

Compression Injuries of Neck: A Microscopic Analysis of Skin and Subcutaneous Tissues

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Abstract

Background: Amongst all the mechanical asphyxial deaths “compression of neck” forms the biggest chunk of the pie. In deaths due to compression of neck, faint ligature mark or absence of ligature mark poses limitations in arriving at conclusion of mechanical asphyxia due to compression of neck. Further limitation is posed in cases of decomposed bodies where the ligature mark may not be obviously appreciable. **Material & Method:** A retrospective analysis of deaths due to mechanical asphyxia by compression of neck was conducted at the department of Forensic Medicine and Toxicology, JSS Medical College, Mysore, Karnataka, India. A total of 40 cases, subjected to forensic autopsy formed the cohort of study. The details were retrieved from the autopsy reports including histopathology, done from January 2005 to December 2010. Gross and microscopic findings of the compression marks were analyzed. **Result:** The ligature mark was completely encircling the neck in 50% of cases. Microscopic findings were remarkable with varying degrees of vital reactions. Thinning of epidermis, crowding and compression of keratinocytes were seen in 67.5% of the cases which were the most consistent microscopic features. The importance of microscopic analysis for timing such injuries as to antemortem or postmortem is discussed with a forensic viewpoint. **Conclusion:** It is a useful tool in faint ligature mark and in putrefied bodies to arrive at the cause and manner of death.

Keywords: Forensic autopsy, compression of neck, mechanical asphyxia, histopathology.

Introduction

Amongst all the mechanical asphyxial deaths “compression of neck” forms the biggest chunk of the pie. Compression injuries on neck are characterized by a ‘ligature mark’, as seen in cases of hanging and ligature strangulation. Although the neck is constricted by a ligature material in both the cases, the constricting force is endogenous in former and exogenous in later

[1]. In hanging the force applied to the neck is derived from the gravitational drag of the weight of the body or part of the body of the victim [2]. But in strangulation the active force from outside is used to cause the constriction.

In deaths due to compression injuries of neck, the mark on the neck is the principal sign, though not the conclusive one. If the mark is dried and brown in appearance, it may have been applied before or soon after death. Exercising caution from the experiments of Casper, who concluded that a mark of hanging took place during life can also be produced if the body is suspended within a couple of hours or even longer after death, the evidence/findings, etc must be scrutinized in entirety [3]. It is suggested that a portion of the skin and deeper tissue in relation to the ligature mark

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should be examined microscopically for the evidence of tissue reaction [3]. A thorough microscopic examination may reveal the presence of effusion of red cells but there would be no evidence of tissue reactions which takes some hours to develop [4]. The absence of tissue reaction does not exclude ante-mortem hanging. In deaths due to compression of neck, faint ligature mark or absence of ligature mark poses limitations in arriving at conclusion of mechanical asphyxia due to compression of neck. Further limitation is posed in cases of decomposed bodies where the ligature mark may not be obviously appreciable.

The objectives of this study were to analyze the gross pattern of compression on the neck, the microscopic features in the underlying subcutaneous tissues and its association with the configuration of ligature mark as well as the degree of decomposition.

This study emphasizes on the importance of microscopic analysis of skin and subcutaneous tissue from ligature site and shows that microscopic examination of 'ligature mark' is more conclusive in comparison to gross examination.

Material and methods

This is a 5 year retrospective autopsy study done on a cohort of 40 cases of asphyxial deaths due to compression of neck carried out at department of Forensic Medicine and Toxicology, JSS Medical College, JSS University, Mysore, Karnataka, India from January 2005 to December 2010. The said cohort consisted of 38 suicidal hanging, 2 ligature strangulation, including 2 decomposed bodies. Gross and microscopic findings of the compression marks were retrieved from the autopsy reports and the data was compiled and analyzed.

