

## Role of pyloric sphincter in estimating time since death & in toxicological analysis

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### Abstract

**Background and Objects:** Estimation of time since death from rigor mortis in various parts of the body plays vital role in forensic investigations. The aim of the study was to find out the appearance of rigor mortis in pyloric sphincter and how far it influences in toxicological analysis.

**Methods:** Study was done on 60 known corpses (34 males and 26 females) during and prior to the medico legal autopsy at Tirunelveli Medical College, Tamilnadu, India. The dye was introduced into the stomach through Ryle's tube intubation and examined for presence of dye in the small intestine after various time intervals.

**Results:** Among 60 cases, dye was not found in 26 cases when the time since death was less than 12hours. The dye was noted in small intestine in 34 cases where the time since death was after 12hours.

**Interpretation:** This study clearly proves that rigor mortis of pyloric sphincter passes off by 12hours since death. When the time since death is concluded as more than 12hours, preservation of stomach and small intestine separately is of no value. Mere presence of poison in stomach and small intestine is not a confirmative evidence of ante mortem poisoning.

**Conclusion:** This study proves that rigor mortis in pyloric sphincter shows major impact in determination of cause of death and in toxicological analysis.

**Key words:** Pyloric sphincter, Rigor mortis, Time since death, Toxicology

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### Introduction

In science, variability is the rule and stability is the exception, Forensic medicine also being a part of this developmental science is still an ocean, whose ultimate depth has not been assessed and yet to be explored. The dead do not rise to say when they are dead. They also do not follow any mathematical precision in the time of appearance and progression of their changes after death. These changes that follow after death were so erratic in their appearance and progression that they have been eluding the scientists all over the world to come into their grip. The postmortem interval plays a very crucial and clinching part in the annals of the investigative machinery and the administration of justice and organ transplantation. Likewise in cases where there are no visible findings to arrive at a cause of death, the Forensic Pathologist is put to a position to squeeze his brain and juice out all the knowledge he knows in different facets of medical knowledge to arrive at an empirical opinion. The elusive nature of the findings also drags him to rely on scientific analysis to give opinion. At present, the time of death is inferred by many criteria like the changes

that occur in the body after death, biochemical and enzymatic changes that occur in body fluids after death, Forensic entomology, materials collected at scene of crime and belongings of body etc. Usually most of the autopsies are done within 24 hrs after death. Rigor mortis plays a major role in estimation of time since death practically. Rigor mortis occurs in all muscular tissue and organs.<sup>(1)</sup> Rigor mortis develops in different parts of the body in different times.

The distal opening of the stomach is the pylorus and comprises of circular muscle.<sup>(2)</sup> Pyloric sphincter acts as a barrier preventing the mixture of stomach and intestinal contents. It remains slightly tonically contracted almost all the time. It is mentioned in most of the text books that immediately after death, in ordinary circumstances, sphincters of the body relax.<sup>(3)</sup> Immediately after death, pyloric sphincter also goes into a state of primary relaxation just like any other muscle tissue. In some other textbooks, it is mentioned that normally pylorus is in the closed state. After death also, it maintains the same position, thereby preventing stomach contents entering into the small intestine. The stomach contents do not enter the duodenum after death.<sup>(4)</sup> The same status is maintained during the state of rigor mortis of pyloric sphincter. How long does the pyloric sphincter be in a state of rigor mortis? – forms one of the aim of this study.

In cases of poisoning or suspected poisoning and in cases where there is no macroscopic findings to arrive at a cause of death, Forensic Pathologists solely rely on toxicological analysis to give a final opinion regarding the cause of death. Routine viscera for toxicological

analysis are preserved by different methods in different parts of India. In Tamilnadu, a Southern state in India, practice of preserving stomach with its contents and proximal part of small intestine with its contents in separate bottles still exists. For toxicological analysis certain authors advice not to preserve stomach with its contents and proximal small intestine with its contents in a same bottle because detection of poison in the stomach and intestines will have a bearing upon the time of survival.<sup>(5)</sup> The same is being implemented in the state of Tamilnadu. Some other authors advocate preserving both stomach and proximal small intestine with contents collectively. This is being followed in other states. Is it beneficial to preserve stomach with its contents and proximal part of small intestine with its contents separately? This forms another aim of this study.

