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A comparative study of ligature marks in cases of Hanging and strangulation autopsied at RIMS, Ranchi

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Abstract : *Introduction :- Hanging and ligature strangulation are the two forms of violent mechanical asphyxia in which ligature marks are found. Hanging is mostly suicidal while strangulation is mainly homicidal; hence differentiation between the two is necessary.*
Material and Method: This cross sectional study was conducted in the department of Forensic Medicine and Toxicology, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India, during a period of one year ranging from 1st November 2016 to 31st October 2017.
Results: During this period, a total of 2981 cases of medico-legal autopsy were conducted, out of which 180 cases were having ligature marks (6.04%). There were 163 cases of hanging (5.47% of total 2981 cases) and 17 cases of strangulation (0.57% of total 2981 cases). Out of 180 cases, 90.56% (163) were of hanging and 9.44% (17) were of strangulation. The ligature mark in hanging was oblique in 100% cases, discontinuous in 96.93% cases and the subcutaneous tissue underneath the ligature mark was pale and dry in 100% cases. The ligature mark in strangulation was transverse in 100% cases, continuous in 100% cases and subcutaneous tissue underneath the mark was contused in 88.2% cases.
Conclusion:- Oblique and discontinuous ligature mark along with dry and pale subcutaneous tissue is suggestive of hanging while a transverse and continuous ligature mark with contused subcutaneous tissue is indicative of strangulation.

Keywords - *Hanging, ligature mark, oblique, strangulation, transverse.*

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I. Introduction

Ligature marks on the neck are found in hanging and ligature strangulation. Hanging is a form of death produced by suspending the body with a ligature round the neck, the constricting force being the weight of the body (or a part of the body weight)[1]. In strangulation, the exchange of air between the atmosphere and the lungs is prevented by way of constriction of the neck by means of a ligature material or by some other means, without suspending the body of the victim, where the force of constriction is applied from outside (exogenous in origin) and is not the weight of the body or the head of the victim[2]. In strangulation by ligature, the ligature material is tightly tied around the neck[2].

In hanging, ligature material may be any substance that is available at the time of the impulse and has been used as a ligature. Knot is frequently in the form of a single knot to produce a running noose or fixed by a granny or reef knot, occasionally a simple loop is used[3].There may be more than one turn around the neck and / or more than one knot imparting corresponding complexity to the mark.

In strangulation, ligature may be applied as one turn around the neck or even less, as homicide have been perpetrated by assailant pulling U shaped ligature against the front and sides of neck, while standing at the back.

It is also well known fact that discontinuity along the course of the ligature mark is another important criterion while describing ligature mark of hanging or strangulation. Authors have mentioned that hanging mark almost never completely encircles the neck[4-9]. In strangulation, unless the killer is pulling upwards, there will

be no gap in the mark. However, there can be discontinuity along the course of ligature mark due to interposing clothing, scalp or beard hairs or fingers of the victim in both hanging and strangulation[5].

Observation is incomplete when obliquity along the course of the ligature mark is not noted in cases of hanging and strangulation. Authors have reported that hanging mark is situated obliquely across the circumference of neck[{5-8}]. Where suspension point is low, the pull on the rope is almost at right angle to the axis of the body, so the resulting mark may be almost horizontal. In strangulation, unlike hanging, the mark tends to encircle victim's neck horizontally. However, the mark may be oblique as in hanging, if the victim has been compressed by a cord while in recumbent posture, or if the victim was sitting and the assailant applied the ligature on the neck while standing behind victim, thus using the force backward and upward[{6,8}]. Simpson K has opined that the mark of hanging usually rises to a 'peak' pointing the junction of the noose and vertical part of the ligature, this being a distinguishing feature from ligature strangulation. However, exceptions occur if the suspension point is low, a horizontal mark may be produced which can be confused with strangulation. In strangulation, the mark is usually horizontal and will not show any rising peak to a suspension unlike hanging.
Considering the difficulties faced by different authors in diagnosing the ligature marks of hanging and strangulation, an attempt will be made in this study to establish the most reliable factors for differentiating patterns of ligature marks of hanging from that of strangulation.

II. Materials And Methodology

The present study was carried out in the Department of Forensic Medicine & Toxicology, Rajendra Institute of Medical Sciences, Ranchi, from 1st November 2016 to 31st October, 2017. The materials for the present study were dead body brought for medico legal and pathological autopsy from various police stations of Ranchi District (Jharkhand) at the Forensic Medicine Department of RIMS, Ranchi. During the study period total 2981 cases were autopsied, out of which only 180 cases were having ligature mark. Only those cases which died due to asphyxia as a result of either hanging or strangulation, either alone or in association with other injuries were included for the study.

