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LIGATURE MARK ON THE NECK;
HOW ELUCIDATIVE?

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ABSTRACT… Introduction: There are three types of compression of neck which are of prime forensic importance – (1) Manual strangulation (2) Hanging (3) Ligature strangulation. Ligature mark is found in the latter two types.[1] Ligature mark is a pressure mark on the neck underneath the ligature. Initially it appears as a pale groove which on drying becomes yellowish brown parchment like.[2,5] **Objective:** The aim is to study the information provided by a ligature mark in ligature asphyxial deaths. **Methodology: Study Design:** A retrospective study on ligature asphyxial deaths. **Setting:** Forensic Medicine and Toxicology Departments of King Edward Medical University, Lahore and Nishtar Medical College, Multan. **Period:** January, 2012 to December, 2013. **Results:** The incidence of violent ligature asphyxial deaths was 4.21% of the total medicolegal deaths autopsied. Age group 21 to 30 years accounted for the maximum cases (37.6%). Male: female ratio was 1.02. Nylon rope (44.7%) was the most common ligature material used. Ligature mark was single in all cases and was situated above thyroid cartilage in 82.92% cases of hanging. In ligature strangulation deaths, mark was one in number in 93.18% cases and was below thyroid cartilage in 97.72% cases. The manner of death in hanging was mostly suicidal (90.24%) as compared to homicidal in all cases of ligature strangulation. Ligature mark was incompletely encircling the neck in 85.36% cases and obliquely present in 100% cases of hanging. In all deaths due to ligature strangulation, it was completely encircling and transversely present around the neck. Underlying soft tissues of neck were glistening white in all hanging deaths while it showed extravasations of blood in all ligature strangulation cases. **Conclusions:** A meticulous examination of the ligature mark during autopsy, though not conclusive, can give valuable information that can be very helpful in diagnosing deaths due to hanging and ligature strangulation.

Key words: Hanging, ligature strangulation, ligature mark, autopsy.

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INTRODUCTION

There are three types of compression of neck which are of prime forensic importance – (1) Manual strangulation (2) Hanging (3) Ligature strangulation. Ligature mark is found in the latter two types.[1] Ligature mark is a pressure mark on the neck underneath the ligature. Initially it appears as a pale groove which on drying becomes yellowish brown parchment like.[2,5]

While conducting autopsy on ligature asphyxial deaths, autopsy surgeon often comes across cases when the only principle external sign present is the ligature mark on the neck. It is easy to diagnose hanging and ligature strangulation in the presence of the characteristic features of their ligature mark. However, atypical ligature marks are also seen which may cause difficulty in diagnosing hanging and strangulation. The distinction between the two types is very important because strangulation is presumed to be homicidal and hanging is considered to be suicidal unless proved otherwise.[2] Therefore an error in judgment can convict an innocent or a murderer can escape justice. While determining the cause of death resulting from compression of neck, three important parameters i.e. level, discontinuity and obliquity of ligature mark are always considered to differentiate hanging from strangulation.

AIMS AND OBJECTIVES

1. To study the pattern of age and gender distribution of hanging and ligature strangulation deaths.
2. To determine the distinguishing features of ligature mark on autopsy in hanging and ligature strangulation.

3. To analyze the data regarding ligature mark and study its feasibility to be used for the differential diagnosis of ligature asphyxial deaths.

MATERIAL AND METHOD

This retrospective study was conducted in Forensic Medicine Departments of King Edward Medical University, Lahore and Nishtar Medical College, Multan from January 2012 to December 2013.Out of 2016 medicolegal autopsies, there were 41 cases of hanging and 44 cases of ligature strangulation. These cases were studied in detail by review of history, police papers and postmortem findings etc. The parameters studied were age and gender of victim, manner of death and the ligature mark with reference to its site, level, number, discontinuity, obliquity, type of material and internal appearance. The findings/ data were recorded on a specially designed proforma and tabulated using SPSS version15.

RESULTS

A total of 2016 medicolegal autopsies were conducted during the two year period from January 2012 to December 2013. Out of these, 85 cases were of hanging and ligature strangulation, with the incidence rate of 4.21% (Table-I).

