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CASE REPORT

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

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Abstract We report a case of terminal-stage small-cell lung cancer with multiple metastases in which postmortem computed tomography and magnetic resonance imaging (collectively called "autopsy imaging") were performed and correlated with conventional autopsy findings. In this case, autopsy imaging provided contemporaneous data that supported conventional autopsy findings. Autopsy imaging revealed the process of primary tumor growth, changes in metastatic lesions, and occurrences of new metastases in the terminal stage and made it easier to understand the clinical course of the patient. The usefulness of autopsy imaging after traumatic death, sudden death from natural causes, or congenital anomaly has been reported. Here, we attempted a preliminary study of its use in the detection of death due to tumor. Our results indicated that autopsy imaging provides useful information in cancer-related death and may be an alternative when conventional autopsy cannot be performed.

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Introduction

A new concept in autopsy, called virtual autopsy, has been developed in European countries and the United States.[1–11] In Japan, the concept of autopsy imaging has recently been proposed because of the decline in autopsy rates and widespread use of postmortem computed tomography (CT).[12–16] However, most reports on virtual autopsy and autopsy imaging described cases of traumatic death, sudden death from natural causes, or congenital anomaly, with relatively few articles regarding oncology, such as cancer-related death.[12]

In the terminal stage of malignant tumors, the primary lesion sometimes drastically increases in size, and new metastases may occur. However, imaging examination is not clinically indicated in patients in a terminal stage or is impossible to perform. In this study, we performed autopsy imaging on a case of terminal-stage small-cell lung cancer, often encountered in clinical practice, and compared postmortem imaging findings with antemortem imaging and conventional autopsy findings. We noted the usefulness of autopsy imaging for death due to tumors.

Case report

A 64-year-old man was admitted to the palliative care unit of our institution 1 month prior to his death. At 2 years 3 months before his death, he was diagnosed as

having small-cell lung cancer. The initial symptom was left cervical lymphadenopathy. He had been treated with a combination of chemotherapy and radiation therapy for the primary lesion in the right upper lobe and metastases in cervical and mediastinal lymph nodes, brain, and left adrenal gland.

He complained of a severe headache 5 days before his death but refused to undergo further examination. After the episode his consciousness gradually decreased, and eventually he died. His last antemortem CT and magnetic resonance (MR) imaging examinations had been done at another institution 2 months before his death. According to his own wish, a conventional autopsy was performed. Postmortem CT and MR imaging were done before conventional autopsy, with the consent of his family.

Autopsy imaging has been approved by the ethics committee in our institution since 2004. Postmortem CT was performed 30 min after and postmortem MR imaging 7 h after the declaration of death. The autopsy imaging was conducted after wrapping the corpus in a disposable waterproofed cloth. Scanning tables were covered with waterproofed paper and a cotton bed sheet. After scanning, the paper and sheet were removed, and the scanning table was sterilized with a benzethonium chloride diluent and wiped with a cloth.

A board-certified radiologist and a board-certified respiratory physician reviewed the antemortem imaging findings obtained at another institution and compared them with the postmortem imaging findings. Discordance in imaging interpretation was resolved by consensus. After informing a board-certified pathologist of the results of the autopsy imaging, the pathologist performed the autopsy 17 h 30 min after death. Autopsy imaging and conventional autopsy findings were then correlated in detail. Antemortem imaging findings were compared with the autopsy imaging findings with the aid of pathological findings.

Brain

Antemortem MR imaging (2 months before death) showed multiple brain metastases (Fig. 1a). Radiation therapy was performed on the whole brain over a 10-day period with 30 Gy at another institution. Postmortem CT indicated hemorrhage in the left temporal lobe, but the delineation was not clear owing to bone artifacts (Fig. 1b). On postmortem MR imaging, each metastasis had decreased in size or disappeared. The left temporal lobe metastasis was shown as low signal intensity with a high signal intensity rim on the T1-weighted image (Fig. 1c). Pathology examination revealed hemorrhage associated with tumor necrosis (Fig. 1d), which was believed to be a cause of the severe headache before his death.

Chest

Antemortem CT (2 months before death) showed the primary lesion in the right upper lobe, which measured 3.5 cm at the largest dimension (Fig. 2a). The tumor had increased to 5 cm on the postmortem CT and MR imaging (Fig. 2b,c), which was confirmed by the autopsy findings (Fig. 2d). Pneumonia of the left lower lobe was detected on postmortem CT and MR imaging, but it was absent on antemortem CT.

Abdomen

Postmortem MR imaging showed multiple nodules about 1 cm in diameter in the liver (Fig. 2c) that were histologically confirmed as metastases (Fig. 2e). Neither antemortem contrast-enhanced CT (2 months before death) nor postmortem CT showed such metastatic nodules.

Discussion

Comparison of antemortem imaging findings (2 months before death) with the autopsy imaging findings revealed drastic enlargement of the primary lesion as well as changes in existing metastases and the occurrence of new metastatic lesions. The large discrepancies between the antemortem imaging findings and conventional autopsy findings make an accurate radiological-pathological correlation difficult. Autopsy imaging proved to be accurate regarding the body's condition and allowed point-to-point correlation with conventional autopsy findings. Because of this, the clinical course was better assessed using autopsy imaging.

Modalities used for autopsy imaging in this study were CT and MR imaging. For diagnosis of a trauma case, postmortem CT is useful because bone fracture and abnormal distribution of internal gas, such as intravascular gas and free abdominal air, are clearly shown.[1,11,17] In this study, MR imaging of the brain delineated the left temporal lobe metastasis more clearly than did CT. MR imaging detected multiple liver metastases, whereas CT did not. MR imaging has the benefit of fewer artifacts from bones and higher contrast resolution than CT, and it is considered more useful for autopsy imaging in cancer cases.

