



Study of Pattern of Ligature Mark and Type of Knot in Hanging in Jodhpur Region of Western Rajasthan

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Introduction

The tripod of life comprises of three vital organs namely brain, heart and lungs. Serious pathological and morphological abnormalities of any part of the body prove fatal due to direct or indirect involvement of either or all of the organs of tripod of life. Essential structures of neck including nerves, blood vessels, and other have a direct or indirect control on the function of respiratory, circulatory and nervous system. The compression of the neck involving the important structures may prove fatal. One of the major modes of 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. Hanging is one of the most common methods of suicide in India; other types of hangings are homicidal hanging, judicial hanging, and autoerotic hanging (**camp et al, 1976**)². Hanging differs from strangulation in which the neck is constricted irrespective of any effect caused by the weight of the

body. The various structures damaged in hanging include the soft tissues like skin, subcutaneous tissue, fascia, muscles, blood vessels, lymph nodes and the bony and cartilage tissues like the hyoid bone and larynx (**A. Keithmant, 1984**)¹.

As till now very less studies has been carried out in Jodhpur region of Rajasthan regarding pattern of ligature mark and type of knot in Hanging. A study of pattern of ligature mark and type of knot in Hanging has been undertaken.

Keywords: Hanging, Ligature, Neck, Medico-Legal, knot.

The aims and objectives of study

1. To find out the incidence of hanging in Jodhpur region of Western Rajasthan.
2. To study the pattern of ligature mark and type of knot in Hanging.
3. To compare the pattern of ligature mark and type of knot in Hanging, found in the present study with other similar studies by different workers.

Review of literature

Hanging is a form of death produced by suspension of the body by a ligature round the neck, constricting force being the weight of the body (or a part of the body weight). Hanging is best defined as the constriction of neck by a ligature tightened by the weight of the body. **Sharma et al**³ studied 2668 medico-legal cases during 1997-2004 and observed that 91 cases (3.4%) deaths were due to hanging.

The hanging can be classified on the basis of the position of the knot used or according to the degree of suspension of the body or according to the intention / motive for causing hanging.

According to point of suspension- (i) **Typical Hanging** -When the point of suspension is over the centre of occiput, there is a maximum possibility of occlusion of the arteries and this is known as typical hanging. In this, ligature runs from the midline above the thyroid cartilage symmetrically upwards on both sides of the neck to occipital region. (ii)**Atypical Hanging** - In this type, the point of suspension is at any place around the neck other than center of occiput.

According to extent of suspension- (i)**Complete Hanging** -In hanging from a high point of suspension, the victim is either fully suspended with his feet clean off the ground. (ii) **Partial Hanging**-In hanging from a low point of suspension, a comparatively little force about 4.5 kg is enough to occlude blood vessels of the neck. The term partial hanging is used for such cases in which the bodies are partially suspended or for those in which bodies are in sitting, kneeling, prone or any other posture.

According to the intention/motive – (i) Suicidal (ii) Homicidal (iii) Accidental

Fimate L.⁵The common place for hanging are domestic but extra domestic sites like desolated places,

jungles, abandoned building and yards etc., are not uncommon. In case of suicidal hanging the victim usually chooses time when none else is in around. Ceiling bars or hooks, branch of tree, ceiling fan, arch or bar of door frame are common points of suspension observed by **Gerald feigin, (1999)**⁶. The neck is stretched, elongated and the head is always inclined to the side opposite to the knot. **Saini O P et al (2005)**¹⁸

Ligature Material - Ligature material which may be any substance that is available at the time of impulse has been used by the suicides as a ligature for hanging. Ligature material tied around the neck with some additional length for fixing it to the point of suspension. This may be rope, metallic chains and wires, leather straps, belt, bed sheet, scarf, dhoti, sari, turban, sacred thread, dupatta, newar, handkerchief, shirt, neck tie, cord of pajamas etc. **C.J. Polson (1985)**¹⁵ has reported a case in which a baby slipped out of its high chair and was suspended on the edge of its table. **Gerald et al (1999)**⁶ reported few uncommon ligature material i.e. shoe laces, bed sheet and panties. 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. **Saini O.P. et.al. (2005)**¹⁸. Any deviation from the running noose or noose fixed by a granny or reef knot demands a careful interpretation. Occasionally there may be more than one turn around the neck and/ or more than one knot imparting corresponding complexity to the mark on neck. A running noose can tighten at the time of suspension and may then produce a mark which takes a horizontal turn but it is likely to be above the thyroid cartilage **O.P. Saini, et.al. (2005)**¹⁸. The common site for the knot is the right or left side of the neck or at occiput, suspension by a knot below the chin is very rare. Occasionally death in vehicular accident is due to

