Occult Cancer Detected by Positron Emission Tomography/Computed Tomography Image Fusion

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Abstract. A 60-year-old male in a high-risk group for lung cancer, who also had positive sputum cytology, underwent examination by chest plain radiography, chest computed tomography (CT) and bronchofiberscopy. However, initially no abnormal findings were detected with these diagnostic modalities. Furthermore, thin-section spiral chest CT disclosed only a slight thickness of the right side of the tracheal wall, while consequent re-examination by bronchofiberscopy revealed only a light ulcerative lesion in the same area. However, the existence of a primary tumor was not confirmed using these modalities. Therefore, FDG-PET (positron emission tomography with fluorodeoxyglucose) was performed and demonstrated accumulation corresponding to the anterior mediastinum, although the exact location of the tumor was unclear by FDG-PET alone. Therefore, FDG-PET/CT image fusion was performed and resulted in the detection of a tracheal carcinoma on the outside of the right side of the tracheal wall. The patient then underwent tracheal sleeve resection including the tumor and tracheoplasty accompanied with wrapping using the flap of the thymus right lobe. To the best of our knowledge, this is the first reported case of tracheal carcinoma detected by FDG-PET/CT image fusion with consequent radical resection.

Detection of the origin of a primary tumor is fundamental and essential for diagnosis and treatment, however, early detection of the primary unknown carcinoma is not always easy in practice. Generally, in the case of positive sputum cytology, chest X-rays, chest computed tomography, (CT) including thin-section spiral CT and bronchofiberscopy have been used to detect a primary unknown carcinoma in the tracheo-bronchial tree. Primary unknown tumors that cannot be located with these diagnostic modalities, known as occult cancers, pose serious problems for clinicians.

Case Report

A 60-year-old male, who was a heavy smoker (40 cigarettes per day for 40 years), underwent physical examination in April 2003, due to being in a high-risk group for lung cancer, although no symptoms were evident. As his sputum cytology disclosed class V, squamous cell carcinoma, sequential examination including chest X-ray, chest CT and bronchofiberscopy were performed. Thin-section spiral chest CT disclosed a slight thickness of the right side of the tracheal wall (Figure 1), while re-bronchofiberscopy showed only a light ulcerative lesion in the same area (Figure 2). However, the primary tumor remained undetected in the tracheo-bronchial tree. Therefore, FDG-PET (positron emission tomography with fluorodeoxyglucose) was performed and demonstrated accumulation corresponding to the anterior mediastinum. Consequently, FDG-PET/CT image fusion was performed and detected a tracheal carcinoma on the outside of the right side of the tracheal wall (Figure 3).

Then, under general anesthesia, the patient underwent tracheal sleeve resection of four tracheal cartilage rings including the tumor and tracheoplasty accompanied with wrapping using the flap of the thymus right lobe. Macroscopically, the tracheal carcinoma was 12 mm in

Abbreviations: PET, positron emission tomography; CT, computed tomography; FDG-PET, positron emission tomography with fluorodeoxyglucose.

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Figure 1. Thin-section spiral chest CT disclosed a slight thickness of the right side of the tracheal wall.

Figure 2. Re-bronchofiberscopy showed only a light ulcerative lesion in the same area.

Figure 3. FDG-PET /CT image fusion was performed and detected a tracheal carcinoma on the outside of the right side of the tracheal wall.

Figure 4. Macroscopically, the tracheal carcinoma was 12 mm in diameter, with ulceration inside the tracheal wall confirmed outside the resected trachea.
diameter, with ulceration inside the tracheal wall confirmed outside the resected trachea (Figure 4). Microscopically, the proximal and distal edges of the resected trachea were free from tumor invasion. The postoperative course was uneventful and the patient was discharged three weeks later.

Discussion

Primary unknown carcinoma in the tracheo-bronchial tree, which does not show abnormal findings on chest X-ray, chest CT, or bronchofiberscopy, but produces positive sputum cytology, poses many problems for clinicians. However, literature on the detection of primary unknown tumors is limited because, as soon as the primary tumor is detected, it is classified according to its origin. Detection of the origin of the primary tumor is fundamental and essential for diagnosis and treatment. As the present case was in a high-risk group for lung cancer, a detailed examination, as mentioned above, was performed. However, the primary tumor was not detected by these modalities.

Since the 1990’s, FDG-PET has emerged as an important imaging modality. FDG-PET is a nuclear technique by which metabolic processes can be visualized and measured in vivo, using short-lived radionuclides. Particularly in the thorax, FDG-PET has been shown to be of use in differentiating benign from malignant pulmonary lesions and in staging lung cancer (1). Furthermore, the procedure is non-invasive and provides information about the entire body in one session. These advantages may be of value in detecting primary tumors. In 1998, Kole et al. (2) demonstrated the potential of FDG-PET to detect primary tumors after unsuccessful conventional diagnostic workup. However, in general, PET imaging is inferior to CT imaging with respect to the exact localization of the tumor. Recently, the advent of multimodality imaging scanners combining PET and CT has led to a new paradigm in imaging display and presentation that raises new challenges in imaging navigation and communication (3). In the present case, PET/CT image fusion was performed and detected primary tracheal carcinoma on the outside of the right side of the tracheal wall.

Primary malignant tumors of the trachea are uncommon, with primary malignant neoplasms of the trachea accounting for only 0.2% of all malignancies. Moreover, the incidence of these tumors is less than 0.2 per 100,000 persons per year, with a prevalence of 1 per 15,000 autopsies (4). Consequently, making an accurate diagnosis in a timely fashion is difficult. Squamous cell carcinomas of the trachea are ulcerative and extend exophytically from the tracheal wall (6). These issues made early detection difficult in the present case.

In primary lung cancer, conventional imaging modalities are employed first. In the present case, thin slice chest CT did not detect any abnormal findings and bronchofiberscopy showed only a light ulcerative lesion of the tracheal wall. Because the present case comprised early stage tracheal carcinoma without direct invasion to adjacent tissue and no lymph node swelling, detection by these techniques was, by definition, difficult. However, tracheoplasty was curative, with four tracheal rings resected due to the early stage of the carcinoma.

To the best of our knowledge, this is the first report of tracheal carcinoma detected by PET/CT image fusion with subsequent radical resection. PET/CT image fusion appears to be effective and useful for tumors of the tracheo-bronchial tree for which abnormal findings are not detected by conventional imaging modalities, disclosing only positive sputum cytology. In particular, in early stage tracheal carcinoma without any symptoms, PET/CT image fusion may be an effective diagnostic modality.

References


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