International Journal of Forensic Expert Alliance
https://doi.org/10.70818/ijfea.v01i01.018
Vol. 1, No. 2, 2024

ISSN (Print): 3078-6673
ISSN (Online): 3078-6681

ARTICLE | OPEN ACCESS

Forensic Evaluation of Hanging-Related Deaths from Crime Scene to Autopsy

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ABSTRACT: ***Introduction:*** Hanging is among the top methods of suicide in the world, and it contributes to a significant proportion of global mortality. It represents an expert forensic puzzle, needing meticulous plotting to disentangle suicides from homicides from accidental deaths. The purpose of this study is to evaluate the forensic characteristics of hanging-related fatalities, to generate demographic and postmortem data, and to assist in a more accurate classification of causes of death to optimize preventive measures in the future. ***Methods:*** The study population involved 50 suspected hanging cases. Data were collected from the Department of Forensic Medicine and Toxicology at Rajshahi medical college, Rajshahi, Bangladesh over 12 months from February 2024 until March 2025, concentrating on cases of hanging deaths. Data were retrieved from case files, including demographic details, crime scene investigation reports submitted by investigating officer as inquest report of respective autopsy cases, and autopsy findings. Descriptive statistics were used to recapitulate demographic data, crime scene findings, and autopsy results. ***Results:*** The most presented cases (76%) were male and of mean age 20–40 years (56%). Private homes accounted for the most deaths (64%), with outdoor locations (20%) and prisons (16 %) trailing behind. Fifty percent of ligature material was rope, (70%) was fixed knots, and (84%) was complete suspension. Patients were diagnosed in a median period of 5.1 days, and significant postmortem findings were horizontal ligature marks (60.0%) and low incidence of skeletal fractures (30.0%). Toxicology was positive for significant alcohol (40%) and sedative use (24%). Suicide was the most common manner of death (84 percent), followed by accidental deaths (10 percent) and homicides (6 percent). ***Conclusion:*** The result of this study underlines the need for a multifaceted forensic study of individuals who die from hanging. This information can improve the classification of the manner of death while also offering valuable information on how to prevent suicides by correlating data found from crime scene data, ligature materials, and autopsy findings. The findings highlight the need for improved mental health care and tailored intervention programs among persons at risk, particularly young to middle-aged males. More research is needed on the environmental and psychological factors influencing these deaths.

Keywords: Postmortem, Hanging, Crime Scene, Autopsy, Death investigation, Forensic Medicine and Toxicology.

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How to cite this article:
Jahan Z, Uddin MK, Talukdar S, Chowdhury MA, Rahman MS, Sharmin N; Forensic Evaluation of Hanging-Related Deaths from Crime Scene to Autopsy. *Int. J. Forensic Expert Alliance*. 2024; 1 (2):63-67

Article history:
Received: September 28, 2024
Revised: October 26, 2024
Accepted: November 22, 2024
Published: December 27, 2024

Peer Review Process:
The Journal abides by a double-blind peer review process such that the journal does not disclose the identity of the reviewer(s) to the author(s) and does not disclose the identity of the author(s) to the reviewer(s).

INTRODUCTION

This is one of the most commonly used suicide methods worldwide, accounting for about half of all suicide deaths globally.[1] As a variety of ligature strangulation, hanging presents a specialized forensic pathology challenge demanding a rigid demarcation of suicidal, homicidal, and accidental cases.[2] Hanging deaths also constitute a significantly high proportion of mortality in developed and developing countries, among the most common causes of suicide worldwide. Suicide is a leading public health issue and by far the most prevalent method in

WHO (2015) suicide statistics, especially in men and older individuals.[3] Apart from the immediate clinical significance, the forensic dilemma and scientific ramifications on accurately establishing the manner of death in hanging cases bear substantial ramifications in legal and public health sectors, hence the need to order this field of research topmost in the interest of forensic medicine. Forensic evaluation of deaths from hanging involves a team approach that connects investigation efforts, crime scene analysis, and medical findings to determine how and why the person died. Different aspects of hanging deaths must be appreciated (specifying the cause/manner of death as suicide/homicide/accident) to aid in accurate classification as well as prevention and health care efforts. By comparison, the epidemiology of hanging-related deaths has a different demographic profile. This issue is particularly pronounced for males, as men have a much higher suicide rate than women.[4] The clinical perspective on this method as a weak point is again emphasized by the fact that the vast majority of hanging-related suicides are found in individuals in the 20–40 age group, who typically are under considerable psychosocial and financial pressure as well as dealing with mental illness.[5]

