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Case report

Pattern of FDG-PET uptake in lipoid pneumonia simulating lung cancer

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ABSTRACT

Lipoid pneumonia presents with a variety of lung abnormalities, particularly mass forming lesions that mimic lung cancers. While ^{18}F-fluorodeoxyglucose (FDG)-positron emission tomography (PET) is expected to discriminate both diseases, some previous reports showed pseudo-positive FDG uptake in lipoid pneumonia. Here, we report a case of pathologically proven chronic lipoid pneumonia in a 78-year-old Japanese man. Computed tomography (CT) showed multi-lobar mass-forming lesions with a fat-density. PET confirmed the spotty accumulation of FDG in the corresponding fat-density area on CT, suggesting lipoid pneumonia. We reviewed the literature and discussed the FDG uptake patterns in lipoid pneumonia.

1. Introduction

Lipoid pneumonia is an uncommon condition and is pathologically characterized by abnormal lipid deposition in the lungs, which initiates inflammatory processes. Different sources of oily substances of mineral, vegetal, or animal origin have been described in association with exogenous lipoid pneumonia. Chronic lipoid pneumonia typically manifests as mixed-density consolidation and mimics primary lung cancers on computed tomography (CT). While ^{18}F-fluorodeoxyglucose (FDG)-positron emission tomography (PET) is expected to discriminate both diseases, previous studies reported a pseudo-positive FDG uptake in lipoid pneumonia, illustrating a limitation of this approach. Here, we report a case of pathologically-proven chronic lipoid pneumonia showing a spotty FDG uptake in the corresponding fat-density area on CT. We focused on the FDG uptake patterns in lipoid pneumonia and added a literature review.

2. Material and methods

2.1. Case presentation

A 78-year-old man presented with abnormal shadows on routine postoperative thoracic CT. He had a surgical history of colonic and gastric cancers, which were operated upon 8 and 13 years before, respectively. Physical examination revealed no abnormalities. The CT revealed mixed-dense consolidation in the middle and right lower lobes with a fat density of less than −30 Hounsfield units (Fig. 1A–D). On PET, the FDG uptake was distributed in spots in the consolidation of both lobes (standardized uptake value (SUV): 5.7) (Fig. 2). Areas of high FDG uptake partly matched with the fat-density areas on corresponding CT (Fig. 2, arrow marks). Pathological diagnosis was made using biopsy specimens obtained via bronchoscopy from the right lower lobe. Pathological examination of hematoxylin and eosin-stained sections revealed aggregation of rounded, empty vacuoles corresponding to lipid deposition (Fig. 3, asterisk marks). Small lipid droplets were phagocytosed by alveolar macrophages (Fig. 3, arrow marks), which are characteristic findings of lipoid pneumonia. In an additional interview, the patient reported none of the specific conditions predisposing to lipid aspiration or inhalation.

3. Results and discussion

Lipoid pneumonia is a rare condition that is characterized by the deposition of exogenous or endogenous lipids in lung tissues. Previous reports showed diverse CT findings in lipoid pneumonia, including masses, nodules, dense or ground-glass infiltration, crazy-paving appearance, pleural effusion, pneumothorax, calcification, and cavitation [1,2]. Among these, mass-forming lesions, the most common subtype in chronic lipoid pneumonia, are particularly important in differentiating from lung cancers. While presence of fat density in mass lesions is a key finding in lipoid pneumonia, necrotic lesions and mucous retention in lung cancer also appear similarly low density on CT. Recently, FDG-PET plays a crucial role on diagnosing lung cancers; however, pseudo-positive FDG uptake has been reported in lipoid

