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Original Research Article

A HOSPITAL BASED PROSPECTIVE STUDY TO FIND OUT THE COMPARISON OF THE PATTERN OF LIGATURE MARK ALONG WITH HISTOPATHOLOGICAL FINDINGS IN CASE OF MECHANICAL ASPHYXIA DEATH AT AJMER REGION IN RAJASTHAN

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ABSTRACT

Background: Every person has his or her own problems which may be due to financial, social, spiritual or psychological reasons but still life is beautiful. One of the major modes of suicidal death is asphyxia and type of asphyxia most commonly encountered in medico legal practice is mechanical asphyxia. Among the means of producing mechanical asphyxia constriction around the neck plays a major role. In this study an attempt has been made to establish the most reliable morphological features for differentiating the pattern of ligature mark in cases of violent asphyxia deaths due to compression of neck by the ligature in hanging and ligature strangulation along with the analysis of the histopathological findings of the neck structures especially in Ajmer region. **Materials and Methods:** This is a hospital based observational study conducted done on all cases of hanging and ligature strangulation reported at department of Forensic Medicine & Toxicology, J.L.N. Medical College, Ajmer (Rajasthan) during two-year period form September 2018 to august 2020 years. Highly decomposed and charred burnt bodies were excluded from the study. Detailed and complete external examination of the body was carried out along with dimensions of ligature mark, neck circumference and site of ligature mark, its pattern and other morphological features. **Result:** Our study showed that the numbers of hanging cases were 24 times more than that of ligature strangulation cases. Ligature in situ was found in 11 (5.72%) cases of hanging. Among 29 cases of typical hanging in 89.65 % cases single ligature mark was present while in remaining 10.35% cases multiple ligature mark were present. In atypical hanging in 97.54% cases single ligature mark was present. The dribbled and dried saliva was found in 131 (68.22%) cases, presence of semen at glance in 67(34.89%) cases and passage of fecal matter in 51 (26.5%) cases of hanging. **Conclusion:** We observed that the incidence, circumstances and post-mortem findings in cases of hanging and ligature strangulation were almost same which was observed by the other recognized authors in the field. In the present study we could not make any comparison between anti-mortem and post-mortem hanging due to no availability of the cases.

INTRODUCTION

Life is full of ups and downs. Every person has his or her own problems which may be due to financial, social, spiritual or psychological reasons but still life is beautiful. But some people could not cope up instead think of ending their life by committing suicide in the phase of unfavorable conditions.

Approximately 1.5% of people died by suicide.[1] This makes suicide the 10th leading cause of death worldwide.[2] Over the past 30 years the incidents of suicide by hanging has increased, especially among young adults.[3] Suicide is the third leading cause of

death in 15-19-year-olds. Rates of committing suicides are generally higher among men than women, ranging from 1.5 times as much in the developing world to 3.5 times in the developed world.[4] The most commonly used method of suicide varies between countries, and is partly related to the availability of effective means.[5] Common methods of suicide include hanging, pesticide poisoning, and firearms.[6,7] One of the major modes of suicidal death is asphyxia and type of asphyxia most commonly encountered in medico legal practice is mechanical asphyxia. Among the means of producing mechanical asphyxia constriction around the neck plays a major role. Three forms of pressure on the neck are of medico-legal importance, namely manual strangulation, ligature strangulation and hanging. Hanging or self-suspension is a form of ligature strangulation where the pressure is produced by the weight of the body itself. It is almost invariably suicidal except in some masochistic accidental cases. But homicidal hanging is extremely rare. All cases of hanging are considered to be suicide until the contrary is proved. Any substance available at hand may be used as ligature. Articles commonly used as ligature are soft materials like dhoti, sari, bed sheet, sacred thread, handkerchief, neck tie or it may be the hard and pliable material like electric cord, belt, wire, leather strap. In short, the material can be anything handy and available near the place of occurrence as the suicide is an impulse mediated act. Hanging is one of the most common methods of suicide. It accounts for 5% to 12% of cases investigated in forensic and legal medicine. Although most of the cases of hanging are suicidal but it may also be accidental or even can be used to conceal crime. Thus, it is vital to systematically perform a forensic autopsy in a case of hanging to determine the actual manner of the death. The ligature mark is a vital piece of evidence especially when the killer has taken away the actual ligature. Taking the most important findings i.e. ligature mark into consideration there are few points like level, discontinuities and obliquity of the ligature mark which differentiate hanging from ligature strangulation. There has been extensive study about external appearance of the asphyxia deaths due to hanging and ligature strangulation but histopathological study of the neck structures in this case are few. In this study an attempt has been made to establish the most reliable morphological features for differentiating the pattern of ligature mark in cases of violent asphyxia deaths due to compression of neck by the ligature in hanging and ligature strangulation along with the analysis of the histopathological findings of the neck structures especially in Ajmer region.

