

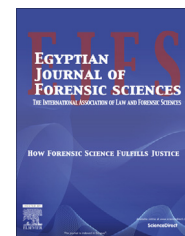
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An autopsy study of death due to Suicidal Hanging – 264 cases

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KEYWORDSHanging;
Ligature mark;
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Neck;
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Abstract The present study was carried out between 2010 and 2013, a total of 7968 Autopsies were conducted of which 3.31% ($n = 264$) cases were deaths due to hanging. The most preferred ligature materials were Stole ($n = 79$) and Bed spread/Sari ($n = 68$). In 88% of the cases, hanging was complete. Females ($n = 136$) and males ($n = 128$) were equally affected. The major age group involved in both the sexes was of 31–40 years, contributing to 50.76% ($n = 136$) of the self suspension. In 80.58% ($n = 213$) of the incidents, ligature mark showed discontinuity (incomplete). A Slip type of knot was used in majority of the noose, contributing to 97.73% ($n = 258$) of the suspensions. In 87.88% ($n = 232$) of hanging an oblique shaped ligature mark was noticed. The horizontal and near oblique ligature marks were seen only in cases of partial suspension. In 95.45% ($n = 252$) of the cases, the ligature mark showed blackening of the skin (friction burn). Only 4.54% ($n = 12$) showed intact skin. The outer layer of the skin over the ligature mark showed displacement in majority of the cases. Married victims contributed to 70.45% of cases. Domestic issues were the commonest reason ($n = 82$) for self suspension, of which female ($n = 68$) formed the majority of victims. In 70.83% ($n = 187$) of cases damage to neck muscle fibers and hemorrhage at the Sternal end of the Sternocleidomastoid muscle were present. In 85.61% ($n = 226$) of cases the cervical vertebra was intact. In 52.27% ($n = 138$) of the cases the internal carotid artery showed transverse tear. In 99.42% ($n = 248$) cases the thyroid cartilage was found intact. The hyoid bone was damaged in 6.06% ($n = 16$) of the victims. Majority of the victims, 59.09% ($n = 156$) belonged to low socioeconomic class.

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1. Introduction

Death due to hanging is not unusual across the world, this makes the majority of Asphyxia deaths.¹ Many a times

suspensions are raised with the manner of deaths in cases of suspension of the body (complete and partial) and position of ligature marks, resulting in punishment of Innocent or sparing the Guilt. Hence this study is conducted to study in detail the Autopsy findings of deaths due to hanging so as to put an end to these speculations surrounding the deaths in hanging.² This study helps to differentiate self suspension from other forms of hanging. This is a prospective study, conducted between 2010 and 2013. In this study only cases of Suicidal

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Hanging findings are analyzed and studied thoroughly, other manners of suspension are excluded. All the information related to the Circumstances was collected from the Police and from the deceased's family members. All factors deemed important to conclude Suicidal Hanging had been considered as the elements of the study (Fig. 1).

2. Materials and methods

- The study was conducted between 2010 and 2013. A total of 7968 Autopsies were conducted of which Suicidal Hanging contributed to 3.31% ($n = 264$) of cases.
- All the cases referred to the Legal Medicine Department for Autopsies were the material source for the study.
- Crime scene examination was done in a few cases and in majority of the cases crime scene photographs and investigating officer records were the inputs.
- Autopsies were conducted with enmasse removal of Thoracic and Abdominal Organs and the neck was the last to be dissected after removal of the Cranial Structures.
- External findings of the ligature mark were described, photographed and sketched.
- Internal findings of the neck by layer by layer dissection of the neck.
- Carotid artery damage to the Intimae was by gross examination and Toluidine blue dye examination.
- Cervical vertebra fracture, thyroid, cricoid and hyoid bone fractures were confirmed by Radiological examination and further confirmed through the dissection method.

- The ligature material was always brought along with the dead body with the noose and knot intact (Table 1).

