

CQ32 What are useful findings that suggest external causes of death in postmortem CT?

Grades of recommendations:

C1 for evaluating the condition

C2 for determining the cause of death

Useful postmortem CT findings suggestive of external causes of death may include the following: findings suggestive of trauma death such as fractures, bleeding, or bullets (fired by weapons), foreign objects in the respiratory tract (choking), cervical bone/cartilage fractures such as hyoid fractures (due to hanging and strangulation), groups of findings suggesting drowning, high attenuation in the digestive tract suggesting intoxication, groups of findings suggesting hypothermia, or cardiovascular gas suggesting gas embolism due to decompression sickness, and others.

Explanation-----

Background

1) Basic knowledge of external causes of death in forensic medicine

External causes of death refer to all the deaths listed in the "Manner of death" column except "illness and natural death" and "unknown causes of death" in Japanese death certificates [1]. In the death certificate, external causes of death are classified as follows: accidental death (traffic accident / fall / drowning / smoke, fire, and flame injury / asphyxia / poisoning / other accidental deaths), other and unknown external causes of deaths (suicide/ murder /other and unknown extrinsic causes). Specific causes of these external deaths include trauma, drowning, burn deaths, asphyxia, poisoning, hypothermia, or hyperthermia.

2) Meaning of suggesting external causes of death by postmortem CT

The role of postmortem CT suggesting an external factor is important because it may lead to a determination of accidental or criminal death that was not expected from the external examination of the corpse. There are some recent reports from Japan describing that postmortem CT revealed external causes of death that had not been identified by external examination [2-4]. In some of these cases, autopsies had been reconsidered and performed, which apparently changed the judgment of law enforcement officers.

Postmortem CT findings suggesting external causes of death

Papers discussing the possibility of death investigations by postmortem CT were all based on "cause of death" comparisons between CT and autopsies [5-13]. None of these have examined "manner of death", including external causes of death. Therefore, this CQ cannot be considered a comprehensive

answer to the question posed in the title based on a literature review. However, several postmortem CT findings suggesting specific causes of death that constitute external causes of death have been reported, and are summarized in other specific CQs in the guidelines here. The findings introduced in these CQs should be considered as useful findings to suggest external causes of death. In this section, those findings are listed below, but readers are asked to refer to the corresponding CQ for a detailed explanation.

Trauma (CQ 34, 35, 36)

Postmortem CT findings suggestive of trauma death include findings inside the body resulting from the application of external force, and findings related to the particular object that produced the external force leading to death. Specific examples include fractures, contusion of organs, deformation and displacement of organs, bleeding, gas (ectopically generated as a result of applied external force), and findings of the injuring instrument/object such as bullets fired by weapons.

Asphyxia (CQ38)

Postmortem CT findings suggesting choking due to airway lumen obstruction include foreign objects in the airway. Fractures of the cervical bone and cartilage, which are represented by hyoid bone and thyroid cartilage fractures, are known as findings suggesting hanging or strangulation due to external neck compression.

Drowning (CQ39)

As findings suggesting drowning, fluid retention in the paranasal sinuses, fluid retention in the respiratory tract, lung ground glass opacity, pleural fluid retention, gastric dilatation and fluid retention have been reported.

Burn death (CQ43)

In the case of burn deaths, no useful findings have been reported on postmortem CT to suggest the cause of death.

Poisoning (CQ41)

Drug tests from various samples such as from the blood are indispensable for the diagnosis of poisoning, and poisoning death cannot be determined by postmortem CT. However, in cases of death after drug overdoses, it is known that high-attenuation components derived from tablets and similar are found in the gastrointestinal tract such as the stomach and duodenum, and this finding may lead to the discovery of the cause of death due to poisoning.

Other

Concerning hypothermic deaths, it is known that postmortem CT may show that the aerated area of the lungs is maintained, clot formation in the large blood vessels or in the heart is prominent, and a large amount of urine is retained in the bladder (CQ 44). In deaths due to hyperthermia, there are no known useful postmortem CT findings reported (CQ45). Starvation death can be regarded as external causes of death in cases such as neglect, but postmortem CT findings suggesting starvation death have not been fully examined to date (CQ47). Postmortem CT images of gas inside the heart and large blood vessels is important for suggesting gas embolisms including decompression sickness as a cause of death in the event of death during diving (CQ46).

Column-----

For this CQ, when postmortem CT suggest external causes of death, the examining doctor may determine the cause of death as accidental or criminally caused, which was initially unexpected from the external examination without postmortem CT of the corpse. A question arises, that if the findings suggesting an external cause of death, which was not expected from the external findings, and if an unnatural death report to law enforcement officers has not been made, should the examining doctor report these deaths? Article 21 of the Physician Law states that "a doctor must report to a competent police station within 24 hours if he/she examines a corpse or a stillborn baby who is more than 4 months from gestation and finds that there are unnatural issues in the findings." However, there is no definition of unnatural deaths, and it is the current situation that each specific case of "unnaturalness" is evaluated at the discretion of the corresponding doctor. In recent years, some advocate an "external unnatural death" theory stating that deaths should be reported to the police only if abnormal findings are found, superficially, on the external surface of the corpse. According to this theory, even if there are abnormal findings on postmortem CT, the death may not be reported as long as there is no abnormality on the external surface.