Total number of autopsies conducted	Violent ligature asphyxial deaths	Percentage of ligature asphyxial deaths
2016	85	4.21%

Table-I. Incidence of Hanging and Ligature Strangulation Deaths

As per Table-II, majority of cases 32 (37.6%) of hanging and ligature strangulation deaths belonged to the age group 21-30 years. Out of 41 cases of hanging, 27 (65.85%) were male and 14 (42.8%) were female while out of 44 cases of ligature strangulation, females 28 (63.63%) were more than males 16 (36.36%). Overall male to female ratio was 1.02.

Age group (in years)	Hanging		Ligature strangulation		Total (%)
	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(18.82)
41-50	6	3	2	2	13(15.29)
>50	2	0			2(2.35)
Total (%)	27 (65.85)	14 (34.14)	16 (36.36)	28 (63.63)	85 (100%)
M/F Ratio	1.7		0.57		1.02

Table-II. Age & Sex Wise Distribution of Hanging and Ligature Strangulation Deaths

As per Table-III, Nylon rope was used as ligature in majority of deaths due to hanging 23 (56.09%) and ligature strangulation 15 (34.09%). However, second most common ligature material was dupatta 18 (43.9%) in hanging while it was wire 10(22.72%) in ligature strangulation. Moreover, ligature material was not known in 5(11.36%) cases of ligature strangulation.

Type of material	Hanging No (%)	Ligature strangulation No (%)	Total (%)
Dupatta	18 (43.9)	5 (11.36)	23 (27.05)
Nylon Rope	23 (56.09)	15 (34.09)	38 (44.7)
Wire	0	10 (22.72)	10 (11.76)
Cotton rope	0	9 (20.45)	9(10.58)
Not known	0	5(11.36)	5(5.88)

Table-III. Type of ligature material used

Ligature mark was single in all cases 41(100%) and was situated above thyroid cartilage in most of the cases 34 (82.92%) of hanging. In majority of cases of ligature strangulation, ligature mark was one in number 41 (93.18%) present below thyroid cartilage 43 cases (97.72%). The manner of death due to hanging was predominantly suicidal 37(90.24%) as compared to homicidal in all cases of ligature strangulation 44(100%) (Table-IV).

Ligature mark was incompletely encircling the neck in 35 cases (85.36%) and obliquely present around the neck in all cases 41 (100%) of hanging. In all deaths due to ligature strangulation 44 (100%), the ligature mark was completely encircling and transversely present around

the neck. Underlying soft tissues of neck were glistening white in all hanging deaths 41(100%) while it showed extravasations of blood in all ligature strangulation cases 44 (100%) (Table-V).

Type of neck compression	Number of turns			Level of ligature mark			Manner of death		
	1	2	3	Above TC	At level of TC	Below TC	Suicidal	Homicidal	Accidental
Hanging No (%)	41 (100)	0	0	34 (82.92)	5 (12.19)	2 (4.87)	37 (90.24)	4 (9.75)	0
Ligature strangulation No (%)	41 (93.18)	3 (6.81)	0	0	1 (2.27)	43 (97.72)	0	44 (100)	0
Total (%)	82 (96.47)	3 (3.52)	0	34 (40)	6 (7.05)	45 (52.94)	37 (43.52)	48 (56.47)	0

Table-IV. Number of Turns, Level of Ligature Mark and Manner of death

Type of neck compression	Encirclement		Direction		Internal appearance	
	Complete	Incomplete	Oblique	Transverse	Glistening white	Extravasation of blood
Hanging No (%)	6(14.63)	35(85.36)	41(100)	0	41(100)	0
Ligature strangulation No (%)	44(100)	0	0	44(100)	0	44 (100)
Total (%)	50(58.8)	35(41.2)	41(48.2)	44(51.76)	41(48.23)	44(51.76)

Table-V. Encirclement, Direction and Internal Appearance of Ligature Mark

DISCUSSIONS

The ligature mark is a vital piece of evidence especially when the actual ligature is not available for examination.[1]

