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Original Research Article

Morphological and Histopathological Changes in the Structure of the Neck in Cases of Hanging: A Comprehensive Review

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Abstract

Background: Hanging is a leading mode of suicide in India. While diagnosis is usually aided by a well-defined ligature mark, cases of partial hanging or faint marks make reliance on external findings alone difficult. Examination of internal neck structures and histopathology can provide vital supportive evidence. **Aim:** To assess the socio-demographic profile and gross as well as histopathological changes in the neck structures of deaths due to hanging. **Materials and Methods:** An observational cross-sectional study was conducted in the Department of Forensic Medicine, Rajiv Gandhi Medical College, Thane, from January 2021 to June 2022. Out of 1247 autopsies, 115 cases of hanging were included. Detailed demographic data were obtained, and bloodless neck dissection for clarity was performed. Tissue samples from skin, subcutaneous tissue, muscles, and carotid arteries were examined grossly and histologically using H&E stain. **Results:** Most cases were males (67.8%), with a male-to-female ratio of 2:1, predominantly in the 21–30 year age group (39.2%). Complete hanging (80.9%) was more common than partial hanging (19.1%). Gross soft tissue injuries were seen in 62.6% of cases, while histopathological changes were observed in 89.6%. Carotid intimal tears were noted grossly in 12.2% but histologically in 68.7% of cases. **Conclusion:** Histopathology consistently demonstrated ante-mortem changes in the examined neck structures, thereby reinforcing its importance in forensic practice. These findings support its role as an essential adjunct to gross examination, as it provides reliable microscopic evidence that strengthens the medico-legal opinion, particularly in cases where the external or gross findings are doubtful or inconclusive.

1. 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.¹ Hanging is one of

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the most common forms of suicide in India. According to a survey by National Crime Records Bureau in 2023, suicide by 'Hanging' (58.2%) followed by consuming 'Poison' (25.4%) were the prominent means of committing suicides.² Various structures are damaged in death due hanging which include the soft tissues like skin, subcutaneous tissue, neck muscles, blood vessels and the bony and cartilaginous tissues like the hyoid bone, thyroid cartilages and larynx.³⁻⁶ In cases of suspected hanging, the post-mortem examination is not limited to the identification of the external ligature mark alone. When the classical mark is absent or poorly defined, additional parameters become critical for diagnosis. A systematic bloodless neck dissection of the neck structures helps in detecting deep tissue injuries that may not be apparent externally. Complementing this, histopathological examination of skin and soft tissues from the site of suspected compression can reveal evidence of vital reaction, which continues to be considered the benchmark in establishing ante-mortem injury.

The present study was done to examine both the external and internal changes in the neck structures in cases of hanging. In most cases, the ligature mark is clearly seen and helps in confirming the diagnosis. However, in some situations, such as partial hanging or when the ligature mark is faint, it becomes difficult to rely only on external findings. In such cases, looking at the tissues of the neck under the microscope can give useful information. Histopathology can show changes that prove the injury happened before death and can support the diagnosis of hanging. By studying both the gross appearance and the microscopic findings, this research aims to make the cause of death more certain, especially in cases where the external signs are unclear.

2. Aims and Objectives:

The aim of the present study was to evaluate the socio-demographic, gross morphological, and histopathological profile of neck structures, including the skin, subcutaneous tissue, neck muscles, and carotid arteries, in cases of death due to hanging. The objectives were to analyze the socio-demographic characteristics of the deceased, to document the gross and microscopic morphological changes in the neck structures and to assess the histopathological alterations in tissues at the ligature site,

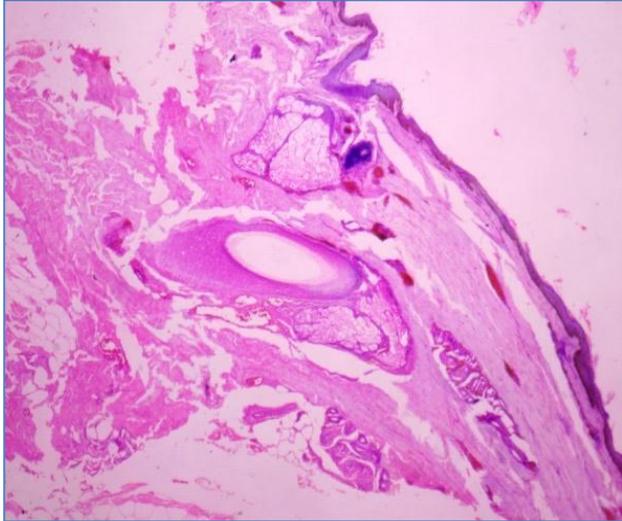
3. Materials and Methods:

