Original article

Comparison of Axillary Temperature with Oral Temperature and Determination of Optimum Placement Time of Thermometer in Adults of Teaching Hospital, Nepal

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Abstract

Introduction: Accurate temperature measurement is important to person, in whom suspicion of infection could result in investigations, administration of antibiotics, and even hospital admission. This study was done with the aim to determine the optimal dwell time of the thermometer in oral and axillary sites required to accurately reflect the stabilized core body temperature.

Method: Cross-sectional survey of 113 adult patients was done who were admitted in Manmohan Cardio- Thoracic Vascular and Transplant Center (MCTVC) in the period between 16th July to August 2013. Ethical approval from the Institutional Review Board (IRB) of TUIOM and permission from the respective hospital authority was taken before data collection. Conventional glass mercury thermometer were checked and brought to 95 degree of Fahrenheit before each measurement of the temperature. Two thermometers were simultaneously placed in oral cavity and in the axillary skin sites. Reading of the oral temperature was done in 1 and 3 minutes, similarly, reading of axillary temperature was done in 3 and 5 minutes. Data was analyzed in SPSS 18 by using parametric and nonparametric tests.

Results: Findings revealed the mean temperature difference between 1 minute oral to 3 minute axilla was 0.92 ± 0.79 SD, and the 3 minute oral to 5 minute axilla was 0.96 ± 0.82 SD, the difference was significant ($P<0.05$). Further, the mean oral temperature in 1 minute was 97.75 ± 1.27 SD, and in 3 minutes was 98.69 ± 1.37 SD. Similarly, mean temperature of axilla in 3 minutes was 97.67± 1.40 SD, whereas mean in 5 minutes was 98.43 ± 1.46 SD. The mean difference was significant.

Conclusion: The effective time to measure oral temperature was three minute and it was five minutes for axillary measurement.

Key words: Temperature, degree of Fahrenheit, oral and axillary measurements

Introduction

Body temperature is a complex variable of physiological function that demonstrates variability in a predictable, time-dependent manner. It also appears to vary in several clinical situations[1]. Despite environmental temperature extremes and physical activity, temperature control mechanisms of human beings keep body's core temperature relatively constant within a range as low as 35^{0}C (95^{0}F) during sleep and cold exposure, to 40^{0}C (104^{0}F) during strenuous exercise[2-3].

Body temperature variations are observed by the site of measurements. Temperature is an important indicator of a variety of disease states and clinical syndromes. Therefore, an accurate temperature measurement is important, especially in immune-compromised person whose suspicion of infection could result in investigations, administration of antibiotics, and even hospital admission[4]. As body temperature assessments are key diagnostic indicators, all health services need reliable, valid, readily available, and accessible body temperature assessment devices[5].

As core body temperature variations are observed in the site of measurements, accurate readings of temperature are critical to the rapid, effective, and precise diagnosis process. False high readings of it may lead to expensive and painful diagnostic studies and medical interventions for patients whereas false low readings may lead to greater morbidity and mortality. For measurement of temperature, the use of mercury thermometers is conventional and convenient but the length of time required to achieve an accurate measurement varies by the sites of its placement[6].

Axillary site for temperature measurement is safe and easy to perform, whereas oral thermometry to be the most accurate and reproducible method[7]. A range of 4-7 minutes of placement time for stabilization of axillary thermometry (AT) has been recorded[8-9] whereas, recommended oral temperature (OT) placement time to be 3 to 4 minutes[9]. But in our practice, there is one (1) minute dwell time of conventional mercury thermometer in oral cavity and three (3) minutes in axillary site. It gave evidence to researcher to hypothesize the cases of true fever missed in our practice. Therefore, the present study was done to compare the axillary temperature with oral temperature in adult with the aim of finding out the optimum placement time of the conventional mercury in glass thermometer. It was an attempt made to give this commonly practiced procedure on scientific basis.

Methods

Analytical Cross-sectional study design was adopted for this study. Here, comparison of axillary and oral temperature in degree of Fahrenheit with mercury glass thermometer with time variations was done. First reading time of oral temperature was one minute and the second reading time was three minutes. Similarly, the first reading time of axillary temperature was three minutes and the second reading time was five minutes. All admitted adult patients of both sex (over 18 years of age) in Manmohan Cardio-Thoracic Vascular and Transplant Center at one month period (July 16 to August 16, 2013) were the population of this study.

As counting the census of that month, 304 patients were admitted. Among them, 102 didn't meet inclusion criteria. Among remaining 202 patients, 89 refused to participate in this study. Therefore, 113 patients were the sample size of the study. Patients who were in first postoperative day, in ventilator, in unconscious state, under 18 years of age, mentally incompetent, and with infection/sore in oral cavity were excluded from this study.

