JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, September 2012, Vol. 57, No. 5
doi: 10.1111/j.1556-4029.2012.02230.x
Available online at: onlinelibrary.wiley.com

PAPER

PATHOLOGY/BIOLOGY

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Observed Characteristics of Suicidal Hangings: An 11-year Retrospective Review

ABSTRACT: Many studies have been published regarding suicidal hanging deaths, and most forensic pathologists and coroners are very familiar with such causes of death. Forensic pathologists are challenged over their rulings regarding manner of death in part because the general public has a limited scope of knowledge. One such challenge centers on the question of whether a hanging can be a suicide if the individual is not fully suspended. The authors designed a retrospective study to review suspension in hangings and to analyze other criteria used to help in deciding manner of death. We examined 229 suicidal hanging deaths over an 11-year period (1997 through early 2009) using the data from two separate jurisdictions in Ohio. In conclusion, we found that the vast majority (83.4%) of people who hanged themselves were found partially suspended. Among other criteria analyzed, only the presence of petechial hemorrhages and acute neck injury was statistically significant.

KEYWORDS: forensic science, forensic pathology, suicide, hanging, partial suspension, full suspension, statistics, neck injury

There are many textbook chapters, scientific articles, and numerous anecdotal reports regarding suicidal hanging deaths. While the cause of death (hanging) is obvious to the observer, the manner of death (suicide, homicide, or accident) is not always apparent without a thorough investigation. Cases where the decedent is only partially suspended may be particularly difficult to understand when it is called a suicide. Literature review found only one article that addressed the extent of suspension in hanging deaths, a short report written by Olive Bennewith et al. (1). However, this paper does not specifically address suspension and what it could mean regarding the manner of death.

The impetus for this retrospective review was a challenge regarding the manner of death by a family who claimed that their adolescent son could not have committed suicide as he was not fully suspended. Even after a complete investigation by forensic personnel, many families cannot accept that their loved one hanged themselves on purpose. They argue that the death was an accident and try to provide reasons why it was an accident. One common reason is that the person could not have wanted to die because he was not completely suspended off the ground by the ligature.

Anecdotal knowledge suggests that partial suspension, described as when a part of the body touches or rests against a surface while in a hanging position, is "extremely common" (2). We undertook this project to ascertain the frequency of occurrence of partially suspended suicidal hangings by reviewing cases in our jurisdictions. Summit County, Ohio, is a mid-Western community of *c.* 545,000 people composed of 82.6% White people, 14.0% Black people, 1.1% Hispanic origin, and 1.8% Asian. Hamilton County, Ohio, is similar in that 71.6% are White people, 24.9% Black people, 1.9% Hispanic origin, and 1.9% Asian (3). The data analyzed from Summit County were for an 11-year period (1997 through early 2009) and from Hamilton County for a 4½-year period (January 2005 through mid-2009). Several other criteria that are of investigative importance in determining the manner of death were also reviewed.

Materials and Methods

The cases presented in this review all had manners of death certified as suicide. We excluded a single case of a complex suicide whereby the victim hanged himself while jumping from a second-story window. People who die by a ligature while engaging in sexual activity are classified as accident victims and were not included in this study.

The computerized case database of the Summit County Medical Examiner's Office and the Hamilton County Coroner's Office was reviewed for the years 1997 through mid-2009 and 2005 through mid-2009, respectively, to identify cases of suicidal hanging. The ranges of years reflect the years during which computerized data are readily available. Cases of both adults and children were reviewed and tabulated. For the purposes of this review, children are defined as less than 18 years of age. Information regarding race and sex were also collected. Ethnicity was obtained from the death certificate.

Autopsy cases were evaluated for the following criteria involving the hanging itself: type of suspension (full vs. partial), acute neck injury, the presence or absence of petechial hemorrhages, and bodily injuries. Included in cases of partial

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Received 7 Mar. 2011; and in revised form 24 June 2011; accepted 15 May 2011.

suspension were those who were discovered in the kneeling position, sitting position, or various recumbent positions.

Other criteria collected that aid in the determination of manner of death include a history of psychiatric illness, previous suicidal attempts or suicidal ideation, evidence of self-mutilation, the presence of a suicide note, concurrent drug or ethanol use at the time of death, the presence or absence of neck padding (which includes hair), and any history of recreational asphyxia. When information is unavailable for whatever reason, an "unknown" category is used.