hanging when victim is suspended by steering wheel of a car. Verma S.K. et al²⁴ has reported a case of accidental hanging in lift. As in all of these cases of hanging without ligature material. The marks of hanging on victim were restricted to the front of neck.

Ligature mark-Ligature mark depends on the nature and position of the ligature used, and the time of suspension of body after death. If the ligature is soft, and the body cut down from the ligature immediately after death, there may be no mark. Again, the intervention of a thick and long beard or clothes on the neck leads to the formation of a slight mark. Sometimes, the pattern of the ligature material is impressed on the skin and a characteristic diagonal mark of the strands found when the rope is used. The wide band of cloth when used as a ligature on the bare skin may cause a narrow ligature mark, due to tension lines in the stretched cloth. The mark is superficial and broad, if a cloth or a soft rope is used. The mark is a groove, or furrow, the base is pale, hard leathery and parchment like, and margins are red and congested. Ecchymoses and slight abrasions in the groove are rare, but may be found in some cases for instance in judicial hanging. Ecchymoses alone have no significance as to whether hanging was caused during life or not but abrasions with hemorrhage are strongly suggestive of it having taken place during life. Sharma G A et al (2002)¹⁹, Sharma B.R. et. al. (2005)²¹. Usually only one mark is found. Multiple marks may be present due to multiple turns around the neck or upward displacement after application due to fall. The mark is usually situated above thyroid cartilage between larynx and the chin and is directed obliquely, upwards following the line of mandible and interrupted at the back or may show an irregular impression of a knot, reaching the mastoid processes behind the ears towards the point of suspension. The mark may be found on or below the thyroid cartilage, especially in case of partial hanging. It

may also be circular if a ligature is first placed at the nape of neck and then its two ends are brought horizontally forwards and crossed, and carried upwards to the point of suspension from behind the angle of the lower jaw on each side. The mark will be circular and oblique if a ligature is passed round the neck more than once. In this case, there may be evidence of skin bruises whenever it is caught between the ligatures. Near the position of the knot, it is like an inverted "V". **Internal Appearance of Neck-** The subcutaneous tissues under the ligature mark are usually dry, white and glistening, if the body has been suspended for a long time.

Material and method

The present study has been conducted in the department of Forensic Medicine and Toxicology at Dr. S.N. Medical College and attached Hospitals (MGH and MDMH) Jodhpur during the period of 1 January to 31 December 2017. During this period a total number of 104 cases of hanging and ligature strangulation were observed, which are brought for postmortem examination through various police stations of Jodhpur with alleged history of suicide by hanging. Highly decomposed and charred burnt bodies were not included in this study. A detailed history regarding socioeconomic status, marital status, habits, prevailing mental illness, suicidal note etc. were enquired from the police/ other persons ie. relatives/public etc.

Inclusion criteria

1. All cases brought with history of suicide by hanging.
2. Cases diagnosed as suicide by hanging after post mortem examination.

Exclusion Criteria

Unclaimed, unknown, highly decomposed and charred burnt bodies without relevant history.

Observation

Photograph depicting external & internal findings under the ligature mark



T-1, Ligature material specific observation

Type of Ligature Mark	Hanging		
	Fixed Knot	Slip knot	Total
Cotton rope	49 (49.00)	2 (2.00)	51 (51.00)
Chunni	31 (31.00)	2 (2.00)	33 (33.00)
Sari	5 (5.00)	–	5 (5.00)
Nylon rope	2 (2.00)	–	2 (2.00)
Plastic rope	3 (3.00)	–	3 (3.00)
Lungi	3 (3.00)	–	3 (3.00)
Bed sheet	1 (1.00)	–	1 (1.00)
Niwar	2 (2.00)	–	2 (2.00)
Total	96 (92.30)	4 (3.85)	100 (96.15)

