Received: 17 May 2024 | Accepted: 30 June 2024

DOI: 10.1002/rcr2.1427

CASE REPORT

Respirology Case Reports | WILEY

^{18}F-FDG accumulation at the early onset of acute exacerbation of idiopathic interstitial pneumonia on ^{18}F-FDG PET/CT: A case report

Kimitaka Akaike[1] | Koichi Saruwatari[1] | Shinya Sakata[1] | Seitaro Oda[2] | Shinya Shiraishi[2] | Shinji Iyama[1] | Aiko Masunaga[1] | Yusuke Tomita[1] | Hidenori Ichiyasu[1] | Takuro Sakagami[1]

[1]Department of Respiratory Medicine, Kumamoto University Hospital, Faculty of Life Sciences, Kumamoto University, Kumamoto, Japan

[2]Department of Diagnostic Radiology, Kumamoto University Hospital, Faculty of Life Sciences, Kumamoto University, Kumamoto, Japan

Correspondence
Kimitaka Akaike, Department of Respiratory Medicine, Kumamoto University Hospital, Faculty of Life Sciences, Kumamoto University 1-1-1 Honjo Chuo-ku Kumamoto City, Kumamoto 860-8556, Japan.
Email: demio0601@gmail.com

Associate Editor: Arata Azuma

Abstract

Acute exacerbation of idiopathic interstitial pneumonias (AE-IIPs) is a disease associated with a poor prognosis in patients with IIPs. However, the specific characteristics of fluorine-18 2-fluoro-2-deoxy-d-glucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) imaging for AE-IIPs remain unclear. Herein, we present the case of a patient with lung cancer combined with IIPs who underwent ^{18}F-FDG PET/CT at the early onset of AE-IIPs. The scan, conducted 18 days post-bronchoscopy for lung cancer evaluation, revealed AE-IIPs before the onset of respiratory failure. New ground-glass opacities appeared, accompanied by significant ^{18}F-FDG accumulation extending beyond these regions. To the best of our knowledge, this report represents the first assessment of ^{18}F-FDG PET/CT images at the early onset of AE-IIPs before respiratory failure in humans. The observed features in this PET image could potentially contribute to our understanding of the pathophysiology of AE-IIPs.

KEYWORDS

^{18}F-FDG accumulation in interstitial lesion regions, acute exacerbation of idiopathic interstitial pneumonias, fluorine-18 2-fluoro-2-deoxy-d-glucose positron emission tomography/computed tomography

INTRODUCTION

Acute exacerbation of idiopathic interstitial pneumonias (AE-IIPs) often causes fatal respiratory deterioration in the patients with IIPs. Fluorine-18 2-fluoro-2-deoxy-d-glucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) is frequently used to determine the lung cancer (LC) stage. In patients with LC and idiopathic pulmonary fibrosis, higher preoperative ^{18}F-FDG accumulation in lung interstitial lesions was reportedly associated with a higher incidence of AE of idiopathic pulmonary fibrosis after thoracic surgery for LC.[1] However, the impact of ^{18}F-FDG accumulation in lung interstitial lesions on AE-IIPs remains unclear.

This report presents a case of a patient who underwent ^{18}F-FDG PET/CT at the early onset of AE-IIPs.

CASE REPORT

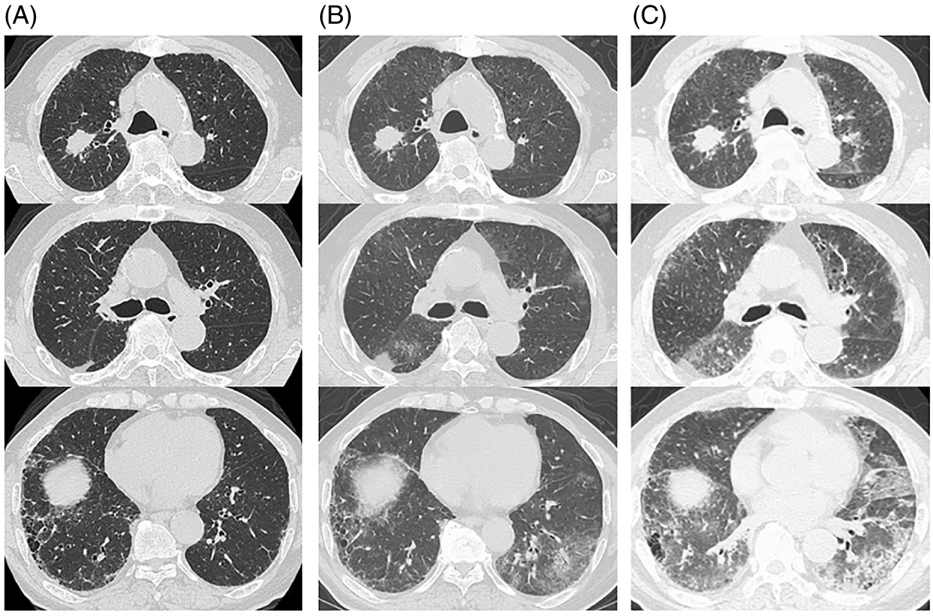
An 80-year-old man, previously diagnosed with IIPs 5 years prior at another hospital, was under observation. A chest CT at that hospital revealed a tumour shadow, and he was referred to our hospital.

