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Original Research Article

Analysis of compression injuries over neck: One-year prospective study

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ABSTRACT

In compression of neck cases with faint or absent ligature mark on the neck and with minimal internal findings it may be difficult to opine about the cause and manner of death. Many times, in forensic practice, cases occur where there is allegation from maternal side of married woman particularly in cases of dowry deaths, where relatives claim that it is a case of post-mortem hanging. In such cases there is importance of clubbing the gross findings. These findings may be helpful in arriving at conclusions in such unsolved and doubtful cases. The present study was conducted in Department of Forensic Medicine and Toxicology of a Government Medical College and Hospital in year 2017. Total 2781 postmortem examinations were conducted in 2017. Out of that total 2781 cases, 176 compression of neck cases came for postmortem and amongst these 105 cases were studied in detail as per inclusion criteria. Out of 105 cases of compression around neck, which were studied, there were 93 cases of hanging, 10 cases of ligature strangulation, 01 case of manual strangulation and 01 case of accidental strangulation studied. Out of total 105 cases, 66 were males and 39 were females. In this study maximum cases of neck compression were observed in 21 to 30 years age group (30 cases). Intimal tear of carotid artery was observed in 11 cases of hanging and no carotid artery intimal tear was found in case of strangulation. In the present study, fracture of hyoid bone alone was found in total 11 cases of which 06 cases were in hanging, 05 cases were in strangulation. Fracture of thyroid cartilage was found in 03 cases of which 02 cases were of strangulation and 01 case of throttling. No case of cricoid cartilage fracture either alone or in combination to fracture of throat skeleton was observed in the present study.

1. Introduction

Death by compression of neck may arise from ligature or manual strangulation, hanging, blow upon neck, arm locks and variety of accidental lesions such as, entanglement with cords or falling on to neck. Although deaths due to compression of neck are classified under asphyxial deaths, yet it is not the sole element involved. This is one of the most complex and controversial areas of asphyxial death, as mechanism is uncertain and frequency of such deaths makes them common problem for both Forensic experts and Jurist.[1] Unlike hanging, strangulation should be assumed to be homicidal until contrary is proved. The distinction between hanging and ligature strangulation is utmost important to ascertain the manner of death. Ligature applied to neck within two hours of death will usually produce ligature mark. Postmortem suspension of body may be used by criminals to mislead the investigating agency and to hide the crime. In some cases, hanging may be homicidal and in all such doubtful cases, examination of scene of crime becomes important as a circumstantial evidence.[2] A great challenge rests in front of forensic experts in cases of asphyxial deaths to establish the cause and manner of death. The various features of hanging and strangulation deaths that are available from the case history, police investigation, gross findings and internal findings can lead a forensic expert to the conclusion of

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compression of neck as the cause of death. However, doubtful cases which test the mettle of forensic expert do always exist. In cases with faint or absent ligature mark on the neck and with minimal internal findings it may be difficult to comment about the cause and manner of death. Many times, in forensic practice, cases occur where there is allegation from maternal side of married woman particularly in cases of dowry deaths, where relatives claim that it is a case of post-mortem hanging.[3] In such cases there is importance of clubbing the gross findings with histopathological findings. These findings may be helpful in arriving at conclusions in such unsolved and doubtful cases. In this study socio-demographically compared the gross changes in neck structure, gross observation in skin, strap muscle, sternocleidomastoid muscle, common carotid artery and esophagus. Correlation between various ligature materials and internal neck structure also studied.[4]

2. Materials and Methods

This observational study was conducted in Department of Forensic Medicine, Government medical college and hospital in year 2017. Total 2781 brought for postmortem examination and amongst them 105 (3.77%) cases were studied as per inclusion criteria of all brought dead cases of unnatural deaths due to compression of neck brought for medico legal autopsy to the mortuary of Government Medical College and hospital. Exclusion criteria were bodies brought with 1) decomposition 2) hospitalization 3) having trauma over neck, extreme overstretching, or whiplash-injuries in vehicular accident, neck surgery, pathological lesion. Standard Performa was designed to collect the information of cases regarding age, sex, occupation, marital status, residence status rural, urban, place of occurrence, circumstances of death, type of ligature material, manner of death. The examination of ligature material, whenever available was carried out in this study.

