

CQ26: Is it possible to detect malignant tumors and determine their role as cause of death using postmortem imaging?

Recommendation Grade:

Condition Assessment: C1

Cause of Death Determination: C2

Postmortem CT can reveal malignant tumors, as well as associated findings such as large volumes of pleural effusion, ascites, or hemorrhage, which may aid in determining the cause of death.

However, not all malignancies can be identified. Some tumors may remain undetectable even on antemortem imaging, and in other cases, postmortem imaging alone may not allow reliable differentiation from other diseases.

Explanation

• Background

CT is one of the standard diagnostic tools for detecting malignant tumors such as lung cancer, gastric cancer, esophageal cancer, and colorectal cancer¹.

In advanced-stage malignancies, the direct cause of death may include respiratory failure due to massive malignant pleural effusion², hemorrhage from the tumor³, hepatic failure due to liver metastases⁴⁻⁸, cardiac failure caused by myocardial metastasis⁹, disseminated intravascular coagulation (DIC)¹⁰, or tumor embolism in the pulmonary artery^{11 12}.

• Imaging Findings

Postmortem CT can detect malignant tumors and associated findings such as massive pleural effusion, ascites, and hemorrhage, which may aid in determining the cause of death^{13 14}. Cases where malignant tumors were detected by postmortem CT and subsequently confirmed anatomically include brain tumors^{15 16}, pharyngeal cancer¹⁷, lung cancer^{13 15-17}, intestinal tumors^{18 19}, hepatic tumors¹⁸, and adrenal tumors²⁰. In a study of 494 non-traumatic patients who underwent postmortem CT in the emergency department, malignant tumors were detected in 8 cases, and the findings were considered potentially fatal²¹. However, to date, no comprehensive studies have systematically assessed the diagnostic performance of postmortem CT for malignant tumors.

On the other hand, because postmortem CT is typically performed without contrast agents and is affected by postmortem changes, malignancies may often go undetected^{13 17 22}. In a study of 821 autopsy cases, previously undiagnosed malignant tumors were found in 66 cases (8%), and in 26 cases (3.1%), the tumor was identified as the direct cause of death²³. Diffuse liver metastases⁴⁻⁸, myocardial metastases⁹, and pulmonary artery tumor emboli^{11 12} are often difficult to diagnose even with antemortem CT, and are considered extremely difficult to detect using postmortem CT. Additionally,

there are reports that postmortem imaging alone may not reliably differentiate between primary and metastatic lung cancer, or between metastatic liver tumors and hepatic abscesses¹⁷. Therefore, definitive diagnosis requires conventional autopsy or minimally invasive autopsy with histopathological examination¹⁵⁻¹⁹. Postmortem MRI has also demonstrated limitations in detecting certain malignancies, including renal tumors, melanoma, and hepatic metastases from neuroblastoma⁸. Thus, it should be noted that not all malignant tumors can be diagnosed through postmortem imaging.

○ Literature Search Strategy and Selection (as of August 12, 2023)

【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))))	30,745
2	malignancy	4,084,632
3	causes of death	273,283
4	#1 and #2 and #3	246

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

#	Search formula	Number of articles
1	(((死後CT/AL)or(死後MRI/AL)or((死亡時画像診断/TH or 死亡時画像診断/AL))or((死亡時画像診断/TH or オートプシー・イメージング/AL)) or((死亡時画像診断/TH or オートプシー・イメージング/AL))))and(LA= 日本語, 英語 and PT= 会議録除く)	902
2	(腫瘍/TH or 悪性腫瘍/AL)	2,387,873
3	(剖検/TH or 剖検/AL)	81,316
4	#1 and #2 and #3	42

●Additional Sources Not Captured by the Search Strategy

References [1] , [2] , [3] , [4] , [5] , [6] , [9] , [10] , [13] , [14] , [15] , [16] , [17] , [18] , [19] , [20] , [21] , [22] , [23]

