

Histopathological Changes in Neck Structures in Cases of Asphyxial Deaths

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Abstract: Background: Hanging is one of the common methods of asphyxial deaths. A gross and histopathological changes in skin and subcutaneous Tissues at ligature Site in cases of asphyxial deaths is helpful in making exact diagnosis of hanging and differentiating it from other form of asphyxia death like strangulation. Objective: To assess the importance of histopathological analysis of tissue underneath the ligature mark in cases of hanging and strangulation. Materials and Methods: The present study was done on medicolegal autopsies conducted at the department of Forensic Medicine and Toxicology, Maharaja Agarsen Medical College (MAMC), Agroha from 01.04.2022 to 31.03.2023 to study the gross and histopathological changes in neck structures. Results: During study period 32 cases were examined for gross and histopathological changes. In majority of the cases (93.75%), the ligature mark was present. The ligature mark was incompletely encircling the neck in 84.4% cases. The ligature mark was situated above the thyroid cartilage level in maximum 18 (56.3%) cases. On dissection of the neck, fracture of thyroid cartilage and fracture of hyoid bone was seen in 18.8% cases and 9.4% cases respectively. On the microscopic histopathological examination, congestion was the most common finding of the piece of ligature skin, comprising of 56.25% cases. Histopathological changes in carotid arteries were tear in tunica intima, tear in tunica media and congestion, which were found in 12.5% cases each. 3.1% cases had tear of adventitia. Conclusion: The gross and histopathological changes in the skin and subcutaneous tissues at the ligature site in cases of asphyxial deaths can provide important information regarding the cause and manner of death. It is crucial to perform a detailed examination of the ligature site, internal structures of the neck along with microscopic examination to arrive at an accurate diagnosis and determine the circumstances surrounding the death.

Keywords: Asphyxia, ligature, histopathology, hanging, asphyxial death

1. Introduction

Violent asphyxial deaths have significant contribution to suicidal, homicidal and accidental deaths. Asphyxia is a term derived from Greek actually a misnomer which literally translates as “stopping of the pulse”. Asphyxia is caused due to interference in the uptake or release of oxygen. (1) Among various means causing asphyxia, constriction around the neck and drowning are most commonly encountered type in medico legal practice. The other means include: suffocation, traumatic asphyxia, effects of chemicals or gases etc. (2) Hanging and strangulation are one of the major types of violent asphyxial deaths that pose a great challenge to forensic experts. Hanging is one of the commonest methods of approach in case of suicidal deaths in India. According to NCRB data 2020, hanging constituted 57.8% cases of suicides in India (3). Virtually all hangings are suicides until otherwise proved contrary (4). On external examination in cases of constriction of the neck by a ligature, features like cyanosis, petechial hemorrhages, la facie sympathetique, dribbling of saliva, post - mortem staining over the hands and feet, etc., may be present (5). The classical triad of asphyxia consisting of cyanosis, congestion, and edema, and petechial hemorrhages are not specific to death caused due to constriction of the neck. A complete interior inspection of neck tissues and histological study of the ligature mark and internal neck structures provide additional and important information. In forensic medicine, the term “vital reaction” describes the complex physiological events that occur when an extraneous force or noxa comes into contact with a living organism (6). Macroscopical and microscopical reactions of body tissues can be useful signs for differentiating ante mortem and post

mortem injuries and to determine whether an injury was sustained during life or not. However, caution has been recommended in the interpretation of such findings alone as vital signs (7). The histopathological examination may provide vital scientific information that, on corroboration with other findings, can help determine the cause of death.

Aim

The gross and histopathological study of the traumatized/affected tissue and other neck structures (soft tissues) will help in distinguishing the ante - mortem and postmortem aspects and add impetus in making the circumstances and cause of death in violent asphyxia more lucid (8).

2. Materials and Methods

- Study design: Descriptive cross - sectional study.
- Place of study: The present study was conducted in the department of Forensic Medicine and Department of Pathology at Maharaja Agrasen Medical College, Agroha, Haryana
- Study period: The study was conducted from 01.04.2022 to 31.03.2023.
- Inclusion criteria: Dead bodies coming to MAMC mortuary for post mortem examination only with alleged history of hanging or strangulation.
- Exclusion criteria: Bodies which shows signs of decomposition.
- Sample size: 32 cases

Dissection technique: The skull and the chest cavity were dissected first and then the detailed dissection of the neck

Volume 12 Issue 4, April 2023

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was carried out. It provides a comparatively clearer field for the study of neck structures and avoids congestive artefactual hemorrhages in the neck structures. The neck dissection was completed by layer wise inspection starting with subcutaneous tissue and proceeding with muscle layers, blood vessels and other deeper structures in the neck beneath ligature mark. All gross findings were noted and a portion of skin and subcutaneous tissue from the site of ligature mark, carotid vessels were excised and sent to department of pathology in plastic jar containing 10% formalin for histopathological examination.

Histopathological processing was carried out in Automatic Tissue Processor. Steps involved in Automatic tissue processor -

- 1) Fixation - to prevent further changes in tissue.
- 2) Dehydration – removal of water from the tissue.
- 3) Clearing – removal of the dehydrant (alcohol) from the tissue and clearing the tissue.
- 4) Impregnation – removal of clearing agent from the tissue and impregnation with paraffin wax takes place in an oven heated to 56 - 60c depending upon melting point of wax.

The histopathological data was recorded and findings were correlated in all cases and data so obtained was subjected to appropriate statistical analysis.

