to the axillary thermometry among children. Temperature of 300 children between the age group of 2-6 years was assessed and compared by using digital axillary thermometer(Omron MC-246), infra red tympanic membrane thermometry (infinity check FDIR-V1) and infra red temporal artery thermometry (infinity check FDIR-V1)._ _Results: More than half (53%) of children were in age group of 4-6 years and majority (69%) of the children were male . The range of temperature measured by tympanic membrane thermometry (92.6-99.5) was more close to the range of temperature measured by axillary thermometry(92-100.2) as compared to the temporal artery thermometry (92.6-99.5). The calculated F value by using ANNOVA showed that (222.2) is greater than tabulated F value (2.99) at 0.05 level of significance. Conclusion: Axillary thermometry cannot be replaced by tympanic membrane thermometry in paediatric population where a quick, comfortable and more accurate thermometry is required._

Keywords: Axillary Thermometry, Tympanic Membrane Thermometry, Temporal Artery Thermometry, Children

1. Introduction

Background of the Study

Vital signs are Body Temperature (T), Pulse (P), Respirations (R), and Blood Pressure (BP) indicates the function of some of the body's homeostatic mechanisms. Measurement and interpretation of the temperature is important component of assessment that can yield information about underlying health status The temperature measurement is a simple and easy to learn task, but interpreting the measurements and incorporating it into ongoing care and assessment require knowledge, problem – solving skills, critical thinking and experience. Although measuring vital signs are usually part of routine care, they provide valuable information and their evaluation should not be taken lightly.[1] Traditionally, oral, rectal and axillary sites have been used but according to various studies rectal site was reported to be a core temperature and is gold standard. Therefore, it is difficult to choose a body site to use as the reference standard for comparing readings obtained by different instruments or at different sites.[2]

Many anatomical sites and devices have been used to measure the body temperature like mercury thermometer ,digital thermometer, tympanic membrane sensors , liquid crystal skin contact thermometers etc .[3] but the best site is still a matter of controversy whichever technique used it should be simple, quick, reliable, safe and reproducible.[4] The use of mercury containing glass thermometers, despite alternate means of thermometry, is still the standard for obtaining temperature in many health care settings. Mercury

thermometers have a 25% error rate after a use or shelf life of 8 months. The main concern with these devices is the possibility of mercury exposure and poisoning on breakage.[5]

2. Need of the Study

Digital Thermometers, have evolved as a result of technological advancements in clinical thermometry, digital thermometers are increasingly finding preference among healthcare professionals. This is due to the fact that digital thermometers are considered faster, economical, and capable of recording temperature with greater precision compared to glass/mercury thermometers.[6]

The temperature measurement by digital axillary thermometer provides some advantages, but the child must be undressed and the arm should be immobile for at least 5 minutes[7]. It is safe, easily accessible and reasonably comfortable. In neonatal units, where ambient temperature are stable. Axillary measurements are found to be as accurate as rectal measurements. However, there are several disadvantages, axillary measurement requires supervision in case displacement occurs and it takes longer than rectal or oral measurement (5 minutes) which is not cost effective with regard to nursing time. Also, temperature measurement at this site is notoriously inaccurate as the sweating and evaporation causes' axillary temperature to be lower than the core body temperature.[8]

The tympanic thermometer can detect temperature within a few seconds by directing the tip of the instrument towards the tympanic membrane. Readings are not affected by

serumin or otitis media.[9] The infra red readings can be obtained from the temporal artery. Temporal artery thermometers provides all advantages of tympanic thermometry without the problem of operator needing to aim the instrument at the tympanic membrane. Many studies have demonstrated that temporal artery readings are accurate as rectal reading when taken as core temperature.[10]

It may be more accurate in children than adults, who have a thicker layer of skin over the temporal artery, which has an impact on temperature results.[11]Since the nurses are not using these type of thermometer in daily practice as they are not aware about the availability of these types of thermometer so there is a need to replace current practice with the new and advanced technologies[12]. So, there is a need to find out the appropriate thermometry that is temporal artery thermometry or tympanic membrane thermometry in terms of the accuracy which will replace axillary thermometry for temperature measurement in children.

3. Aim and Objective

To assess and compare the accuracy of temperature measured by tympanic membrane and temporal artery thermometry with reference to the auxiliary thermometry among children

4. Materials and Methods

300 children 2-6 years of age attending outpatient department, admitted in paediatrics ward and paediatric intensive care unit of selected hospital was selected using Non probability Purposive sampling technique . The three instruments used were digital Axillary thermometer (omraon MC-246), infra red Tympanic membrane thermometer (infinity check FDIR-V1) and infra red temporal artery thermometer (infinity check FDIR-V1) and there zero error was considered as given by the manufacturer The reliability of the thermometers was considered as given by the manufacturer i.e for digital axillary thermometer is + 0.4 ºF, for infra red temporal artery thermometer is + 0.2 ºF and for infra red tympanic membrane thermometer is + 0.5 ° F.

