

CQ 9: Can Postmortem Interval Be Estimated Based on Gas Evaluation in Postmortem CT?

Recommendation Grade: C1

There are currently no established reports demonstrating that gas evaluation on postmortem CT (PMCT) can be reliably used to estimate the postmortem interval (PMI). Although a few studies have explored the relationship between gas distribution and PMI, these are limited to specific populations, such as late postmortem cases or forensic autopsy series. Currently, accurately estimating PMI based solely on gas findings in PMCT remains challenging.

Explanation

● Background

In forensic autopsy and postmortem examination practice, estimation of the postmortem interval (PMI) is one of the most important—and often officially requested—tasks. PMI is typically estimated based on early postmortem changes, such as rectal temperature, postmortem rigidity, and postmortem lividity, as well as late postmortem changes, including putrefaction and skeletonization.

However, accurate estimation is difficult because numerous factors, including body habitus, pre-existing disease, environmental conditions at the time of death, and clothing, influence these changes. The longer the postmortem interval, the more difficult it becomes to estimate PMI from postmortem changes alone, even for experienced forensic pathologists, often resulting in only a broad time range.¹

One of the notable strengths of PMCT is its ability to detect gas, which can be challenging to assess at autopsy (see CQ8 for details on gas detection and quantification in postmortem imaging). While many studies have described gas distribution on PMCT in relation to putrefaction or post-resuscitation changes,²⁻⁴ there are very few reports that directly address the possibility of PMI estimation based on gas findings, and even those offer only limited applicability. This limitation is likely due to the complex and multifactorial influences on gas formation and distribution after death. Therefore, further research is required in this area.

● Estimation of Postmortem Interval Based on Gas Findings in PMCT

In a study using micro-CT on three euthanized rats, imaging was performed every 24 hours for seven days, and gas volumes in the portal vein and small intestine were quantified. The study reported that portal venous gas increased exponentially with time since death, while small intestinal gas increased linearly.⁵ Another study analyzed 46 human cadavers with a mean postmortem interval of 34 hours, using pre-autopsy CT to quantify lung volume, intrahepatic gas, and rectal gas. The results showed that intrahepatic gas increased with the postmortem interval, whereas rectal gas decreased.⁶

In a third study involving 27 cadavers who died simultaneously in a flood and underwent PMCT within seven days, portal venous gas was found to appear significantly earlier than hepatic venous gas. Portal venous gas was consistently observed within 48 hours postmortem, and the liver parenchyma was

completely replaced by foamy gas after 64 hours⁷.

○ Literature Search Strategy and Selection (April 7, 2024)

【PubMed】

#	Search formula	Number of articles
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"))	31,375
2	gas	474,256
3	postmortem interval	6,364
4	#1 AND #2 AND #3	27

【医中誌 Ichushi-Web (Japan Medical Abstracts Society Database)】

#	Search formula	Number of articles
#1	(死後/AL) and ((FT=Y) PT=原著論文,会議録除く CK=ヒト)	4,573
#2	(死亡時/AL) and ((FT=Y) PT=原著論文,会議録除く CK=ヒト)	678
#3	((画像診断/TH or 画像診断/AL)) and ((FT=Y) PT=会議録除く CK=ヒト)	266,892
#4	((X線CT/TH or X線CT/AL)) and ((FT=Y) PT=会議録除く CK=ヒト)	102,448
#5	((MRI/TH or MRI/AL)) and ((FT=Y) PT=原著論文,会議録除く CK=ヒト)	85,771
#6	#1 or #2	5,044
#7	#3 or #4 or #5	277,138
#8	#6 and #7	1,225
#9	(餓死/AL) and ((FT=Y) CK=ヒト)	9
#10	((飢餓/TH or 飢餓/AL)) and ((FT=Y) CK=ヒト)	478
#11	((栄養失調/TH or 低栄養/AL)) and ((FT=Y) CK=ヒト)	11,094

#12	#9 or #10 or #11	11,331
#13	#8 and #12	3

■References

- 1) 高取建彦 監：NEW エッセンシャル法医学 第6版, p56-60, 医歯薬出版, 2019
- 2) Egger C et al：Distribution of artifactual gas on postmortem multidetector computed tomography (MDCT) . Int J Legal Med 2012；126：3-12 (level 4a)
- 3) Takahashi N et al: Intrahepatic gas at postmortem multislice computed tomography in cases of nontraumatic death. Jpn J Radiol 2009；27：264-268 (level 4b)
- 4) Fischer F et al: Postmortem 24-h interval computed tomography findings on intrahepatic gas development and changes of liver parenchyma radiopacity. Forensic Sci Int 2012；214：118-123 (level 4b)
- 5) Iwamoto C et al: Postmortem interval estimation using the animal model of postmortem gas volume changes. Leg Med 2018；32：66-70 (level 4b)
- 6) Okumura M et al: Analysis of postmortem changes in internal organs and gases using computed tomography data. Leg Med 2017；25：11-15 (level 4b)
- 7) Sapienza D et al: Post mortem CT of intrahepatic gas distribution in twenty-seven victims of a flood: Patterns and timing. Leg Med 2017；29：18-21 (level 4b)