

## Digestive Status of Stomach contents - An indicator of Time Since Death

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**Abstract:-** Meticulous autopsy not only provides information regarding cause and circumstances leading to death but also helps in estimating time since death. The inspection of gastric contents must be part of every post-mortem examination because if the time of taking last meal is known, the approximate time since death may be calculated indirectly. It has been determined through extensive research that under ordinary circumstances the stomach empties its contents 4 to 6 hours after intake of meal. Present study was conducted on randomly selected 1000 postmortem cases, out of which in 507 cases, history regarding time of last meal was available. Gastric emptying of food contents was divided in three categories- No gastric emptying, Partial gastric emptying and complete gastric emptying in relation to time interval in hours. Physical state of food contents was also studied in two stages (1) Recognizable and (2) Unrecognizable /Pulpy food in relation to time interval. Gastric emptying time ranged between 1 to more than 10 hours was recorded, and data was analysed upto 4 hours, 6 hours, 10 hours and more than 10 hours duration of last meal intake. From the present study it was concluded that estimation of time since death is possible from the state of food contents in stomach and its emptying time indirectly with the help of other parameters meant for calculation of time of death.

**Keywords:** Gastric contents , liquid , semisolid , pulpy food , Gastric emptying , Gastro stasis, Gastro paresis.

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### I. Introduction

Main objective of post-mortem examination is not only to determine cause of death but also to calculate time since death. Time since death can be calculated by using various parameters like Rigor-mortis, Postmortem lividity, cooling of body, decomposition changes, amount of urine formation and emptying of gastric contents from stomach and intestine, so this is one of the most important factors of consideration in a murder case. It may very well convict a murderer, break an alibi, or eliminate a suspect<sup>1</sup>. Estimating the time of death, especially in cases where there are no witnesses, is critical to the investigation. A definite time of death can corroborate or disprove a suspect's alibi. Identification of meals generally corroborates or negates the story of witnesses, especially in sudden death.<sup>2</sup>

Digestion is an active ante mortem process, which does not continue after death. Although acids and enzymes are present, the peristaltic movements necessary to churn food with them are absent.<sup>2</sup> The presence of food particles in the stomach and upper small intestine provides still another source of information to the doctor regarding time since death. When and what the deceased ate for his last meal is important information for the doctor who will conduct the autopsy. Various ingested food materials remain within the stomach for variable periods of time, depending on the nature and size of the meal. It has been determined through extensive research that under ordinary circumstances the stomach empties its contents 4 to 6 hours after a meal.<sup>3</sup> According to Modi, the gastric emptying varies in human being from 2 1/2 to 6 hours.<sup>3</sup> In certain cases the medical examiner will be able to determine the type of food, which still remains in the stomach, if matched with the last known meal. This can help establish a time period.<sup>4</sup> A number of contributing factors including type of food item, particles size, volume of food, types of food consumed, temperature and individual metabolism may have direct effect upon the digestion and emptying of ingested food in stomach.<sup>5</sup>

The state of digestion and transportation rate of food from the stomach into the duodenum depends on several factors, such as anatomical, physiological, pathological, psychological, agonal, kind of food, etc, which contribute to great intra- and inter individual variability of gastric emptying.<sup>6</sup> The quantity and digestive state of gastric contents is modified by the following factors:

- 1) The total quantity of food taken.
- 2) The ratio of solid to liquid in meal.
- 3) The carbohydrate, fat, protein contents of food.
- 4) Marked variation between individuals.
- 5) Variation in the same individual from day to day, psychogenic and endocrine factors.<sup>7</sup>

The emptying rate increases directly with meal weight. The stomach usually starts to empty within ten minutes after the first mouthful of food has entered. The bulk of the meal leaves the stomach within two hours. A light meal (small volume) usually leaves the stomach within 1/2 to 2 hours after being eaten, a medium-sized meal requires 3 to 4 hours and a heavy meal 4 to 6 hours.<sup>8</sup> A carbohydrate meal leaves the stomach more rapidly than a protein meal, because carbohydrates are reduced to a semi-fluid state rapidly and a protein meal leaves the stomach more rapidly than fatty meal. Fluids and semi-fluids leave the stomach very rapidly (within two hours), after being swallowed. If water is ingested with a solid meal, the water is emptied rapidly and separately and is not influenced by either the weight or total calories of the accompanying solid meal. Milk leaves rapidly, whereas meat and pulses are retained longer. Moreover Meat, green vegetables and roots cannot be recognised after four hours. Emptying of the stomach depends upon the consistency of the food, motility of stomach, osmotic pressure of stomach contents, quantity of food in duodenum, surrounding in which food was taken, emotional factors and residual variations.<sup>9</sup>

The examination of gastric contents is an essential component of Forensic Autopsy. Stomach contents only give any information as what deceased ate last and possibly when, and if any role of the contents of stomach played in causing death.<sup>10</sup>

