



**An autopsy-based study of ligature mark due to neck compression**

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**Abstract**

Asphyxial fatalities caused by hanging and ligature strangulation are constricting in nature, with the former virtually invariably suicidal and the latter nearly usually homicidal, posing a challenge to medicolegal experts, particularly in situations involving dubious circumstantial evidence. In hanging and ligature strangulation, the ligature mark serves a diagnostic significance in determining the manner and cause of death. Hospital Based Descriptive Observational Study was conducted in Medico-Legal autopsies conducted for deaths due to compression of neck at S.M.S. Medical College Jaipur, during period 1<sup>st</sup> Aug. 2020 to 31<sup>st</sup> July 2021 for ligature mark study. Youth were predominant age group deaths

due to Hanging. Majority of victims were married, male, Hindu. Chunnis, saree and plastic rope are commonest ligature material used by Hanging death subjects. All cases of ligature strangulation ligature are singly present, transverse, U-shape with grooving. muscle hematoma in underlying neck tissue.

**Keywords:** Asphyxia, Autopsy, Compression of neck, Ligature mark, Hanging, Strangulation.

**Introduction**

Death is universal truth for all creatures in this world, but the human creature, who can take their own lives before maturity by committing suicide by means of poison, hanging, self-injury etc. Hanging is one of the most common methods of suicide.[1] Hanging is a form of

ligature strangulation in which the force applied to the neck is derived from the gravitational drag of the weight of the body or part of the body.[2] Virtually all hangings are suicidal. Accidental hangings are uncommon and homicidal hangings are very rare.[3]

Ligature strangulation (termed as strangulation in common use) is that form of death which is caused by means of a ligature round the neck and the constricting force being anything other than the weight of the body. [4]

Although, characteristic ligature mark of typical hanging is well described in text, yet challenges exist as most cases results due to atypical hanging. Moreover, cases of partial hanging simulate findings of strangulation, which again raises suspicion in such deaths. So, Death by hanging is a questionable situation and it is a demand by courts/investigating officer that whether the ligature mark is created by hanging or strangulation. Although many times autopsy surgeon also has to face difficulty to identify between hanging and strangulation.

The pattern of ligature mark is quite variable across variety of cases due to variations of circumstances, varying mechanical force, position of the body at the time of hanging, ligature material, weight of dead body and position of knot. Ligature mark plays diagnostic role in an establishment of manner and cause of death in hanging and ligature strangulation. Pattern of ligature mark and its manifestations differentiate deaths due to hanging, where body weight is the constricting force from other asphyxia deaths resulting from compression of neck. This study, is thus being undertaken to observe the pattern of ligature mark in established death cases of hanging and ligature strangulation brought for post-mortem examination to SMS Hospital Jaipur.

## Material and methods

Hospital Based Descriptive Observational Study was conducted in Medico-Legal autopsies conducted for deaths due to compression of neck at Mortuary, S.M.S. Medical College Jaipur, during 1 year period (1<sup>st</sup> Aug. 2020 to 31<sup>st</sup> July 2021). The study was initiated after seeking permission from review research board and institutional ethical committee. After data collection, all relevant details entered in Microsoft excel data sheet. The data compiled on Microsoft Excel into SPSS. Categorical data was expressed as means and standard deviation. Non-categorical data expressed as percentages and proportions. The derived results were tested for significance using chi square test and other appropriate statistical tests for significance. P value less than 0.005 were considered as statistically significant.

## Results & discussion

A Total of 4096 autopsies were conducted in the Mortuary of S.M.S. Hospital, Department of Forensic Medicine & Toxicology, Jaipur during study period of 1<sup>st</sup> August 2020 to 31<sup>st</sup> July 2021. After inclusion and exclusion criteria 100 cases (2.47% of total) were selected for study. 97% cases of death due to compression of neck by ligature were hanging while 3% cases were ligature strangulation.

Most vulnerable group is found among 20-29 years (42%) of age group which is similar to the previous studies conducted by Momin SG et al [5], Sheikh et al [6] and Joshi et al [7]. This observation is quite obvious as majority of un-natural deaths are reported in young adults because of their active participation in day-to-day activities, family problems, unemployment, poverty and stressful events, uneventful love life, burden of studies and marital disharmony, making them more vulnerable to all type of un-natural episodes resulting in fatalities.

Males were almost twice the number of females accounting to deaths, it is quite obvious fact, male being active member of our society. Similar findings were observed by Sheikh et al [6] and Jani et al [8]. Contrast findings were studied by M Ahmad, et al [9] in which only 40% of total study population is of male sex.