In the present study, 4.21% cases out of total 2016 medicolegal autopsies were of hanging and ligature strangulation which is similar to Indian studies by Momin et al[6] and Sheikh.[7] The study showed maximum number of cases (37.6%) in 21- 30 years age group which is consistent with observations of Momin et al (40.2%)[6], Sheikh (42.4%)[7] and Pravin (39.3%)[8] from India. In a study from Karachi[9], there were 37.03% cases between 15-25 years of age which is comparable with the study. The above findings can easily be explained by the fact that this age group is the most active phase of life and is thus more exposed to stress and strains like marital disharmony, financial crises, failure of love affairs, unemployment, etc. Furthermore, there is a transition from student's life, where parents bear most of the expenses/ responsibilities, to practical life where they are expected to commence their professional career supporting themselves as well as their families financially. This is the start of a new chapter in life abreast with the challenges and issues of the real world, which sometimes these young people are unable to handle and fall victim to it.

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[6] and Sheikh[7] in India. 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.[10] Male dominance can be explained by the fact that ours being a male dominant society, male members are more exposed to stress and strains of daily life and thus are more vulnerable victims.

The present study reflected female predominance in ligature strangulation (63.63%). A four year study from Patiala, India[11] reported that female victims constituted 66.66% of violent asphyxial deaths caused by ligature strangulation thus in accordance with this study. A South African study[12] based on reports of the National Injury Mortality Surveillance System, from 2001 to 2005 found that homicidal strangulation is predominant in females than males in the metropolitan centers

of South Africa. The possible explanation for this is strangulation is the method preferred by assailants having physical strength greater than their victims thus overpowering them easily, as revealed by higher proportion of female deaths in our study. Usually these cases are reported with sexual assault.

The commonest type of ligature material used was nylon rope followed by dupatta in the study. A study of 145 victims of hanging and strangulation deaths in Aurangabad region of Maharashtra over a period of 2 years also reported that ligature material used by the victims was nylon rope followed by duppata.[8] Total 84 cases of asphyxial death due to hanging were studied during October 2008 to June 2010 by Bhosle.[13] The ligature material most commonly used to commit suicide by hanging was nylon rope followed by long handkerchief and chunni. Rope as the commonest ligature material for hanging was also reported in studies by Uzun et al in Turkey[10], Cooke et al in Australia[14] and Elfawal et al in Saudi Arabia.[15] However, it is in contrast to Indian studies by Momin et al[6] and Sharma et al[16] who found chunni as the commonest ligature material used. This is probably because anything that is readily within the reach of the victim when the impulse to commit suicide arises is used as ligature material. Nylon rope was also preferred for committing homicide probably due to its easy availability, accessibility and portability.

According to the study, ligature mark was single in all cases (100%) of hanging and in majority of deaths due to ligature strangulation (93.18%). This is in accordance with the study conducted on deaths due to hanging and ligature strangulation in Rajkot, India[6] reporting single ligature mark in all cases of hanging and 85.71% cases of ligature strangulation. Similarly, a study by Sharma et al[16] from 1997 to 2004 observed single loop in 93% cases of hanging supporting the findings.

Ligature mark was situated above the level of thyroid cartilage in 82.92% cases of hanging which is similar with observations of Bhosle (83.33%)[13], Sharma et al (85%)[16] and Naik (82.94%)[17].The proportion of cases with ligature mark below the level of thyroid cartilage was more in studies by Elfawal et al (24.59%)[15] and Dixit et al (23%)[18] as compared to the present study (4.87%). The high reporting may be because of more cases of partial hanging in the former studies. Various authors[1-4] have also reported that hanging mark is situated in the upper part of the neck usually above the laryngeal prominence. According to Reddy[5] in 80% cases, ligature mark of hanging is present above the thyroid cartilage, in 15% at the level and in 5% it is present below the thyroid cartilage (mostly in partial hanging).In all cases (100%) of ligature strangulation, ligature mark was found below thyroid cartilage which is in agreement with studies by Momin et al[6] and Sharma et al.[16] Simpson[1] and Knight[4] have also reported the same.

