Role of Rigor Mortis in Assessment of Time Since Death

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Abstract

Background: Evaluating time since death is an fundamental part of medico-legal investigations. Rigor Mortis is determined by routine convential method of corpus examination and detecting development of postmortem changes which are affected by many internal and external factors.

The study was done on 100 medico-legal autopsies. Presence of Rigor Mortis in the cadavers was observed both in voluntary and involuntary muscles. Voluntary muscles were tested by gently moving the parts (eyelids, jaw) or by gently flexing the joints. Involuntary muscles like heart by slightly compressing it.

Most of the cases belonged to 21-40 years of age group (45%) followed by 41-60 years (32%). 78% of the victims were males while only 22% were females .66% of the cases were reported to be the Road traffic accidents, 13% were poisoning cases, 7% natural death and 4% hanging. Majority of the cases seen were those of brought dead cases i.e; 57% and the hospital deaths recorded were 43%. 99% of victims were clothed. Mean maximum temperature was 33.86±6.6hrs and minimum temperature noted was 24.31±6.5hrs &percentage humidity recorded was 33.51±20.2 . In this study 95% Rigor Mortis was recorded in eyelids, 95% of Rigor Mortis was seen in jaw, 95% in the neck, 96% in the right upper limb, 94% in the left upper limb,80% cases in right lower limb and 80% in the left lower limb. Minimum Postmortem interval recorded was 4 hrs and maximum postmortem interval reported was 36 hrs. Mean PMI reported was 14.80±5.87 hrs. Majority of the cases were reported from two police stations Mullana, which were 46 in number and from Barara ,24 in number.

Key words: *Rigor Mortis; Postmortem interval; Time since death; Autopsy; Forensic case work.*

Introduction

Estimating the time gap in between death and autopsy is an important aspect of every medico-legal case after death.

Determination of approximate time since death is important in all the unnatural cases and criminal cases which include homicide, accidents, and suicide cases .Development of. Rigor Mortis is based upon different physical and chemical changes known to occur within the dead body.[1]

The term Rigor mortis is a latin origin word which means stiffness of death. It is one of the identifiable signs of death, which is characterized by stiffening of the muscles of the body caused by chemical changes that occur in muscle postmortem.[2] The primary reason for the development of rigor mortis is the loss of adenosine triphosphate from the anoxic tissue[3,4]. Rigor mortis starts to develop 2–4 hours after death and develops fully by 6 to 12 hours and gradually dissipates until approximately 72 hours after death. It has been found that post-mortem muscle proteolysis is responsible for the relaxation following rigor mortis[5,6]

The onset of Rigor Mortis after death depends on the surrounding temperature. The biochemical changes that take place in the dead body is chemical breakdown of energy molecules i.e; ATP in the muscles, which is

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the source of energy required for activity. In absence of ATP, myosin molecules adhere to actin filaments and the muscles become firm, hard and rigid[7].

Various **factors** affecting the process of Rigor Mortis are age and condition of the body,mode of death, surroundings,various environmental condition have an effect on the development and disappearance of rigor mortis like in various tropical and temperate zones .

Work regarding the appearance, duration and disappearance of stiffness in various muscles in a cadaver has been extensively carried out both in India and abroad by many researchers.[8,9] These researchers have conducted this study for assessing the time of death from the onset and time span of Rigor Mortis which rely on many factors including weather.[10,11] India is having diverse weather conditions that exist throughout its various parts at a given time. Haryana is one such place in North India which experiences extremes of weather conditions.[12,13,14]

The factors that interfere with the onset and duration of rigor mortis are temperature, existing ante-mortem pathologies, age, body muscular mass, presence of infections, temperature, climatic conditions and the degree of muscular activity immediately before death.[15,16,17]

District Ambala is one such place in North India, which experiences extremes of weather conditions. Available literature on this topic is patchy and scanty especially from this geographical location. As per best of my knowledge, no study has been conducted on factors influencing rigor mortis from Ambala. Therefore, it was planned to study the effect of temperature, humidity and other factors on the onset, duration and sequence of appearance and disappearance of rigor mortis in subjects of Ambala.

Aims and Objectives

- To correlate the known postmortem interval with the extent of Rigor Mortis.
- To ascertain the effect of local temperature and humidity on Rigor Mortis and variation in the post mortem interval.
- To correlate and evaluate the variation of various external and internal factors which influence the Rigor Mortis.