MATERIALS AND METHODS

This is a hospital based observational study conducted done on all cases of hanging and ligature strangulation reported at department of Forensic Medicine & Toxicology, J.L.N. Medical College, Ajmer (Rajasthan) during two-year period form September 2018 to august 2020 years. Highly decomposed and charred burnt bodies were excluded from the study.

Methodology: Various identification data of the victim i.e. age, sex, marital status, resident etc. has been recorded. Suspension of dead body along with place of incidence, time and suspected cause of death were noted from the inquest report accompanying the dead body, the preliminary investigation report submitted by police played a very important role in this regard and other related information were gathered from the victim's attendants. Detailed and complete external examination of the body was carried out along with dimensions of ligature mark, neck circumference and site of ligature mark, its pattern and other morphological features. Routine instrument and material of dissection will be used for internal examination of body. The neck structure was dissected to study the pathology caused by compression underneath the ligature mark. The dissection was done in layers i.e. skin and subcutaneous tissue, muscles of neck, thyrohyoid complex, trachea and larynx. Any fracture of the thyrohyoid complex was noted; appropriate tissue section including samples of skin and subcutaneous tissue, muscles, thyrohyoid complex and cervical lymph nodes from neck beneath the ligature mark was dissected and was preserved in 10% formalin solution for histopathological examination. Routine "Hematoxylin and Eosin" stain was used. A tissue sample was taken from 5 normal cases for comparison as a control.

RESULTS

This is a hospital based prospective study conducted in the department of Forensic Medicine & Toxicology at J.L.N. Medical College, Ajmer over a period of two years from September 2018 to August 2020. During this period 2000 Post-mortem (autopsies) were conducted at the mortuary of J.L.N. Medical College, Ajmer. Out of these 200 cases were of ligature compression around the neck has been included in this study as per inclusion criteria. Among these 200 cases, 192 cases were of hanging and 8 cases of ligature strangulation out of which 3 cases were of homicidal ligature strangulation and 5 cases of accidental ligature strangulation Highly decomposed and charred burnt bodies were not included in this study. Tissue sample were also taken from five (5) normal cases for the purpose of comparison.

Our study showed that the distribution of cases in this study according to the ligature material used for committing suicide by hanging or causing ligature strangulation. These data were compiled from the information furnished by investigating police

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officer, and the fact was further verified by taking history from relatives and other accompanied person or in few cases ligature material was found around the neck i.e. "the ligature in Situ". Ligature in situ was found in 11 (5.72%) cases of hanging. Ligature in "situ" was found in one case of accidental ligature strangulation and in none of the case of homicidal ligature strangulation. Out of 192 cases of hanging in 179(93.22) cases Fixed Knot was found and slip knot were found in 13 % cases. In the present study in all cases of ligature strangulation slip knot was found [Table 1]. In this study according to the standard classification of cases of hanging from point of suspension as revealed from police person, observations, statements of the relatives and accompanied person. Atypical (163 cases, 84.89%) and complete (150 cases, 78.12%) type of hanging is predominant to typical (29 cases, 15.10%) and partial (42, cases 21.87%) type of hanging. Our study showed that among 29 cases of typical hanging in 89.65 % cases single ligature mark was present while in remaining 10.35% cases multiple ligature mark were present [Table 2]. In atypical hanging in 97.54% cases single ligature mark was present. In ligature strangulation in 62.5% cases single ligature mark was noticed and multiple marks in 37.5% cases [Table 3].

In the present study the ligature mark in hanging was placed in upper part of the neck i.e. above thyroid cartilage in 89.58% cases. It was obliquely placed and incompletely encircles the neck in majority of cases. In strangulation the ligature mark was placed on the level of thyroid cartilage in 25% cases and below the thyroid cartilage in 80% cases [Table 4].

Our study showed that the external postmortem findings other than the ligature mark in cases of hanging and ligature strangulation. The dribbled and dried saliva was found in 131 (68.22%) cases, presence of semen at glance in 67(34.89%) cases and passage of fecal matter in 51 (26.5%) cases of hanging. In the present study in none of the case of ligature strangulation dribbling of saliva or evidence of dried marks of salivary stain were found [Figure 1].

