CQ38 Is it useful to use postmortem images to determine asphyxia?

Grades of recommendations:
C1 for evaluating the condition
C2 for determining the cause of death

There is some diagnostic value in using postmortem images for asphyxia due to upper airway obstruction and neck compression. Postmortem CT can visualize foreign objects, tumors, and fractures, and MRI can visualize soft tissue abnormalities. Postmortem images are useful as a complementary modality in assessing the cause and situation of asphyxia.

Explanation----------
Background

Asphyxia is distinguished into external and internal asphyxia. External asphyxia is where the intake of external oxygen into the blood due to airway obstruction or ventilation problems is impaired. Internal asphyxia is cells (localized occurrences) of asphyxia in which gas exchange between blood and peripheral tissue is impaired by chemical substances and the oxygen utilization of peripheral tissues is disturbed. The causes of external asphyxia are classified as follows depending on the site of occurrence of the external force [1].

① Decrease in oxygen partial pressure in the atmosphere
② Nose and mouth obstruction
③ Airway obstruction
④ External neck compression (hanging, ligature strangulation, manual strangulation)
⑤ Chest compression
⑥ Drowning
⑦ Other (pneumothorax trauma, hemothorax, and others)

Postmortem images of upper airway obstruction

In asphyxia where oxygen supply to the lungs has been impaired by obstruction of the upper airway lumen, postmortem CT have identified occluded foreign objects and tumors from the nasal cavity to the tracheal lumen. Foreign objects in the lumen (pharynx and larynx [2, 3] and trachea [4]), hemoptysis (renal cancer endobronchial metastasis [5], tuberculosis), soft tissue swelling (Ludwig angina, hereditary angioedema, and others) [7-10]. Postmortem CT showed that these resulted in upper airway obstruction result in asphyxia. A foreign object in the respiratory tract was found by postmortem CT examination of a decayed corpse that had been buried one year after death. Based on these results, there are reports of cases in which the cause of death was diagnosed [11]. Postmortem

CT have also been reported to be useful in cases where the nose and mouth of a newborn baby was hand-closed resulting in killing, and then leaves were packed into the oral cavity [12].

Postmortem image of neck compression

Mechanical compression of the neck is a forensic approach to identify cervical neck hanging (hanging by the neck with the body weight suspended by a cord: hanging), ligature strangulation (pulling the cord wound around the neck with a hand and others, to compress the neck: ligature strangulation), manual strangulation (without using a cord, squeezing the neck with hands or feet: manual strangulation). In mechanical compression of the neck, the main cause of death is a decrease in cerebral blood flow due to occlusion of the cervical blood vessels and the resulting interruption of the oxygen supply to the brain. Airway obstruction is not always a prerequisite for death [1].

Figure 1 Male in the 40s, Cervical Neck hanging (3 days after death)

A Postmortem CT shows a fracture and flexion of the right large angle of the hyoid bone.

B Hyoid bone cartilage VR image: The right large angle of the hyoid bone is displaced to the head side. With hanging from the neck, fractures are not always found in the hyoid bone (thyroid cartilage). Alternatively, even if the bone is broken, and if there is no displacement, it cannot be evaluated by postmortem CT. In addition, it is often difficult to identify organic reactions such as bleeding by postmortem CT, and it is difficult to distinguish these from postmortem damage.

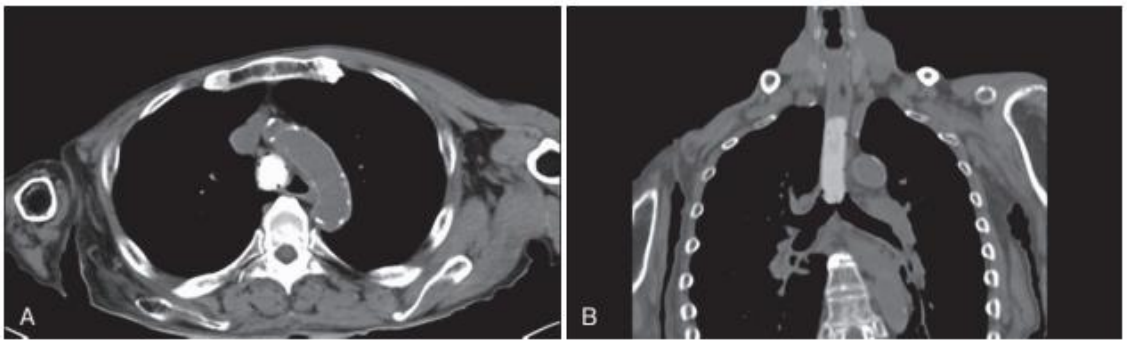
It is said that more than half of the fractures of the hyoid bone and thyroid cartilage are seen in cervical neck hanging, and fractures are also found in the cricoid cartilage and the larynx [13-15]. Postmortem CT can clearly visualize even small fractures that are difficult to see with an autopsy [16].

