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To: pathologists, coroners, lawyers and other interested parties

**Re: the mechanisms of death in HANGING and possible windows of opportunity to rescue persons who hang themselves from death**

Having received requests to explain these phenomena over many years, here is a short summary of what I know from my experience, discussion with senior forensic pathologists (who see more hangings than I do), and the published literature. The latter covers observations and speculation over 200 years; some experimental evidence from work on animals as well as humans (in an era of laxer ethical regimes than those current now); and careful observations of a small number of video recorded hanging deaths. See the reference list below.

*Complete suspension* hanging means that the person has a ligature around the neck, with no other support; *incomplete suspension* means that a part of the body is supported, so reducing the weight applied to the neck. There is no evidence to indicate that the mechanisms or the timings of death differ significantly between these two scenarios.

Mechanisms of death

There are three main proposed mechanisms that cause the death in hanging; they are not mutually exclusive:

1. Neck compression reduces blood flow to and from the brain, so damaging the brain;
2. Neck compression reduces air flow into the lungs, so causing anoxia and damaging the brain;
3. Neck compression impacts on the carotid body and the vagus nerve, sending impulses to the heart, casing arrhythmia, asystole, and cardiac arrest.

Modern observations and reviews, as well as hospital observations of vagal stimulation, discount the third explanation - which was primarily espoused by Keith

Simpson and Bernard Knight in the UK. This mechanism is no longer considered important.

Airway compression is considered less important than it used to be, again based on observations and careful consideration of anatomy.

Thus compression of blood vessels to & from the brain is considered to be the most important process causing death.

Sequence of events in hanging

The agonal sequence of events in hanging, as evident from filmed hangings, is as follows:

| | Average time |
|---|---|
| Loss of consciousness | 10 $\pm$ 3 s |
| Convulsions | 14 $\pm$ 3 s |
| Decerebrate rigidity | 19 $\pm$ 5 s |
| Deep rhythmic abdominal respiratory movements | 19 $\pm$ 5 s |
| Decorticate rigidity | 38 $\pm$15 s |
| Loss of muscle tone | 1 min 17s $\pm$ 25 s |
| End of abdominal respiratory movements | 1 min 51 s $\pm$ 30 s |
| Last muscle movements | 4 min 12 s $\pm$ 2 min 29 s |

Other specific hanging scenarios

There is no evidence to indicate that *alcohol intoxication* affects the sequence of events following suspension or their timings;

*Auto-erotic hanging* (where ischaemic habituation might play a role) appears to differ from non-auto-erotic hanging only in the timing of abdominal respiratory movements (delayed) and of last muscle movements (sooner).

There is no evidence to indicate that using *different ligature materials* (narrow/wide; soft/hard; metal/cloth/plastic/rope) makes any difference to the outcome.

Timing of brain damage and opportunity for intervention to prevent death

The neuropathological consensus is that brain neurones ordinarily die from hypoxia *'within 5 minutes'* if oxygen and circulation are denied. In hanging, the hypoxic damage evidently starts within seconds of suspension, causing unconsciousness; neurones are thus rapidly sub-lethally injured, but recovery is possible if the suspension is interrupted within 5 minutes. The 5 minute rule should be taken as a maximum, not a minimum, and there necessarily is uncertainty over its precision, and whether it could apply to all persons under all circumstances.

There are publications from emergency departments concerning survival vs death following attempted suicide hanging and 'near-hanging'. The 5 minute limit is

emphasised as critical for possible survival. Single case reports report full recovery following a hang-time of up to 15 minutes, but they are exceptional and not the norm (and necessarily indicate a publication bias toward unusual successes in resuscitation).

In conclusion, it is sensible to state to interested parties that unless an intervention happens within a few minutes of suspension, it is unlikely that there would be a full return to normal state.

**Professor Sebastian Lucas FRCP FRCPath**

References


Sauvageau et al. Agonal sequences in 14 filmed hangings. Am J Forensic Med Pathol, 2011; 32:104-107.

Sauvageau. Agonal sequences in 4 filmed hangings. J Forensic Sci, 2009; 54:192-194.

Clement el al. Mechanism of death in hanging: a historical review. J Forens Sci, 2010; 55:1268-1271.

Boghossian et al. Respiratory, Circulatory, and Neurological Responses to Hanging: A Review of Animal Models. J Forens Sci, 2011; 55:1272-1277.

Rossen et al. Acute arrest of cerebral circulation in man. Arch Neurol Psych, 1943; 50 :510-528.

Saukko & Knight. Suffocation and asphyxia, In: Knight's Forensic Pathology, 4th edition, CRC Press, 2015.

Yildirim et al. The Effective Factors on Survival in Near-Hanging. Journal of Anesthesia & Critical Care: Open Access Volume 2 Issue 2 – 2015.

Kodikara. Attempted suicidal hanging: an uncomplicated recovery. Am J Forensic Med Pathol, 2012; 33(4) DOI:10.1097/PAF.0b013e3182443585