This phenomenon of suicide by hanging in this explicit populace has been extensively considered in literature, sustaining the need for superior attention to mental health overhaul and suicide prevention procedures for the young to middle-aged population. In forensic inquiries, the analysis of the crime scene is decisive for understanding the framework of the death. The type of ligature substantial, type of knot, and position of the body all (provide) important information regarding whether the death was suicidal, homicidal, or accidental. A typical suicidal hanging is defined by the use of fixed knots and full suspension of the body.[6] However, suppose you see differential ligature marks where the decedent made a poor man's suicide attempt or was interrupted in the process or a poor man's suspension (partial) from ropes, belts or cloth. In that case, you may be left to conclude. While a suicide note can support the assumption of intentional suicide, its absence does not preclude the possibility of suicide or other causes of death.[7, 8] The initial examination findings and post-mortem examination/autopsy findings form an essential part of the forensic exploration of deaths in hanging.

An autopsy will aid in the detection of ligature injuries, any fractures of the hyoid or thyroid cartilages, and the presence of petechial hemorrhages — classic signs of asphyxiation. Toxicological analyses are also necessary, as alcohol and sedatives have been detected in a notable number of hangings, showing that they may affect the choice to commit suicide.[9] The majority of cases were without skeletal fractures, which in no way alters the cause of death, as fatalities from hanging can occur in the absence of typical hyoid or thyroid cartilage fractures.[10] The literature on the epidemiology and psychological determinants of suicide by hanging is extensive, but there is a notable research gap addressing the forensic context of these deaths. Existing studies of deaths from hanging tend to examine demographic or psychological aspects of patients, while less is said about the details of crime scenes and autopsy findings. Additionally, the differentiation of accidental deaths, suicides, and homicides can be difficult and often requires thorough forensic investigation[11]. In this critical study, we aim to perform a detailed forensic investigation of hanging deaths, including demographic profiling, crime scene findings, types of ligature materials, and autopsy findings from the crime scene to the autopsy. In doing so, it aims to enhance the accuracy of the classification of deaths and to inform prevention strategies for the reduction of hanging-related fatalities. We hope this study will add to our understanding of hanging deaths and underscore the necessity for a close forensic investigation combining both inferences from the scene and autopsy. By appreciating the unique aspects of hanging-associated death, this study intends to advocate for the formulation of evidence-based suicide prevention strategies and to make forensic practice death classification more precise.

Objectives

General Objective

To perform a detailed forensic evaluation of hanging-related deaths, integrating demographic, crime scene, and autopsy findings to accurately classify the manner of death (suicide, homicide, or accidental) and provide insights for improved death investigation and prevention strategies.

Specific Objectives:

To analyze the demographic profile of individuals who die by hanging, including their age, gender, and the location of the incident (home, outdoor, or prison).

To examine the crime scene characteristics of hanging-related deaths, focusing on the types of ligature materials, knot types, and body position (complete or partial suspension).

METHODS

This retrospective study was conducted to explore the forensic assessment of hanging-related deaths, inspecting demographic characteristics, crime scene analysis, ligature materials, knot types, and autopsy findings. The objective of the study is to evaluate the hanging-related deaths from crime scenes to autopsy. The study population involved 50 suspected hanging cases. Data was collected from the Department of Forensic Medicine and Toxicology at Rajshahi medical college for over 12 months from February 2024 until March 2025, concentrating on cases of hanging deaths. Data were retrieved from case files, including demographic details, crime scene investigation reports, and autopsy findings. Descriptive statistics were used to recapitulate demographic

data, crime scene findings, and autopsy results. Occurrences and percentages were calculated for categorical variable quantity, while mean values were computed for age distribution. Data was obtainable in tables to facilitate easy interpretation of the findings. This procedural approach ensures a comprehensive analysis of hanging-related deaths, correlating both crime scene and autopsy data to enhance death classification and forensic accuracy.

