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Original Research Article

The Estimation of Time since Death by Rule of Thumb Method Applied to the Corpses Brought to GGH Mortuary, Guntur

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Abstract:

A physical change that may occur in a corpse after death would be heat exchange from the body to the surrounding environment. An attempt has been made by the investigators to estimate time since death by Rule of thumb method which takes into account the rate of fall of temperature. A total of 100 human corpses selected for the study. The study was conducted from January to march of the year 2022. It is very difficult to specify normal body temperature, as this value can vary considerably between individuals. Rectal temperatures in a group of healthy subjects can vary between 34.2 ℃- 37.6 ℃, with a mean of 36.9 ℃. Rectal temperature is often referred to as deep central temperature, similar in value to that of brain, heart, lungs and abdominal organs.

Keywords: Core Temperature, Deep central temperature, Diurnal variation.

Introduction

A remarkable physical change that may occur in a corpse after death would be heat exchange from the body to the surrounding environment provided there might have been temperature gradient existed between the body and the environment. It is very difficult to specify normal body temperature, as this value can vary considerably between individuals. Rectal temperatures in a group of healthy subjects can vary between 34.2 ℃- 37.6 ℃, with a mean of 36. 9° C. Rectal temperature is often referred to as deep central temperature, similar in value to that of brain, heart, lungs and abdominal organs. Many factors influence body temperature. Most individuals show diurnal variation in which the body temperature fluctuates by ± 0.5℃. around the person's normal mean temperature. There are so many factors influence body temperatures like emotional stress of pleasure and displeasure, febrile diseases and endocrine disorders like hyperthyroidism, exposure to a cold environment, peripheral circulatory disorders etc.

Age also affects body temperatures, children tend to have higher rectal and oral temperatures than adults. Conditions that prevent heat loss or heat production and which lead to thermoregulatory imbalance are like heat stroke, fainting, heat exhaustion etc.

Materials and Methods

In this study a total of 100 human corpses were taken to estimate the time since death from Rule of thumb method where time since death is known. Of the 100 cases, 50 were males and another 50 were females.Fig.1. The study was conducted for a period of 3 months in the winter season from January to march of the year 2022. The winter season is ideal for studying the cooling pattern of the human corpse because ambient temperature is always less than body temperature which is unlike in summer where ambient temperatures recorded is always far high than the body temperature[1,2].

All these cases are collected from the Acute Medical Care unit of the Government General Hospital who were admitted and undergone treatment as Medico Legal Cases and sent to the mortuary for autopsy. The recording of rectal temperature of the corpse was done in the Acute Medical Care Unit of the hospital after death declaration by the duty doctor to the attenders.

Then corpse was shifted to the mortuary by the ward attenders for autopsy.

After admission to the mortuary, the name, sex, age, height & built, weight, Medico Legal Case Number & In-patient Number, date and time of death, cause of death were recorded. Then the bodies were stripped, made naked, placed over the mortuary table in prone position with both upper limbs lying side by the body. Thermometer (chemical), graduated from 0° C to 50° C was inserted into the rectum of the corpse by keeping the buttocks wide apart, such that at least 10cms of it from its tip should be there in the rectum [3,4]. (Figure 6,7) The chemical thermometer, as such kept there undisturbed, and reading is taken after 5mts interval, the time being required for its stabilization [3,4]. The recording of rectal temperature was made by the investigator without disturbing the corpse and thermometer [3,4]. The readings are substituted in the given set of formulae to obtain calculated time since death. The results thus obtained are analyzed with the original time since death of the chosen corpses. Informed consent was taken from the deceased′s attenders for the same. Institutional ethics committee gave no objection certificate for the project. The general method used by many to calculate the postmortem period involved the following two formulae i.e. method A and method B. method A is in degrees Fahrenheit and Method B is in degrees Centigrade[5,6,7].