However a head injury, physical or mental shock or stress may completely inhibit the secretion of gastric juice, the motility of the stomach and the opening of the pylorus, and undigested food may be seen after more than 24 hours. Any illness or emotional stress, may prolong the emptying time for many hours.<sup>6,19</sup> Gastroparesis is symptomatic chronic disorder characterized by delayed gastric emptying. It usually occurs to secondary disorder precipitated by primary cause like Diabetes mellitus, post surgical complications, motility disorder, gastric infection, metabolic and endocrine disorder etc.<sup>11</sup>

## **II. Aims And Objectives**

- a) To determine the approximate time of death, by examination of gastric contents of deceased's body.
- b) From state of digestion and amount of food found in the stomach to know that for how long deceased had survived after taking his last meal in relation to certain factors like whether patient was in shock, coma or suffered any intracranial content injury soon after intake of last meal.
- c) To help in criminal cases regarding excluding some putative killers who could not be able to approach the victim at that particular time and may help in giving more weight-age towards the others whose movements or activities happened to coincide with the estimated time, and in civil matters like transfer of estate of property, insurance, compensation claims may hinge upon this time of death.
- d) To identify the gastric components and determination of its relationship between deceased and specific location which not only help in estimation of post-mortem interval but can also serve to link chain of evidences which may act as a guide for reconstruction of events of crime.<sup>2</sup>

## **III. Material and Method**

The material for present study was obtained from unfortunate victims who after death were brought to mortuary at Department of Forensic Medicine & Toxicology, Govt. Medical College, Amritsar, Punjab, were randomly selected in one thousand medicolegal necropsies. Preliminary data along with detailed history of last meal intake (if any) was taken from the relatives/friends or from circumstantial evidences (as per inquest) and at what time deceased took last meal before death, and contents of last meal intake, history of any hospital record or any disease like gastric ulcer, paralytic ileus, psychogenic disturbances or emotional disturbances or head injury and coma were taken into consideration. Gastric contents were examined as regards their physical state of contents of food in form of (a) Recognized and (b) Unrecognized food and their state of digestion in form (a) Non digested b) Partially digested and (c) Completely digested and pulpy.

## **IV. Method**

Body was opened with routine midline I- Shaped incision extending from sternal notch to pubic symphysis. Abdominal muscles were cut along sub-costal margins, recti muscles divided to have maximal exposure of abdominal cavity. Stomach was separated from greater and lesser omentum and double ligature was tied at cardiac and pyloric end to prevent soiling of abdominal cavity. Stomach separated between double ligature and placed over clean tray and cut along greater curvature and contents measured in graduated container and then gastric contents were examined for their physical state and state of digestion<sup>5</sup>. For the estimation of

time since death examination of gastric contents was carried out in four time slabs of 4 hours, 6 hours, 10 hours and more than 10 hours duration.

## V. Observations

### 4.1 History of last meal intake

Out of 1000 necropsies, in 507 (50.70%) cases history regarding timing of last meal intake was available and in remaining 493(49.30%) cases it was not available. So this study was analysed in 507 postmortem cases only.

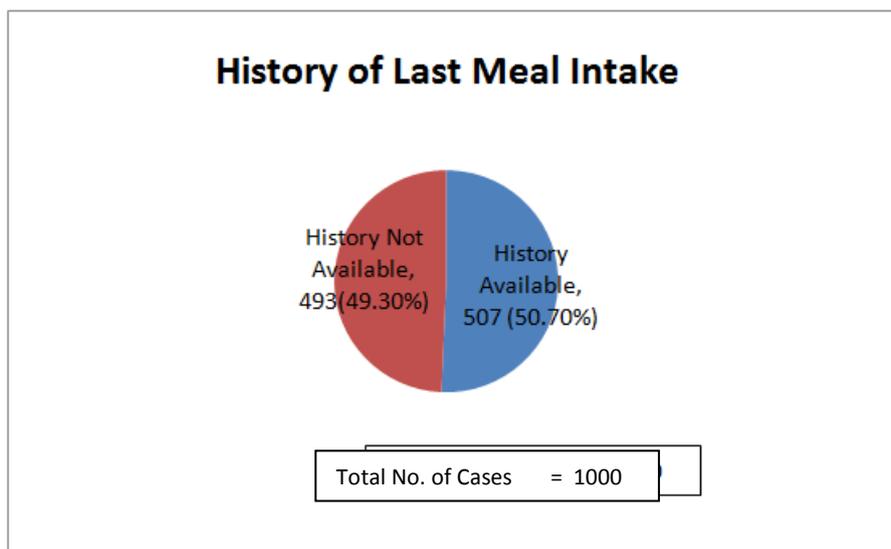


CHart no. 1 - History of last meal intake

### 4.2 Age and Sex

All cases were divided in nine groups according to their age and sex, each group constituted a decade. Out of 507 necropsies studied 79.29 % were males and 20.71 % were females. The majority of male cases 25.62 % were in age group of 21-30 years , followed by 23.13 % comprised of 31-40 years age group and 21.39% cases belonged to age group of 41-50 years. While among females 29.52% cases were reported in the age group of 21-30 years, 22.85% were studied in age group of 31 – 40 years and 14.29% in 41-50 years age group. Thus maximum cases among males were 70.14 % , females 66.67% and total in both sexes 69.43%, in the age group ranged between 21- 50 years .

