

An Observation of Cooling of Dead Body for Estimation of Time Since Death in IGIMS, Patna, Bihar

Saroj Kumar Ranjan^{1*}, Pinki Kumari², Aman Kumar³, Sanjeev Kumar⁴, Sidharth Ramanujam¹

¹Junior Resident (Academic), ²Senior Resident, ³Additional Professor, ⁴Associate Professor,
Department of Forensic Medicine and Toxicology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

ABSTRACT

Background: Cooling of body after death is also known as Algor Mortis. Now a days recording of temperature of a dead bodies has its medico-legal importance in connection with determination of time since death. It is variable and depends upon various factor including the atmospheric temperature of a particular region.

Aim & Objective: The main objective of this objective was to record the fall of temp in dead body as supportive data for determination of time since death at Patna (Bihar).
Materials & Methods: The present study was conducted on 140 dead bodies brought for post-mortem examination at IGIMS, Patna from September 2016 to March 2018 after clearance of ethical committee.

Results: Between 3 to 6 hours after death, temperatures were recorded by 96.6°F to 95.6°F in 37.50% of cases and in 28.12% cases by 95.6°F to 94.6° F and in 34.37% cases by 94.6°F to 92.6°F. In the cases examined during 24 hours to 36 hours after death rectal temperatures were found to be lowered by 78.6°F to 74.6°F in 0.08% cases, and in 91.66% cases bodies were found to be cooled to environmental temperature.

Conclusion: The most important responsibility of the doctors performing post mortem examination to answer this point as precisely and accurately as possible. It is manifestly impossible to say the exact moment of death but a near approximation may be reached by closely recording of rectal temperature every half hourly for three hours.

Keywords: Dead Body, Algor Mortis, Rectal Temperature.

*Correspondence to:

Dr. Saroj Kumar Ranjan,
Junior Resident (Academic),
Department of F. M. T.,
IGIMS, Patna, Bihar, India.

Article History:

Received: 03-04-2019, **Revised:** 29-04-2019, **Accepted:** 14-05-2019

Access this article online	
Website: www.ijmrp.com	Quick Response code 
DOI: 10.21276/ijmrp.2019.5.3.011	

INTRODUCTION

Cooling of body after death is also known as Algor Mortis.¹ Now a days recording of temperature of dead bodies has its medico-legal importance in connection with determination of time since death. Cooling of body or algor mortis is due to loss of all physical, chemical and metabolic functions of the body after death.² In a living person body temperature is maintained at a level by heat gain equal to heat loss. Heat gain is obtained by metabolic activities at a cellular level whereas heat loss is obtained by catabolism. The process of metabolism and catabolism is so minutely balanced that the body temperature remains constant. After death there is no heat gain but there is constant loss of body heat until it comes to the level of environmental temperature.³ This phenomenon is completed by the help of conduction, convection, radiation and evaporation. It is variable and depends upon various factor including the atmospheric temperature of a particular region. Lot of studies are conducted in Europe, Latin America and other parts of world but few in India and other tropical countries. India itself has all type of climatic variants from North to south.

In Patna (Bihar) which is grassland of north India has four primary climate ie. Summer, winter, spring and rainy season. All have different atmospheric temperature which affect the algor mortis to a large extent. The result of algor mortis is certainly a supportive data for establishing time since death in a dead body.⁴⁻⁶ It is known that whatever parameter we use, they are subjected to a wide range of variation and are affected by various factors like age, sex, built, condition of the body, personal resistance, place, environmental condition, cause of death, clothing etc. so the parameters should be graduated and treated for different place, in different season and for different individual characteristics so that time elapsed since death can be calculated in possibly narrow range in particular case.⁷

Due to these variations the findings by various foreign workers who have worked in different atmospheric condition and places and in different ethnic groups may not be of great value in solving the day-to-day problems of doctors doing post-mortem examination in IGIMS Patna.

The main objective of this objective was to record the fall of temp in dead body as supportive data for determination of time since death at Patna (Bihar).

MATERIALS & METHODS

The present study was conducted on 140 dead bodies brought for post-mortem examination at IGIMS, Patna from September 2016 to March 2018 after clearance of ethical committee.