For the category of psychiatric illness, the criteria were considered positive if there was a clinically documented history of depression or another psychiatric illness or if the individual expressed symptoms of depression or a psychiatric illness to a medical professional. A reported history of depression by a nonmedical person was excluded. In our criteria, a suicide note was described as a note on a piece of paper, a text message, an instant message (computer), an e-mail message, or a word document on a computer that could be recovered. Also considered a suicide note was a verbal utterance or communication made *just prior to or at the time of the suicide* (e.g., phone call to a family member or friend) on a recording device that could be transcribed at a later time. Unrecorded oral communication was not considered a suicide note. For the criteria of concurrent drug or alcohol abuse, this study did not focus on specific drugs or drug levels, although the toxicology laboratories performed blood alcohol and drug screens according to the standard operating procedure of each office. Alcohol and substance abuse treatments were not included in any criteria, including the psychiatric illness category.

Statistical analysis was carried out using Pearson's chi-square test. A probability level of <0.05 was considered significant.

Results

Subjects

A total of 161 cases from Summit County, Ohio, and 120 cases from Hamilton County, Ohio, were selected for review. Fifty-two cases were excluded from the analysis because the degree of suspension could not be determined, leaving a total of 229 cases for evaluation (Table 1). Of these, 192 (83.84%) were males and 201 (87.77%) were White people (Caucasian). The majority of the deaths involved adults ($n = 202$). The youngest suicide case was 8 years old and the oldest was 87 years old.

Findings

Table 2 specifically looks at the primary question of partial versus full suspension. Of the 229 cases reviewed, 83.41% were partially suspended as compared to 16.59% who were fully suspended. There is a preponderance of males over females in both the partial and full suspension categories, among adults and children. Adult males outnumber adult females by as much as five to one. Male children are three to four times more likely than female children to hang themselves.

Acute neck injuries were only seen in the partial suspension category (16.75%). These data were found to be statistically significant ($p < 0.007$). Petechial hemorrhages were more commonly present in the partial suspension category (40.31%) as opposed to those in the full suspension category (15.79%). The difference in these two populations was statistically significant ($p < 0.005$). Bodily injuries (injuries other than neck injuries found around the ligature) were observed in slightly less than 1/3 of victims regardless of the degree of suspension.

Table 3 presents the criteria that aided in the determination of manner of death when compared to full and partial suspension. In each category, the numbers are about the same and are not statistically significant.

The numbers of cases with a psychiatric history were slightly more prevalent in the partial suspension category (47.12%) than in those in the full suspension category (39.47%). Cases of prior suicide attempts were combined with prior suicidal ideations in the tabulation. Such history occurred in 51–53% of cases.

Self-mutilation was found in a minority of all cases (23/229), but was slightly less prevalent in the partial suspension category. In slightly less than 1/3 of all cases, a suicide note was left. In our review, it was also noteworthy that in *c.* 36% of cases, it is unknown whether there is a suicide note or not. The screens for drug or alcohol use were positive in 53% and 42% of these hanging victims. Finally, only six people (2.62% of the total study population) used padding between the ligature and the neck. For this study, the authors did not further describe the padding used. All were in the partial suspension category. Not one of the cases reviewed had clear evidence of previous recreational asphyxia.

Discussion

To categorize the manner of death as a suicide, the forensic pathologist requires a "preponderance of the evidence," not merely "more likely than not" (4–6) that the victim wanted to die. This philosophy requires that the forensic investigative effort fully evaluate the circumstances of death to determine the intent and to exclude a homicide mimicking a suicide. The forensic pathologist takes certain steps to gather the evidence needed to make this decision.

The first step after a thorough scene examination is the examination of the body of the deceased person. Specifically, the ligature mark has features that lend itself to hanging as opposed to ligature or manual strangulation as seen in a homicide or an accidental hanging. The mechanism of death is occlusion of the blood vessels and/or airway in the neck by external pressure.

TABLE 1—*Age, sex, and race of the case review population.*

Age	Number	Percent	Race	Number	Percent
Male	192	83.84	White people	201	87.77
Adults	172	75.10	Black people	24	10.48
Children	20	8.73	Asian	2	0.87
Female	37	16.16	Hispanic	2	0.87
Adults	30	13.10			
Children	7	3.06			

Age range 8 years to 87 years.