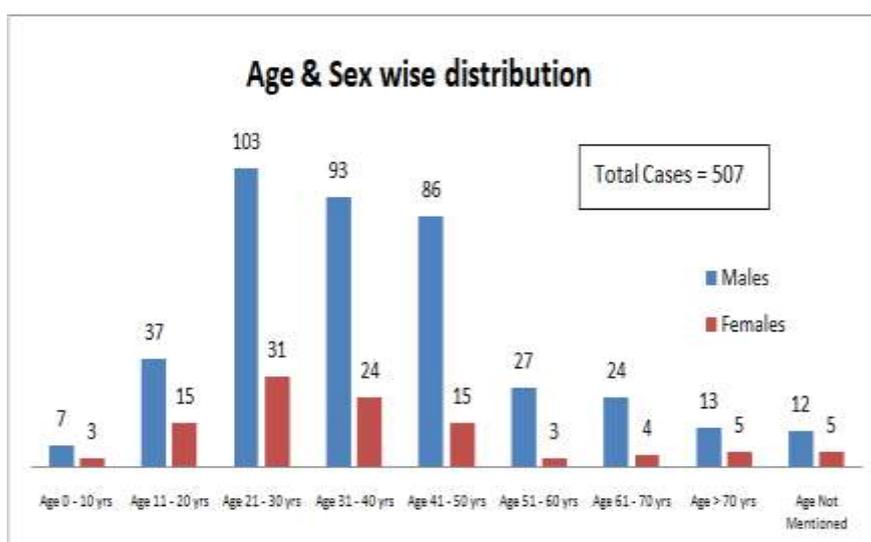
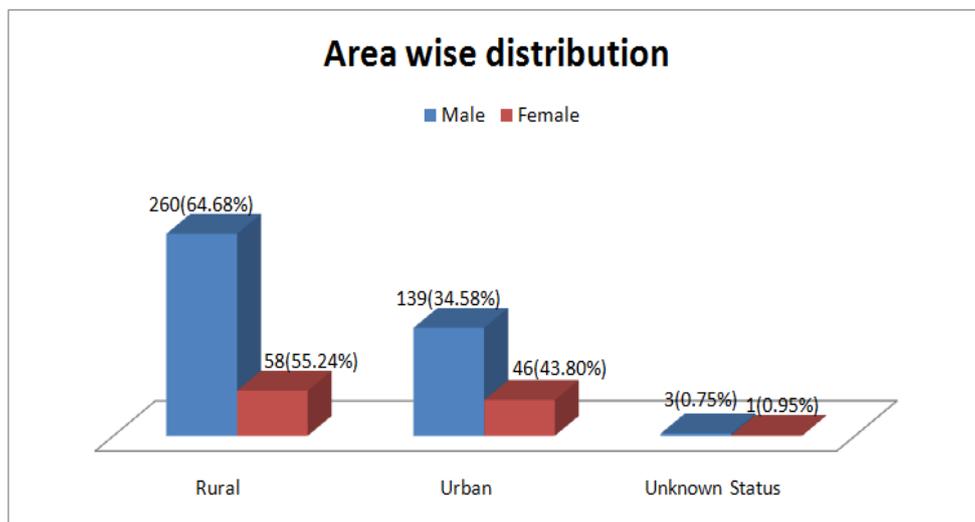


chart no. 2 - Age and Sex-wise Distribution

### 4.3 Area-wise Distribution of cases

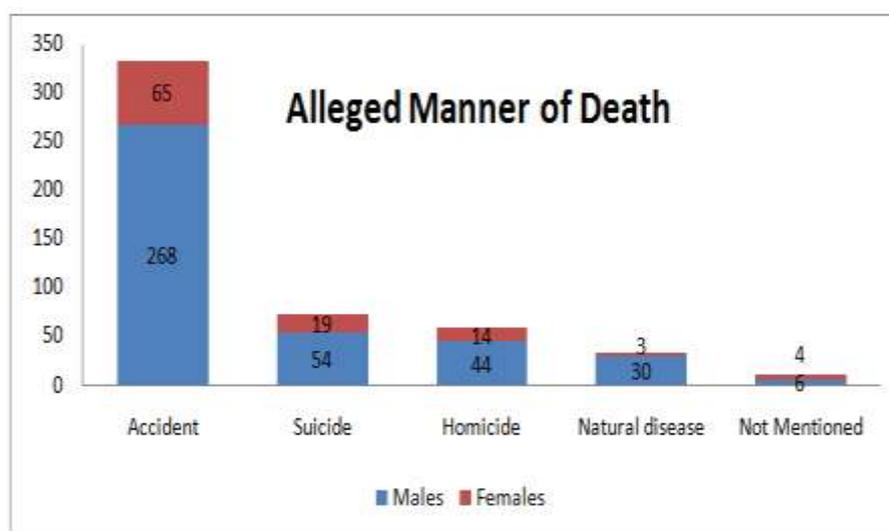
64.68% male cases hailed from rural area whereas their urban counter parts constituted 34.58 % cases and in 0.75% cases , their residential address was not known. Similarly 55.24 % female cases belonged to rural area and 43.80 % cases were from urban area and in 0.95 % cases their residential address was not known. Thus total cases from rural area were 62.72% and from urban area were 36.49%,in both sexes .