Majority of hanging cases (90.24%) were suicidal in this study. All cases of hanging should be considered suicidal until proved otherwise[2]. The suicidal manner in hanging deaths was also reported in studies by Cooke et al (93.21%) in Australia[14], Elfawal et al (96.7%) in Saudi Arabia[15] and Azmak D (100%) in Turkey.[19] In Pakistan, studies from Karachi[9] and Lahore[20] reported that all hanging cases were suicidal. This reflects that this abhorrent act is the result of environmental and psychological factors. Males are more vulnerable because they, being the breadwinner of the family, are exposed more frequently to outdoor work facing the financial problems augmented by poverty, unemployment, drug abuse and the stress and strains of daily life. Females usually commit suicide due to poverty, harassment and marital disharmony. Other factors which are common to both sexes are extra marital affairs, failure in examination, ill health and mental illness. However this explains only why hanging is the preferred method of suicide among males and does not mean that suicide is more common in males as females usually resort to other methods like poisoning, drowning etc to end their lives.

All strangulation cases were homicidal in the present study. This is in accordance with the studies conducted in Karachi[9], Lahore[20] and

Peshawar[21] reporting homicidal manner of death in all strangulation cases. Predominance of homicide among deaths due to ligature strangulation was reported by studies from India[8], Germany[22], Turkey[23] and Japan[24] as well.

The direction of the ligature mark was oblique in all cases (100%) of hanging while it was horizontal in all cases (100%) of ligature strangulation. This is in line with observations of Momin et al[6] and Sharma et al [16] in India. A ten year study by Naik[17] in New Delhi including 258 cases of hanging and 8 cases of ligature strangulation revealed similar results and concluded that obliquity of the ligature mark is the most reliable criterion for differentiating hanging from ligature strangulation. Numerous authors[1-5] have also documented that hanging mark is situated obliquely across the circumference of neck. However, in case of hanging by running noose, the resulting mark may be almost horizontal but will still be present in the upper part of neck[5]. In strangulation, unlike hanging, the ligature mark is transverse[1-5]. However, the mark may be oblique as in hanging, if the victim was dragged by the ligature or strangled in recumbent posture or if the victim was sitting and the assailant applied ligature on the neck while standing behind him thus pulling upwards and backwards.[1,2] Simpson[1] and DiMiao[3] opined that the mark of hanging usually has an inverted V- shaped configuration(peak) indicating the junction of the noose and vertical part of the ligature, which is a distinguishing feature from ligature strangulation in such a scenario.

This study showed that ligature mark was incompletely encircling the neck in 35 cases (85.36%) of hanging. On the other hand, the ligature mark was complete around the neck in all cases (100%) of ligature strangulation. These findings are in agreement with studies by Momin et al[6], Sharma et al[16] and Naik.[17] It is also well known fact documented in literature that discontinuity along the course of the ligature mark is an important differentiating feature between hanging and strangulation.[2] Authors have mentioned that hanging mark is incomplete with a gap indicating the position of the knot with no damage to the skin in the gap[2,3]. However, when a slipping knot is used, then it may cause the noose to tighten squeezing through the skin all around the neck.[1,4,5] In rare cases, mark will be incomplete in deaths due to ligature strangulation. Simpson[1] documented that ligature mark may be present across the front of the neck in strangulation, when the assailant either applied pressure from the front or pulled from the back using a ligature stretched between two hands. Also, there can be discontinuity along the course of ligature mark due to interposing clothing, scalp or beard hair or fingers of the victim in both hanging and strangulation.[2]

On dissection of neck underlying soft tissues were dry, white and glistening in all cases (100%) of hanging while it showed extravasations of blood in all cases of ligature strangulation which is in accordance with the other studies[6] and literature.[2-5]

CONCLUSIONS

A meticulous examination of the ligature mark during autopsy, though not conclusive, can give valuable information that can be very helpful in diagnosing deaths due to hanging and ligature strangulation. The character of the mark may vary depending upon various factors. However, obliquity in the course of ligature mark slanting upwards towards the knot is a better criterion for differentiating hanging from ligature strangulation. Though the presence of discontinuity along the course of ligature mark is highly suggestive of hanging but its absence neither rules out hanging nor concludes strangulation. In doubtful cases final opinion will be made depending upon the circumstantial evidence, crime scene investigation and autopsy findings.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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1	Dr. Mariam Arif	Prepared the proposal, data collection and compilation, manuscript writing