

Analysis of Injuries over Neck and its Association with Ligature Mark in Hanging and Strangulation

(Gross and microscopic examination of Ligature mark on neck in cases of ligature strangulation and hanging)
Sheeba Shabbir¹, Hidayat ur Rehman², Duresshehwar³, Muhammad Arif⁴, Tasneem Murad⁴ and Riffat Masood⁵

¹Department of Forensic Medicine, HBS Medical College, Islamabad, ²Department of Forensic Medicine, Muhammad Medical College, Peshawar, ³Department of Forensic Medicine, Islamabad Medical and Dental College, Islamabad, ⁴Department of Forensic Medicine, IIMC, Rawalpindi, ⁵Department of Forensic Medicine, Foundation University Medical College, Islamabad

ABSTRACT

Objective: To study gross and microscopic patterns of ligature mark in antemortem and postmortem hanging and strangulation.

Materials and Methods: A descriptive study was conducted in Federal Government Services Hospital Islamabad. 106 cases of asphyxia death were analyzed. The victims age, sex, socioeconomic status, site of incident was noted and analyzed by using SPSS 20. These cases were studied in detail by review of history, police papers and postmortem findings etc. Other parameters such as manner of death, ligature mark its level of constriction, number of rounds, position, type of material and internal appearance was also noted.

Results: The site and position of ligature is significant in typical cases of hanging and strangulation. Microscopic examination of ligature mark in hanging (n=41) showed discontinuity, breaking, wrinkling and compression of the skin (dermal and epidermal layers) along with micro hemorrhages and inflammatory changes in subcutaneous tissues. Underlying soft tissues beneath the ligature mark on the neck were glistening white in appearance in all cases of hanging while it showed extravasations of blood in all ligature strangulation cases (n=44).

Conclusion: It was concluded that the ligature mark needed to be evaluated along with other external features, internal findings and histopathological features. Histopathological examination of the ligature mark gives significant information that can be very helpful in diagnosing deaths due to ligature strangulation or hanging. The correlation of external, internal and microscopic findings may be helpful in diagnosing

Key Words: ligature mark, hanging, ligature strangulation, dissolution of skin, wrinkling

Introduction

Introduction: Imprint abrasion injuries, most commonly observed when exposed skin comes in contact with a rough surface of a moving object, causing a compression of the skin layers, grinding or rubbing off the upper layers of the epidermis. This is due to an application of blunt force over the soft tissue which leaves an impression over that area such lesion is seen in ligature strangulation and in cases of hanging¹.

Ligature mark may be the only evidence available in cases of asphyxia deaths due to either hanging or strangulation².

The most common method in cases of sexual homicide is constriction of neck by hands or by ligature³. Sometimes the only finding the surgeon medico legal observed while conducting an autopsy on a death due to asphyxia was a ligature mark on the neck⁴. In typical hanging where the constricting force is the body weight; it is easy to differentiate on the characteristic features of a ligature mark from ligature strangulation. But, in atypical hanging, where the constricting force is weight of head, the ligature marks site and shape and pattern are same as that of ligature strangulation⁵. The distinction between the two types is very important because strangulation is presumed

AUTHOR CORRESPONDENCE:

Dr. Sheeba Shabbir

Department of Forensic Medicine,
HBS Medical College,
Islamabad

to be homicidal and hanging is considered to be suicidal unless proved otherwise⁶. The importance of medico legal opinion increases in suspected cases where victim was strangled to death and then hanged to give false impression of suicide⁷.

In hanging the nature of ligature mark depends upon the material of the ligature, constricting force (body or head weight) and the time of suspension of body after death. In cases of homicidal death if the ligature material is soft and removed immediately after death, the mark might be absent but on autopsy a glistening white band will be seen under the skin of ligature mark⁸. Thick and long beard or clothes on neck may lead to formation of a dull and ill formed ligature mark. Thus, the ligature mark examination has a vital role in diagnosis of cause manner and mode of death. Hence, examination of ligature material and mark becomes an indispensable part of autopsy⁹.

