Case Report

An Advanced-stage Large-cell Neuroendocrine Lung Carcinoma with Intramedullary Spinal Metastases Detected by Positron Emission Tomography

Shao-Ming Yu1*, Yu-Chuan Chang2,3, Wen-Chi Chou1,4
1Department of Hematology and Oncology, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
2Department of Nuclear Medicine, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
3Department of Medical Imaging and Radiological Sciences, College of Medicine, Chang Gung University, Taoyuan, Taiwan
4Department of Internal Medicine, College of Medicine, Chang Gung University, Taoyuan, Taiwan

Abstract

Large-cell neuroendocrine carcinoma (LCNEC) is a rare form of lung cancer with an aggressive behavior that frequently metastasizes to liver, brain, and bone. Intramedullary spinal cord metastasis (ISCM) is a rare clinical presentation of solid cancer and always indicates a dismal prognosis. This article presents a 72-year-old male patient diagnosed with an advanced-stage LCNEC who initially presented with ISCM that was diagnosed by positron emission tomography-computed tomography (PET-CT). This case demonstrates the diagnostic performance of PET-CT for ISCM. PET may be an alternative diagnostic modality for patients intolerant or unable to receive magnetic resonance imaging study to detect ISCM in those with LCNEC.

Keywords: Intramedullary spinal cord metastasis, large-cell neuroendocrine lung carcinoma, positron emission tomography

INTRODUCTION

Large-cell neuroendocrine carcinoma (LCNEC) of the lung is a rare form of lung cancer, with an aggressive disease behavior and extensive metastases to multiple organs. For patients with spinal cord compression, the most common metastatic sites are the vertebral bone with cord compression, followed by epidural metastases, and most uncommonly by intramedullary spinal cord metastasis (ISCM). The gold standard diagnostic modality for ISCM is magnetic resonance imaging (MRI). However, the use of MRI is limited by the time-consuming examination, need for patient cooperation in the examination room, and inability to perform whole-body examinations. A few cases of ISCMs have been detected by fluorine-18-fluorodeoxyglucose-positron emission tomography (FDG-PET). Herein, we present a case with imaging.
MRI has been widely used to evaluate at admission. Lumbar spine MRI revealed right lung cancer with multiple lymph nodes and ISCMs from surrounding cord edema. An excisional biopsy of left SCF lymphadenopathy showed metastatic LCNEC. PET-CT for tumor staging disclosed right lung cancer with multiple lymph nodes and spinal cord metastases at the T1–T3 level [Figure 1]. The maximum standardized uptake values (SUVs) of FDG–avidity lesions of the primary lung tumor, lymph node, and ISCM metastases were 12.4, 11.3, and 8.0, respectively. Intravenous corticosteroids with dexamethasone were prescribed from the day of admission to reduce cord edema. Palliative radiotherapy was delivered to the spinal metastases but with a poor clinical response. Due to rapidly worsening clinical condition and performance status, systemic palliative chemotherapy was not feasible, and best supportive care was provided. The patient died about 2 weeks after the diagnosis of lung cancer.

Discussion

LCNEC has a low incidence in primary lung cancer and mainly occurs in older males and heavy smokers. With an aggressive clinical behavior, the 5-year overall survival rate of LCNEC ranges from 15% to 40%, with frequent metastases to the liver, brain, and bone. ISCMs are an uncommon clinical presentation but are more frequently being diagnosed, due to therapeutic advances and improvements in cancer-specific survival. Lung cancer is the most common primary site of ISCMs, accounting for nearly 50% of cases of ISCMs. The clinical presentations of ISCMs may manifest as back pain and hemicord syndrome with or without autonomic dysfunction. ISCM has been reported to be the initial presentation at the diagnosis of cancer in 10% to around 20% of ISCM cases. The reported median survival after a diagnosis of ISCMs is only 3.6 months. MRI has been widely used to evaluate malignancy with central nervous systemic involvement. Contrast-enhanced MRI with gadolinium is sufficiently sensitive for intramedullary spinal lesions and can demonstrate ISCMs from surrounding cord edema. A small proportion of patients are asymptomatic or have nonspecific back pain at the intramedullary lesion, which is incidentally disclosed on MRI examination. Early diagnosis and treatment rather than a radiosensitive histology are paramount in determining the outcome. In a retrospective review, surgical management may have contributed to improved survival and neurologic outcomes in selected patients with solitary lesions without brain metastasis.

