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## A study of various patterns of ligature mark produced in cases of hanging brought to the mortuary, GGH, Guntur

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### Abstract

**Background:** Amongst all form of asphyxial death, hanging is most frequently encountered by forensic experts. Easy availability and presence of wide range of ligature materials at home itself makes hanging a preferred method of committing suicide over other methods. Findings over neck vary from case to case depending upon various factors like position of knot over neck, composition of ligature material, duration of suspension etc.

**Aim & Objectives:** The aim of the present study is to identify the various pattern of ligature mark produced in cases of hanging brought to the mortuary.

**Methodology:** The present prospective study was carried out in the Department of Forensic Medicine & Toxicology, Guntur Medical College & GGH Hospital, Guntur, during the period from Feb to December 2017 and includes a total of 40 cases of death due to Hanging, brought to the mortuary of the hospital for medico-legal postmortem examination.

**Results:** In the present study, Majority of cases observed were young adults in third decade i.e., 21-30 years – 20 (50%) followed by individuals in fourth decade i.e., 41-50 years – 07(17.5%). Most of the victims belong to middle and lower socio economic strata - 15(37.5%) and 25 (62.5%) respectively. In the present study most of the victims belongs to urban 28 (70%) areas than the rural areas 12 (30%). In our study chunni was the major ligature material for hanging observed in 16 (40%) cases. Postmortem findings revealed that majority of cases showed that bluish colour nails, lips and earlobes. Microscopic examination - breaking, wrinkling and compression of skin along with micro haemorrhages and inflammatory changes in sub-cutaneous tissues were notified.

**Conclusion:** The correlation of external, internal and microscopic findings leads to easy formulation of final opinion these cases. It also, to some extent helps to delineate antemortem cases of hanging with postmortem cases.

**Keywords:** Ligature mark, hanging, postmortem

### Introduction

Hanging is that form of asphyxia which is caused by suspension of the body by a ligature which encircles the neck, the constricting force being the weight of the body <sup>[1]</sup>. Sometimes, hanging is adopted as a last resort after other forms of suicide (poisoning, cut throat injury, etc.) have failed to produce the desired effect. The thought to hang one-self may come progressively or on an impulse <sup>[2]</sup>.

Hanging is one of the commonest methods of approaching case of suicidal deaths in India. Eight lakh cases of suicides have been reported all over the world in the year 2012 and 1, 34,600 suicide cases have been reported in India in the same year amongst which 41,726 (31%) were victims of hanging. Thus, hanging was found out to be second most common cause of suicidal death in India in the year 2012. The most common cause being death by pesticide intake.

The “mark of hanging” on the victim depends upon the height of suspension point, nature and composition of the ligature material used, weight of the body, duration of suspension, things which were intervene between the ligature material and skin of the neck and requires experts skill and care for the determination of cause and manner of death. Multiple rounds of ligature around the neck with two or more fixed knots calls a special care in interpretation to decide the cause and manner of death other injuries over the neck and bodily injuries could complicate the matter.

Thus, the ligature mark becomes a crucial aid in diagnosis and evaluation of the corpse. Hence, examination of ligature material and mark becomes an indispensable part of autopsy. Ligature produces a mark as a furrow or groove in the tissue which is pale initially, turns yellow or yellowish brown and becomes dry; it will be hard on touch, parchment like due to drying of slightly abraded skin. Oozing of blood and serous fluid is also occasionally observed. With progression of time, the furrow dries and becomes brownish grey. The ligature mark is more detectable in cases where the ligature is narrow and material is hard. The suspension time is directly proportional to the detectability of ligature mark. The contrast between reddish and paler bands of skin can be accentuated in a properly taken photograph. Thus, multiple pictures are taken at different times till autopsy is completed – this technique is called as “bracketing” or colour saturation [3]. Usually single line or mark is found. But, multiple marks may also be seen in cases of spiral turns, multiple turns around neck or upward displacement of material after application due to fall. In majority of cases the mark is found above thyroid cartilage between larynx and chin and will be oblique in direction. The mark is directed upwards, parallel to the line of mandible and is incomplete at the back with an ill-defined impression of the knot at the point of suspension, which is usually at mastoid process of one side. Sometimes, mark may be present on or below thyroid cartilage in case of partial hanging. The mark will be circular and oblique if a ligature is passed around the neck more than once. Inverted “V” shaped mark is found near the knot [4].