Materials and Method

This descriptive study was conducted in Federal Government Services Hospital Islamabad. Tissue samples and data was collected by Forensic Medicine department whereas tissue samples were analyzed and interpreted by Pathology department from Islamabad Medical and Dental College, Islamabad. Date was collected from Jan-Dec 2018. Cases of asphyxia deaths due to ligature strangulation and hanging were examined and noted. Gross and histopathological examination were performed on skin samples taken from ligature make after dissection of neck. Out of 106 cases of asphyxia deaths, there were 41 cases of hanging and 44 cases of ligature strangulation. Data was collected on specially designed research tool (Proforma) and statistical values were calculated by using SPSS version 20. First inquest report and postmortem finding were noted and photographed after obtaining permission from medical superintendent of the hospital. Samples were sent to histopathologist for examination.

Dissected Tissue fixation and microscopic examination: A skin tissue sample (size 1x1 cm) with full depth was cut from the site of ligature mark. The excised tissue was fixed in 10% formalin solution. The ligature mark due to hanging and strangulation were studied separately and findings were noted on MS-Excel version 2016. The sections were stained with hematoxylin and eosin and slides were examined. The final opinion was recorded and findings were correlated in all the cases for further evaluation.

Results

The Federal Government Services Hospital Islamabad is one of the busiest hospitals in the capital. It is providing health services to 0.5 million natives of the city. The reported cases were merely an ice berg of incidences actually happened in the city. Out of n=106 cases of asphyxia deaths, 85 cases were of hanging and ligature strangulation. Incidence Rate (IR) was 4.21%. The Table-1 shows the demographic distribution of the cases. Majority of cases 32 (37.6%) of hanging and ligature strangulation were from middle age group 21-30 years. Male female ratio was 1.02. Out of 41 cases of hanging, 27 (65.85%) were male and 14 (42.8%) were females. Out of 44 cases of ligature strangulation, females were 28 (63.63%) whereas males were 16 (36.36%).

Table -1: Demographic distribution of hanging and strangulation cases

Age group in Years	Hanging		Ligature strangulation		Total (%)
M/F Ratio	1.7 (Male)		0.57 (Female)		1.02
	Male	Female	Male	Female	
0-10	0	0	2	0	2 (2.35)
11-20	4	3	4	9	20 (23.5)
21-30	8	6	5	13	32 (37.6)
31-40	7	2	3	4	16 (18.32)
41-50	6	3	2	2	13 (15.29)
50>	2	0	0	0	2 (2.35)
Total (%)	27 (65.85)	14 (34.14)	16 (36.36)	28 (63.63)	85 (100)

Table-2: Characteristics of a Ligature Mark

Type of compression of neck	Number of turns around the neck			Position of ligature mark above / below thyroid cartilage		Manner of Death	
	1	2	> 2	Above	Below	Suicidal	Homicidal
Hanging	41	0	0	39	2	37	4
Strangulation	41	3	0	1	43	0	44
Total	82	3	0	40	45	37	48

The number of rounds of ligature in hanging around the neck was found single in 39 (95%) cases. In all typical cases of hanging the ligature mark was above the thyroid cartilage 34 (82.92%). In almost all cases of ligature strangulation, a single ligature mark was found 41 (93.18%).(Figure 1) In 43 cases (97.72%) the ligature mark was below the thyroid cartilage. Predominantly in cases of hanging the manner of death was suicidal 37(90.24%) whereas it was 100% in all cases of ligature strangulation 44(100%) Table -2.

In two cases the significance of ligature mark was remarkable. Case 1: There were two ligature marks one below the thyroid cartilage and other one incompletely encircling the neck and obliquely present around the neck. Case 2: the ligature mark was below the thyroid cartilage and was complete but FIR showed it was a case of partial hanging where the knot was running noose, foot was resting on the ground, and constricting force was the weight of the head.