TABLE 2—*Partial versus full suspension with associated findings.*

Category	Number (%)	Category	Number (%)
Partial suspensions	191 (83.41)	Full suspensions	38 (16.59)
Male adults	144 (75.39)	Male adults	28 (73.68)
Female adults	25 (13.09)	Female adults	5 (13.16)
Male children	16 (3.14)	Male children	4 (10.53)
Female children	6 (3.14)	Female children	1 (2.63)
Acute neck injury*	32 (16.75)	Acute neck injury	0 (0.00)
Petechial hemorrhages**	77 (40.31)	Petechial hemorrhages	6 (15.79)

*$p < 0.007$, **$p < 0.005$.

TABLE 3—*Characteristics assisting with manner of death determination.*

Category	Number (%)	Category	Number (%)
Total partial suspensions	191 (83.41)	Total full suspensions	38 (16.59)
Psychiatric illness			
Partial suspension		Full suspension	
Yes	90 (47.12)	Yes	15 (39.47)
No	79 (41.36)	No	16 (42.11)
Unknown	22 (11.52)	Unknown	7 (18.42)
Prior suicide attempts/ideation			
Partial suspension		Full suspension	
Yes	99 (51.83)	Yes	20 (52.63)
No	25 (13.09)	No	6 (15.79)
Unknown	67 (35.08)	Unknown	12 (31.58)
Self-mutilation			
Partial suspension	17 (8.90)	Full suspension	6 (15.79)
Suicide note			
Partial suspension		Full suspension	
Yes	58 (30.37)	Yes	12 (31.58)
No	63 (32.98)	No	12 (31.58)
Unknown	70 (36.65)	Unknown	14 (36.84)
Drug and/or alcohol use			
Partial suspension		Full suspension	
Yes	102 (53.40)	Yes	16 (42.11)
No	89 (46.60)	No	22 (57.89)

A common misconception is that a person can only develop enough force (pressure) on the neck organs if fully suspended. Actually, DiMaio and DiMaio (2) have documented that only small amounts of force applied to the neck are required for a fatal outcome. It takes only about 4.4 lbs. of pressure to compress the jugular veins, 11 lbs. to compress the carotid arteries, 33 lbs. to compress the trachea, and 66 lbs. to compress the vertebral arteries. Pressure required to occlude the jugular veins or carotid arteries is less than the weight of an average adult head (10–12 lbs.) and can be achieved during full or partial suspension. In typical suicidal hangings with full suspension, the loop of material used to hang the individual passes around the neck and creates an upward slope toward the point of suspension (7). In partial suspensions, the appearance of the ligature mark may be atypical. There may not be a complete ligature mark around the neck, there may not be an upward slope to the marks, or there may not be a ligature mark at all. A good scene examination to evaluate the circumstances of the hanging is necessary in all cases.

The results of our case review confirmed previously reported statistics that suicidal hangings are far more common in males than in females (8,9). Males are 6.5 times more likely to hang themselves than females. Suicide in general is more common in men than in women (10). In our population, the male deaths were five times more prevalent than female deaths in the adult category. In children, although there were a much smaller number of cases to review, yet there was still nearly a three to one difference. Why males have a higher suicide rate than females is a subject that is complex and poorly understood and involves aspects such as sex, social factors, medical factors, and occupations. The fact that hanging is also more common in males is also a poorly understood statistic.

This review showed that the majority of the cases involved White individuals. This, however, would most likely depend on the population studied, and as the populations of the counties studied in Ohio have a majority of Caucasians, such statistics are expected.

Our review found that the vast majority of suicidal hangings were partial suspensions. This represents a much higher percentage when compared to those observed by Bennewith et al. (1). The majority of victims of hangings are cut down from the ligature prior to the appearance of medical or forensic personnel at the scene. This is not unexpected. If a family member finds the deceased, the natural compulsion is to cut the person down and start life-saving measures. Emergency medical technicians also have the same motivation. And it is not uncommon for family members or medical personnel to not remember the state of suspension prior to cutting the individual down. And so, the state of suspension of these victims could not be independently determined. We excluded those types of cases from our review, as they would only be speculative.

