

**AN ANALYTIVAL STUDY OF LIGATURE MARK IN CASES OF HANGING & LIGATURE STRANGULATION**Y. K. C. Rangaiah<sup>1</sup>, R. Shankar<sup>2</sup>, L. C. Obulesu<sup>3</sup>**HOW TO CITE THIS ARTICLE:**

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**ABSTRACT:** Deaths by ligation of neck are in practice from the time immemorial and before advent of civilization. In uncivilized societies, the application of ligation for taking away the life of another person was one of the commonest practices which were successfully carried out into the civilized societies. Earliest it was a homicidal method as suicide was considered as a heinous act. Ligature mark is a pressure abrasion produced on the neck by ligature material due to force either from weight of the body or external energies. More over the impression was ligation leads to wind pipe constriction for which manual violence is needed. When compared to other modalities of un-natural deaths, death by ligation was found world-wide popularity and is one of the preferred methods to take or take away the life. This study is conducted in the department of Forensic Medicine and Toxicology, Gandhi Medical College & Hospital, Secunderabad. The period of analytical study of ligature mark in cases of deaths due to hanging and ligature strangulation is from Jan. 2012 to Dec.2012. The total number of autopsies done during the year of 2012 is 4950, among the total Autopsies hanging & ligature strangulations deaths were 522. A detailed study of these 522 cases of deaths due to hanging and ligature strangulation were analyzed with special reference to 'ligature mark'.

**KEYWORDS:** Asphyxia Deaths, Deaths Due To Hanging, Ligature Materials Used, Suicide, Accidental & Homicidal.

**INTRODUCTION:** In monarchies and feudal societies, the ligations were carried out publicly not only as a mean of punishment but also to terrorize the people.

For an autopsy surgeon, cases of hanging by ligature are a common encounter. The difficulty increases many folds when one has to differentiate ligature mark of suicidal hanging from ligature strangulation, particularly when associated with other bodily injuries occur in both occasions. Ligature mark is a vital piece of evidence in ligature strangulation when killer has taken away the actual ligature.<sup>1</sup> Taking the most important finding i.e. ligature mark into consideration, there are few points which differentiate hanging from ligature strangulation like-level, discontinuity, obliquity of the mark etc. Significant percentage of lock up deaths had been reported in the state of Andhra Pradesh by ligature application. Many conditions like passion disappointments, loss of property, misfortune, financial losses, poverty, disgust with life, physical and mental sufferings, religious mania, unhappy love, failures in many aspects, marital problems, jealous, unbearable fear and pain are some of the common known reasons for an individual who were tempted to put an end to his or her life by suicide by hanging which is one mode of self-killing. In conditions like revenge, jealous, adultery, loss of faith, religious mania, unhappy love are some of the known reasons for ligature strangulations. In the present study we concentrated to discuss and find conclusions about some of the features of ligature mark in hangings and ligature-strangulations.<sup>2</sup>

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We also discussed about marital status, socio-economic status, manner of death, ligature material and other associated injuries. Hanging is that form of asphyxia which is caused by suspension of the body by a ligature, which encircles the neck, the constricting force being the weight of the body, where the whole weight is not necessary. Weight of the head (5kg to 6kg) is enough to act as a constricting force. So death happens in partial hangings also, which are on toes, feet touching, kneeling, sitting and lying down postures. Many deaths of sexual asphyxias are of partial hangings.

Symptoms of hanging starts with loss of power and subjective sensations, followed by flashes of light, ringing and hissing of noises in the ears, mental confusion, loss of consciousness, which is so rapid, thus it is regarded as a painless form of death.<sup>3</sup> Stage of convulsions follow face is distorted and livid, eyes prominent and there is violent struggling. Respiration stops before heart, which may continue to beat for 10-15 min.

Causes of deaths in hanging & ligature strangulation are asphyxia, venous congestion, cerebral anaemia, reflex vagal inhibition, fracture or dislocation of the cervical vertebrae. Delayed deaths are rare, if occurs, are due to aspiration pneumonia, infections, oedema lungs and larynx, hypoxic encephalopathy, brain infarction, brain abscess and cerebral softening. In persons who survived, secondary effects like hemiplegia, epileptic form convulsions, amnesia, dementia, cervical cellulites, parotitis and retro pharyngeal abscess are soon. Usual fatal period in hanging is 3-5 minutes.

