Original Article

Pattern and Clinicopathological Profile of Violent Asphyxial Deaths in a Hilly Region: A Two-Year Retrospective Descriptive Autopsy Study

Abhishek Sharma[1], Parmesh Singh[2], Pankaj Pathania[2]

[1]Assistant Professor, Department of Forensic Medicine and Toxicology, Shri Lal Bahadur Shastri Government Medical College and Hospital, Mandi at Nerchowk, Himachal Pradesh, India. [2]Senior Resident, Department of Forensic Medicine, Shri Lal Bahadur Shastri Government Medical College and Hospital, Mandi at Nerchowk, Mandi, Himachal Pradesh, India

Abstract

Background: Asphyxial deaths represent a major portion of medicolegal autopsy cases. These can occur due to hanging, wet drowning or strangulation. The mode of asphyxial death is dependent on several factors including geographical location, environmental conditions, demographic characteristics etc. For instance, in hilly areas, availability of natural water resources and scattered population may affect the incidence of certain types of asphyxial deaths. **Material and Methods:** In this retrospective descriptive study, we studied all the cases of violent asphyxial deaths that were brought to our department of forensic medicine, which is situated in a hill station over a period of two years (Jan. 2024 – Dec. 2025). We collected data from the postmortem reports and analyzed it with regard to the type of asphyxia, age of the victim, sex of the victim, manner of death, seasonality, autopsy findings etc. **Results:** We analyzed 50 cases. Of them, 27 (54%) were hanging cases; 20 (40%) were wet drowning cases and 3 (6%) were strangulation cases. Out of all the cases studied, majority were male and maximum numbers fell into the age category of 21–40 years. Most of the hanging cases were suicides and majority of wet drowning cases were accidents. Wet drowning was found to be increased significantly during the months of summer and monsoon. Commonly used ligature material was easily available household articles. Classical ligature marks were observed in majority of hanging cases but internal neck injuries were rare. **Conclusion:** The present study highlights that the pattern of violent asphyxial deaths in the hill stations is affected by both environmental as well as social factors. Hanging continues to remain the most common type of asphyxial death in hilly stations and the incidence of wet drowning varies significantly throughout different seasons. Therefore, careful autopsy examination, especially in case of hangings is mandatory for finalizing the cause and manner of death. Preventive measures specifically designed according to local environment may help in reducing the occurrence of such fatal events.

Keywords: Violent asphyxia, Hilly region, Seasonal variation, Ligature mark, Medicolegal investigation.

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Introduction

The frequency of hanging in forensic practice is highest in cases of suicide among violent asphyxiating deaths. Hanging occurs when the body is suspended by a ligature around the neck, and constriction is created by the weight of the body. A distinction exists between hanging and strangulation based upon mechanism and context of injury. Strangulation refers to direct external compression of the neck using forceps, hands, rope, wire, cord or any other material, excluding suspending by a ligature. This method of causing asphyxia is generally associated with homicide. Suffocation (obstruction of the airway or deprivation of breathable air) and wet drowning (asphyxia caused by being submerged in a fluid medium) can result in either similar or different mechanisms, pathologic findings and legal interpretations depending on how well studied the specific circumstances of each case were. Therefore, all three categories require individualized consideration through autopsy examination and analysis of circumstantial data.[1,2]

Patterns of epidemiology of violent asphyxiating deaths will depend on the geographic area, culture and socioeconomic conditions, along with environmental factors. In developing countries and numerous rural areas throughout the world, there has been frequent reporting of suicidal hanging as the primary type of asphyxial death.[35] Rates of wet drowning are likely to be higher in areas with ample amounts of water bodies.[6] Although it is less common, strangulation continues to remain a serious medicolegal issue due to its relationship to interpersonal violence. Variables related to demographics including age, gender, employment and socioeconomic status may affect the occurrence rate. Studies repeatedly report that young adult men predominate in violent asphyxiating deaths. This phenomenon has been attributed to stressors due to psychological issues,

Address for correspondence: Dr. Abhishek Sharma, Assistant Professor, Department of Forensic Medicine and Toxicology, Shri Lal Bahadur Shastri Government Medical College and Hospital, Mandi at Nerchowk, Himachal Pradesh, India.
E-mail: abhirpgmc@gmail.com

