

## **CQ33 Can postmortem CT rule out all external causes of deaths?**

### **Grades of recommendations: D**

Postmortem CT may not show findings suggestive of external causes of death, such as some trauma or poisoning. Postmortem CT alone cannot be used to rule out external causes of death.

### **Explanation-----**

#### **Background**

External causes of death refer to all the items listed in the “Manner of death” column except “illness and natural death” and “unknown causes of death” in the death certificate in Japan [1]. Conversely, external causes of death must be excluded from a conclusion that a specific case is an internal cause of death, such as in the case of morbid death. This CQ is intended to consider whether it is appropriate to exclude external causes of deaths solely by postmortem CT.

#### **Comparative study of autopsy results and postmortem CT findings**

External cause of death is a concept that delineates a specific case as not a "cause of death" but a "manner of death". Regarding the determination of external causes of death, no studies have compared postmortem CT with autopsies, and this CQ should be considered as applying to each specific cause of death that includes external causes of deaths.

#### **Trauma**

Among external causes, trauma is the most reviewed causes of death on postmortem CT. We have referred to three systematic reviews extracted by the search formula described below. In a 2009 systematic review (15 references, 244 cases), postmortem CT detection rates of trauma as a cause of death were 46% to 100%, while detection rates of overall trauma revealed by autopsies were 53% to 100% [2]. There are many differences in the research protocols, and it was difficult to determine an all-encompassing, unified conclusion, it is thought that organ injuries, small soft tissue injuries, and blood vessel injuries are easily overlooked on postmortem CT, and this is considered to be a factor that reduces CT detection rates. A 2015 systematic review (26 references, 563 cases) reported that postmortem CT showed a low detection rate of organ injuries and soft tissue injuries, and that aortic injury had a particularly low detection rate [3]. In a systematic review from 2017, the authors extracted 22 out of 2,600 articles that were considered to show mild to moderate risk of bias, and reviewed these reports. As a result, it was not possible to reach a unified, all-encompassing conclusion about causes of death detection due to differences in research protocols. However, postmortem CT alone were less sensitive to organ injuries than fractures (bone fracture: 63-100%, organ injuries: 10-83%) [4]. From

these conclusions, it may be stated that even in the case of trauma injuries, especially when the main cause of death is organ injury or aortic injury, postmortem CT result in findings of false negative trauma deaths, and external causes of death may be overlooked unless trauma was noticed by an external examination.

In addition, some fatal cervical spinal cord injuries are overlooked by postmortem CT, and there are cases in which it was not possible to diagnose trauma death due to lack of any fatal trauma on external findings and no other fatal organ injuries, overall warning that external causes of death can be overlooked based on postmortem CT alone in such cases [5].

Additionally, the view that a trauma injury was caused either antemortem or postmortem (from the presence or absence of vital reactions) is also important for the forensic diagnosis of trauma death. Some vital reactions such as minute volumes of bleeding, may be difficult to detect by postmortem CT. In such cases, even if a fracture is found on postmortem CT, it may be considered as a postmortem injury. It has been pointed out that this may reduce the detection rate of antemortem injuries [6-8].

Additionally, postmortem CT poses the risk of misdiagnosing findings caused by fatal trauma as morbid findings. For example, it has been reported that a trauma death caused by traumatic subarachnoid hemorrhage was misdiagnosed as natural death [8].

**About external causes of death other than trauma**

Poisoning and burn deaths cannot be diagnosed by postmortem CT alone. Image findings may also suggest asphyxia, drowning, and hypothermic deaths, though these were not established in all cases. The details of this are described in each relevant CQ. Generally speaking, exclusion of these categories of deaths by postmortem CT alone is difficult.

Literature search formula and literature selection (2019/5/28)

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](https://www.mhlw.go.jp/toukei/manual/dl/manual_h31.pdf) (Accessed on June, 2, 2019) (Japanese)
- [2] Scholing M et al: The value of postmortem computed tomography as an alternative for autopsy in trauma victims: a systematic review. *Eur Radiol* 2009; 19: 2333–2341 (Level 1)
- [3] Jalalzadeh H et al: Post-mortem imaging compared with autopsy in trauma victims : a systematic review. *Forensic Sci Int* 2015; 257: 29-48 (Level 3)
- [4] Eriksson A et al: Diagnostic accuracy of postmortem imaging vs autopsy: a systematic review. *Eur J Radiol* 2017; 89: 249–269 (Level 1)
- [5] Makino Y et al: Spinal cord injuries with normal postmortem CT findings: a pitfall of virtual autopsy for detecting traumatic death. *AJR* 2014; 203: 240–244 (Level 4b)

- [6] 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)
- [7] Iwase H et al: Can cervical spine injury be correctly diagnosed by postmortem computed tomography? *Leg Med* 2009; 11: 168–174 (Level 5)
- [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)