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Original Research Article

Comparison of various methods of temperature measurement in children admitted in the pediatric ward of a tertiary care center

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ABSTRACT

Background: Temperature measurement is an important procedure in the diagnosis and management of childhood illness. Rectal measurement of temperature is often done with resentment from the child, the parents as well as the physician. Intra aural (Tympanic), temporal artery and axillary measurements are commonly undertaken for temperature recording in children. The aim of the study was to compare the various methods of temperature measurement (intra aural, temporal artery and axillary measurements) in children. This was a hospital based descriptive study (pilot study) from a pediatric tertiary care center.
Methods: This was a hospital based descriptive study (pilot study) from a pediatric tertiary care center. 250 children admitted with history of fever in the pediatric ward. All consecutive children with fever were recruited for the study. Children with ear pain, ear discharge and wax in the ear were excluded.
Results: Inter-group comparison was performed using student paired t-test. There was no difference in the temperature measured by axillary and temporal artery touch when compared with intra aural. Temperature measured by infra-red temporal at 3 cm showed significant lower temperature. Temporal artery and axillary measurements had a correlation coefficient of 0.74 and 0.64 respectively when compared with intra aural measurement.
Conclusions: Temporal artery and axillary measurements are not significantly different from intra aural measurement in children. For the ease of measurement, better correlation, better compliance of the child, temporal artery method can be a reliable preferred temperature measurement in children with fever.

Keywords: Axillary, Temperature, Temporal artery

INTRODUCTION

Temperature measurement is a common procedure undertaken in pediatrics which helps management of febrile illness. The method of measurement varies with the physician and the age of the child.[1,2] Measurement of core temperature is the ideal method of assessment of fever in children. Rectal measurement is known to reflect the core temperature. However, the rectal method is neither preferred by the physician nor the child since it is invasive and creates discomfort to the child as well. Though rare, the reported complication of rectal perforation has made them less preferred method of temperature measurement in clinical settings. However recent reports have identified noninvasive infra-red intra aural measurement (tympanic) to be as accurate as rectal

temperature.[3] Infrared temporal artery and axillary measurement is commonly used in children. This study was undertaken to compare these commonly used methods of temperature measurement in children.

The aim of the study was to compare the infrared intra aural(tympanic), digital axillary and infrared temporal artery temperature measurement among children with fever in the pediatric ward.

METHODS

To compare the infrared intra aural (tympanic), digital axillary and infrared temporal artery temperature measurement among children with fever in the pediatric ward.

This was a hospital based descriptive study. The study was set at the Pediatric department of a semi urban tertiary care Government Institute. The study duration was from June 2016 to September 2016. All children admitted with fever during the study period were chosen for the study. All consecutive children with fever were recruited.

Exclusion criteria

Children with ear infections, ear pain and wax in the ear and neonates (age less than 28 days) were excluded.

Children admitted with history of fever during the study period were chosen for the study. Following informed written consent (with assent in older children) the study population was recruited consecutively. History regarding ear infections or pain in the ear were noted and children were subjected for ear examination. Children with wax in the ear, discharge or perforation in the ear drum were excluded. All children underwent sequential measurement of all the three methods of temperature measurement. Digital axillary, infra-red intra aural and infra-red temporal touching the skin and at 3 cm distance were the methods of temperature measurement. Axillary temperature was measured using the digital thermometer and the temperature was taken as soon as the beep sound was heard with the digital thermometer kept at the axilla. This was followed by temporal method of measurement using the infra-red thermometer kept on the skin pressed across the forehead skin sliding laterally to the hair line in contact with the skin.

The thermometer was held near the temporal region over the skin and then at a distance of 3 cm. The reading was noted for both the measurements from the digital display. This was followed by tympanic measurement using the infra-red thermometer. Disposable aural caps were used for each measurement. The ear canal was pulled downward and backward and the aural probe was inserted in the canal until it snugly got fitted in the ear canal and the digital display of temperature was noted. Children were consequently recruited based on their willingness and were not included more than once in this study. Infra-red aural measurement was compared with emporal and axillary measurement. Mean and standard deviations were calculated. The temperature measured by various methods were compared using the Student t-test. A P-value less than 0.05 was considered statistically significant. Graph pad software version 2016 was used for calculating student t-test. Correlation coefficient was arrived for the various methods of measurement.

RESULTS

The study group comprised of 250 children. Male female distribution revealed male female ratio to be 1.17:1. Among the study group 38 were less than 3 years (15.2%), 99 between 3-7 years (39.6%), 88 between 7-10 years (35.2%) and 25 between 10-12years (10%). Comparison was done between intra aural and the axillary and temporal (touch and 3cm).

The temperature ranged from 97˚F-103.5˚F in tympanic, 97.3˚F-104.1˚F in temporal touch, 97.5˚F-103.5˚F in temporal 3 cm, 95.5˚F-103.5˚F in axillary measurement. The mean and standard deviation of the various methods of measurement has been summarized in table 1.

Table 1: Mean and standard deviation of the various methods of measurement.