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financial problems, drug/alcohol abuse and increased likelihood of exposure to dangerous situations. Rural and mountainous areas also have fewer resources available for mental health treatment and social support which can contribute to the increasing risk of suicide.[79] In addition to sociodemographic variables and cultural influences, geographical terrain (in particular hilly/mountainous terrain), represents an underappreciated factor in determining patterns of asphyxiating deaths. Terrain in hilly/mountainous areas has several features including steep slope/depths of valleys/dense vegetation/dispersed habitations/natural suspension points (e.g., trees/elevated structures), all of which can make hanging easier. Additionally, isolation and difficulty obtaining immediate medical attention can lead to increased mortality rates from asphyxiating deaths. In addition to recreational/domestic/occupational usage of water in hilly terrain (i.e., rivers/streams/seasonal rivulets) during the summer months; monsoon seasons bring unpredictable/hazardous water flow which increases the potential for accidental/fatal wet drownings. Thus, seasonal variation plays an important role; recreational/ domestic/ occupational water usage during summer months combined with hazardous conditions during monsoons increase the potential for an increase in wet drowning deaths.[1,8] Forensic autopsy provides the basis for determining the cause and manner of violent asphyxial deaths. The autopsy process utilizes a combination of the external examination findings/pathologic changes seen within organs/internal organs and investigation into the location where the victim was found. In cases of hanging, the ligature marks are typically positioned at an angle to the midline of the head. There is usually parchmentizing (drying/shrinkage) of skin at sites of ligature constriction and there is often no substantial evidence of traumatic injury to internal structures of the neck. Strangulation tends to show more prominent external trauma (abrasions, ecchymosis) and internal damage (hemorrhage in muscle layers surrounding the neck, fracture to hyoid bone/thyroid cartilage). Cases involving wet drowning may show fine froth at the mouth/nostrils, distension and edema of lungs and presence of water/debris in airways/stomach. While some features are typical of certain causes, not all are diagnostic; therefore correlation with history/toxicology/data obtained from crime scene investigation is necessary for making conclusions regarding cause and manner.[13] Although factors contributing to asphyxial death are acknowledged by professionals; relatively little literature addresses violent asphyxial deaths occurring in hilly terrain; most studies are derived from urban/plain population who have entirely different environmental/social contexts than those residing in mountainous regions.[1012] Consequently, additional regional based research is warranted to elucidate effects on distribution and characteristics of violent asphyxial deaths by unique topography/seasonal patterns/sociocultural aspects. This study examines the prevalence and pathological profiles of violent asphyxial deaths in a hilly region over two years. The demographic variables examined included types and manners of death; seasonal trends; and details concerning forensic autopsy examinations with particular focus on hanging since it accounts for the majority of violent asphyxial deaths. Results are intended to provide additional information to existing forensic literature relevant to mountainous regions and assist in creating prevention programs that address the environmental/socioeconomic realities prevalent in this region.[13,14]

Materials and Methods

This retrospective descriptive study was conducted over a period of two years, from 1st January 2024 to 31st December 2025, in the Department of Forensic Medicine and Toxicology of a tertiary care centre in a hilly region of Himachal Pradesh.

Inclusion Criteria:

All cases with alleged history of:

- Hanging
- Wet drowning
- Strangulation

Exclusion Criteria:

- Poisoning
- Carbon monoxide poisoning
- Nonmechanical asphyxia

Data Collection: Relevant information was collected from inquest papers and autopsy reports using a structured proforma.

Statistical Analysis: Data was recorded on a Microsoft excel spreadsheet. Statistical analysis was performed with SPSS student version 27.0 (SPSS Inc. Chicago, USA).

Ethical consideration: The ethical permission regarding the use of data of violent asphyxia death cases for this retrospective analysis has been obtained from the authority, and the identity of the deceased persons has not been disclosed anywhere. Informed consent was not required as the study is based on medicolegal autopsies which are conducted on the request of law enforcing agencies and no consent is required for medicolegal autopsies in our country.

Results

A total of 50 cases of violent asphyxial deaths were studied over the two year period. Hanging was the most common cause of death, accounting for 27 cases (54%), followed by wet drowning with 20 cases (40%) and strangulation with 3 cases (6%) [Table 1].

Table 1: Distribution of Asphyxial Deaths

Asphyxial Death	Number of Cases (%)
Hanging	27 (54%)
Wet drowning	20 (40%)
Strangulation	03 (06%)
Total	50

Hanging: The majority of hanging cases were observed in the age group of 31–40 years (n = 8), followed by 21–30 years (n = 7) and 11–20 years (n = 4). Fewer cases were seen in the age groups of 41–50 years and 51–60 years (n = 2

each), while 3 cases were noted in individuals above 60 years. Only one case occurred in the 0–10 years age group [Figure 1].

