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The clinical application value and the imaging characteristic of ^{18}F-FDG PET/CT in tuberculous pericarditis

Xiaoqing Du[1], Feng Zhu[2*] and Qian You[2*]

Abstract

Background Tuberculous pericarditis is the most common cause of pericardial disease in tuberculosis-endemic areas. Accurate and early diagnosis of tuberculous pericarditis is crucial due to its high mortality; however, the diagnostic accuracy of current methods remains suboptimal. This study aims to investigate the clinical application value and imaging characteristics of ^{18}F-FDG PET/CT in tuberculous pericarditis.

Methods A total of 11 patients with tuberculous pericarditis were retrospectively analyzed in this study. Patients were categorized into two groups based on the presence or absence of pericardial ^{18}F-FDG uptake. Differences in clinical symptoms between the two groups were assessed using the Mann-Whitney U test. Additionally, all tuberculous lesions in lymph nodes and other organs within the scanning range were systematically evaluated.

Results Tuberculous pericarditis was successfully detected by ^{18}F-FDG PET/CT in 9 of the 11 patients, yielding a diagnostic sensitivity of 82%. Seven of these 9 patients exhibited diffuse pericardial ^{18}F-FDG uptake on PET imaging, accompanied by lamellar pericardial thickening on CT. Two patients showed no pericardial ^{18}F-FDG uptake. A significant difference was observed in the duration of symptoms prior to ^{18}F-FDG PET/CT examination between patients with and without pericardial ^{18}F-FDG uptake (Z=-2.15, $P=0.036$). Specifically, patients without pericardial ^{18}F-FDG uptake had a notably shorter symptom duration before undergoing ^{18}F-FDG PET/CT (7 days/10 days vs. 40 (30,135) days). In this study, a total of 169 mediastinal lymphadenitis, 16 supraclavicular lymphadenitis, 1 cervical lymphadenitis, and 44 lymphadenitis in other areas were identified. Among the 11 patients, 7 exhibited intrapericardial tuberculosis involvement, primarily affecting the lungs and peritoneum.

Conclusions ^{18}F-FDG PET/CT demonstrated high sensitivity in the diagnosis of tuberculous pericarditis. The most common characteristic on ^{18}F-FDG PET/CT was diffuse pericardial ^{18}F-FDG uptake on PET accompanied by lamellar pericardial thickening on CT, which is indicative of tuberculous pericarditis. As a systemic examination, ^{18}F-FDG PET/CT can also detect tuberculosis in other organs, providing complementary diagnostic information for tuberculous pericarditis, thereby facilitating the selection of a more appropriate biopsy site.

Keywords ^{18}F-FDG PET/CT, Clinical value, Imaging characteristic, Tuberculous pericarditis

*Correspondence:
Feng Zhu
181515688@qq.com
Qian You
youqiansuda2007@126.com

[1]Department of nuclear medicine, the affiliated hospital of Jiangnan University, #1000, Hefeng Rd, Wuxi 214000, China
[2]Department of respiratory medicine of The Fifth People's Hospital of Wuxi (infectious disease hospital of Wuxi), Affiliated Wuxi Fifth Hospital of Jiangnan University, #1215, Guangrui Rd, Wuxi 214000, China

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Background

Tuberculosis is a communicable disease caused by the bacillus *Mycobacterium tuberculosis*. It remains the leading cause of death from an infectious disease and ranks among the top 10 causes of mortality globally, particularly affecting low- and middle- income countries where it imposes a substantial disease burden [1]. In 2023, tuberculosis was responsible for approximately 1.25 million deaths worldwide, including 1.09 million HIV-negative individuals and 161,000 people living with HIV [2]. Although primary a pulmonary disease, *Mycobacterium tuberculosis* can affect any organ, frequently manifesting as cardiac involvement. Following central nervous system involvement, cardiovascular complications represent one of the most common extrapulmonary manifestations of tuberculosis. Tuberculous pericarditis is a severe form of the disease and is the predominant cause of pericardial disease in regions where tuberculosis is endemic [3]. If left untreated or inadequately managed, tuberculous pericarditis can result in life-threatening complications such as cardiac tamponade, constrictive pericarditis, and death [4]. The mortality rate in cases of effusive tuberculous pericarditis may reach up to 8–16% in HIV-negative patients, with a 2-to-3-fold increase in HIV-positive individuals [5].

Early diagnosis of tuberculous pericarditis using microbiological methods is challenging due to the low concentration of *Mycobacterium tuberculosis* in the pericardial fluid. While some prior studies have suggested that ^{18}F-FDG PET/CT may serve as a promising tool for evaluating tuberculous pericarditis [6, 7, 8], most of these reports are limited to case reports and lack of comprehensive investigations. The aim of this study is to investigate the clinical utility and imaging features of ^{18}F-FDG PET/CT in the context of tuberculous pericarditis.