External and internal examination of neck structure was carried out to note injury over neck, extravasation of blood in soft tissue, muscle, common carotid artery, fracture of throat skeleton was examined in situ in en block. Carotid artery was observed with reference to intimal tear by using Methelyne blue insufflation (Special dye) by naked eye examination and fractured neck structure were dissected with care at autopsy. The study was carried out on medicolegal cases brought for postmortem examination by police with inquest and proper requisition; hence no consent was necessary to obtain from relatives or any other authority in this particular study. However, as per the prevailing mandatory standard procedures of the Institute, the prior permission cum no objection certificate to carry out the study was obtained from Institutional Ethical Committee.

3. Results and Observations

3.1. Age and sex

Total 2781 cases were studied in 2017 and among them 105 cases were studied. Out of them 66 were males and 36 were females. The age and sex related data given in table no. 1 and 2. The mean age of male 59.09, female was 25.94 and standard deviation of male 17.20 and female 08.97 (Table 1). Maximum 30 cases (28.57%) were observed in age group 21 to 30 years. No any case was observed above 80 years age group. No any female case observed above 51 years age group. Common age group in both sexes, i.e. male and females was 21-30 years followed by 11-20 years. Male preponderance was observed in all age groups except 11-20 years age group. (Table 2)

3.2. Manner of neck compression

Table 3 shows, out of total 11 cases of homicide, 11 cases were of ligature strangulation, 01 case of accidental ligature strangulation and 01 cases were of manual strangulation (throttling). No case of homicidal hanging was found. Out of total 93 cases of suicide, all the cases were of hanging. Out of 105 cases of compression around neck, which were studied, there were 93 cases of hanging, 11 cases of homicidal neck compression (10 cases of strangulation and 01 case of manual strangulation) of which 7 were female in majority and accidental strangulation was 01 case. Out of total 105 cases of violent asphyxial deaths due to neck compression 66 were males. Out of total 93 suicides, 61 were males and 32 were females with male: female ratio 1: 0.52.

3.3. Occupation

Figure 1 shows common working group found dead due to compression of neck was farmers 29 (27.62%) followed by laborers 23.

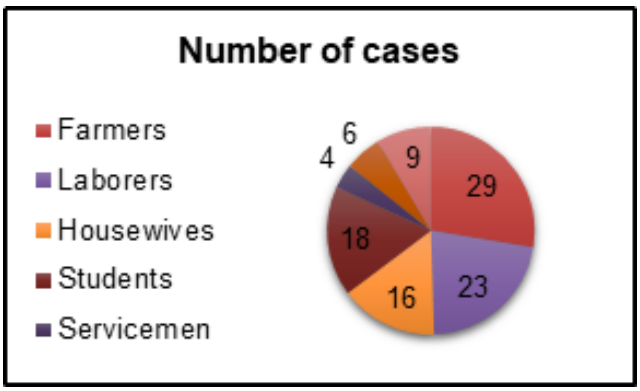

Fig. 1: showing occupation wise distribution of cases

Table 1: Number of cases and mean age of population

Sex	Number of cases %	Age in years		Standard Deviation
		Mean	Range	
Male	66 (62.85%)	59.09	3.5 to 80	17.20
Female	39 (37.14%)	25.94	13 to 50	08.97
Total	105	31.11	3.5 to 80	15.17

Table 2: Percentage wiseage and sex distribution of cases

Age in years	Males (77.91)	Females (22.09)	Total (100%)
0 to10 yrs	03 (02.85)	00 (00)	03 (02.85)
11 to 20 yrs	13 (12.38)	14 (13.33)	27 (25.71)
21 to 30 yrs	15 (14.28)	15 (14.28)	30(28.57)
31 to 40 yrs	14 (13.33)	7 (06.66)	21 (19.99)
41 to 50 yrs	09 (08.57)	03 (02.85)	12(11.42)
51 to 60 yrs	08 (06.66)	00 (00)	08(06.66)
61 to 70 yrs	02 (01.90)	00 (00.00)	02 (01.90)
71 to 80 yrs	02 (01.90)	00 (00.00)	02(01.90)
Above 80 yrs	00(00.00)	00 (00.00)	00(00.00)
Total	66 (62.85)	39 (37.14)	105 (100)