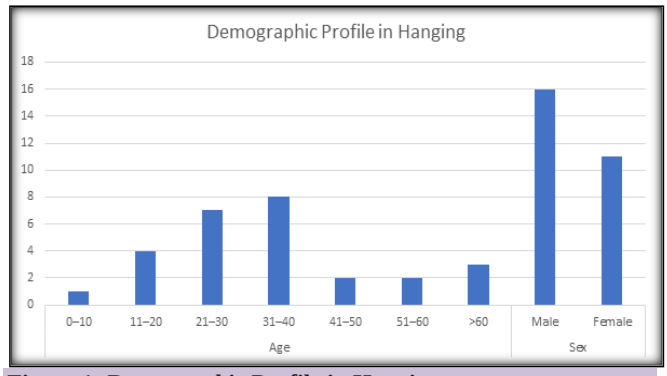

Figure 1: Demographic Profile in Hanging

A male predominance was observed with 16 males (59.3%) and 11 females (40.7%). Most victims belonged to rural areas (n = 26, 96.3%), with only one case from an urban background.

Seasonal distribution showed maximum cases during winter (n = 9), followed by autumn (n = 7), summer (n = 6), and spring (n = 5) [Figure 2].

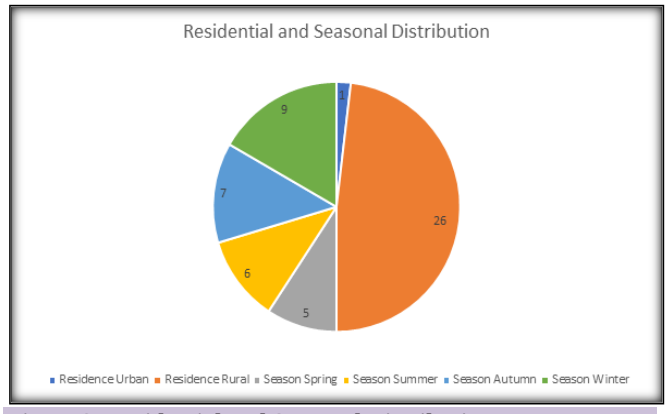

Figure 2: Residential and Seasonal Distribution

Regarding ligature material, dupatta/saree was most commonly used (n = 13, 48.1%), followed by nylon rope (n = 8, 29.6%). Other materials included electric wire and bedsheet (n = 2 each, 7.4%) and belt (n = 1, 3.7%). In one case, the ligature material was not recorded.

Typical knot position was observed in 13 cases (48.1%), atypical in 9 cases (33.3%), and submental in 5 cases (18.5%). The ligature mark was located above the thyroid cartilage in most cases (n = 22, 81.5%), at the level in 4 cases (14.8%), and below in one case (3.7%). Oblique ligature marks were present in 26 cases (96.3%), and noncontinuous marks in 24 cases (88.9%) [Figure 3].

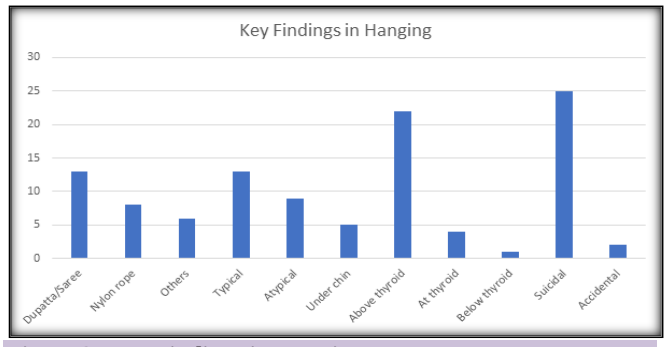

Figure 3: Key Findings in Hanging

Parchmentisation was observed in 80% cases. Abrasions were present in 25 cases (92.6%). Petechial hemorrhages were seen in 22 cases (81.5%), cyanosis in 18 cases (66.7%), and salivary dribbling in 6 cases (22.2%). Tongue protrusion was noted in 8 cases (29.6%), while facial congestion was seen in 2 cases (7.4%).