Methods

Study patients

We retrospectively reviewed the medical records of all patients who underwent ^{18}F-FDG PET/CT at the nuclear medicine department of the affiliated hospital of Jiangnan University from January 2015 to December 2022, aiming to identify patients imaged for tuberculous pericarditis. The inclusion criteria were as follows: (1) tuberculous pericarditis was confirmed by laboratory examination, biopsy pathology, or clinical follow-up; and (2) completed clinical data were available. The exclusion criteria included: (1) incomplete clinical data; (2) presence of other bacterial or viral infections; and (3) a history of autoimmune disease or malignant tumors. A total of 23 patients were initially identified, of whom 12 were excluded due to lost follow-up data. Consequently, 11 patients were finally included in this study. By reviewing the medical records, we collected comprehensive clinical data, including symptoms, symptom duration, body temperature, disease course, blood routine examination results, autoimmune antibody tests, sputum smear and culture results, T-cell spot test (T-SPOT), polymerase chain reaction (PCR, Xpert MTB/RIF) testing results, next-generation sequencing technology (NGS) results, thoracoscopic examination findings, pathological biopsy results, therapeutic regimens, treatment duration, and HIV test results.

A "definite" diagnosis of tuberculous pericarditis was established by detecting *Mycobacterium tuberculosis* bacilli in the pericardial fluid or histological sections of the pericardium through culture, PCR (Xpert MTB/RIF) testing, or NGS. A "probable" diagnosis was considered when there was evidence of tuberculosis at another site in a patient with unexplained pericarditis, characterized by a lymphocytic pericardial exudate with elevated levels of unstimulated interferon-gamma (ulFN-**γ**), adenosine deaminase (ADA), or lysozyme, and/or a favorable clinical response to anti-tuberculosis chemotherapy.

PET/CT acquisition and image analysis

^{18}F-FDG PET/CT was performed using a hybrid PET/CT scanner (Biograph True Point PET/CT, Siemens) after an overnight fast without high-fat low-carbohydrate diet. Images were acquired from the skull base to the proximal thigh (1.5 min per bed position), 60 min after intravenous administration of 5.55MBq/kg ^{18}F-FDG. The ^{18}F-FDG was produced by the nuclear medicine center of the affiliated hospital of Jiangnan University with radiochemical purity > 95%. All patients' blood glucose levels were required to be below 11.1 mmol/L at the time of ^{18}F-FDG injection. PET/CT images were independently analyzed by two senior nuclear medicine physicians for the detection of foci of non-physiological hypermetabolism, and any discrepancies were resolved through consensus. Pericardial ^{18}F-FDG uptake (in addition to physiological myocardial uptake when present) was defined as circumferential ^{18}F-FDG uptake distinct from the myocardium and corresponding anatomically to the pericardium on CT. The degree of ^{18}F-FDG uptake was quantified by generating a volume of interest to calculate the maximal standard uptake value (SUVmax).

Visual analysis

Pericardial ^{18}F-FDG uptake patterns on PET were categorized into four types: (1) no ^{18}F-FDG uptake; (2) focal ^{18}F-FDG uptake; (3)diffuse ^{18}F-FDG uptake; and (4) mixed ^{18}F-FDG uptake, which refers to the coexistence of focal and diffuse uptake.

Pericardial morphologies on CT were also classified into four types: (1) normal pericardium; (2) nodule formation; (3) lamellar thickening; and (4) mixed thickening,

indicating the coexistence of nodule formation and lamellar thickening.

Patients were divided into two groups based on the presence or absence of pericardial ^{18}F-FDG uptake. The maximum distance between the visceral and parietal pericardium on cross-sectional CT was measured as an indirect indicator of the amount of pericardial effusion. Additionally, the maximum thickness of the pericardium was measured on CT. All length measurements were expressed in centimeters.

Tuberculous foci in lymph node and in other organs

All lymph nodes with an SUVmax higher than that of the mediastinal blood pool in the patient were categorized into four regions: mediastinal, supraclavicular, cervical, and other areas. For these lymph nodes, the SUVmax, CT value (expressed in Hounsfield units [HU]), maximum diameter, and minimum diameter were measured. Additionally, the SUVmax of all tuberculous foci in other organs within the scanning range were also measured.

Statistical analysis

Data were analyzed using SPSS Statistics 23.0. Data following a Gaussian distribution were expressed as mean ± standard deviation, while data with a non-Gaussian distribution were expressed as median (interquartile range). Differences between groups were assessed using the Mann-Whitney U test. $P<0.05$ denoted statistical significance.

Results

Patient characteristics

A total of 11 patients were included in this study. The characteristics of the Patients are presented in Table 1. One patient was diagnosed with "definite" tuberculous pericarditis (tubercle bacilli were identified in the pericardial histological section obtained via thoracoscopy), while the remaining 10 patients were diagnosed with "probable" tuberculous pericarditis. Among these, empiric anti-tuberculosis chemotherapy was effective in 6 patients; a tuberculous granuloma was detected in the pathological section of a mediastinal lymph node biopsy in 1 patient; tubercle bacilli were identified in the resected third lumbar vertebra in 1 patient; *Mycobacterium tuberculosis* was detected in sputum using Xpert MTB/RIF, and the sequence of *Mycobacterium tuberculosis* 120,193 was identified in the brain abscess puncture fluid by NGS in 1 patient; and NGS identified tubercle bacilli in the alveolar lavage fluid in 1 patient.

