

Anny Sauvageau,¹ M.D., M.Sc. and Stéphanie Racette,¹ B.Sc.

Agonal Sequences in a Filmed Suicidal Hanging: Analysis of Respiratory and Movement Responses to Asphyxia by Hanging*

ABSTRACT: The forensic literature on the pathophysiology of human hanging is still limited. Therefore, forensic pathologists often feel uncomfortable when confronted with related questions. Here presented is the filmed suicidal hanging of a 37-year-old man. This recording allows a unique analysis of agonal movement sequences: loss of consciousness (13 sec), convulsions (15 sec), decortication rigidity (21 sec), decerebration rigidity (46 sec), second decortication rigidity (1 min 11 sec), loss of muscle tone, (1 min 38 sec) and last isolated muscle movement (4 min 10 sec). As for respiratory responses, very deep respiratory attempts started at 20 sec. Respiratory movements progressively decreased and completely stopped at 2 min. Despite the fact that extending the presented data on all cases of hanging asphyxia would be a mistake, this case gives a very interesting insight into movement and respiratory response to asphyxia by hanging.

KEYWORDS: forensic science, hanging, asphyxia, videorecording

Forensics pathologists are often asked questions about the pathophysiology of hanging. How long does it take to lose consciousness? How long does it take to have an irreversible brain injury? Unfortunately, those questions are almost impossible to answer accurately at the moment. The literature on human hanging is very limited and experimental protocols are, of course, out of question. In that perspective, filmed hanging could give a unique insight into the pathophysiology of asphyxia by hanging.

We here report the case of a 37-year-old man who recorded his hanging suicide. This recording is here analyzed in terms of respiratory and movement responses to asphyxia by hanging.

Case Report

A 37-year-old man tied his neck with a padded rope fixed on the rail system on an electric garage door (Fig. 1). The padded rope consisted of a relatively large hanging ligature, made of soft material; the knot being in the posterior part of the neck. The victim used the remote control to close the door, therefore hanging himself. His feet were fixed in ski boots, tied with chains to a metal platform. A video camera was previously set to film his suicide.

Film Analysis

Before the final hanging, the man hesitated for 23 sec, making the door go up and down with the remote control. Then, he finally closed the door and hanged himself. Considering the time of hanging onset to be time 0, the agonal sequences were the following:

¹Laboratoire de sciences judiciaires et de médecine légale, Edifice Wilfrid-Derome, 1701, Parthenais street, 12th floor, Montreal, QC, Canada H2K 3S7.

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apparent loss of consciousness (13 sec), convulsions (15 sec), decortication rigidity (21 sec), decerebration rigidity (46 sec), second decortication rigidity (1 min 11 sec) and finally, loss of muscle tone (1 min 38 sec). As a matter of fact, after the hanging onset, the man remained apparently conscious for about 13 sec. Afterwards, his eyes closed and his head dropped down. This loss of consciousness was almost immediately followed by vigorous convulsions (15 sec). Twenty-one seconds after hanging, the body presented decortication rigidity, with extension of trunk and lower limbs combined with upper-limb flexion (Fig. 2a). At 46 sec, the body suddenly moved from this pattern of rigidity to decerebration rigidity, with full extension of both upper and lower limbs (Fig. 2b), before returning back to a decortication rigidity at 1 min 11 sec. At 1 min 38 sec, the body slowly lost muscle tone, the extremities falling down along the side of the body. After this loss of muscle tone, a few isolated muscle movements were observed from time to time, that last isolated muscle movement being observed at 4 min 10 sec.

The hanging in the present case does not seem to occlude the airway completely and respiratory movements are well seen in the film. Twenty-seconds after the hanging, very deep respiratory attempts with rhythmic respiratory chest and abdominal muscle contraction started. Respiration was loud and wheezing. At 1 min 11 sec, abundant saliva freely flowed from the mouth. Respiratory movements progressively decreased and completely stopped at 2 min.

Discussion

Despite great advances in the field of forensic science over the last decades, little is known about the pathophysiology of human hanging. The literature on body responses to asphyxia by hanging is still very limited.

