SOHAG MEDICAL JOURNAL
Vol. 21 No.3 October 2017

Updates In Estimating Postmortem Interval

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Abstract

Background: Estimation of postmortem interval is considered one of the most important issues in forensic medicine. It aids the police investigation and help to know the time of the crime and its relation to the assailant. It also important in some civil problems as inheritance. There are multiple methods that used for estimaton of PMI as: rate of cooling after death, detection of supravital reactions, rate of development of hypostasis, rigor mortis, life cycle of insect and the decomposition changes that occur after death. Also usage of body fluids as chemical method for estimation of time passed since death shows great advances. Recently application of DNA and RNA in this field has done aiming at more accurate estimation of PMI.

Aim of the work: Introducing and establishing the basic knowledge about Postmortem Interval estimation and focusing on new approaches for postmortem interval estimation.

Conclusion: PMI estimation is the time between time of death and time of identification of corpse. It has a role in forensic medicine specially in crimes. It helps to aid the police in their investigation and reduce the number of assailant. PMI estimation is still depend on early and late postmortem changes as algor mortis, rigor mortis, hypostasis and putrefaction. But recently there are new methods as detection of new biomarkers, using of microscopic changes that occur after death in multiple organs with success of these trials was noted and a correlation between them and PMI was found. DNA and RNA also participate in estimating time since death by detection the rate of degradation and its relation with PMI.

Definition of postmortem interval (PMI):

Postmortem interval (PMI) means the time passed since death. Estimation of PMI is done through information that depend on estimation of sets of time: Time A and Time B . Time A is the time when the decent was last known to be alive, while time B is the time when the decent was found dead. The time since death is presented certainly between these times (between death and examination of the dead body) based on different factors as algor mortis ,rigor mortis , postmortem lividity and decomposition **(Prahlow, 2010).**

There are multiple early and late postmortem changes that may aid in PMI estimation:

Early postmortem changes as:

1- **Supra vitality:** supravital reactions are defined as reactions of tissue that occur on postmortem excitation.
2- **Algor Mortis** is a term utilized to describe postmortem cooling of the body.
3- **Postmortem lividity**: It is one of the early signs that occurred after death. Circulatory arrest with loss of hydro static pressure lead to settling of blood in lower parts of the body under the effect of gravity, with discolouration of these parts of body.
4- **Rigor mortis:**it's a chemical change resulting in stiffening of the body muscles following death due to changes in myofibrils of the muscle tissues.
5- **Dryness of skin and visible mucosa with development of tache noire (Perper, 2006).**

Late post mortem changes as:

1- **Autolysis (self-digestion):** is a cellular self-destruction process caused by hydrolytic enzymes that were originally contained within cells **(Hau et al., 2014).**
2- **Putrefaction:** is degradation of tissues by microorganism activity, such as bacteria, fungi and protozoa, which originate from normal biota in human **(Dent et al., 2004) (Paczkowski and Schütz, 2011)**
3- **Decomposition**: caused by aerobic microbial process that may create punget rotten odour originate from metabolic products of oxidation . It is a dry, acidic process on an oxidative basis **(Madea et al., 2014).**

Forensic Entomology:

Forensic entomology is the use of insects during investigation of crimes for estimation of PMI for decomposed bodies in criminal cases. It is also includes when and where human death occur **(Haskell, 2007).** After someone dies insects colonize the body soon after death. The reason why flies and other insects are used to determine the PMI, or more precisely, the time since colonization, is that their life cycles have been extensively studied and are fairly accurately predicted. The only information available to forensic entomologists is the time from colonization, based on the physical presence of eggs, to the presence of the adult insect. Thus, calculations for PMI utilize the timeline of the insects' life stages to determine the time it took from colonization to the beginning of the scene investigation **(Voss et al., 2008)(Gomes et al., 2006).**

Role of thanatochemistery in determination of PMI:

Thanatochemistry is the chemistry of death. It is used to describe the changes that occur in the chemical composition of the human corpse as soon as death occurs. It can give a quantitative measurement to determine the time passed since death **(Madea, 2005).** These biochemical changes may provide chemical markers for helping to determine the time since death (post-mortem interval) as: blood cells that may assist in PMI estimation by morphological changes that were detected in early post mortem interval by special stains. These changes appear in eosinophils ,neutrophils and monocytes showing early recognizable pyknotic degenerative changes (at 6 h) ,with lymphocyte became altered after (24 h), using of this technique is up to 120 hours post mortem , and the change in the concentration of multiple markers such as : potassium ,sodium ,chloride, hypoxanthine ,lactic acid ,glucose ,lipid ,protiens and enzymes all of these may participate in PMI estimation **(Swift, 2006).**

Role of imaging in estimation time passed since death:

It can identify postmortem changes by CT providing an index for objective estimation of PMI. It investigate postmortem changes and the relationship between PMI and the volumes of organs and gases with findings suggest an increase in intrahepatic gas concomitantly with increase in PMI and decrease of intrarectal gas volume was noticed with progression of time after death **(Okumura et al., 2016).**

Role of postmortem changes of organs in PMI estimation

Estimation of time since death using the postmortem autolytic changes that occur in the tissues and tissue fluids had been used. Various tissues are used such as heart, liver, kidney, uterus, skin labial mucosa and gingival tissues. Estimation of different levels of different biomarkers had been done **(Munoz et al., 1999).**

Role of DNA and RNA in PMI estimation

The analysis of time-dependent degradation of nucleic acids (both DNA and RNA) became a focus of attention in clinical medicine as well as in forensic science **(Sidova., et al 2015).** There are multiple organs and tissues had been used for extraction of DNA and RNA and have

a role in PMI estimation as :brain, spleen, liver, heart, kidney, teeth and dental pulp. The results of some studies noticed that the rate of degradation of DNA and RNA is affected by the distances of the organs from the gut (considered as site of microorganism) so the far the organ from the gut the slower the rate of degradation **(Huang et al., 2006).**

Summary and conclusion

Postmortem interval estimation consider an important issue in forensic medicine. It aim at identification of the time passed since death for answering a lot of questions and aiding the police investigations for solving the crime and knowing the assailant.

Estimation of the postmortem interval is a problem that seek for answer. It was determined by using multiple methods as: early and late postmortem changes, changes in biochemical parameters after death, detection of microscopic changes that were occurred in organs after death and lastly the detection of DNA and RNA degradation rate and their relation with PMI estimation.

Early and late postmortem changes are one of old methods that still used until now. Of these changes :(a) supra vita reaction. It depends on mechanical, electrical and pharmacological excitation of muscles in trial to find a relationship between them and PMI. (b) Algor mortis (postmortem cooling) is still used for this purpose depending on normogram method that take in consideration environmental temperature and temperature of corpse at time of death with detection of rate of cooling to know time passed since death. (c) Depending on the rate of development of hypostasis and rigor mortis PMI can be roughly estimated. (d) Putrefaction is one of the important late postmortem changes that could be ordered chronologically aiming at giving an information about postmortem interval.

Biochemical changes of multiple parameters were also involved as it was known that changes in potassium concentration after death had a great role in PMI estimation. Recently detection of changes in other parameters as insulin and cholesterol was done with finding of equations that aid in this issue. GC/MS is recently used for detection of multiple metabolomes at the same time aiming at saving time for rapid estimation of PMI.

The concentrations of volatile fatty acids were found to increase in decomposition fluid with passage of time which could guide the estimation of PMI. As death occur, there are microscopic changes that occur in cells of multiple organs, studying of these microscopic changes in multiple organs as kidney, liver, skin, dentaL pulp and lens showed a relationship between these changes and time passed since death.

As DNA has a great role in our life nowadays so it found to be able to aid in estimation of time passed since death by detection of the rate of degradation of DNA and RNA that were found to correlate with PMI. They should be extracted from tissues that have characters of good preservation of them. B-actin is one of RNA markers that was found to correlate significantly with PMI.