Conventional glass mercury thermometers were used to measure body temperature and it was recorded in a structured format with measurement unit of degree of Fahrenheit. Mercury of each thermometer was checked and calibrated to 95°F before each. Proposal was approved from Institutional Review Board of IOM, and permission for data collection was taken from the respective hospital authority.

Data were coded manually, and entered in and analyzed with SPSS version 18. Descriptive statistics such as frequency and percentage, parameters (mean and standard deviation) were calculated. To compare the parameters parametric test (independent t test) was applied. After completion of parametric test, data were transformed to different variables to make adjustments for non-parametric test. For qualitative analysis, Pearson's chi square test was applied.

Results

Demography showed most of the respondents were (40.7%) middle aged adult, followed by young adult 31%, and rest of other respondents (28.3%) were elderly adult. Majority of the respondents were (55.8%) male, followed by 44.2% female respondents. The mean age of the respondents' was 48.94 with standard deviation of 16.44.

The mean oral temperature of the respondents in one minute was 97.75^0F (± 1.27 SD) and mean oral temperature in three minutes was 98.69^0F (± 1.37 SD). Similarly, respondents' mean axillary temperature in three minutes was 97.67^0F (± 1.40 SD) and mean axillary temperature in five minutes was 98.43^0F (± 1.46 SD). **(Refer table 1)**. The difference between oral and axillary temperature in 1 minute, 3 minutes and 5 minutes was significant ($P < 0.05$). The mean difference of oral temperature from one minute to three minutes was 1.08^0F (± 1.00 SD), and the mean difference of axillary temperature from three minutes to five minutes was 0.97^0F (± 0.81SD). The difference was found significant ($P < 0.05$). **(Refer table 2)**. Respondents' mean difference between one minute oral temperatures from the three minutes axillary temperature was 0.92^0F (± 0.79 SD), similarly the mean difference between three minutes oral temperatures from five minutes axillary temperature was 0.96^0F (± 0.82 SD). P value of independent t test showed significant difference between axillary and oral mean temperature. **(Refer table 3)**. Most of the respondents were male. The axillary temperature in three minute reading time, out of 59 clients, 57.6% male and 42.4% female had temperature < 98.6^0F. **(Refer table 4).**

Table 1 Mean Temperature with Time Variables

Time Variable	Mean	Standard Deviation	p value
Oral temperature in one minutes	97.75	1.27	0.000
Oral temperature in three minutes	98.69	1.37	
Axillary temperature in three minutes	97.67	1.40	0.000
Axillary temperature in five minutes	98.43	1.46	

Table 2 Mean Difference of Temperature with Time variables

Variables	Mean	Standard Deviation	p value
Difference of oral temperature from one minute to three minute	1.08	1.00	0.000
Difference of axillary temperature from three minute to five minute	0.97	0.81	0.000

Table 3 Axillary and Oral Mean Temperature Difference

Variables	Mean	Standard Deviation	p value
Difference between 1 minute oral temperature from 3 minute axillary temperature	0.92	0.79	0.000
Difference between 3 minute oral temperature from 5 minute axillary temperature	0.96	0.82	

Table 4 Respondents' Temperature Difference according to Sex

N = 113

Variables	Temperature in Degree of Fahrenheit		
	<98.6	**98.7 – 101**	**> 101.1**
Axillary temperature in three minute			
Male	44 (50%)	18 (75%)	1(100%)
Female	44 (50%)	6 (25%)	0 (0)
Total	**88 (100)**	**24 (100)**	**1(100)**
Axillary temperature in five minute			
Male	32 (46.4%)	28 (73.7%)	3 (50%)
Female	37 (53.6%)	10 (26.3%)	3 (50%)
Total	**69 (100)**	**38 (100)**	**10 (100)**
Oral temperature in one minutes			
Male	48 (51.6%)	14 (73.7%)	1 (100%)
Female	45 (48.4%)	5 (26.3%)	0 (0%)
Total	**93 (100)**	**19 (100)**	**1 (100)**
Oral temperature in three minute			
Male	34 (57.6%)	27 (54%)	2 (50%)
Female	25 (42.4%)	23 (46%)	2 (50%)
Total	**59 (100)**	**50 (100)**	4 (100)

Discussion

In this study, out of 113 respondents, 40.7% were middle aged adult, followed by young adult 31%, and rest of the others (28.3%) were elderly adult. Similarly, 55.8% respondents were male, followed by 44.2% female respondents. The mean age of the respondents' was 48.94 with standard deviation of 16.44.

