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An Insight into Experiences of Forensic Expert and Pathologist on Prostrate Degeneration with Post Mortem Interval in Human Cadavers

Mopuri Venkateswarlu[1], C. Lakshmi Kalavathi[2], Ananth Rupesh Kattamreddy[3], Arun Ravula[4], Zunaid Ali Ahamed S[5]

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ABSTRACT

Background: Estimating postmortem interval is effective forensic tool for investigating time of death useful in criminology. Many gross, microscopic and molecular methods available for estimating postmortem interval. Human prostate is last soft tissue organ to degenerate in human cadavers and its histopathology in cadavers can be used for estimation of post mortem interval. Studies reported Histopathologies of different organs to estimate postmortem intervals for purpose of calculating time since death. In our study we tried to observe Post mortem interval estimation in human cadavers with Histopathological changes in Prostrate.

Objectives: To estimate postmortem interval from Histopathological examination of prostate in human cadavers and identify Histopathological changes in human prostate in relation to time since death.

Methodology: Prostate from cadavers registered for autopsy in our institute were examined grossly along with histopathology as per criteria laid down for sampling.

Results: Histopathological sections from total of 36 human cadavers were studied. Changes like epithelial disruption of acini, nuclear changes, inflammatory cell collection in stroma, fatty degeneration and sequential necrotic changes were reported in relation to time since death. Earliest degeneration changes in prostrate acini began at 6 hours postmortem and changes in stroma began at 12 hours. First atrophic changes in acini began at 19 hours postmortem and continued to progress till 3 days after which identification of any glandular or stromal tissue became extremely difficult.

Conclusion: Significant changes in Prostrate were documented between 6 hours and 72 hours postmortem. Changes in human prostate can be used for estimating postmortem interval.

Keywords: Forensic Pathology; Autopsy; Histology; Prostate; Criminalistics.

Author's Credentials: *[1]Associate Professor, Department of Forensic Medicine and Toxicology, [2]Assistant Professor, Department of Pathology, ACSR Government Medical College, Nellore 524004, Andhra Pradesh, India, [3]Assistant Professor, Department of Forensic Medicine and Toxicology, Andhra Medical College, Visakhapatnam 530002, Andhra Pradesh, India, [4,5]Postgraduate, Department of Forensic Medicine and Toxicology, ACSR Government Medical College, Nellore 524004, Andhra Pradesh, India.*

Corresponding Author: ***C Lakshmi Kalavathi,*** *Assistant Professor, Department of Pathology, ACSR Government Medical College, Nellore 524004, Andhra Pradesh, India.*

Email: *drclk30@gmail.com*

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Introduction

Post Mortem Interval and Estimating the time since death is one of the important objectives and major difficulty in a medico legal autopsy especially in unwitnessed death investigations. Common methods used in practice for assessment of early postmortem interval include gross examination of corpse for postmortem lividity, rigor mortis, algor mortis, histo-morphological analysis, thanato-chemistry and supra-vital reactions are few to mention.[1]

Studying degenerative histopathology in different organs at microscopic level will increase the precision of predicting early postmortem interval to some extent.[2] General architecture of each organ is observed along with cellular membrane changes, cytoplasmic staining ability and integrity, nucleolemma integrity, nuclear contraction or vacuolation, chromatin appearance are generally studied as part of autolytic process to estimate time since death with support of organ study by histopathology. Molecular methods like studying the degeneration of DNA, mRNA, RNA transcripts, DNA and proteins are also used for estimating the early postmortem interval.[3]

Novel scoring methods of Histo indices are emerging as a further development of Histopathological methods for estimating postmortem interval. Hepatic Decomposition Score (HDS) based on autopsy histopathology of human livers was proposed for more accurate assessment of postmortem interval for bodies from indoor setting. The model was also found to be statistically robust in predicting the postmortem interval.[4]

However, there are multiple endogenous and exogenous variables which influence the estimation of time since death. Humidity, temperature, septicemia are few such factors.[5] Over reliability and over generalizations are seriously discouraged in any frontier of research. Studies reported Histopathologies of different organs to estimate postmortem intervals for purpose of calculating time since death. Most of these studies were performed on animals where testes, leydig cells, sertoli cells, liver, heart and kidney were used as specimens to estimate the time since death.

