Rom J Leg Med [22] 225-228 [2014]
DOI: 10.4323/rjlm.2014.225

A case of complex mechanical asphyxia due to physical restraint and gagging in an obese man

Jiao Mu[1,2], Shaohua Zhu[1], Lan Zhou[3], Luo Zhuo[4], Ananda Sunnassee[5], Hongmei Dong[1,]*

Abstract: Death from positional asphyxia by physical restraint takes place when the abnormal position of the victim's body compromises the process of respiration. Dying in a supine restraint position is rare. The term "gagging" describes the blockage of the internal airways by ramming certain objects into the mouth. Here, we report the case of a 47-year-old obese man who had been kidnapped and was found dead in a supine position with limbs bound together in the back and the mouth gagged with stick. Apart from a very low level of the drug estazolam, and mild trauma on the body surface, autopsy findings were unremarkable. There were no injuries or pathological findings to account for his death. The cause of death was certified as mechanical asphyxia following gagging and restraint in a supine position. The victim's obesity is a co-factor in hastening his death.
Key Words: forensic science, forensic pathology, positional asphyxia, gagging, obesity, forensic autopsy.

The term "physical restraint" in the medical and legal settings describes a fixed body position caused by the use of certain external devices, for example, during custody of prisoners or transportation of agitated psychiatric patients. Deaths occurring during and/or in close proximity to a physical restraint have been attributed to positional asphyxia. Positional asphyxia refers to a compromise of respiration because of splinting of the chest and/or diaphragm preventing normal respiratory excursion, or occlusion of the upper airway due to abnormal positioning of the body. There are various reports about positional asphyxia in reverse suspension, head-down position, hyperflexion of the neck, and a 'jack-knife' position [1]. However, death due to positional asphyxia in a restraint supine body position is a rarely reported. The term "gagging" describes the blockage of the internal airways by ramming certain objects into the mouth, which may be accidental or homicidal. The gags are usually soft rather than hard objects. Here, we report a case of unusual complex mechanical asphyxia resulting from physical restraint in the supine position and gagging with a stick in an obese man.

1) Department of Forensic Medicine, Huazhong University of Science and Technology, Tongji Medical, College, No. 13 Hangkong Lu, Hankou, Wuhan, Hubei 430030, PR China
** Corresponding author: Department of Forensic Medicine, Tongji Medical College of Huazhong University of Science and Technology, 13 Hangkong Road, Wuhan, Hubei 430030, P. R. China, Tel. 86-18062128672, Fax: 86-27-83692638, Email: 123730562@qq.com*
2) Department of Forensic Medicine, Hebei North University, No. 11 Zuanshinan Road, Zhangjiakou , Hebei 075000, PR China
3) Center of Forensic Science and Technology, Bureau of Public Security for Jiangsu province, Nanjing, Jiangsu 210024, PR China
4) Fujian provincial Public Security Department, Fuzhou 350001, PR China
5) Ministry of Health and Quality of Life, Victoria Hospital, Mauritius

CASE REPORT

A 47-year -old male was found dead in a restraint supine position in the corner of a deserted house (Fig. 1). Stockings were tied together around his forehead, and a black leather belt was wrapped around his head covering eyes and ears. A wooden stick, 30 cm long and 2 cm in diameter, was located on his neck, with a rope winding both ends (Fig. 2). An imprint around the mouth was present, which was consistent with the stick on the neck. The victim's wrists were bound behind his back and his ankles were tied together. His knees were bent and his hobbled ankles were tied together to his bound wrists by a rope (Fig. 3).

The body was 165 cm long and weighed 90 kg (BMI: 33.06 kg/m^2). The distribution of livor mortis was consistent with the position of the body at the scene. The right eyebrow and inner canthus region had fresh lacerations (2 cm in length). The right eyelid was bruised. Few petechiae were seen in the conjunctiva. The upper and lower lip mucosa had irregular abrasions and contusions. The injuries corresponded to the belt, rope, stockings and the stick, which were used to tie up the victims. The left parietal scalp had abrasions measuring 4.0 cm × 0.3 cm in greatest dimensions. Sporadic hemorrhagic patches were seen on the undersurface of the scalp, particularly on the right temporal (4.0 cm × 2.0 cm) and left parietal areas (2.0 cm × 2.0 cm). The brain, weighing 1420 g, was congested and edematous, but had no intracerebral bleeding and contusion. Few of scattered petechial hemorrhages were seen on the epicardium and tracheal mucosa. The combined lung weight was 838 g. The heart (weighed 340 g) revealed no macroscopic and microscopic abnormalities, including its coronaries, valves, and blood vessels. The abdominal viscera were generally congested. There were no other remarkable autopsy and histological findings.