This was studied in 60 cases where time of death was documented.

### Materials and Methods

This prospective study was conducted in Tirunelveli Medical College, Tamilnadu, which is situated in the southernmost part of India covering Kanyakumari, Tirunelveli and Tuticorin districts of Tamilnadu. The prevailing climate is tropical. The changes in rigor mortis are due to climatic conditions and may vary in different regions of India as climatic conditions are different from this place of study. The population considered in the study was comprised of 60 cases autopsied in the center. In the cases the time since death was recorded. Cases with history of poisoning or suspected poisoning were excluded from the study to avoid wrong interpretation of chemical analysis results. Cases of asphyxia deaths were also excluded from the study as there is possibility of relaxation of sphincters. Ethical clearance was obtained from the Institutional Ethical review committee and the permission to conduct the study was sought from college administration office. The permission from the relatives of the deceased was obtained prior to the procedure.

During autopsy, Ryle's tube was introduced into the stomach through nostrils (Fig. 1). The approximate length of the tube to be introduced was calculated based on the distance between the bridge of nose and the angle of mandible and to the xiphoid process or in few cases the tube was inserted till the 50cms mark on the tube was reached. The entry of the Ryle's tube into the stomach cavity was confirmed by pushing air inside the Ryle's tube with a help of syringe, through the external end of the tube and simultaneous auscultation in left hypochondrium.

250ml of dye solution (ultramarine 1:10 water dilution) was introduced into the stomach through Ryle's tube by gravitation. The tube was removed after infusion and the dye was allowed to remain inside the gastrointestinal tract as such till the time of autopsy. Whether the dye has passed through the pylorus or not was noted. The esophagus, stomach and small intestine were identified and double ligated in cardiac end, pyloric end and the small intestine 20cms away from the pyloric end. They were carefully detached from their attachments and separated. Stomach & proximal small intestines were dissected out. The macroscopic evidence of dye in the stomach and/or small intestine was recorded accordingly. The possible stomach contents were aspirated out and collected in a separate clean container for preservation.

### Results

Out of 60 cases, in 26 cases, the dye was introduced and autopsy was performed within 12 hours after death. In those cases the dye was not found to cross the pylorus (Fig. 2). But in 34 cases where irrespective of the period of introduction of dye the autopsy being performed after 12 hours the dye was seen to have crossed the pylorus. The comparison of positive and negative results (Positive – Dye noted in Small Intestine, Negative - Dye not noted in Small Intestine) has been given in Table 1.

**Table 1: Comparison of Positive and Negative (Positive – Dye noted in Small Intestine, Negative - Dye not noted in Small Intestine) results**

S. No	Time since death	No of cases fall within time since death	No of Positive Cases (Dye noted in Small Intestine)	No of Negative Cases (Dye not noted in Small Intestine)
1	0-2	0	0	0
2	2-4	1	0	1
3	4-6	5	0	5
4	6-8	3	0	3
5	8-10	6	0	6
6	10-12	11	0	11
7	12-14	8	8	0
8	14-16	3	3	0
9	16-18	10	10	0
10	18-20	6	6	0
11	20-22	2	2	0
12	22-24	3	3	0

