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Отсроченная смерть при незавершённом повешении: исследование причин и сопутствующих факторов по результатам аутопсии

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АННОТАЦИЯ

Обоснование. Незавершённый суицид путём повешения часто приводит к патологическим состояниям у лиц, переживших странгуляционную асфиксию различной длительности. У госпитализированных пациентов могут возникать осложнения, приводящие к отсроченной смерти.

Цель исследования — оценить различные факторы, связанные с причинами отсроченной смерти в случаях незавершённого повешения, и предложить рекомендации по улучшению работы служб экстренной медицинской помощи.

Материалы и методы. Проспективное исследование по результатам аутопсии проводилось в период с 2012 по 2021 год на кафедре судебной медицины Медицинского колледжа им. М.С. Рамайя (Индия). В исследование были включены все случаи незавершённого повешения с последующей госпитализацией пациентов, которые впоследствии скончались от полученных осложнений и были подвергнуты судебно-медицинскому вскрытию.

Результаты. Пострадавшими, как правило, были женщины в возрасте от 19 до 30 лет. Более половины из них смогли добраться до больницы в течение 30 минут – 1 часа после инцидента, 47,8% испытывали асфиксию в течение 1–3 минут, при этом 65% пациентов ещё были живы более суток. Чаще всего встречалось неполное повешение со слабовыраженной странгуляционной бороздой, 95,7% из них закончились падением с высоты не менее 1 метра. При вскрытии чаще всего обнаруживали отёк головного мозга и лёгких. Смерть в большинстве случаев наступала в результате гипоксической энцефалопатии.

Заключение. Предикторами летального исхода при незавершённом повешении являются продолжительность странгуляции, большая высота падения, отсутствие контакта с опорой, отёк головного мозга и лёгких, гипоксия, гипотензия.

Ключевые слова: повешение; причина смерти; осложнения; самоубийство.

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Delayed deaths in near-hanging cases: An autopsy study of causes and associated factors

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ABSTRACT

BACKGROUND: Near-hanging refers to individuals who survive a hanging injury for various durations. However, hospitalized patients succumb to complications resulting in delayed deaths.

AIM: to evaluate various factors associated with causes of delayed death in near-hanging events and provide insight into the improvement of emergency services.

MATERIALS AND METHODS: A prospective autopsy-based study was conducted at the Department of Forensic Medicine, M.S. Ramaiah Medical College, between 2012 and 2021. All near-hanging cases of hospitalized patients who later succumbed to complications and were subsequently subjected to medicolegal autopsy were included in the study.

RESULTS: Victims were commonly women aged 19–30 years. More than half of them could reach the hospital within 30 min to 1 hour, and 47.8% of them were suspended for between 1–3 min. Moreover, 65% survived for more than a day. Partial hanging with a faint ligature mark was more common, and 95.7% of them had taken off from a platform with a falling height of <1 metre. Cerebral edema and consolidation were the common postmortem findings in the brain and lungs. Death was attributed to hypoxic encephalopathy in the majority of the cases.

CONCLUSION: Longer the duration of suspension, higher fall height, noncontact with the ground while being suspended, cerebral edema, hypoxia, pulmonary edema, hypotension, and need for resuscitation are predictors of fatal outcomes in near-hanging events.

Keywords: hanging; cause of death; complications; suicide.

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不完全缢吊导致的延迟死亡：根据尸检结果对死亡原因和相关因素的研究

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简评

论证。不完全缢吊自杀往往会导致不同时间段的勒死窒息幸存者出现病理状态。住院患者可能会出现导致延迟死亡的并发症。

该研究的目的是评估与不完全缢吊导致的延迟死亡原因有关的各种因素，提出关于改善紧急医疗服务的建议。

材料与方法。这项前瞻性尸检研究是2012年至2021年在印度M.S.Ramaiah医学院（M.S.Ramaiah Medical College）法医学系进行的。该研究包括所有不完全缢吊并随后住院治疗的病例。这些患者随后死于并发症，并接受了法医学尸体检验。