Internal neck findings were minimal. No case showed neck muscle hemorrhage. Hyoid bone fracture and carotid intimal tear were each observed in one case (3.7%), and no thyroid cartilage fractures were noted. Most cases were suicidal (n = 25, 92.6%), with 2 accidental cases (7.4%).

Wet drowning: Maximum cases were observed in the age groups of 21–30 years and 31–40 years (n = 5 each, 25%), followed by 11–20 years (n = 4, 20%). Cases in the age groups of 41–50, 51–60, and above 60 years were equal (n = 2 each, 10%). No cases were seen in the 0–10 years age group.

There was a marked male predominance with 16 males (80%) and 4 females (20%). Most cases belonged to rural areas (n = 19, 95%), with one urban case.

Seasonal variation showed higher incidence during summer and autumn (n = 7 each, 35%), followed by spring and winter (n = 3 each, 15%).

Froth was present in 7 cases (35%). Lung oedema was observed in 9 cases (45%), and lung distension in 11 cases (55%). Paltauf hemorrhages were seen in 10 cases (50%), and petrous temporal hemorrhage in 13 cases (65%). Diatoms were detected in all cases (100%), while water in the stomach was present in 8 cases (40%).

Table 2: Key Findings in Wet drowning and Strangulation

Condition	Finding	Present
Wet drowning	Diatoms	20
	Lung distention	11
	Petrous hemorrhage	13
	Paltauf's hemorrhage	10
	Froth	7
Strangulation	Facial congestion	3

Strangulation: Cases were distributed across the age groups of 21–30, 31–40, and 41–50 years (n = 1 each). Females constituted the majority (n = 2), while one case involved a male. Two cases occurred during autumn and one during spring.

External signs of struggle were present in 2 cases (66.7%). Ligature marks, abrasions, and nail marks over the neck were also observed in 2 cases each (66.7%).

Facial congestion, petechial hemorrhages, and strap muscle contusions were present in all cases (100%). Hyoid bone fracture was noted in one case (33.3%), while thyroid cartilage fracture was observed in all cases (100%) [Table 2].

Discussion

Results of this research are indicative of an overwhelming majority of victims dying from asphyxia through hanging. These results are reflective of data collected from other regions within India, in which hanging has been the most common method utilized by suicide attempts. Availability of simple items (ligatures) to create a noose, and/or lack of need for extensive preparation prior to use, may contribute to prevalence of hanging in this population.

While the number of wet drowning related deaths was significantly larger than those reported in many urban based studies, it could be attributed to the unique geography surrounding this area.

There are numerous streams and rivers throughout this region. The rough terrain contributes to an elevated risk of slips and falls into these bodies of water. Therefore, wet drowning will increase during warm or rainy months when people are more likely to interact with water bodies and encounter dangerous situations. Adults aged young and middle aged were the groups who suffered the greatest loss of life. As members of society, they face a variety of stressors such as financial difficulties, work requirements and social obligations. In addition to the fact that men experienced a greater rate of death from both hanging and wet drowning then women, there may have been several contributing factors. For example, male subjects would be expected to experience greater opportunities for risky behaviours outdoors. In addition to sex differences, there were clearly defined seasonal patterns in each type of death. Wet drowning rates increased during warm weather months and immediately following monsoons. Although hanging occurred at a slightly greater frequency during cold weather months, further investigation will be required to understand why this is true.

Classical autopsy findings were present in almost all hanging cases. These included the presence of ligature marks and very little internal trauma. This supports the understanding that in a substantial percentage of cases, especially partial suspension cases, less than lethal amounts of internal injury may occur. Similarly, autopsy findings for wet drowning cases were consistent with typical descriptions, although caution must be taken when interpreting findings and additional supporting evidence should be obtained whenever possible.[1,11,16] Cases of strangulation were very rare but exhibited clear signs of forceful strangulation.

Conclusion

Hanging was the most common form of violent asphyxial death in this study, followed by wet drowning and strangulation. Young adult males were most commonly affected. The geographical features of the hilly region played a significant role in shaping the pattern of deaths.[10]

Wet drowning showed clear seasonal variation, while hanging remained relatively consistent. Autopsy findings were largely in accordance with classical descriptions.[13,13]

Preventive strategies should focus on mental health awareness, early identification of vulnerable individuals, and improving safety around water bodies. Detailed medicolegal examination remains crucial for accurate determination of cause and manner of death.

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Conflicts of interest

There are no conflicts of interest.

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