**Chart no. 3** - Showing area-wise distribution of males & females

### 4.4 Alleged manner of death

In male group, the maximum number of cases 66.67 % studied were of alleged accidents followed by 13.43 % cases of suicide and 10.94 % cases were of homicide. In 7.46 % cases the alleged manner of death was natural disease whereas in 1.49 % no alleged cause of death was mentioned in police inquest papers. Similarly in females maximum 61.90 % alleged cases reported were of accident followed by 18.09 % of suicide and 13.33% cases of homicide. 2.86 % cases comprised of natural disease process where as in 3.80 % cases, no alleged manner of death was mentioned in police inquest reports. Out of total cases , 65.68% died due to accidents while incidence of deaths due to suicide was 14.40% and homicide was 11.44%, in both sexes.

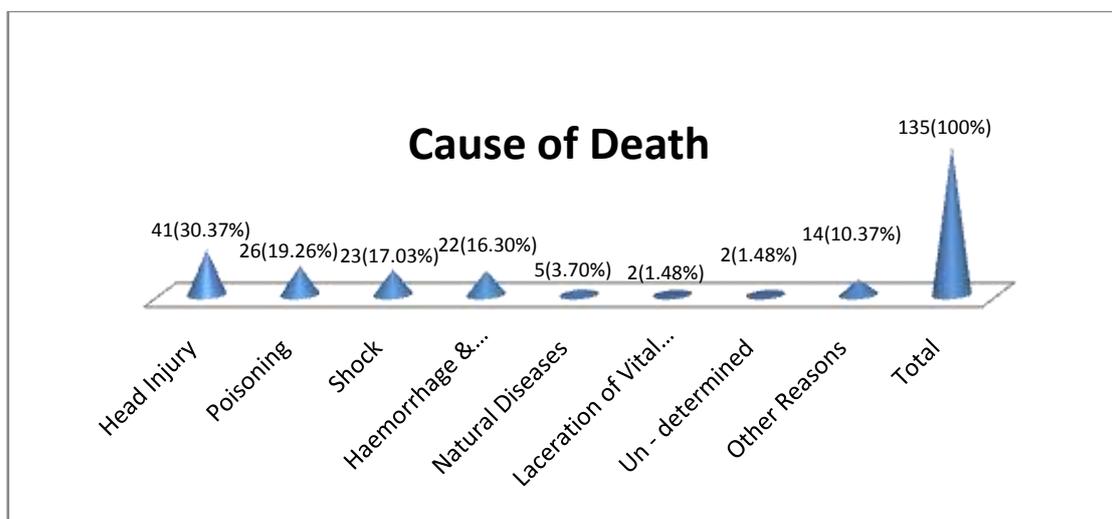


**chart no. 4** - Alleged manner of death of males and females

### 4.5 Cause of death-wise distribution of cases in which history of hospital stay was present

Out of total 507 cases in which positive history of last meal intake was available, 26.63 % were declared dead in hospital during treatment . Out of total hospital admitted cases 30.37 % have died during treatment of head injury and 19.26 % cases due to poisoning. Only shock constituted 17.03 % cases whereas haemorrhage and shock contributed 16.30 % cases .Patients which died due to other reasons like embolism, sepsis, emphysema, liver failure, multiple organ failure etc. constituted 10.37 % cases. Natural diseases were

found in 3.70% cases where history of hospitalization was present. In 1.48 % cases the cause of death was laceration of vital organs. Similarly in remaining 1.48% cases cause of death could not be ascertained. This study included these 26.63% cases of unnatural deaths which have died during treatment at hospital.

