CQ15: Is it useful to perform postmortem imaging before autopsy?

Recommendation Grade: B

Using postmortem imaging prior to autopsy allows for the objective documentation of findings that may be lost during dissection. It also enables the identification of infectious risks or the presence of foreign objects, which can help ensure safety during the autopsy by preventing environmental contamination and secondary infection. Postmortem imaging may also reveal internal therapeutic artifacts, which can be useful for personal identification. Conversely, autopsy plays a vital role in interpreting postmortem imaging findings. Postmortem imaging and autopsy have complementary roles, and it is recommended that imaging be performed before autopsy whenever possible.

Explanation

● Background

The autopsy rate for unnatural deaths in Japan remains low compared to Western countries. It gradually increased from 11.4% in 2013 to 12.8% in 2016, but declined again to 9.8% in 2022[1]. One of the contributing factors is that autopsies other than judicial autopsies, those under the Postmortem Investigation Act, or administrative autopsies conducted by medical examiners, require consent from the bereaved family[2]. Following the practice in Western countries, where dedicated postmortem imaging scanners are used in forensic facilities, an increasing number of institutions in Japan have also introduced such equipment. In addition, some general hospitals are using clinical imaging devices for screening the cause of death[2]. As the use of postmortem CT expands, its application as a pre-autopsy examination is also becoming more common.

● Characteristics

Postmortem imaging can be performed prior to a full autopsy and serves not only as a non-invasive examination but also as a method to objectively document the condition of the body before dissection[3]. Since it poses no disadvantage to the deceased, postmortem imaging is desirable whenever possible.

In some cases, findings related to the cause of death can be identified, and one study reported an approximate 12% increase in sensitivity for determining the direct cause of death[4]. Even when the cause of death is not directly visualized, postmortem imaging can reveal the presence of pre-existing disease or injury, contributing to understanding the circumstances that led to death. Moreover, imaging findings can help guide the direction of the autopsy even when the cause of death remains unknown[4].

Postmortem imaging is generally superior to autopsy in detecting foreign objects. In reports of its use before autopsy during large-scale disasters, internal medical devices were identified in advance and could be compared with antemortem medical imaging, proving to be useful[5]. The spatial relationship between the body surface and internal foreign objects can also be recorded in three dimensions,

enabling objective and reproducible evaluation. Therefore, performing postmortem imaging prior to autopsy is important (see CQ39 and CQ40). On the other hand, there are reports that gastrointestinal perforation caused by plastic objects was not detected by postmortem CT but was confirmed during autopsy[6].

Postmortem CT enables the recording of findings that may be lost during autopsy—such as the presence and distribution of internal gas[7] (see CQ8), the volume and location of fluid accumulation (see CQ5), and the anatomical positioning of organs[8]. Some reports have indicated that postmortem CT provides better overall assessment than autopsy in cases such as multiple facial fractures or numerous peripheral bone fractures, where it is difficult to obtain a comprehensive and objective record through dissection alone[9].

Postmortem imaging can also help identify internal lesions, including potential infections, prior to autopsy[10–12], thereby contributing to the safety of the procedure by reducing the risk of environmental contamination and secondary infection. However, some studies suggest that postmortem imaging alone is insufficient to replace conventional autopsy for diagnosing infections or trauma[6 12].

Postmortem CT allows for the pre-autopsy assessment of the entire skeletal system and can reveal pathological conditions such as old fractures, which may not be visible upon external examination. This is particularly important in suspected abuse cases or unexplained pediatric deaths. In such cases, even if postmortem CT has been performed, additional X-ray imaging is recommended[13].

Postmortem imaging and autopsy are complementary diagnostic tools. Whether one method is superior or both are necessary depends on the nature of the case and the specific questions being addressed[4]. It is therefore essential to select the most appropriate method in order to determine the correct cause of death[14]. Postmortem imaging can objectively document the condition of the body at the time of death. In cases where medical devices are present in the body, it is important to assess whether any positional abnormalities existed at the time of death[15]. In hospital settings, it is recommended to perform postmortem imaging before removing any medical devices, and the same practice should be applied in home care settings.