69% married and 31% unmarried cases are observed. It concludes that married couples are more prone to hang themselves. Similar findings were observed by Kumar V et al [10], Nagaraju V et al [11], Chikhalkar BG et al [12] and Behera A et al [13]. Predominant victims were Hindu (91 %), because Hindu population is more in western region of India. Gouda N et al [14] and Khajuria B [15] were noticed similarly. Most of the victims are from upper lower status (69%); lower middle-class victims occupied 17% of deaths and high-income group people are found in 3% of death. Similar findings were observed in the studies conducted by Nagendra Gouda M. [14]

Maximum deaths occurring in urban areas (72%) outnumbered the rural area (28%). This may not represent the magnitude of entire unnatural deaths occurring in those areas. Similar findings were conducted by B. S. Chavan, et al. [16] People living in nuclear families (41%) outnumbered those in Joint (59%). Similar findings were observed in the studies conducted by MR Nagendra Gouda.[14] 91% deaths occurred at home in closed place where outside home deaths occurred in 9% cases. Closed space chosen for increasing possibility of death in victims. 79% victims brought dead to hospitals and 21% undergone for treatment, later declared dead in hospital. Because majority of subjects, may be were taking their lives without discussing anyone, so it is too late for others to save their lives.

Most common ligature material is chunni 40% cases used, followed by saree (22%) and least common ligature

material used were cable wire, electric wire, metallic chain, sacred thread, shawl, shirt. Consistent findings were noticed by Momin SG et al [5] and Sharma BR et al [17] who also found chunni as commonest ligature material.

Maximum number of the persons in the study population are choosing ceiling fan (77%) as point of suspension followed by ceiling rod, open tree, ceiling fan hook, door hook, wall hook, kitchen exhaust fan, stair railing, machine, pipe, tin-shed hanger. Complete hanging is taking lives mostly, which accounted for 83%, while partial hanging cases account for 17 % cases. Ahmad M et al <sup>[18]</sup>, Sai Sudheer T et al [19] were also observed similarly.

Recent failure of love claimed majority of lives; followed by Marriage failure, poverty and Job Failure, Family dispute, Exam, Family torture, Loan, Bankruptcy and property disputes. Least cause of recent failure incidences was Betrayed, Property loss, Unemployment, Chronic Disease (like silicosis).

Number of ligatures is found as single in 97% (62% male, 35% female) cases, while in 3% cases multiple ligatures was found. Similar observation was found by Momonchand et al [20] (96%). All three (100%) cases of ligature strangulation show single ligature mark. 45% cases having continuous ligature mark, while 55% cases containing interrupted ligature mark. Similar findings were observed in the studies conducted by M.I. Sheikh et al [6].

In every case of hanging the direction of ligature mark is oblique. It is significant with p value <0.001. Similar findings observed in the study done by Momin SG et al [5] and Naik SK et al [21]. Typical hangings are seen in 40 cases and atypical hangings are seen in 60 cases. Similar findings were observed in the studies conducted

by Sharma BR et al [17].

Ligature mark was situated above the level of thyroid cartilage in 90% cases. In case of ligature strangulation, ligature mark was above Thyroid Cartilage in 2 cases and in 1 case it was below Thyroid Cartilage. Level of ligature above thyroid cartilage is predominant and significant in hanging cases. It concludes that in maximum number of cases ligature mark situated above the thyroid cartilage in our study, which is similar with observation of Momin SG et al [5] and Naik SK [21] study. 97% account for V-Shaped ligature at knot and in 3% cases account for U-shaped ligature at the knot. It is significant with hanging where V-shaped is unique and in ligature strangulation U-shape at knot is more prevalent. Most of cases showed parchmentization over ligature mark. This is due to dryness of skin under ligature, has parchment like consistency.

59% cases showing grooving and 41% does not having grooving over ligature mark. It is quite seen in thin ligature material and long-time suspension bodies where ligature produce groove in the skin under the ligature mark. 8 cases were observed le-facie-sympathique in deaths due to hanging. It is showing that le-facie-sympathique is more predominant in hanging deaths due to compression of sympathetic ganglion. Dribbling of salivary stains present over the angle of mouth is considered as an important and surest sign of ante-mortem hanging. Dried salivary stains over the angle of mouth were observed in most of the cases. No saliva stain was observed in ligature strangulation cases.

Cervical vertebrae and hyoid bone fracture was found fractured in few cases (3%), of hanging deaths. One case was reported fracture in ligature strangulation case. The reason being the fracture increases with age, high level of ligature mark on the neck, increased duration of

suspension and with a thin hard ligature material. Similar findings were observed in the studies conducted by Green H et al [22], Feign G [23], while contrast findings were observed by Sharma BR [17]. Out of 3 cases of ligature strangulation, 1 case was reported with fracture of thyroid cartilage in deaths due to compression over neck; while rest of the 2 cases did not show any fracture of thyroid cartilages. Similar findings were observed in the studies conducted by Momonchand et al [20], Feign G [23] Few cases were reported with feet trauma, and hematoma underlying muscle and petechial haemorrhages in larynx.

### Conclusion

Youth were predominant age group deaths due to Hanging. Majority of victims were married, male, Hindu. The ligature is single, oblique, level is above thyroid cartilage, position of knot is posterior, V-shape pattern, grooved, parchment like, continuous and interrupted in most of the hanging cases. few cases were noted with cervical vertebrae and hyoid bone fracture. Chunni, saree and plastic rope are commonest ligature material used by Hanging death subjects. All cases of ligature strangulation ligature are singly present, transverse, U-shape with grooving. muscle hematoma in underlying neck tissue. petechial haemorrhages in larynx, intimal tear in the carotid artery. The prominent characteristic feature of asphyxia deaths is congestion of face and La-facies-sympathique.