Inclusion criteria

We included all deaths related to hanging, regardless of the manner for the study.

Only the cases where crime scene and autopsy results were accessible were included.

Cases were included for all age groups and both sexes to conduct a thorough demographic analysis

Exclusion criteria

Cases where the cause of death could not be conclusively attributed to hanging were excluded Cases without complete or available crime scene or autopsy data were excluded.

Bodies in advanced decomposition or bodies where forensic examination was insufficient to determine the hanging type were also excluded.

RESULTS

Table 1: Demographic Characteristics of Hanging-Related Deaths Among the Participants (n=50)

Variable	Category	Frequency (n)	Percentage (%)
	<20 years	5	10%
	20–40 years	28	56%
Age Group	>40 years	17	34%
	Male	38	76%
Sex	Female	12	24%
	Home	32	64%
	Prison	8	16%
Location	Outdoor (forest, etc.)	10	20%

There were 50 deaths related to hanging in the study cohort: the majority were men (76%, n=38), with a mean age of 20–40 years (56%, n=28). A smaller proportion was aged under 20 (10%, n=5) or over 40 (34%, n=17). Private homes held most events (64%, n=32), followed by outside (20%, n=10) and prisons (16%, n=8). Although the age distribution suggests greater vulnerability among young to middle-aged adults, the male predominance aligns with global suicide trends.

Table 2: Crime Scene & Ligature Findings Among the Participants (n=50)

Variable	Category	Frequency (n)	Percentage (%)
Ligature Material	Rope	25	50%
	Belt	12	24%
	Cloth (scarf, towel)	10	20%
	Electrical wire/cable	3	6%
Knot Type	Fixed knot (e.g., slipknot)	35	70%
	Non-fixed (simple loop)	15	30%
Position	Complete suspension	42	84%
	Partial suspension	8	16%
Suicide Note	Present	18	36%
	Absent	32	64%

The most commonly used ligature material was rope (50%, n=25) followed by belt (24%, n=12) and cloth (20%, n=10). Seventy percent (n=35) of cases were closed with fixed knots (slipknots) and the most common mechanism was 84% (n=42) with complete suspension (foot off the surface). Thirty-six percent (n=18) of the patients had a suicide note recovered suggesting potential premeditation. A high suspension rate (72%, n=36), sectional body complete suspension (16%, n=8) appears to support typical suicidal hanging mechanics, though potential partial suspension when noting also supportive rapid intervention or incomplete asphyxiation mechanism, etc.

Table 3: Autopsy Findings in Hanging-Related Deaths Among the Participants (n=50)

Variable	Category	Frequency (n)	Percentage (%)
Ligature Mark	Horizontal	30	60%
	Oblique	20	40%

Hyoid/Thyroid Fracture	Present	15	30%
	Absent	35	70%
Petechiae (Eyes/Mouth)	Present	22	44%
	Absent	28	56%
Toxicology Positive	Alcohol	20	40%
	Sedatives/antidepressants	12	24%
	Negative	18	36%

Ligature marks were horizontal (60%, n=30) or oblique (40%, n=20), in accordance with classic hanging dynamics. Hyoid or thyroid cartilage fractures identified in only 30% (n=15), highlighting their variable incidence despite fatal asphyxia. Petechiae (44%, n=22) and facial congestion were common yet non-specific. Toxicology revealed alcohol (40%, n=20) and sedatives (24%, n=12) demonstrate that substance use is a potential risk factor. Seventy percent (n=35) were without fractures, thus calling into question whether skeletal injuries should serve singly to confirm the diagnosis.

Table 4: Manner of Death Classification Among the Participants (n=50)

Manner of Death	Frequency (n)	Percentage (%)
Suicide	42	84%
Homicide (staged)	3	6%
Accident	5	10%

Suicides (84%, n=42) were majority and homicidal hangings (6%, n=3) were determined by discrepancies with respect to strangulation (e.g., ligatures not visible, defensive marks). Incidental deaths (10%, n=5), including autoerotic asphyxiation and pediatric. The homicide cases highlight why scene and autopsy data should be analyzed together in order to rule out foul play, especially when below the line figures such as ligature markings are inconsistent with suspension mechanics.