However, although the cause of death was not as expected from the external inspection, then if the postmortem CT findings suggest external causes of death, the possibility of accidental or criminally caused death must be raised, and in order to determine whether it is an accident or a crime, law enforcement officers (police and other authorities) must investigate the situation. Therefore, to prevent overlooking accidental or criminally caused deaths, notification of unnatural deaths should be considered in cases in which there are CT findings suggesting external causes of death, even if there is no external abnormality. Also, it should be noted that even if postmortem CT findings do not suggest external causes, they do not prove that the death is not due to external causes such as poisoning. If there remain unclear or unresolved matters arising in the process leading to death, notification should be considered.

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) OR "post mortem"))AND "magnetic resonance"))OR((((postmortem) OR post-mortem)OR "post mortem"))AND MDCT))OR((MSCT) AND(((postmortem)OR post-mortem)OR "post mortem"))	23,668
2	“cause of death”	87,472
3	“manner of death”	1,009
4	“diagnostic accuracy”	39,702
5	usefulness	122,137
6	feasibility	183,803
7	#2 or #3 or #4 or #5 or #6	426,960
8	#1 and #7	1,736

Ichushi (Medical Journal)

#	Search formula	Number of documents
1	(死後/AL)and((FT=Y)PT=原著論文,会議録除く CK=ヒト)	4,582
2	(死亡時/AL)and((FT=Y)PT=原著論文,会議録除く CK=ヒト)	683
3	((画像診断/TH or 画像診断/AL))and((FT=Y)PT=会議録除く CK=ヒト)	270,065
4	((X線CT/TH or X線CT/AL))and((FT=Y)PT=会議録除く CK=ヒト)	103,856
5	((MRI/TH or MRI/AL))and((FT=Y)PT=原著論文,会議録除く CK=ヒト)	86,742
6	#1 or #2	5,058
7	#3 or #4 or #5	280,349
8	#6 and #7	1,228
9	((外因死/TH or 外因死/AL))and((FT=Y)PT=会議録除く CK=ヒト)	58
10	#8 and #9	7

From other than search formula

[1]

References

- [1] Ministry of Health, Labour and Welfare: 2019 Manual for filling in Death Certificates (Certificates for Deaths). https://www.mhlw.go.jp/toukei/manual/dl/manual_h31.pdf (Accessed on June, 2, 2019)
- [2] Hayakawa M et al: Does imaging technology overcome problems of conventional postmortem examination?: a trial of computed tomography imaging for postmortem examination. *Int J Legal Med* 2006; 120: 24-26 (Level 5)
- [3] Iwase H et al: Evaluation of computed tomography as a screening test for death inquest. *J Forensic Sci* 2010; 55: 1509-1515 (Level 5)
- [4] Takahashi N et al: The effectiveness of postmortem multidetector computed tomography in the detection of fatal findings related to cause of non-traumatic death in the emergency department. *Eur Radiol* 2012; 22: 152-160 (Level 4b)
- [5] Thali MJ et al: Virtopsy, a new imaging horizon in forensic pathology : virtual autopsy by postmortem multislice computed tomography (MSCT) and magnetic resonance imaging (MRI): a feasibility study. *J Forensic Sci* 2003; 48: 386-403 (Level 4b)
- [6] Leth PM: Computerized tomography used as a routine procedure at postmortem investigations. *Am J Forensic Med Pathol* 2009; 30: 219-222 (Level 5)
- [7] Roberts IS et al: Post-mortem imaging as an alternative to autopsy in the diagnosis of adult deaths: a validation study. *Lancet* 2012; 379: 136-142 (Level 4a)
- [8] Kasahara S et al: Diagnosable and non-diagnosable causes of death by postmortem computed tomography: a review of 339 forensic cases. *Leg Med* 2012; 14: 239-245 (Level 4b)
- [9] Proisy M et al: Whole-body post-mortem computed tomography compared with autopsy in the investigation of unexpected death in infants and children. *Eur Radiol* 2012; 23: 1711-1719 (Level 4b)
- [10] Le Blanc-Louvry I et al: Post-mortem computed tomography compared to forensic autopsy findings: a French experience. *Eur Radiol* 2013; 23: 1829-1835 (Level 4b)
- [11] Ampanozi G et al: Accuracy of non-contrast PMCT for determining cause of death. *Forensic Sci Med Pathol* 2017; 13: 284-292 (Level 4b)
- [12] Shelmerdine SC et al : Diagnostic accuracy of postmortem CT of children : a retrospective single center study. *AJR* 2019; 212: 1335-1347 (Level 4b)
- [13] Cirielli V et al: Virtual autopsy as a screening test before traditional autopsy: the verona experience on 25 cases. *J Pathol Inform* 2018; 9: 28 (Level 5)