G140 Postmortem Eye Temperature Measurement: A New Method of Time of Death Estimation?

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After attending this presentation, attendees will be familiar with a process of body cooling after death. The knowledge of cooling rates of different body sites is of use estimating the Time of Death (TOD).

This presentation will impact the forensic science community by showing the possibility of estimation of the TOD, especially in the early postmortem period, by measuring the temperature in the eyes of human corpses.

Estimation of the TOD is an important issue for the forensic pathologist examining the body at the death scene. The TOD estimation methods actually used in practice, based on postmortem changes such as hypostasis, rigor mortis, rectal temperature, or different supra-vital reactions are still not of satisfactory precision.

Recent studies in pigs and humans have shown a possibility of significantly decreasing the TOD estimation error, in particular regarding the very early postmortem period, by choosing the eye as the temperature measurement site.

The single eye, rectal, and ambient temperature measurements were taken at the scenes of death in 21 cases with known TOD (1h 35min to 5h 15min), using pin probes connected to a high-precision electronic thermometer (Dostmann-electronic). The measured eye temperatures ranged from 20.2°C to 33.1°C. Rectal temperatures were measured at the same time and ranged from 35.0°C to 37.4°C. Ambient temperatures (1°C to 24°C), environmental conditions (still air to light wind) and hair amount on the head were also recorded every time. TOD was calculated using a formula based on Newton's law of cooling previously successfully applied in comprehensive studies on pigs: $T = T_a + (T_0 - T_a)exp(-k_c t)$ (Eq. 1) where T is the temperature of the body site, T_a is the ambient temperature (assumed to be constant during the course of cooling until the time of the measurement), T_0 is the initial human eye temperature (assumed to be 34.9°C), k_c is a first order cooling rate constant, and t is the time since death. The mean value of k_c=-0.113h^{-1} had been previously determined in studies on the postmortem cooling process in pig eyeballs. Thanks to both the significantly faster postmortem decrease of eye temperature and the residual or lack of plateau effect in the eye, no influence of body mass, TOD in the human death cases using eq. 1 could be estimated with quite good accuracy. The maximum TOD estimation error during the postmortem intervals up to around 5h was 1h 28min in one case among 21, while for the rest of 20 cases it was not more than 53min, while mean error for all 21 cases was ± 49 min. However, this highest overestimating TOD error in one case may be explained by baldness of this one examined individual.

The results from 21 cases with 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 normal environmental conditions (still air, normal humidity). The study is being continued and the model is going to be improved using the new results from successive cases.

Time of Death, Body Cooling, Eye Temperature

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