■References

- 1) 日本医学放射線学会 編：画像診断ガイドライン 2021 年版, 金原出版, 2021
- 2) Davidson B : Malignant effusions : from diagnosis to biology. *Diagn Cytopathol* 2004 ; 31 : 246-254 (level 4b)
- 3) Sandomenico F et al : Spontaneously ruptured hepatocellular carcinoma : computed tomography-based assessment. *Diagnostics (Basel)* 2023 ; 13 : 1021 (level 4b)
- 4) Allison KH et al : Radiographically occult, diffuse intrasinusoidal hepatic metastases from primary breast carcinomas : a clinicopathologic study of 3 autopsy cases. *Arch Pathol Lab Med* 2004 ; 128 : 1418-1423 (level 5)
- 5) Hanamornroongruang S, Sangchay N : Acute liver failure associated with diffuse liver infiltration by metastatic breast carcinoma : a case report. *Oncol Lett* 2013 ; 5 : 1250-1252 (level 5)
- 6) Rowbotham D et al : Acute liver failure secondary to hepatic infiltration : a single centre experience of 18 cases. *Gut* 1998 ; 42 : 576-580 (level 5)
- 7) Simone C et al : Rapid liver enlargement and hepatic failure secondary to radiographic occult tumor invasion : two case reports and review of the literature. *J Med Case Rep* 2012 ; 6 : 402 (level 5)
- 8) Nakano S et al : Pseudocirrhosis caused by lung adenocarcinoma with diffuse liver metastasis : an autopsy case report. *Thorac Cancer* 2021 ; 12 : 2046-2049 (level 5)
- 9) Murakami T et al : Cardiac metastasis of renal pelvic cancer. *Int J Urol* 2007 ; 14 : 240-241 (level 5)
- 10) Adelborg K et al : Disseminated intravascular coagulation : epidemiology, biomarkers, and management. *Br J Haematol* 2021 ; 192 : 803-818 (level 4b)
- 11) He X et al : Pulmonary tumor embolism : a retrospective study over a 30-year period. *PLoS One* 2021 ; 16 : e0255917 (level 4b)
- 12) Ho AL et al : The diagnostic challenge of pulmonary tumour thrombotic microangiopathy as a presentation for metastatic gastric cancer : a case report and review of the literature. *BMC Cancer* 2015 ; 15 : 450 (level 5)
- 13) Ikeda G et al : Postmortem computed tomography and magnetic resonance imaging in a case of terminal-stage small cell lung cancer : an experience of autopsy imaging in tumor-related death. *Radiat Med* 2007 ; 25 : 84-87 (level 5)
- 14) Takahashi N et al : Multiple lung tumors as the cause of death in a patient with subarachnoid hemorrhage : postmortem computed tomography study. *Jpn J Radiol* 2009 ; 27 : 316-319 (level 5)
- 15) Bolliger SA et al : Postmortem imaging-guided biopsy as an adjuvant to minimally invasive autopsy with CT and postmortem angiography : a feasibility study. *AJR Am J Roentgenol* 2010 ;

195 : 1051-1056 (level 4b)

- 16) Poulsen K, Simonsen J : Computed tomography as routine in connection with medico-legal autopsies. *Forensic Sci Int* 2007 ; 171 : 190-197 (level 4b)
- 17) Roberts IS et al : Post-mortem imaging as an alternative to autopsy in the diagnosis of adult deaths : a validation study. *Lancet* 2012 ; 379 (9811) : 136-142 (level 4b)
- 18) O'Donnell C et al : Demonstration of liver metastases on postmortem whole body CT angiography following inadvertent systemic venous infusion of the contrast medium. *Int J Legal Med* 2012 ; 126 : 311-314 (level 5)
- 19) Weustink AC et al : Minimally invasive autopsy : an alternative to conventional autopsy? *Radiology* 2009 ; 250 : 897-904 (level 4b)
- 20) 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)
- 21) 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)
- 22) Yamazaki K et al : Comparison between computed tomography (CT) and autopsy findings in cases of abdominal injury and disease. *Forensic Sci Int* 2006 ; 162 : 163-166 (level 4b)
- 23) Parajuli S et al : Undiagnosed fatal malignancy in adult autopsies : a 10-year retrospective study. *Hum Pathol* 2016 ; 48 : 32-36 (level 4b)