It is often stated in medical literature that prostate is one of the most resistant organs to decompose in human cadavers and its histopathology in cadavers can be used for estimation of post mortem interval. Abdel Rahman Mahmoudet al conducted a study on prostate samples obtained from albino rats which revealed post mortem changes observed in prostrate over a period of more than two weeks. Also it was observed in their study that light microscopic examination of prostate samples didn't show any significant structural alteration during the first twelve hours after death. Significant epithelial disruption, inflammatory cells and fatty degeneration began to appear in the prostatic acini after 24 hours. When post mortem was performed they observed that after two days the prostatic acini showed significant atrophy and necrosis. Stromal calcification started to appear 6 days postmortem. One week to four weeks PM, the prostatic acinar epithelial disruption, atrophic acini, necrosis and stromal calcification became more common till no more normal glandular or fibro muscular architecture can be detected.[6]

Studying the relationship between post-mortem changes, decomposition time intervals, and prostrate degeneration in human bodies can have significant implications in forensic science, pathology, and medical research.[7] Understanding the patterns and timelines of post-mortem changes can aid forensic investigators in estimating the time since death. This information is crucial in criminal investigations to establish timelines and gather evidence. For donated organs, it's essential to know the effects of post-mortem changes on different organs. Research can provide insights into the viability of organs for transplantation and enhance the success rates of organ transplants. Also time of prostrate degeneration with time of death as estimated from post mortem interval contributes to a better understanding of how diseases affect post-mortem changes, especially in organs like the prostate. This knowledge may lead to improved diagnostic tools and methods for identifying or studying diseases in deceased individuals.

Interdisciplinary collaboration between forensic scientists, pathologists, and medical researchers would be essential to ensure a comprehensive and well-rounded approach to the study. Conducting research on the relationship between post-mortem changes, decomposition time intervals, and prostate degeneration is not only scientifically intriguing but also holds practical applications that can benefit various fields, from forensics to medicine. Every single study in the field of estimation of time since death will complement to the existing literature and increase scientific rigor of medico legal work.

In our study we tried to identify Histo-pathological changes in human prostate in relation to time since death with estimate postmortem interval from Histopathological examination

of prostate in human cadavers and observe applicability of Histopathological examination of human prostate in medico-legal practice.

Methodology

In our study Human Cadavers registered for Medico Legal autopsy at Tertiary Hospital constituted the study sample. The study was carried for one-year duration and only those satisfying the criteria of enrolment were included. Limited purposive sample was used for the preliminary observational study.

We included cases of cadavers of male sex registered for medico legal autopsy in which time since death is exactly verifiable over a range of less than 2 hours in the study. We excluded cadavers of female sex were excluded from the study. Also cadavers of male sex with age group less than 20 years and more than 60 years, with any history of prostatic pathology or surgical intervention, with discernible gross pathology during dissection were excluded. Also cadavers with trauma causing damage to urinary bladder, urethra as observed physically during autopsy and also cadavers with loss of prostrate integrity physically or due to severe systemic sepsis and cases preserved in cold storage were excluded from the study sample.

Whole prostate is removed from human cadavers during autopsy and divided in to four equal halves and were sent to the Department of Pathology preserved in 10% formalin along with clinical details and gross findings. The tissue samples received were processed for histopathology. All Histopathological sections were stained with Haematoxylin and Eosin stain and examined. No other special stains were used during the study for observing the degenerative changes in the prostrate as H&E staining provides a good overall assessment of tissue morphology and allows for the visualization of cellular details, including nuclear and cytoplasmic structures.

Observations and Results

A total of 36 samples were studied. The age distribution of the sample is as follows:

The time since death profile of the study sample is as follows:

Table 1: Showing Post Mortem Interval of Study Sample

Sl. No	Post Mortem Interval	No. of Cases studied
1	0-6 hours	5
2	7-12 hours	7
3	13-18 hours	6
4	19-24 hours	10
5	25-36 hours	4
6	37-48 hours	2
7	49-72 hours	1
8	73 hours and above	1

Specimens showing gross pathology were excluded in the study. However, incidental findings were noted in few cases. Prostatitis, Squamous metaplasia, prostatic intraepithelial neoplasia were seen in one case each. Three cases of 41-50 years age group and three cases of 51-60 years age group showed adenomatous fibro-muscular fibroplasia changes. Among the study sample stromal hyperplasia was noticed earlier than hyperplasia of adenomatous component with advancing age.