Method	Mean (Fahrenheit)	Standard deviation
Intra-aural	100.45	1.35
Infrared touch	100.42	1.60
Infrared 3 cm	99.71	1.52
Axillary	100.25	1.38

Various temperature measurements have been compared and shown as scatter plots with correlation coefficient (r) in figure 1-6.

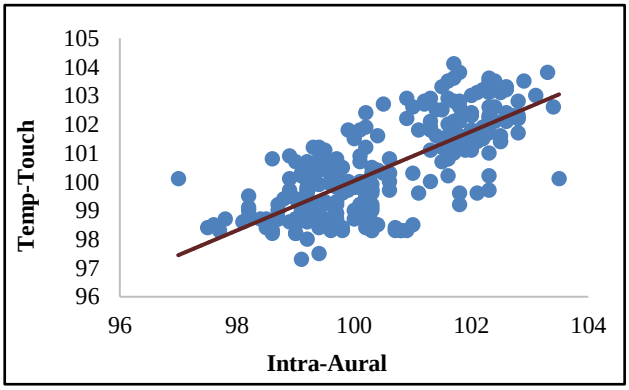

Figure 1: Scatter diagram of correlation between intra aural and temporal touch (r=0.73).

Inter group comparison was done for the intra aural with the other three methods of measurements. results of the comparison are shown in Table 2.

For all the 3 methods (intra-aural, Infra-red touch and axillary), the in-group variability was noted to be very small as denoted by the SD, indicating the good precision in temperature reading of all 3 methods.

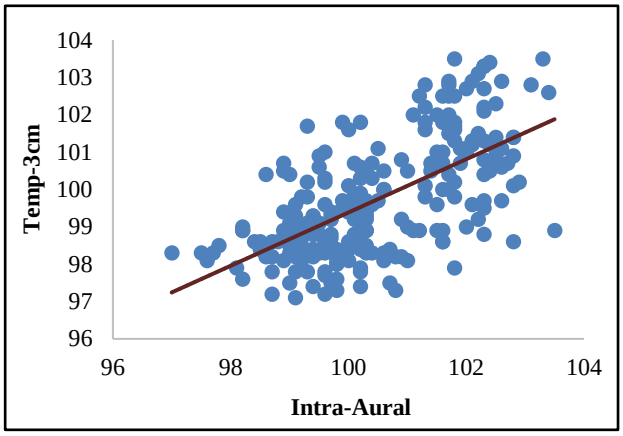

Figure 2: Scatter diagram of correlation between intra aural and temporal (3cm) (r=0.63)

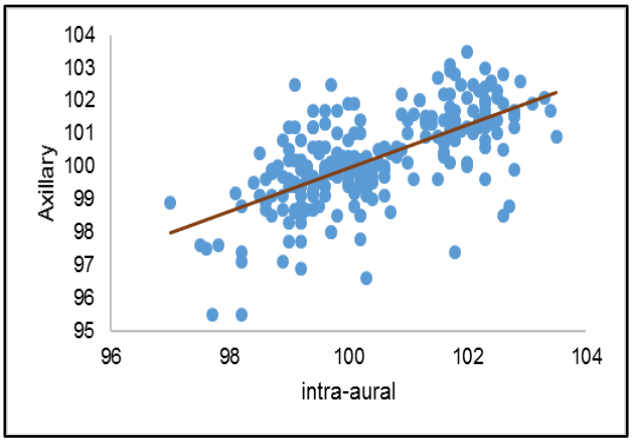

Figure 3: Scatter diagram of correlation between intra aural and axillary (r=0.64).

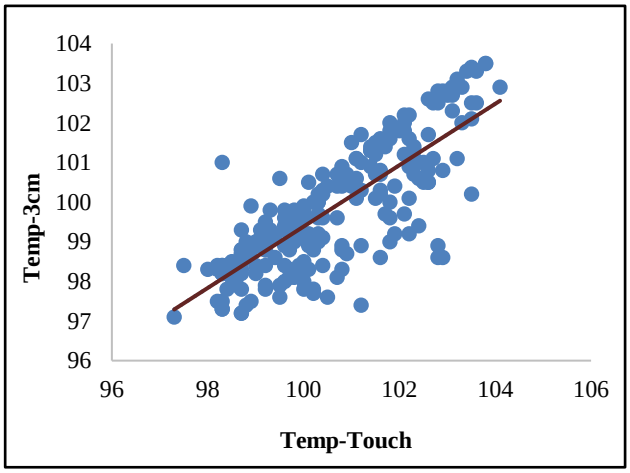

Figure 4: Scatter diagram of correlation between temporal touch and temporal 3 cm (r=0.81).

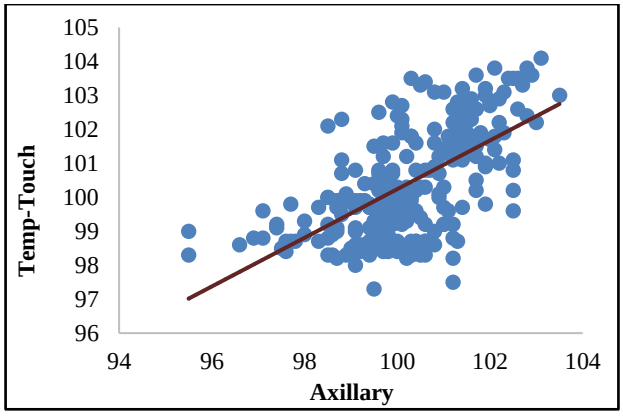

Figure 5: Scatter diagram of correlation between axillary and temporal touch (r=0.62).