It is easy to diagnose hanging and ligature strangulation when one finds the classical features. However all features are seldom present together. The application of pressure on the neck often results in findings, which are quite variable. A proper assessment of various post-mortem findings is therefore necessary under such circumstances. Apart from the typical ligature mark, atypical ligature marks are also seen leading to lot of curiosity in the mind of autopsy surgeon during the day-to-day postmortem examination.

In the present study the authors have tried to make an attempt to study external, internal, gross features of neck correlating these findings with Histo-morphological observations in respective cases to establish the exact mode and nature of death of the individual.

#### **Objectives of the present study**

1. To compare the appearance of ligature marks with the corresponding ligature material.
2. To analyze the variations in the ligature mark in respect of the position, duration of suspension and height from ground level.

#### **Methodology**

All the cases of hanging brought to the mortuary, GGH, Guntur, are studied in detail during the post-mortem examination and the pattern of ligature mark and its extent, location, shape associated injuries and corresponding changes in subcutaneous tissue and neck structure. The findings are correlated with the ligature material brought by the police/ in situ. Any deviations from the original pattern is observed and discussed.

#### **Informed Consent**

Will be taken from the relatives of the diseased. Permission taken from institute ethical committee.

#### **Type of the study**

Prospective comparative analytical study.

#### **Duration of the study**

11 months (From February to December 2017).

#### **Inclusion criteria**

All the asphyxia deaths due to hanging brought to the mortuary, GGH, Guntur.

#### **Exclusion criteria**

- a. Deaths other than asphyxial deaths in cases of strangulation, smothering and choking.
- b. Cases of hanging brought in decomposed state.

#### **Safety precautions**

Proper precautions are taken to maintain secrecy of the identity of the deceased and to protect the reputation of the relatives of the deceased.

#### **Statistical analysis**

The collected data analysed with suitable statistical tool and to find out the significance of the results.

#### **Results**

The total numbers of autopsies conducted in mortuary at GGH, Guntur from February 2017 to December 2017 were 1410. Amongst the above 40 (2.83%) cases of asphyxial deaths due to hanging were notified. All the cases were examined with emphasis on ligature mark – gross and histopathological examination.

In the present study, Majority of cases observed were young adults in third decade i.e., 21-30 years – 20 (50%) followed by individuals in fourth decade i.e., 41-50 years – 07(17.5%).

In the present study 26 (65%) male victims and 14 (35%) female victims were found. Most of the victims belong to middle and lower socio economic strata - 15(37.5%) and 25 (62.5%) respectively. In the present study most of the victims belongs to urban 28 (70%) areas than the rural areas 12 (30%).

The present study revealed that typical hanging was observed only in 04 (10%) cases in which position of knot was found behind the neck in occiput region, while atypical hanging in which position knot present either on right or left side of neck was reported in 28 (70%) cases. In 08 (20%) cases position of knot was not found appreciable.

The ligature material was found in all the cases examined. Chundi was the most common ligature material used by victims in present study – 16 (40%), followed by nylon rope in 08 (20%) and other materials like saree, bed sheet etc., were also used (Table 2). An unusual plastic tape like material was observed in one case.

The pattern of ligature mark was present in 08 (20%) cases. A single ligature mark was found in 35 (87.5%) and multiple rows in 2(5%) cases. In present study two types of knots were found. Slip knot was found in 10 (25%) and fixed knot in 6 (15%) cases. There was no particular knot in 24 (60%) cases, where, a simple loop, encircled ligature material etc., were observed.

The ligature mark was situated above thyroid cartilage in 32 (80%) cases, at the level of thyroid cartilage in 5 (12.5%) cases and below thyroid cartilage in 3 (7.5%) cases. Complete encirclement of mark around the neck was observed in 06 (15%) cases and partial encirclement of neck in 34 (85%) cases.

**Postmortem findings**

Petechial haemorrhages (sub conjunctival haemorrhage) were seen in the 01 [2.5%] cases. Body showed post mortem lividity in the legs in 02 [5%] cases. This depends mostly on the duration of suspension of the body and nature of the ligature materials used and also the time elapsed between death and autopsy. Bluish discoloration of nails/lips/earlobes was the most common finding observed in 16 (40%) cases. Protrusion of tongue was seen in 03 [7.5%] cases. The probable reason for this phenomenon could be that the constricting force of the ligature caused upward pressure on the neck structure causing elevation of the tongue. [Table 3] Salivary stain was present in 04 [10%] cases of hanging. Saliva is often found dribbling from angle of the mouth down the chin. This is supposed to be sure sign of ante mortem hanging as secretion of saliva being a vital function, cannot occur after death. Hyoid bone fracture was not found in any such cases of hanging. In our study, majority of victims were of young age below 40 years, and the frequency of fracture of hyoid bone was found increased with age as it got ossified.