Inclusion criteria:

1). All cases of hanging and strangulation coming for autopsy in the department of FMT, RIMS, Ranchi during the study period.

Exclusion criteria:

1). Highly decomposed body will be excluded

III. RESULTS

During the study period, a total of 2981 cases of medicolegal autopsies were conducted, out of which 180 cases were having ligature marks. Hence in my study, 180 cases were considered. Out of 180 cases 163 were of hanging and 17 were of strangulation.

TABLE 1: Gender wise distribution of cases (N=180)

Gender	Frequency	Percentage
Male	127	70.6
Female	53	29.4
Total	180	100.0

TABLE 2 : Age wise distribution of cases :

Age	Frequency	Percentage
0-15 years	11	6.1
15-30 years	121	67.2
30-45 years	36	20.0
45-60 years	9	5.0
>60 years	3	1.7
Total	180	100.0

TABLE 3: Distribution of hanging and strangulation cases on the basis of encirclement of ligature mark.

Encirclement	HANGING		STRANGULATION	
	Frequency	%	Frequency	%
Continuous	5	3.1	17	100
Discontinuous	158	96.9	0	0
Total	163	100.0	17	100

TABLE 4 : Comparison of direction of ligature marks of hanging & strangulation

Outcome	Direction of ligature mark		Total	Chi square value
	Oblique	Transverse		
Hanging	163(100%)	0 (0%)	163	χ^2=180
Strangulation	0 (0%)	17(100%)	17	df=1
Total	163	17	180	p<.0001

TABLE 5 : Comparison of Tissue underneath the ligature mark of Hanging & Strangulation

Outcome	Tissue underneath the ligature mark		Total	Chi square value
	Pale & dry	Contused		
Hanging	163(100%)	0 (0%)	163	χ^2=156.898
Strangulation	2 (11.8%)	15(88.2%)	17	df=1
Total	165	15	180	p<.0001

IV. DISCUSSION

. The present study was conducted to analyze the differentiating features of ligature marks of hanging and strangulation.Hanging is a common finding that we come across during autopsy examinations. According to recent report published by NCRB-2013, there is increasing trend of death due to hanging from 2010 to 2012 i.e. 31.4% to 37.0% while decreasing trend of death due to poisoning i.e. 33.1% to 29.5%. It is showed that the hanging is the most common method applied to commit suicide in India. As per findings of other different studies by different scientists in different part of the country it was observed that the poisoning is first mode of suicides and hanging is the next most frequent method in India.[10-12, 13, 14]

During autopsy examinations, we come across strangulation but not as often as hanging, Strangulation is taken to be homicidal, unless proved otherwise. It is a common method of homicide. Homicidal strangulation accounts for approximately 10–20% of all homicidal deaths in various countries[15-18].

Gender-wise distribution of hanging

As shown in TABLE 1, out of 163 victims of hanging, 117 (72%) were males and 46 (28%) were females. The male to female ratio was 2.54:1. Males outnumbered the females in the present study. Similar findings were reported by other scientists like Abhishek Yadav et al (2013) found that the males to female ratio were 1.7:1,[19] Patel et al (2012) 1.5:1[20], Meera Th & Singh MBK (2011) 3.4:1,[21] Sharma et al (2005) 2.1:1[22] and Singh et al (2003) 1.5:1.[20] Male preponderance can be explained by the fact that in Indian society the male members are more expected to bear all the responsibilities. So, they have the dual pressure of career and family responsibilities.

Gender-wise distribution of strangulation cases

As shown in TABLE 1, out of total 17 victims of strangulation during the study period, 10 (59%) were males and 7 (41%) were females. The percentage of females in strangulation as compared to that in hanging remains usually higher because strangulation is many a time associated with sexual assault. According to Finnish homicide data, female percent of strangulation is 30%,[23] while according to Helina Hakkanen, the female percent is 48%. The result of this study falls between the two results.

Age distribution of hanging cases

As shown in TABLE 2,Out of 163 cases of hanging, maximum number belonged to the age group 15-30 years, followed by the age group 30-45 years, and least being in the age group >60 years. These findings are similar to the findings of other authors A Abhishek Yadav et al (2013)[19], who found 21-30 years of age to be most vulnerable for hanging, followed by 11-20 years of age.

The above findings can easily be explained by the fact that 21-30 years of age group is most susceptible to frustration in life because of many factors like failure of love affairs, stressful marital life, dowry, financial crunch, and pressure of making a good career after completion of studies etc.

