Isolated Haemorrhagic Brain Metastasis from Lung Adenocarcinoma in a 68-year-old Man

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ABSTRACT
A solitary brain tumour originating from a lung adenocarcinoma in a 68-year-old man is reported. The imaging features were discordant with the clinical picture and prompted surgery and subsequent histological examination. Results of computed tomography and magnetic resonance imaging suggested that the lesion was a haematoma. However, during positron-emission tomography using 2-fluoro-2-deoxy-D-glucose labelled with fluorine 18, the lesion showed predominantly low tracer avidity and an abnormal focus of signal intensity. The resected mass showed a high degree of haemorrhage, and histological examination of the mass revealed features characteristic of a metastatic adenocarcinoma — namely, clearly formed glands and mucin production. For any intracerebral haemorrhage that does not resolve or shows imaging features atypical of haematoma, a histological diagnosis should be sought.

Key Words: Adenocarcinoma; Brain neoplasms; Cerebral hemorrhage/diagnosis; Lung neoplasms; Radionuclide imaging

INTRODUCTION
Brain metastases occur in 20% to 40% of cases of systemic cancer and account for about one-half of all cases of intracranial tumour.1 Detection of the metastatic brain tumour is not only important in its prompt management, but also often critical to the appropriate choice of treatment. To gain a better understanding of the imaging spectrum of this malignancy, we report a case of metastatic brain tumour originating from a lung adenocarcinoma in a 68-year-old man. The results of radiological tests initially did not correlate with the anatomical findings, prompting surgery and histological examination of the resected mass. A diagnosis of metastasis was subsequently made. This case report thus illustrates the importance of histological diagnosis for intracerebral haemorrhage that does not resolve or shows imaging features atypical of haematoma.

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Minimal perifocal oedema was also detected. On the basis of these CT findings, our preliminary diagnosis was spontaneous haemorrhage with suspicion of underlying malignancy.

Magnetic resonance imaging (MRI) was performed with a 1.5-T superconductive system (Siemens Magnetum; Siemens, Erlangen, Germany). On precontrast T1-weighted spin-echo images, the lesion was lobulated and had well-delineated borders. In addition, the lesion showed mixed signal intensity — markedly high signal intensity in the peripheral part of the lesion, iso–signal intensity in some parts, and scattered foci of low signal intensity (Figure 2). On T2-weighted turbo spin-echo images, the lesion was heterogeneous and had large areas of low signal intensity. An area of high signal intensity corresponding to the mild oedema surrounded the mass anteriorly (Figure 3). After administration of gadolinium, the lesion showed partial heterogeneous enhancement on T1-weighted images (Figure 4).

To better characterise the lesion and as part of oncological surveillance, the patient was referred to another
institution for positron-emission tomography (PET) using 2-fluoro-2-deoxy-D-glucose (FDG) labelled with fluorine 18. Whole-body and regional brain PET demonstrated a focus of abnormal FDG uptake that corresponded to the lesion detected with CT and MRI (Figure 5). Because of the surrounding oedema and deafferentation, there was a reduction in adjacent cortical FDG uptake. No further glucose-avid abnormality was present in the rest of the body. The lesion was thus diagnosed to be an expansile mass with haemorrhage. Total resection of the lesion was performed. The resected specimen consisted of several fragments of pinkish tissue. Incision of a sample of tissue revealed yellowish debris with a high degree of flesh haemorrhage and some necrotic tissue. Histological examination of the mass revealed features characteristic of a metastatic adenocarcinoma — namely, clearly formed glands and mucin production. The patient had a good postoperative recovery and was referred to the oncology department for whole-brain radiation therapy.