Pericardial patterns on PET and CT

The pericardial ^{18}F-FDG uptake patterns on PET and the pericardial anatomic morphology on hybrid CT are summarized in Table 2; the quantitative and semi-quantitative values of tuberculous pericarditis on PET/CT are presented in Table 3; while the corresponding images are illustrated in Figs. 1, 2, 3 and 4.

Among the patients in this study, 9 exhibited increased pericardial ^{18}F-FDG uptake. When using increased pericardial ^{18}F-FDG uptake as the diagnostic criterion without considering the specific uptake patterns on PET or morphological features on CT, the sensitivity of ^{18}F-FDG PET/CT for tuberculous pericarditis was 82%. Diffuse pericardial ^{18}F-FDG uptake on PET accompanied by lamellar pericardial thickening on hybrid CT (7/9) represented the most common imaging characteristic of ^{18}F-FDG PET/CT in tuberculous pericarditis.

Two patients demonstrated no pericardial ^{18}F-FDG uptake. The symptom durations before ^{18}F-FDG PET/CT examinations were 7 days and 10 days, respectively, for these 2 patients, compared to a median of 40 (30,135)

Table 1 The characteristics of patients

No.	Gender	Age(y)	Symptoms	Duration(day)	Diagnosed methods
Case1	male	77	cough, chest tightness	180	T-SPOT(+), Anti-TB (+)
Case2	female	76	cough, hemoptysis	90	T-SPOT(+), Anti-TB (+)
Case3	female	62	fever (Tmax 39.5℃)	40	T-SPOT (+), *Biopsy
Case4	Male	77	Fever (Tmax 38.7℃)	7	Anti-TB (+)
Case5	Male	73	Fever (Tmax 38.5℃), short of breath	180	T-SPOT(+), Anti-TB (+)
Case6	Male	74	Fever (Tmax 38.6℃), Chest pain	10	Anti-TB (+)
Case7	Male	48	Cough, chest distress	20	#thoracoscopic
Case8	Male	71	Chest distress, asthma	30	T-SPOT(+), ^Biopsy
Case9	Female	69	Blurred vision, headache	30	$Xpert(MTB/RIF), @NGS
Case10	Male	74	Cough, asthma	90	T-SPOT (+), & NGS
Case11	Male	81	Fever (Tmax 38.1℃)	30	Anti-TB (+)

Abbreviations: T-SPOT (+) positive T-SPOT results; Anti-TB(+) empirical antituberculosis therapy demonstrated efficacy; *Biopsy pathology identified the tuberculous granuloma in the biopsy section of the third lumbar vertebra; #thoracoscopic Acid-fast bacilli were detected in thoracoscopic biopsy specimens using the Xpert(MTB/RIF) assay; ^Biopsy The pathology of the mediastinal lymph node biopsy section revealed the presence of tuberculous granulomas; $Xpert(MTB/RIF) Mycobacterium tuberculosis was detected in the sputum sample using the Xpert(MTB/RIF) assay; @NGS the presence of Mycobacterium tuberculosis strain 120,193 was identified in the brain abscess puncture fluid through NGS sequencing; & NGS the presence of Mycobacterium tuberculosis complex group 8 was detected in alveolar lavage fluid by NGS

Table 2 Pericardial ^{18}F-FDG uptake patterns on PET and pericardial morphology on CT

No.	Pericardial ^{18}F-FDG uptake patterns on PET	Pericardial morphology patterns no CT	The size of the maximal pericardial nodule	Pericardial effusion	Tuberculous foci in other organs
Case1	diffuse uptake	lamellar thickening	NA	no	LN
Case2	diffuse uptake	lamellar thickening	NA	yes	Pleura, LN
Case3	mixed uptake	mixed thickening	0.48×0.79 cm	no	L3
Case4	no uptake	normal	NA	no	no
Case5	diffuse uptake	lamellar thickening	NA	no	Peritoneum, LN
Case6	no uptake	normal	NA	no	no
Case7	diffuse uptake	lamellar thickening	NA	yes	pleura
Case8	diffuse uptake	lamellar thickening	NA	yes	LN
Case9	focal uptake (2 sites)	mixed thickening	0.82×0.57 cm	no	Lung, brain
Case10	diffuse uptake	lamellar thickening	NA	yes	Lung, LN
Case11	diffuse uptake	lamellar thickening	NA	yes	Lung, LN

Abbreviations: NA not available; LN lymph node; L3 the third lumbar

Table 3 The quantitative and semi-quantitative values of tuberculous pericarditis on PET/CT

Number	11
SUVmax of pericardium	9.7 ± 6.4
Thickness of pericardium	0.81 ± 0.49
CT value of pericardium	37.2 ± 15.48
The amount of pericardium effusion	0.78 (0, 3.32)
SUVmax of tuberculous foci in other organs	8.27 ± 5.43

days for patients with pericardial ^{18}F-FDG uptake, indicating a significant difference (Z=-2.15, P = 0.036).

Pericardial effusion was observed in 46% (5/11) of the patients, and no cardiac tamponade events were recorded in this study.