His peripheral oxygen saturation (SpO_2) was 96%, with a modified Medical Research Council dyspnea scale score of 1. Laboratory results showed a Krebs von den Lungen-6 (KL-6) level of 703 U/L, consistent with previous values. His rheumatoid factor level increased slightly to 15 IU/mL, but other autoantibodies associated with connective tissue diseases were not detected (Table 1). Chest CT revealed a tumour shadow in the upper lobe of the right lung against a background of bilateral preexisting interstitial pneumonia

TABLE 1 Laboratory data at diagnosis of lung cancer.

Haematology			Biochemistry			Serology			Coagulation	
WBC	6700	/μL	TP	7.2	g/dL	CRP	0.16	mg/dL	PT-INR	0.93
Neut	70.3	%	Alb	4.2	g/dL	CEA	82.1	ng/mL	aPTT	28.7 Sec
Lymph	23.8	%	T-Bil	0.6	mg/dL	CYFRA	5.4	U/mL		
Mono	4.3	%	AST	18	U/L	Pro-GRP	47.1	pg/mL		
Eosin	0.9	%	ALT	18	U/L	KL-6	703	U/mL		
Baso	0.7	%	LDH	182	U/L	RF	15	IU/mL		
RBC	480×10^4	/μL	CK	90	U/L	ANA	1:40	titre		
Hb	14.4	g/dL	γ-GTP	28	U/L	MPO-ANCA	<0.2	U/L		
Ht	43.4	%	Na	140	mEq/L	PR3-ANCA	<0.6	U/L		
Plt	28.8×10^4	/μL	K	4.8	mEq/L	Anti-ARS	<5.0	Index		
			Cl	107	mEq/L	Anti-MDA5	<4.0	Index		
			Ca	10.3	mg/dL					
			BUN	13.2	mg/dL					
			Cr	0.79	mg/dL					

Abbreviations: Alb, albumin; ALT, alanine transaminase; ANA, antinuclear antibodies; ANCA, antineutrophil cytoplasmic antibodies; Anti-ARS, anti-aminoacyl-tRNA synthetase antibody; Anti-MDA5, anti-melanoma differentiation-associated protein 5 antibody; aPTT, activated partial thromboplastin time; AST, aspartate aminotransferase; Baso, basophils; BUN, blood urea nitrogen; Ca, calcium; CEA, carcinoembryonic antigen; CK, creatine kinase; Cl, chloride; Cr, creatinine; CRP, C-reactive protein; CYFRA, Cytokeratin 19 fragment antigen; Eosin, eosinophils; GTP, glutamyl transferase; Ht, haematocrit; K, potassium; KL-6, Krebs von den Lungen-6; LDH, lactate dehydrogenase; Lymph, lymphocytes; Mono, monocytes; MPO, myeloperoxidase; Na, sodium; Neut, neutrophils; Plt, platelets; Pro-GRP, pro-gastrin releasing peptide; PT-INR, prothrombin time-international normalized ratio; RBC, red blood cells; RF, rheumatoid factor; T-Bil, total bilirubin; TP, total protein.



		at the time of first visit to our hospital (at the time before bronchoscopy)	at the time of ^{18}F-FDG PET/CT (18 days after bronchoscopy)	at the time of hospitalization (9 days after ^{18}F-FDG PET/CT))
SpO_2	(%)	96 (on room air)	95 (on room air)	86 (on room air)
mMRC		1	1	2
CRP	(mg/dL)	0.16	6.14	8.33
KL-6	(U/L)	703	884	1076