Age distribution of strangulation cases

Similarly, we found that maximum cases of strangulation, like hanging, fall in the 15-30 years age group numbering 8 (47.1%) out of total 17, followed by 30-45 years age group numbering 4 (23.5%), and least falling in the age group >60 years numbering only 1 (5.9%).

This result is more or less similar to the result of the study of Momin G Sadikhusen et al[24] (2012), in which maximum number of cases were in the age group 21-30 being 42.85%, followed by age group 31-40 years being 28.6%. Other studies such as Sheikh et al[25] and Joshi et al[26] also reported similar results being 42.4% and 44.18% in the age group 21-30 years.

Comparison of ligature marks of hanging and strangulation on the basis of encirclement i.e. continuity and discontinuity

As per TABLE 3, out of 180 cases, 22 (12.2%) ligature marks were continuous and 158 (87.8%) were discontinuous. Out of the 22 continuous ligature marks, 17 (77%) were present in strangulation cases, and 5(23%) were present in hanging cases. In 100% cases of strangulation, the ligature mark was continuous, while continuous ligature mark in hanging was present only in 3.1% cases (5 out of 163). Discontinuous mark was present in 96.9% cases of hanging.

These findings are similar to that reported by Momin G Sadikhusen et al[24] who reported 100% continuous ligature marks in strangulation and 20% marks to be continuous in cases of hanging. Patel Jignesh B[27] reported 67% marks of strangulation to be continuous, and 19.58% hanging marks to be continuous.
The findings are also comparable to that obtained by Sharma B R et al[22.]

Comparison of ligature marks of hanging and strangulation on the basis of direction i.e. oblique and transverse/horizontal

According to TABLE 4, out of 180 cases of ligature marks found during the study period, 163 (90.56%) were oblique, while 17 (9.44%) were transverse. All the 163 marks of hanging cases were oblique, that is, 100% hanging marks were oblique. Also ligature marks in 100% cases of strangulation were transverse or horizontal.

This finding is exactly similar to the finding of Sadikhusen G Momin[24] who also found 100% strangulation marks to be transverse and 100% hanging marks to be oblique. The finding is also consistent with Naik S K.[28]

Contrary to this finding, Patel Jignesh B[27] reported 67% of strangulation mark to be oblique (2 out of 3) and 33% to be transverse (1 out of 3). He also reported 4.12% of ligature mark of hanging to be transverse and 95.88% to be oblique.

Comparison of ligature marks of hanging and strangulation on the basis of subcutaneous tissue and soft tissue underneath the ligature mark

In accordance with TABLE 5, the subcutaneous tissue and soft tissue underneath the ligature mark was pale and dry in 165(91.7%) cases out of 180 cases and contused in 15 (8.3%) cases. Out of 163 cases of hanging, all showed pale, dry and glistening subcutaneous tissue i.e. in 100% cases of hanging, the tissue underneath the mark is pale and dry. Tissue underneath the ligature mark was contused in 88.2% cases of strangulation (15 out of 17 cases) and pale and dry in 11.8% cases (2 out of 17 cases). It was further noted that the 2 cases of strangulation in which the tissue under the mark were pale and dry, were done by soft and broad material and the ligature material was still present in-situ, tightly in the neck. A hard ligature is more likely to cause contusion of the tissues as compared to a soft material.

The finding is similar to that observed by Sadikhusen et al[24] who reported 100% cases of hanging to have pale, white and glistening underlying soft tissues. They also reported 100% cases of ligature strangulation showed extravasation of blood in underlying soft tissues. Patel Jignesh B et al[27] report that 66% cases of strangulation show bruising of subcutaneous tissue while bruising of subcutaneous tissue was also present in 4.12% cases of hanging.

V. Summary And Conclusion

Hanging and strangulation are two forms of mechanical asphyxia having ligature marks, 180 cases of which were encountered during the period. Hanging is usually suicidal and strangulation is taken to be homicidal, unless shown otherwise. Obliquity of mark is the best measure for diagnosis of hanging. Discontinuity of mark is also strongly suggestive of hanging. Pale and dry subcutaneous tissue is also a finding of hanging but may also be very less commonly found in ligature strangulation. Transverse ligature mark is a better measure for diagnosis of strangulation. Contusion of subcutaneous tissue and soft tissue underneath the ligature mark is also diagnostic of strangulation but they may also be pale very less commonly, especially when a soft and broad ligature material is used and left tight in-situ in the neck.

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