Figure 1: Brownish imprint abrasion of the skin over the neck due to hanging, Dupata ligature Mark in case of (a)Hanging, (b) Ligature Strangulation

Gross examination

On autopsy, while dissecting the neck, the underlying tissue beneath the ligature mark was hard parchment like a white glistening band. (Figure 2) This glistening band was found in all cases of hanging but was also found in 4 cases of ligature strangulation where the victim was asphyxiated from the behind with an electric wire. All the cases showed atypical injuries such as sign of resistance in the form of nail marks, sign of struggle bruises, signs of asphyxia like congestion of face, ecchymosis, petechial hemorrhages were present above the level of constriction.



Figure 2: White Glistening Band beneath the ligature mark

Microscopic Examination

Soft tissue injuries beneath the underlying ligature mark were noted in all cases of hanging and in four

cases of strangulation n=89 (57.64%). Under the microscope the pale, white and glistening structures showed focal engorged capillaries. Areas of hemorrhagic collections in muscle plane was also observed (Figure 4). In rest of the 37 cases of ligature strangulation; the tissue sample showed no significant findings. Histopathological evaluation was performed in all 85 cases.

In cases of hanging characteristic skin changes were observed such as discontinuity of epidermal and dermal layers of skin (breaking) in 21 (25.30%) cases. Wrinkling of the underlying tissues (mixing up) just like grinding compression of epidermal and dermal layers of skin in 30 (36.14%) cases. (Figure 3) There was decreased skin thickness with increased basophilia (compression) in 28(33.73%) cases. Only congestion of underlying tissues was observed in 35 (42.16%); hemorrhagic collection was noticed in 18 (21.68%). (Figure 4)

In atypical ligature strangulation cases n=4 out of 44 cases, congestion of tissues, frank areas of hemorrhages and cellular infiltrates were found in 2 (6.63%) cases.

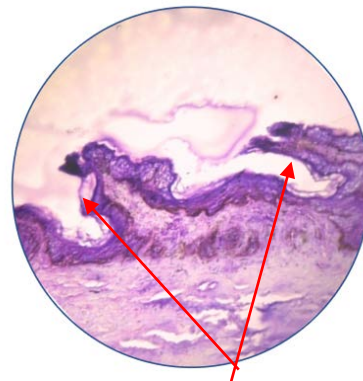


Figure 3: Skin wrinkling and discontinuity (eosin hematoxylin stained x10)

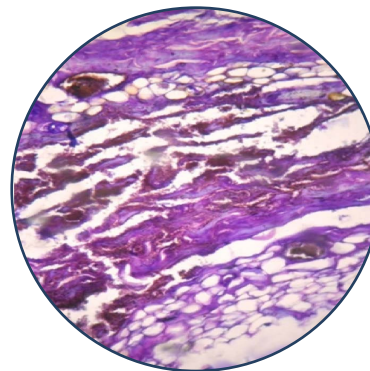


Figure 4: Subcutaneous hemorrhages at the plane of Ligature (eosin hematoxylin stained x10)

Discussion

In case of asphyxia death due to trauma, the level of constriction is very significant. In cases of run over chest injuries, the area above the tire mark showed congestion and cyanosis. In cases of hanging and strangulation same phenomenon is observed¹⁰. The incidence of asphyxia death reported annually was 85 (13%) out of 651 medicolegal autopsies conducted annually which is similar to Indian studies by Momin et al and Sheikh.¹¹⁻¹² Our study showed maximum number of cases (37.6%) belong to a age group 21- 30 years which is consistent with observations of Momin et al (40.2%) , Sheikh (42.4%)⁷ and Pravin (39.3%) from India¹¹⁻¹²⁻¹³. The age group 21-30 years is the most vulnerable phase of life, during this period youth started struggling for better earning, higher education and true love which exposes them to stress and strains like marital disharmony, financial crises, failure of love affairs, unemployment, etc. In this study, among cases of hanging, 65.85% were males and 34.14% were females, which is consistent with observations of Momin et al and Sheikh in India¹¹⁻¹². A study of 761 autopsies conducted from 1998 to 2002 in Turkey, reported 70.56% males and 29.44% females committed suicide by hanging which is close to this study.¹⁴