Method A

$$\text{Time since death (TSD in Hours)} = \frac{\text{Rectal temperature at time of death (°F)} - \text{Rectal temperature at time } T_1\text{(°F)}}{1.5}$$

Method B

$$\text{Time since death (TSD in Hours)} = [\text{Rectal temperature at time of death (°C)}] - [\text{Rectal temperature at time } T_1\text{(°C)}] + 3$$

Results

Table 1: No. of Cases Vs Time since death

Sl. No	Mode of Death	No. of Cases (n)	Original TSD	Calculated TSD
1.	Violent Deaths	100	2 Hrs	2hrs + 2-4^{0}C.
2.	Non -Violent Deaths	100	2 Hrs	2hrs - 0.5-2^{0}C.

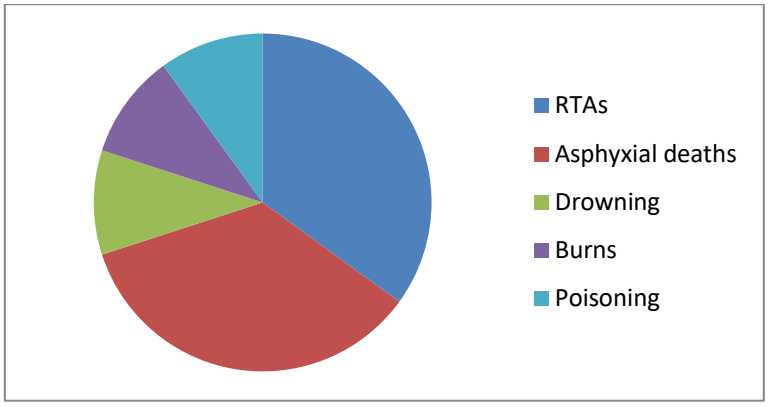

Figure 1: Percent wise distribution of cases

