Original Research Article

Assessment of onset and progress in the high ambient environmental temperature influenced on rigor mortis in Tirunelveli district

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Abstract

Background: India is a country with vast diversity in population and climate. So, we cannot follow a single method or time pattern in calculating the time since death. This may be due to extremes of variation in temperature pattern in comparing the whole of India and the world. Estimating the Time Since Death is considered as one of the most difficult and inaccurate techniques in Forensic Pathology. Various evidence must be correlated to each other in order to arrive some sensible time limit, within which the death could have occurred. **Aim::** This study was aimed to fix a time pattern for the rate of onset and progress of Rigor Mortis from examining individual joints that completed the progress of Rigor Mortis with reasonable evidences and to reveal the real-time taken for onset, progress, and completion of Rigor Mortis in Tirunelveli District, where high average ambient temperature was recorded. **Materials and Methods:** The study was conducted in 2015on 100 bodies of dead patients at Tirunelveli Medical College. All Medico-Legal and Non-Medical Legal cases, with a known time of death, only were selected for this study. The study was conducted in the veranda of the mortuary at that time. The dead bodies were not preserved in the cold storage during the entire study period. Height, built and nourishment, various premorbid conditions, time with the date of death and the environmental temperature on that day of the study were carefully recorded. Inch tapes were used for measuring height and nourishment. **Results:** In the age group of 41 to 50 years the Rigor Mortis completed early. Rigor Mortis took more time to complete than normal time in the age group of 11 to 20 years, because of lesser muscle mass. Moreover, irrespective of all the age group studied, the range of time taken for the completion of R. M was in between 3.3 hours to 6.45 hours. The time pattern in the earlier completion of R.M was in between 3.3 hours to 4.2 hours. But, in the late completion of R.M, the range of time pattern was in between 6.3 hours to 6.45 hours. The Mean time did not show any variations in the onset and progress of R.M. It was maintained in between 5.06 hrs to 5.34 hrs. On interpretation, the time shows 0.15 hr variation in between the age groups of 30 years to 60 years when comparing with the total variation of 0.5 hrs in the selected study. **Conclusion:** The role of onset and progress of R.M in estimating Time Since Death is a useful method. The MEAN time taken for the progress completion of Rigor Mortis is less than 6.00 hours. This time pattern was derived from 100 bodies studied. Cause of death varied, age pattern varied, sex pattern varied, but the annual ambient environmental temperature was high but constant with little variation, throughout the study period.

Key Word: Post Mortem cooling of the body, Rigor Mortis, Post Mortem lividity and other Decomposition changes.

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Received Date: 10/02/2019 Revised Date: 22/03/2019 Accepted Date: 13/04/2019
DOI: https://doi.org/10.26611/10181011

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 19 April 2019

INTRODUCTION

Rigor Mortis is occasionally helpful in determining whether a body has been moved after death. If a body is found in an unusual position – for example, one that could not have been maintained under the influence of gravity during primary relaxation of the muscles after death – this position implies that the body has been moved after the development of Rigor Mortis.[1] Rigor Mortis may make it difficult for an examination of the palms and inner aspects of the fingers but not otherwise, so that current marks or defense injuries located there

How to cite this article: M Sivanandam, Gokula Pandia Shankar. Assessment of onset and progress in the high ambient environmental temperature influenced on rigor mortis in Tirunelveli district. *MedPulse International Journal of Forensic Medicine.* April 2019; 10(1): 01-05. https://www.medpulse.in/Forensic%20Medicine/