结果。受害者多为19至30岁的女人。半数以上的受害者能在事发后30分钟至1小时内到达医院。47.8%的患者在1-3分钟内经历了窒息。同时，65%的患者在超过一天后仍然存活。最常见的是不完全缢吊，勒痕不明显，其中95.7%的病例是从至少1m的高处坠落。尸体解剖时最常发现的是脑水肿和肺水肿。大多数病例死于缺氧性脑病。

结论。不完全缢吊致死的预测因素包括：勒死时间长、坠落高度高、未与支撑物接触、脑水肿和肺水肿、缺氧、低血压。

关键词：缢吊；死因；并发症；自杀。

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BACKGROUND

Hanging is a cause of asphyxia-related death where the body is suspended by a ligature around the neck, and the weight of the body induces a constricting force around the neck. Near-hanging refers to individuals who survive a hanging injury for various durations. These cases constitute <1% of admissions in the intensive care unit [1]. Although hospitalized, patients succumb to complications resulting in delayed deaths. The type of hanging, duration of suspension, time required to reach the hospital, and vital parameters of the patient on hospital arrival are factors associated with outcomes.

AIM

This study aimed to evaluate various factors associated with causes of delayed death in near-hanging events and provide insight into the improvement of emergency services.

MATERIALS AND METHODS

This prospective autopsy-based study was conducted at the Department of Forensic Medicine, M.S. Ramaiah Medical College, between 2012 and 2021. All near-hanging cases of hospitalized patients who later succumbed to complications and were subsequently subjected to medicolegal autopsy were included in the study. Autopsy findings, findings from the visit to the scene of occurrence in certain cases, facts provided by the investigating officer, in-depth interviews of eyewitnesses, and hospital case records were analyzed.

Ethical review

Ethics approval was obtained from the Ethics Committee of MS Ramaiah Medical College.

RESULTS

In this study, 28 (60.9%) patients were between 19 and 30 years old, and 12 (26.1%) were <18 years old. Moreover, 36 (78.3 %) were female, and 10 (21.1 %) were male. In 32 (69.6%) patients, the near-hanging event occurred on the weekdays. Most of the incidents (n = 22, 47.8%) occurred between 8 pm and 8 am. Forty-six cases occurred indoors in the residence of the patients. The police were the investigating authorities in 38 cases (82.6%) and the executive magistrate in the remaining (Table 1).

Basic life support was initiated by the ambulance technicians for 36 patients, and 10 patients were brought to hospitals in other modes of transport, and life support was initiated at the hospital. Moreover, 34 and 38 patients had hypoxia and hypotension on arrival to the hospital emergency, respectively. Forty patients were intubated and put on mechanical ventilation (Table 2).

Twenty-four patients could reach the hospital emergency in 30 min to 1 h, 20 reached within 30 min, and 2 came after 1 h. Moreover, 22 (47.8%) patients were suspended by ligature for 1–3 min before being brought down, and 14 were brought down after being suspended for 3–5 min. Further, 16 (34.8%) patients survived for 1–3 days, and 14 (30.4%) of them lived for >3 days (Table 3).

Hanging was successful in 34 cases (73.9%) where the body was suspended completely. Height fallen was measured as the distance from the platform to the feet. The height was 0.5–1 m in 28 cases (60.9%) and <0.5 m in 16 (34.8%). A single ligature mark was found in all patients, was present above the thyroid cartilage in 38 (82.6 %), and was oblique in 40 (87%). The ligature marks were broad and narrow in 34 (73.9%) and 12 (26.1%) patients, respectively. It corresponded to the material used. Rope was used in 12 cases, causing a narrow ligature mark, and cloth materials like saree, veil, bedsheets, and curtains were used as ligature materials in 34 cases, which caused broader ligature marks. The mark was interrupted in 38 (82.6%) patients (Fig. 1) and

Table 1. Demographic profile and circumstances

Parameters	N = 46 (%)
Age group	
• <18 years	12 (26.1%)
• 19–30 years	28 (60.9%)
• >30 years	6 (13%)
Sex	
• Male	10 (21.1%)
• Female	36 (78.3%)
Days	
• Weekends	14 (30.4%)
• Weekdays	32 (69.6%)
Time	
• 8 am–2 pm	8 (17.4%)
• 2 pm–8 pm	16 (34.8%)
• 8 pm–8 am	22 (47.8%)
Indoors	46 (100%)
Inquest conducted by	
• Police	38 (82.6%)
• Magistrate	8 (17.4%)