T-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	
Typical	4	2	0	6	0	12
Atypical	9	19	0	58	2	88
Total	13	21	0	64	2	100
Complete	11	20	0	56	1	88
Partial	2	1	0	8	1	12
Total	13	21	0	64	2	100

T-3, Distribution of cases of hanging according to ligature marks

Type of hanging	Ligature mark		Total
	Single	Multiple	

Typical	9 (81.82)	2 (18.18)	11 (100.00)
Atypical	85 (95.51)	4 (4.49)	89 (89.00)
Total	94 (94.00)	6 (6.00)	100 (100.00)

T-4, Distribution of cases of hanging according to ligature marks

Number of Turns	Hanging	
	Number	Percentage
Single	91	91.00
Multiple	9	9.00
Total	100	100.00

Discussion

In this present study, the Cotton Rope was the most commonly used ligature material for hanging and in 51 (49.04%) cases followed by Chunni 33 (31.73%) and Sari in 5 (4.80 %) cases. In this study the Cotton Rope is exclusively used for committing suicide by hanging because of Cotton Rope is easily available in Indian house hold situation and it also ensure that the act (compression of neck) will be successfully accomplished just like judicial hanging. Chunni is the common part of the dress of the female in Rajasthan and other part of North India. In study by **Joshi Rajeev et al⁸** 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. In study by **Shaikh et al²⁰** 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 al²¹** 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. Our study is in accordance **Joshi Rajeev et al⁸**. Ligature material was present in -Situ in 13 (12.50 %) cases of hanging.

Tabata et al (1998)²³ observed ligature material in-Situ in 19.9% cases of compression of neck, similar to our study. In this present study, out of 100 cases of hanging atypical type of hanging found in 88, (88%) cases and typical type of hanging in 12, (12%) cases. Complete type of hanging found in 88, (88%) cases and partial type of hanging in 12, (12%) cases. Accordingly atypical hanging predominant to typical hanging and complete hanging predominant to partial hanging. The most commonly chosen point of suspension in this study is Ceiling Fan 64 (64%) cases followed by Beam 21 (21%) cases and then Roof Hook 13 (13%) cases. Our study is compared with **Naik S.K. et al (2005)**¹¹ who reported 7.39 cases of typical hanging and 92.6% cases of atypical hanging similarly **Jani et al**⁷ has reported 9 (39.2%) cases of typical and 14 (60.8%) cases of atypical hanging. In both of the study, the higher incidence of atypical hanging can be explained on the basis of easy access of tying of knot on either side of the neck than the occipital region. Study was conducted by **Naik S.K. et al (2005)**¹¹ the death due to complete hanging (93.53 %) cases and partial hanging (6.47%) cases. Jani et al⁷ has reported 14 (60.8%) cases of complete hanging and 9 (39.2%) cases of partial hanging. In this study to the higher incidence of complete hanging can be explained due to belief that it would ensure death just like judicial hanging. As per information gathered from the police inquest officers, relatives and the findings of neck. Among the 100 cases of hanging, 91 (91%) cases had single mark around the neck and 9 (9%) cases had multiple marks. In typical type of hanging single mark observed in 11 (91.67%) cases and multiple mark, 1 (8.33%) cases. In atypical type of hanging single mark observed in 80 (90.91%) cases and multiple marks in 8 (9.09%) cases. This study suggests that single mark is