3. Results

- The commonest ligature materials of choice were Stole ($n = 79$; 29.92%) and Sari ($n = 68$; 25.76%). The least common ligature material of choice was Waist Belt ($n = 2$; 0.76%). The other materials used were Plastic Rope ($n = 28$; 10.68%), Bed Sheet ($n = 22$; 8.33%) and Cotton Rope ($n = 19$; 7.20%) in decreased order of appearance. The majority of the noose had a Slip type of knot contributing to 97.73% ($n = 258$) of the suspensions and only 2.27% ($n = 06$) showed fixed knot (Table 2).
- Females ($n = 136$) and males ($n = 128$) were closely the victims of self suspension. The major age group affected in both the sexes was in the range of 31–40, contributing to 50.76% ($n = 136$) of the self suspension. The age group preferred for self suspension was between 21 and 30 years, contributing to 31.06% ($n = 82$) of the cases. The least affected ages were in children less than 10 years ($n = 01$). There were no incidents reported above 60 years of age (Table 3).
- In 80.58% ($n = 213$) of cases the ligature showed discontinuity (incomplete) and only 19.32% ($n = 51$) showed complete ligature (Continuity) mark. The oblique shape of ligature mark was present in 87.88% ($n = 232$) of hanging. 6.82% ($n = 18$) of cases showed horizontal ligature mark in partial suspension and 5.30% ($n = 14$) of cases showed near oblique ligature mark. The horizontal and near oblique ligature marks were seen only in cases of Partial Hanging. In

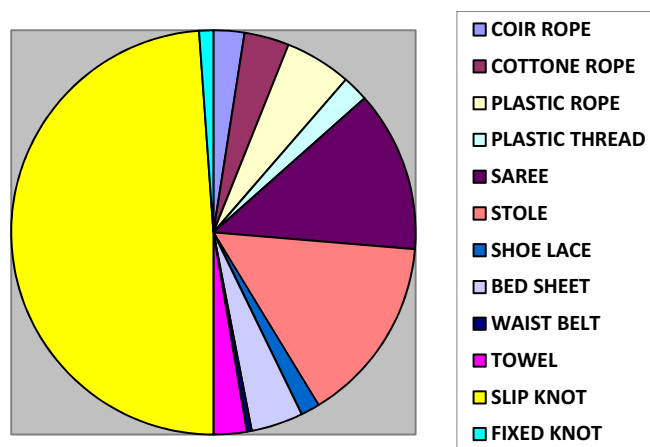


Figure 1 Types of ligature material and knot type.

Table 1 Age and sex distribution.

	< 10 years	11–20	21–30	31–40	41–50	51–60	> 60
Age	01	21	82	134	24	02	00
Male	01	12	18	86	09	02	00
Female	00	09	64	48	15	00	00
Total	01	21	82	134	24	02	00

Total: Male-128; Female-136.

Table 2 Morphology of the ligature mark.

Ligature mark	No.	Percentage (%)
Complete mark	51	19.32
Incomplete (Discontinuity)	213	80.68
Oblique shape	232	87.88
Horizontal shape [partial suspension]	18	6.82
Near oblique shape [partial suspension]	14	5.30
Above the thyroid cartilage	218	82.58
Over the thyroid cartilage	27	10.22
Below the thyroid cartilage	19	7.20
Abrasion/Excoriation	249	94.31
Grooving	249	94.31
Leathery hard and pale	249	94.31
Color change – blackening	252	95.45
Heaping of Epithelium in margins	249	94.31
Right side accumulation of Epithelium	162	61.36
Left side accumulation of Epithelium	84	31.81
Undisplaced epithelium	18	6.82
Intact skin	12	4.54

Table 3 Type of hanging, socioeconomic class, places of self suspension and marital status.

Complete Hanging	232	88%
Partial Hanging	32	12%
Married	186	70.45%
Unmarried	78	29.55%
Out of house	26	9.85%
Inside house	242	91.67%
Work place	06	2.27%
Low income class	156	59.09%
Middle income class	242	91.67%
High income class	18	6.82%

94.31% of cases the ligature mark ($n = 249$) was characterized by Excoriation (Abrasion), Grooving, Leathery hard consistencies, Paleness and showed heaping and displacing of the superficial part of the skin around the ligature mark. In 82.58% ($n = 218$) of cases the ligature marks were situated above the thyroid cartilage. Only 7.20% were situated below the thyroid cartilage, whereas 10.22% ($n = 27$) were situated over the thyroid cartilage. In 95.45% ($n = 252$) the ligature mark showed blackening of the skin (friction burn). Only 4.54% ($n = 12$) showed intact skin. The displaced epithelium was unidirectional, 162 cases showed rightward displacement and 84 cases showed leftward displacement, and 18 showed no sign of displacement of the epithelial tissue (Table 4).