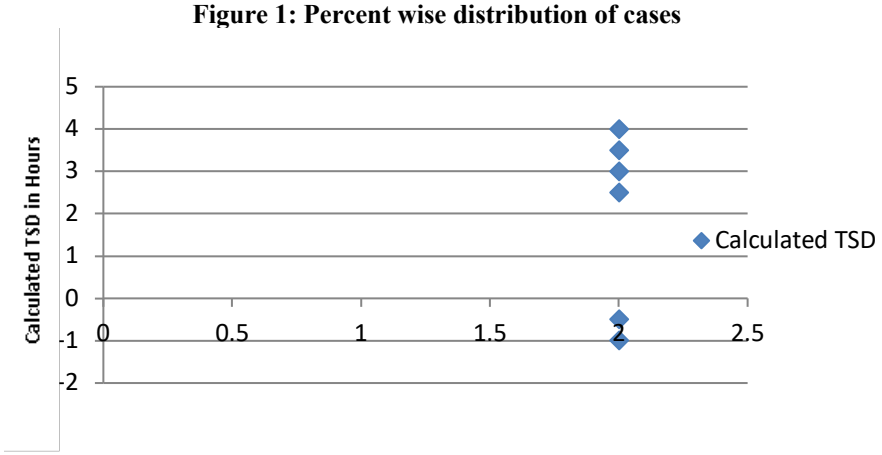

Figure 2: Calculated TSD Vs. Original TSD

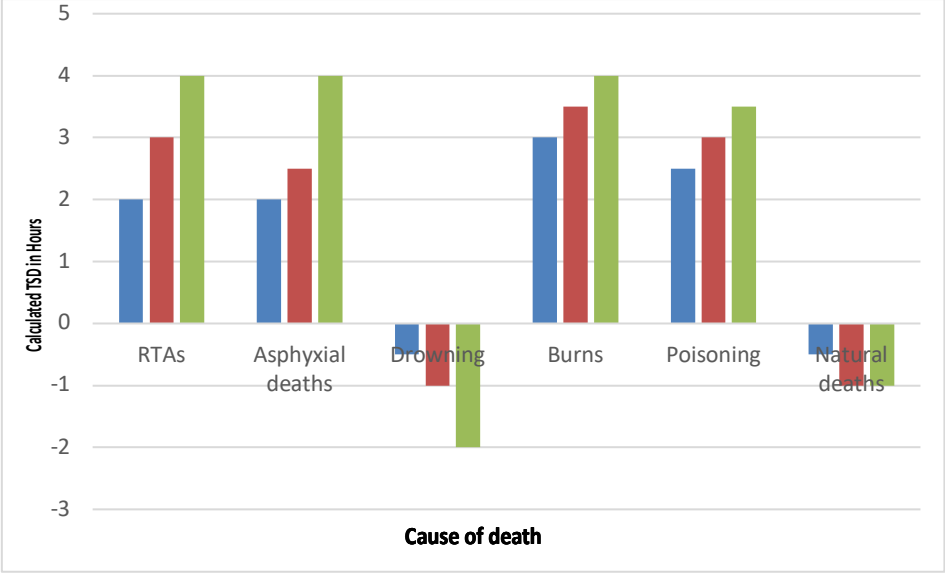

Figure 3: Fluctuation in Calculated TSD vs. Original TSD

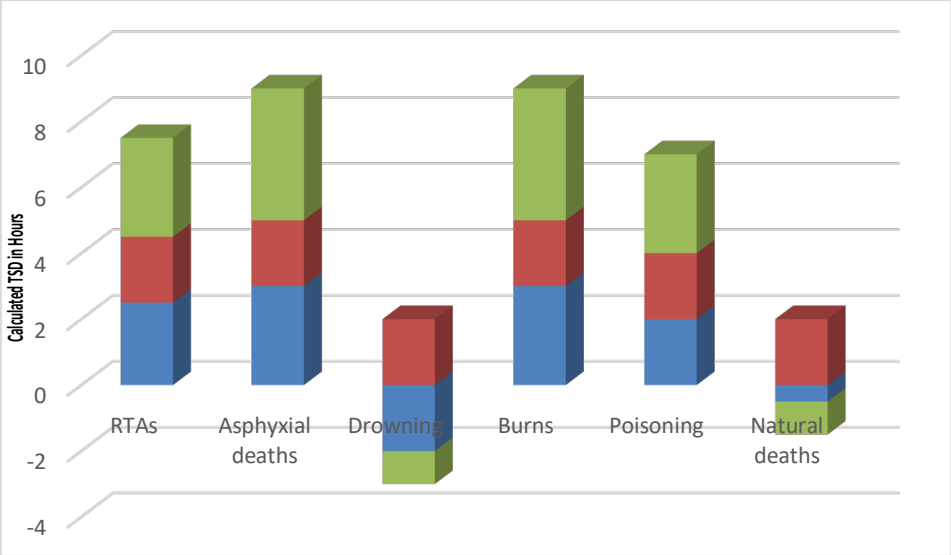

Figure 4: Calculated TSD Vs. Original TSD

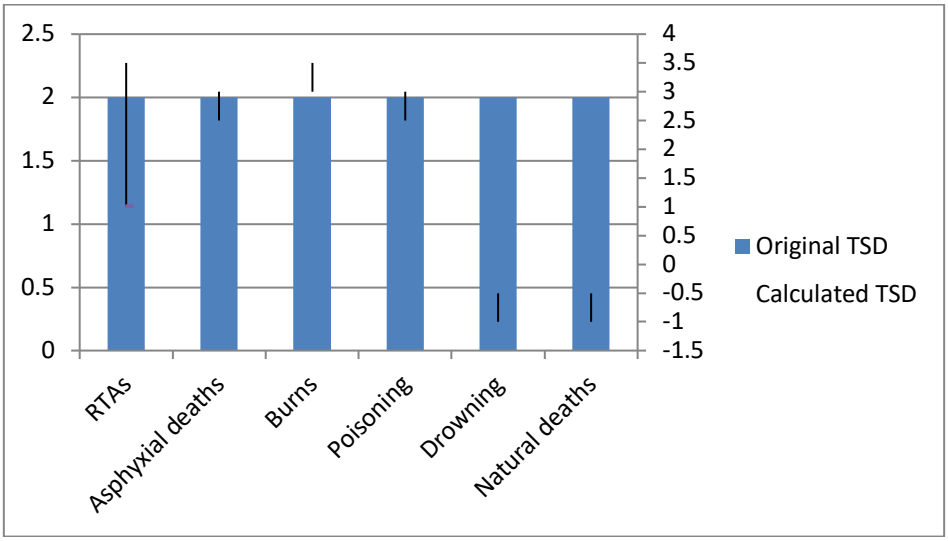

Figure 5: Calculated TSD Vs. Original TSD

Figure 6:

Figure 7:

In total 100 cases were studied (50 males and 50 females). Cases included in the study were; Road Traffic Accidents (n=60), Burns (n=10), Asphyxial deaths (n=10), Poisoning (n=10) and Natural deaths (n=10). Fig.1.

