Chapter 7
Comparative Study of Conventional Techniques and Functional Nanomaterials for PMI

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ABSTRACT

The most vital part of a medico-legal investigation is the estimation of the period since death. The procedures now in use for determining this time period depend on a wide range of variables that are frequently out of the forensic examiner's control. Therefore, using nanosensors to analyse changes in biological components has provided a special benefit to precisely estimate the PMI. The evaluation of post-mortem intervals using novel functional nanomaterials techniques is compared in detail to conventional methods in this chapter. It also discusses the difficulties in making an accurate assessment due to changing environmental conditions as well as the benefits of using nanomaterials.

INTRODUCTION

A significant challenge in forensic investigations is determining the post-mortem interval (PMI). Forensic case investigations are greatly influenced by early, accurate PMI estimates. There are many acknowledged techniques that can be used to study cadaver phenomena in order to identify early PMI, such as monitoring rectal temperature, post-mortem lividity, muscle relaxation, and stomach content. Due to significant variances in these methods and a variety of environmental and individual factors, a significant inaccuracy in PMI assessment may occur (Liao et al., 2020).

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Definition of Postmortem Interval

The time between death and finding a body is called the post-mortem interval (PMI). In order to identify the time of death, it is necessary to find human remains. The time between a person passing away and a body being found is known as the post-mortem interval (PMI) (Gelderman, Boer, Naujocks, IJzermans, & Duijst, 2018).

Importance of Postmortem Interval

The PMI gives a temporal range that can be used to identify the human remains and help in the study of potential causes of death, therefore its understanding is crucial. To pinpoint the exact time of death, two techniques have been developed: the Henssge-nomogram and electrical or mechanical activation of skeletal muscles. Because the body ceases cooling once it reaches the ambient temperature, these three approaches are only useful when the PMI is transient. Up to 13 hours after a person has passed away, both mechanical and electric muscle stimulation are performable. it is challenging to pinpoint the precise time of death in case of longer PMI (Gelderman et al., 2018).

Introduction of Nanomaterials

Nanomaterials have over time found utility in catalytic applications such as environmental remediation, nanomedicine, and other fields due to their tiny size, large surface area, and enhanced reactivity. These nanoparticles can be functionalized with wide variety of functional groups, which both enhance and add to the nanomaterials' already existing characteristics. These functionalized nanomaterials have a much wider range of uses and also perfect for use in forensic research. Recent advances in the detection of explosives, illegal substances, chemical and biological warfare agents, and fingerprints identification have been made possible by these functionalized nanoscale materials (Rawtani, Tharmavaram, Pandey, & Hussain, 2019).

Estimation of Postmortem Interval

Death investigations are quite tough since it is impossible to measure the postmortem interval (PMI). PMIs are frequently the result of postmortem alterations such as hypostasis, rigor mortis, rectal temperature, or various supravital reactions in forensic practice. Even though numerous studies have been done to develop more accurate techniques, there is no such technique that can be used to estimate PMIs accurately, especially after prolonged PMIs and in more thoroughly degraded remains. There are currently no suitable or workable methods that can be applied as quick and accurate PMI estimators at crime scenes due to the inherent difficulties of keeping living materials (Xia, Zhai, Liu, & Mo, 2015).

Since autopsies provide easy access to biofluids, the PMI has been assessed using a number of biofluids over the years. However, the environment has a significant impact on the precision and reliability of biofluid measurements. For this purpose, vitreous humor gain attention because of its benefits over cerebrospinal fluid and blood, it is recognized as a suitable biological matter for post-mortem biochemical research. VH is the sole physically isolated fluid due to its anatomical location, resistance to pollutants, and ability to remain intact even in situations of open craniocerebral trauma. PMI has been calculated by using a variety of biochemical components of VH, including potassium, magnesium, and hypoxanthine