- Of the total 264 cases of self suspension, 88% of the hanging were complete and 12% were due to Partial Hanging. Majority of the victims, 59.09% ($n = 156$) belonged to poor or low socioeconomic class, and 34.09% ($n = 90$) belonged to average class. Only 6.82% ($n = 18$) were from the High Income Group. In 91.67% ($n = 242$) of cases, the incidents occurred inside the house, the least preferred place was work place in 2.27% (06). And the other preferred place was outside the House in 9.85% ($n = 26$). Majority of the victims were married comprising 70.45% of the cases and only 29.55% of the cases were unmarried (Table 5).
- The domestic issues were the commonest factor responsible ($n = 82$) for hanging, of which female ($n = 68$) formed the

Table 4 Motivating Factors.

Motivating factors	Male	Female
Domestic (Dowry related)	14	68
Love relationship	15	49
Financial	32	04
Education/career	10	08
Work related	08	02
Disease related	22	32

Table 5 Internal findings in the neck.

Neck tissue	No.	Percentage (%)
Sternocleidomastoid	187	70.83
Thyroid cartilage	2	0.76
Hyoid bone	16	6.06
Cricoid cartilage	00	00
Carotid artery	126	47.73
Cervical vertebra	38	14.39

major share of victims. This was followed by love/relationship related issues ($n = 64$), here too females formed the major part of the victims ($n = 49$). The other major contributing factors were the disease conditions ($n = 54$) of the victims compelling to hanging. Other factors like financial issues ($n = 38$), education/career issues ($n = 18$) and work related issues ($n = 10$) contributed to self suspension.

- 70.83% ($n = 187$) of cases showed contusion, damage to muscle fibers and hemorrhage at the Sternal end of the Sternocleidomastoid muscle. 85.61% ($n = 226$) of cases showed the cervical vertebra intact, only 14.39% ($n = 38$) showed fracture involving cervical vertebra. In 52.27% ($n = 138$) of the cases the internal carotid artery showed transverse tear. 99.42% ($n = 248$) cases showed intact thyroid cartilage, only 0.76% ($n = 02$) showed damage to thyroid cartilage, similarly in 93.94% ($n = 248$) of cases the hyoid bone was intact. The hyoid bone was damaged in 6.06% ($n = 16$) of the victims. None of the victims showed damage to the cricoid cartilage in self suspension.

4. Discussion

The present prospective study was conducted between 2010 and 2013. A total of 7968 cases were autopsied of which deaths due to hanging comprised 3.31% ($n = 264$) of Autopsies. Similar studies conducted by Hassan et al.³ in a two year period in Kuwait reported a total of 118 cases. In another study conducted by Kumar and Verma⁴ in Lucknow (India) a total of 4405 cases were autopsied in a five year period of which only 10% of cases were due to hanging. Dean et al.⁵ had studied on 229 cases. Hence regional socioeconomic and Cultural factors play an important role in Suicidal Hanging. Hence the present study is unique due to its highest number of case studies as compared to the other studies elsewhere in the world. The present study is compared with the other studies conducted elsewhere in relation to various incidences surrounding Suicidal Hanging in Table 6. In the present study the commonest choice of ligature material used was female dress (soft)

Table 6 Comparison of results of the present study with similar studies conducted in different parts of the world.