may be overlooked. Marked anal dilatation may be observed in Post Mortem cases, particularly in children.[2] As previously mentioned, when the death occurred and precedes the onset of Rigor Mortis, the whole body musculature loss its tone. In children, R.M may fix a time of a dilated anal orifice, and this finding may persist even after Rigor Mortis has faded. But this anal dilatation is not, therefore, a sufficient marker of penetrative anal abuse.[3] Muscle relaxation immediately after death with the opening of the eyes and mouth and subsequent fixation in Rigor Mortis often occurs after death, giving the face the appearance of grimacing. However, despite common beliefs, the face of a decedent does not reflect whether the individual's last moments were of fear or fright.[4] India is a country with vast diversity in population and climate. So, we cannot rely on and follow a single method of the time pattern in calculating the Time Since Death. This may be due to extremes of variations in temperature pattern in comparing the whole of India.[5]The references available on post mortem cooling of the body in estimating Time Since Death, ends in calculating the rate of fall in the rectal temperature. This won't be useful in our area. Post-Mortem Lividity and other decomposition changes are not a constant occurrence in all deaths. Post-Mortem Lividity is not temperature dependent.[6] These methods are also won't be useful for our area. And frequently in the cool temperate countries, they consider Rigor Mortis as a difficult method in estimating Time Since Death, because of the extremes of the variations in environmental temperature for a day, days and months. But, estimation of Time Since Death using the onset and progress of Rigor Mortis will be useful here rather than other factors that are useful in the estimation of Time Since Death. Apart from all the factors that alter the onset and progress of Rigor Mortis, the environmental temperature is an important one.[7]

MATERIALS AND METHODS

The study was conducted in 2015on 100 dead bodies of admitted patients at Tirunelveli Medical College Hospital. All Medico-Legal and Non-Medico Legal cases, with a known time of death, were selected. The study was conducted in the veranda of the mortuary. The dead bodies were not preserved in the cold storage during the study period. Height, built and nourishment, various premorbid conditions, time and date of death and the environmental temperature was carefully recorded. Inch tapes were used for measuring height and nourishment.

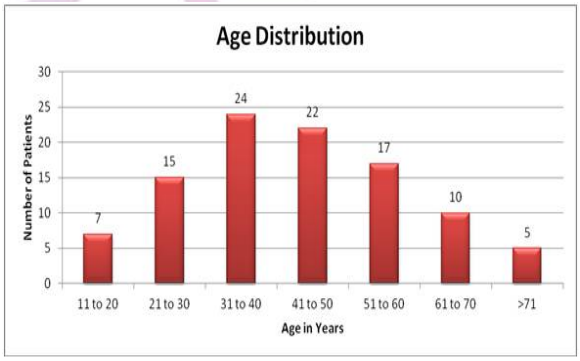
Inclusion Criteria: All dead bodies with a known time of death from both Medico-Legal cases and Non-Medical Legal Cases admitted and died in Tirunelveli medical college hospital.[1]. Only those cases were selected in which Time Since Death was known.[2] Both the Medico-Legal Cases and Non-Medico Legal Cases but admitted and died in our hospital with a known time of death.3]. Bodies with well / moderately built with good muscle mass were only selected irrespective of sex and age.

Exclusion Criteria: Those bodies, in which there were any artificial means of preservation was used, were not selected in this study. [during treatment or transport-E.x. cooling with ice, embalmed bodies, bodies kept in cold storage, etc). Bodies for this study, on those days, with extremes of temperature variations like rainfall with cool and chills were not selected as study days. The dead body to be examined was kept under normal environmental temperature at the veranda of the mortuary at Tirunelveli Medical College Hospital until completion of the examination. After completion of the examination, the examined dead body or bodies were kept inside the cold storage of the mortuary.

METHODOLOGY OF EXAMINATION

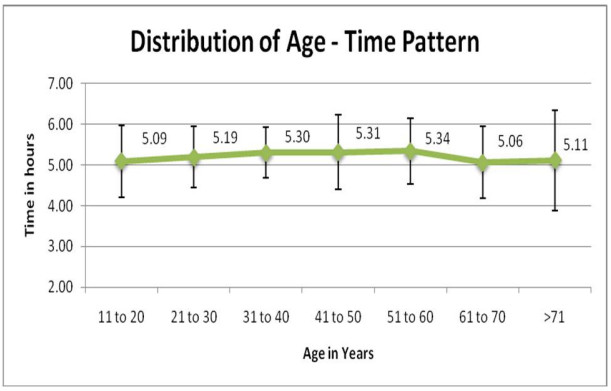
The examination was conducted only on skeletal muscles. It was by examining various joints activated by groups of skeletal muscles. Application of mild to moderate force to flex or extend the concerned joints on hourly interval was done and the results were recorded. Facial, abdominal and chest muscles were the exceptions. They were examined by gentle pulling or pressing. They were also recorded.