Tuberculous foci in lymph nodes and in other organs

A total of 169 mediastinal tuberculous lymphadenitis, 16 supraclavicular tuberculous lymphadenitis, 1 cervical

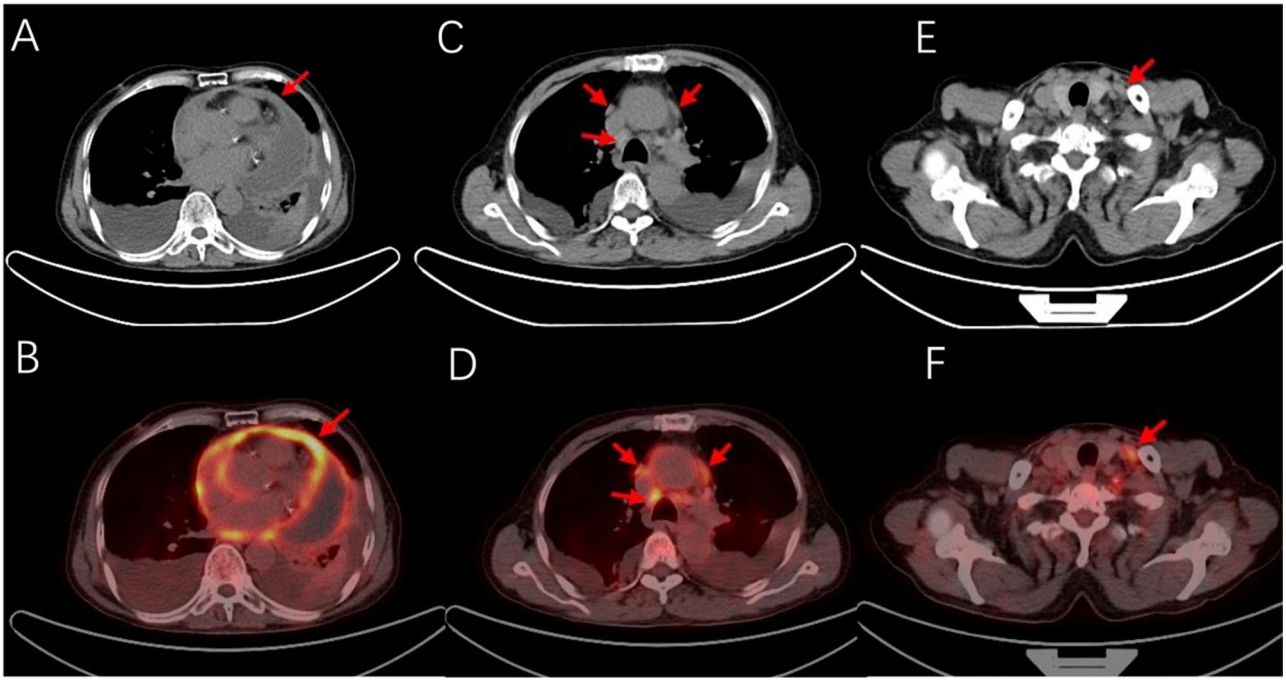

Fig. 1 A 74-year-old male presented with a three-month history of cough and asthma. ^{18}F-FDG PET/CT imaging revealed tuberculous pericarditis, pulmonary tuberculosis, and tuberculous lymphadenitis. NGS identified Mycobacterium tuberculosis complex sequences in the patient's bronchoalveolar lavage fluid. Images **A-B** demonstrated pericardial lamellar thickening with diffuse ^{18}F-FDG uptake; images **C-D** illustrated mediastinal tuberculous lymphadenitis with high ^{18}F-FDG uptake; images **E-F** highlighted supraclavicular tuberculous lymphadenitis. All lesions are indicated by red arrows