Histopathological evaluation was performed in all 40 cases. Three characteristic skin changes and three salient features of subcutaneous and soft tissues were recorded. Discontinuity of epidermal and dermal layers of skin (breaking) was noticed in 12 (30%) cases. Increased waviness of epidermal and dermal layers of skin (wrinkling) was noticed in 14 (35%) cases. There was decreased skin thickness with increased basophilia (compression) in 08(20%) cases. All the three features were notified in 06 (15%) cases. Only congestion of underlying tissues was observed in 18 (45%); hemorrhagic collection was noticed in 08 (20%); congestion of tissues and frank areas of haemorrhages were seen in 05 (12.5%) cases and congestion along with frank haemorrhages and cellular infiltrates were found in 05 (912.5%) cases.

**Table 1: Gender wise distribution**

Sex	Number	Percentage
Male	26	65%
Female	14	35%
Total	40	100%

**Table 2: Residence of the study population**

Residence	Number	Percentage
Rural	12	30%
Urban	28	70%

**Table 3: Age wise distribution**

Age	No. of. Males	No. of. Females	Total
0-10	0	01	01
11-20	03	02	05
21-30	14	06	20
31-40	00	02	02
41-50	05	02	07
51-60	03	01	04
61-70	01	00	01
71-80	00	00	00

**Table 4: Position of knot**

Occiput	Right side of Neck	Left side of Neck	Not open
04	18	10	08

**Table 5: Type of ligature materials used in Hanging**

Ligature materials	Number of cases	percentage
Chunni	16	40%
Nylon rope	08	20%
saree	04	10%
Jute rope	04	10%
Bed sheet	02	05%
Electric wire	01	2.5%
Nawar cloth	02	5%
Nawar plastic	02	5%
Plastic tape met	01	2.5%

**Table 5: Postmortem examination findings**

Findings	Number of cases	%
Sub-conjunctival Haemorrhage	02	5%
Protrusion of tongue	03	7.5%
Salivary stain	04	10%
Ear/Nose/ Mouth bleed	05	12.5%
Bluish discoloration of nails/lips/ear lobes	16	40%
Post mortem lividity over lower limbs	02	05%
Semen ejaculation	04	10%
Fecal matter passed off	02	5%
Feet plantar fixed	01	2.5%
Petechial Haemorrhage over scalps	01	2.5%
Total	40	100%

**Table 6: Microscopic changes in Hanging**

Sl.no	Microscopic detail	No. of cases (N = 40)	Percentage (%)
<b>Skin changes</b>			
1.	Breaking	12	30%
2.	Wrinkling	14	35%
3.	Compression	08	20%
4.	All the three	06	15%
<b>Internal neck structures</b>			
1.	Congestion	18	45%
2.	Hemorrhage	08	20%
3.	Congestion+ Hemorrhage	05	12.5%
4.	Congestion+ Hemorrhage+ Cellular infiltration	05	12.5%
5.	None of the above	04	10%

## Discussion

The present prospective study was carried out in the Department of Forensic Medicine & Toxicology, Guntur Medical College & Guntur General Hospital, Guntur (A.P.) during the period from Feb 2017 to 31st May 2017. It has been compared with other similar studies carried out in different parts of the world to bring out the similarities and differences.

The ligature mark in hanging needs detailed and extensive examination. Inspection, palpation and internal examination followed by histopathological examination have to be carried out in an orderly manner. The nature and texture of ligature material, type of hanging (complete / partial) also plays a vital role in correlating the findings in respective cases. In majority of cases partial examination or missing of some trivial but important findings leads to derivation of wrong and inconclusive evidences which in turn leads to confusion<sup>[5]</sup>.

In present study 40 cases are hanging (13.3%) % out of 300 cases of post mortem were recorded in a period of four months (Feb to May 2017). The above statement clearly depicts that, the number of cases of hanging are increasing and there is a definite need for formulation of necessary steps to control this social evil.

