NEW METHOD OF DETERMINING THE WEIGHTED MEAN TEMPERATURE

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The weighted mean temperature method is widely used to study heat transfer in an organism.

Various authors suggest measuring this temperature at a different number of points on the body surface [1-3].

The temperature readings obtained at several points are analyzed in the following manner: the figures reflecting the temperature at various points are multiplied by a coefficient characterizing the size of the surface of the body portion on which the temperature was measured. The obtained values are added. When determining the weighted mean temperature from five points [1] the temperature of the skin of the forehead, chest, wrist, hip, and shin are multiplied respectively by the coefficients 0.07, 0.5, 0.05, 0.18, and 0.2 and the results are added, thus obtaining the weighted mean temperature. For example: $T_{wm} = 34.7 \cdot 0.07 + 34.6 \cdot 0.5 + 33.8 \cdot 0.05 + 33.2 \cdot 0.18 + 34 \cdot 0.2 = 34.2°$.

Among the shortcomings of this method of determining the weighted mean temperature are the difficulties associated with the calculations which take up considerable time and the inconvenience owing to limiting the mobility of the examinee (a heavy cable connects him with the recording instrument).

Resistance of Each of the Thermocouples of the WMT Sensors Depending Upon Its Placement

Site of placement	Correction coefficient	Resistance (in ohms)
Chest	0.5	75.2
Shin	0.2	30.1
Hip	0.18	27.32
Wrist	0.05	7.52
Forehead	0.07	10.53
Total resistance		150.67

The weighted mean temperature (WMT) sensor designed by V. V. Yakovlev, one of the authors of this article, consists of several series-connected with thermal resistances made of 0.05 mm copper or 0.05 mm nickel. Their number is determined by the number of points on the skin surface from which the measurements are made (5, 15, 18 and more). A connecting cable consisting only of two conducting strands leads off from the WMT sensor even if the number of points from which the temperature is recorded is 18 and more.

The resistance of each thermocouple is selected so that it corresponds to the correction coefficient. For example, when studying the weighted mean temperature after the manner of Vitte (five points) the resistance of each thermocouple of the WMT sensor depending upon its placement, was as follows (see table).

In the norm, for each portion of the body (forehead, chest, wrist, etc) a definite temperature inherent to its characteristics. The correction coefficient expresses a part of the total skin surface with a temperature identical within the limits of a given portion. The WMT sensor, consisting of series-connected thermal resistances each of which corresponds to the correction coefficient, automatically averages out the temperature with consideration of the surface from which it is recorded.

The use of the WMT sensor permits not only determining almost instantaneously the weighted mean temperature at any instant of the experiment, but also records it as a continuous curve on an EPP-09 automatic recorder.

To elicit the limit of accuracy of measuring the weighted mean temperature by means of the proposed WMT sensor in comparison with the data obtained by the usual mathematical analysis, phantom experiments were carried out. In five vessels filled with warm water of different temperatures we placed five sensors of an ordinary electrical thermometer and individual thermal resistors of the WMT sensor. Then we measured the water sequentially in each vessel by means of ordinary sensors and calculated the weighted mean temperature by multiplication by the appropriate coefficient with subsequent addition of the results. At the same time, by pressing the keys of the recording instrument we measured the weighted mean temperature by means of the WMT sensor. By frequently changing the temperature in the vessels and simultaneously measuring the weighted mean temperature by the indicated methods, we compared the data obtained.

The divergences of the temperature measured by the usual method and by means of WMT sensor were within the limits of 0-0.3°. In this case deviations were absent in 34% of the cases, did not exceed 0.1° in 36%, 0.2° in 17%, and 0.3° in 13% of the measurements. The results of a time study of the process of calculating the weighted mean temperature by the usual mathematical method showed that the time necessary for this was 100-200 times greater than when the measurements were carried out by means of the WMT sensor.

LITERATURE CITED

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