Table 2. Clinical data

Parameters	N = 46 (%)
Basic life support at the scene	36 (78.3%)
Hypoxia on hospital arrival	34 (74%)
Hypotension on hospital arrival	38 (82.6%)
Mechanical ventilation on hospital arrival	40 (86.9%)

Table 3. Time parameters

Time between the incident and presentation	
• <30 min	20 (43.5)
• 30 min–1 h	24 (52.2)
• >1 h	2 (4.3)
Duration of suspension	
• <1 min	8 (17.4)
• 1–3 min	22 (47.8)
• 3–5 min	14 (30.4)
• >5 min	2 (4.3)
Survival time	
• <6 h	4 (8.7)
• 6–12 h	4 (8.7)
• 12–4 h	8 (17.4)
• 1–3 days	16 (34.8)
• > 3 days	14 (30.4)

was continuous in the remaining. In 18 of them (39.1%), the mark was prominently visible (Fig. 2), whereas it was faint in 28 (60.9%) cases (Fig. 3). Nail scratch abrasions were found in two cases. A knot was found in the occipital region in 24 (52.1%) cases, and the right side of the neck was the second common site of knot in 18 (39.1%). The knot was fixed in 28 (60.9%) cases, and a slip knot was noted in 18 (39.1%).

The ligature mark was an abrasion, and as it heals, the gross color change was recorded during autopsy, which would determine the age of the injury. In 16 cases, the ligature mark was reddish brown, which corresponded to injury aged 1–3 days (Fig. 1). The survival time (Table 3) also correlated with the age of the injury.

Internal examination of the neck revealed bruising of neck tissues in four cases and fracture of the hyoid bone in two. The airways were congested in the majority of the cases (n = 44). The brain was edematous in 36 (78.3%) cases and softened in 4. Six patients had both edema and softening of the brain. Computed tomography of the brain was performed in all cases. Edema was a common finding in the brain (n = 32), followed by anoxic injury (n = 8), and both were seen in 6 cases.

Common lung findings included consolidation (n = 16), edema (n = 16), and aspiration (n = 10). Four patients had both edema and consolidation. The heart including the coronary arteries was intact in all cases. The spleen was softened in eight cases. In 12 cases, gross findings were confirmed by histopathological examination.

Hypoxic encephalopathy was the most common cause of death (n = 20), followed by aspiration pneumonia (n = 12). Infection/septicemia and asphyxia were the causes of death in 4 and 2 patients, respectively. In eight cases, death was attributed to a combination of pathology, i.e., hypoxic encephalopathy with aspiration pneumonia (n = 2) and hypoxic encephalopathy with infection (n = 6).

Fig. 2. Prominent ligature mark.

Fig. 1. Interrupted ligature mark on a victim who survived for 3 days.

Fig. 3. Faint ligature mark.

DISCUSSION

A total of 1,53,052 suicide events were reported in India in 2020, and 57.8% (88,460) of the victims resorted to hanging to end their lives [2]. Near-hanging refers to a person who survives a hanging event and reaches the hospital. Thus, factors in near-hanging cases must be identified to determine the prognosis; this would serve as feedback to improve emergency medical services.

Factors that affect the survival period include duration of suspension, force of constriction, type of hanging (complete or partial), initiation of early resuscitative measures, time taken to reach the hospital, and status on hospital arrival. Incomplete encircling of the neck by ligature and partial hanging are also attributed to minimized hypoxic–ischemic damage to the brain [3].

In this study, the majority of the patients (60.9 %) were between 19 and 30 years old, and 78.3% were females. According to Rao, women and men were equally affected, and the majority were between 31 and 40 years old [4]. However, in Australia, young men between their late teenage years and mid-30s predominated [5]. In this study, the height fallen was 0.5–1 m in 28 (60.9%) cases, and Boots et al. recorded it to be <1 m in height in 85% of the cases [5]. Hanging was complete in 34 (73.9%) cases, where the body was suspended completely, and the remaining 12 (26.4 %) were partial hanging, i.e., some parts of the body were in contact with the ground. One-third of the cases were partial hanging in the study by Boots et al., whereas 7 out of 10 cases were partial hanging in the study by Sane et al [5,6].