In the authoritative textbook known as the Spitz (1), only a few lines address this issue of body responses to asphyxia: "It has been



FIG. 1—Captured image from the victim's videorecording showing position of the victim on the scene, immediately before hanging onset. A padded rope is noted around the victim's neck and fixed above the victim on the rail system on an electric garage door.

suggested that consciousness may persist for up to 10 seconds in cases of abrupt cardiopulmonary arrest, because of oxygen already present in brain tissue. However, experience appears to negate this hypothesis with the thought that oxygen is not the sole determining



FIG. 2—Captured images from victim's videorecordings: (a) victim in decortication rigidity with upper limb flexion, (b) victim in decerebration rigidity with full extension of upper limbs.

factor in extending awareness, but that simultaneous active and sound blood pressure is also required" (1). In the DiMaio's Forensic pathology (2), it is said that "pressure on the neck in the area of the carotid arteries causes unconsciousness in an average of 10 sec." The DiMaio's is also referring to an old study of 1943 by Rossen et al. (3). In this strange but highly instructive study, 85 male volunteers from 17 to 31 years of age were asphyxiated by inflating a pressure cuff on their neck. Loss of consciousness was observed in about 5–11 sec and mild generalized tonic and clonic convulsions followed (3). Studies like this one would be almost impossible to conduct those days, for obvious ethical problems.

Studies on animals have also been realized, like a good study by Ikeda et al. on the course of respiration and circulation in death due to typical hanging by experimentation on 15 dogs (4). However, how data on animal studies apply to human beings is highly questionable.

Of course, execution judicial hanging were witnessed, but those deaths are very different in nature from typical hanging, death being caused mostly by fracture-dislocation of the upper cervical vertebrae with transection of the cord rather than asphyxia by compression of neck structures (1,2).

In 1989, a German paper reported an autoerotic accident by hanging recorded with a video camera (5). In this case, a 24-year-old man hanged himself by tying a hangman's noose from the ceiling. Then, sitting on an office chair, he was able to tighten the noose by lowering the seat. According to the authors, the victim seemed initially relatively calm on the video. He prepared his setting for about 5 min and then hanged himself. Loss of consciousness was observed after about 55 sec, followed by intermittent convulsions for about 6 min. This unique case, with no equivalent in the English literature so far, presented data that correlate with the present case: rapid loss of consciousness in seconds (13 and 55 sec) followed by several minutes of intermittent convulsions (4 and 6 min).

For the moment, those two film analysis are just isolated case studies. Despite the fact that it gives very interesting data on movement and respiratory response to asphyxia by hanging, to extend the presented data to all cases of hanging asphyxia would be a mistake. Several factors would certainly have an effect on the movement and respiratory responses to asphyxia: the type of hanging ligature (soft vs. rigid, large vs. thin, with or without knots...), the position of the hanging (suspended hanging, standing up hanging, hanging in a sitting position...) and type of victims (young vs. old, man vs. female, obese vs. thin...). Nevertheless, those filmed suicides contribute to a better understanding of the pathophysiology of asphyxia by hanging in humans.

Conclusion

This video was in our laboratory for several years before the authors decided to undertake this systematic analysis. Also, from time to time, we hear that other recordings of such hangings do exist, mostly in the context of autoerotic accident. We think those videos should be systematically reviewed and compared.

When this case was presented at the 58th Annual Meeting of the American Academy of Forensic Sciences (AAFS), a call for other recordings was sent. Each scientist who has such a video or can get access to such a video is welcome to join our newly formed Working Group on Human Asphyxia (WGHA) and this video will be added to our study. From the initial response at the AAFS, the authors are confident that the WGHA can lead to a better understanding of the pathophysiology of human hanging in a relatively short time.

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Additional information and reprint requests:

Anny Sauvageau, M.D., M.Sc.

Laboratoire de sciences judiciaires et de médecine légale

Édifice Wilfrid-Derome

1701, Parthenais street

12th floor

Montreal, QC

Canada H2K 3S7

E-mail: a.sauvageau@msp.gouv.qc.ca