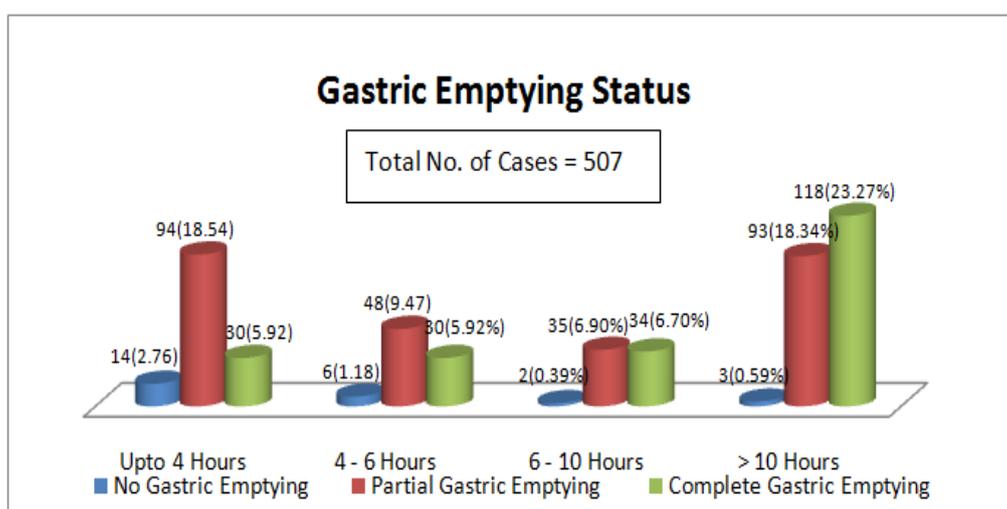


**Chart no. 5** - Cause of death-wise distribution of cases in which history of hospital stay was present

**4.6.1 Gastric emptying status in both sexes:-**

Out of 507 cases in both sexes full stomach was found in 4.93 % cases with no gastric emptying after more 10 hours duration of last meal intake. In total, partial gastric emptying was observed in 53.25 % cases, in both sexes. Out of which partial gastric emptying was found in 18.54 % cases upto 4 hour duration of last meal intake, 9.47 % cases showed partial emptying from 4-6 hours duration, in 6.90% cases from 6-10 hours duration. Partial gastric emptying was also observed in 18.34% cases after more than 10 hours duration of last meal intake.

In total, complete gastric emptying was observed in 41.81 % cases, in both sexes, out of which in 5.92 % cases , stomach was found completely empty when examined upto 4 hours duration of last meal intake, again in 5.92% cases from 4- 6 hours duration and in 6.70% cases upto 10 hours duration and in 23.27% cases after more than 10 hours duration of last meal intake .



**Chart no. 6** - Gastric emptying time in both sexes ( At different time intervals)

**4.6.2 Gastric emptying in male group**

In male group, out of 402 cases in total , 4.48 % cases were observed with no gastric emptying and stomach was full of food contents even after 10 hours of last meal intake. Partial gastric emptying was found in 53.73% cases amongst males. Out of which partial gastric emptying was observed in 37.50% cases upto 4 hours duration, in 18.98 % cases from 4- 6 hours, in 11.57% cases upto 6- 10 hours duration and in 31.95 % cases after more than 10 hours duration of last meal intake.

Complete gastric emptying was observed in 41.79% cases amongst males, out of which 11.30% cases were present with complete gastric emptying upto 4 hours duration, in 13.69% cases from 4- 6 hours duration and in 17.26% cases upto 10 hours duration and in 57.74% cases after more than 10 hours of last meal intake.

Gastric Emptying → Time interval in hours ↓	No Gastric Emptying		Partial Gastric Emptying		Complete Gastric Emptying	
	No.	%age	No.	%age	No.	%age
<b>Upto1 hour</b>	-		10	4.62	3	1.78
<b>1-2 hours</b>	3	16.66	21	9.72	5	2.97
2-3 hours	8	44.44	27	12.5	3	1.78
3-4 hours	-		23	10.64	8	4.76
4-5 hours	3	16.66	26	12.03	12	7.14
5-6 hours	-		15	6.94	11	6.54
6-7 hours	1	5.55	8	3.70	10	5.94
7-8 hours	-		4	1.85	11	6.54
8-9 hours	-		7	3.24	1	0.59
9-10 hours	-		6	2.77	7	4.16
>10 hours	3	16.67	69	31.95	97	57.74
Total cases (402)	18	4.48	216	53.73	168	41.79

**Table no. 1-** Gastric emptying time in Males ( At different intervals)

#### 4.6.3 Gastric emptying in Females

In female group out of 105 cases in total, 6.67% cases were observed with no gastric emptying and stomach was full of contents even after 10 hours of last meal intake. Partial gastric emptying was found in 51.43% cases amongst females. Out of these cases partial gastric emptying was observed in 24.07% cases upto 4 hours duration, in 37.04% cases from 4- 6 hours, in 55.56% cases from 6-10 hours duration and in 44.44% cases after more than 10 hours duration of last meal intake. Complete gastric emptying was observed in 41.90% female cases, out of which stomach was completely empty in 25.0% cases upto 4 hours duration, in 43.18% cases from 4-6 hours duration and in 54.55% cases from 6- 10 hours duration and in 47.73% cases after more than 10 hours of last meal intake.

Gastric Emptying → Time interval in hours ↓	No Gastric Emptying		Partial Gastric Emptying		Complete Gastric Emptying	
	No.	%age	No.	%age	No.	%age
<b>Upto1 hour</b>	-		-		2	4.54
<b>1-2 hours</b>	-		2	3.70	1	2.27
2-3 hours	2	28.57	6	11.11	4	9.09
3-4 hours	1	14.28	5	9.26	4	9.09
4-5 hours	3	42.86	5	9.26	2	4.55
5-6 hours	-		2	3.70	5	11.36
6-7 hours	1	14.28	1	1.85	2	4.45
7-8 hours	-		6	11.11	2	4.45
8-9 hours	-		1	1.85	1	2.27
9-10 hours	-		2	3.70	-	
>10 hours	-		24	44.44	21	47.73
Total cases (105)	7	6.67	54	51.43	44	41.90