Table 2: Age distribution of study sample

Sl. No	Age	No. of Cases
1	21-30	9
2	31-40	10
3	41-50	11
4	51-60	6

The following histological changes were seen with respect to time since death:

Table 3: Histological changes were seen with respect to time since death

Post Mortem Interval	Light Microscopy- Histo-Pathological changes
0-6 hours	No significant structural changes in both acinar and stromal compartments.
7-12 hours	Epithelial disruption in prostatic acini in some fields. Stroma showed no significant changes.
13-24 hours	Marked epithelial disruption in prostatic acini, pyknosis of nuclei, inflammatory cell collection seen in stroma. (Fig 1-2)
25-48hours	Marked atrophy of acini along with karyorrhexis, karyolysis of nuclei and significant inflammatory cell collection in stroma. (Figure 3)
49-72 hours	Marked atrophy and necrosis of acini, karyolysis of nuclei, distortion and necrosis of stromal tissue noticed. (Fig 4-5)
73 hours – 1 week	Necrosis, complete distortion of glandular and fibro muscular architecture, occasional stromal calcification and decreased stain uptake seen. Even corpora amylacea is not identifiable in specimens in which postmortem interval is close to 1 week. (Fig 6)

The temperature max / min / day varied between 27/20°C to 39/27°C during the study. Humidity varied from 78% to 99% during the study.

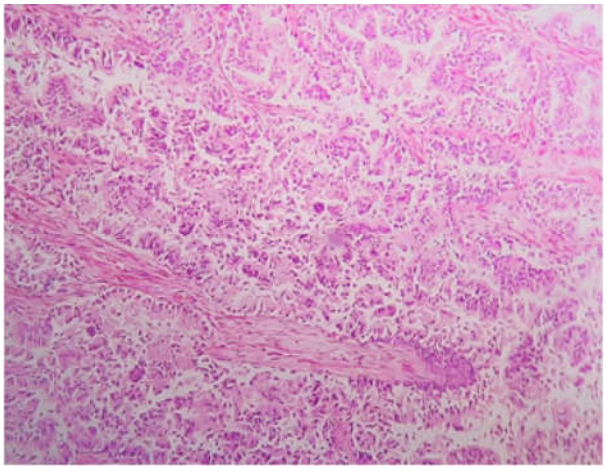

Fig. 1: Marked epithelial disruption in prostatic acini, pyknosis of nuclei, inflammatory cell collection seen in stroma (H& E Staining - 40X)

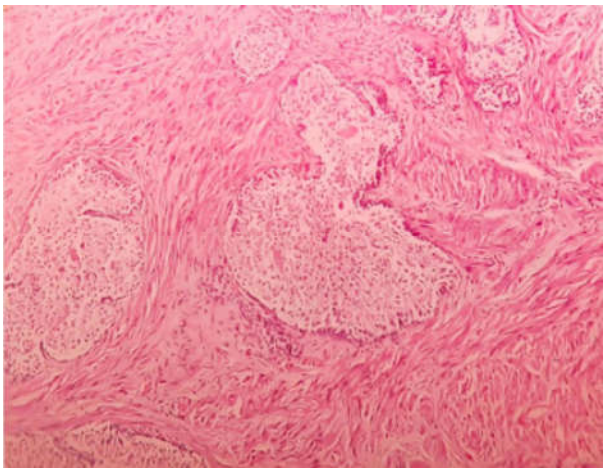

Fig. 2: Marked epithelial disruption in prostatic acini, pyknosis of nuclei, inflammatory cell collection seen in stroma (H& E Stain - 40X)