Author	Place of study	No. of cases	Ligature material	Ligature, knot and its position	Age	Sex	Ligature mark shape	Site of ligature mark	Skin and ligature mark	Type of Suspension	Marital status	Socioeconomic class	Sternocleidomastoid	Thyroid/cricoid/hyoid bone	Internal carotid artery	Cervical vertebra
Present Study	Jamaica/India	264	Stalk (n = 79), 29.92% and Saree (n = 682; 76%)	Slip knot in 97.73; Fixed knot in 2.27% cases	21-30 years, contributing to 31.06%	Females-51.5%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Kurtulus et al. ¹ , Jayaprakash ² , Srekhumar ³	Turkey India	108 189	49% jaisee, shawl, lunged 29% (cotton rope, Plastic Rope, telephone cable)	Slip knot in 97.73; Fixed knot in 2.27% cases	40.97 ± 17.41 years Middle age in 64.9%	71.66% 70.9%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Abd-Elwahab et al.	Kuwait	118		Slip knot in 97.73; Fixed knot in 2.27% cases	21 and 50 years (87.3%) 3rd Decade-45%	73%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Dem et al.	USA	229		Slip knot in 97.73; Fixed knot in 2.27% cases	21 and 50 years (88.7%) 4th Decade (about 36%)	86.46%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Al Madani et al.	Saudi Arabia	133		Slip knot in 97.73; Fixed knot in 2.27% cases	21 and 50 years (88.7%) 4th Decade (about 36%)	86.46%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Praffan et al.	Nepal	44	47.72%:- ROPE; 31.81%:- used shawl; 9.09%:- used Sari; Belt-2.27% or Sari (32%) or chuna (24%)	Slip knot in 97.73; Fixed knot in 2.27% cases	21-30 years-57%	63%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Sharma et al.	India	72	86%:-the ligature material was soft	Slip knot in 97.73; Fixed knot in 2.27% cases	21-30 years-57%	63%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Saisudher ⁴ , Nagaraja ⁵	India	200 cases		Slip knot in 97.73; Fixed knot in 2.27% cases	21-30 years-57%	32%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Olive Bennewith et al.	UK	162	Rope-98.8%; Cord-49.4%; Belt -13.1% Electric cable- 11.9%	Slip knot in 97.73; Fixed knot in 2.27% cases	42-40 years	Males (40.6 years) and females (42.2 years)	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Suminska - Ziemann, Blich-Bogusawska Nikolij ⁶ , Zivkovic Charonmate N et al.	Poland Serbia Thailand	61 20		Slip knot in 97.73; Fixed knot in 2.27% cases	42-40 years	Males-89%	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Nikolic S et al.	Belgrade	557		Slip knot in 97.73; Fixed knot in 2.27% cases	Average age of 52.4 ± 17.8 years	74%-Males	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)
Hajna Suarez-Peñaranda et al.	Czech Republic Spain	178 228		Slip knot in 97.73; Fixed knot in 2.27% cases	Average age of 52.4 ± 17.8 years	74%-Males	87.38%-oblique shape; 6.82%-Horizontal Suspension, remaining near oblique suspension	82.38%-Above the hyoid cartilage; 10.22% across the hyoid cartilage	94.31%:- Excoriation, Grooving, Leathery hard consistence, Paleness and showed heaping and displacing of the epidermis. 80.83%:- Desquamation 95.65%:- stowed Buckening-friction	88% of the hanging were Complete and 12% were due to Partial Hanging	Married- 70.45%	59.09% (n = 156) belonged to Poor or Low socioeconomic class and 34.09% (n = 89) belonged to Average class. Only 6.82% (n = 18) were from the high Income Group	70.83%	0.76% hyoid cartilage; 1% hyoid bone	52.27%	14.39% (n = 38)