Table 1: Type of Ligature Material and Type of Knot Wise Distribution of Cases

Type of Material	Hanging n (%)			Ligature strangulation n (%)			Total n (%)
	Sliding Knot	Fixed Knot	Total	Sliding Knot	Fixed Knot	Total Knot	
Belt	1 (0.52)	-	1 (1.52)	-	-	-	1 (0.5)
Bed sheet	1 (0.52)	5 (2.60)	6 (3.12)	-	-	-	6 (3.00)
Chunni	6 (3.12)	79 (41.1)	85 (44.27)	1 (12.5)	-	1 (12.5)	86 (43)
Cotton rope	2 (1.04)	34 (17.70)	36 (18.75)	3 (37.5)	-	3 (37.5)	39 (19.5)
Muflar	-	2 (1.04)	2 (1.04)	-	-	-	2 (1.00)
Niwar	-	5 (2.60)	5 (2.60)	-	-	-	5 (2.5)
Nylon rope	-	7 (3.64)	7 (3.64)	2 (12.5)	-	2 (12.5)	9 (4.5)
Stole	2 (1.04)	10 (5.20)	12 (6.25)	-	-	-	12 (6.00)
Sari	1 (0.52)	22 (11.45)	23 (11.97)	1 (12.5)	-	1 (12.5)	24 (12)
Wire	-	1 (0.52)	1 (0.52)	1 (12.5)	-	1 (12.5)	2 (1.00)
Swapi/Turban	-	14 (7.29)	14 (7.29)	-	-	-	14 (7.00)
Total	13 (6.77)	179 (93.2)	192 (100.0)	8(100.0)	0	8 (100.0)	200(100.0)

Table 2: Type of Hanging and Point of Suspension Wise Distribution of Cases

Type of Hanging	Point of Suspension						Total
	Hook	Bar/Beam	Branch of Tree	Fan	Railing	other	
Typical	7	2	1	18	1		29
Atypical	16	18	8	115	3	3	163
Complete	18	14	6	109	3		150
Partial	5	6	3	24	1	3	42
Total	23	20	9	133	4	6	192

Table 3: Distribution of Cases of Hanging and Ligature Strangulation According to Ligature Marks

Number of Turns	Hanging		Ligature Strangulation	
	Number	Percentage	Number	Percentage
Single	185	96.35	5	62.5
Multiple	7	3.64	3	37.5
Total	192	100	8	100

Table 4: Relation between Number, Level and Apparent Length of Ligature Mark in Cases of Hanging and Ligature Strangulation

Type of neck compression	Single mark	Multiple mark	Level of Ligature mark			Apparent length		
			ATC	OTC	BTC	<NC	=NC	>NC
Hanging (n=192)	185 (96.35)	7 (3.64)	172 (89.58)	17 (8.85)	3 (1.56)	166 (86.45)	11 (5.72)	15 (7.81)
Ligature strangulation (n=8)	5 (62.5)	3 (37.5)	0 (0.00)	2 (12.5)	6 (75)	5 (62.5)	2 (25)	1 (12.5)
Total	190 (95)	10 (5)	172 (86)	19 (9.5)	9 (4.5)	171 (85.5)	13 (6.5)	16 (8.0)

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NC = neck circumference, TC = Thyroid cartilage, ATC = above thyroid cartilage, BTC = below thyroid cartilage, OTC = on the thyroid cartilage.