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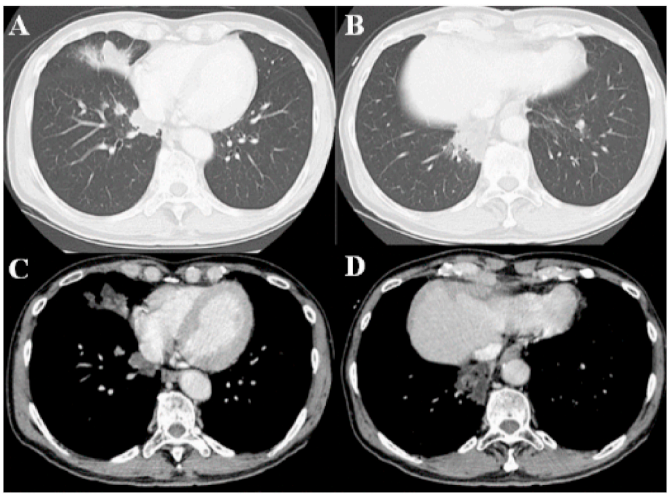

Fig. 1. Computed tomography images Computed tomography shows mixed-dense consolidations that include fat density in the middle and lower lobes.

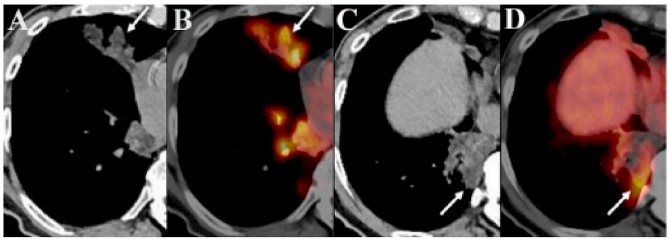

Fig. 2. Positron emission tomography images The positron emission tomography scan shows spotty accumulation of ^{18}F-fluorodeoxyglucose in the matched low density area on computed tomography (arrow marks).

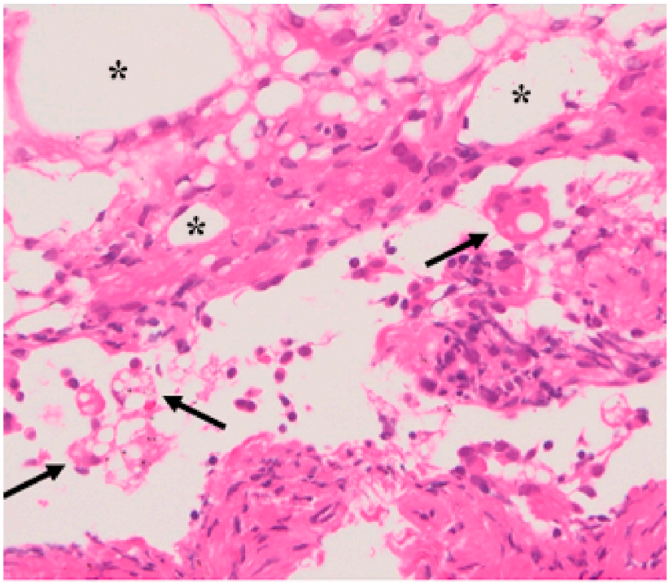

Fig. 3. Pathological examination of a lung biopsy specimen Aggregation of lipid deposition is observed as rounded, empty vacuoles stained with hematoxylin and eosin (asterisk marks). Small lipid droplets are phagocytosed by alveolar macrophages (arrow marks).

pneumonia, resulting in the simulation of lung cancers [3–6]. We comprehensively searched English literature and summarized 9 cases of lipoid pneumonia conducting FDG-PET as presented in Table 1 [3–11].