**DISCUSSION**

Metastatic brain disease is among the most common causes of intracranial masses in adults. Between 30% and 50% of patients with parenchymal brain metastasis have solitary lesions on imaging scans, although the majority of these lesions have multiple foci. The reported cumulative incidence of brain metastasis from lung cancer after 5 years ranges from 16% to 90%. Clinical manifestations related to such tumours are frequently late occurrences. The lesions are usually of low density on CT scans, although hyperdense areas may be an unusual feature of this type of tumour. Acute haemorrhage, dense cellularity, high protein concentration, and calcific content all contribute to the hyperdense appearance on a non-enhanced CT scan. Even though vascular metastases — for example, those originating from renal and thyroid carcinoma, choriocarcinoma, and melanoma — have a propensity to bleed, haemorrhagic metastasis is still more likely to be related to lung and breast cancer than to these other tumours, because lung and breast cancer are so much more common. In the patient in this report, the lesion had a dense appearance on CT scans. The extent of haemorrhage found at the pathological examination could not account for the spontaneous...
hyperdensity on the CT scan. The dense appearance could be explained either by a combination of the high protein concentration and the high viscosity of the tissues or by intratumoural haemorrhage.

On T1-weighted MRI scans, haemorrhagic metastases usually show variable heterogeneous enhancement. In contrast, T2-weighted images appear hypointense to isointense. Areas of reduced intensity may be seen on T2-weighted images not only because of the presence of blood products, but also because of calcification, hypercellularity, or the presence of proteinaceous material. This effect could also be a result of the paramagnetic effect of melanoma. In our case, the lesion generally had a high signal intensity on T1-weighted MRI scans but a low heterogeneous signal intensity on T2-weighted images. Although T2-weighted images appeared more typical than the T1-weighted ones, the amount of blood products found at the histological examination was too low to explain the significant decrease in T2-weighted signal intensity. The hyperdensity on CT scans, the hyperintensity on T1-weighted MRI scans, and the hypointensity on T2-weighted MRI scans can all be attributable to the high protein content of the necrotic tissue within the mass.

The patient in this case underwent FDG-PET, because this test had the potential to provide additional in vivo biochemical and physiological information about the brain lesion and hence reveal the biological aggressiveness of the mass. The lesion was predominantly hypometabolic and had an eccentric hypermetabolic focus. Because tumour cells are known to proliferate rapidly, they are expected to have an increased rate of glucose metabolism, and FDG-PET studies show that metastatic brain tumours indeed exhibit fast FDG uptake — generally at a rate comparable to that of FDG uptake by normal cortical grey matter. However, the rate of FDG uptake in metastatic brain lesions can be higher or lower than that in adjacent grey and white matter, because FDG is handled in a different manner by different kinds of tumours.

For cerebral tumours, the cell proliferation rate is associated with FDG avidity. Metastases with a metabolic rate exceeding that of normal grey matter can be identified easily on FDG-PET scans. But metastases that are mildly FDG-avid can be obscured by the relatively high background cortical activity. Furthermore, perifocal oedemas that frequently surround metastatic deposits show relatively low levels of FDG accumulation and may decrease the conspicuity of lesions through volume-averaging effects.

Brain metastases can thus appear hypometabolic or hypermetabolic. The sensitivity and specificity of FDG-PET in detecting brain metastasis range from 68% to 75% and from 38% to 83%, respectively. The optimal imaging of FDG uptake by PET depends on numerous variables, which include the tumour histology, size of lesion, cell proliferation rate, ratio of viable to necrotic cells, duration of treatment, associated inflammation or infection, and resolution of the PET scanner. Benign lesions, such as inflammatory or infectious foci, can absorb sufficient FDG, thereby leading to false-positive results. On the other hand, large necrotic tumours with low metabolic rates have a low FDG uptake rate and hence yield false-negative results.

CONCLUSION

Our case report reveals the usefulness of functional-anatomical correlation in assessing a haemorrhagic brain lesion. Brain metastasis can be hypometabolic or hypermetabolic, and the importance of coregistration between MRI and CT findings and of the correlation between these and clinical findings has been illustrated. In addition, asymmetrical distribution of FDG in white matter, as shown in PET images, always indicates an abnormality. Thus, PET can aid in defining appropriate targets for biopsy. For any intracerebral haemorrhage that does not resolve or shows imaging features atypical of haematoma, a histological diagnosis should be sought.

REFERENCES