Another finding is the presence of petechiae**.** Spitz reports that over 50% of suicidal hanging victims have petechial hemorrhages, although he does not distinguish between those fully and partially suspended (7). Petechiae in hangings are fine and pinpoint size. They appear when venous pressure above the level of the ligature increases, causing rupture of the fine capillaries and leakage of blood into the surrounding tissues. They are commonly found in the conjunctivae and face, but may also be present within the mucosal membranes of the mouth and hypopharynx. Petechiae are more common in partial hangings. In full suspension, usually both the arteries and veins are obstructed, and no blood flow goes in or out of the head. Petechiae are much less likely in such cases, and frequently, the face of the decedent is pale. In our case review, there were more petechial hemorrhages in the partial suspension population, 77/191 (40.31%) as opposed to 6/38 (15.79%) in the full suspension population.

The second step in the examination is an internal examination, paying specific attention to acute neck injuries. The forensic medical literature indicates that injuries to internal neck structures in hanging deaths are found in less than half of the cases (2,9,11). A layer-by-layer anterior neck dissection is standard in most offices and is performed by examining the superficial and deep muscles, thyroid cartilage, thyroid gland, and hyoid bone for acute injuries. A less common dissection involves examination of the carotid arteries and jugular veins, looking for tears of the intima (internal lining of the vessel). These were not performed in most cases, and therefore, intimal tears may have been missed (12). Dissections of the carotid arteries are frequently a procedure avoided by North American forensic pathologists because of the common practice of embalming. Unlike certain religious groups and cultures, embalming is a very common practice in the United States because of the sometimes prolonged delay between death and burial, and the carotid arteries are major vessels used to embalm the head (13).

Subtle injuries to the deep structures of the posterior neck such as hemorrhage or high cervical vertebral fractures can be detected through posterior neck dissections. This is performed by doing a layer-by-layer dissection through the posterior neck muscles and ligaments including the atlanto-occipital ligaments. Posterior neck dissections are not routinely performed on hanging victims in our offices. Such dissections are not necessary to make the diagnosis of a suicidal hanging but are sometimes performed at the discretion of the pathologists if the circumstances surrounding the death are suspicious or a specific inquiry is made.

The most common injuries of the neck are fractures of the hyoid bone or thyroid cartilage, or injuries to the strap muscles of the neck. These injuries are more common in forceful

strangulation where the tissues of the neck are forced posteriorly, crushing them against the spinal vertebrae and creating fractures. Hangings compress the neck tissues upward and sometimes at an angle (depending on the point of suspension), missing the cartilage and bones. Our case review showed that 16.75% of partial suspension hangings had neck injuries. None of the fully suspended cases had any injuries. The numbers between these two groups were shown to be statistically significant ($p < 0.007$). This can most likely be explained by the fact that partial hangings and the angles they create may place different pressures on the internal neck structures instead of a clear upward compression. These different angles are more likely to press on the cartilage and bone creating fractures or hemorrhages into the muscle.

A common misconception in suicidal hangings is that there are always fractures of the neck. "Fracture of the neck plays virtually no role in non-judicial hanging" (2, p. 247). We found no neck fractures in our study population.

The category of bodily injuries includes acute injuries to the body that are not part of neck injuries. These injuries include abrasions, lacerations, and contusions of the body, more often the limbs than the torso. These must be evaluated carefully to rule out the possibility of struggle during a homicide. These marks often appear during the hanging process itself that is not always a benign process. If there is incomplete occlusion of the neck vessels or trachea, as is possible in partial suspension, the victim may struggle which can include scratching or clawing at the ligature, striking close objects, or seizure-like activity.

After the autopsy is complete, it is important to re-examine the circumstances surrounding the death, as additional information will be available, including psychiatric and medical records. An initial medical opinion may have been formed after the external and internal examination but more information is needed to support and determine the manner of death. Our case review gathered data regarding common criteria that may help the forensic pathologist make such decisions. None of the criteria we examined (Table 3) were statistically significant when comparing between partial and full suspension but were left in these categories as further evidence that they occur in all types of hanging suicides.

The presence of psychiatric illness is found in slightly more partial suspension cases than full suspension cases. In including cases of psychiatric illness in our review, we required a diagnosed mental illness like depression or bipolar disorder. It was important to gather the data from a medical professional. It is not uncommon for people to say to one another "I'm depressed" when, in fact, they are only referring to temporary feelings. We cannot ask friends or co-workers to interpret this "depression." In those cases where a nonmedical person overheard such a comment, we chose to exclude them from our tabulations. There are between 11 and 19% of cases in our study where the mental health history is unknown. This is not unexpected. Depressed or suicidal individuals are isolated and sometimes never seek any sort of mental health care.