The time since death estimated by Rule of thumb method is more or less compatible with the original time since death. Table No:1, Fig.2.

The estimated time since death by Rule of thumb method and original time since death fluctuates by ± 0.5- 4hours in all the studied cases. Table No:1, Fig.2.

The over estimation of time since death in violent death cases by + 2 to 4hours is due to production of metabolic heat after death which continues for about 02-04 hours. Fig.3,4,5.

The underestimation of time since death in poisoning cases, natural death cases by -0.5 to 2 hours is due to decrease in the production of metabolic heat after death. Fig.3,4,5.

Discussion

The estimation of time since death by Rule of thumb method is an acceptable method in a human corpse by recording the rectal temperature either at the scene of offence where the body was first found dead or at the time of conducting the postmortem examination. To study the cooling patterns of the human corpses, it is ideal to choose winter season of the year, where the body temperature is always significantly high than the ambient temperature. During the process of recording rectal temperatures, the ambient temperature was almost remained more or same for the entire 3 months of study period and it was 27°C-28°C. The rectal temperatures recorded from the selected human corpses varied from 36°C-39°C. All the cases selected had died due to unnatural deaths of varied

etiology showing significant rise in body temperature at the time of death. The elevated body temperature recorded from all the corpses signifying the occurrence of post-mortem caloricity probably due to violence & exertion they faced at the time of death. On average, it took 18-20 hours for the thin built bodies to reach the ambient temperature, whereas 20-22 hours for moderately built bodies and for thick built bodies 22-24 hours[1,2].

The shape of the cooling curve of a human corpse is of great importance as it is inevitably the basis on which all post mortem temperature investigations were made. The human body cools in a manner adequately described mathematically by the double exponential formula. The cooling curve obtained from the observed data of the investigators show more or less double exponential one. It is observed that the process of cooling is retarded in its earlier stages represented by a flat portion in upper most part of the cooling curve in all observed cases, signifying the occurrence of a lag period in the earlier stages of cooling, known as "temperature plateau", determined physically by the variable period of 2-4 hours in all cases [5,6]. The duration of plateau largely depends on the original body temperature at the time of death which is considerably high in violent unnatural deaths[5,6].

The phenomenon of temperature plateau was due to delay in establishment of temperature gradients and the continuation of metabolic processes that do not cease at the moment of death but continue for a short period after clinical death, responsible for production of heat at cellular level, which maintains the plateau [5,6]. Followed by a plateau, the cooling curve shows a steeper part, having two different components of variable lengths i.e., the upper sloping part of variable length and the lower linear part of variable length. The upper sloping part of the cooling curve represents the period of quickest cooling; whereas the lower linear part corresponds to period of slowest cooling [7]. The part of the cooling curve that is of forensic use is the sloping one, which represents the period of fast cooling [7].

The cooling of a human corpse does not follow the Newton's law of cooling and it is adequately described by a double exponential formula, and the shape of the curve is a sigmoid one[7]. The initial stages of cooling reported a "lag period", known as temperature plateau for a variable length on the cooling curve; the calculated period of plateau on the curve is 2-4 hours in all observed cases. The steeper part of the cooling curve shows two different components of variable length i.e., the upper sloping and lowers more (or) less linear part[7]. The duration of the sloping part on the curve is proportional to the original body temperature at the time of death [7]. The duration of the linear part on the curve is proportional to the original body temperature at the time of death [7]. The initial rate of cooling to be 0.5° C/ hour and reaches the 1^0C/hour during the period of maximum cooling. The rate of cooling varied from 0.3–0.6°C/ hour the average being 0.5^0C / hour. With such a small rate of fall in temperature, it is not advisable to estimate the time since death, based on the cooling process of the body[8-10]. The average rate of fall in temperature thus obtained is during winter season, hence the applicability of this data to the temperature based – time estimation methods are restricted to winter season only [8-10].

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