H118 The Succession of Postmortem Protein Degradation in Different Muscles in Rats and Humans

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Learning Overview: The goal of this presentation is to highlight the importance of investigating influencing factors on postmortem phenomena in order to apply them to determine the time of death. This presentation analyzes the dynamics of postmortem protein degradation in the context of the composition of muscle fibers and the temperature influence.

Impact on the Forensic Science Community: In forensic science, an accurate determination of the time of death is still a challenge and, therefore, a central topic in forensic research studies. This presentation will impact the forensic science community by detailing that although postmortem protein degradation has proven to be a valuable tool, further research is required for broad range applicability of the method for criminal investigation.

The determination of time since death is of central interest in forensic research. Therefore, new and innovative methods are under investigation in order to improve the currently available tool set. A promising new method, based on biochemical analysis of postmortem protein degradation, uses decomposition patterns of muscle proteins to determine the Postmortem Interval (PMI). To date, this technique was mainly applied on thigh muscle tissue. Sampling of this muscle may not always be possible or has to be excluded under specific circumstances, and investigation of degradation behavior of other muscles is necessary in order to provide a broader applicability of this method. In general, skeletal muscle represents the largest homogeneous body compartment and is qualified as a target tissue for this method, not only due to the high abundance and protein content but also because it is easy to sample and yet well protected by the skin. Nevertheless, it remains unclear how muscle fiber composition and/or the location of muscles within the body affect protein degradation behavior after death and whether distinct muscles show different protein decomposition patterns. Temperature, for example, has a major impact on protein degradation and decreases unevenly throughout the body after death. This, together with the proximity to the gastrointestinal system, may lead to different postmortem protein decomposition in muscles located near the body core compared to distal muscles in extremities.

To test this hypothesis, four different muscles (M. vastus lateralis, M. psoas major, M. soleus, and M. gastrocnemius lateralis) were collected from an experimental setup in rats and also from humans during autopsy in order to investigate the influence of the location within the body and decreasing temperature during cooling, as well as differential fiber-type composition. The M. gastrocnemius lateralis is mainly built out of fast type II muscle fibers, whereas the M. soleus is composed of mostly slow type I fibers, but both muscles are located in the lower leg. In contrast, the M. psoas major and M. vastus lateralis are situated in the trunk and upper leg, respectively, and have even fiber-type ratios. Samples were biochemically analyzed using Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis (SDS-PAGE) and Western blotting. Protein degradation patterns were compared between the different muscles and species. Immunohistochemistry was performed in order to determine fiber-type composition of the investigated muscles.

Results show similar degradation patterns in animals and humans regardless of fiber-type composition. In contrast, temperature significantly affects postmortem protein degradation. Muscles in near proximity to the body core show faster degradation compared to muscles of the periphery, most likely due to different location of muscles and their respective cooling behavior after death. This study provides evidence that the location of muscle within the body has a higher impact on protein degradation than muscle fiber composition. However, there are still some factors that can additionally influence protein degradation patterns. Ambient temperature, physical conditions, or antemortem diseases may cause differences in the muscle type distribution and consequently in postmortem protein degradation. To optimize this method, further investigations and comparisons between different muscle types will be necessary.

Protein Degradation, Muscle, PMI

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