Toxicological result was positive for estazolam. The concentration of estazolam was 0.014 μg/g in the blood, 0.044 μg/g in the liver tissue and 1.41μg/g in the stomach contents.

The case was solved early. Police investigations revealed that the victim had been kidnapped one day before his death. The suspect confessed that he imposed the physical restraint on the victim to prevent his escape. A stick was gagged in the victim's mouth to silence him (Fig. 4).When he found the victim dead, he removed the stick from the mouth to the neck. The victim had been in good physical and mental condition apart from grade II obesity. There was no pre-existing medical history.

Figure 1. Scene: the victim in a fixed supine body position.

Figure 2. Scene: The silks socks and leather were tied around his head and a wooden stick was located on his neck.

Figure 3. The physical restraint: his wrists tied together behind his back and ankles bent together and secured to his wrists.

Figure 4. The face was extensively swollen. The mouth was gagged with stick.

DISCUSSION

Positional asphyxia usually exhibit non-specific autopsy findings, the following three criteria for the diagnosis have been suggested: discovery of the deceased in a position inhibiting adequate respiration; reasonable explanation for inability of self-extrication from the position; and other causes of natural or violent death must be excluded [2]. Referring to the current case, no disease or injury was responsible for the death, and moreover, the toxicological result was negative except extremely low level of estazolam which is far from the toxic levels (1000μg/L) and unlikely causing the man's death. Without exception, the present case met the criteria of positional asphyxia. Thus, positional asphyxia due to physical restraint was considered to have caused death.

It is well known that the restrictive position, such as prone, hobble, and head-down position, could lead to a restrictive pulmonary function pattern and even death. In this case, the victim was in a hogtying supine position, thus his shoulders were hyperextended. Reay *et al.* [3] suggested that hyperextension of the shoulders could seriously limit chest wall relaxation and expansion. However, as of yet, the impact of supine restraint position on pulmonary function is still ambiguous. The NICE Guideline Development Group thought there were dangers related to restraint in any position for prolonged periods, including supine position. Chan *et al.* found convincing differences in the effects of pulmonary function in the restrained supine position. A statistically significant reduction in FEV1 (forced expiratory volume in 1 second), FVC (forced vital capacity), and MVV (maximal voluntary ventilation) was found in the restrained supine position [4]. In the reexamination of custody restraint position and positional asphyxia, Chan *et al.* asserted that Pulmonary Function Test (PFT) changes consistent with a restrictive pattern were also seen simply by placing subjects in a supine position [5]. Additionally, the current guidance within the National Health Service (NHS) states that all restrained positions should be considered to present equal risk. According to these literatures, evidence that the supine position with hog-tying has an adverse effect on respiratory function and contribute to the occurrence of asphyxial death is unequivocal.

However, despite the compromised pulmonary function, the restrictive position alone might not lead to death. Some scientists have argued that factors such as drug intoxication, excited delirium, trauma, stress, obesity, or catecholamine hyperstimulation are more important for sudden death from positional asphyxia [6]. In this case, we focused on the possible co-factors and especially on obesity, since the victim had a protuberant abdomen and a BMI of 33.06.

Recently, some cases of positional asphyxia in obese man have been reported [1, 7-9]. Previous authors demonstrated that obesity significantly decreases respiratory system compliance and increases inspiratory resistance and the work of breathing in anesthetized patients [10, 11]. Recent experiments confirmed that the obesity has significant effects of decreasing the lung volumes, FRC and ERV and the main reason has been found to be inadequate pulmonary gas exchange [12, 13]. Thus, obese persons may be at greater risk for development of restrictive pulmonary function.