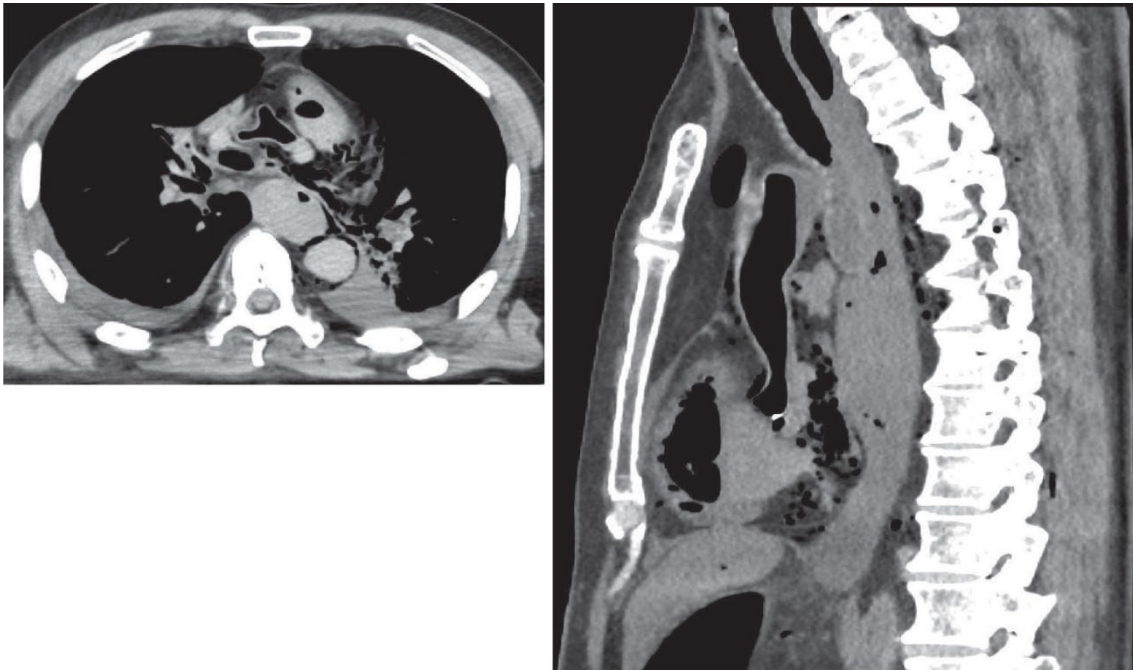


Figure 1. Male in His 70s with a History of Esophageal Cancer

A soft-tissue mass occupying the thoracic esophagus is observed. A definitive diagnosis of malignancy cannot be made based on postmortem CT alone.

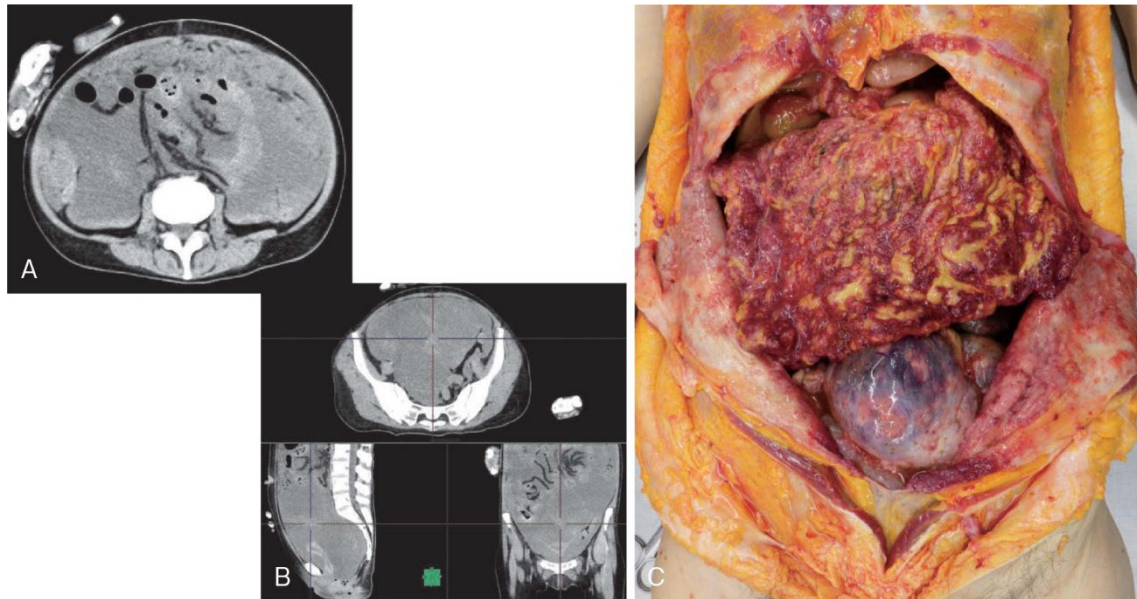


Figure 2. Female in Her 40s with Ovarian Cancer

A: Axial Abdominal CT B: MPR C: Gross Specimen

A multilocular cystic tumor is observed in the abdominal cavity, showing continuity from the pelvic cavity. Thickening of the omentum is seen in the anterior upper abdomen, consistent with omental dissemination. Autopsy confirmed ovarian cancer with numerous peritoneal metastases and omental dissemination.