During external examination of autopsy, mark over neck is a very important and specific sign of death from hanging & ligature strangulation, Ligature mark depends upon-composition of ligature, width and multiplicity of ligature, weight of the body suspended, degree of suspension, the tightness of the encircling ligature, length of time body has been suspended, position and type of the knot. Ligature Mark is deep and near horizontal on the opposite side, with inverted 'V' on the side of the knot, where apex of the v corresponds with the position of the knot. Knot impression may be found if the ligature is tight on the skin. In 80% Of the cases, mark is situated above the thyroid, between the larynx and chin, at the level of thyroid in 15% cases and in 5%, it is below thyroid, especially in partial suspensions.<sup>4</sup> A portion of skin and deeper tissue should be examined microscopically for evidence of vital reaction, indicating ante-mortem hanging. Neck should be examined after emptying three cavities i.e., cranial, thoracic and peritoneal cavities. Superficial small haemorrhages in the underlying layers of skin are produced directly by ligature. Only in 5% - 10% cases, bruising of strap muscles of neck were noticed. In 5% - 10% cases intima of carotid shows transverse splits.<sup>5</sup> Vertebral arteries also shows tears and sub intimal haemorrhages. Fractures are rare below 40 years of age, usually a direct result of ligature pressure but it can be traction or 'tua' fracture. Generally superior horns of thyrohyoid are fractured. The abdominal organs are congested, but brain congested. Sub-Arachnoid effusions are common. Hangman's fracture also noticed in some.

Strangulation is caused from constriction of neck by a ligature without suspending the body. Mark generally encircles the neck transversely but is more prominent on front and sides than back, where skin is thick and tough. Any material like cloth or hair may intervene between ligature and skin and mark may not be encircled totally.<sup>6</sup> Crossing over impression of two uniting points of ligature is characteristic but overlapping is also observed in some cases.<sup>7</sup> Internal examination of neck structures reveals severe engorgement and haemorrhages into the tissues. Brain shows congestion and Petechial haemorrhages. Out of 83 hanging cases only 12% had fractures (of thyroid mostly, hyoid and cervical lastly. In ligature strangulation, rarely a narrow ligature may be used, the so called "cheese cutter method".<sup>8</sup>

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Strong pressure may lacerate the skin or cut into the deeper tissues and cartilages. Petechial haemorrhages are usually found immediately adjacent to the ligature mark, which is confirmation that the mark was made during life.

**Experiments:** We have conducted 876 autopsies in the dept. of Forensic Medicine and Toxicology, Gandhi Medical College & Hospital, during the period of 2012 and noted the findings where the cause of deaths are alleged as deaths due to hangings and ligature strangulations

**These Cases are analyzed keeping in View of the Following:**

- History obtained from relatives, Visit of scene of crime in suspicious cases, Description of scene of crime, injuries over body, last seen alive, first seen dead and other information from the inquest report, Postmortem findings in the Autopsy reports, Suicide notes, if any, present, Study of case sheets, where death occurs in hospitals, as a complication of hanging.

**RESULTS AND OBSERVATIONS:** There are 4950 post-mortem examinations done at Gandhi Hospital Mortuary in the year of 2012. Among them 522(10.6%) cases are hanging (10%) and ligature strangulation (0.6%) cases. Maximum number (209) cases of hangings (i.e. 42.3%) occurred in 21-30 years of age group people especially in males (122 cases). And it is followed by 31-40 years age group people (122 cases, i.e. 25%). Least number (2) of cases (i.e. 0.38%) occurred in 51-60 years of age group people (i.e. only in males). Maximum number (11) of cases occurred in 51-60 and 61-70 years of age group peoples especially in males (). No cases occurred in 0-10 and 71-80 years age group people's maximum number (122) of hanging cases (i.e. 24.8%) occurred due to family problems. Among them males were more (86 cases). Least number of hanging cases (19 i.e. 3.8%) occurred due to mental illness. Among them females were least (4 cases i.e. 0.8%). Maximum number (6) of ligature strangulation cases (i.e. 20.8%) occurred due to financial disputes and all were in males. Least number (1) of ligature strangulation cases occurred due to personal affairs and mental illness. Hyoid fracture present in 2.6% of hanging cases and 3.4% cases of ligature strangulations. Thyroid fractures are present in 17.2% of ligature strangulations and 0.6% cases of hangings. In hanging, most of them are suicidal (i.e. 468 cases, 94.9%), least are accidental (0.4%) and medium are homicidal (2%). In ligature strangulations, most of them are homicidal (75%) and least is suicidal (6%).