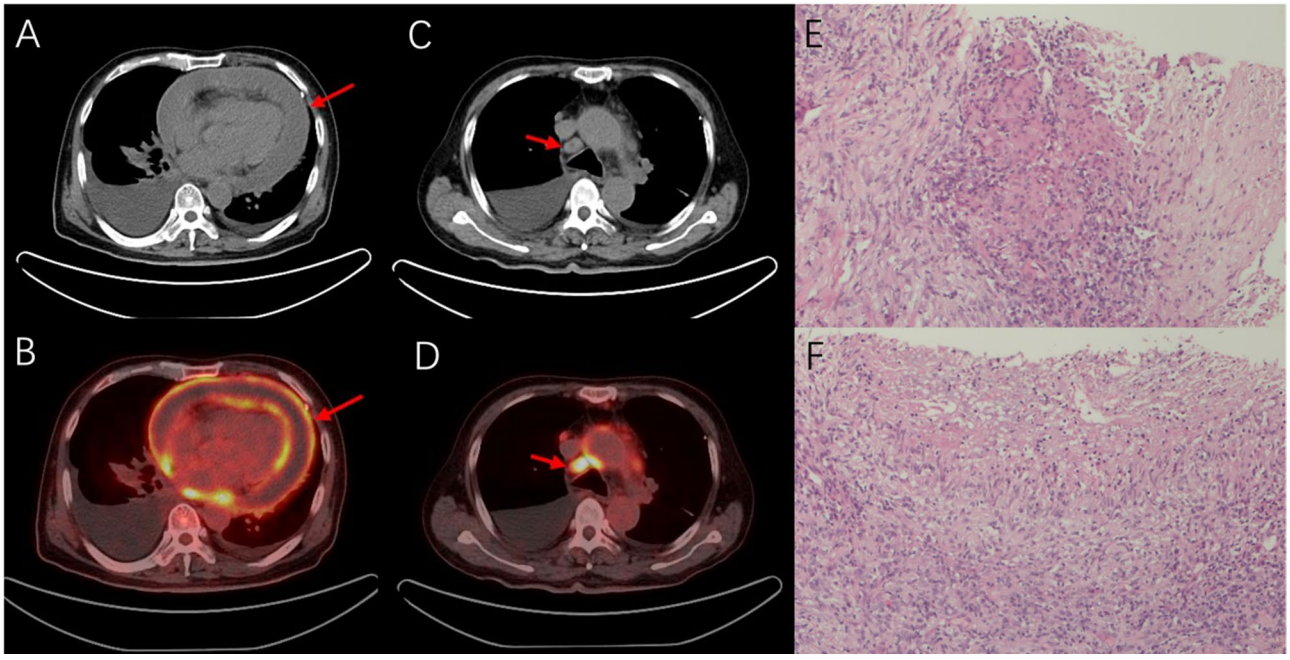

Fig. 2 A 71-year-old male presented with chest distress and asthma lasting for one month. An ^{18}F-FDG PET/CT scan revealed tuberculous pericarditis and mediastinal tuberculous lymphadenitis. The symptoms were fully alleviated following empiric anti-tuberculosis therapy. Images **A-B** demonstrated slightly lamellar thickening on CT with diffuse ^{18}F-FDG uptake on PET; images **C-D** highlighted mediastinal tuberculous lymphadenitis with high ^{18}F-FDG uptake; images **E-F** (HE×200) exhibited a typical granulomatous structure characterized by central caseous necrosis surrounded by epithelioid cells, lymphocyte infiltration, and fibrous tissue hyperplasia. All lesions are indicated by red arrows

tuberculous lymphadenitis, and 44 tuberculous lymphadenitis located in other regions were included in this study. The parameters of these lymph nodes are presented in Table 4. More than half of the mediastinal tuberculous lymphadenitis were distributed in region 3 A (20%, 33/169), 2R (17%, 28/169), and 4R (15%, 26/169).

In addition to lymph node tuberculosis, 7 out of the 11 patients also exhibited tuberculous foci in other organs (Table 2).

Discussion

The most challenging etiology of infectious pericarditis is tuberculous pericarditis, as its clinical manifestation range from asymptomatic states to severe complications such as cardiac tamponade or constrictive pericarditis. Additionally, the diagnostic yield of current methods remains suboptimal. Pericardial fluid analysis is crucial for characterizing pericardial effusion; however, pericardiocentesis is often limited by the location and volume of pericardial effusion. In this study, only 5 patients exhibited pericardial effusion. Even in cases where pericardial effusion is present, the detection rate of acid-fast bacillus (AFB) via direct smear varies widely, ranging from 0 to 42% [9]. AFB culture can enhance diagnostic accuracy but requires more than 6 weeks for results. Reuter H reported that tuberculous pericarditis is frequently paucibacillary, leading to negative AFB smears and cultures in pericardial fluid [10]. Surgical approaches can be used to obtain pericardial tissue, but the information is often nondiagnostic, and the procedure itself can be technically demanding due to constriction or adhesion. Untreated tuberculous pericarditis carries a high mortality rate and frequently progresses to constrictive pericarditis [11], necessitating surgical intervention with less favorable long-term outcomes.

The diagnostic sensitivity of ^{18}F-FDG PET/CT was 82% in this study. Diffuse pericardial ^{18}F-FDG uptake accompanied by lamellar pericardial thickening (7/9) was the most common characteristic of tuberculous pericarditis observed on ^{18}F-FDG PET/CT. These findings are consistent with Aisheng Dong's study, where 3 out of 5 patients with acute tuberculous pericarditis exhibited diffuse ^{18}F-FDG uptake in the pericardium [12]. Visual thoracoscope for diagnosing tuberculous pleurisy relies on the presence of multiple yellowish-white miliary tubercules of uniform size (usually < 5 mm) on the visceral and parietal pleura. Although these multiple nodules can be detected, their small size makes it challenging to identify their nodular features using CT, which typically shows a pattern of smooth, uniform thickening [13]. In this study, 1 patient demonstrated mixed pericardial ^{18}F-FDG uptake associated with mixed pericardial thickening, with the largest nodule measuring 0.48 × 0.79 cm. Another patient showed 2 focal pericardial ^{18}F-FDG uptakes accompanied by mixed pericardial thickening, with the 2 high-uptake nodules measuring 0.42 × 0.27 cm and 0.82 × 0.57 cm,