This study revealed that the mean oral temperature of the respondents in one minute was 97.75 (± 1.27 SD), whereas, the mean oral temperature in three minutes was 98.69 (± 1.37 SD). Similarly, respondents' mean axillary temperature in three minutes was 97.67 (± 1.40 SD), whereas, respondents' mean axillary temperature in five minutes was 98.43 (± 1.46 SD). The mean difference between oral temperature in one minute and three minute was significant, because p value of independent t test was <0.05. Similarly the mean axillary temperature difference between three minute to five minute was also significant (t test p value <0.05). Furthermore, the mean temperature difference from one minute to three minute of oral site was 1.08 (± 1.00 SD). Interestingly, the mean temperature difference from three minute to five minute of axillary site was 0.97 (± 0.81 SD). These findings indicated that human body temperature taken from oral site in 1 minute would be low by 1.08^{0}F than temperature taken in 3 minute time period from the same site. In addition to this, temperature taken from axillary site in 3 minute was low by 0.97^{0}F than temperature taken in 5 minute time from the same site. With support of this findings, Akibami & Sowunmi and Morley, et al., demonstrated a range of 4-7 minutes of placement time of thermometer for stabilization of axillary temperature[8-9] whereas others have found it to be unacceptably high (12 minutes) dwell time of the thermometer[10].

This study revealed that the mean difference between 1 minute oral temperatures from 3 minute axillary temperature was 0.92 (± 0.79 SD). Similarly the mean difference between 3 minute oral temperatures from 5 minute axillary temperature was 0.96 (± 0.82 SD). P value of t test showed the significant difference between axillary and oral mean temperature. Supporting to this finding Akibami[8] recommended oral temperature (OT) placement time to be 3 to 4 minutes which is comparable to our findings of 3 minutes. In support to our study findings Haddock[10] indicated that AT stabilization time should be 6 minutes and OT stabilization time should be 4 minutes. In support to our study findings Chaturvedi[11] indicated that AT stabilization time should be 6 minutes and OT stabilization time should be 4 minutes. In Contrast, authors concluded that showed with mercury thermometers there is no clinical advantage in using a measurement time longer than 3 minutes[12].

In this study majority of the respondents were male, and out of 59 clients, 57.6% male had temperature < 98.6^{0}F in axilla in three minute time, whereas 42.4% female had temperature <98.6^{0}F in the same site. In this study, greater number of respondents (78.9%) had temperature increased to range of 98.7^{0}F to 101^{0}F when it was taken by three minute dwell time orally, whereas only 15.8% respondents had temperature in the same range when it was taken by one minute dwell time orally. This difference was calculated by Pearson's chi square p value <0.05 showed significant difference. Similarly, greater percentage (52.6) of respondents had temperature increased to range of 98.7^{0}F to 101^{0}F when it was taken by five minute dwell time in axilla, whereas only 47.4% of respondents had temperature in the same range when it was taken by three minute dwell time in axilla. This temperature difference with time variables in both site was calculated by chi square p value, and showed significant difference (<0.05). findings of this study also showed 12.9% respondents whose temperature was taken from axillary site in three minute was in range of 98.7 to 101^{0}F, whereas the percentage of the respondents gone to 63.2%, when the temperature was taken orally in one minute. The difference between two site of temperature showed significant by chi square p value <0.05. and findings also showed that 20.3% respondents whose temperature was taken from axillary site in five minute time was in range of 98.7 to 101^{0}F, whereas the percentage of the respondents gone to 48%, when the temperature was taken orally in three minute. The difference between two site of temperature showed significant by chi square p value <0.05. This finding is also supported by Haddock[10] indicated that AT stabilization time should be 6 minutes and OT stabilization time should be 4 minutes. In this study mean oral temperature is higher by 0.94^{0}F, where Smith[5] concluded that oral temperature is higher by 0.39°F than groin and axillary sites. Study revealed no significant difference between mean temperature of male and female.

Conclusion and Recommendation

On the base of findings, it is concluded that 3- minute dwell time of thermometer in oral cavity gives higher reading of temperature than 1- minute dwell time of the same site. Five minute dwell time of thermometer in axilla gives higher reading of temperature than three minute dwell time of the same site. There is higher reading of temperature taken from the oral cavity by 0.94^{0}F than the temperature taken from the axillary site.

On the base of conclusion, it is recommended that, health practitioners need to review the dwell time of mercury thermometer in oral cavity from current practice of 1 minute to 3 minute and in axilla from current practice of 3 minute to 5 minute, otherwise true case of fever might be missed in clinical setting. Practitioner need to document clearly the site of temperature taken from in client's treatment chart in their practice. Management need to review their practitioners' current thermometer dwell

time for temperature measuring and recording unit of the temperature. Further control study is recommended with minimized possible error to bring valid scientific base for correction or to support current practice.

Conflict of interest: None declared.

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