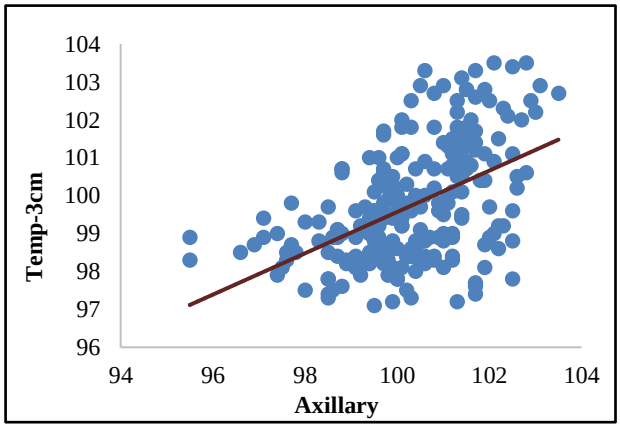

Figure 6: Scatter diagram of correlation between axillary and temporal (3cm) (r=0.49).

Inter-group comparison was performed using student paired t -test it is noted that there was no difference in the temperature measured by axillary and temporal artery touch. Temperature measured by infra-red temporal at 3 cm showed significant lower temperature.

Table 2: Comparison among the methods of measurements.

Comparison	t- value	p- value
Intra aural vs. temporal touch	0.227	0.82 (-0.2301 to 0.2901)
Intra aural vs. temporal 3cm	5.755	<0.0001 (-0.4874 to 0.9926)
Intra aural vs. axillary	1.638	0.1020 (-0.034 to 0.44)
Axillary vs. temporal touch	1.2721	0.2039 (-0.4326 to 0.0926)
Axillary versus temporal 3cm	4.1589	<0.0001(0.2849 to 0.7951)
Temporal touch vs. temporal 3cm	5.0868	<0.0001 (0.4358 to 0.9842)

This difference in temperature measurement at 3 cm distance was statistically significant as compared with

axillary, intra-aural, infra-red touch. There were no complications of any sort in the study group.

DISCUSSION

Temperature measurement is an essential component of medical diagnosis and planning investigation and treatment in children.[1] The best site for measurement of core temperature is the hypothalamus. since it is inaccessible, closest values would be reflected by the pulmonary artery, distal esophagus, bladder and rectum.[2] Rectal temperature measurement is the gold standard but is not the preferred mode of measurement both for the physician and the children. It carries the theoretical drawbacks like rare rectal perforation in neonates, spread of infections and slow to reflect the temperature changes.[2] Temperature measurement was conventionally done using mercury thermometers in the past. With increasing awareness about environment friendly devices, digital measurement of temperature came into routine use. However, the site of measurement does make a difference in reflecting the core temperature.

Other measurements including oral and axillary measurement is again not the comfortable method of measurement in children. Both procedures need the children to co-operate and also need thorough cleansing after every use. Commonly used methods are the infra-red, intra aural and temporal measurements. methods of measurements Temporal measurement is more comfortable for the child as well as the physician. Aural measurement though close to core temperature needs careful measurement and needs the thermometer caps for individual use. Intra aural measurement, which measures the radiant heat from the tympanic membrane is an alternative to rectal temperature.[3-10] This is a safe procedure and does not carry the risk of perforation when introduced in the ear canal. This is acceptable by children. But tympanic measurements will be significantly affected by ear infections and presence of wax in the ears.[11]

Studies have shown that axillary measurement to be not so accurate with rectal in comparison to temporal artery measurements. Studies have also shown that there is a good correlation between rectal and axillary temperature but the accuracy of axillary temperature is better at higher temperatures than at lower temperatures.[12,13] Though different formulas exist to calculate the expected rectal temperature from the measured axillary temperature none can be recommended at present.[14,15]Comparison of axillary, tympanic and temporal with rectal measurement has shown good correlation with all methods and the correlation was highest for temporal artery measurement in this study.[16-20]

A comparison of temperatures measured by the commonly used methods like digital axillary and infra-red temporal and aural were undertaken for their correlation. Intra aural measurement had a good correlation with infra-red temporal and axillary. All the three methods did not show any statistically significant difference in temperature recorded. There was a significant correlation between intra aural with temporal touch and axillary method. The infra-red temperature measured at 3 cm distance showed a significantly lower temperature in comparison with the axillary and the temporal touch values. A comfortable method of temperature measurement in children will be temporal artery measurement which does not need child compliance as compared to intra aural and axillary.

CONCLUSION

Among the various methods of temperature measurement infra-red temporal touch and digital axillary have good correlation with intra aural and hence can be reliably used in children. Since infra-red temporal touch is much easier technique than digital axillary, temporal measurement may be preferred in children.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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