Cervical vertebral fractures are also frequently seen, especially in the hanging caused by jumping from high places [14]. In the fractures of the cervical neck in humans who have been hanged by a fall from high places, type 1 has less bleeding and may be difficult to find from the autopsy, but postmortem CT are useful for visualization of fractures [17]. However, fractures of the atlas and axis are not always found [18].

It has been reported that gas may be found in the soft tissue of the neck in the cervical neck, suggesting the presence of fractures near the gas [15]. Coincident with the fracture, postmortem CT showed laryngeal edema [18] and postmortem MRI showed vocal cord adduction and glottic closure [19]. Mediastinal emphysema and soft tissue emphysema are findings of biological reactions of the neck of a hanging cadaver. Proof of this is difficult to determine by autopsy, but postmortem CT makes it straightforward to identify emphysema [20, 21]. It has also been reported that if the neck groove due to the hanging by the neck is deep, it may be possible to evaluate this (mediastinal emphysema and soft tissue emphysema) by referring to a 3D reconstructed image of VR (volume rendering) [14].

In ligature strangulation and manual strangulation, postmortem CT reports of hyoid bone and thyroid cartilage fractures have been reported. In addition, postmortem MRI allowed identification of hemorrhage of the posterior cricoarytenoid muscle [22]. In ligature strangulation and manual strangulation, bleeding of the subcutaneous fat in the neck, soft tissue such as muscles, lymph nodes, pharynx, and larynx is frequently observed [23-26]. Postmortem MRI are useful for the evaluation of soft tissue in corpses subjected to neck compression [26], and in particular the use of fat suppression images makes it easier to detect signals of slight abnormalities [22, 26]. Postmortem CT are limited in usefulness because of the difficulties to accurately detect small amounts of bleeding in the neck and in putrefied corpses [14, 16].

Figure 2 Male in the 70s, a case of cardiopulmonary arrest after complaining of asphyxia while eating Mochi (rice cake) and transported to emergency room. Medical history: cerebral infarction.



Postmortem CT was obtained 27 minutes after death.

A high attenuation structure occupying the lumen from the trachea to just above the bifurcation is observed.

Other postmortem images from cases of asphyxia

A patient who suffered from asphyxia due to respiratory dysfunction caused by chest and abdominal compression died with the trunk of the body being sandwiched between cars. Postmortem CT showed bleeding around the duodenum, flattening of the aorta and inferior vena cava [27]. There are also reports of death due to air embolization with helium gas [28].

Column----------

Postmortem CT can assess airway conditions that are not apparent on the surface. Therefore, they have great significance as a screening tool before an autopsy. It is desirable to combine reconstructed images such as sagittal sections, coronal sections, and 3D as appropriate for evaluations. When airway obstruction or asphyxia due to a foreign object is suspected, and it is indispensable to evaluate information including postmortem images and situational evidence. It is also necessary to take into consideration such factors as regurgitation residue from the esophagus and stomach during the period of death, movement of airway contents due to body position changes, and intentional additions of foreign objects when a crime is suspected of being involved.

Postmortem CT/MRI are useful for assessing bone, cartilage, and soft tissue when asphyxia is caused by mechanical compression of the neck. Even if a postmortem image has few findings suggesting asphyxia due to neck compression, it is not acceptable to exclude asphyxia as a cause of death. A composite diagnosis is required by combining the situation at the time of death, external surface findings, and autopsy findings.

There are no research reports to date on postmortem images that show forensic external findings such as death from asphyxia, bleeding points on the face or eyes, in addition, internal findings such as congestion of organs such as the lungs, liver, kidneys, and brain. With postmortem images it is also difficult to determine chemical asphyxia, including from carbon monoxide, internal asphyxia (which is classified as poisoning as a cause of death), and external asphyxia due to lack of oxygen.

Literature search formula and literature selection (2019/ 6 /2)

PubMed

#	Search formula	Number of documents
1	((((((((((postmortem)OR post-mortem)OR "post mortem"))AND imaging))OR(((((postmortem)OR post-mortem)OR "post mortem")) AND CT))OR(((((postmortem)OR post-mortem)OR "post mortem")) AND "computed tomography"))OR(((((postmortem)OR post-mortem) OR "post mortem"))AND MR))OR(((((postmortem)OR post-mortem)	23,704

	OR "post mortem"))AND "magnetic esonance")))OR(((((postmortem) OR post-mortem)OR "post mortem"))AND MDCT))OR((MSCT) AND(((postmortem)OR post-mortem)OR "post mortem")))	
2	(((putrefaction OR gas OR autolysis OR decomposition)))AND #1	781

Ichushi（Medical Journal）

#	Search formula	Number of documents
1	(死後 CT/AL or 死後 MRI/AL or(死亡時画像診断 /TH or 死亡時画像診断 /AL)or(死亡時画像診断 /TH or オートプシーイメージング /AL))and(LA= 日本語 ,英語 and PT= 会議録除く)	529
2	(窒息 /AL or 縊頸 /AL or 絞頸 /AL or 扼頸 /AL)and #1	23

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