13	24-26	1	1	0
14	26-28	0	0	0
15	28-30	1	1	0



Fig. 1

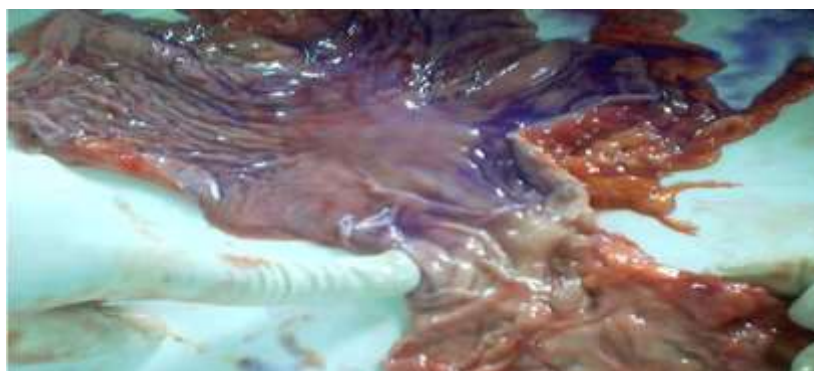
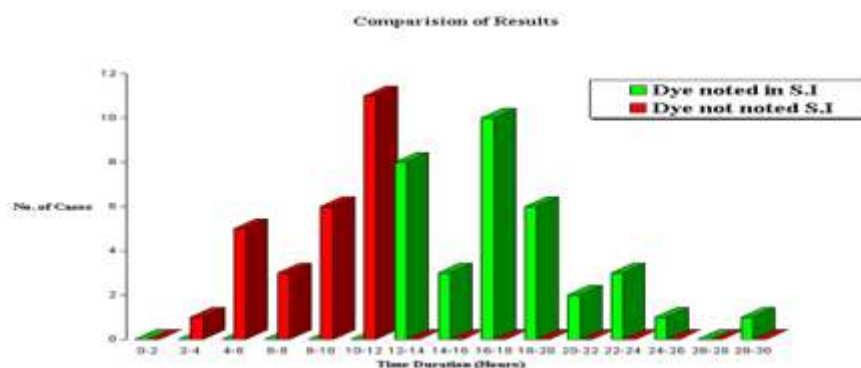


Fig. 2



S.I – Small Intestine

**Fig. 3: Diagrammatic representation of Comparison of Positive and Negative (Positive – Dye noted in Small Intestine, Negative - Dye not noted in Small Intestine) results**

### Discussion

Emptying of stomach is an ante mortem phenomenon and it depends on the type of food, osmotic pressure of the material entering into the duodenum, duodenal osmoreceptors a neural origin and the influence of gastro intestinal hormones.<sup>(6)</sup> After death, every muscle in the body both voluntary and involuntary undergo rigor mortis.<sup>(7)</sup> Rigor mortis is most likely to develop simultaneously in all the muscles and to involve

completely small masses of the muscles much more rapidly than large masses.<sup>(8)</sup> The order of onset and passing off of the rigor mortis may be determined by the quantum and kind of the muscle involved. Rigor mortis in small muscular internal organs appears quite early and disappears early. It appears in the heart usually with, in hour of death and may stay for 10 to 12 hours.<sup>(9)</sup> The pyloric sphincter is usually in a contracted state and immediately after death also maintains the same posture

unless it is made to open due to external or internal forces during the period of primary relaxation due to the muscle bulk of pylorus, which contains more contractile circular muscle fibres. During the period of rigor mortis also, it maintains the same contracted posture. So the stomach contents should not pass into the intestine during these stages. But how long this condition is maintained is very clearly seen from the results of this study.

As per our study till about 12 hours after death, stomach contents were not found to cross the pyloric sphincter. It clearly proves the forces that act on the pyloric sphincter externally and internally inside the abdomen were not sufficient to make it open up to about 12 hours after death. This means that the pyloric sphincter has offered some resistance and it can be perceived that it is due to rigor mortis of the pyloric sphincter. The diagrammatic representation of comparison of positive and negative results has been given in Fig. 3. In violent asphyxial deaths, e.g.: strangulation, hanging, there may be relaxation of sphincters and discharge of materials through them, during the terminal stage of death. The cases of asphyxia deaths were also excluded from the study as there is possibility of relaxation of sphincters. In other forms of deaths, we do not see materials found passing through sphincters at the time of death or during the stage of primary relaxation.

The routine viscera<sup>(10)</sup> we preserve during postmortem examination contains.

1. Stomach with its contents  
- Bottle No. 1
2. Proximal small intestine and its contents  
- Bottle No. 2
3. Half Kilogram of liver and Half of each kidney -  
Bottle No. 3
4. Sample of preservative  
- Bottle No. 4

But it is well documented that certain poisons are predominantly absorbed even in stomach and above. E.g. Cyanide and in some other poisons, ingestion of massive doses can cause death within a very short duration. Documented Literature being thus, the opinion of presence of poisons in stomach alone is highly debatable. So presence of poisons in stomach alone cannot be concluded that it could be a post-mortem introduction of poison.