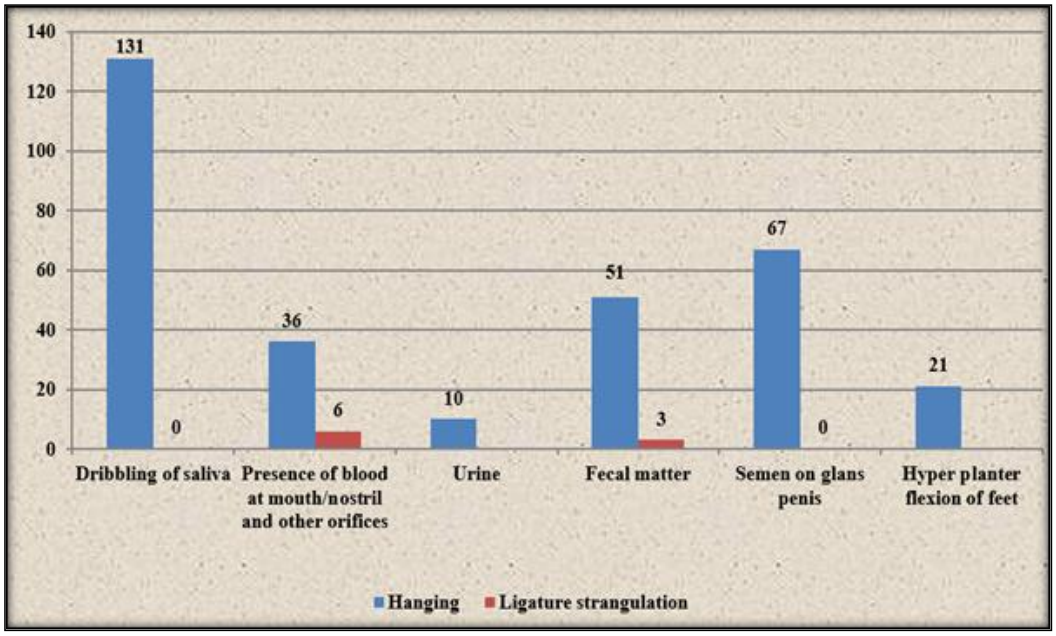

Figure 1: Distribution of External Postmortem Findings in Cases of Hanging and Ligature Strangulation

DISCUSSION

Our study showed that the numbers of hanging cases were 24 times more than that of ligature strangulation cases. This is consistent with the finding of R K Boyal et al 2018,[8] where hanging is 21 times more than that of ligature strangulation while Nawal kumar et al 2018,[9] in their study reported hanging cases 9.58 times than that of ligature strangulation.

The incidence of hanging is more than that of ligature strangulation which is also in accordance with the many other workers reports viz. Sheikh Khaza et al,[10] Gargi et al,[11] Momanchand et al.[12] The incidence of suicide by hanging among all autopsies in the present study was 9.60%. The reason for higher frequency of suicide in our study can be explained, considering various factors such as poverty, unemployment, family disputes, love affair, depression, insanity, drug addiction etc. Low incidence of strangulation can be explained on the basis of peaceful society and lower incidence of heinous crimes in the city of Ajmer.

Ligature in situ was found in 11 (5.72%) cases of hanging. Ligature in "situ" was found in one case of accidental ligature strangulation and in none of the case of homicidal ligature strangulation. Accordingly, in the present study chunni was the most commonly used ligature material for hanging followed by cotton rope, swapi and saree. This is consistent with the finding of Dheeraj D buchade et al,[13] M Ahmad et al,[14] and Ali E et al.[15]

In ligature strangulation the most commonly used ligature material was cotton rope. In study by Shaikh et al,[16] commonest ligature material was Nylon Rope in 35 (53.02%) cases followed by Linen in 21 (31.8%) cases. In study by Sharma B.R. et al,[17] commonest ligature material was Chunni in 17 (30.90%) cases followed by Nylon Rope in 10 (18.18%) cases, Bed Sheet in 9 (16.36%) cases and Jute Rope in 7 (12.73%) cases.

In study by Joshi Rajeev et al,[18] out of 55 cases commonest ligature material was Rope 14 (32.5%) cases, followed by Chunni 8 (18.16%) cases and Parna (Turban) in 5 (11.6%) cases.

Out of 192 cases of hanging in 179(93.22) cases Fixed Knot was found and slip knot were found in 13 % cases. This is consistent with the findings of TH meera et al 2011,[19] where fixed knot and slip knot was observed in 89.28% and 10.71% cases respectively. Ali E et al,[15] reported fixed knot in 32% and slip knot in 59% cases. Vipul Namdeorao et al,[20] observed fixed knot in 64.62% cases and slip knot in 21.3% cases. In the present study in all cases of ligature strangulation slip knot was found. This is consistent with the finding of R K Boyal et al 2018.Our study showed that atypical hanging (84.80%) is predominantly more than typical hanging (15.10%). This is consistent with the finding of Vipul Namdeorao et al 2015,[20] Pal sk et al 2018,[21] Ramakrishna et al2018,[22] and Suresh chand et al2017.[23]

In ligature strangulation in 62.5% cases single ligature mark was noticed and multiple marks in 37.5% cases. In cases of hanging in majority of cases single ligature mark was found which is consistent with finding of various other authors viz. Vipul namdeorao et al,[20] M. Ahmad et al,[14] T Meera et al,[19] B R Sharma et al.[17]

Our study showed that the majority of the cases of hanging the level of ligature mark was found above the thyroid cartilage in the present study as well as study conducted by Ali E et al,[15] R K Boyal et al,[8] B R sharma et al,[17] and Suresh chand et al,[23]

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reported ligature mark above the thyroid cartilage in 50% cases.