**Table no. 2 -** Gastric emptying time in Females (At different intervals)

#### 4.6.4 Gastric emptying status after 10 or > 10 hours of consumption of last meal in a relation to different cause of death in hospitalized cases

Out of total 39 cases of head injury, 35.8% cases showed partial gastric emptying after more than 10 hour duration while in 64.2% cases complete gastric emptying was observed after more than 10 hours of last meal intake. Out of total 23 cases of shock, 43.48% cases showed partial gastric emptying after more than 10 hour duration and in 52.17% cases complete gastric emptying was observed after more than 10 hours of last meal intake. Out of total 20 cases of poisoning, 25% cases showed partial gastric emptying after more than 10 hour duration in 70% cases complete gastric emptying was observed after more than 10 hours of last meal intake. Out of total 10 cases of shock and haemorrhage, 60% cases showed partial gastric emptying after more than 10 hour duration in 40% cases complete gastric emptying was observed after more than 10 hours of last meal intake.

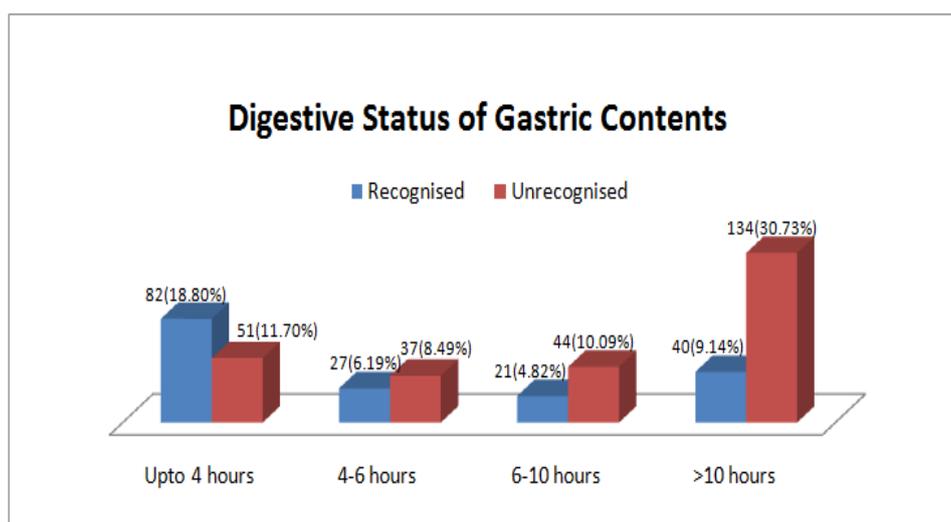
	No emptying (Full stomach)		Partial Emptying		Complete Emptying		Total	%age
	No.	%age	No.	%age	No.	%age		
Head Injury	-		14	35.8	25	64.2	39	35.78

Shock	1	4.35	10	43.48	12	52.17	23	21.01
Poisoning	1	5	5	25	14	70	20	18.35
Shock and haemorrhage			6	60	4	40	10	9.17
Natural Disease	-		1	25	3	75	4	3.67
Laceration of Vital Organ	-		1	100	-		1	0.92
Others	-		4	40	6	60	10	09.17
Undetermined	-		-		2	100	2	1.83
Total (109)	2	1.83	41	37.61	66	60.55	109	100.00

**Table no. 3** - Gastric emptying status after 10 or > 10 hours of consumption of last meal in a relation to different cause of death in hospitalized cases

**4.7.1 Digestive status in both sexes**

As far as digestive status was concerned, food contents were recognizable in 38.99% cases and unrecognizable 61.01% in both sexes. Out of 38.99% cases, food contents were recognizable in 18.80% cases upto 4 hours duration, in 6.19% cases from 4-6 hours duration, in 4.82% cases from 6-10 hours duration and in 9.14% cases after more than 10 hours duration of last meal intake. The food contents were unrecognizable in 61.01% cases, out of which food contents could not be recognized in 11.70% cases upto 4 hours duration, in 8.49% cases from 4-6 hours duration, in 10.09% cases from 6-10 hours duration and in 30.73% cases after more than 10 hours duration of last meal intake. The available trend in chart no. 7 was showing decline in percentage of recognizable form of food upto 10 hours duration with passage of time, as it was being converted from recognizable to partially recognizable and ultimately to unrecognizable and pulpy food.



**chart no.7** Digestive Status in both sexes ( At different intervals)

**4.7.2 Digestive status among males**

In 85.82% male cases food was found in stomach in both recognized and unrecognized forms. In 39.13% cases food was in the recognizable state in the form of roti, dal, rice, vegetables or milk products. Out of total 39.36% cases which represented with recognizable food contents, in 51.85% cases food was recognizable upto 4 hours of last meal intake, in 14.81% cases from 4-6 hours, in 9.63% cases from 6-10 hours and in 23.70% cases after more than 10 hours of last meal intake. Whereas unrecognizable form of food was detected in 60.87% cases. Out of 345 males food was found in unrecognizable state in 17.62% cases upto 4 hours, in 15.71% cases from 4-6 hours and in 17.14% cases from 6 to 10 hours of last meal intake. In 49.52% cases which were examined after more than 10 hours duration the food was found in unrecognizable form.