Table 3: Showing cases according to cause and manner of compression

Cause of death in compression to neck	Homicide (n=11)		Suicide (n=93)		Accident (n=1)	
	Male	Female	Male	Female	Male	Female
Hanging (n=93)	00	00	61	32	00	00
Ligature Strangulation (n=11)	04	06	00	00	01	00
Manual Strangulation (n=01)	00	01	00	00	00	00
Total (105)	04	07	61	32	01	00

3.4. Residence

In this study most of the victims 73 (69.53%) were from urban area and rural area 32(30.47%).

3.5. Marital status

In the present study**,** out of total cases, married males were 43 (40.95%) and married females were 25 (23.80%), One case was of divorced and two cases of widowed.

3.6. Place

Figure 2 shows out of 105 cases of compression of neck, the maximum incidence of cases 66 occurred in their home.

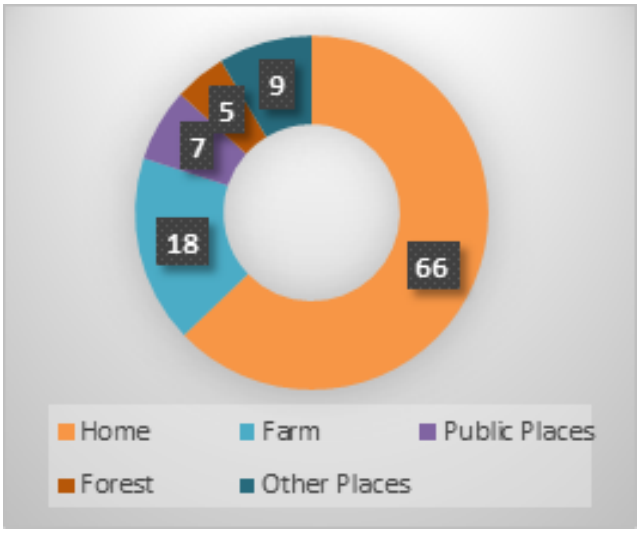

Fig. 2: Place of occurrence of cases

3.7. Type of ligature material

Figure 3 shows the most common ligature material used by victim or assailant for compression of neck was nylon rope in 51 (48.57%) cases followed by soft material like Shela.

Type of ligature material used in compression of neck cases.

3.8. Type of ligature mark and ligature knot

Table 4 shows that there was fixed type of noose in total 48 (45.72%) cases, out of which 11 were showing complete ligature mark of around the neck and 37 shown incomplete

Table 4: Relation of type of ligature mark with type of ligature knot

Type of ligature knot	Type of ligature mark		Total
	Complete Mark around neck	Incomplete mark around neck	
Fixed	11 (10.48%)	37 (35.24%)	48 (45.72%)
Running	27 (25.71%)	10 (09.52%)	37 (35.23%)
Not known	7 (06.67%)	13(12.38%)	20 (19.05%)
Total	45 (42.86%)	60 (57.14%)	105 (100%)

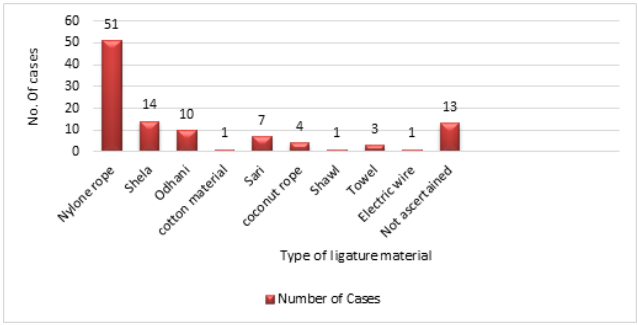

Fig. 3: Type of ligature material used in compression of neck cases

mark around the neck. Similarly, there was a running type of noose in total 37 (35.23%) cases, out of which 27 were showing complete ligature mark around the neck and 10 shown incomplete ligature mark around the neck. Of total 27 cases where exact knot type could not be ascertained, 15 cases were that where ligature material itself was not known and in 11 cases knot was opened by the relatives or police officers.