PET is commonly used in lung cancer staging and evaluation in the current clinical practice, especially in detecting distant metastases. In prior studies, differences in FDG–avidity have been reported in different types of lung cancer. According to Aquino et al., the average SUVs of squamous

---

**Table 1: Patient's hemogram and prothrombin time**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>10.3 (×1000/μL)</td>
</tr>
<tr>
<td>RBC</td>
<td>3.62 (×10^6/μL)</td>
</tr>
<tr>
<td>Hb</td>
<td>10.0 (g/dL)</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>31.5 %</td>
</tr>
<tr>
<td>MCV</td>
<td>89.2 (fl)</td>
</tr>
<tr>
<td>RDW</td>
<td>17 %</td>
</tr>
<tr>
<td>Platelet</td>
<td>217 (×1000/μL)</td>
</tr>
<tr>
<td>PT (INR)</td>
<td>1.1</td>
</tr>
</tbody>
</table>

---

**Figure 1:** (a) Positron emission tomography axial view, (b) positron emission tomography coronal view, (c) positron emission tomography-computed tomography axial view. Positron emission tomography-computed tomography for evaluating tumor status showing fluorodeoxyglucose-uptake lesions over right hilar area (red arrow; main tumor of large-cell neuroendocrine carcinoma and hilar lymphadenopathy (LAPs)) and T1–T3 level (blue arrow; intramedullary spinal cord metastasis). The maximum standardized uptake values of main tumor, LAPs, and the spinal cord metastases was 12.4, 11.3, and 8.0, respectively.
cell carcinoma (SUV: 9.2 ± 1) and large-cell carcinoma (SUV: 7.5 ± 1.5) were higher than that of adenocarcinoma (SUV: 4.6 ± 0.8 in the nonbronchioloalveolar [bronchioloalveolar carcinoma (BAC)] subtype and 1.6 ± 1.2 in the BAC subtype).\[9\] In another analysis, the maximum SUV value was significantly higher for squamous cell carcinoma than small-cell carcinoma and adenocarcinoma.\[6\] For pulmonary neuroendocrine tumors, the maximum SUV has been reported to be significantly different for carcinoids (mean, 4.0; median, 3.4), LCNECs (mean, 12.0; median, 10.7), and small-cell carcinomas (mean, 11.6; median, 11.7).\[7\] In another study, the mean SUV\(_{\text{max}}\) of LCNECs was around 9.0,\[8\] and a higher SUV\(_{\text{max}}\) has been shown to be a poor prognostic factor in patients with LCNECs.\[7,8\]

Nevertheless, only a few cases of lung cancer with ISCMs detected by PET have been reported. These cases reported different histological subtypes of lung cancer, including squamous cell carcinoma,\[9\] adenocarcinoma,\[10\] small-cell carcinoma,\[11\] and large-cell carcinoma\[12\] and one case only being described as nonsmall-cell lung cancer.\[13\] In the case of large-cell carcinoma, there was no further description about the subgroup histology.\[12\] ISCM was found in one case by PET at the same time as the primary cancer was diagnosed;\[13\] however, in other four cases, ISCMs were revealed on PET during the subsequent follow-up for re-evaluation of disease status. Two cases had multifocal FDG-uptake lesions along the spinal cord, suggesting diffuse ISCMs.\[10,12\] In other three cases, PET revealed focal FDG–avid lesions over upper cervical, lower cervical, and thoracic areas, respectively.\[9,11,13\]

The SUVs of ISCMs in different types of lung cancer have not been clearly elucidated, probably due to the rarity of cases. In a small analysis of FDG-PET evaluation in patients with active myelopathy, the mean value of SUV\(_{\text{max}}\) detected in neoplastic lesions was significantly higher than in inflammatory lesions (3.3 vs. 1.9, \(P < 0.001\)), and half of the ISCMs in patients with solid tumors originated from lung cancer.\[14\] The SUV of ISCM in our case was 8.0. Compared with MRI, FDG-PET or PET-CT has relatively limited spatial resolution in detecting intramedullary lesions. One retrospective study tried to evaluate the visibility of ISCMs on PET compared with MRI. The results suggested that most ISCMs can be detected on PET when performed near the time of pretreatment MRI.\[15\] Several factors were reported to cause false-negative PET resulting in detecting ISCMs and should be kept in mind, including small lesion size, distracting uptake by adjacent bony vertebrae or disseminated systemic metastases, and lack of specific attention to the spinal cord. The authors concluded that PET can be considered as an option to evaluate ISCMs in some settings, such as for patients in whom MRI is contraindicated or PET has been done for tumor staging.\[15\] In conclusion, since the early management of ISCMs benefits survival and neurologic function, the use of PET as a widely used tool for tumor staging and re-evaluation might be helpful in the early detection of ISCMs.

**Declaration of patient consent**

The authors certify that they have obtained appropriate patient’s family consent form. In the form, the patient’s family has given the consent for the patient’s images and other clinical information to be reported in the journal. The patient’s family understands that the patient’s name and initial will not be published and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**