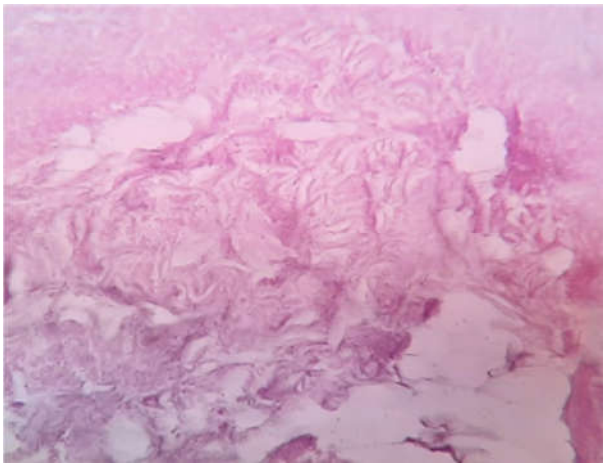

Fig. 3: Marked atrophy and necrosis of acini, karyolysis of nuclei, distortion and necrosis of stromal tissue noticed (H& E Stain - 40X)

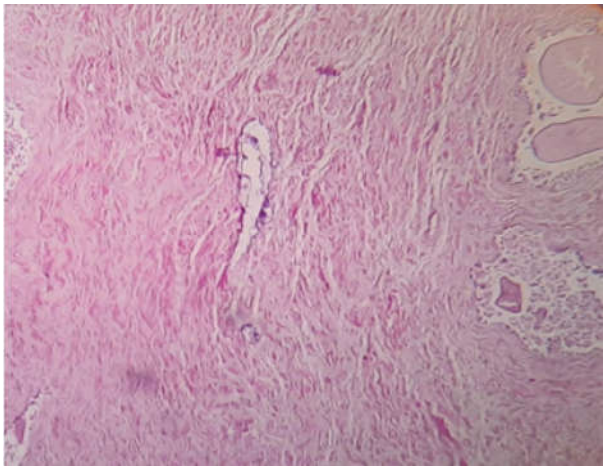

Fig. 4: Marked atrophy of acini along with karyorrhexis, karyolysis of nuclei (H& E Stain - 40X)

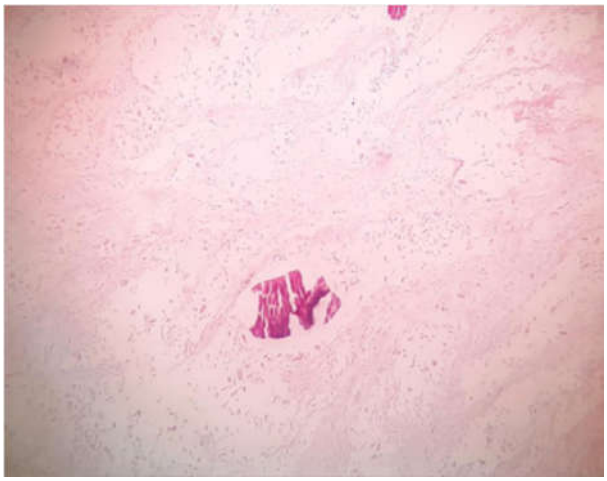

Fig. 5: Marked atrophy of acini along with karyorrhexis, karyolysis of nuclei (H&E Stain - 40X)

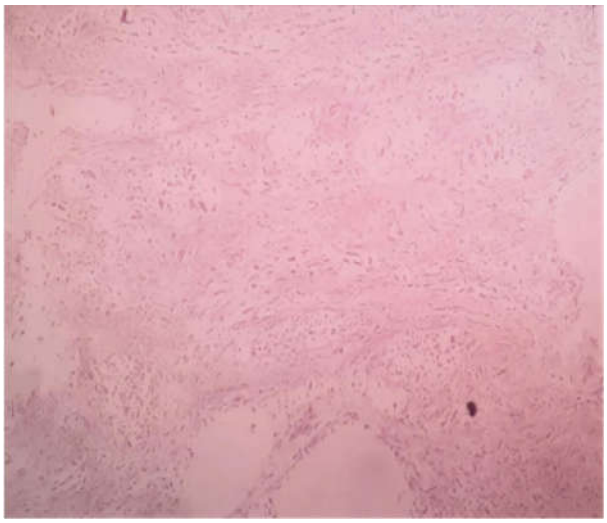

Fig. 6: Necrosis, complete distortion of glandular and fibro muscular architecture, occasional stromal calcification and decreased stain uptake seen. Even corpora amylacea is not identifiable in specimens in which postmortem interval is close to 1 week. (H & E Stain - 40X)

Discussion

The absence of any study on estimating postmortem interval from histology of human prostate justifies the necessity of current study. It is often stated in medical literature that prostate and virgin uterus are the most resistant organs to decompose,[8] hence prostate can be a good candidate for estimating time since death in early postmortem and fresh phase of late postmortem period that is from 7 to 10 days after death. In current study, in-situ and in-vivo degeneration of human prostate are evaluated.