Study Design: Prospective and Observational study

Exclusion Criteria

- a) Mutilated and decomposed bodies
- b) Known to be suffering from HIV, Hepatitis B
- c) Heatstroke
- d) Septicaemia
- e) Strychnine poisoning
- f) Pontine Hemorrhage

Materials

- Laboratory thermometer (for environmental temperature)
- Clinical thermometer (for rectal temperature)

- Scalpel with blade
- Dead body

On arrival of dead body screening of challan paper and inquest paper brought by constable was done. The probable time of death, condition of clothing the place from where the body is brought, the cause of death as suspected by the witness and I.O was recorded.

The actual condition of body along with the clothing were noted and atmospheric temperature were recorded with the help of thermometer. At the same time rectal temperature was also recorded. The atmospheric temperature and the rectal temperature were recorded at every half hourly interval upto three hour. Six such temperature recording were noted.⁸

The seasonal variation was also recorded which was grouped in 4 subhead for each primary season as categorised below:

S1 – Summer – April, May, June, July.

S2 – Rainy - August, September.

S3 –Winter – October, November, December, January.

S4 - Spring - February, March.

The rate of cooling was calculated by the formula evaluated as⁹:

Rate of Cooling^{10,11} =

$$\frac{\text{Rectal temperature at the time of death} - \text{Rectal temperature after body was found}}{\text{Rate of temperature fall}}$$

Rate of temperature fall

- during summer - 0.75⁰F/hr
- during winter– 1.5⁰F/hr
- other season – 1.0⁰F/hr

The rate of fall of temperature over the dead body at this central part of Bihar was established.

In the light of rate of fall of temperature its correlation and matching with rigor mortis and decomposition helped in establishing time since death with great accuracy. It may give data for further evaluation of time since death in other part of Patna and in Bihar.