material [(Stole ($n = 79$) and Sari ($n = 68$)] constituting to 55.68% ($n = 147$) cases and the least preferred choice was the Waist Belt, reported in only 2 cases (0.76%), similar were the observations made by Jayprakash and Sreekumar⁶ Sharma et al.⁷, they had opined 47% and 56% of their victims respectively preferred Soft ligature material like sari, Stole, shawl. These results were contrary to the observations made by Pradhan et al.⁸ wherein they had observed that only 9.09% ($n = 4$) used sari. Whereas the study conducted by Saisudheer and Nagaraja⁹ concluded with 86% of Soft material used for ligature. In the present study hard ligature materials like Plastic Rope, Coir Rope and Cotton Rope comprised 22.72%, similar were the observations made by Jayprakash and Sreekumar.⁶ This wide nature of deviations in the choice of ligature material depends on the dressing fashion of the population and occupation. It is observed that Sari in the southern part of India and Stole [Chunni] among females from northern India are widely used and are easily available in the house and hence the obvious choice in these regions. Whereas in the UK (Bennewith)¹⁰ the commonest choice was hard materials like Rope, Belt, Cord and Cable, soft materials like Sari or Stole were least found in that region. Hence factors like sex of the victim, culture, geographic location and place of the act played an important role in this. The present study also indicated the fact that 88% of the hangings were complete [$n = 232$], these results are close to the observations made by Sharma et al.⁷ and Saisudheer and Nagaraja,⁹ in their study, 68% and 64% of the cases respectively were due to Complete Hanging, however these observations are contrary to those made by Dean et al.⁵ and Pradhan et al.⁸. They observed that 83.4% [$n = 229$] and 47.37% of their cases were due to Partial Hanging, all these observations highlight the regional influence, lifestyle and to a certain extent the type of residence. In the present study females and males were equally affected contributing to 136 and 128 cases respectively, and the majority belonged to 31–40 years (50.76%; $n = 136$) and the least affected age group was from those below the first decade and above 6th decade, these results are contrary to the claims made by Jayprakash and Sreekumar⁶ and Sharma et al.⁷ wherein, the male to female victim ratio was 2:1. However their observations closely matched with the age group involved. The observations made by Kurtulus et al.,¹¹ Jayprakash and Sreekumaran,⁶ Abd-Elwahab et al.,³ Suminska-Ziermann¹² and Al Madni et al.¹³ are more deviating as they found that the Males were more affected than females in the ratio 3:1. This wider variation in the sex group is possibly due to the cultural, religious, economic and lifestyle factors driving the individual to Suicidal Hanging. In the present study, 80.58% ($n = 213$) of the victims ligature mark showed discontinuity (incomplete), similar were the observations made by Jayprakash & Sreekumar⁶ and Saisudheer & Nagaraja⁹. They had concluded that 78% and 82% of their victims, respectively showed incomplete ligature marks. In the present study the most preferred knot was the Slip knot, contributing to 97.73% ($n = 258$) of cases. These results were contrary to those made by Sharma et al.⁷ wherein they had concluded 71% of their victims had fixed knot. The observation made by Saisudheer and Nagaraja⁹ was close to the observations made in the present study. Obliquity of the ligature mark was noticed in 87.88% ($n = 232$) of cases and Horizontal ligature mark was noted in 6.82% ($n = 18$) of cases, similar were the observations made by Jayprakash and Sreekumar,⁶ however the Horizontal ligature mark was noted in

Partial Hanging. The type of knot, continuity of mark and completeness of hanging are important in determining the ligature mark over the neck. In a Complete Hanging wherein the body is completely suspended with a slip knot the ligature mark will be oblique and continues without disruptions, whereas in fixed knot non continuity of the mark is common though Obliquity is maintained in Complete Hanging. In Partial Hanging with Slip knot the continuity is maintained but the mark is situated horizontally whereas in fixed knot with partial suspension horizontal mark is present over front of the neck and missing over the nape of the neck. Hence the type of knot and type of suspension determine the ligature mark and its continuity over the neck. The morphology of the ligature mark highlighted that 94.31% ($n = 249$) of the ligature mark showed grooving, contrary to the claims made by Saisudheer and Nagaraja⁹ wherein they had observed grooving in 54% of their cases. In the present study a unique pattern was noticed with grooving that the grooving was associated with heaping up of the epithelium due to displacement of the superficial skin in a directional fashion.

Majority of these displacements were toward the right side neck ($n = 162$) and in 18 cases there were no such displacements observed. The displacement was due to the friction movement of the ligature against the skin surface of the neck during the process of decorticate and decerebrate rigidity during the process of Suspension by a ligature around the neck. This also indirectly confirms the ante mortem nature of Suspension, however further study in this area is required. The blackening or darkening of the displaced skin noticed in 95.45% ($n = 252$) of cases was due to the heat generated during the friction of ligature material against the skin surface. The author considers these observations as one of the factors in determining the ante mortem nature of hanging; these observations were not found in similar studies done elsewhere. 70.45% of the victims were married, similar were the observations made by Saisudheer and Nagaraja⁹ wherein 82% of his victims were married. The major motivating factors observed in the study were Domestic/Family related issues comprising 82 cases (31.06%), similar were the observations made by Saisudheer and Nagaraja⁹, who concluded that 18% of cases were due to family related issues. The other major factors were the disease conditions contributing to self suspension, comprising 20.45% ($n = 54$) of cases. These observations were contrary to the claims made by Saisudheer and Nagaraja⁹ they had claimed 6% of their victims had died due to diseased conditions. Other factors like relationship crisis ($n = 49$), financial worries ($n = 38$), career issues ($n = 18$) and work stress ($n = 18$) also contributed to the cause. Hence the psychological state, economic state of the individual and his health issues are the major driving force behind Suicidal Hanging. Since these issues are closely associated in married individuals, Suicidal Hanging is common among them. The most preferred Places to commit the act in 91.67% ($n = 242$) of cases were the places of residence, similar were the views of Uzün et al.¹⁴. In their study of 761 cases, 634 victims preferred places of residence. The reason is privacy and easy manipulations to commit the act apart from non interference in the process of Suicide. In the present study, 82.58% ($n = 218$) of the victims had their knots over the sides of the neck (atypical hanging), similar were the views of Saisudheer and Nagaraja⁹ and Sharma et al.⁷ who had opined that 89% and 88% of the cases respectively, were Atypical Hanging [knot over the sides of

