H131 Eye Temperature Measured After Death in Human Bodies as an Alternative Method of Time-of-Death Estimation in the Early Postmortem Period

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Learning Overview: After attending this presentation, attendees will better understand the process of postmortem body cooling, particularly in the eyeball, and its application in the estimation of the Time Of Death (TOD), especially in the early, several-hours-long postmortem period.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing the method of TOD estimation based on measurement of the postmortem eyeball temperature.

TOD estimation is a key matter for forensic pathologist examining the body at the death scene. In such cases, the body temperature should be measured aiming at TOD estimation. This is of great value when the body temperature is still higher than the environmental temperature and the TOD can be calculated on the basis of the difference between the body and the environmental temperature. However, despite the above and other possibilities of the TOD estimation (i.e., depending on postmortem changes such as lividity, rigor mortis or different supra-vital reactions, or even biochemical methods), they are still of not satisfactorily accurate.

In the current study, single (in 20 patients) or double (within a one-hour interval in 10 patients) eyeball and rectal temperature measurements were taken in patients who died in Medical University of Gdansk Hospital Intensive Care Unit. The actual TOD in each patient was exactly known and the body temperature was recorded shortly later (between 0.5h to 3.5h). The temperature was measured using pin probes connected to a high-precision electronic thermometer. The measured eye temperatures ranged from 29.7°C to 33.6°C. Ambient temperatures in all cases was stable (22°C), corresponding to usual room temperature. TOD was calculated using a formula based on Newton's law of cooling previously successfully applied in comprehensive studies on pigs and recent studies on human bodies:

$$t = -\frac{\ln(\frac{T - T_a}{T_0 - T_a})}{kc}$$

(equation 1)

where t is the time which passed since death (TOD), T is the temperature of the body site, T_a is the ambient temperature (constant: 22°C in the present study), T_0 is the initial human eye temperature (assumed to be 35°C), and k_c is a first order cooling rate constant. Thanks to stable ambient temperature and knowledge of the exact TOD, the actual study allowed the adjustment of the mean value of k_c= -0.2 h^{-1} in comparison to the recent studies. Thanks to both the significantly faster postmortem decrease of eye temperature and the residual or lack of plateau effect in the eye, and no influence of body mass, TOD in the human death cases using equation 1 could be estimated with quite a good accuracy. The maximum TOD estimation error during the postmortem intervals up to 3.5h was slightly higher than 1h minimum in 4 cases among 30, while for the rest of 26 cases it was less than 1h, while mean error for all 30 cases was ±24min. The results from 30 new cases with exactly known TOD show that the presented method of TOD estimation may be of satisfactory accuracy in the early postmortem period, particularly when applied to bodies found at room temperature and in standard environmental conditions.

Eye Temperature, Postmortem, Time-of-Death Estimation