CQ 11: Is Postmortem CT Useful for Determining the Cause of Death in Out-of-Hospital Cardiac Arrest (OHCA) Cases?

Recommendation Grade: C1

When postmortem CT is performed in cases of out-of-hospital cardiac arrest (OHCA), it may help identify causes of death in approximately 30% of cases, including hemorrhagic conditions such as aortic dissection, aortic rupture, cardiac rupture, subarachnoid hemorrhage, and intracerebral hemorrhage, as well as pneumonia, gastrointestinal diseases, and malignancies. Among these, diagnoses such as pneumonia, GI disorders, and malignancies may depend in part on clinical judgment by the interpreting physician. In contrast, it is often difficult to diagnose cardiac causes, which account for about 60% of OHCA cases. Compared to cases where postmortem CT is not performed, conducting CT imaging may increase the likelihood of identifying a specific cause of death. For optimal results, it is recommended that postmortem CT interpretation be performed by physicians experienced in postmortem imaging.

Explanation

● Background

Out-of-hospital cardiac arrest (OHCA) refers to a condition in which cardiac and/or respiratory function has ceased outside of a medical facility.

OHCA is classified into primary cardiac (cardiogenic) arrest and secondary arrest due to non-cardiac causes.[1] According to Utstein-style data collected in Japan from 2013 to 2015, the distribution of causes for OHCA was as follows[2]:

- Cardiac origin: 62.3%
- Cerebrovascular disease: 3.2%
- Respiratory disease: 7.7%
- Malignancies: 3.8%
- External causes: 7.1%
- Drowning: 3.2%
- Other non-cardiac causes: 12.7%

● Imaging Findings

Studies on postmortem imaging in OHCA cases have all been conducted at single institutions using postmortem CT.[3–8] When postmortem CT is performed in OHCA cases, it is reported that the cause of death can be identified in approximately 30% to 37% of cases.[3–5] Commonly identified causes include hemorrhagic conditions such as aortic dissection, aortic aneurysm rupture, cardiac rupture, subarachnoid hemorrhage, and intracerebral hemorrhage, as well as pneumonia, malignancies, and

gastrointestinal perforation.

● **Usefulness of Postmortem CT**

In a study where two forensic radiologists independently interpreted postmortem CT scans of OHCA patients presenting to the emergency department, 336 cases of natural death were analyzed. The results were as follows[3]: In 74 cases (22.0%), a definitive diagnosis was made based on postmortem CT alone, including conditions such as aortic dissection, aortic aneurysm rupture, cardiac rupture, subarachnoid hemorrhage, intracerebral hemorrhage, and visceral artery aneurysm rupture. In 28 cases (8.3%), the CT suggested a likely cause of death, including gastrointestinal bleeding, intestinal obstruction and perforation, malignancy, and pneumonia. In 234 cases (69.6%), diagnosis was not possible with CT alone. The overall diagnostic yield of postmortem CT was 30.3%. Inter-reader agreement between the two radiologists was very high, except in cases of pneumonia, intestinal obstruction, and malignancy, where discrepancies occurred.[3]

Another study examined 129 OHCA cases, comparing 53 cases with postmortem CT and 76 without.[6] In the CT group, emergency physicians issued the death certificate based on CT findings at the time of presentation. Later, 39 of these cases were reviewed by board-certified radiologists, and 31/39 (79.5%) showed agreement with the initial diagnosis. In 3 cases (7.7%), the cause of death may have been misclassified: Two cases originally listed as senility were later found to be lung cancer and anterior mediastinal hematoma with lung tumor, respectively. One case initially diagnosed as psoas muscle hypertrophy with abscess was later found to be a ruptured common iliac artery aneurysm. The study also reported that cases with postmortem CT had a significantly higher rate of specific causes of death listed on death certificates than those without CT.[6]

In a retrospective study of 1,121 patients who died after being transported in cardiac arrest to an emergency center, the rate of postmortem CT utilization was 38% among cases diagnosed with endogenous causes of death, compared to only 16% in undetermined cases. This suggests that performing postmortem CT increases the likelihood of diagnostic clarification.[7]

In another study focusing on postmortem CT for OHCA cases—where these cases formed the majority—the rate of cause-of-death identification was relatively low (23.2%).

The authors attributed this lower rate to the limited involvement of radiologists in image interpretation.[8]

Column: The Role and Challenges of Radiologic Technologists in Postmortem Imaging

Radiologic technologists in Japan are nationally licensed professionals defined under Article 2, Paragraph 2 of the Radiologic Technologists Act as: “Persons licensed by the Minister of Health, Labour and Welfare to engage in the practice of irradiating the human body with radiation under the direction of a physician or dentist.”[9] Furthermore, Article 24 of the same law stipulates that: “No one

other than a physician, dentist, or radiologic technologist shall engage in the acts defined in Paragraph 2 of Article 2."[10]

However, the law does not clearly state whether a corpse legally constitutes a "human body," and thus, the legal framework for allowing non-technologists to perform postmortem imaging (except for physicians and dentists) remains ambiguous. In non-clinical settings such as forensic institutes, it is often difficult to staff certified radiologic technologists. In such cases, non-technologist personnel may carry out postmortem CT scanning and image handling under the direction of a physician or dentist.[11] [12] That said, from a general perspective, no other profession besides radiologic technologists is trained to appropriately perform, modify, or optimize imaging protocols for medical imaging procedures. To avoid misinterpretation of postmortem findings, inappropriate or unnecessary adjustments to imaging parameters must be avoided—making the involvement of radiologic technologists highly desirable. In fact, the 2011 report by the Japanese Ministry of Health, Labour and Welfare titled "Study Group Report on the Utilization of Imaging in Cause-of-Death Investigation,"
states under the section on "Personnel Requirements for Imaging and Interpretation" that: "As in clinical imaging, postmortem imaging should, in principle, be conducted by radiologic technologists. Interpretation should be performed by radiologists who have completed dedicated training in postmortem imaging, and a report (tentatively termed 'postmortem imaging report') should be prepared accordingly."[13]