3.9. Particulars of ligature mark

Table 5 shows the ligature mark was present above the level of thyroid cartilage in 81 cases (77.14%), at the level of thyroid cartilage in 18 cases (17.14%) and only in 06 cases (05.72%) mark was below the thyroid cartilage. The ligature mark was obliquely placed in 97 cases (92.38%) and horizontal in only 08 cases (07.62%). In relation to depth of ligature mark, in 79 cases (75.24%) deep, grooved mark was found and it was shallow in 26 cases (24.76%) out of which in five cases ligature mark was too faint.

3.10. Signs of asphyxia

Table 6 shows cyanosis was present in 75 of cases, external or internal petechiae were found in 90 of cases. Out of total cases of hanging, 65 cases were found with signs of cyanosis, internal petechial hemorrhage, fluidity of blood, congestion and edema; all cases of throttling and strangulation (11) were present with signs of cyanosis, internal petechial hemorrhage, Subconjuctival hemorrhage, fluidity of blood, congestion and edema. Out of 93 cases of hanging, dribbling of saliva was present in 36 (38.70%) cases. This study observed the dribbling of saliva in the form of dried saliva stains; opposite to the position of noose in cases.

3.11. Neck soft tissue injuries

Table 7 shows out of 93 cases of hanging, in 20 cases subcutaneous tissue hemorrhage were observed. 09 cases show hemorrhage in the strap muscle and 64 cases shows no hemorrhage. Out of 11 cases of manual strangulation, all casesshow hemorrhage in subcutaneous tissue and neck muscles. Intimal tear of carotid artery was evident in 11 cases of hanging. No carotid artery intimal tear was found in case of strangulation.

3.12. Throat skeleton fracture

Table 8 shows fracture of hyoid bone alone was found in 11 cases, of which 06 cases were in hanging, 05 cases were in strangulation. Fracture of thyroid cartilage was found in 03 cases of which 02 case was of strangulation and 01 case of throttling. 93 cases of hanging were no fracture found and 04 cases of strangulation were no fracture found. No case of cricoid cartilage fracture either alone or in combination to fracture of throat skeleton was observed in the present study.

4. Discussion

Out of 105 cases of compression around neck we observed 66 males and remaining 39 females. Findings of this current study are similar to the findings of male predominance as observed in the studies Batra et al. (2003)[5] (male to female ratio 1: 0.19), Sharma et al. (2005)[6] (66.66% males), Ambade et al. (2008),[6] Uzun et al. (2007)[7] and Sharma et al. (2008)[8] but, findings of Naik et al. (2005)[9] reported higher number of females in hanging as well as strangulation cases; differ from this study findings.

In this study, almost 75% cases were observed to be from age group 11 to 40 years. Out of which maximum cases (30 cases) were from age group of 21 to 30 years, whereas only few cases were observed in extremes of age groups i.e. 3 cases in age group 00 to 10 and 2 cases in group 61 to 80 years. This was similar to the findings of studies from various parts of India reported by Ambade et al. (2008)[10] and Sharma et al. (2008)[8] and NCRB report 2015.[11] The

Table 5: Particulars of ligature mark in cases

Particulars of Ligature mark		No. of cases	Percentage (%)
Level of mark over neck	Above the level of thyroid	81	77.14
	At the level of thyroid	18	17.14
	Below the level of thyroid	6	05.72
Direction	Obliquely placed	97	92.38
	Horizontally placed	08	07.62
Depth	Grooved	79	75.24
	Shallow	26	24.76

Table 6: External and internal signs of asphyxia in cases

Asphyxial signs on Autopsy examination	Present in no. of cases	Percentage (%)
Cyanosis	75	71.42
Dribbling of saliva	36	38.70
External or internal petechial (under scalp, brain matter, pleura, pericardium, larynx)	90	85.71
Fluidity of blood	96	91.42
Congestion and edema	92	87.61
Combination of cyanosis, internal petechial hemorrhage, fluidity of blood, congestion and edema. (Hanging)	88	83.80
Combination of cyanosis, internal petechial hemorrhage, Subconjuctival hemorrhage, fluidity of blood, congestion and edema. (Strangulation)	10	09.52
Combination of cyanosis, internal petechial hemorrhage, Subconjuctival hemorrhage, fluidity of blood, congestion and edema, abrasions over neck. (Throttling)	01	00.95