FIGURE 1 Inspiratory phase chest CT findings at the level of the aortic arch, tracheal carina, and the lung bases at the time of first visit to our hospital (at the time before bronchoscopy) (A), at the time of ^{18}F-FDG PET/CT (18 days after bronchoscopy) (B), and on admission to our hospital (9 days after ^{18}F-FDG PET/CT) (C). Chest CT demonstrates a tumour shadow in the upper lobe of the right lung, against a background of reticular shadows with bronchiectasis in the bilateral lung fields, and honeycombing in the base of the right lung field at the time of the first visit to our hospital. At the time of ^{18}F-FDG PET/CT implementation, newly scattered GGOs are present in the bilateral lung fields, in addition to the original interstitial lesions in the bilateral lung fields. Nine days after ^{18}F-FDG PET/CT was performed, GGOs have extensively spread with consolidations in the bilateral lung fields, which is accompanied by the development of respiratory failure and worsening laboratory finding, including elevated levels of KL-6. CT, computed tomography; ^{18}F-FDG, fluorine-18 2-fluoro-2-deoxy-d-glucose; GGOs, ground-glass opacities; KL-6, Krebs von den Lungen-6.

as probable usual interstitial pneumonia pattern. (Figure 1A). Bronchoscopy with transbronchial biopsy was performed for the tumour shadow, confirming LC with IIPs with a high confidence of idiopathic pulmonary fibrosis.

Eighteen days post-bronchoscopy, ^{18}F-FDG PET/CT, conducted for LC staging, revealed newly identified scattered bilateral ground-glass opacities (GGOs) in the lung fields (Figure 1B). The maximum standardized uptake value (SUV_{max}) in the lung interstitial lesions, including new GGOs, was 7.9 and 9.1 in the early and delayed phase, respectively, exceeding new GGOs fields, especially in the delayed phase, on ^{18}F-FDG PET/CT images (Figure 2). At that time, his respiratory condition had not worsened, and C-reactive protein and KL-6 levels showed only mild elevation (6.14 mg/dL and 884 U/L, respectively). Thus, we diagnosed a respiratory infection and treated the patient with antibiotics.

However, the patient was admitted to our hospital 9 days after the ^{18}F-FDG PET/CT scan for respiratory failure, requiring oxygen administration at 4 L/min via nasal cannula. Laboratory results revealed further elevated levels of C-reactive protein and KL-6, at 8.33 mg/dL and 1076 U/L, respectively. Chest CT demonstrated an increased extension of bilateral GGOs and consolidations (Figure 1C), reaching the regions of ^{18}F-FDG accumulation in the delayed phase. Therefore, the patient was ultimately diagnosed with bronchoscopy-triggered AE-IIPs, and was treated with corticosteroid pulse therapy. Subsequently, hypoxemia improved, and chest X-ray revealed regression of bilateral GGOs and consolidations on day 23 of hospitalization.

DISCUSSION

The mechanisms underlying ^{18}F-FDG accumulation in lung interstitial lesions involve enhancement of the glycolytic system by Glucose Transporter 1 (GLUT-1) activity during the differentiation of lung fibroblasts into myofibroblasts in interstitial lesions.[2] Previous studies have reported a correlation between higher ^{18}F-FDG accumulation in lung interstitial lesions of patients with IIPs and poor prognosis, such as increased respiratory function impairment and mortality.[3] Additionally, in patients with LC and interstitial pneumonia, an association was reported between pretherapeutic ^{18}F-FDG accumulation in lung interstitial lesions and the incidence of AE of interstitial pneumonia after LC treatment.[1] However, the impact of ^{18}F-FDG accumulation on interstitial lesions at the onset of AE-IIPs in humans remains unknown.

Tanguy et al. reported that ^{18}F-FDG accumulated in the lung injury area of mice on ^{18}F-FDG PET/CT images from days 20 to 21 after intratracheal administration of bleomycin.[4] Furthermore, El-Chemaly et al. demonstrated that