Results and Observations

Observations were made as in terms of gross and microscopic changes at the ligature site. The gross study revealed that the ligature mark was encircling the neck completely in 50%

(n=20) of cases and incomplete in remaining 50% cases (n=20) [Figure 1].

In 95% of the study sample, the ligature mark was seen above the level of thyroid cartilage, which was due to hanging. In 5% of the cases, the mark was seen at the level of the thyroid cartilage, caused by strangulation [Figure 2]. The ligature mark was deep and obvious in 62.5% of the cases, and was faint or absent in the rest [Figure 3].

The subcutaneous area of ligature mark showed microscopically dilated and congested vessels in 85% of cases. Thinning of epidermis and crowding and compression of keratinocytes were seen in 67.5% of the cases, followed by crowding and pushing up of adnexal structures, in 40% of the cases. Rolling and focal fragmentation of epidermis was seen in 30% and 15% of the cases respectively. Separation of layers was appreciated in 10% of cases. [Figure 4].

In 2 cases of strangulation the microscopic features of epidermal thinning, crowding and pushing up of adnexa with separation of layers was noted along with dilated and congested vessels in the epidermis. Rolling and focal fragmentation were seen in one case.

In putrefied cases which formed 5% of the sample, epidermal crowding, fragmentation, rolling and thinning was appreciated in both the cases. [Figure 5] However the sub-epithelial region showed necrosis of tissue.

Discussion

Anatomically, the skin consists of epidermis & dermis as two main layers [5-6]. Epidermis is composed of a keratinised stratified squamous epithelium that grows continuously but maintains its normal thickness by the process of desquamation. The dermis is composed of a dense connective tissue that imparts mechanical support, strength and thickness to the skin. The hypodermis contains variable amounts of adipose tissue arranged into lobules separated by connective tissue septa. It lies deep to the dermis and is equivalent to the subcutaneous fascia [5].

Fig 1. Course of ligature mark around the neck

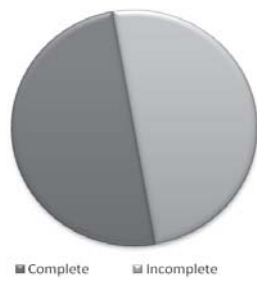


Fig 3. Configuration of ligature mark

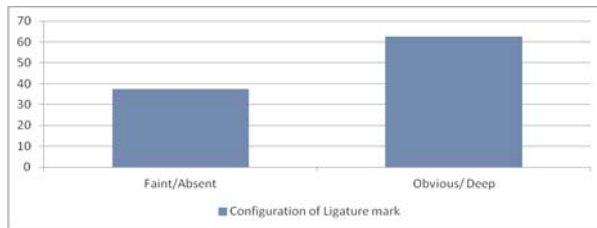
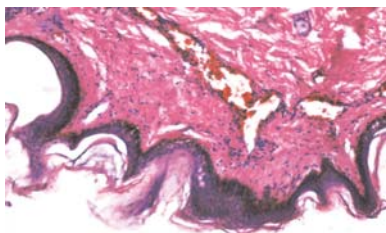


Fig 5. Section of skin from ligature showing thinning of epidermis



The thickness of the skin varies over the surface of the body, from less than 1mm to more than 5mm. The skin on the face and neck is considered as relatively thin in comparison to those of palms and soles [5]. The anatomical configuration of the skin derives much significance while interpreting the nature of forces on the surface, as in compressive neck injuries.