Ropes were used as ligature materials in 26% of the cases and cloth materials in 74%. In contrast, ropes or cords (42%) were more commonly used than clothing or bed linen (23%) in the study by Boots et al [5]. The ligature mark was interrupted in 38 cases (82.6%) and was continuous in the remaining, similar to that reported by Rao reporting showed discontinuity in 80.58%. The knot was fixed in 28 cases (60.9%) and a slip type in 18 (39.1%), which was in contrast to the findings of Rao where a slip knot was used in the majority of the noose, contributing to 97.73% (n = 258) of the suspensions [4].

The ligature mark was present above the thyroid cartilage in 38 cases (82.6%) and was oblique in 40 (87%) similar to the observations by Rao (82.58% and 87.88%, respectively) [4].

In 16 cases, the ligature mark was reddish brown, which corresponded to the injury aged 1–3 days. The color of the ligature mark depends on the duration of the suspension, complexion of the victim, and survival period. However, studies correlating the age of the injury (survival period in the present study) and the color of the ligature mark are limited. During hospitalization, the color of the ligature mark (abrasion) changes depending on the stage of healing. Abrasion is a blunt force injury where aging can be determined by gross color changes. Rao et al. reported dark-brown ligature marks in 52% of cases, red in 21.33%, and

Table 4. Autopsy findings

Parameters	N = 46 (%)
Type of hanging	
• Complete	12 (26.1%)
• Partial	34 (73.9%)
Height fallen	
• < 0.5 m	16 (34.8%)
• 0.5–1 m	28 (60.9%)
• > 1 m	2 (4.3%)
Number of ligature mark	
• Single	46 (100%)
Level of the ligature mark	
• Above the thyroid cartilage	38 (82.6%)
• At the thyroid cartilage	8 (17.4%)
Direction of the ligature mark	
• Oblique	40 (87%)
• Horizontal	6 (13%)
Width of the ligature mark	
• Wide	34 (73.9%)
• Narrow	12 (26.1%)
Continuity of the ligature mark	
• Interrupted	38 (82.6%)
• Continuous	8 (17.4%)
Prominence of the ligature mark	
• Faint	28 (60.9%)
• Prominent	18 (39.1%)
Peri-ligature injuries	
• Nail scratch abrasions	2 (4.3%)
• Nil	44 (95.7%)
Stage of healing of the ligature mark	
• Bright-red color (fresh)	10 (21.7)
• Bright-red scab (12–24 h)	12 (26.1)
• Reddish-brown scab (1–3 days)	16 (34.8)
• Dark-brown scab (4–7 days)	6 (13.0)
• Scab fallen off (>7 days)	2 (4.3)
Position of the knot	
• Occiput	24 (52.1%)
• Chin	2 (4.3%)
• Right side of the neck	18 (39.1%)
• Left side of the neck	2 (4.3%)

Table 4. Ending

Parameters	N = 46 (%)
Type of knot	
• Slip	18 (39.1%)
• Fixed	28 (60.9%)
• Neck tissues	
• Pale	42 (91.3%)
• Contused	4 (8.7%)
External examination	
• Dried salivary stains	6 (13%)
• Bluish discolored nail beds	8 (17.4%)
• Petechiae	6 (13%)
• Petechiae and tongue bite	2 (4.3%)
• Tongue bite	2 (4.3%)
• Defib mark	2 (4.3%)
Ligature material	
• Saree	20 (43.5%)
• Dupatta/veil	14 (30.4%)
• Bedsheet/curtain	4 (8.7%)
• Rope	8 (17.4%)
Brain gross findings	
• Edema	36 (78.3 %)
• Softening	4 (8.7 %)
• Edema and softening	6 (13.1 %)
• Infarct/abscess	Nil
Lungs gross findings	
• Consolidation	16 (34.7 %)
• Aspiration	10 (21.7 %)
• Edema	16 (34.8 %)
• Consolidation + edema	4 (8.7 %)
CT brain findings	
• Edema	32 (69.8 %)
• Anoxic injury	8 (17.4%)
• Edema and anoxic injury	6 (13 %)
Cause of death	
• Aspiration pneumonia	12 (26.1)
• Aspiration pneumonia + hypoxic encephalopathy	2 (4.3)
Infection	4 (8.7)
• Infection + hypoxic encephalopathy	6 (13)
• Hypoxic encephalopathy	20 (43.5)
• Asphyxia	2 (4.3)

pale in 14.67%. [7]. However, the age of the ligature mark (abrasion) did not correlate with its color.