Recommendation:

Despite the great importance of PMI estimation, it still face a lot of obstacles that were needed to overcome them.

A lot of researches must be done on microscopic changes that occur in cells after death in trying to find a relationship that accurately determine PMI.

DNA and RNA usage in this field need more investigations and researches for supporting and confirming their role in PMI estimation.

References

1- **Dent, B.; Forbes, S. and Stuart, B. (2004):** Review of human decomposition processes in soil. Environmental Geology 45(4): 576-585.

2- **Gomes, L.; Godoy, W. and Von Zuben, C. J. (2006):** A review of post feeding dispersal in blowflies: Implications for entomology. Naturwissenschaften 93:207–215.

3- **Haskell, N. H.(2007):** Forensic entomology. In: Legal Medicine(American College of Legal Medicine Textbook Comittee. 7th edition. chapter 69 . Sanbar, S. S.; Firestone, M. H.; Fiscina, S.; LeBlang, T. R.; Wecht, C. H. and Zaremski, M. J. (eds.) ..Mospy Elseiver . Philadelphia : 645-650

4- **Hau, T. C.; Hamzah, N. H.; Lian, H. H. and Hamzah, S. P. A. A. (2014):** Decomposition process and post mortem changes: review. Sains Malaysiana 43(12): 1873–1882 .

5- **Huang, H. S.; Matevossian, A.; Jiang, Y. and Akbarian, S. (2006):** Chromatin immunoprecipitation in postmortem brain. Journal of Neuroscience Methods, 156 (1–2):284–292 .

6- **Madea, B. (2005):** Is there recent progress in the estimation of the postmortem interval by means of thanatochemistry. Forensic Science International, 151(2- 3): 139– 149.

7- **Madea, B.; Henssge, C.; Reibe, S.; Tsokos, M. and Kernbach-Wighton, G. (2014):** Postmortem changes and time since death . In: Handbook Of Forensic Medicine. 1st edition. Chapter 7. Madea, B. (ed.). Wiley Blackwell : 66-96.

8- **Munoz, D. R.; Almeeida, D. E.; Lopes, E. A. and Iwamura, E. S. M. (1999):** Potential definition of the time of death from autolytic myocardial cells: a morphometric study. Forensic Science International, 104 (2-3):81-89 .

9- **Okumura, M.; Usumoto, Y.; Tsuji, A.; Kudo, K. and Ikeda, N. (2016):** Analysis of postmortem changes in internal organ and gases using computed tomography data. Legal Medicine, 25 :11-15 .

10- **Paczkowski, S. and Schütz, S. (2011):** Post-mortem volatiles of vertebrate tissue. Applied Microbiology and Biotechnology, 91(4): 917-935.

11- **Perper, J. A. (2006):** Time of death and changes after death: anatomical consideration. In: Spit'z and Fisher's Medicolegal investigation of death: Guidelines for the application of pathology to crime investigation. 4th edition. Chapter 3. Part 1. Spit'z, W. U. and Spit'z, D. J. (eds.). Charles C Thomas, Springfield: 88-100.

12- **Prahlow, J. (2010):** Postmortem changes and time of death. In: Forensic Pathology For Police, Death Investigations, Attorneys and Forensic Scientists. 1st edition. Chapter 8. Prahlow, J. (ed.). Humana Press: 179-183.

13- **Sidova, M.; Tomankovaa, S.; Abaffya, P.; Kubistaa, M. and Sindelka, R. (2015**): Effects of post-mortem and physical degradation on RNA integrity and quality. Biomolecular detection and quantification, 5 : 3-6 .

14- **Swift, B. (2006):** Timing of Death. In: Essentials of Autopsy Practice. Chapter 8. Rutty, G. N. (ed.). Springer: 193-195 .

15- **Voss, S. C.; Forbes, S. L. and Dadour, I. R. (2008):** Decomposition and insect succession on cadavers inside a vehicle environment. Forensic Science, Medicine, and Pathology, 4(1) :22–32.