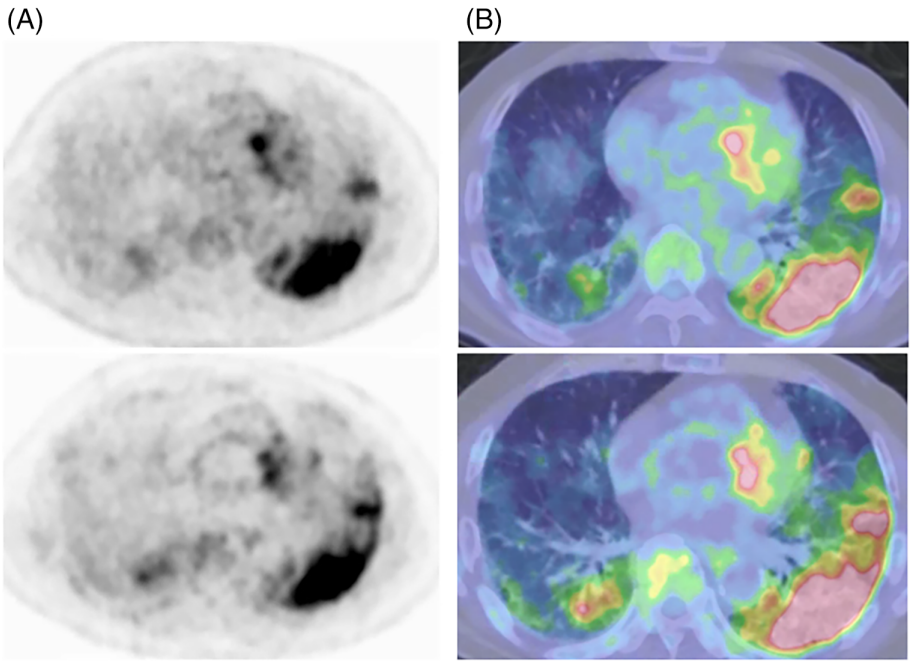


FIGURE 2 ^{18}F-FDG PET/CT images at the level of the lung bases at the early onset of AE-IIPs 18 days after bronchoscopy. The upper row corresponds to the early phase, whereas the lower row represents the delayed phase. PET image on the corresponding CT images (A). PET/CT fusion image (B). ^{18}F-FDG PET/CT images in the early phase show that the newly identified GGOs by AE-IIPs on CT images are associated with increased ^{18}F-FDG accumulation. The SUV_{max} of the newly identified GGO areas in the early phase is 7.9. Additionally, ^{18}F-FDG accumulation in the delayed phase is higher and demonstrates a more extensive distribution beyond the GGO areas by AE-IIPs than those of the early phase. The SUV_{max} of the newly identified GGO areas in the delayed phase is 9.1. AE-IIPs, acute exacerbation of idiopathic interstitial pneumonias; CT, computed tomography; ^{18}F-FDG, fluorine-18 2-fluoro-2-deoxy-d-glucose; GGOs, ground-glass opacities; SUV_{max}, maximum standardized uptake value.

inflammatory cells expressed GLUT-1 in bronchoalveolar lavage fluid and lung biopsy tissues from patients with IIPs.[5] Here, ^{18}F-FDG accumulation, induced by GLUT-1 expression, may be useful for the evaluation of acute lung injury, including AE-IIPs, and chronic lung fibrosis.

Generally, ^{18}F-FDG accumulation in malignant lesions increases in the delayed phase compared to the earlier phase and decreases in inflammatory lesions over time. Notably, in this case, SUV_{max} of the interstitial lesions in the delayed phase was higher, with a more extensive distribution beyond the new GGOs by AE-IIPs than in the early phase. Moreover, the newly identified GGOs and consolidations extended to the ^{18}F-FDG accumulation areas in the delayed phase when the patient subsequently developed respiratory failure accompanied by deteriorating laboratory findings. Consequently, the ^{18}F-FDG accumulation area in the delayed phase may more accurately and promptly reflect the disease status of AE-IIPs than in the early phase and other physical findings, contributing to the elucidation of the pathophysiology of AE-IIPs.

This case underscores that ^{18}F-FDG accumulation in interstitial lesions manifests at the early onset of AE-IIPs, providing a more accurate and prompt reflection of the disease status of AE-IIPs.

AUTHOR CONTRIBUTIONS

Kimitaka Akaike wrote the original draft of the manuscript. Kimitaka Akaike, Koichi Saruwatari, and Takuro Sakagami revised the manuscript. All authors edited and approved the final version of the manuscript.

ACKNOWLEDGMENTS

We thank Editage (www.editage.com) for the English language editing. This case report was presented as an abstract at the Japan Respiratory Society Regional Conference held in Miyazaki, Japan, on October 28 2023.

FUNDING INFORMATION

The authors declare that they received no support for this research, authorship, and/or publication of this article.

CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

As the patient had passed away, written informed consent for publication was obtained from his wife.

ORCID

Kimitaka Akaike https://orcid.org/0000-0002-7714-1552
Takuro Sakagami https://orcid.org/0000-0002-9057-1127

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How to cite this article: Akaike K, Saruwatari K, Sakata S, Oda S, Shiraishi S, Iyama S, et al. ^{18}F-FDG accumulation at the early onset of acute exacerbation of idiopathic interstitial pneumonia on ^{18}F-FDG PET/CT: A case report. Respirology Case Reports. 2024;12(7):e01427. https://doi.org/10.1002/rcr2.1427