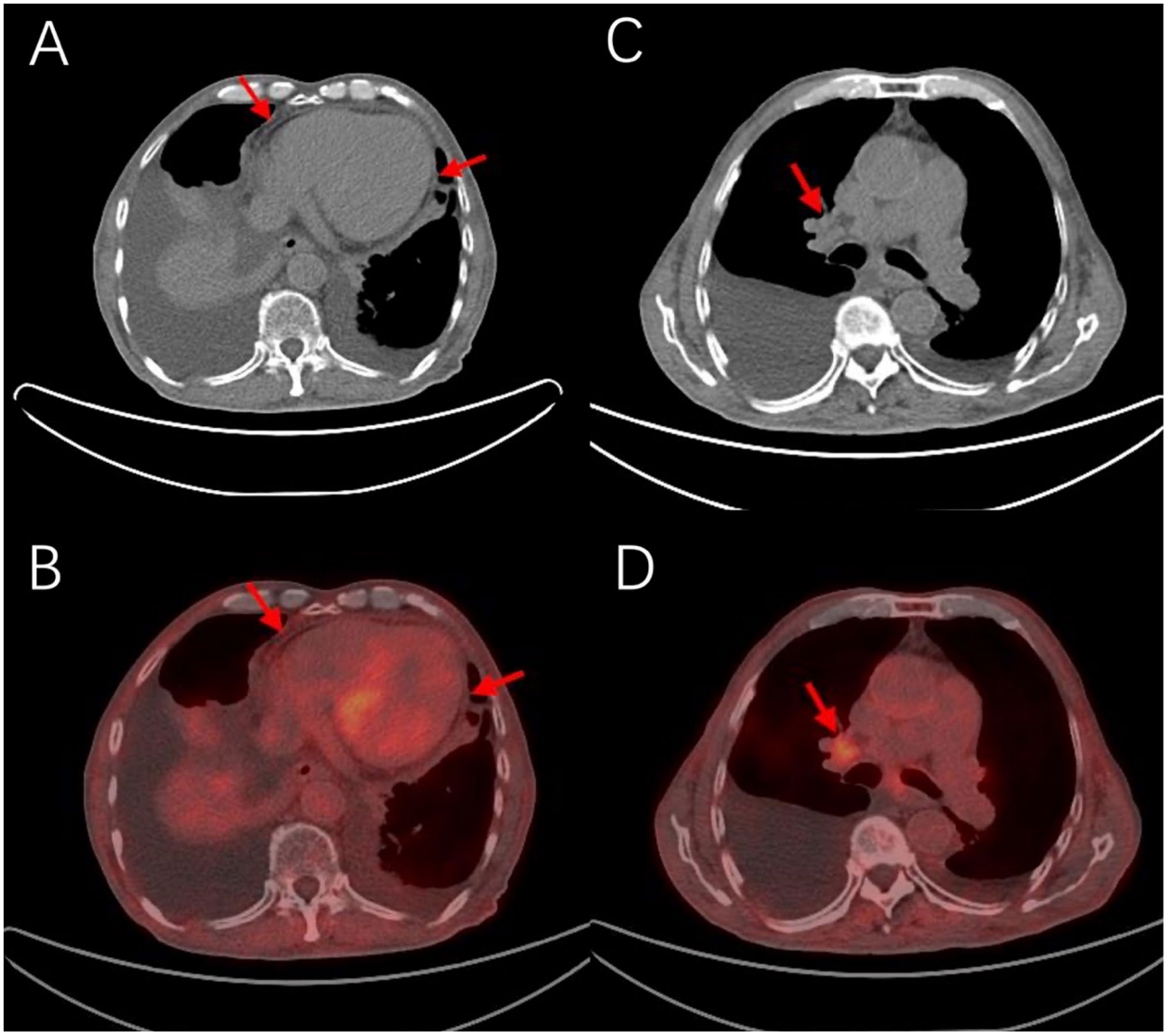

Fig. 3 A 74-year-old male presented with a fever (Tmax 38.6℃) lasting for 10 days. No significant tuberculous foci were identified on ^{18}F-FDG PET/CT imaging. One month later, the patient revisited the clinic due to persistent fever, and echocardiography revealed newly developed pericardial effusion. A pericardial effusion puncture was performed. The analysis of the pericardial fluid demonstrated elevated levels of ADA, LDH, protein, and CA125, while serum tests showed increased ESR and CRP. Following empirical anti-tuberculosis therapy, the pericardial effusion resolved completely. Images **A-B** show no ^{18}F-FDG uptake in the pericardium; Images **C-D** demonstrate mediastinal lymph nodes of uncertain nature with mild ^{18}F-FDG uptake and bilateral pleural effusion. All lesions are indicated by red arrows

respectively. A previous study reported that parietal pleural thickening greater than 1 cm could help differentiate benign from malignant cases [14]. The nodules in the pericardium of the 2 patients in this study were less than 1 cm in size. Additionally, pulmonary tuberculosis was detected in both patients via ^{18}F-FDG PET/CT, making the diagnosis of tuberculosis pericarditis relatively straightforward.