Digestive status → Time interval in hours ↓	Recognised		Unrecognised	
	No.	% age	No.	% age
Upto 1 hour	8	5.92	4	1.90
1-2 hours	20	14.81	9	4.29
2-3 hours	26	19.25	11	5.24

3-4 hours	16	11.85	13	6.19
4-5 hours	14	10.37	17	8.09
5-6 hours	6	4.44	16	7.62
6-7 hours	3	2.22	14	6.67
7-8 hours	3	2.22	9	4.29
8-9 hours	4	2.96	4	1.90
9-10 hours	3	2.22	9	4.29
>10 hours	32	23.70	104	49.52
Total (345)	135	39.13	210	60.87

**Table no. 4 - Digestive Status in males (At different intervals)**

**4.7.3 Digestive status among Females**

In 86.67% female cases food was present in stomach in both recognizable and unrecognizable form. Out of which 38.46 % cases represented with recognizable food contents. In 34.29% cases food was present in stomach in recognizable form upto 4 hours of last meal intake, in 20.0% cases from 4-6 hours, in 22.86% cases from 6-10 hours duration. In 22.86 % cases food was recognizable even after more than 10 hours duration of last meal intake. Out of 61.54 % cases in which food was found in unrecognizable or pulpy form, in 25.0 % cases food remained in unrecognizable state upto 4hours duration , in 7.14% cases from 4-6 hours duration , in 14.28 % cases upto 10 hours duration and in 53.57% cases after more than 10 hours duration of last meal intake.

Digestive status → Time interval in hours ↓	Recognised		Unrecognised	
	No.	% age	No.	% age
Upto 1 hour	1	2.85	2	3.57
1-2 hours	2	5.71	-	-
2-3 hours	6	17.14	6	10.71
3-4 hours	3	8.57	6	10.71
4-5 hours	4	11.42	2	3.57
5-6 hours	3	8.57	2	3.57
6-7 hours	2	5.71	2	3.57
7-8 hours	5	14.28	3	5.35
8-9 hours	1	2.85	1	1.78
9-10 hours	-	-	2	3.57
>10 hours	8	22.86	30	53.57
Total (91)	35	38.46	56	61.54

**Table no. 5 - Digestive Status in females ( At different intervals)**

**VI. Discussion**

The present study was a scientific effort to establish relationship between state of gastric food contents and their emptying time from stomach with estimation of time since death. So it was mainly focused on 50.71% autopsy cases randomly selected out of 1000 post-mortem cases with male dominance (79.29% ) over female ( 20.71%) and rural area cases (62.72%) over urban (36.49%) in which maximum number of cases 69.43% examined were in age group of 21-50 years , in both sexes . Manner of death were different with maximum reported cases of accidents (65.68%) followed by suicide (14.40%), homicide (11.44%) and natural disease (6.50%) respectively .This study also included hospital admitted cases in which the cause of death was head injury (30.37%), Poisoning (19.26%), shock (17.03%) and haemorrhage and shock (16.30%) etc, in the descending order. State of gastric food contents and their emptying time were analysed and compared in both sexes collectively and separately and the results were quite comparable from previous researches conducted on the dead bodies.

As per observations of this study full stomach was observed in only 4.93% cases, with no gastric emptying even after 10 hours duration of last meal intake. Partial gastric emptying was observed in 53.25 % cases in total, (male 53.73% and female 51.43% cases) after more than 10 hours duration of last meal intake. Partial gastric emptying chart no. 6 was showing declining trend after 4 , 6 and 10 hours duration indicating gradual decline in number of partial gastric emptying cases with passage of time upto 10 hours duration . Complete gastric emptying was observed in 41.81% cases in total among both sexes while it was 41.79 % cases in males and 41.90% in females after more than 10 hours duration of last meal intake. Complete gastric emptying chart no. 6 was showing ascending trend with increase in number of cases with full gastric emptying upto 10 hours duration of last meal intake, then rapid upward increase was seen in number of cases after more than 10 hours duration. In both, partial and complete gastric emptying cases were showing sharp increase in number after more than 10 hours duration. Correlation graph between complete gastric emptying and unrecognised food contents was showing synchronized parallel graph between two different parameters and there was rapid increase in number of complete gastric emptying cases corresponding to unrecognised food content cases after more than 10 hours duration of last meal intake.

In both sexes total number of partial and complete gastric emptying cases observed were 25.73% upto 4 hours duration, 16.18% cases from 4-6 hours duration, 14.32 % upto 10 hours duration and 43.78% after more than 10 hours duration of last meal intake.

Further, in this study food contents in the stomach were recognizable in 38.99% cases while these were unrecognizable in 61.01% cases, in total, before and after more than 10 hours duration of last meal intake. Out of which in 49.62% cases food contents were unrecognizable before and in 50.38% cases after more than 10 hours duration of consumption of last meal intake. As per chart no. 7 of Digestive status there was reverse trend of both of recognized and unrecognized food contents in between 4-6 hours duration and proving the fact that there was decline in number of cases with recognized food contents and increase in number of cases with unrecognized food contents of stomach, with the passage of time. Trend of Unrecognized food contents of stomach was ascending rapidly after 10 hours duration and that of recognized food contents was declining rapidly after 4 hours, 6 hours, 8 hours and 10 hours duration and indicating near completion of food digestion process.