Material and Method

The study conducted was a cross-sectional study in which total of 100 cases were collected which were preserved in deep freezer at a temperature between 0-4ºC. Presence of Rigor Mortis in the corpses was observed in the both voluntary as well as involuntary muscles. Voluntary muscles were be tested by gently moving the parts eyelids, jaw, neck, upper limbs, lower limbs or by gently flexing or moving the joints. Involuntary muscle like heart was tested by slightly compressing it.Rigor Mortis of the iris was observed from the dilatation or constriction of the pupils.

Inclusion Criteria

Those cases were selected where the time of death was known which would help to ascertain the appearance, progress and disappearance of Rigor Mortis at various intervals.

Exclusion Criteria

The following dead bodies were be excluded from the study;

(1) Decomposed bodies.

(2) Artificially preserved bodies.

(3) Bodies showed heat stiffening, cold stiffening and instantaneous Rigor.

Statistical Analysis

All the cases were entered in proforma & statistical analysis was done. Chi-square test was applied in our study. The data were presented as mean ± Standard deviation for determining Post-mortem Interval.

Observations& Result

The present study of Rigor Mortis was to estimate Post-mortem interval was conducted on 100 medicolegal necropsies which were performed in the Mortuary of Department of Forensic Medicine and Toxicology, Maharishi Markendeshwar Deemed to be University ,Mullana, Ambala w.e.f 1st April,2017 to 15th May 2019. Only those cases were selected in which the exact time of death was known and no artificial means of preservation had been employed.

TABLE 1: AGE AND GENDER WISE DISTRIBUTION OF THE CASES

Age group (in years)	Gender					
	Male		Female		Total	
	NUMBER	%	NUMBER	%	NUMBER	%
0-20 years	11	14.0%	2	9.1%	12	12.0%
21- 40 years	33	42.3%	11	50.0%	45	45.0%
41- 60 years	25	32.1%	7	31.8%	33	33.0%
> 60 years	9	11.5%	2	9.1%	10	10.0%
Total	78	100%	22	100%	100	100%

Table 1 and shows age and sex wise distribution of the study cases. Among male cases majority of them fell in the age group of 21-40 years (42.3%), followed by 41-60 years (32.1%). Among females majority of the cases were also in the age group of 21- 40 years (50%) followed by 41-60 years (31.8%).

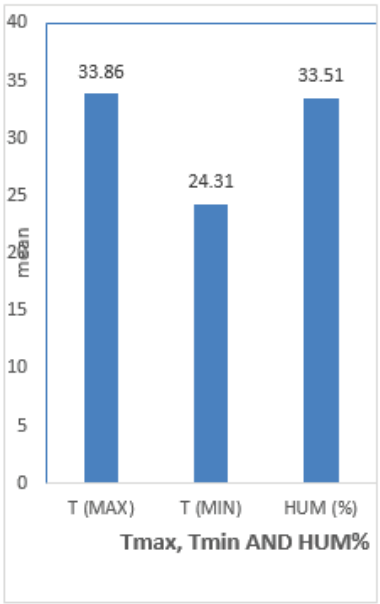

FIGURE 1:MEAN T MAX,TMIN AND HUM%

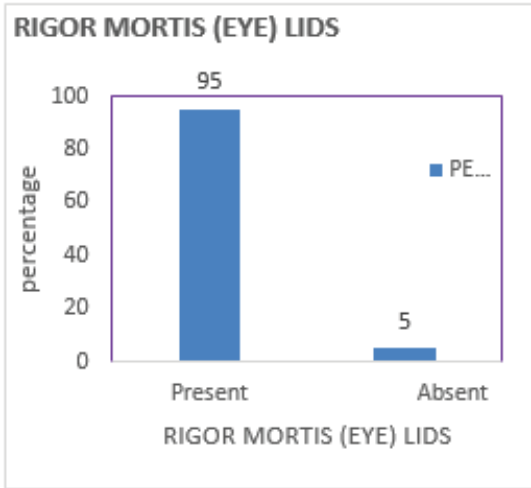

FIGURE 2 :RIGOR MORTIS EYELIDS

F IGURE 1 Shows the mean maximum temperature, mean minimum temperature and percentage humidity of the postmortem subjects.