RESULTS



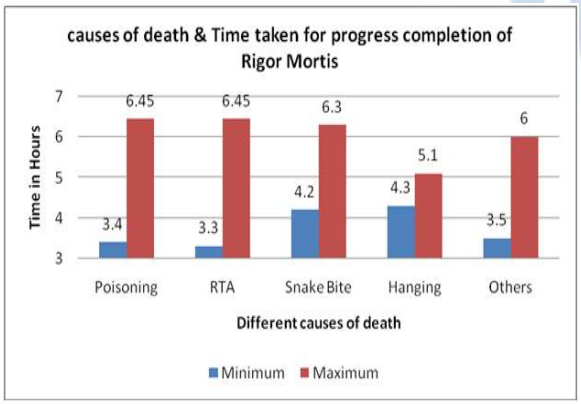
Graph 1: Shows the age distribution chart

Graph 1 shows in the studied 100 bodies, 7 bodies belong to11 to 20 years of age group, 15 bodies belong to 21 to 30 years of age group, 24 bodies belong to 31 to 40 years of age group, 22 bodies belong to 41 to 50 years of age group, 17 bodies belong to 51 to 60 years of age group, 10 bodies belong to 61 to 70 years of age group. And 5 bodies were above the age group of 70years, and it was not by the selection criteria by the age but was on the basis of good muscle mass and built. Male preponderance was more in our study.



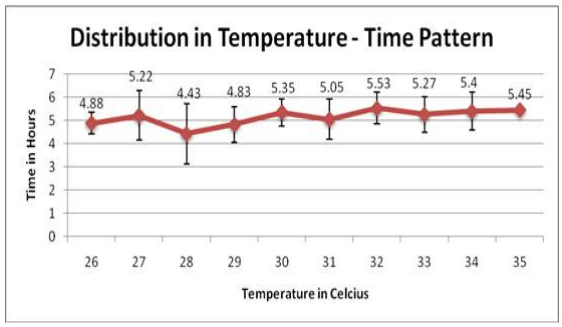
Graph 2: the mean time for the progress completion of rigor mortis in individual age groups

Graph 2: showed Age did not make any major differences in the onset and progress of Rigor Mortis. The MEAN TIME did not show many variations in the onset and progress of R.M. It was maintained in between 5.06 hrs to 5.34 hrs. On interpretation, the time shows 0.15 hr variation in between the age groups of 30 years to 60 years when compared with the total variation of 0.5 hrs in the selected study.



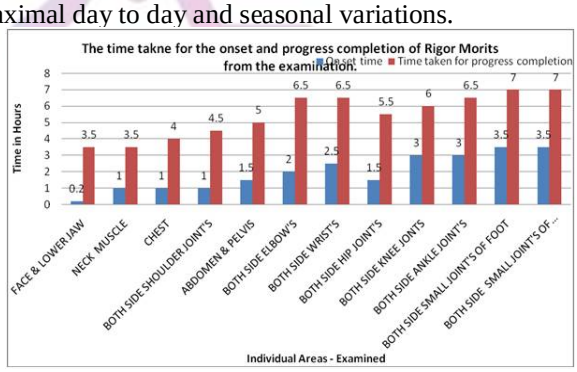
Graph 3: the range of time taken for completion of rigor mortis for selected different causes of death.