This observational cross-sectional study was conducted in the Department of Forensic Medicine at a tertiary healthcare center between January 2021 and June 2022. The study population comprised all cases of hanging deaths brought for medico-legal autopsy during the study period. A total enumeration method was employed, yielding 115 cases of hanging deaths out of 1247 autopsies. Decomposed and burned bodies, as well as cases of alleged fatal neck compression due to causes other than hanging, were excluded. Detailed information on the demographic profile of the deceased, circumstances of death, type of ligature material, and classification as complete or partial hanging was obtained from inquest reports and relatives. In certain cases, supplementary information was collected through visits to the scene of occurrence or from photographs taken at the scene.

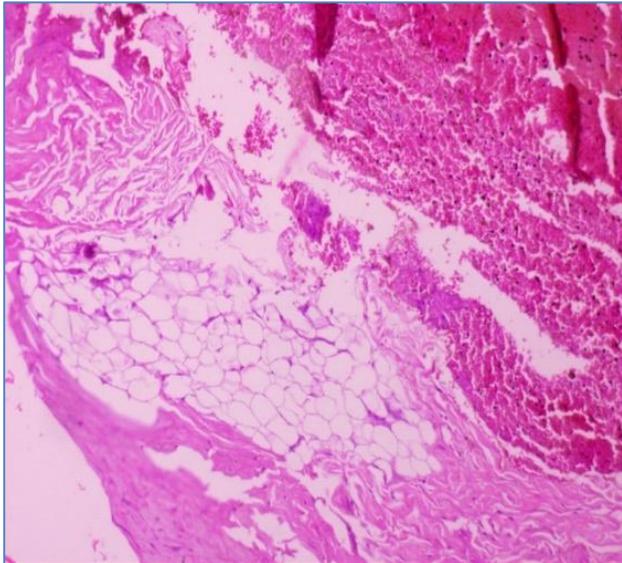
All autopsies were performed according to the standard autopsy protocol, beginning with a general and local external examination and concluding with a general and local internal examination. For neck dissection, a bloodless technique was followed: thoraco-abdominal contents and the brain were removed prior to the procedure. A block measuring 12–20 cm was placed beneath the shoulders to provide slight neck extension, thereby facilitating dissection. Neck dissection was performed according to the method described by Prinsloo and Gordon, layer by layer. The skin below the ligature mark, subcutaneous tissue, neck muscles, and carotid arteries were carefully examined. Special attention was given to the detection of Amussat's sign (longitudinal tears of the carotid artery). Representative samples of skin, subcutaneous tissue, muscles, and carotid artery were preserved in 10% formalin.

The preserved tissues were processed and stained with hematoxylin and eosin (H&E) stain for histopathological examination. Slides were prepared and examined in collaboration with the Department of Pathology, and gross as well as microscopic findings were documented. Photographic documentation of gross and histological changes was also carried out in selected cases. All collected data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 20.0. The objective of the methodology was to identify and document histopathological changes in the skin, subcutaneous tissue, muscles, and carotid arteries at the ligature site in deaths due to hanging.

Picture 1: Photomicrograph of skin showing epidermal compression and condensation of collagen fibers in the dermis, H&E, 40X



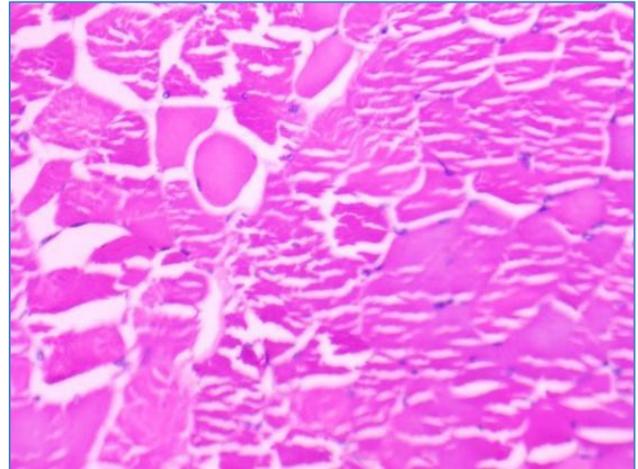
Picture 2: Photomicrograph of subcutaneous tissue showing hemorrhages and intervening fibrous septa, H&E, 100X