**DISCUSSION:** In the department of Forensic Medicine, Gandhi Medical College & Hospital, post mortems conducted in the year of 2011 are 4259, in 2012 are 4950 and in year 2013 (up to October 2012) are 4950. Out of these the total number of asphyxial deaths from hanging and ligature strangulation are 9.2%, and 10% in years 2011 & 2012 respectively. This clearly shows urban trauma on human psychology which is to be dealt is in the purview of psychologists and sociologists. Maximum number (209) cases of hangings (i.e. 42.3%) occurred in 21-30 years of age group people especially in males (122 cases). And it is followed by 31-40 years age group people (122 cases, i.e. 25%). Least number (2) of cases (i.e. 0.38%) occurred in 51-60 years of age group people (i.e. only in males). Maximum number (11) of cases occurred in 51-60 and 61-70 years of age group peoples especially in males. No cases occurred in 0-10 and 71-80 years age group peoples. This is obvious because as it is a period of transformation in human calendar during which vulnerability from stress is more. This applies to both males and females.<sup>9</sup>

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This is followed by the adolescent period of female sex; this may be due to early physical and mental maturity with influence of emotional factors, in female sex. The incidence of ligation deaths is minimal in the extremes of life. In the early childhood (below 10 yrs.) the deaths are either homicidal or accidental in nature as emotions have no important role to play. As in hanging the deaths from the ligature strangulation are seen in middle age group they are rare in extremes of life. This is in accordance with general homicidal pattern but the contradicting feature is preponderance of male sex in ligature strangulation.<sup>10</sup> When asphyxia is adopted as homicidal mode, the female sex is usually subjected to throttling or smothering as they offer less resistance. Maximum number (340) of hangings occurred in married (i.e. 68%) especially in males (210 cases i.e. 42%). Least number (10) of cases (i.e. 2%) occurred in unknown males. And no cases occurred in unknown females. Maximum number (19) of cases (i.e. 66%) occurred in married peoples and among them 17 cases (i.e. 59%) were males. And least number (4) of cases (i.e. 13%) occurred in unknown people.<sup>11</sup>

Maximum number (396) of cases (i.e. 75.9%) occurred in Middle class people. Among them 389 cases were hangings and 7 were ligature strangulations. Least number (9) of cases (i.e. 1.7%) occurred in Upper class family. Among them 4 were due to hanging and 5 were due to ligature strangulations. Maximum Number (122) of hanging cases (i.e. 24.8%) occurred due to family problems. Among them males were more (86 cases). Least number of hanging cases (19 i.e. 3.8%) occurred due to mental illness.<sup>12</sup> Among them females were least (4 cases i.e. 0.8%). Maximum number (6) of ligature strangulation cases (i.e. 20.8%) occurred due to financial disputes and all were in males. Least number (1) of ligature strangulation cases occurred due to personal affairs and mental illness. In males family disputes are leading cause, where as in females, harassment is the leading cause, particularly in married women. Male sex is more vulnerable to matters connected with money, where as it is least important for female sex. With regard to other factors like personal affairs, health and mental illness, the trend is same for the both the sexes. Maximum numbers (420) of cases were complete type hangings and 15% cases were partial hangings. Postures of deceased among the partial hangings were feet touching (51%), sitting (20%) and kneeling (10%). Contrary to expectation in females also complete suspension is the choice of order and the preference for high point of suspension is due to non-availability of a low point, intention to enact the crime in secrecy and dilemma of the desired effect with low point<sup>13</sup>. The two cases of accidental hanging observed in the study are partial in nature and the victim in case of accidental hanging are either children while playing or adults under the influence of alcohol or other drugs. In case of partial hanging in two thirds of cases, feet are seen touching the ground followed by kneeling position.<sup>14</sup> Nature of Ligature material is soft in most of the cases (322, i.e. 61.7%), among these 309 cases were hanging and 13 cases were ligature strangulations. And it is hard in few cases i.e. 18 (3.4%). Nature of ligature material the preferred choice is a soft material like cloth followed by firm materials like rope. Hard materials like iron wires, cable wires, etc. are used very rarely and the victims are almost always of male sex only. Encirclement of ligature mark is complete in 29 cases (i.e. 5.9%) and incomplete in 464 cases (94.1%). With regard to course of ligature is partial in nature with interruption either over nape of the neck or on the side of the knot. In 5.9% of cases, it is complete in nature around the neck with knot of slip variety only. In present study of ligature strangulation which is of male sex, the ligature mark is complete with crossing over or overlapped ends, but this phenomenon is not seen in cases of hanging with completely encircled ligature mark.<sup>15</sup> Hence crossed ends or overlapped ends of ligature mark can be considered as diagnostic of manual violence.

