

Synovial hemorrhages of the knee joints as a vital sign of fatal hypothermia

The cold represents an underestimated health issue for a man because the abilities of the human body to resist low ambient temperatures without adequate clothing are minimal. The professional literature defines hypothermia as a non-physiological state with core body temperature being below 35 °C, severe hypothermia sets when core body temperature is lower than 27 °C. Death due to hypothermia usually appears if core body temperature declines to 25 °C. The most hypothermia-prone and vulnerable individuals involve infants, seniors, homeless people, intoxicated or injured subjects and people from various reasons exposed to extreme cold.

Even in the era of molecular, genetical and virtual methods, postmortem diagnostics of hypothermia remains difficult mainly because of the absence of any specific and consistent diagnostic sign. Accordingly, the optimal diagnostic approach has to encompass not only careful external and internal examination of the deceased person, but also critical analysis of available information from the place of fatality, appraisal of the medical history, evaluation of the local meteorological situation, body temperature measurements, performance of histological and chemico-toxicological analyses, ultimately also postmortem imaging and molecular biology analysis.

The primary goal of the presented doctoral thesis resides in the assessment of the diagnostic significance of the inner knee sign in postmortem diagnostics of hypothermia and its contextualization with other verified hypothermia-related diagnostic signs. The inner knee sign – up to now not a systematically scrutinized marker of the intravital body exposition to the cold – consists of a facultative triad of findings identifiable within synovial structures of knee joints (hyperemia of the synovial membrane, bleedings into the synovial membrane and bloody discoloration of the synovial fluid).

A prospective study file consisting 82 fatally hypothermized individuals between 2009 to 2017 was set to realize the doctoral thesis's goals (35 female, 47 males; mean age 66,7) as well as a control file comprising 150 subjects who died suddenly, unexpectedly or violently (persons with impairment of the blood's clotting ability or severe traumatization of the lower limbs were excluded from both files). The author of the thesis also proposed a simplified dissection procedure for the evaluation of the internal knee joint structures and possible synovial specimen collections.

Inner knee sign was identified in 68 subjects included in the study file (82,9 %). The highest occurrence proved the hyperemia of the synovial membrane (68 cases; 82,9 %), the second most frequent were hemorrhages into the synovial membrane (54 cases; 65,9 %), and bloody discoloration of the synovial fluid reached the least incidence (42 cases; 51,2 %). The inner knee sign showed a statistically significant relation to cold erythema ($p = 0,001$) and frank hemorrhaging to pancreatic tissue respectively ($p = 0,016$); there was no statistically significant relation to Wischnewsky spots, acute renal fatty degeneration or bleeding into core skeletal muscles. In the control file, there was no positive record of the inner knee sign at all.

Results of the study confirmed the inner knee sign as a highly sensitive and specific morphological mark of the intravital body exposition to low ambient temperatures and also qualified this sign as to be accepted among other established diagnostic signs of fatal hypothermia. The diagnostic importance of the inner knee sign contrasts especially in cases which are characterized by nonspecific autopsy findings and the overall lack of typical morphological diagnostic signs.