Importantly, with increasing BMI, an increase in abdominal mass and intra-abdominal pressure is expected [14]. The consequence of increased intra-abdominal pressure in a supine position not only causes impaired diaphragmatic movement, but also causes compression of the inferior vena cava and reduced venous blood return to the heart and subsequently an impaired cardiac output. This mechanism, the inferior vena cava syndrome, has been suggested as a cause of sudden death during restraint [8].

For the cause of death, gagging should be considered in addition to positional asphyxia. It is noteworthy that, the victim's mouth was gagged with a stick, which can prevent communication, and also potentially restrict breathing by mouth. Gasping for air with a stick gagged in the mouth and lying in a hog-tying supine position, it is likely that the thick neck contributed to the obstruction of the posterior pharynx at the base of the tongue, leading to potential respiratory compromise. Thus, gagging must have contributed to the victim's asphyxia.

CONCLUSION

In conclusion, after excluding death due to disease, trauma and intoxication, mechanical asphyxia due to physical restraint and gagging, exacerbated by obesity, was determined as the cause of death. It is stressed that the possible role of gagging and obesity must be taken into consideration when dealing with a similar case of positional asphyxia.

References

1. Hayashi T, Buschmann C, Correns A, Herre S, Tsokos M. Fatal positional asphyxia. Forensic science, medicine, and pathology. 2012:1-3.
2. Stratton SJ, Rogers C, Green K. Sudden death in individuals in hobble restraints during paramedic transport. Annals of Emergency medicine. 1995;25:710-712.

3. Reay DT, Fligner CL, Stilwell AD, Arnold J. Positional asphyxia during law enforcement transport. The American journal of forensic medicine and pathology. 1992;13:90-97.
4. Chan TC, Vilke GM, Neuman T, Clausen JL. Restraint position and positional asphyxia. Annals of Emergency Medicine. 1997;30:578-586.
5. Chan TC, Vilke GM, Neuman T. Reexamination of custody restraint position and positional asphyxia. The American Journal of Forensic Medicine and Pathology. 1998;19:201-205.
6. Mirchandani HG, Rorke LB, Sekula-Perlman A, Hood IC. Cocaine-induced agitated delirium, forceful struggle, and minor head injury: a further definition of sudden death during restraint. The American journal of forensic medicine and pathology. 1994;15:95-99.
7. De Donno A, De Fazio A, Greco M, Introna F, Maglietta R. Death in head-down position in a heavily intoxicated obese man. Legal Medicine. 2008;10:204-209.
8. Nissen T, Rørvik P, Haugslett L, Wynn R. Physical restraint and near death of a psychiatric patient. Journal of forensic sciences. 2013;58:259-262.
9. O'Halloran RL. Reenactment of circumstances in deaths related to restraint. The American journal of forensic medicine and pathology. 2004;25:190-193.
10. Pelosi P, Croci M, Ravagnan I, Tredici S, Pedoto A, Lissoni A, *et al.* The effects of body mass on lung volumes, respiratory mechanics, and gas exchange during general anesthesia. Anesthesia & Analgesia. 1998;87:654-660.
11. Sprung J, Whalley DG, Falcone T, Warner DO, Hubmayr RD, Hammel J. The impact of morbid obesity, pneumoperitoneum, and posture on respiratory system mechanics and oxygenation during laparoscopy. Anesthesia & Analgesia. 2002;94:1345-1350.
12. Dixon BJ, Dixon JB, Carden JR, Burn AJ, Schachter LM, Playfair JM, *et al.* Preoxygenation Is More Effective in the 25 [degrees] Head-up Position Than in the Supine Position in Severely Obese Patients: A Randomized Controlled Study. Anesthesiology. 2005;102:1110-1115.
13. Jones RL, Nzekwu M-MU. The effects of body mass index on lung volumes. Chest journal. 2006;130:827-833.
14. Pelosi P, Croci M, Ravagnan I, Cerisara M, Vicardi P, Lissoni A, *et al.* Respiratory system mechanics in sedated, paralyzed, morbidly obese patients. Journal of Applied Physiology. 1997;82:811-818.