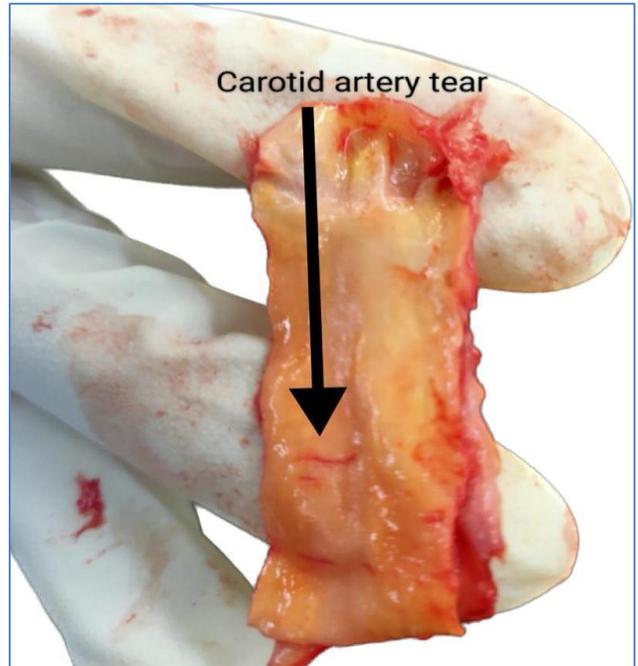
4. Observations & Results:

Out of 115 cases of hanging, 37 were females and 78 were males, which gives male: female ration of around 2:1. Males are twice as prone as females to hang themselves. The age group from 21-30 years had the most cases - 39.2%, followed by 31-40 years age group - 23.4%. 10.4% were aged 20 years or below. 18.3% were 41-50 years old, while 9.1% individuals were over 50 years old. Out of 115 cases of hanging 66.1% (n=76) were married individuals and 33.9% (n=39) were unmarried individuals. Incidence of hanging is more in married cases compared to unmarried cases with ratio of 2:1. The reasons may be stress due to marital problems, financial instability, dowry deaths, extra-marital affairs etc.

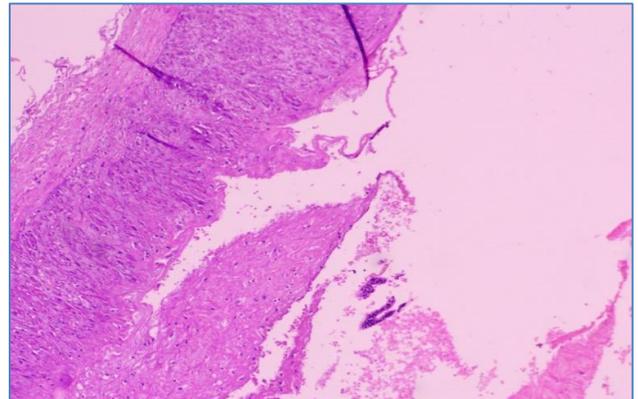
Picture 3: Photomicrograph of muscles showing opaque fibers with loss of cross striations, H&E, 400X.



Picture 4 : Photograph showing carotid artery intimal tear on gross examination.



Picture 5: Photomicrograph showing carotid artery with tear in intima and media layers, H & E, 100X.



Out of 115 cases of hanging, there were 93 (80.9%) cases of complete hanging and 22 (19.1%)

cases of partial hanging. Therefore, the frequency of complete hanging is four times as that of partial hanging. The most used materials for the purpose of hanging were odhni (n=43; 37.4%), nylon rope (36; 31.3%) and saree (n=20; 17.4%). Dupatta (n=5; 4.3%), Gamcha (n=4; 3.5%), bedsheet (n=2; 1.8%), blanket, electric cable, nylon belt, polypropylene strap, towel (each 1 case) was the other ligature materials used in cases of hanging. Therefore, the most widely used ligature materials are the readily available materials at home such as nylon rope, odhni and sarees.