FIGURE 2 Shows Rigor Mortis (eye lids). Among 95% of the cases Rigor Mortis was present in the eyelids. In 5% cases rigor mortis has started disappearing

Table 2: MEAN POST MORTEM INTERVAL

Mean POSTMORTEM IN TERVAL (Hours)						
	NUMBER		Minimum	Maximum	Mean	Std. Deviation
PMI (in hours)	100	4	36	14.80	5.871	

Table: 2 Result showed that the maximum postmortem interval recorded was 36 hours while minimum postmortem interval recorded was 4 hours. Mean PMI was found to be 14.80± 5.871 hours.

FIGURE 3 Testing of Rigor Mortis in Upper Limb

Discussion

In the present study 100 medico-legal cases were taken. Among those, 78% of the participants were males while only 22% were females. Age and sex wise distribution of the study cases showed that among male cases large proportion of them fell in the age group of 21-40 years (42.3%), followed by 41-60 years (32.1%). Among females majority of the cases were also in the age group of 21- 40 years (50%) followed by 41-60 years (31.8%). In my study the main cause of death was found to be Road traffic accident which constitutes 66% of the cases, followed by 13% of the poisoning cases, 7% natural death and 4% hanging. In my study majority of the deaths were brought dead cases they were 57%, while 43% death cases were those which were admitted in hospital. 99% of the cases were wearing clothes. Mean TMAX in the present study was calculated to be 33.86± 6.6 hours, mean TMIN was found to be 24.31±6.49 hours and mean HUM% was estimated to be 33.51±20.5 %. In my study among 95% of the cases were those in which Rigor Mortis was present in the eyelids and 5% were those in which rigor mortis is seen to be disappearing. In 95% of the cases Rigor Mortis was present in the jaw, 95% cases of Rigor Mortis was seen in neck, in 96% in the right upper limb, in 94% in left upper limb, in 80% cases in right lower limb and in 80% of the cases in left lower limb. Also from my study the maximum number of cases that came to mortuary for autopsy were seen in the month of April i.e 22 while the minimum number of cases seen were in January and February i.e 2. Also the minimum duration of Postmortem interval was 4 hours and maximum duration of Postmortem interval was 36 hours.The mean postmortem interval calculated was 14.80±5.87hrs.

Similar finding were observed by Dalal J et al presented with almost same findings .he has done his study on rigor mortis from the Amritsar which is bordering state adjacent to Haryana where present study was done.

In this study also the mean duration for completely developed Rigor Mortis was 18 hours and 19 minutes, the shortest duration being 3 hours and 15 minutes and the longest 33 hours and 40 minutes. 94.6% of cases. Rigor Mortis was found to establish first in the muscles of eyelids followed by lower jaw, neck, upper limbs, trunk, lower limbs and lastly fingers and toes. It regressed in the same manner in which it had appeared. However, in 5.4% cases course was found to be uncertain.

Similar study conducted by R.K Gorea from Amritsar in which 128 cases were selected from various medicolegal cases brought to mortuary complex of medical college, Amritsar. In this study if the rigor mortis has not appeared PMI is less then 3 hrs & 15 minutes,while longest duration in which rigor mortis had not completely appeared in the body as 14 hrs. Rigor mortis gives us a satisfactory PMI when due weightage is given to temperature and humidity.

Similar study was conducted by M.sugatha et al .This study was a cross- sectional study in which 500 medicolegal autopsies done at Osmania General Hospital morturary were the exact time of death was known and the body had been kept at prevailing room temperature. Effect of various factors on the appearance and disappearance of the rigor mortis like temperature ,humidity clothing was also observed in the same manner with almost same results.

Conclusion

From the present study, the following is concluded:

1. Rigor Mortis is a definite sign of death and is a indicator of postmortem interval when many environmental factors are shown to have an effect upon it like temperature and humidity.

2. Sequence of onset and disappearance of Rigor Mortis is first in eyelids, then lower jaw, neck and rest of the body. It lasted the longest in the lower jaw.

3. Most of cases follow the normal course of appearance and disappearance of rigor mortis but rule of twelve does not apply to all cases.

4. Rigor Mortis is affected by other factors besides temperature and humidity like nourishment, clothing, illness and activity prior to death.

Though much study has been done on animals, a bigger study is required on human corpses beginning from time of death till the time of disposal especially in hospital deaths where disposal is delayed so that hour by hour estimation of time since death from Rigor Mortis can be done.Also while transferring of a dead body from emergency to mortuary rigor mortis get distorted and various factors affect the rigor mortis that should also be taken into consideration in future.

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Ethical Clearance: After taking Institutional Ethical committee clearance the data was collected from the victims coming to the mortuary of the forensic department of MMU university, Mullana

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