In the present study Majority of deaths due to hanging were males [67.5%] with male: female ratio 2:1. These studies were accordance with the previous studies by other authors Manoj K Baishya *et al.*<sup>[6]</sup> K.M. Pathak *et al.*<sup>[7]</sup> and differ from SH Bhosle *et al.*<sup>[8]</sup>

The highest number of cases of death due to hanging in males were in the age group of 21-30 years [50%]. Similar to study conducted by S.H. Bhosle *et al.*<sup>[8]</sup> G.K. Bharath *et al.*<sup>[9]</sup> and differ from study conducted by N. Vijaykumari<sup>[10]</sup>

The incidence of hanging was found to be more common in married individuals, 40% of males and 20% of females were married individuals. Similar findings were observed in study done by Saisudheer and Nagaraja<sup>[11]</sup>.

Middle and lower income group is hardly hit in the society. Thus, 45% of cases belong to middle socioeconomic strata and 43% of cases were from lower socioeconomic strata. The observations correlated with the findings of Saisudheer and Nagaraja<sup>[11]</sup>. Family related issues, financial derailments and other miscellaneous reasons play a pivotal role leading to psychological breakdown and increased suicidal tendencies in the pupils of middle and lower socioeconomic strata.

Highest numbers of victims were from urban region i.e., 70%, while 30.5% were from rural area. Similar findings were observed by Manoj K Baishya *et al.*<sup>[6]</sup> and differ from author Tripude B.*et al.*<sup>[12]</sup> and Samantha AK *et al.*<sup>[13]</sup>

In the present study, the common ligature materials used in hanging was chunni. In all the studies done by various researchers, cloth material – chunni was found to be the commonest ligature material followed by nylon rope and saree<sup>[3, 4]</sup>.

Numerous facts can be established by examining ligature material. It produces a particular pattern over the skin and the characteristics of the mark broadly depend on material used. As per the above tabular column, common household material is being used for hanging in majority of individuals. Thus, it depicts that in majority of cases the decision of committing suicide by hanging is an unplanned one under extreme psychological disturbances. In particular period of

time whatever material was available it has been used by the victims.

In present study maximum number of 32 cases (80%) showed ligature mark above thyroid cartilage which was also observed by Saisudheer and Nagaraja (88%) & Sharma *et al.*<sup>[11, 4]</sup>. In hanging the ligature mark was normally situated higher in the neck above laryngeal prominence. The position of mark in hanging depends on the way – the device was fixed and the suspension point<sup>[14]</sup>. According to Reddy KSN, the mark of hanging is situated above the level of thyroid cartilage in between larynx and chin in 80%, at the level of thyroid cartilage in 15% and below the level of thyroid cartilage in about 5% cases, that too in case of partial hanging<sup>[15]</sup>. All the above facts are correlating with the observations in present study.

In present study position of the knot in a majority of cases was found present in right and left side of neck 45% and 25% respectively [atypical hanging]. Similar findings were observed by Manoj K Baishya *et al.*<sup>[6]</sup> and differ from Mishra P.K. *et al.*<sup>[15]</sup>.

In present study, incidence of fracture of hyoid bone was observed in only one case (1.20%). In other studies also the percentage of cases showing hyoid bone fracture was very less. In a study conducted by Tripude B.H. *et al.*,<sup>[16]</sup> there was increased incidence of hyoid bone fracture.

In the present study, found that majority of the cases were showed 16 (40%) bluish colour of nails, lips and ear lobes. Salivary stain was observed in 4 (10%) cases. These studies were correlated with previous findings of Mohammed M. Sheikh *et al.*<sup>[17]</sup> observed in 38.37% cases. Our findings are not consistent with Modi.

## Conclusion

The present study tries to emphasize that, the ligature mark needs to be evaluated along with other external features, internal findings and histopathological features. Thus, if this procedure of linking all the findings is followed as a routine practice in cases of death due to hanging the formulation of final opinion in doubtful cases also will become easy. This in turn helps to distinguish ante mortem ligature mark with post mortem ligature mark and to establishing the cause and mode of death. Hence, a perfect pathway can be made out to derive appropriate means in the administration of justice.

In future prospective study can be conducted including psychological autopsy for extended in depth study which can be helpful for the society and aiming towards reducing such untimely and unfortunate incidences.

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## Conflict of Interest

The authors declare that they have no conflict of interest.

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