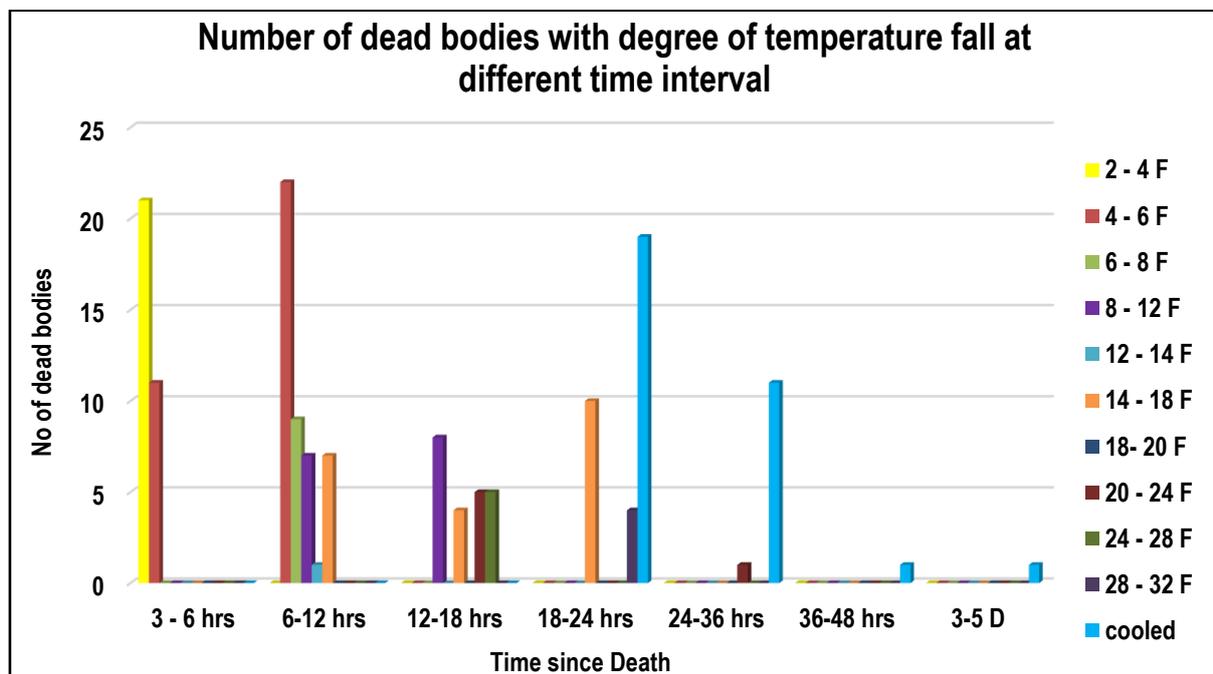
RESULTS

Demographics Profile

In the present study total 140 cases were examined in which 114 cases were male and 26 cases were female. 11% cases (15 cases) were falls in the age range between 0-18 years, 59% cases (83 cases) in between 19-40 years, 23% cases (32 cases) in between 41-60 years and 7% cases (10 cases) above 60 years of age. The total cases observed was of different type of case in which 58% RTA is highest in number, 23% Firearm injury, 10% Poisoning, 7% Hanging, 1% Acute gastroenteritis and remaining 1% were died due to Electrocutation.

Table 1: Showing number of dead bodies with degree of temperature fall at different time interval.

TSD (Hrs.)	Degree of Temperature fall (F)										Total	
	2-4	4-6	6-8	8-12	12-14	14-18	18-20	20-24	24-28	28-32		Cooled
3-6	21	11	0	0	0	0	0	0	0	0	0	32
	65.62%	34.37%										
6-12	0	22	9	7	1	0	0	0	0	0	0	39
		53.84%	23.07%	17.94%	0.02%							
12-18	0	0	0	8	0	4	0	5	5	0	0	22
				36.36%		18.18%		22.72%	22.72%			
18-24	0	0	0	0	0	10	0	0	0	4	19	33
						30.30%				12.12%	57.57%	
24-36	0	0	0	0	0	0	0	1	0	0	11	12
								0.08%			91.66%	
36-48	0	0	0	0	0	0	0	0	0	0	1	1
											100%	
3-5 days	0	0	0	0	0	0	0	0	0	0	1	1
											100%	



TSD= Time since death, cooled= equal to atmospheric temperature, Hrs=hours

Cooling of Dead Bodies

Rate of cooling of body were found to be variable depending upon the various factors. Between 3 to 6 hours after death, temperatures were recorded by 96.6°F to 95.6°F in 37.50% of cases and in 28.12% cases by 95.6°F to 94.6°F and in 34.37% cases by 94.6°F to 92.6°F.

In cases examined during 6 hours to 12 hours after death, temperatures were recorded by 93.6°F to 91.6°F in 53.84% cases, by 90.6°F to 89.6°F in 23.07% cases, by 88.6°F to 86.6°F in 17.94% cases. Whereas 0.02% cases body was found to be cooled to the level of environmental temperature.

In cases examined during 12 hours to 18 hours after death in 36.36% cases rectal temperature were recorded by 88.6°F to 86.6°F, in 18.18% cases by 84.6°F to 80.6°F, in 22.72% cases 76.6°F to 72.6°F. Whereas 22.72% cases body was found to be cooled to the level of environmental temperature.

In cases examined between 18 hours to 24 hours after death, rectal temperature were recorded by 84.6°F to 80.6°F in 30.30% cases, by 70.6°F to 66.6°F in 12.12% cases. Where as in 57.57% Cases body was found to be cooled to the level of environmental temperature.

In the cases examined during 24 hours to 36 hours after death rectal temperatures were found to be lowered by 78.6°F to 74.6°F in 0.08% cases, and in 91.66% cases bodies were found to be cooled to environmental temperature.

DISCUSSION

It was observed in this study that the rate of cooling of dead bodies in Patna, Bihar was variable in different seasons. It is because of the fact the atmospheric temperature in this part of India is greatly variable in different season group as compared to other part of India. The difference between the body temperature and surrounding atmosphere is wide and naturally the dead body has to cool of the variable range of temperature. The people of Bihar are comparatively of average weight than the general population in western European countries. Consequently the

amount of heat loss is moderate in Bihar. In majority of dead bodies studied in this work the cause of death was hemorrhage and shock as a result of RTA. As loss of blood causes much heat loss from body so this factor is responsible for more rapid cooling rate. The temperature difference between the atmosphere and the dead bodies was greater in winter and lesser in summer So that time taken to cool the body were found to be very much variable.¹² Modi, Lambert, Kamath and Chandra working on Indian subjects have observed that the rate of cooling is much more rapid in India than in Western countries.