According to the International Association of Forensic Radiographers (IAFR), the roles and responsibilities of radiologic technologists in postmortem imaging vary by country (e.g., Japan, Australia, Denmark, Finland, the UK, and Switzerland). In some countries, technologists play a central role, from modality selection to image acquisition.[14]
Some radiologists advocate for closer collaboration with technologists to ensure optimized postmortem imaging practices.[15]

While the involvement of radiologic technologists is ideal, it is also important to acknowledge the practical challenges faced by some forensic facilities—including limited staffing and financial constraints—that make continuous deployment of technologists unrealistic. In such cases, even partial involvement is valuable. This may include collaborative communication, remote guidance, or continuing education workshops open to technologists.

It is also important to note that education on postmortem imaging is not yet systematically included in radiologic technologist training. The official curriculum guidelines issued by the Ministry of Health, Labour and Welfare for technologist training institutions currently do not include explicit references to the imaging of deceased bodies.[16] As such, each institution decides independently whether to offer such instruction. Improving postmortem imaging education for radiologic technologists should be considered a future priority.

○ Literature Search Strategy and Selection (May 15, 2024)

【PubMed】

#	Search formula	Number of articles
1	((out-of-hospital) AND cardiac arrest) AND causes of death	744
2	Search(((postmortem CT) OR (postmortem imaging)) OR (post-mortem CT)) OR (post-mortem imaging)	12,992
3	(((out-of-hospital) AND cardiac arrest) AND causes of death) AND (Search(((postmortem CT) OR (postmortem imaging)) OR (post-mortem CT)) OR (post-mortem imaging))	5

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

#	Search formula	Number of articles
1	院外死亡/AL	32
2	(院外心停止/TH or 院外心停止/AL)	6,036
3	(院外心停止/TH or 院外心肺停止/AL)	6,059
4	#1 or #2 or #3	6,619
5	((@X 線 CT/TH and @死亡時画像診断/TH) or 死後 CT/AL)	1,246
6	((@MRI/TH and @死亡時画像診断/TH) or 死後 MRI/AL)	142
7	(死亡時画像診断/TH or オートプシー・イメージング/AL)	1,490
8	#5 or #6 or #7	1,758
9	#4 and #8	90
10	(#9) and (PT=会議録除く)	37

●Additional Sources Not Captured by the Search Strategy

References［1］,［2］,［9］,［10］,［11］,［12］,［13］,［14］,［15］,［16］

■References

1） 日本救急医学会：医学用語解説集；院外心肺停止.
https：//www.jaam.jp/dictionary/dictionary/word/1002.html (in Japanese)

2） Kiyohara K et al：Out-of-hospital cardiac arrest at home in Japan. Am J Cardiol 2019；123：1060-1068（level 4a）

3） Nakaki Y et al：Performance of postmortem CT in the diagnosis of natural death from out-of-hospital cardiac arrest. Jpn J Radiol 2024；42：825-831（level 4a）

4） 渡　潤：CPA 症例に対する死後画像診断（オートプシー・イメージング）の有用性．日本救急医学会関東地方会雑誌 2018；39：236-240（level 4a）(in Japanese)
5） 芦田泰之：救急外来で施行した Autopsy imaging の現状．松江市立病院医学雑誌 2018；22：16-19（level 4a）(in Japanese)
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7) Kato A et al：A clinical study on the investigation of the cause of a patient's death after cardiopulmonary arrest on arrival J Showa Med Univ 2011；71：92-101（level 4a）(in Japanese)
8） 市川順子ほか：Postmortem Computed Tomography Scan as Autopsy imaging at a Single Tertiary Center：1－Year Review．J Japan Society Clin Anesthesia 2020；40：588-591（level 4a）(in Japanese)
9） 診療放射線技師法（昭和二十六年法律第二百二十六号）第二条二項(in Japanese)
10）診療放射線技師法（昭和二十六年法律第二百二十六号）第二十四条(in Japanese)
11）日本法医学会企画調査委員会：死後画像診断に関する調査（2016 年 3 月実施）．日本法医学会課題調査報告，2016
http://www.jslm.jp/problem/gazoushindan.pdf (in Japanese)
12）日本医師会死亡時画像病理診断（Ai ＝ Autopsy imaging）活用に関する検討委員会：巻末付録 アンケート調査結果 4．死亡時画像診断病理診断（Ai ＝ Autopsy imaging）活用に関する検討委員会第二次中間報告；死亡時画像診断病理診断（Ai）の実態の把握及び今後の死亡時医学検索の具体的な展開の方途について，2009 (in Japanese)
13) 厚生労働省：死因究明に資する死亡時画像診断の活用に関する検討会報告書，2011
http://www.mhlw.go.jp/stf/shingi/2r9852000001j3a1.html (in Japanese)
14）Doyle E et al：A limited overview of forensic radiography in six countries as presented at the ISFRI 2021 congress. Forensic Imaging 2023；33：200540
15) 小西淳也:死亡時画像診断における放射線科医の位置づけと読影の実際. INNERVISION 2018；33：28-30 (in Japanese)
16）厚生労働省医政局長通知：診療放射線技師養成所指導ガイドラインについて．医政発 0331 第 26 号 平成 27 年 3 月 31 日(in Japanese)