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Original Article

COMPARISON OF BODY TEMPERATURE RECORDINGS USING MERCURY AND LIQUID CRYSTAL FOREHEAD THERMOMETERS

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ABSTRACT:

Objectives: The study was carried out to compare the recordings of body temperature using oral mercury thermometer and liquid-crystal forehead thermometer, so as to assess and ascertain the accuracy and validity of the later method.

Setting: Hira General Hospital, Abbottabad.

Subjects and Materials: Simultaneous recordings were made using the two devices in randomly enrolled 147 patients. The ages of patients ranged from 10 years to 90 years. FeverScan liquid-crystal forehead thermometer, Boots (UK) was used for forehead temperature while Chinese made mercury thermometer (Safety) was used to check oral temperature.

Results: Significant difference existed between the recordings of two devices. The mean difference was 1.19 degree F ($p<0.001$). FeverScan liquid-crystal forehead thermometer recorded higher temperatures. In patients without pyrexia both devices recorded temperature within normal range.

Conclusions: The sensitivity of FeverScan liquid-crystal forehead thermometer to detect fever was comparable to mercury thermometer but was unreliable in grading fever and showed a tendency to over estimate the temperature. It is a good device for home use but health providers should not use it. Mercury thermometer remains the gold standard.

KEY WORDS: body temperature, liquid-crystal forehead thermometer, mercury thermometer, oral, recording, comparison.

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INTRODUCTION

In 1868 Carl Wunderlich laid down the position that normal temperature was a sign of health while mobility of temperature indicated disease. He showed that certain types of temperature fluctuations were characteristic of certain diseases. Some of this was controversial, and arguments over the accuracy of measurements and the meaning of the readings when they were available continued through the century, Nevertheless, thermometry was established and reinforced the idea of specific, graphic and objective data as fundamental to clinical practice.[1]

Man's body temperature is maintained between 97-99°F. (36-37.5°C). The standard method of measuring this temperature is to use a clinical thermometer which have Fahrenheit and Centigrade scales. Fahrenheit scale extends

from 94-108 degrees with an arrow at 98.6 to indicate the mean value of body temperature. Centigrade scale extends from 35-42° with an arrow at 37°C.

Special thermometers are available with scales extending down to 80°F for use with patients who suffer from hypothermia.

Used clinically the thermometer is placed under the tongue, in the axilla, in the groin or inserted into the rectum. The transfer of heat is much slower, and if the thermometer is removed early a low recording will be obtained. The recommended time period is 3 to 5 minutes. The reading obtained in the axilla is about 0.5°F lower than that in the mouth.

The temperature recorded in the mouth may not be a true indication of the body temperature if a hot or cold drink has been taken within the previous half- hour. It will also be inaccurate if the subject is breathing through the mouth. The body temperature is not constant. It fluctuates throughout the day. It is commonly found that a maximum occurs in the evening and a minimum in the early hours of the morning. In women there is also a monthly variation. The temperature in the second half of the menstrual cycle is higher than during the first half. The temperature rises during exercise and after a hot bath.[2]

The introduction of liquid crystal forehead thermometer has made temperature recording seemingly very easy. Such thermometers being free of chemicals are safe as compared to mercury thermometers. They have an additional advantage of minimizing the risk of transfer of certain bacteria or viruses from one subject to another. Due to easy recording a common man can use it and record the temperature very easily. A trend is developing both in health providers and general population to use forehead thermometers but the accuracy of this device to record and grade temperature is uncertain. We tried to ascertain the accuracy and validity of liquid crystal forehead thermometer by comparing the reading with the more reliable oral mercury thermometer.

SUBJECTS AND MATERIALS

This study was carried out on 147 patients attending Hira Hospital, Abbottabad. These subjects were randomly enrolled and their ages ranged from 6 to 90 years. Pulse and temperature were recorded using the two devices. Oral temperature was recorded with Chinese made (Safety) mercury thermometer while the forehead temperature was recorded using FeverScan liquid crystal (Boots, UK) thermometer. It was ensured that the subjects had not taken cold or hot drink during the last 30 minutes and that they were sitting in ambient room temperature for the last one hour. The usual room temperature during the study period was 20 to 30°C. It was also made sure that at the time of recording forehead temperature the forehead skin was dry and clean. Pyrexia was

Table I: Comparison of different methods for recording body temperature in all cases

Temperature (Mercury thermometer)	*Temperature (Fever Scan)*	*Difference*	*p-value*
99.78± 1.19	100.98± 1.19	1.20	< 0.47*

* Not significant

Table II: Comparison of different methods for recording body temperature in subjects with pyrexia

Temperature (Mercury thermometer)	*Temperature (Fever Scan)*	*Difference*	*p-value*
101.2± 1.19	102.5± 1.19	1.20	< 0.44*

* Not significant

Table III: Comparison of different methods for recording body temperature in subjects without pyrexia

Temperature (Mercury thermometer)	*Temperature (Fever Scan)*	*Difference*	*p-value*
97.7± 1.19	98.6± 1.19	0.8	< 0.53*

Values are expressed as mean ± S.E.M.

* Not significant

defined as body temperature exceeding 99°F. Difference of one degree F was considered significant.

RESULTS

Mean values of temperature from both the methods were calculated and compared with each other to determine the level of significance by applying student's 't' test. The data was further analyzed separately in patients with and without pyrexia. The results are summarized in Table I-III.

Out of 147 patients 29 subjects had a normal temperature on mercury thermometer. Interestingly 25 out of these (86%) had normal temperature recording on FeverScan whereas the remaining four (14%) showed a higher recording.

DISCUSSION

Temperature recording is an essential step in the evaluation of both indoor and outdoor patients throughout the world. Patients presenting with high grade fever and who appear toxic and acutely ill warrants an urgent diagnostic evaluation, leading to prompt therapeutic intervention.[3] Thus grading of temperature has clinical implications. Mercury thermometers are widely used for such purposes. Introduction of liquid-crystal thermometers has made temperature recording easy and safe but their accuracy has been questioned.[4-6]

The present study shows that a significant difference exists between the recordings of two devices. (Table-I). Our findings are consistent with other investigators[4-6]. One study reported by Board and colleagues suggested that not only did the disposable thermometer records quicker than the mercury thermometer but it was as accurate[7]. We did not find any other large scale study substantiating this claim. Our study shows that liquid-crystal thermometers tend to over estimate the body temperature by 1.19°F. This difference of temperature can significantly affect the management of patients with pyrexia.

Analysis of our data further elucidates (Table II & III) that liquid-crystal thermometers are equally good in screening as compared to mercury thermometers but were totally unreliable and misleading in grading the body temperature. On an average it shows 1.19° F higher reading than oral temperature recorded with mercury thermometer. This has also been documented in other studies.[8]

We conclude that the sensitivity of liquid-crystal thermometer to detect fever is comparable with that of mercury thermometer but it does not accurately measure the grading of fever. In many cases the grading of fever and its pattern is useful to make a diagnosis. Liquid-crystal thermometer is not useful in this respect and should not be used. It is a good device for home use but health providers should not use it. Mercury thermometer remains the gold standard.

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