While analysing the study cohort, it was observed that in majority of the cases the ligature mark was deep (62.5%) and placed above the level of thyroid cartilage (95%). Microscopy showed dilated and congested vessels in the dermis (85%) along with epidermal thinning and crowding of

Fig 2. Position of ligature mark

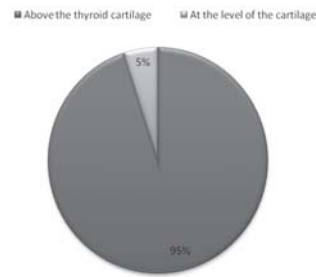
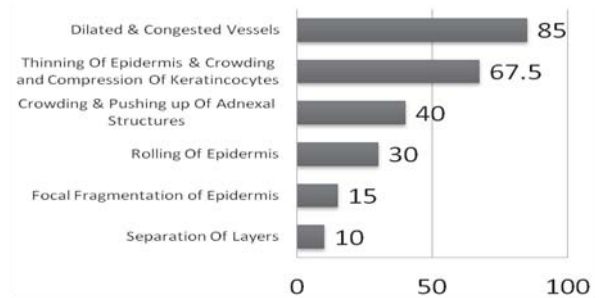


Fig 4. Graphical representation of incidence of histopathological changes in skin in compression injuries of neck



keratinocytes (67.5%) [Figure 6]. A similar study conducted by Yadav A and Gupta BM Showed dilated and congested vessels in 31% of the cases [7].

Microscopic analysis of ligature mark was positive for compressive forces as evidenced by epidermal thinning (67.5%), focal fragmentation (15%) [Figure- 7], rolling (30%) and separation of layers [Figure 8]. In a reported study, it was shown that 46% of the cases had epidermal thinning followed by focal fragmentation in 35% and rolling in 44% of the cases [7]. Crowding and pushing up of adnexal structures also favours compression as the causative force. The term focal fragmentation means discontinuity of the epidermis and rolling indicates increased waviness of the epidermis. The underlying dermis is devoid of adnexal structures like hair follicles, sebaceous glands. The presence of these alterations in the skin, either alone or in various permutations and combinations, suggests that mechanical compression of neck has taken place.

It was further observed that the microscopic changes were positive irrespective of ligature mark being complete/ incomplete or faint/

obvious. Even in putrefied bodies which formed 5% of the study sample the microscopy was positive.

Ante-mortem nature of injury was confirmed by 'dilated and congested vessels' in the upper dermis. The absence of tissue reaction and lack of congestive changes however cannot be taken as evidence that the body was hung after death [8].

Fig 6. Section from skin showing crowding and compression of keratinocytes

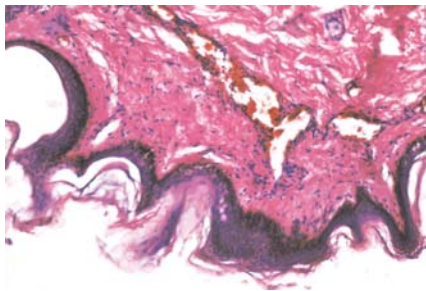
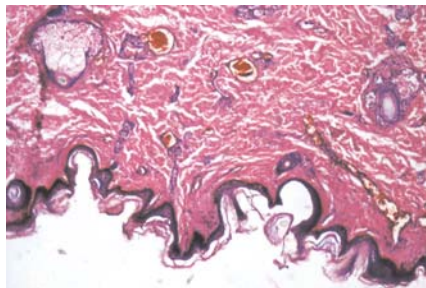


Fig 8. Section from skin showing rolling of epidermis and dilated and congested vessels in the dermis



Conclusions

The present study re-affirms on the routine microscopic analysis of ligature mark in all cases of compression of neck by ligature. It is a useful tool in faint ligature mark and in putrefied bodies to arrive at the cause and manner of death. It would facilitate in administering the justice.

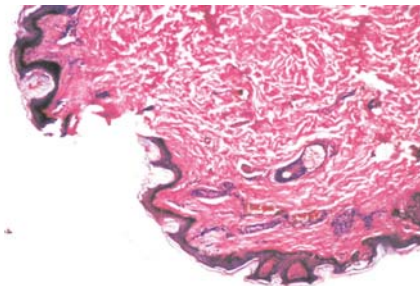
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Limitations of the study

The current study is a retrospective analysis done on a smaller study cohort. A prospective study including a larger sample would be more beneficial.

Fig 7. Section from skin showing focal fragmentation



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