Families seem to more readily accept suicide as the manner of death when the victim has a history of prior suicide attempts or explicit suicidal ideation. It can be very difficult to explain to family members that the absence of such history does not preclude the classification of suicide. This study demonstrated that approximately half of the victims have no documented previous suicidal attempts or ideation.

"Self-mutilation is deliberate self-harm without the intent to die" (14, p. 427). Individuals who self-mutilate do so for reasons such as self-punishment, to express feelings that cannot be put into words, or as a way to regulate or manage strong emotions from stress or anger (15). The most common forms of self-mutilation are cutting and burning. Barbara Stanley et al. (14) found those suicide attempters who have a history of self-mutilation have significantly higher levels of depression, hopelessness, aggression, anxiety, impulsivity, and suicidal ideation. They also tend to underestimate how lethal their suicide attempts really are. The research did not find self-mutilators committed suicide more often than those without a history of self-mutilation, but suggested that the group may be at a greater risk for suicide (14). We found a small population of cases, between 8.9 and 15.79%, who had evidence of self-mutilation. Further information regarding this behavior was not explored and is beyond the scope of this review.

The presence of a suicide note at or near a scene of death is a very controversial and sensitive topic for family members. Many family members feel that a loved one would not kill themselves without expressing a reason why or without saying "good-bye." It is hard to comprehend that suicide is a very selfish act, and during the preparation and last moments of an individual's life, the family members and other loved ones may not be in the mind of the individual. It is also not uncommon for family or friends to find and hide or destroy a suicide note to "protect" the memory and dignity of the deceased person. The actual frequency of the presence of a note at the death scene may be much higher than our statistics show. And also, the percentage of cases where there is no note, or where it is unknown if there ever was one, may widely fluctuate in either direction as well.

Most forensic offices perform routine blood, vitreous, and/or urine toxicological analyses for blood alcohol and drugs of abuse. In this case review, the blood levels of drugs and alcohol are not discussed. Only the presence or absence of drugs and alcohol was tabulated to discover the frequency of their presence. Drugs may act like a "crutch" or provide courage. In both the partial and full suspension cases, there were roughly between 40 and 50% of cases with and without drugs and alcohol.

The final category examined is that of neck padding, and only six cases of 229 exhibited such findings. Neck padding involves the use of clothing or other material being placed in between the ligature and the skin of the neck in an effort to prevent injury. These study subjects used clothing and long hair for padding, although the authors did not specify which types of clothing were used. Neck padding is a common finding in cases of people who use asphyxia for recreation. This activity goes by the name "choking game" and other monikers (16). Neck padding is also common in autoerotic asphyxia (sexual practices involving strangulation to increase sensation). Recreational, accidental, and sexual asphyxia cases were excluded from this review. The purpose of neck padding in our cases may include simply the prevention of injury to the neck and an effort to minimize the pain. A good scene investigation is necessary to determine whether recreational or autoerotic asphyxia is an element in the hanging. If found, these would change the manner of death from suicide to accident.

Suicide in young children is difficult to evaluate. None of the children in our study population had a diagnosis of attention deficit/hyperactivity disorder (ADHD). There has been exciting research regarding the association between ADHD and the increased risk for depression and suicide written by Andrea Chronis-Tuscano et al. The authors discovered that ADHD in young children predicts future adolescent depression and/or suicidal attempts (17). Continued research in this field may identify

high-risk youth and lead to a means of reducing future suicidal outcomes.

Even after complete investigations, forensic pathologists are still being challenged on their rulings of suicide as the manner of death. Families of the deceased frequently request the medical examiner or coroner's office to change the ruling of suicide to something else (accident, homicide, or undetermined). Sometimes they bring a lawsuit to have the manner of death amended. The literature reports that *c.* 40% of medical examiners and coroners surveyed said that they have been threatened by a lawsuit**.** Eight percent of responders of a recent survey indicated that they had been sued one to two times, and 1% had several lawsuits brought against them (6). The purpose of our retrospective review was to provide more clear evidence about suicidal hangings in an attempt to provide comfort to the families of the deceased. However, we would like to strongly recommend continued research, especially among children, searching for and identifying potential risk factors for suicide. It is our hope that once such factors are found, prevention efforts can be put forth to reduce the risks in susceptible populations.

Acknowledgments

The authors would like to thank Nichole Davis (Kent State University intern) for her help in entering the decedent information into the Microsoft Access database to make it available for analysis.

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