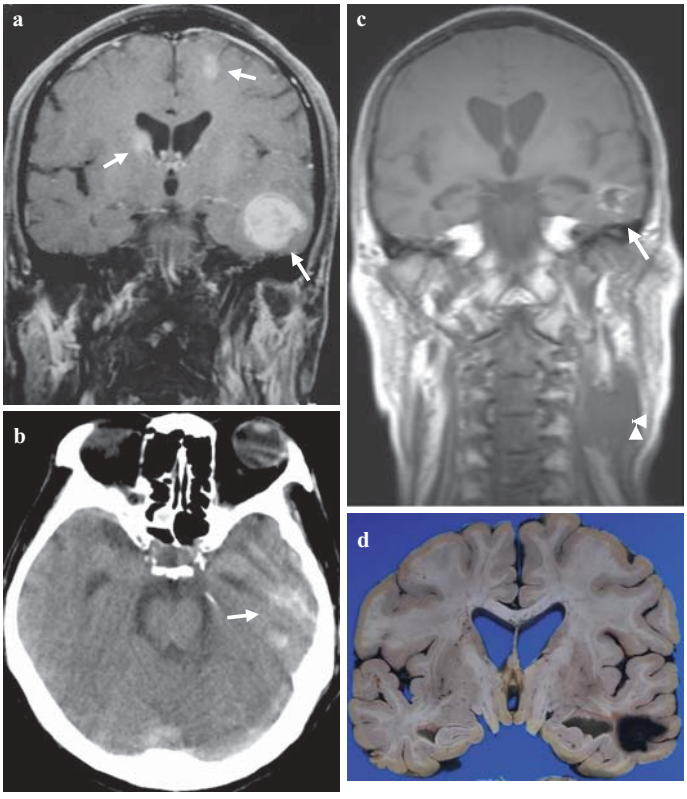

Fig. 1. **a** Antemortem contrast-enhanced coronal magnetic resonance imaging (MRI) of the brain shows multiple brain metastases (*arrows*). **b** Postmortem computed tomography (CT) of the brain shows hemorrhage in the left lobe (*arrow*), although the lesion is obscured by bone artifacts. **c** Postmortem T1-weighted coronal MRI of the brain shows a low signal intensity nodule with a high signal intensity rim (*arrow*) and left cervical lymphadenopathy (*arrowheads*). **d** Brain metastasis in the left lobe is necrotic accompanied by hemorrhage

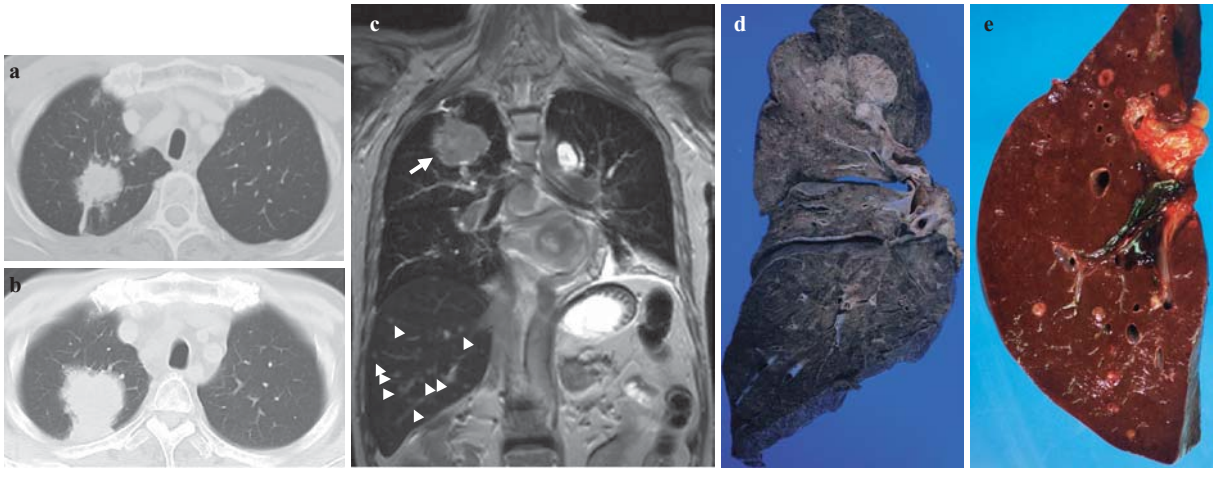

Fig. 2. **a** Antemortem CT of the chest shows the primary lung cancer lesion in the right upper lobe, measuring 3.5 cm in major diameter. **b** Postmortem CT of the chest shows the enlarged primary lesion, which is 5 cm in major diameter. **c** Postmortem T2-weighted coronal MRI of the chest and upper abdomen shows the primary lesion, which is 5 cm in major diameter (*arrow*), and multiple high signal intensity nodules in the liver (*arrowheads*). **d** Macroscopic appearance of the primary lesion of the lung cancer in the right upper lobe. **e** Macroscopic finding of multiple liver metastases

Although the role of autopsy imaging in cancer cases has not been established, it may be an alternative when consent is not given for a conventional autopsy. Autopsy imaging may potentially replace conventional autopsy. It is possible to diagnose certain diseases, such as subarachnoid hemorrhage, by imaging alone, without the need of confirmation by conventional autopsy. Even autopsy imaging may not be necessary when adequate antemortem examinations are available. Refining interpretation skills may change the situation. Further expe-

rience is needed to assess the current roles of the conventional autopsy and autopsy imaging.[17–22]

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