● Important CT Findings That Are Often Missed at Autopsy

There are reports of findings that were successfully identified on postmortem CT but were missed during autopsy. These include fractures (in the limbs, pelvis, and face), pneumothorax, bone metastases, pleural effusions, and subcutaneous emphysema[16].

Column: Additional Reasons to Use Both Autopsy and Postmortem Imaging

Using postmortem imaging in conjunction with autopsy has been shown to improve the sensitivity for directly diagnosing the cause of death[4]. Meanwhile, clinical literature on cardiovascular imaging in living patients emphasizes the importance of performing clinical autopsies in deceased individuals[17]. Autopsy is particularly valuable in cases of sudden and unexpected death, especially when advanced cardiovascular imaging was not performed prior to death. Other reported benefits include: enhancing our understanding of the sensitivity and specificity of advanced cardiovascular imaging techniques; providing insights into the natural progression of cardiovascular diseases, rare conditions, and treatment-related complications; and enabling rapid recognition of novel cardiac pathologies[17].

○ Literature Search Strategy and Selection

【PubMed】（2024/5/21）

#	Search formula	Number of articles
1	Search: ((postmortem CT) OR (post-mortem CT)) OR (post mortem CT)	13,016
2	Search: (#1) AND (autopsy)	3,048
3	Search: (#2) AND (cause of death investigation)	212
4	Search: (#2) AND (cause of death investigation) Filters: from 2010-2024	191
5	Search: (#3) AND (infection) Filters: from 2010-2024	19

【PubMed】（2024/5/29）

#	Search formula	Number of articles
1	Search: ((postmortem CT) OR (post-mortem CT)) OR (post mortem CT)	13,038
2	Search: (#1) AND (DVI)	11

【医中誌 Ichushi-Web (Japan Medical Abstracts Society Database)】（2024/5/21）

#	検索式	文献数
1	((死亡時画像診断/TH or 死後画像/AL) or (死亡時画像診断/TH or 死亡時画像診断/AL)) and (PT=原著論文，解説，総説，図説，Q＆A，講義，会議録除く)	728
2	((解剖術/TH or 解剖/AL)) and (PT=原著論文，解説，総説，図説，Q＆A，講義，会議録除く)	89,128
3	(#1 and #2) and (PT=原著論文，解説，総説，図説，Q＆A，講義，会議録除く)	194

4	(#3) and ((PT=症例報告・事例除く) AND (PT=原著論文，解説，総説，図 説，Q＆A，講義，会議録除く))	144

●Additional Sources Not Captured by the Search Strategy
References［1］,［2］,［9］,［17］

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3） Grabherr S et al：Application of contrast media in post-mortem imaging （CT and MRI）. Radiol Med 2015；120：824-834（level 4b）

4） Sonnemans LJP et al：Can virtual autopsy with postmortem CT improve clinical diagnosis of cause of death? A retrospective observational cohort study in a Dutch tertiary referral centre. BMJ Open 2018；8：e018834（level 4a）

5） O’Donnell C et al：Contribution of postmortem multidetector CT scanning to identification of the deceased in a mass disaster：Experience gained from the 2009 Victorian bushfires. Forensic Sci Int 2011；205：15-28（level 5）

6） Macoin E et al：The importance of autopsy in a case of digestive perforation undetected by postmortem computed tomography. Am J Forensic Med Pathol 2021；42：201-204（level 5）

7） Hussein MN et al：Postmortem computed tomography differentiation between intraperitoneal decomposition gas and pneumoperitoneum. Int J Legal Med 2022；136：229-235（level 4b）

8） Gascho D et al：Use of postmortem computed tomography to detect bowel obstruction and its relationship to the cause of death. Am J Forensic Med Pathol 2018；39：30-37（level 5）