DISCUSSION

The results of this study offer insightful analysis of the demographic traits, crime scene investigation, autopsy findings, and mode of death in hanging-related fatalities. Comprising 50 cases mostly men (76%), the cohort had a mean age range of 20 to 40 years (56%). This male preponderance is in line with world suicide rates, whereby males are more prone than women to participate in suicidal activity.[4] Our study's age distribution fits past studies stressing the increased vulnerability of adults in their prime years, especially in the 20–40-year range.[12] The smaller percentage of people under 20 (10%) or over 40 (34%), suggests that hanging-related deaths are most common in this middle age group, which might reflect a complicated interaction of socio-economic, psychological, and life-stage pressures. The site of hanging-related deaths also offers an important background for comprehending the situation surrounding these events. The most deaths happened in the house (64%), next outside (20%), then jails (16%). According to earlier studies, a sizable fraction of suicides—including hanging—occur in private homes, which is generally linked with the solitary character of such acts.[13] The fact that some events happened outside or in prisons implies that various environmental elements could influence the conditions of hanging-related deaths, such the need of privacy, confinement, or lack of mental health resources in institutional settings.[11] With regard to ligature material and technique, our research revealed that rope was the most often utilized ligature (50%), followed by belts (24%), and cotton (20%). Given these are typical traits of such deaths, the high frequency of fixed knots (70%) and total suspension (84%) supports the idea that hanging-related deaths are usually suicidal in this sense. In 36% of cases, suicide notes point to premeditation in some form that fits studies demonstrating a relationship between suicide notes and more meticulous preparation.[14]

Consistent with the usual hanging posture, autopsy results showed that ligature marks were mostly horizontal (60%). Consistent with earlier research showing fractures occurring in just a fraction of hanging cases, the presence of hyoid or thyroid fractures (30%) was rather low. Although their absence does not exclude hanging as the cause of death, 44% of cases had petechial hemorrhages, a common occurrence in hanging deaths from hypoxia.[10] The results of toxicology tests revealed alcohol (40%) and sedative use (24%) in a considerable number of cases, therefore highlighting the part that substance use may play as a possible risk factor for hanging-related deaths—a topic of much-documented research.[9] About the way death was categorized, the great majority (84%) of the cases were classified as suicides, which is in line with earlier studies showing hanging is among the most often used suicide tactic.[15] But underlining the need of a complete scene and autopsy investigation in separating between suicide and homicide, a small proportion (6%) of cases were classified as homicides, often due to inconsistencies at the scene such as hidden ligatures or defensive wounds. Additionally noted were accidental hanging fatalities (10%), including

autoerotic asphyxiation cases—rather rare but historically documented in the literature.[16] Finally, by stressing the main demographic, circumstantial, and forensic features of hanging-related deaths, this study contributes to the increasing corpus of knowledge on these events. The findings highlight the need of a thorough, interdisciplinary approach to look at hanging deaths, especially in differentiating between accidental, suicide, and murder. To enhance preventative and intervention plans, future studies should keep investigating the etiology of hanging-related deaths including environmental elements, mental health, and drug use.

Limitation of the study

The sample size of 50 cases, while sufficient for descriptive analysis, may limit the generalizability of the findings. So, the results may not represent the whole community.

CONCLUSION

This study highlights the need for a multimodal forensic work-up in hanging cases. Delving deeply into the analysis of the crime scene, ligature materials, knot types, and the details of autopsy findings helped us to categorize the manner of death in most instances successfully. The majority of cases were suicides with male and 20–40 age predominance, which corresponds with the global trends. It also finds specific forensic markers — ligature marks, fractures, and toxicology findings of the blood — relevant in differentiating suicides from homicides and accidental deaths. These results also highlight the standing of a multidisciplinary tactic while inspecting forensic cases, compounding evidence from the crime scene, and validation post-mortem to ascertain the proper details for death classification. This study increases the understanding of hanging-related deaths, which is crucial for creating effective suicide prevention tactics by providing demographic, circumstantial, and forensic characteristics. Forthcoming research must identify the psychological, social, and environmental determinants of hanging-related mortality, with prominence on mental health provisions and targeted interventions for at-risk populations like young to middle-aged men.

Funding: No funding sources
Conflict of interest: None declared

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