neck]. This is possibly due to the victim tying the noose around his neck during the time of suspension and then jumping over it, the other possibility is that the knot position changing after suspension during the terminal phases of hanging. The majority of the ligature marks over the neck were situated above the thyroid cartilage in 82.58% ($n = 218$) of cases, whereas in only 7.20% of cases the ligature mark was situated below the thyroid cartilage, similar were the views of Saisudheer and Nagaraja⁹ who in their study observed that 88% of their cases showed the marks above the thyroid cartilage, however the views expressed by Sharma et al.⁷ were contrary, in their study they had observed that in 58% of their cases the ligature marks were situated above the thyroid cartilage. The presence of ligature mark above the thyroid cartilage is due to the yielding soft tissue between upper bony margin of the jaw and the lower protruding thyroid cartilage besides the concentration of a larger force on small area of the neck. The study of neck structures indicated that the Sternocleidomastoid muscle was involved in 70.83% ($n = 187$) of cases, similar were the views of Sharma et al.⁷, however these observations were contrary to the claims made by Jayprakash and Sreekumar,⁶ who had concluded that only 19.6% of their cases showed damage to the Sternocleidomastoid fibers, however they had also indicated that 1.1% of the internal carotid artery showed intimal tears which is contrary to the observations made in the present study wherein 52.27% of the victims showed intimal tears in the carotids. Suárez-Peñaranda,¹⁵ Hejna¹⁶ and Jayprakash and Sreekumar,⁶ made contrary claims to the present study. They observed that 9.1%, 16.1% and 9.1% of cases respectively had intimal tears of carotid. In cases of hanging and more preferably in Complete Hanging there is always the Sternocleidomastoid muscle subjected to Shear movement from external large indenting pressure on its belly causing a tear of its attachments from the sterna end besides this, the constricting force squeezes the impending carotid artery causing sudden constriction of the wall and its rupture. Other factors like the decorticate, decerebrate and conclusive phase on the ligature also contribute to this process. This may not be the case in all Partial Hanging wherein part of the body force acts on muscles and vessels. The present study also highlighted the fact that in majority of the victims, Thyroid [99.42%] and Hyoid [93.94%] bones were unaffected, similar were the views of Jayprakash and Sreekumar,⁶ Nikolic et al.,¹⁷ Charoonnate et al.¹⁸ and Saisudir and Nagaraja⁹ wherein their observations are close to those made in the present study. These observations are disputed by those made by Suárez-Peñaranda¹⁵ wherein he observed that 75% of the victims had fractures involving the thyroid and hyoid. This is because of the fact that majority of his victims were in 4th and 5th decade of life wherein the bones are ossified leading to the fracture unlike the present study wherein the majority of the victims were between 21 and 30 years. The other factors like height of suspension and type of hanging also play an important role. The majority 59.09% ($n = 156$) of the victims in the present study belonged to the low socioeconomic group, contrary to the claims made by Saisudheer and Nagaraja,⁹ who had observed that 78% of their victims belonged to the Middle income group. In the present study 14.4% of the cervical vertebra showed fractures and observations contrary to those made by Kurtulus et al.¹¹ They observed 67.6% of their victims with cervical vertebra fracture. But the study conducted by Jayprakash and

Sreekumar⁶ and Nikolic, Zivkovic¹⁹ claimed 1.6% and 3.3% of victims with cervical fracture. These wide variations in the Incidences are possibly due to factors like age of the victim, Weight of the victim, type of suspension and height of suspension. The study highlights the influence of regional, religious, cultural, socioeconomic factors and demographic factors responsible for Suicidal Hanging. It also encourages further research into these factors so as to prevent the incidences of Suicidal Hanging.

Conflict of interest

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Ethical approval

Necessary ethical approval was obtained from the institute ethics committee.

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