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Ligature mark present above the thyroid cartilage in 430 cases of hangings (i.e. 87.2%) and in 9 cases of ligature strangulations (i.e. 31%). At the level of the thyroid cartilage, 47 cases (i.e. 9.5%) in hanging and 5 cases in ligature strangulations (17.2%). Below the thyroid cartilage, 16 hanging cases (i.e. 3.3%) and 15 ligatures strangulation cases (51.8%). In all the 4 cases of ligature strangulation in present study, the ligature mark is present over or below the level of thyroid cartilage (75%). So it is rather course of the ligature mark on the neck than the position of the mark which helps in coming to a conclusion regarding the nature of the application<sup>8</sup>. Pattern of ligature mark seen only in 51 cases of hangings (i.e. 10.3%) and absent in 442 cases (i.e. 89.6%). Ligature mark is present in 5 cases (i.e. 17.2%) and absent in 24 cases (82.8%).

Mouth is closed in 48.3% of ligature strangulation cases. 48.3% of ligature strangulations were shown tongue inside the open mouth and 17.2% of cases tongue clinched between teeth. In 27.6% of ligature strangulations, protruded tongue was seen. In 444 cases (90.1%) of hanging does not shown any other injuries but only 49 cases (9.9%) were shown other injuries. In 18 cases (i.e. 62.1%) of ligature strangulations shown injuries other than ligature mark and in 11 cases (37.9%), other injuries are absent. In case of deaths from hanging, the injuries are present over limbs and scalp in the form of small abrasions or contusions and trivial in nature. Hyoid fracture present in 2.6% of hanging cases and 3.4% cases of ligature strangulations. Thyroid fractures are present in 17.2% of ligature strangulations and 0.6% cases of hangings. In hanging, most of them are suicidal (i.e. 468 cases, 94.9%), least are accidental (0.4%) and medium are homicidal (2%). In ligature strangulations, most of them are homicidal (75%) and least is suicidal (6%).

### CONCLUSIONS AND SUGGESTIONS:

1. In ligation deaths suicide by hanging is fast developing as a preferential mode, particularly in urban conglomerates, over taking other modalities like poisoning, burning and drowning etc. as it is considered as a pain less death and can be accomplished with minimal effect. In contrast, homicidal deaths from ligation are becoming rare and replaced by other modalities like stabbing, shooting or blunt evidence, as it is violence not only within the reach of arm but also of the actual body contact and influenced by other factors particularly the victim – aggressor's body ratio.
2. Ligation deaths from hanging are most common in the middle age group, the period of an emotional outlet and outburst, and almost are suicidal in nature. In contrast, hanging deaths in the formative period i.e. in childhood, mostly accidental in nature and in the reconciliation period i.e. old age, are suicidal.
3. The homicidal ligation deaths from ligature strangulation are seen in middle age group, the victims are mostly males (c.f. female in manual strangulation). Animosity, envy, extra marital relationships etc. are the usual predisposing factors as in other homicides.
4. In ligation deaths by hanging, male preponderance is seen but this does not confirm the increased suicidal tendency in male sex because the preferred mode for female sex is 'conflagration'.
5. The incidences of suicidal ligation deaths from hanging are more common in the middle income group as they are the fulcrum of the society with wavering or oscillating mentality. Comparatively, low or high strata of the society are at the ends of the community balance with little upsets and down falls.

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6. The leading predisposing factor for mortality is harassments in case of females, family and financial problems in case of males, leading to physical or mental stress in the both sexes.
7. Irrespective of sex, complete hanging is the choice and partial hanging is opted when environment is not conducive for complete hanging.
8. Soft materials are the preferred choice for ligation, particularly sari in married group. Bed sheets, dhotis and chunnis in unmarried group. Hence the marital status of the deceased and the nature of the ligature material can also be used as indicator in arriving to the manner of death.
9. Atypical hangings are more particularly with knot on left side. There by typical hangings with knot over the occipital region or under the chin usually allow suspicion as it is a deviation from normalcy.
10. An interrupted ligature mark over and above thyroid cartilage is diagnostic of hanging, whereas the completely encircling mark over and below the thyroid with crossing over or overlapping ends are hall marks of ligature strangulation.
11. It is not customary to get an imprint of ligature mark with a patterned ligature material. The presence of pattern over ligature mark has a positive value but its absence has more negative value.
12. The grooving of the skin produced by ligature material depends more on area of contact and duration of suspension rather than the consistency of the material.
13. Symptoms like clinched teeth or protrusion of tongue can be considered as indicator rather than specific either for hanging or ligature strangulation.
14. The presence of bodily injuries other than ligature mark should be given a consideration if they are severe and have a direct bearing with the ligature mark.
15. Despite the fact that practically all hangings are suicidal, occasionally accidental, and rarely homicidal and involve only the victim. But question may arise whether that specific hanging is really suicide and not something else, implying that the possibility of homicide has not been excluded to the satisfaction of the person asking questions. This can be answered by performing a complete autopsy which reveals or exclude other causes of death.

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