Bruising of neck tissues was seen in 4 (8.69%). Jayprakash and Sreekumar observed damage to the sternocleidomastoid fiber in 19.6% of their cases. [8] The hyoid bone was fractured in 2 (4.35%) cases, and Rao also reported similar findings (6.06%) [4].

Common lung findings included consolidation (43%), edema (43%), and aspiration (21.7%). However, Boots et al. observed aspiration in 9% of the cases and pulmonary edema in 2%. [5].

In 12 cases, gross findings were confirmed by histopathological examination. In an autopsy study of 8 cases by Swapan Debbarma et al., [9] histopathological examination revealed pulmonary edema in 6 cases and pneumonia in 2. The brain had a hypoxic injury in 5 cases and congestion only in 3.

During autopsy, the brain was edematous in 36 (78.3%) cases and softened in 4. CT of the brain was conducted during hospitalization in all cases. Edema was the common finding in the brain (n = 32), followed by anoxic injury (n = 8), and both were seen in 6 cases. In a hospital-based study where CT was done in 29% of the near-hanging cases, Boots et al. observed that 13% of the patients had cerebral edema [5]. Congestion, edema, and softness of the brain were found in 5 of 8 cases in an autopsy study by Swapan Debbarma et al [9].

Moreover, 78% had a Glasgow Coma Scale of 3 and received basic life support at the scene by ambulance paramedics and the remaining 10 on hospital arrival. In addition, 52% of the cases reached the hospital emergency department in 30 min to 1 h, 43% reached within 30 min, and 5% came after 1 h. Moreover, 74% and 82% of the patients had hypoxia and hypotension on arrival to the hospital emergency department, and 87% were intubated and put on mechanical ventilation.

In this study, 34.8% of the patients had a survival period of 1–3 days, and 30.4% lived for >3 days. In a study by Sane et al., deaths were delayed ranging from 9 h to 72 d [6]. Kumar reported the shortest survival period of 15 h, whereas in the present study, 8.7% of the patients survived up to 6 h [10.] According to Harish et al., the longest survival period was 7 and 14 days [11].

Moreover, Boots et al. observed that 22% had a GCS of 3 at the scene, and 32% required cardiopulmonary resuscitation at the scene by bystanders, ambulance, or paramedics. Where an ambulance was used (73%), the response time was <10 min, and 43% required intubation, which was mainly performed in hospital [5].

Hypoxic encephalopathy was the most common cause of death (43.5%), followed by aspiration pneumonia (26.1%). Infection/septicemia and asphyxia were the causes of death in 8.7% and 4.3% of the cases, respectively. In eight cases, death was attributed to a combination of pathology, i.e., hypoxic encephalopathy with aspiration pneumonia (4.3%)

and hypoxic encephalopathy with infection (13%). Constriction of the neck by ligature causes vascular obstruction of the neck vessels and cerebral hypoxia resulting in hypoxic encephalopathy. Boots, Sane, Swapan Debbarma, and Nithin et al. have also reported hypoxic encephalopathy as the leading cause of delayed death in nonjudicial hanging [5,6,9,12].

CONCLUSION

The outcome in near-hanging events depends both on the circumstances of hanging and clinical parameters. The type of hanging, duration of suspension, falling height, time taken to reach the hospital, and whether life support was given at the scene are some of the factors that determine survival. Hypoxia, hypotension, and poor neurological status on hospital arrival are clinical predictors of fatal outcomes. All near-hanging cases irrespective of the clinical status should be provided with prompt emergency services and aggressive intensive care to reduce mortality.

ADDITIONAL INFORMATION

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Authors' contribution. All authors made a substantial contribution to the conception of the work, acquisition, analysis, interpretation of data for the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work.

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