Table 7: Neck soft tissue injuries in cases

Neck findings at Autopsy	Hanging (n=93)		Strangulation (n=11)		Throttling(n=1)		
	Present	%	Present	%	Present	%	Total
a) Hemorrhage in subcutaneous tissue	20	21.50	11	100	01	100	32
b) Hemorrhage in strap muscle	09	09.67	11	100	01	100	21
c) Hemorrhage in sternocleidomastoid muscle	00	00	11	100	00	00	11
d) Hemorrhage in esophagus	00	00	00	00	00	00	00
e) No hemorrhage	64	68.83	00	00	00	00	64
Total	93	100	11	100	01	100	105
Carotid Artery intimal tear with Methylene blue insufflations by naked eye examination	Present	Absent	Present	Absent	Present		Absent
	11 (11.82%)	82 (88.18%)	00	11 (100%)	00		00

Table 8: Throat skeleton fracture in relation to compression of neck

Throat skeleton fracture	Compression of neck			
	Hanging (%)	Strangulation (%)	Throttling (%)	Total (%)
Fracture of hyoid	06(05.71)	05 (04.76)	00	11 (10.47)
Fracture of thyroid cartilage	00 (0.00)	02 (01.90)	01(00.95)	03 (02.85)
Cricoid fracture	00 (00)	00 (00)	00	00 (00)
Fracture of throat skeleton in combination with cricoid fracture	00 (00)	00 (00)	00	00 (00)
No fracture	87(82.87)	04 (03.80)	00	91(86.67)
Total	93(88.58)	11 (10.47)	01(00.95)	105 00)

present finding does not match with Bowen A (1982).[12] Who reported high incidence of hanging deaths over age of 50 years in males and in age group of 40-49 years in female.

In this study most of the victims 73 were from urban area and rural area 32. However, we haven't come across any study regarding distribution of locality with regards to such cases.

In the present study**,** out of total 105 cases, 68 individuals were married and 34 individuals were unmarried. This study coincides with studies of Vijayakumari (2011)[13] Bardale et al. (2011)[14] and TSaisudheer et al (2012).[15]

As per as occupation of victims is concerned farmers were found to be most affected group contributing 29 (27.62%) out of total 105 cases. According to NCRB 2015, 13% of total suicide victims were from the group engaged in Farming/Agricultural activities.[11]

In the present study out of 105 cases of compression of neck, 62.85% of cases occurred at the house of residence of deceased. Similar findings were observed by Cooke et al. (1995),[16] Uzen et al. (2007).[7]

In present study most commonly encountered ligature material in the form of nylon rope which was observed in 51 (48.57%) cases. These findings coincide with the study of Dixit et al. (2001)[17] and Cooke et al. (1995).[16]However, our findings differ from study by, Sharma et al. (2005)[6] Shaw and Danielle M. (2005).[18]

Complete ligature mark was found to be more prevalent than incomplete ligature mark i.e. in 60 and 45 cases respectively. Out of 60 cases where incomplete ligature mark was found, in most of the cases (37) noose was found to be fixed whereas out of 37 cases of incompletely ligature mark fixed knot was observed only in 11 cases. Sharma et al (2005)[6] reported lower incidence of completely encircling ligature mark (16.48%). Text books authors like Reddy[1] states that the ligature mark completely encircling the neck is usually common with running type of noose because the noose moves towards the neck due to weight of body and thus completely constricting the neck; giving complete ligature mark. In presence study running knot was found to be most commonly associated with complete ligature mark around the neck.

