Possible death mechanisms other than respiratory asphyxia in a suicidal hanging case

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Abstract: Hanging is the most common suicide method that has been seen in the routine autopsy practice. Known mechanisms of death include asphyxiation due to airway obstruction, cerebral ischemia due to arterial blockage, vagal inhibition (reflex cardiac arrest) due to carotid sinus compression, congestion due to venous blockage, fractures in cervical vertebral column with the cord injury.

A 84 year-old man with totally laryngectomy found hanging from a tree in the garden of his house, and referred to Council of Forensic Medicine to determine cause of death. On the autopsy upper airway was found to be ligatured from the level of hypopharynx. Case has been breathing via laryngectomy hole on his neck before suicide attempt. Case has been determined to be an interesting example for mechanism of death other than respiratory asphyxia in hanging cases.

Key Words: hanging, totally laryngectomy, mechanism of death.

Hanging is the most common suicide method that has been seen in the routine autopsy practice [1]. According to Turkish statistical suicide data from Turkish Statistics Institute between the years 2002-2011 hanging was the most common suicide method for both sexes [2].

In hanging cases there are various mechanisms that lead to death. Known mechanism include asphyxiation due to airway obstruction, cerebral ischemia due to arterial blockage, vagal inhibition (reflex cardiac arrest) due to carotid sinus compression, congestion due to venous blockage, fractures in cervical vertebral column with the cord injury [3-6].

We present a suicidal hanging case with totally laryngectomy. This case was interesting about some couple of issues. There are some interesting topics to be discussed on this case. First, the mechanism of death, other than mechanical asphyxiation. Second, again the mechanism of death but from other point of view which is difficult to be known by people out of medicine practice (especially forensic medicine) and its criminal aspect. Third, may be the will to die in a case with cancer.

CASE

A 84 year-old man found hanging from a tree in the garden of his house. On the information which was obtained from his wife, it was learned that he was suffering and having treatment for larynx cancer for 2 years. He had a totally laryngectomy operation 2 years ago.

There were no struggle findings on the death scene or at home; there was a chair which was thought to be used for jumping from the height to complete the hanging.

After initial inspections case was referred to our Morgue Department to determine the cause of death. A laryngectomy hole was seen on the external examination.
of the neck. There was also a ligature mark above the thyroid cartilage (Figure 1). There were subcutaneous bleeding signs in the ligature mark. There were no petechial hemorrhages on conjunctivae and also in any part of the body. There was no further traumatic lesion other than ligature mark on the external examination.

In the autopsy thyroidal cartilage was absent and upper airway has been ligatured from the level of hypopharynx. Lower airway was linked outside from the laryngectomy hole and airflow from the oronasopharynx has been obstructed with the laryngectomy operation. There was subcapsular hemorrhage in the right submandibulary gland which was located underneath the ligature mark. Hyoid bone was found intact. There was a separation between 4th and 5th cervical vertebrae (Figure 2) but there was no bleeding in the vertebral canal and no macroscopical injury on the cervical spinal cord. Spinal cord was found intact in the microscopical examination.

At the inspection of other systems in the autopsy there were masses in both lungs, which were diagnosed as bronchial metaplasia with microscopical examination. Weights of right and left lungs were measured 312 g and 294 g respectively. There were serious pleural adhesions on whole surfaces of both lungs. There were no specific macroscopical and microscopical findings on the examination of other systems.

Blood and urine specimens were collected for toxicological screening but nothing was found in the systematic toxicological analysis.

As a result cause of death was determined as an antemortem hanging.

**DISCUSSION**

**Hanging and neck anatomy**

Neck is joining head and trunk as a part of the trunk and limited by lower margin of corpus mandible, back margin of ramus mandible, porus acusticus externus, apex of mastoid bone and superior nuchal line on the top. Lower limits of the neck are manuvrium sterni, both clavicles, acromiolavicular joint and 7th cervical vertebra [7, 8]. Between these boundaries there are important structures of central nervous system, circulation system, respiratory system, gastrointestinal system, lymphatic system and locomotor system. Spinal cord, cervical plexus, brachial plexus, phrenic and vagal nerves are important nervous structures. Locomotor system composed of seven cervical vertebrae, hyoid bone, thyroid and cricoids cartilages, muscles and fascias. Hypopharynx, epiglottis, larynx, trachea and esophagus are gastrointestinal and respiratory structures of neck.