Based on the chest imaging and description that appeared in literature, two pulmonologists independently characterized CT and PET findings into categories in a blinded manner and finally gained identical results in all cases. On CT, the lesions were solitary (n = 6) or multiple (n = 4) with predilection for the right middle and lower lobes, and measured 20–60 mm in diameter. CT-fat density was evaluated in 5 cases, in which 4 cases manifested spotty distribution. On FDG-PET, SUVs ranged between 3.2 and 11.6 [3–10] with an exception of negative uptake in one case [11]. In all cases, SUVs exceeded a threshold of 2.5 that was previously proposed for the best discrimination between benign and malignant solitary lung nodules [12], illustrating a limitation of SUV alone for discriminating from lung cancers. Therefore, we focused on the pattern recognition of FDG uptake in lipoid pneumonia and tried to categorize the cases into three groups, single nodular, spotty, and peripheral (ring-shaped) patterns. In a total of 9 cases assessed, FDG uptake was shown as having a nodular (n = 4), spotty (n = 3), or peripheral (n = 2) pattern. The patterns were not associated with other factors including a location or multiplicity of the lesions, SUVs, or lipid sources. We believe a spotty pattern of FDG uptake, observed in 2 previous and the present cases, might be a key finding in lipoid pneumonia, because FDG uptake is usually positive in entire lesions of lung cancers. Nevertheless, lung cancers frequently have intratumoral necrosis showing low FDG area, and a variant of adenocarcinoma characterized by a rich mucous production has shown to manifest spotty FDG uptake [13]. Regarding different etiologies of CT-low density in lipoid pneumonia and lung cancer, we were interested in matched FDG hotspot and CT-low density in the present case as well as in the study by Chardin et al. [8]. Active inflammation was ongoing in the site of lipid deposition (CT-low density area) where activated inflammatory cells are recruited and glucose metabolism was promoted, leading to positive FDG uptake in lipoid pneumonia [8]. Thus, we concluded that this finding could be a hallmark for suspecting lipoid pneumonia.

Our study has several limitations. First, the snapshot of the imaging in each case report was not sufficient to evaluate the entire CT and PET patterns. Second, the resolution of PET was lower than that of CT and insufficient to evaluate the small heterogeneity in the lesion. Moreover, there should be unreported cases showing positive or negative FDG uptake in lipoid pneumonia. It is necessary to accumulate more cases to determine the specific recognition pattern on PET in lipoid pneumonia cases.

In summary, we reported a case of lipoid pneumonia and discussed the CT and PET findings along with a literature review. A spotty FDG uptake in corresponding to CT-fat density could be a key finding to suspect lipoid pneumonia.

4. Conclusion

We reported a case of lipoid pneumonia demonstrating spotty FDG uptake on PET and analyzed the literature of FDG-PET studies on lipoid pneumonias simulating lung cancers.

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Table 1
A summary of lipoid pneumonia cases conducting ^{18}F-fluorodeoxyglucose-positron emission tomography.

Case (Ref)	Age, sex	Lipid source	CT scan				PET scan	
			Form	Distribution	Size (mm)	Fat density	SUV	Pattern
1 (3)	72M	vegetable oil	multiple	RUL, RLL	ND	spotty	ND	peripheral
2 (7)	82M	mineral oil	solitary	RML	33	ND	4.2	nodular
3 (4)	65F	mineral oil	solitary	RML	30	–	3.2	nodular
4 (5)	65M	ND	solitary	RML	ND	ND	ND	spotty
5 (8)	76M	animal fat	solitary	RUL	30	ND	11.6	nodular
6 (6)	54M	ND	solitary	RLL	ND	spotty	4.4	spotty
7 (9)	72F	mineral oil	multiple	RLL, LLL	ND	spotty	ND	peripheral
8 (10)	73F	mineral oil	multiple	RLL, LUL	60	+	5.4	nodular
9 (11)	83F	vegetable oil	solitary	LUL	20	ND	normal	–
Present	78M	unknown	multiple	RLL, LUL	45	spotty	5.7	spotty

ND: no data, RUL: right upper lobe, RLL: right lower lobe, RML: right middle lobe.

Author's contribution

All of the authors ensure to task force for preparing the manuscript and approved the final version of the manuscript. All authors contributed to the clinical care for the patient in specialized settings.

Consent for publication

Written consent was obtained from the patient for publication of this case report and for use of accompanying images.

Declaration of interest

None of the authors has any conflicts of interest or any financial ties to disclose.

Submission declaration and verification

The present study was not published or is not currently submitted to any other journal.

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