Authors have reported that ligature mark in cases of hanging situated higher in the neck usually above the thyroid cartilage level. (Knight B 1996,[24] Modi 2004,[25] Reddy K.S.N. 2003,[26] Parikh C.K. 2005,[27] V.V. Pillary 2007,[28] Nandy A 2010.[29] Where suspension is low, the resulting mark may be set at lower level typically immediately above or below the thyroid cartilage (Knight B 1996[24]).

Jason P.J. et al,[30] has reported that position of ligature mark of hanging depends on how the device was fixed on the suspension point. Reddy K.S.N.[26] has mentioned the ligature mark in cases of hanging is situated above the thyroid cartilage between the larynx and Chin in 80% cases. It may be situated at the level of thyroid cartilage in about 15% cases and below the level of thyroid cartilage is an about 5% case especially in partial hanging.

Various text books (Polson 1985,[31]) describe that the ligature mark in hanging is usually situated in the upper part of the neck above the thyroid cartilage and is directed obliquely upward in 85% cases of hanging ligature mark is above thyroid cartilage, 15% cases at the level of thyroid cartilage and in 5% cases below the thyroid cartilage.

While in strangulation the ligature mark is situated usually low down in the neck below the thyroid cartilage and is horizontally or transversely placed and it usually encircles the neck completely. Commonly there is a single ligature mark; it largely depends on the type of ligature material and nature of death.

In the present study the ligature mark in hanging was placed in upper part of the neck i.e. above thyroid cartilage in 89.58% cases. It was obliquely placed and incompletely encircles the neck in majority of cases.

In strangulation the ligature mark was placed on the level of thyroid cartilage in 25% cases and below the thyroid cartilage in 80% cases.

In studies of Sadikhusen G.momin et al (2012),[32] and Suresh chand et al (2017),[23] in 100% cases of ligature strangulation ligature mark was present below the level of thyroid cartilage.

Our study showed that the external postmortem findings other than the ligature mark in cases of hanging and ligature strangulation. The dribbled and dried saliva was found in 131 (68.22%) cases, presence of semen at glance in 67(34.89%) cases and passage of fecal matter in 51 (26.5%) cases of hanging. This is consistent with the finding of Dheeraj D buchade (2019),[33] and Pal S K et al (2018).[21]

In the present study in none of the case of ligature strangulation dribbling of saliva or evidence of dried marks of salivary stain were found. Features like dribbling of saliva, presence of blood in mouth and nostrils, involuntary discharge (fecal matter, urine, blood, semen etc), hyper planter flexor is medico-legally important in solving the motive and manner in cases of ligature compression of the neck i.e. accidental, suicidal, and homicidal.

Evidence of dried marks of dribbling of saliva is suggestive of anti-mortem hanging as it is occasioned due to pressure upon the salivary gland but its absence alone will not suggest that the body was suspended after death. Moreover, it is more likely to be noticed at the scene of suspension rather than at the autopsy table. Salivation from the angel of mouth may not occur when the death is due to vagal inhibition or injury to the spinal cord.

Distribution of postmortem staining in cases of prolonged suspension of the body in hanging leads to its appearance in glove and stocking pattern is found in many cases in this study but not derived in figure because it is an established mechanism of development and appearance of postmortem staining we did not felt any need to further confirmation and elaboration (Knigh B. 1996, Modi 2000,[25] Vij, K. 2001,[34] Reddy KSN,[26] Parikh C.K. 2007,[27] Nandy, A.2010,[29] Pillary V.V. 2010,[35]).

CONCLUSION

We observed that the incidence, circumstances and post-mortem findings in cases of hanging and ligature strangulation were almost same which was observed by the other recognized authors in the field. In the present study we could not make any comparison between anti-mortem and post-mortem hanging due to no availability of the cases. The varied features in cases of asphyxial death (hanging and ligature strangulation) observed during a meticulous autopsy examination; lead a forensic expert to draw conclusion in cause of death due to violent compression of neck. The present study concludes that a detailed evaluation of the gross and histopathological & radiological findings of the neck structures, if undertaken would be more conclusive in establishing the cause and manner of death to aid in the administration of justice.

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