more common than multiple marks in cases of hanging. In this study 100% cases of hanging found oblique direction of the ligature mark and in which the complete encirclement of the neck found in 2 (2%) cases and in 98 (98%) cases it was incomplete. The obliquity of the ligature mark is a constant feature of hanging. This aspect of study has not been carried out by any workers, hence not compared, but it is mentioned in the some text books **Reddy KSN (2007)**¹⁶, **Dixit P.C. (2007)**⁴ **Parikh C.K. (2000)**¹³, **Nandy A (2010)**¹², **Modi (2015)**¹⁰. Out of 100 cases of hanging, the ligature impression were found above the thyroid cartilage level in 98 (98%), cases, followed by on the thyroid cartilage, 2 (2%) cases and in none of the case it was found below thyroid cartilage level. Authors have reported that ligature mark in cases of hanging is situated higher in the neck usually above the thyroid cartilage level. (**Knight B 1996**⁹, **Simpson K, 1997, Parikh C.K 2005**¹³, **Reddy K.S.N. 2007**¹⁷, **V.V. Pillay 2007**¹⁴, **Nandy A 2010**)¹². **Modi 2015**¹⁰. Where suspension is low; the resulting mark may be set at lower level typically immediately above or below the thyroid cartilage (**Knight B 1996**⁹, **Anthony B William S. 2009**)²⁵, **Nandy A 2010**¹². **Jason P.J. et al**⁴¹ has reported that position of ligature mark of hanging depends on how the device was fixed on the suspension point. **Reddy K.S.N. 2007**¹⁷ 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 in about 5% case especially in partial hanging. In study carried out by Etienne Martin (1950) in 80% cases, the level of ligature mark was above thyroid cartilage, in 15% cases at the level of thyroid cartilage and in 5% cases below the level of thyroid

cartilage. Various text books (Modi 1997¹⁰⁶, Poison 1985⁷⁶) 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, in 15% cases at the level of thyroid cartilage and in 5% cases below the thyroid cartilage. In the present study the ligature mark in hanging was placed in upper part of the neck i.e. above thyroid cartilage in 98% cases. It was obliquely placed and incompletely encircles the neck in majority of cases. The gap in the continuity of the ligature mark were observed in 98 (98%) cases of hanging irrespective of their typical and atypical type or complete/ partial type. It is also a well known fact that the discontinuity along the course of the ligature mark is another important criterion while describing the ligature mark of hanging. This study is more or less similar to the study done by **S.K. Nayak 2006**¹¹ which showed presence of discontinuity in 88.9% cases of hanging deaths and absent in 11.11% cases. This fact i.e. discontinuity highly indicating of hanging but is absence neither rules out hanging nor conclude strangulation. This is in accordance with the other authors of the text books "Ligature mark of hanging almost never completely encircles the neck." (**Knight B, 1996**⁹, **Simpson K, 1997**²², **Jason P.J., Anthony B, Williams 2008**)²⁵. However when a slipping knot is used then it may cause the noose to tighten and squeeze the skin through the full circumference of the neck. In most instances the point of suspension is indicated by a gap in the ligature mark (**Knight B 1996**⁹, **Simpson K 1997**²², **Nandy A. 2000**¹², **Modi 2015**¹⁰). Discontinuity along the course of the ligature mark due to interposing clothing, scalp or beard hairs or fingers of victim in hanging. **Knot :-** Fixed knot were found in 96 (96%) cases of hanging

where as slip knot were found in 4 (4%) cases. The impression of the knot, as inverted "V" shaped impression found in five (5) cases of hanging. Keeping in mind the forecast of the handedness of the person who has committed suicide by hanging, the impression of knot inverted "V" found on neck is also studied and in all the five (5) cases in this study it was correctly forecasted.

Thus it was observed that the incidence, circumstances and post-mortem findings in cases of hanging were almost same which was observed by the other recognized authors in the field. The varied features in cases of asphyxial death (hanging) observed during a meticulous autopsy examination, lead to a forensic expert to draw conclusion in cause of death due to hanging.

Conclusion

The study concluded with the following conclusions:-

1. **Cotton rope** (49.04%) was the commonest ligature used in hanging and followed by Chunni (31.73%) and Sari (4.80%).
2. Majority of cases in hanging apparent length of ligature mark found less than below neck circumference (96%) cases.
3. In all cases of hanging (100%) ligature mark was oblique in direction.
4. Single mark was common (91%) in hanging.
5. Atypical (88%) and complete (88%) type of hanging was predominant to typical (12%) and partial (12%) type of hanging respectively.
6. In hanging ligature mark was found above thyroid cartilage level in (98%) cases. It was obliquely placed and incompletely encircles the neck in majority of cases (98%).
7. Discontinuity presents in cases of hanging 98 (98%).

8. In hanging the color of the ligature mark was reddish-brown in majority of cases. Parchmentisation was common in hanging. Thus it was observed that the incidence, circumstances, type and pattern of ligature mark and knot in cases of hanging were almost same which were observed by the other recognized authors in the field. The present study concludes that a detailed evaluation of the type and pattern of the ligature mark and knot, 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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