Case report

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

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ARTICLE INFO

Keywords:
- Computed tomography
- Lipoid pneumonia
- Positron emission tomography

ABSTRACT

Lipoid pneumonia presents with a variety of lung abnormalities, particularly mass forming lesions that mimic lung cancers. While 18F-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 lipid pneumonia. Chronic lipoid pneumonia typically manifests as mixed-density consolidation and mimics primary lung cancers on computed tomography (CT). While 18F-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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https://doi.org/10.1016/j.rmcr.2020.101255
Received 7 June 2020; Accepted 7 October 2020
Available online 12 October 2020
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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 lipid pneumonias simulating lung cancers.

Funding

No funding was received for this work.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Respiratory Medicine Case Reports 31 (2020) 101255

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.

Acknowledgments

We would like to thank Editage (www.editage.jp) for English language editing.

Table 1

A summary of lipoid pneumonia cases conducting 18F-fluorodeoxyglucose-positron emission tomography.

| Case (Ref) | Age, sex | Lipid source | CT scan 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        | –           | 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        | 4.4         | 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.

References

[1] A. Gondouin, P. Manzoni, E. Ranfaing, et al., Exogenous lipid pneumonia: a retrospective multicentre study of 44 cases in France, Eur. Respir. J. 9 (1996) 1463–1469.
[2] V. Hadda, G.C. Khilnani, Lipoid pneumonia: an overview, Expt Rev. Respir. Med. 4 (2010) 799–807.
[3] F. Tahon, Y. Berthezene, S. Hominal, et al., Exogenous lipoid pneumonia with unusual CT pattern and FDG positron emission tomography scan findings, Eur. Radiol. 12 (Suppl 3) (2002) S171–S173.
[4] A. Talwar, R. Mayerhoff, D. London, et al., False-positive PET scan in a patient with lipid pneumonia simulating lung cancer, Clin. Nucl. Med. 29 (2004) 426–428.
[5] B. Mokhlesi, D. Angulo-Zereceda, V. Vaghni, False-positive FDG-PET scan secondary to lipid pneumonia mimicking a solid pulmonary nodule, Ann. Nucl. Med. 21 (2007) 411–414.
[6] B.D. Fox, I. Shechtman, D. Shitrit, et al., A “fat chance” it’s malignant: lipoid pneumonia simulating lung cancer on PET scan, Thorax 62 (2007) 464.
[7] N. Kanaji, S. Bandoh, K. Takano, et al., Positron emission tomography-positive squalene-induced lipoid pneumonia confirmed by gas chromatography-mass spectrometry of bronchoalveolar lavage fluid, Am. J. Med. Sci. 335 (2008) 310–314.
[8] D. Chardin, G. Nivaggoni, P. Viao, et al., False positive 18FDG PET-CT results due to exogenous lipid pneumonia secondary to oil drug inhalation: a case report, Medicine (Baltimore) 96 (2017) e6889.
[9] K. Ansari-Gilani, N. Faraji, R.C. Gilkeson, Increased FDG uptake and chronic lung changes in a case of persistent lipid pneumonia, Clin. Nucl. Med. 43 (2018) e477–e478.
[10] G.A. Osman, A. Ricci, F. Terzo, et al., Exogenous lipid pneumonia induced by nasal decongestant, Clin. Res. J 12 (2018) 524–531.
[11] J. Boutros, M. Muizzone, J. Benzaquen, et al., A case report of exogenous lipid pneumonia associated with avocado/soybean unsaponifiables, BMC Pulm. Med. 19 (2019) 234.
[12] A.S. Bryant, R.J. Cerfolio, The maximum standardized uptake values on integrated FDG-PET/CT is useful in differentiating benign from malignant pulmonary nodules, Ann. Thorac. Surg. 82 (2006) 1016–1020.
[13] H.K. Kim, J. Han, T.J. Frands, et al., Colloid adenocarcinoma of the lung: CT and PET/CT findings in seven patients, AJR Am. J. Roentgenol. 211 (2018) W84–W91.