Graph 3: The range of time pattern for the deaths because of Poisoning was in between 3.4 hours to 6.45 hours with a variation of 1.05 hours. The range of time pattern for the bodies died because of RTA was in between 3.3 hours to 6.45 hours, with a variation of 1.15 hours. The range of time pattern for the bodies died because of SNAKEBITE was in between 4.2 to 6.3 hours with a variation of 1.1 hours. The range of time pattern for the bodies died because of HANGING was in between 4.3 hours to 5.1 hours, with a variation of 0.8 hours. In the remaining 10% of Non-Medico Legal Cases, the range of time pattern was in between 3.5 hours to 6 hours with the variation of time of2.5 hours. In the early completed Rigor Mortis bodies showed the range of time pattern of 3.3 hours to 4.5 hours with a variation of 1.2 hours. In late completed, Rigor Mortis bodies showed the Rangeof5.10 hoursto6.45hours of time pattern with a variation of 1.25 hours. Irrespective of the cause of death the RANGE of time pattern for completion of Rigor Mortis was in between 3.3 hours to 6.45 hours, with the variation of time of 3.31 hours.



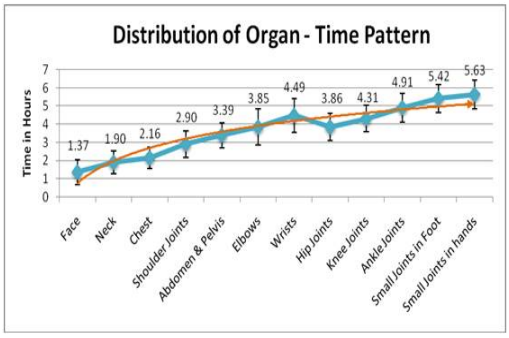
Graph 4: Temperature And Time Taken For The Completion Of Rigor Mortis- Relationship Curves

Graph 4: Out of 100 bodies studied, the time is taken, from the completion of R.M comes in between 4.43 hours to 5.53 hours of a various climatic pattern of palayamkottai during this recorded study. The average annualambient temperature from this study for this year is 290C when compared with the recorded temperature of 29.30Cof Palayamkottai. Palayamkottai temperature was hot, hotter and hottest, throughout the year without any maximal day to day and seasonal variations.



Graph 5: The Range Of Time Taken For The Onset And Completion Of The Progress Of Rigor Mortis During The Study

Graph 5: For the onset of Rigor Mortis the time taken for the whole body, it was in between 0.2 hours to 3.5 hours with a variation of 3.3 hours. To complete the progress of Rigor Mortis the RANGE of time taken was 3.5 hours to 7.0 hours for the whole body with a variation of 3.5 hours.



Graph 6: Distribution Of Organ Time Pattern For Complete Rigor Mortis

Graph :6 The MEAN time concerned regarding the onset and progress of Rigor Mortis, it started first in the face-within the first 2 hours, in theneck1.9 hours, in the chest in 2.16 hours ,in the shoulder joints in 2.9 hours, in the abdomen and pelvis in 3.39 hours, in the elbow joints 3.85 hours, in wrist joints 4.49 hrs, in the hip joints because bigger muscle mass it started earlier i.e in 3.86 hours than the rest of lower limb, in the knee joints 4.31 hours, in the ankle joints it took 4.91 hours, but in the small joints of feet completed the progress of Rigor Mortis before the small joints of hand, for feet it took 5.42 hours, in the small joints of the hands the rigor mortis completed the progress in 5.63 hours. According to the above diagram, the MEAN time taken to complete the progress of Rigor Mortis was 5.63 hours that is below 6.0 hours. This time pattern did not coincide with any time pattern mentioned in the textbooks.