As per our study, there is presence of stomach contents into the small intestine if autopsy is done about 12 hours after death. Some authors are of the opinion that if poison is present in the stomach and small intestine, it is ante-mortem ingestion. As their opinion is rationalized by the fact that stomach contents go into the small intestine only after gastric emptying which is the ante-mortem phenomenon. But our study throws light in this aspect that stomach content which is introduced after death is seen in the small intestine if autopsy is done about 12 hrs after death. Moreover the present study is totally based on post-mortem administration of

a dye into the stomach and visualizing its presence in the small intestine. The results clearly prove the facts.

## Conclusion

From the findings of our study, it is clear that rigor mortis of pyloric sphincter passes off about 12 hours since death in the prevailing climatic conditions of southern most part of India. Rigor mortis of pylorus indicates that the time of death within 12 hours prior to autopsy even though external rigor mortis present throughout the body. In cases where the time of death is not known and rigor mortis is present externally all over the body, preserving stomach and small intestine separately may be of no use if death had occurred more than 12 hours prior to autopsy.

The results of this study also indicate that preservation of stomach with its contents and proximal small intestine with its contents separately in a body where the actual time of death is not known is of little use unless the autopsy surgeon takes into consideration the rigormortis of pyloric sphincter into account before preserving them separately. Moreover in arriving at a cause of death toxicological analysis positive reports in stomach and small intestine are to be taken only as corroborative evidence and not a confirmative one. The other parameters like injuries etc. are to be considered to give an opinion regarding cause of death.

This study is a humble beginning where we have considered only minimal cases (60 cases) and tried to assess the time of death and find out an answer to the complex question, whether stomach with its contents and proximal small intestine with its contents are to be preserved separately or not. The results have thrown light to do further study with more complex and developed methodology.

## References

1. Bernard Knight.2004.The pathophysiology of death. In: Knight's Forensic Pathology,3<sup>rd</sup> ed. London: Edward Arnold(publishers)Ltd;61p.
2. John E. Hall, Guyton. 2013. Gastrointestinal motility. In: Textbook of Medical Physiology, A south Asian 12<sup>th</sup> edition. Amsterdam: Elsevier;447p.
3. Parikhs. 2014. Medico legal Aspects of death Investigations. In: B. V. Subramaniyam. Textbook of Medical Jurisprudence, Forensic Medicine and Toxicology, 7<sup>th</sup> ed. New Delhi: CBS Publishers and Distributors;147p.
4. Narayan Reddy K.S.2014. Postmortem changes. In: The Essentials of Forensic Medicine and Toxicology, 33<sup>rd</sup> ed. New Delhi: Jaypee brother's medical publishers (p) Ltd; 160p.
5. Krishnan Vij. 2008. Medicolegal autopsy. In: Textbook of Forensic Medicine and Toxicology Principles and Practice, 4th ed. Gurgeon, India: Elsevier;34p.
6. Kim E Barrett, et al. 2016.Gastrointestinal Motility. In: Ganong's Review of Medical Physiology, 25<sup>th</sup> ed. New Delhi: Cenveo publishers; p 499-500.
7. Gradwohl.1968. Legal Medicine, 2<sup>nd</sup> ed. Oxford, Butterworth-Heinemann publishers; 86p.

- I. Gordan, H.A. Shapiro. Diagnosis and early signs of death. In: Forensic Medicine- A Guide to Principles, 2<sup>nd</sup>ed. Edinburg, Churchill Livingstone;124p.
8. David Dolinaket al.2005.Post mortem changes. In: Forensic Pathology, 5<sup>th</sup> ed. London, Elsevier Academid Press;p532&533.
9. Apurpa Nandy.2013.Forensic Toxicology. In: Hand book of Forensic Medicine and Toxicology,1<sup>st</sup> ed. Kolkata, New Central Book Agency (P) Ltd; p 472 & 473.