Data Collection Procedure
Axillary temperature was measured by placing digital axillary thermometer into the axilla, parallel to the body till the thermometer emits beep after 3 minutes. Tympanic membrane temperature was measured by placing infra red tympanic thermometer into the ear canal by pulling the ear pinna up and back, till thermometer emits beep after 3 seconds. Temporal artery temperature was measured by placing infra red temporal artery thermometer on the temporal site of the temporal artery, till thermometer beep after 2 seconds. Inferential and descriptive analysis of data was done using SPSS version 20.0.

5. Results
Out of 300 children more than half (53%) of children were in age group of 4-6 years. (69%) of the children were male and most (90%) of the children were selected from the outpatient department.

Range, Mean, Median and Standard Deviation of Temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to axillary thermometry among children

Table 1, N=300

Temperature (º F)	Range	Mean temp. + SD	Median temp
Axillary (A)	92-100.2	98.0 + 0.7	98.1
Temporal artery (T.A)	89.9-99.3	96.2 + 1.4	96.6
Tympanic membrane (T.M)	92.6-99.5	97.0 + 1.0	97

The data presented in table no.1 showed that the range of temperature and standard deviation measured by tympanic membrane thermometry (92.6-99.5) with the median (98.1) was more close to the range of temperature measured by axillary thermometry (92-100.2).

Association between the accuracy of temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to the axillary thermometry among children.

Table 2, N=300

T	Mean	M_D	SD_D	SE_{MD}	Z	p
T.A	96.2	1.8	1.4	0.05	23.4	<0.001
A	98					
T.M	97	1	1.1	0.05	16.4	<0.001*
A	98					

df (298) = 1.96 * Significant (p<0.05)

The data presented in table -2 showed that the calculated "z" value of 16.4 of tympanic membrane thermometry is greater than the tabulated "z" value of 1.96 found to be statistically significant at 0.05 level of significance which means there is significant difference in the accuracy of temperature measured by temporal artery thermometry and axillary thermometry

Correlation between the temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to axillary thermometry in terms of accuracy among children.

Table 3, N=300

Correlational matrix		A	T.M	T.A
Temperature	T.A A	0.193*	0.53* 0.198*	0.193*

df (298) =0.113   * Significant (p<0.05)

Data in Table 3. Showed that the computed coefficient of correlation between accuracy of temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to axillary thermometry was 0.198 and 0.198 at 0.05 level of significance which means axillary thermometry has significantly correlated with tympanic membrane and temporal artery thermometry.

Table 4: One way ANOVA value showing the difference between the means of accuracy of temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to the axillary thermometry among children, N=900

Source of variation	df	Sum of square	Mean square	F ratio

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Between Groups	2	528.42	264.21	
Within Groups	897	1066.55	1.18	222.2*
Total	899	1594.97		

* Significant (p<0.05)

A one way ANOVA was calculated in Table 4. to compare the means of accuracy of temperature measured. The calculated F value (222.2) is greater than tabulated F value (2.99) at 0.05 level of significance (p<0.05). There is statistical significant difference between the accuracy of temperature measured by tympanic membrane thermometry and temporal artery thermometry with reference to the axillary thermometry among children

6. Discussion

Finding from the present study support the use of temporal artery thermometry is not reliable when compared with digital axillary thermometry These findings are consistent with the study conducted by **Sethi .A, Patel. D et al. (2013)** [14]which concluded that infra red forehead thermometer provides unsatisfactory accuracy when compared to digital axillary thermometer (mean difference 2.3 ° F).In present study, there is a low degree correlation between temperature measured by temporal artery thermometry (0.193) and tympanic membrane thermometry (0.198) with reference to the axillary temperature. These findings are consistent with the study conducted by **Osio (2007)** which concluded that there is a weak correlation between temperature measured by an infra red tympanic thermometer , temporal artery thermometer and the axillary thermometry. The limitations of the study are the thermometers were not calibrated during the study period. The recommendations of the study are A study can be done to compare carotid artery temperature , temporal artery temperature , tympanic membrane temperature with reference to axillary temperature A comparative study can be done to assess the effectiveness of temporal artery thermometry, tympanic membrane thermometry with reference to axillary thermometry in neonates. A similar study can be done to assess and evaluate the accuracy of more upcoming advanced thermometer. A similar study can be done to assess and evaluate the accuracy of thermometers in febrile and non febrile children.

7. Conclusion

Each method of temperature measurement in children have their strengths and weaknesses, choices should be made by the nurses to prefer the thermometer which has ease of application, safety and absence of potential risks and better tolerability in children. Despite the fact that temperature measurement in children seems so simple, a wide variety of devices are available to record temperature from the body, ear or skin. This study showed that though the range of temperature measured by tymapni cmmebran ethermometry came out to be more close than with the temperatur emeasured by axillary thermometry but there is a significant difference between the tympanic membrane thermoketry and axillary thermometry so it concludes that the axillary temperature cannot be reliably replaced by tympanic membrane or temporal artery thermometry in children.

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