In 72 cases (62.6%) the knot was seen posteriorly, while in 25 cases (22.3%) knot was seen in left lateral position, whereas in 11 (9.6%) cases knot was seen in right lateral position. There were only 7 (6.1%) cases with knot in anterior position. Depending upon the position of knot it was inferred that, 72 (62.6%) cases were typical hanging, and 43 (37.4%) cases were atypical hanging. In this study, changes in various neck structures were observed both grossly and histopathologically in cases of complete and partial hanging. In complete hanging (n=93), skin and subcutaneous tissue changes were seen grossly in 64.5% of cases and histopathologically in 93.5% of cases, while in partial hanging (n=22), these were observed grossly in 54.5% and histopathologically in 72.7% of cases.

The alterations in the skin and subcutaneous tissue included abrasion, congestion, breaking, disruption, necrosis, haemorrhage, and condensation of collagen fibres. Hemorrhages in neck muscles were noted grossly in 44.1% and histopathologically in 62.4% of complete hanging cases, whereas in partial hanging, they were present in 36.4% of cases both grossly and histopathologically. Carotid artery intimal tear was identified grossly in 15.1% and histopathologically in 76.4% of complete hanging cases, while in partial hanging, no gross tear was found, but 36.4% showed histopathological evidence of intimal tear.

5. Discussion:

In present study, out of total 115 cases of hanging, incidence of soft tissue injury on gross was seen in 72 (62.6%) cases. This is higher than studies by Luke et al⁷ and Arumalla VK et al⁸ which show pale, white and glistening structures with focal engorged capillaries and small areas of haemorrhagic collections in the muscle plane and fibro fatty tissue. In present study, out of total 115 cases of hanging, histopathological changes in soft tissues in the form of congestion, condensation of collagen fibers,

intervening fibrous septa etc. were seen in 103 (89.6%) cases. It was similar to studies conducted by Mukesh Prasad et al⁹ and Perju-Dumbravă D. et al.¹⁰ A much lower incidence is found in studies conducted by Arumalla VK et al⁸ and Navneet et al.¹¹ In present study, out of total 115 cases of hanging, hemorrhages in neck muscles on gross were seen in 49 (42.6%) cases. This is similar to study done by B R Sharma et al¹², Azmak¹³ and Suarez-Penaranda et al.¹⁴ A much lower incidence is found in Indian studies by Jayaprakash and Sreekumari¹⁵ and Ambade et al.¹⁶ Study by Hejna and Zátoková¹⁷ showed an higher incidence of haemorrhage in sternocleidomastoid muscle.

In present study, out of total 115 cases of hanging, histopathological changes in neck muscles were seen in 66 (57.4%) cases. It was much higher compared to studies by Arumalla VK et al⁵ and Navneet et al.¹¹ Only 14 cases (12.2%) out of 115 cases showed transverse intimal tears (Amussat's sign) in the carotid arteries on gross, in the present study. It was comparable to studies conducted by Suarez-Penaranda et al¹⁴, Petr Hejna¹⁷ and S. Balusubramanian et al.¹⁸ However, study conducted by Jayaprakash and Sreekumari¹⁵ showed lower incidence of carotid intimal tears. Studies done by Jani and Gupta¹⁹, Meera and Singh²⁰ and Rao D²¹ show higher incidence of carotid intimal tears on gross examination. In this present study, Amussat's sign on histopathology was seen in 68.7% cases. It was higher compared to studies done by S. Balusubramanian et al¹⁸ and Ghodake et al²².

6. Conclusion:

The present study underlines the critical role of histopathology in the forensic evaluation of hanging. While gross examination of neck structures can provide important clues, it is often limited by variability in external findings, particularly in cases of partial hanging, faint ligature marks, or atypical presentations. Histopathological changes, on the other hand, are more consistent and sensitive, offering microscopic evidence of vital reactions such as haemorrhage, vascular congestion, intimal tears, and tissue disruptions that may not be apparent on gross inspection.

These findings reinforce that histopathology is indispensable in strengthening the medico-legal opinion, especially when gross findings are equivocal or absent. Incorporating histopathological evaluation not only improves the accuracy of diagnosing hanging as the cause of death but also reduces the possibility

of misinterpretation in suspicious or doubtful cases. This, in turn, enhances the reliability of forensic investigations, supports judicial processes, and contributes to upholding justice in society.

