

EVALUATION OF AN INFRA-RED TYMPANIC THERMOMETER DURING COLD WATER IMMERSION AND REWARMING

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INTRODUCTION

Rectal (T_{re}) and esophageal temperature (T_{es}) measurements are invasive and not always practical to obtain in field situations. Rapid and reliable assessment of core temperature (T_c) is especially essential in the management of hypothermic victims. The present study evaluated an infra-red tympanic thermometer during cold water immersion and passive rewarming. The FirstTemp® Genius™ is a hand-held battery-operated device, which non-invasively measures the infra-red radiation emanating from the surface of the tympanum.

METHODS

Five subjects were immersed in 15°C water until either T_{re} or T_{es} decreased to 35°C or by 2°C from pre-immersion values. Following the cold water immersion, the subjects were placed in a sleeping bag for passive rewarming. Throughout the cooling and rewarming period, core temperature was assessed from measurements made at three sites: rectal, esophageal and tympanic. T_{re} and T_{es} were measured with a YSI 701 rectal thermistor, and a YSI 702A esophageal thermistor, respectively. The former was inserted 15 cm, while the insertion length of the latter was determined from sitting height (1). Tympanic temperature (T_{ty}) was measured with a FirstTemp® Genius™ (Intelligent Medical Systems, California) tympanic thermometer. Whereas T_{re} and T_{es} were measured at 10 second intervals by an HP 3497A Data Acquisition System controlled by a Macintosh II computer, T_{ty} was measured at approximately 5 minute intervals.

RESULTS

The FirstTemp® Genius™ was simple to use and after some training trials gave repeatable results. Care was taken to position the measuring probe so that it scanned the tympanum and not the surrounding skin surface. The FirstTemp® Genius™ is designed to be used in clinical settings, and thus it prompts the user after each reading to change the protective sheath covering the sensor, and also automatically initiates a calibration procedure. As a result, the tympanic thermometer cannot be used in a continuous mode, and measurements can only be made at several minute intervals.

Representative responses of T_{re} , T_{es} and T_{ty} obtained from one subject during the cold water immersion and passive rewarming are depicted in Fig. 1. T_{ty} obtained with FirstTemp® Genius™ exhibited a response similar to that of esophageal temperature. This close correlation of T_{es} and T_{ty} was observed in all subjects. The immersion and rewarming data were combined, to determine the correlation between T_{ty} and both T_{re} and T_{es} . The correlation coefficients derived for each subject separately, are given in Table 1.

Table 1 : Correlation analyses of T_{ty} vs. T_{re} and T_{es} .

Subject	T_{ty} vs. T_{re}	T_{ty} vs. T_{es}
1	0.98	0.98
2	0.97	0.98
3	0.90	0.95
4	0.96	0.95
5	0.94	0.96
Mean	0.95	0.96
± S.D.	± 0.03	± 0.02

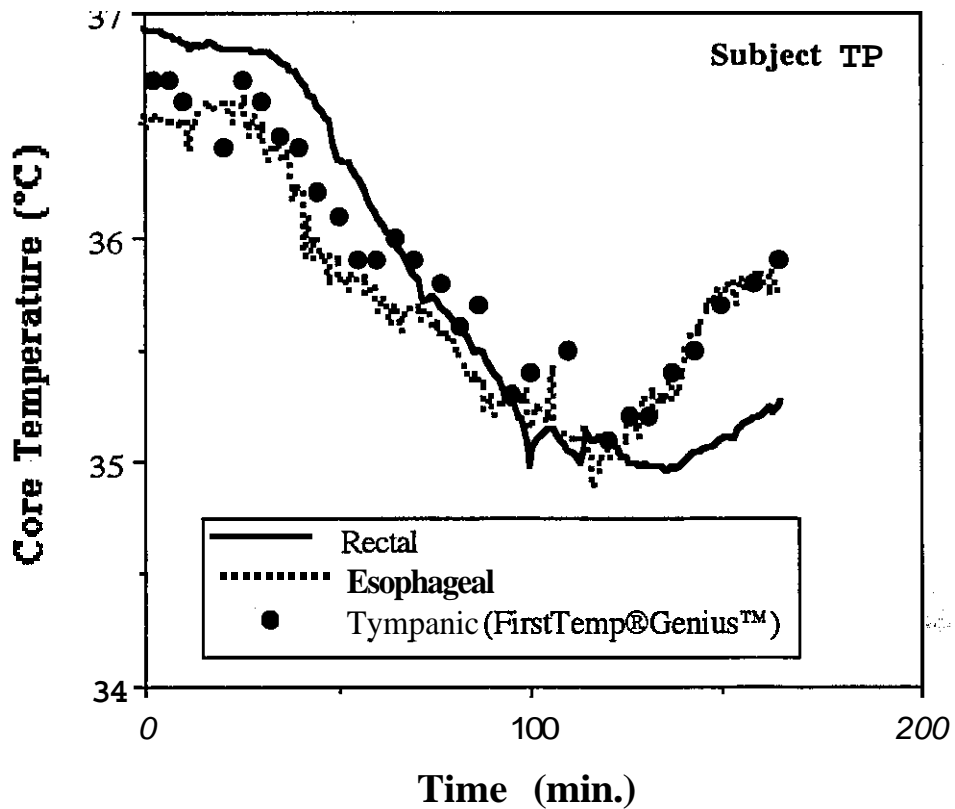


Fig. 1: Tre, Tes and Tty responses during cold water immersion and rewarming for subject TP.

CONCLUSIONS

The FirstTemp® Genius™ tympanic thermometer provides an adequate measure of core temperature, when compared to esophageal and rectal measurements. There is a tendency for it to correlate better to Tes than Tre, confirming previous observations of the relation between Tre, Tes and Tty (2, 3). The disadvantage of measuring tympanic temperature with either a thermocouple or thermistor is that placement of a sensor on the surface of the tympanum elicits pain and may cause damage. The FirstTemp® Genius™ does not require physical contact with the tympanum, and provides repeatable measures with an accuracy and resolution of 0.1°C.

The main disadvantage of the FirstTemp® Genius™ is that erroneous measures may occur occasionally, indicating that the sensor is not properly positioned. Nevertheless, with appropriate training, the present results suggest that it is a useful device for assessing the thermal status of hypothermic victims.

REFERENCES

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