The direction of the ligature mark was oblique in all cases of typical hanging and was observed horizontal in ligature strangulation, these findings correlate well with the study of Hata N, Kominato Y in Japan¹⁵. A ten years study by Naik in New Delhi concluded that position and direction of ligature is the most reliable criterion for differentiating hanging from ligature strangulation¹⁶. But in our study, we have seen that for atypical hanging this is not true, our findings relate well with Simpson and DiMiao which indicated that histopathological findings and atypical asphyxia signs are equally important in making a diagnosis of strangulation or hanging¹⁷.

Study conducted by Yadav A, Gupta BM, on microscopic examination of skin tissue showed significant skin changes such as flattening of cells, discontinuity of the epidermis and dermis were found to be correlating with our study where, breaking (35.16%), wrinkling (46.15%) and compression (43.95%) was observed¹⁸. Congestion of blood vessels (42.16%), hemorrhages (21.68%), cellular infiltration (9.63%) was observed in present study which correlates well with the study conducted in India by Anil Yadav and Gupta¹⁹ Biochemical changes and histochemical changes were also examined by Jason, P.J., Anthony which indicated that several different

chemicals and enzymes are produced in response of skin dissolution at the site of injury. They calculated the timings of the release of these enzymes to calculate the healing response and estimating time since death. Biochemical and histochemical assay is also helpful in differentiating antemortem and postmortem hanging. They also found that the level of adrenaline in blood increase in fear and anxiety specially in cases of homicidal hanging and strangulation²⁰. Further studies are required to establish a relationship between them.

Conclusions

From the study it was concluded that the ligature mark needed to be evaluated along with other external features, internal findings and histopathological features. An examination of the ligature mark during autopsy give significant information that can be very helpful in diagnosing deaths due to hanging and ligature strangulation. The correlation of external, internal and microscopic findings may be helpful in diagnosing. It also, to some extent helps to delineate antemortem cases of hanging with postmortem cases.

Acknowledgement

I am thankful to Dean Prof. Dr. Syed Shoaib Hussain Shah, Prof. Dr. Khalid Hassan, Head department of Pathology, Prof Dr. Saeed Alam and Medical superintendent Federal Government Services Hospital Islamabad for their support and guidance. All authors contributed in data collection, data analysis and manuscript writing. Prof. Syed Shoaib Hussain Shan supervised the whole project, Shabir S and Murad T helped in the data analysis and final review of the manuscript. Tariq N and Durashahwar helped in data analysis, tissue collection preservation, histopathology and interpretation of results. Hidayat UR wrote the manuscript for the first time and did script modifications later on, as advised by reviewers. Arif M helped in data collection, data entry, record keeping and reviewing the manuscript. All the authors contributed significantly to the research that resulted in the submitted manuscript.

Conflict of Interest: No conflict of interest.

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HISTORY	
Date Received	30-9-2019
Date sent for Reviewer	6-11-2019
Date Received Reviewer's Comments	3-12-2019
Date Received Revised Manuscript	5-12-2019
Date Accepted	8-12-2019

CONTRIBUTION OF AUTHORS	
Author	Contribution
Dr. Hidayat ur Rehman	B
Dr. Dureshehwar	C
Dr. Muhammad Arif	C
Dr. Tasneem Murad	B
Dr. Sheeba Shabbir	B

KEY FOR CONTRIBUTION OF AUTHORS:

- A. Conception/ Study Designing/ Planning
- B. Experimentation/ Study Conduction
- C. Analysis/ Interpretation/ Discussion
- D. Manuscript Writing
- E. Critical Review
- F. Facilitated for Reagents/ Material/ Analysis