As we have come across maximum number of hanging cases in our study, ligature mark was found to be above the level of thyroid cartilage 81 (77.14%) cases. As far as direction and depth of the ligature mark is concerned it was obliquely placed in 97 (92.38%) cases and was deeply situated in that of 79 (75.24%) cases. Similar findings were reported by Sharma et al. (2005)[6] Elfawal et al. (1994)[19] Dixit et al. (2001).[17]

Out of 93 cases of hanging, dribbling of saliva was present in 36(38.70%) cases. These observations in this regard are consistent with observations of textbook authors like KSN Reddy.[1] In the present study, cyanosis was present in 75 cases. Congestion and edema of internal organs was present in 92 of the cases. Fluidity of blood was observed in 96 cases. Forensic textbooks like Nandy A[20] K S N Reddy[1] that post-mortem fluidity of blood is not characteristic of asphyxia or any other cause of death for that matter, but rather the result of a high rate of fibrinolysis and may be found in other many conditions. External or internal petechiae were found in 90% of cases, Petechial hemorrhages beneath the pleura and pericardium were regarded by Tardieu [1866] Luke and his colleagues (1985)[3] observed that petechiae were common with incomplete hangings. In textbooks of Reddy[1] quoted that petechiae were common with incomplete hangings. The hemorrhages were reported in muscles in 32 (30.47%) cases, which correlate with Nikolic et al (2003)[21] 33.70%, Sharma et al (2005)[6] 34.00% cases, However Samarasakera and Cooke (1996)[22] reported higher number of cases with hemorrhages (52.00%). The hemorrhages were reported in this study, which correlate with Dixit et al (2001)[17] included all 11 cases of strangulation had soft tissue hemorrhage (100%) correlating with findings of Verma et al (2006), Dixit et al (2001)[17] Intimal tear of carotid artery was evident in 11 (11.82%) cases of hanging, which likely correlates with that of Nikolic et al. (2003)[21] 7.43%, but not correlates with Jani and Gupta (2003)[23] reported high incidence of tear in carotid artery (47.8%).

In the present study, fracture of hyoid bone alone was found in 11 cases, of which 06 cases were in hanging, 05 cases were in strangulation and in no any case of throttling. Which correlate with that of Dixit et al. (2001)[17] Morild I (1996).[24] The present study findings do not correlate with Sheikh et al. (2001)[25] Azmak (2006)[26] Fracture of thyroid cartilage alone was found in 03 case cases of which both cases were of strangulation and one case of throttling which correlating with Feigin (1999)[12] but does not correlate with Morild I (1996)[24] Dixit et al. (2001)[17] Elfawal et al (1994)[19] Bowen BA (1982)[27] Naik et al. (2005)[9] did not find any fracture of hyoid bone or thyroid cartilage in their study. In our study, 87 cases of hanging and 04 cases of strangulation were no fracture found which coincides with study of T Saisudheer (2012).[15]

5. Conclusion

The most common manner of neck compression is suicidal. Hanging (88.57%) is the most common among death due to compression of neck studied. One case of throttling observed in present study. No case of accidental hanging was reported in present study. Eleven case of ligature strangulation found in present study including one case of accidental strangulation. Hanging is one of the preferred methods of suicide by males than females. Male cases outnumbered in female cases in hanging but in strangulation female cases outnumbered male cases. The highest number of cases was found in the age group 21-30 years. Economic Problems, unemployment, failure in love, failure

in examination, alcohol addiction and emotional instability were the alleged reasons for committing suicide in this age group.

More number of cases was found in farmers. Poverty, failure of crops either due to floods or droughts coupled with chronic psychiatric problems related to chronic alcoholism contribute to higher incidence of suicides in farmers.

Any secluded place is preferred to commit suicide by hanging. In our study, the most commonly preferred place of hanging was home. In this study commonly used ligature material is nylon rope (48.57%). In each and every case of ligature compression death, which was studied it was found with at least one of the classical signs of asphyxia however decomposed cases were excluded in present study. Signs of asphyxia are not pathognomic of violent asphyxia, but they still should recall this possibility, especially so in doubtful cases with faint or no ligature mark over neck.

In this study, the ligature mark in most of the cases was directed obliquely (92.38%). Fracture of throat skeleton is common in completely suspended bodies than partially supported bodies and resulted from rapid and forceful constriction of the neck, the ligature supporting the entire body weight and the more force acting on the throat skeleton in this type of hanging. There was no significant difference in hyoid bone horn fracture in relation to position of knot. The most common internal neck finding in neck compression deaths is sternocleidomastoid hemorrhage. In 11 cases of strangulation hemorrhages were observed on gross. Carotid artery injury was present in 11.82% cases of hanging.

6. Source of Funding

None.

7. Conflict of Interest

None.

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