The dead bodies have been found to cool in much less time in India than found by Sidney Smith, Taylor, Thomas, Glaister and others.

CONCLUSION

How long has a body been dead? This is a vexing problem to the medical jurists, forensic expert and police officers in their day to day official duties in dealing with medico-legal cases. The most important responsibility of the doctors performing post mortem examination to answer this point as precisely and accurately as possible. It is manifestly impossible to say the exact moment of death but a near approximation may be reached by closely recording of rectal temperature every half hourly for three hours.¹³ There are various factors influencing the post mortem changes displayed in dead bodies, some being personal relating to the dead bodies and others climatic, atmospheric and seasonal and depending on the surrounding medium in which the bodies lie. As such there have been wide variation in the findings of different authorities; foreign and Indian, regarding the time of appearance and duration of these changes.

From this point of view to know these temperature changes and how they develop in Bihar to find out whether these finding tally or differ in this part of the country with other authentic workers. This study on temperature changes especially rectal temperature changes of dead bodies under the local atmospheric conditions have been undertaken to estimate the time since death.¹⁴

REFERENCES

1. Nandy A. Principles of forensic medicine, 3rd edition. Kolkata: new central book agency (P)Ltd; 2015.P. 245.
2. Davy J. Observations on the temperature of the human body after death. Researches Physiological and Anatomical Vol. I. Smith, Elder and Co., London, 1839; 228-48.
3. Winterton, R.H.S. Newton's law of cooling. Contemp. Phys. 1999; 40 (3): 205-12.
4. Brown A, Marshall TK. Body temperature as a means of estimating the time of death. Forensic Sci 1974; 4:125-33.
5. Marshall TK. Estimating the time of death: the use of body temperature in estimating the time of death. J. Forensic Sci. 1962b; 7 (2): 211-21.
6. Marshall TK. The use of body temperature in estimating the time of death and its limitations. Med. Sci. Law 1969; 9:178-82.
7. Green MA, Wright JC. Post-mortem interval estimation from body temperature data only. Forensic Sci. Int. 1985a; 28: 35-46.
8. Rainy H. On the cooling of dead bodies as indicating the length of time that has elapsed since death. Glasgow. Med. J. 1868;1: 323-30.
9. Marshall TK. Estimating the time of death: the use of the cooling formula in the study of post-mortem body cooling. J. Forensic Sci. 1962a;7 (2): 189-210.
10. Burman JW. On the rate of cooling of the human body after death. Edinburgh. Med. J. 1880;25: 993-1003.
11. Marshall TK, Hoare FE. Estimating the time of death: the rectal cooling after death and its mathematical expression. J. Forensic Sci. 1962; 7 (1): 56-81.
12. Reddy KSN, the Essentials of Forensic Medicine and Toxicology, 34th edition. New Delhi: Jaypee Broths medical publisher (P) Ltd; 2014.p.154.
13. Simonsen J, Voigt J, Jeppeson N. Determination of the time of death by continuous post mortem temperature measurements. Med. Sci. Law 1977;17 (2):112-21.
14. Marshall TK, Hoare FE, Polson J. Rectal cooling after death and its mathematical expression- forensic science 1960;7.

Source of Support: Nil.

Conflict of Interest: None Declared.

Copyright: © the author(s) and publisher. IJMRP is an official publication of Ibn Sina Academy of Medieval Medicine & Sciences, registered in 2001 under Indian Trusts Act, 1882. This is an open access article distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Cite this article as: Saroj Kumar Ranjan, Pinki Kumari, Aman Kumar, Sanjeev Kumar, Sidharth Ramanujam. An Observation of Cooling of Dead Body for Estimation of Time Since Death in IGIMS, Patna, Bihar. Int J Med Res Prof. 2019 May; 5(3):54-57. DOI:10.21276/ijmrp.2019.5.3.011