There were 2 patients without pericardial ^{18}F-FDG uptake in this study. Pericardial effusion was absent at the time of their ^{18}F-FDG PET/CT examinations. One month and one and a half months after the ^{18}F-FDG PET/CT examinations, these 2 patients revisited their doctors due to persistent fever. Echocardiography revealed newly developed pericardial effusion. Subsequently, pericardial effusion puncture was performed. The levels of ADA, lactate dehydrogenase (LDH), protein, and carbohydrate antigen 125 (CA125) in the pericardial fluid, as well as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) in the serum, were elevated in both patients. Following empirical anti-tuberculosis therapy, the pericardial effusion resolved. Sergio Foresti reported a case of a 77-year-old man who was ultimately diagnosed with tuberculous pericarditis but showed negative findings

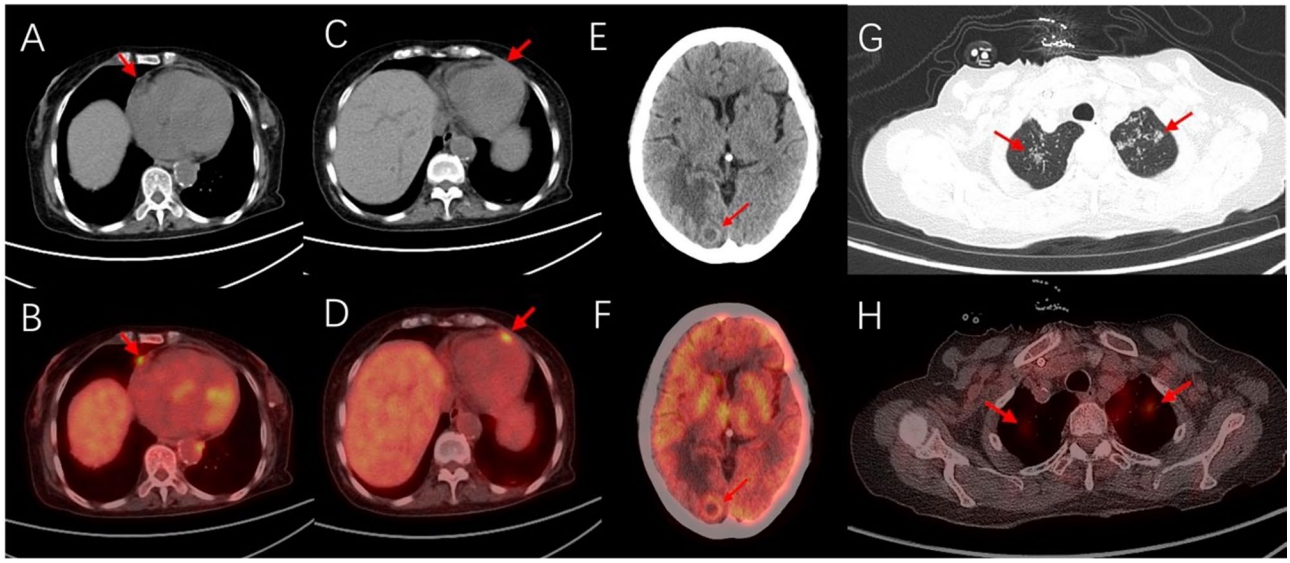

Fig. 4 A 69-year-old female presented with blurred vison and intermittent headache over the course of one month. Brain CT revealed a nodule in the right occipital lobe. Sputum Xpert MTB/RIF testing was positive, and NGS identified Mycobacterium tuberculosis sequence 120,193 in the brain abscess puncture fluid. ^{18}F-FDG PET/CT scan confirmed tuberculous pericarditis, a right occipital tuberculoma, and pulmonary tuberculosis. Images **A-D** demonstrated pericardial nodules on CT with focal ^{18}F-FDG uptake on PET; Images **E-F** highlighted the right occipital tuberculoma; and images **G-H** showed bilateral pulmonary tuberculosis. All lesions are indicated by red arrows

Table 4 The parameters of tuberculous lymphadenitis

Distribution area	count	SUVmax	CT value (HU)	Dmax (cm)	Dmin (cm)
Mediastinal	169	3.1(2.3, 4.5)	41(31,56)	0.92(0.69, 1.23)	0.59(0.42, 0.77)
Supraclavicular	16	2.63 ± 0.961	36.13 ± 16.69	0.73 ± 0.27	0.40 ± 0.11
Cervical	1	2	37	0.76	0.62
Other areas	44	3.1(2.02,4.38)	26.86 ± 13.82	0.87 ± 0.36	0.51(0.36,0.71)

Abbreviations: Dmax the maximum diameter, Dmin the minimum diameter

on ^{18}F-FDG PET/CT imaging, that no granulomas were detected in the pericardial samples following pericardiectomy [15]. A significant difference was observed in the duration of symptoms between patients with and without pericardial ^{18}F-FDG uptake prior to undergoing ^{18}F-FDG PET/CT. Patients without pericardial ^{18}F-FDG uptake exhibited a markedly shorter symptom duration before the examination. Tuberculous pericarditis processes through 4 pathologic stages: ①fibrinous exudation, characterized by abundant mycobacteria, macrophages, and T cells; ②serosanguineous effusion and lymphocytic exudates, marked by the emergence of monocytes and foam cells; ③absorption of effusion and formation of caseous granuloma, accompanied by pericardial fibrosis; and ④calcification of the pericardium and development of constrictive scarring. Neither pericardial effusion nor calcification was evident in the ^{18}F-FDG PET/CT images of the 2 patients. Therefore, it was hypothesized that the tuberculous pericarditis was in the initial pathological stage, and the tuberculosis granuloma had not yet formed in the pericardium of the 2 patients at the time of their ^{18}F-FDG PET/CT examination. The false-negative results indicate that ^{18}F-FDG PET/CT may be more suitable for detecting tuberculous pericarditis in patients who have experienced symptoms for more than 10 days.