Nikolic et al. reported that on the retrospective study among hanging cases, most hanging-related injuries were seen on the locomotor system structures, and among these structures sternoclidomastoid muscle was found as the most affected structure. Affection degree of deeper structures reported as to be depending on the hanging type and localization of the knot [9]. In this respect injury spectrum vary between serious fatal injuries including decapitation [10-12], cervical vertebra injuries
with cord injury [6, 13], and nonfatal soft tissue injuries [9, 14-17].

**Hanging and death mechanisms**

Especially in animal studies in 19th and 20th century and in cases of judicial hangings, respiratory asphyxia, cessation of brain circulation and cardiac inhibition due to nervous stimulation are most mentioned theories as death mechanism of hanging [4]. Additionally, cervical vertebra fractures and spinal cord injuries considered as death mechanism [3-6]. Besides McHugh et al. reported deaths due to early and late respiratory complications and neurologic complications including general status spectrum varying between amnesia and vegetative status, in near-hanging cases [18].

In our case it is obvious that death mechanism is not respiratory asphyxia. Also, case could breathe via laryngectomy stoma that is located below the hanging mark. Exact death mechanism remained obscure as it was obvious that it was not due to respiratory mechanism. There was no finding that let us diagnose or exclude cardiac inhibition due to sympathetic stimulation which also has no specific macroscopic or microscopic autopsy finding. Another mechanism that could not be able to excluded was cessation of the arterial brain circulation. It was suggested that pressures that needed to compress the carotid arteries is 3.2 kg; to compress jugular veins is 2 kg; to compress airway is 15 kg and to compress vertebral arteries is 30 kg [19]. Location of the hanging rope on the neck let us think that both common carotid arteries were not occluded equally [9] but there was no evidence to prove this phenomenon. Cessation of venous circulation while arterial circulation sustains, causes a local hypertension and subsequent capillary rupture. This mechanism leads the formation of petechiae (Tardieu spots) which is an important finding for asphyxial deaths [20]. Conversely in our case there was a paleness at conjunctiva and buccal mucosa.

Penney et al. reported that there was no cervical vertebrae fracture at their each 42 hanging survivors on their 5-year retrospective study [21]. This could be indicative that cervical vertebra fractures are associated with deaths on hanging cases. In our case we found a separation between 4th and 5th cervical vertebrae, but there was no macroscopical or microscopical injury on the spinal cord. Additionally there was no hemorrhage in the cervical vertebral canal. That’s because this mechanism could not be accepted or excluded.

At this point diaphragmatic paralysis due to compression of phrenic nerve, originating from 3rd, 4th and 5th cervical nerve roots, could be blamed but there was no proven hypothesis to explain this kind of death mechanism in literature [22, 23].

Additionally there is another question that if the case was either an ante-mor tem or postmortem hanging case. In suspicious cases answer of this question is very important to guide the investigation to determine if it is a homicide or a suicide. In our case subcutaneous bleeding sign in the hanging mark in the external examination and subcapsular bleeding sign on the submandibular gland which is located under the hanging mark could be accepted as findings of ante-mortem hanging.

In addition to all those discussions, our cases’ expectations from hanging event should be discussed. It is detailed information for lay-person that there are different death mechanisms other than respiratory asphyxia in hanging. Our case chose hanging method to die, although he knew that he could continue breathing from the laryngectomy stoma. This may let us that he had some information about other death mechanisms in hanging or in contrast he didn’t want to die. In the judicial file, his wife indicated about his depression because of laryngectomy operation and maintenance drug therapy after surgery. This could be supportive for death motivation of hanging act.

As a conclusion, we determined that in our case choice of hanging as a suicide method was fulfilled due to common doctrines, not with discussion about the death mechanisms. In our case we found that hanging was an ante-mortem hanging and death mechanism was other than respiratory asphyxia.

**References**