A careful analysis of the ligature mark at autopsy can provide vital information that can aid in the diagnosis of deaths caused by hanging and ligature strangling. Though the existence of a discontinuity along the ligature mark strongly suggests hanging, its absence does neither rule out hanging or rule out strangulation. In circumstances where there is doubt, the final decision will be based on

circumstantial evidence, crime scene investigation, and autopsy findings.

### References

1. Ballur MS, Nagraj BM. Analytical Study of Deaths Due to Hanging Cases Reported at Dr. B.R. Ambedkar Medical College Mortuary During 2010-2012. P1.
2. Saukko P, Knight B, Knights Forensic Pathology. 4<sup>th</sup>ed. Florida, USA: CRC Press;2015. p 386.
3. Dimairo VJ, Dimiao D. Forensic Pathology. 2<sup>nd</sup>ed. Florida, USA: CRC Press; 2001. Jun 28. p264-73.
4. Agrawal A Textbook of Forensic Medicine and Toxicology, Himachal Pradesh, India: Avichal Publishing Company; 2014 pp. 367, 376.
5. Momin SG, Mangal HM, Kyada HC, Vijapura MT, Bhuva SD. Pattern of ligature mark in cases of compressed neck in Rajkot Region: A Prospective Study. J Indian Acad Forensic Med. 2012 Jan-March; 34(1): p40-3.
6. Sheikh MI, Agarwal SS. Medico-legal implications of hyoid bone fracture- a study paper. Journal of Indian Academy of Forensic Medicine 2001.23(4). p 61-3.
7. Joshi Rajeev, Chanana Ashok, Rai Hakumal. Incidence and Medico-legal importance of Autopsy study of fracture of Neck structure in hanging and strangulation. Medico legal update (2007), volume 7(4). p 105-9.
8. Jani CB, Gupta BD. An autopsy study of parameter influencing injury to osteo-cartilaginous structures of neck in hanging. International Journal of Medical Toxicology and Legal Medicine (2002). Volume No. 5(1). p 4 – 7.
9. M Ahmad, MZ Hossain. Hanging as a Method of Suicide: Retrospective Analysis of Post-mortem Cases. JAFMC Bangladesh. December 2010;6(2): p37-9.
10. Kumar V, Roy P, Kumar G, Saha S. Study of Cases of Hanging and Strangulation by Ligature with Special Reference to Morphological Changes in Lungs, Thyroid and Adrenal Glands. Indian J Forensic Med. & Toxi.; 2017 Jan-Jun: 11(1).
11. Nagaraju KV, Kowsil GL. An Analytical Study of Death due to Hanging. Indian J Forensic Med. & Toxi.; 2019 Jul-Sept.; 13(3): p 38-42.
12. BG Chikhalkar, PB Waghmare, AS Thote. A case series on suicide by hanging: a prospective study conducted in Mumbai region. Int J Health Res Medico Leg Prae; 2021 Jan-Jun; 7(1): p32-6.
13. Behera A, Balaban tray JK, Nayak SR. Review of Suicidal Cases, A retrospective study. JIAFM 2005; (2): p100-2.
14. Nagendra Gouda M, Rao SM. Factors Related to Attempted Suicide in Davangere. Indian J Community Med. 2008 Jan;33(1): p15–8.
15. Khajuria B, Sharma R, Bharti O C, Kumar D. Profile of Suicidal Autopsies in a Militancy-Affected State of India. Journal of Clinical and Diagnostic Research.2007 December;1(6): p505-10.
16. Chavan BS, Singh GP, Kaur J, Kochhar R. Psychological autopsy of 101 suicide cases from north western region of India. Indian J Psychiatry. 2008 Jan;50(1): p34-8.
17. Sharma N, Shrivastava, Vyas PC. A Study of Morphology and Histopathology of Ligature Marks in Asphyxial Deaths by Compression of Neck in Jodhpur Region, Rajasthan. J Med Science Clinical R; 2018 June; 6(6): p 923-9
18. Ahmad M, Hossain MJ. Hanging as a Method of Suicide: Retrospective Analysis of Post-mortem Cases. JAFMC Bangladesh. December 2010;6(2): p37-9.
19. Sai Sudheer T, Nagaraja TV. A study of ligature mark in cases of hanging deaths. Int J Pharm Biomed

Sci.2012;3(3): p80-4.

20. Momonchand A, Meera devi T. H. and Fimate L. Violent asphyxia death in Imphal. Journal of Forensic Medicine and Toxicology (1998). Volume 15(1). p 60-4.

21. Naik S K. Obliquity vs. discontinuity of ligature mark in diagnosis of hanging – A comparative study. Anil Agarwal internet journal of forensic medicine and toxicology 2006.volume 7(1). Jan-June.

22. Green H, James RA, Gilbert JD, Byard RW. Fractures of the hyoid bone and laryngeal cartilages in suicidal hanging. J Clin Forensic Med. 2000 Sep;7(3): p123- 6.

23. Feign G. Frequency of neck organ fractures in hanging. Am J Foren Med Path. 1999; 20(2): p128-30.