The lymphatic drainage of the pericardium primarily involves the anterior, posterior, and tracheobronchial lymph nodes, a pattern that is reflected in the distribution of lymphadenopathy observed in cases with tuberculous pericarditis. In this study, a total of 169 mediastinal tuberculous lymphadenopathies were included. More than half of these were located in regions 3 A (20%, 33/169), 2R (17%, 28/169), and 4R (15%, 26/169). Additionally, 16 supraclavicular tuberculous lymphadenopathies and 1 cervical tuberculous lymphadenopathy were identified. A previous study reported a higher diagnostic yield (38.7%) for biopsies conducted at extra-pericardial sites compared to pericardial biopsies, and the most frequently targeted biopsy site was the mediastinal lymph nodes (39.1%), followed by the supraclavicular and cervical lymph nodes [16]. In this study, a mediastinal lymph node biopsy specimen was obtained from 1 patient via needle aspiration biopsy under fiberoptic bronchoscopy. Pathological examination of the biopsy confirmed the

presence of tuberculous granulomas, leading to a diagnosis of tuberculous pericarditis. As a systemic imaging modality, ^{18}F-FDG PET/CT not only aids in detecting pericardial tuberculosis but also helps identify more accessible biopsy sites for clinical practice.

One to two% of patients with pulmonary tuberculous develop tuberculous pericarditis. However, it may also manifest as an isolated extrapulmonary form [17]. In this study, 7 of the 11 patients had concomitant tuberculosis in other organs, primarily affecting the lungs and peritoneum. Lung and peritoneal tuberculosis exhibit distinct imaging characteristics, which can contribute to the collaborative diagnosis of tuberculous pericarditis.

Currently, the commonly used techniques for diagnosing tuberculous pericarditis in clinical practice include AFB smear, AFB culture, ADA measurement in pericardial effusion, T-SPOT.TB, NGS, and PCR (Xpert MTB/RIF). However, the diagnostic efficacy of these techniques remains suboptimal. In this study, only 1 patient was definitively diagnosed with tuberculous pericarditis using these methods, while approximately 55% (6/11) of patients with tuberculous pericarditis received their final diagnosis based on empiric anti-tuberculosis therapy. The use of ^{18}F-FDG PET/CT could provide an imaging basis to support empiric anti-tuberculosis treatment in such cases.

Limitations

This pilot study has several limitations that warrant consideration. First, it is a relatively small-scale, single-institution, retrospective study, which may limit the generalizability of the findings. Second, suboptimal dietary preparation could have resulted in inefficient suppression of physiological ^{18}F-FDG uptake in the myocardium, potentially leading to an overestimation or underestimation of pericardial ^{18}F-FDG uptake. A prospective study incorporating a high-fat low-carbohydrate diet on the day prior to the ^{18}F-FDG PET/CT scan is necessary to validate and refine the results of this pilot study.

Conclusions

^{18}F-FDG PET/CT exhibits high sensitivity (82%) in diagnosing tuberculous pericarditis. It can clearly delineate the inflammatory condition of the pericardium, thereby providing robust evidence to support empiric anti-tuberculosis therapy in selected patients, ultimately contributing to reduced mortality. The most common characteristic of tuberculous pericarditis on ^{18}F-FDG PET/CT is diffuse pericardial ^{18}F-FDG uptake observed on PET imaging, coupled with lamellar pericardial thickening evident on CT. As a comprehensive systemic examination, ^{18}F-FDG PET/CT not only aids in detecting tuberculosis involvement in other organs, offering collaborative diagnostic value for tuberculous pericarditis, but also facilitate the selection of a more appropriate biopsy site. Furthermore, ^{18}F-FDG PET/CT is particularly suitable for patients with tuberculous pericarditis who have experienced symptoms for more than 10 days.

Abbreviations

PCR	Polymerase chain reaction
NGS	Next-generation sequencing technology
ulFN-γ	Unstimulated interferon-gamma
ADA	Adenosine deaminase
SUVmax	Maximal standard uptake value
HU	Hounsfield unit
AFB	Acid-fast bacillus
LDH	Lactate dehydrogenase
CA125	Carbohydrate antigen 125
ESR	Erythrocyte sedimentation rate
CRP	C-reactive protein

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Author contributions

Conception, design, drafting of the manuscript, acquisition, statistical analysis, or interpretation of the data: Xiaoqing Du. Data acquisition. Revise: Feng Zhu. Qian You. All authors reviewed and approved the final version of the manuscript. All authors had read and approved the manuscript.

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Data availability

All data generated or analyzed during this study are included in this article. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was conducted in strict compliance with the principles of the Helsinki Declaration and received formal approval from the Ethics Committee of the Affiliated Hospital of Jiangnan University (Ethics Approval Number: LS2022039). In accordance with the relevant provisions of Chinese laws, specifically the "Measures for Ethical Review of Biomedical Research Involving Humans", since this retrospective study utilized de-identified data and all participants' identity information was removed, the Ethics Committee of the Affiliated Hospital of Jiangnan University exempted this study from the requirement to obtain informed consent.

Consent for publication

Not applicable.

Clinical trial number

Not applicable.

Competing interests

The authors declare no competing interests.

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