3. Observations and Results

Observations were made in terms of gross and histopathological changes at the ligature site. In majority of the cases, the ligature mark was present (30 out of 32, 93.75%) and no ligature mark was seen in 2 (6.25%) cases (Table 1). Out of 30 cases in which ligature mark was present, in 27 (84.4%) cases the ligature mark was incompletely encircling the neck and it was completely encircling the neck in 3 (6.3%) cases (Table 2). The ligature mark was situated above the thyroid cartilage level in maximum 18 (56.3%) cases. In 8 (25%) cases the ligature mark was located at the level of thyroid cartilage and in 4 (12.5%) cases it was situated at and above the thyroid level as seen in (Table 3). On dissection of the neck, fracture of thyroid cartilage and hyoid bone were seen in 6 (18.8%) cases and 3 (9.4%) cases respectively (Table 4). On the microscopic histopathological examination, Congestion was the most common finding of the piece of ligature skin, comprising of 18 (56.25%) cases. Abrasion was found in 4 (12.5%) cases and haemorrhage was seen in 1 (3.12%) case (Table 5). Histopathological changes seen on microscopic examination in carotid arteries were tear in tunica intima, tear in tunica media and congestion, which were found in 4 (12.5%) cases each. 1 case (3.1%) had tear of adventitia (Table 6).

Table 1: Presence of ligature mark

Present	Frequency (n)	Percentage (%)
Yes	30	93.75
No	2	6.25
Total	32	100

Table 2: Encircling of Ligature mark around the neck

Ligature mark	Frequency (n)	Percentage (%)
Incomplete	27	84.4
Complete	3	9.4
Total	30	100.0

Table 3: Position of ligature mark

Placement with respect to thyroid	Frequency (n)	Percentage (%)
Above	18	56.3
At the level	8	25.0
At and above	4	12.5
Total	30	100.0

Table 4: Injuries of internal structure of the neck on gross examination

Injuries	Frequency (n)	Percentage (%)
Thyroid fracture	6	18.8
Hyoid fracture	3	9.4

Table 5: Changes in skin and subcutaneous tissue in and around the ligature mark on microscopic examination

Changes	Frequency (n)	Percentage (%)
Congestion	18	56.25
Abrasion	4	12.5
Haemorrhage	1	3.12

Table 6: Changes in carotid arteries on microscopic examination

Changes	Frequency (n)	Percentage (%)
Tear in tunica intima	4	12.5
Tear in tunica media	4	12.5
Tear of adventitia	1	3.1
Congestion	4	12.5

4. Discussion

In India, hanging is one of the most wide spread used method of suicide. According to NCRB data, hanging is most used mean/mode for committing suicide during 2020 (3). Moreover external neck compression by a hand, ligature or blunt force can also cause fatal mechanical asphyxia through a variety of mechanisms, including airway obstruction, obstruction of jugular venous return, and/or carotid arterial flow, and/or carotid sinus stimulation that might lead to a reflex cardiac death by neural inhibition (9). Unless proven otherwise, virtually all hangings are suicides. Sometimes ligature mark and gross features including associated injuries alone may not be conclusive. Ligature mark similar to that of hanging can be made by fabricating if applied within 24 hours or even later after an individual's death. As a result, in these cases, a complete interior inspection of neck tissues (soft tissue, muscles, vessels, bones, and cartilages) and histological study of the ligature mark and internal neck structures will provide additional and important information. In the study, ligature mark was situated above the thyroid cartilage in maximum 60% (18 out of the 30) cases and in 26.7% it was at the level of thyroid cartilage. Jiwane et al in their study of analysis of compressive neck injury of both hanging and strangulation cases found ligature mark above the thyroid cartilage in 77.14% and in 17.14% cases it was present at the level of thyroid cartilage (10). On gross internal examination of the neck, thyroid fracture (18.8% cases) was seen more than

hyoid fracture (9.4% cases). This also includes one case (3.1%) in which a combined fracture of thyroid and hyoid was present. The results were similar to the study conducted by Rawat et al, as they found fracture of hyoid and thyroid in 2.97% and 0.99% cases respectively (11). Jagtap et al noted hyoid fracture in 96.79% cases while thyroid cartilage fracture was present in 1.45% cases (12). Congestion was most common feature on histopathological examination of skin, present in 56.25% cases. The result of present study shows close similarity with the observation made by Sharma et al (2018) as they found congestion in 47% (13). However they noticed abrasion in 38% cases which is more than the present study (12.5%). Use of hard ligature material (like, nylon rope, jute rope etc.) will result in more damage of superficial layer of skin as compared to soft ligature material. Congestion depends upon the amount of force, the nature of ligature material (soft or hard) does not has any bearing to it. As abrasion may be produced after the death, congestion is only the ante mortem phenomena hence having more medicolegal importance. In present study, injury to carotid artery on histopathological examination in the form of tunical tear or separation was seen in 28.1% cases which showed close proximity with results of study conducted by Ghodake et al (2014) found the injury in 32% cases (14). Comparable results are also found in congestion on histopathological examination of carotid artery (12%) cases in present study, 8% in Ghodake et al. Jiwane et al examined Carotid artery with reference to intimal tear by using Methelyne blue insufflation (Special dye) by naked eye examination and found intimal tear in 11.8% cases and in present study only intimal tear was evident in 12.5% cases (10).

Thus, various features of external mechanical injuries, internal examination with assisted microscopic examination was performed and all findings were correlated. All the observations were linked with respective subsequent findings to obtain an acceptable outcome regarding the mode and manner of death in the victim.

5. Conclusion

The gross and histopathological changes in the skin and subcutaneous tissues at the ligature site in cases of asphyxial deaths can provide important information regarding the cause and manner of death. It is crucial to perform a detailed examination of the ligature site, internal structures of the neck along with microscopic examination to arrive at an accurate diagnosis and determine the circumstances surrounding the death.

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