In forensic investigations, determining the time of death is a critical aspect that often involves a multidisciplinary approach. Forensic experts play a pivotal role in this process by employing various methods to assess postmortem changes. Prostate degeneration is one such indicator utilized in postmortem examinations. As the prostate undergoes specific structural alterations following death, forensic experts carefully examine these changes to estimate the time since death. Combined team approach of a forensic expert with Pathologist allows the forensic expert to observe histopathological alterations, including cellular disintegration and changes in tissue appearance. By correlating these findings with established postmortem intervals, forensic experts contribute valuable insights to investigations. While the assessment of prostate degeneration is just one facet of a comprehensive forensic examination, it underscores the intricate nature of forensic science and its role in unraveling the mysteries surrounding the circumstances of death.

The timelines of degenerative changes in prostate with an inherent pathology may vary. In our study the first evidentiary degeneration changes in acini begin at 6 hours and in stroma begin at 12 hours postmortem. Thereafter, first atrophic changes in acini begin at 19 hours postmortem and continue to progress till 3 days, after which identification of any glandular or stromal tissue becomes extremely difficult.

There were variations compared with animal study[9] on prostate. Initial changes were seen as early as 6 hours postmortem in human prostate whereas no structural alteration was seen in prostate of albino rats up to 12 hours. Significant epithelial disruption, inflammatory cells and fatty degeneration began to appear in the prostatic acini prior to 24 hours and sometimes as early as 18 hours, whereas such changes in animal study were seen after 24 hours only. Marked atrophy of acini and necrotic changes started to appear between 24 to 48 hours in our study whereas such changes were seen only after two days in animal study. Stromal calcification with increasing postmortem interval was less significant in late specimens compared to animal studies. Overall degeneration changes were seen early compared to the animal study.

The composition of prostate tissue may undergo changes with age. These changes can include alterations in glandular structures, connective tissue, and overall tissue organization.[10] The rationale of restricting study sample between 20-60 years is that the prostate volume is considerably very less in individuals less than 20 years and the alterations of benign prostatic hyperplasia increases after the age of 60. During early adulthood around 20 years of age, the prostate undergoes a phase of growth and development. This growth is primarily influenced by hormonal factors, particularly testosterone.

Also there was difficulty in obtaining samples from dead bodies beyond 36 hours because of the excluding bodies preserved in cold storage in the study. However, we recruited few trauma cases and drowning cases as per inclusion criteria.

These variations in human prostate study are worth noticing for any further research. The variations may be because of structural variations, temperature variations and any other exogenous or endogenous variable.

Limitations: Prostrate is confined to male sex only which is the major limitation of the study where it can be utilized for estimation of time of death in males only and not in females.Also the present study did not attempt to study degeneration of human prostate in controlled environment like at different known temperatures, humidity and other atmospheric variables. This study provides a cross sectional data of autolytic and putrefactive changes.

Recommendations: Further studies are advised preferably with large sample and with emphasis molecular studies like studying DNA degradation patterns in human prostate. Further studies in controlled settings are advisable. Corpse related factors like clothing, built; cause of death may also induce an element of unpredictable subtle randomness which is beyond the scope of this preliminary study.

Conclusion

Changes in human prostate can also be used to complement other scientific data in estimating postmortem interval for a prolonged period of time in comparison with other soft tissue organs of human cadavers. Histopathological changes in human prostate in relation to time since death can be effective forensic tool useful for crime investigators. Forensic Histopathology proves yet another sensitive tool of medico legal importance.

Conflict of Interest: ***None to declare***

Financial Support: ***Nil***

Ethical declaration: There is no ethical issue involved in the study and Post Mortem will be performed after obtaining necessary medico legal permissions and consents which also include organ observation and preservation in Human mortal specimens.

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