In essence, the study concludes that histopathological examination should be regarded as an essential adjunct to gross examination in all cases of suspected hanging, ensuring a more comprehensive autopsy examination.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

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References:

- Reddy KSN. The Essentials of Forensic Medicine and Toxicology. 34th ed. New Delhi: Jaypee Brothers Medical Publishers; 2017. P 315.
- National Crime Records Bureau. Accidental deaths and suicides in India – 2022 [Internet]. [Cited on 19th Dec 2023]. Available from: <https://ncrb.gov.in/uploads/nationalcrimerecordsbureau/custom/adsiyarwise2022/1701611156012ADSI2022Publication2022.pdf>
- Mant AK. Taylor's Principles and Practice of Medical Jurisprudence. 13th Ed. Edinburgh, London: Churchill Livingstone; 1984: p 306-16.
- Arya AK, Singh A, Singh A, Bansal MK. Socio-Demographics at no par in Culling Out Hanging as the Mode for Self- Killing. J Forensic Med Sci Law. 2023; 32(1):10-14.
- Bhosle SH, Batra AK, Kuchewar SV. Violent asphyxial deaths due to hanging: A Prospective study. J Forensic Med Sci Law. 2014; 23 (1):1-8.
- Sukhadeve RB, Sonawane SS, Kolle SR. Trends of Suicidal Hanging in western Mumbai Region. J Forensic Med Sci Law. 2019; 28(1):6-10.
- Luke JL, Reay DT, Eisele JW, Bonnell HJ. Correlation of circumstances with pathological findings in asphyxial deaths by hanging: a prospective study of 61 cases from Seattle, WA. J Forensic Sci. 1985; 30(4):1140-7.
- Prasad KJ, Khalid MA, Narayana BL, Prakash GB, Kumar DS, Reddy KB. Ligature mark in hanging-gross and histopathological examination with evaluation and review. Indian J Forensic Med Toxicol. 2017; 11(1):22-6.
- Prasad M, Kumar A, Kumar S, Goel N. Gross and histopathological changes in skin and subcutaneous tissues at ligature site in cases of asphyxial (hanging) deaths at IGIMS, Patna. Eur J Mol Clin Med. 2022; 9(3):11430-4.
- Perju-Dumbravă D, Rebeleanu C, Ureche D, Pop O, Bulgaru-Iliescu D, Radu CC. The medico-legal value of histopathological examination in hanging. Rom J Leg Med. 2018; 26: 349-53.
- Sharma N, Kumar S. Morphology of ligature marks in hanging and ligature strangulation in Jodhpur region, Rajasthan. J Punjab Acad Forensic Med Toxicol. 2018; 18(2):48.
- Sharma BR, Harish D, Sharma A. Injuries to neck structures in deaths due to constriction of neck, with a special reference to hanging. J Forensic Leg Med. 2008; 15(5):298-305.
- Azmak D. Asphyxial deaths: a retrospective study and review of the literature. Am J Forensic Med Pathol. 2006; 27(2):134-44.
- Suarez-Penaranda JM, Alvarez T, Miguens X, Rodriguez-Calvo MS, De Abajo BL, Cordeiro C et al. J Forensic Sci. 2008; 53(3):720-3.
- Jayaprakash S, Sreekumari K. Pattern of injuries to neck structures in hanging-an autopsy study. Am J Forensic Med Pathol. 2012; 33(4):395-9.
- Ambade VN, Kolpe D, Tumram N, Meshram S, Pawar M, Kukde H. Characteristic features of hanging: A study in Rural District of Central India. J Forensic Sci. 2015; 60(5):1216–23.
- Hejna P, Zátoková L. Significance of hemorrhages at the origin of the sternocleidomastoid muscles in hanging. Am J Forensic Med Pathol. 2012; 33(2):124-7.
- Balusubramanian S, Gokulakrishnan A. Incidence of carotid tears in cases of deaths due to hanging – a prospective study conducted in Govt. Stanley Medical College, Chennai. Indian J Forensic Community Med. 2016; 3(2):87-91.
- Jani CB, Gupta BD. An autopsy study of parameters influencing injury to carotid artery in hanging. J Forensic Med Toxicol. 2003; 20(1):18-9.
- Meera T, Singh MBK. Pattern of neck findings in suicidal hanging a study in Manipur. J Indian Acad Forensic Med. 2011; 33(4):350-2.
- Rao D. An autopsy study of death due to suicidal hanging – 264 cases. Egypt J Forensic Sci. 2016; 6(3):248-54.
- Ghodake D, Mohite S, Desai H. Histopathological study of carotid arteries in deaths due to hanging. Medico-Legal Update. 2014; 14(1):82.