According to **Howard**<sup>13</sup> in American journal of Forensic Medicine and Pathology, various ingested food materials remain within the stomach for variable periods of time, depending on nature and size of the meal and it has been determined through extensive research that under ordinary circumstances the stomach empties its contents 4 to 6 hours after the last meal. If the stomach is found to be filled with food and digestion of the contents not extensive, it is assumed that death followed shortly after the meal. If the stomach is entirely empty, death probably took place at least 4-6 hours after last meal. If the small intestine is also empty, the probability is that death took place at least 12 hours or more after last meal, which is correlated with present study.<sup>13</sup> This study is also comparable with study of Health Drip according to which if the stomach is full containing undigested food it can be said that death occurred within 2-4 hours of eating of last meal. However, according to **Jain AK**<sup>20</sup> normally food stays in the stomach for 2 ½ to 3 hours on a mixed diet and rate of gastric emptying depends upon (a) directly on the square root of volume of liquid meal remaining in the stomach and (b) products of protein digestion and acid in the duodenum.

In another study conducted by **Health Drip** a heavy meal leaves the stomach after 5-8 hours of intake which is also close to this study.<sup>14</sup> In another study conducted by **Viras patel and Kalpesh Shah**<sup>2</sup> etc. concluded that identifiable semi-digested food particle were found in those people who died 0-2 hours after last meal, unidentifiable semi-digested food particles were found more commonly in those people who died 2-6 hours after last meal and empty stomach was found who died more than 6 hours after last meal intake.<sup>2</sup> The results of present study are also comparable with **Reddy** which states that medium sized meal requires 3-4 hour for gastric emptying and heavy meal takes 5-8 hours<sup>6</sup>.

However according to **Pekka Saukko and Bernard Knight**<sup>15</sup> the physiological process of digestion of an average meal lasted some 2-3 hours, **Modi**<sup>4</sup> gives 2.5 to 6 hours in man. Adelson stated that stomach begins to empty within 10 minutes of swallowing, that light meal leaves the stomach by 2 hours, heavy meals takes 4-6 hours. All these values, however are subject to variations. Stomach contents which are identifiable by naked eye are usually ingested within 2 hours period. If a victims stomach contains largely undigested food material, then the death is likely to have occurred within an hour or two of the meal. If stomach is empty, the death likely occurred more than 4 hours after eating. However current study differs from **Saram's study**<sup>16</sup> as his study was controlled study of living people under fixed circumstances where as present work was random study of dead people with many variations, where even history of last meal intake and time of death were not accurately reported. So in random autopsy such comparisons are not possible as ideal conditions were deficient or lacking as compared to controlled studies.

In this study, out of total 39 cases of head injury, 35.8 % cases showed partial gastric emptying and in 64.2 % cases complete gastric emptying was observed after 10 hours of last meal intake. A head injury, physical or mental shock or stress may completely inhibit the secretions of gastric juices, the motility of stomach and pylorus opening. Undigested food may be seen even after more than 24 hours.<sup>6</sup>

**Puschel**<sup>18</sup> reported that solid stomach contents found at autopsy 10 days after scalding and 5 days after subdural haemorrhage. In present study gastric emptying has been delayed in cases of head injury, haemorrhage, shock and other pathological diseases for more than 10 hours duration which is comparable with above mentioned studies. Out of total cases of haemorrhage and shock as cause of death, 60 % cases showed partial gastric emptying whereas 40 % cases showed complete gastric emptying after 10 hours duration. Out of total cases of poisoning death in 5 % cases no gastric emptying was observed where as in 25 % cases represented partial gastric emptying and remaining 70 % cases depicted complete gastric emptying after 10 or more than 10 hours duration of last meal intake.

More than 91.52% cases of unnatural deaths who were suffering from head injury, shock, haemorrhage and shock and poisoning were included in this study and were showing delayed gastric emptying of more than 10 hours duration which is comparable to the study of **Viras patel and Kalpesh Shah**<sup>3</sup> in which

gastric emptying time were showing recognizable food contents with identifiable and no gastric emptying were observed in 29.0% after more than 6 hours duration of last meal intake .

## VII. Conclusion

From the present study it was concluded that indirect estimation of time since death can be possible from examination of gastric contents and gastric emptying but due to variability of gastric emptying in different individuals we can not exactly define time since death so other parameters like rigor mortis, post-mortem lividity, cooling of body and putrefactive changes should be taken into consideration. As this study was conducted both in natural and unnatural death cases so there were variations in the results .Separate study in both natural and unnatural death cases will be more helpful. However much more research is required in this field by adopting latest scientific methods like Scintigraphic, Ultrasonography, MRI Scan and digestive enzyme assay in relation to the kind, amount and accurate time of last food consumed with basal metabolic rate and body weight .

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