DISCUSSION

Rigor Mortis is the stiffening of the muscles after death due to complex chemical changes associated with permanent oxygen lack and accumulation of lactic acid. This leads to conversion of the contractile proteins of the muscle into a stiff gel, which persists in this state until the onset of putrefaction causes softening. Although R. M starting develops uniformly throughout the body, it usually becomes first apparent in the smaller muscle groups, due to the lesser muscle mass involved, i.e due to less amount of A.T.P available.[8] Thus it appears first in the muscles of the face and jaw, the limbs stiffening later, though in no fixed order.[9] Asa measure for the Time Since Death, Rigor Mortis is very unreliable for others and on the first glance with scientific knowledge it is easier for a professional Doctor to tell the Time Since Death. But not for all. Like all chemical processes, it is temperature-dependent. In warm conditions, R.M. appears quickly and passes off quickly, due to the early onset of decomposition. In the cold, it may be delayed markedly and in freezing conditions, may not appear at all (though actual freezing of the body fluids in extreme frost may cause stiffening)[10] When a cold body is brought into a warmer environment, then true Rigor may quickly appear. In average high environmental temperature conditions like Palayamkottai, Rigor Mortis is detected within 30min to 1 hour and be generally present within the first 3 to 10 hours, though very wide variations can occur. Rig or frequently presents up to the third or fourth day and may still be detectable after a week in some cases, especially in cold conditions, i.e., in cold storage and in cool geographic regions but not in this study. It is impossible for Rigor and signs of decomposition toco-exist.[11]Ananalysis by Mallachof opinion sin text books and medical papers over a long period showed variations of between 30 minutes and seven hours for the onset of rigor and 2-20 hours for full rigidly and 24-96hours for the persistence of fullRigor.[12] One fairly reliable fact about Rigor is that it comes on much more rapidly after death from electrocution – and also tends to appear quickly after severe exertion just before death. But such cases were not selected in this study. But R.M is a constant occurrence in all dead bodies and can be easily studied from such climates like Palayamkottai. So, Time Since Death can be easily estimated from the onset and progress of Rigor Mortis.13 In my study the onset and progress of Rigor Mortis was proximal to distal, means starts from pupils and face, lower jaw, anterior neck, chest, both side shoulders, abdomen and pelvis, both side hip joints, both side elbows, both side knee joints, both side ankle joints and feet then lastly wrists and small muscles of hands. The pattern did not change. But there is a gross change in the time pattern.[14] All these skeletal muscles involved in Rigor Mortis are examined in concerned joints by gently, gently closing the jaws, gently flexing the neck, gently giving compression with hands to the chest and flexing the joints against extensors as well a sex tension of the joints against flex or groups of muscles (i.e., testing anti-gravity muscles as per the protocol).[15] During my examination of Rigor Mortis, I noticed that there were different patterns of appearances of Rigor Mortis like left to right variation and in lower limb to upper limb extremities variations in few cases that were excluded [not necessarily, but because the occupation was not taken into concern of this study], this may be due to their disease patterns and habitual variations. But they did not make significant variations in the progress of the study. Somebodies after completion of the study have been excluded due to these reasons.[16] Deaths are usually accidental [i.e due to accidents] or suicidal and with occasional homicidal purposes.[17] The poisons are usually agricultural or naturally available vegetable poisons in and around their working field.[18] High environmental temperature is the most influencing factor in the study of Rigor Mortis. In high temperature, Rigor Mortis sets

earlier and passes off earlier not like in constant low temperature.[19,20]

CONCLUSION

The degree ofRigor Mortis may be used in Forensic Pathology, to determine the approximate time of death. A dead body holds its position as Rigor Mortis sets in. Several factors also affect the progression ofRigor Mortis, and investigators take these into account when estimating the Time Since Death. One such factor is the ambient temperature. In warm environments, the onset and pace of Rigor Mortis are speed up by providing a conducive environment for the metabolic processes that cause decay. Low temperatures, however, slow them down. Therefore, for a person who dies in frozen conditions, Rigor Mortis may last several days more than normal, so investigators may have to abandon it as a tool for determining the Time of death

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Source of Support: None Declared
Conflict of Interest: None Declared