9） Daly B et al：Comparison of whole-body post mortem 3D CT and autopsy evaluation in accidental blunt force traumatic death using the abbreviated injury scale classification. Forensic Sci Int 2013；225：20-26（level 4b）

10） Yaguchi D et al：Sudden death from cardiopulmonary arrest on arrival of a patient with pulmonary tuberculosis：a case diagnosed by postmortem ct and autopsy. J Forensic Sci 2018；63：1582-1586（level 5）

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14) O'Donnell C et al：Can post-mortem CT and angiography provide all the answers? Lancet 2017；390（10095）：646-647（level 6）
15) Lotan E et al：The role of early postmortem CT in the evaluation of support-line misplacement in patients with severe trauma. AJR Am J Roentgenol 2015；204：3-7（level 5）
16) Owais AE et al：Could pre-mortem computerised tomography scans reduce the need for coroner's post-mortem examinations? Ann R Coll Surg Engl 2010；92：422-424（level 4b）
17）Basso C, Stone JR：Autopsy in the era of advanced cardiovascular imaging. Eur Heart J 2022；43：2461-2468

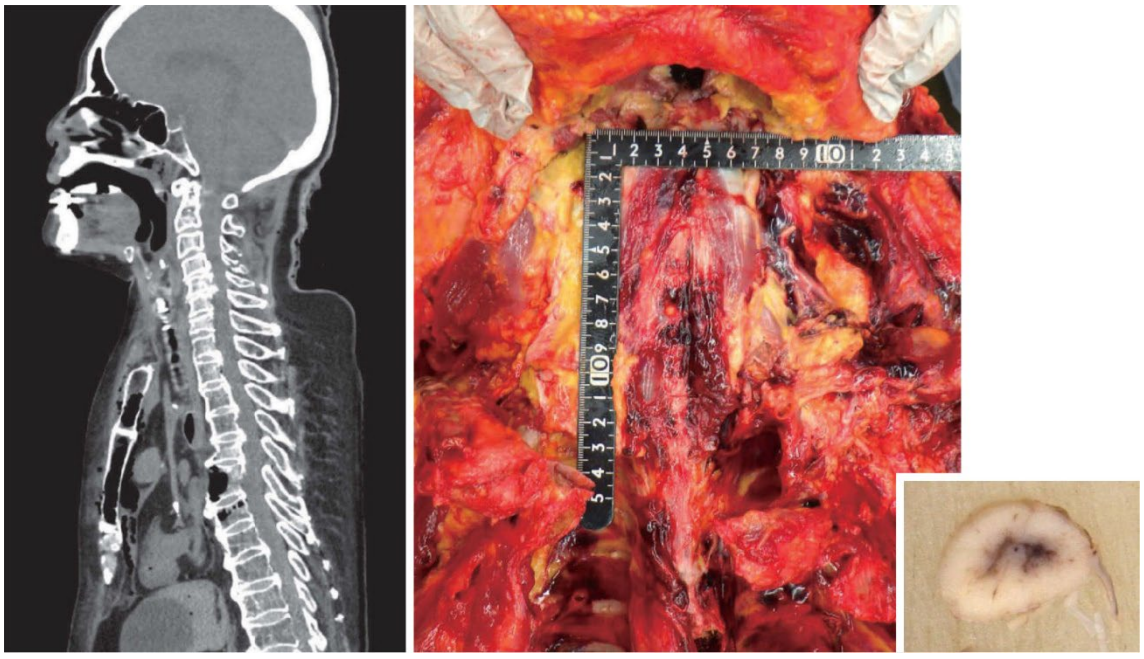

Figure. Cervical Spinal Cord Injury in a Woman in Her 70s

Severe osteophyte formation is observed in the cervical spine. A fracture is noted at the sixth thoracic vertebra. Hematoma is present within the cervical spinal canal. Hemorrhage is also seen within the excised and fixed cervical spinal cord.