The Clinical Value of PET-CT in Searching for Primary Lesions of Malignances

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Abstract: This paper is aimed to explore the clinical value of ^{18}F-FDG PET-CT in searching for primary lesions of multiple metastatic malignances. Data of 35 patients with multiple metastatic malignances which the primary lesion was not clear, were retrospectively studied from January 2019 to April 2023 in our hospital. Systemic ^{18}F-FDG PET-CT examination was performed for all the patients, and the follow-up data were analyzed and summarized. The positive rate of ^{18}F-FDG PET-CT for primary malignant lesions was 74.29% (26/35), the specificity was 87.28%, the sensitivity was 85.43%, and the accuracy was 88.73%. The positive predictive value was 92.31% (24/26). ^{18}F-FDG PET-CT showed a high detection rate of metastatic squamous cell carcinoma and metastatic adenocarcinoma, with 85.36% and 82.41% respectively. ^{18}F-FDG PET-CT examination provides high clinical value in multiple searches of primary metastasis throughout the body.

Keywords: PET-CT; Primary Lesions; Malignances; Rate; Clinical Value

1. Introduction

In recent years, malignant tumors have become an important cause of threats to human life and health, and the incidence rate has increased year by year [1,2]. According to literature reports, the number of patients with primary lesions that have not yet been clearly diagnosed is gradually increasing [3]. Positron Emission Tomography Computed Tomography (PET-CT) has become an important method for searching for primary malignant lesions [4,5]. PET-CT can not only provide anatomical information of the whole body, but also provide metabolic information of malignant lesions at the molecular imaging level. The aim of this study is to explore the application of PET-CT in searching for primary malignant lesions, in order to provide a more reliable method for clinical diagnosis and treatment.

2. Methods

2.1 Subjects

Data of 35 patients (23 males and 12 females) with multiple metastatic malignances which the primary lesion was not clear, were retrospectively studied from January 2019 to April 2023 in our hospital. The average age was 53.45 years (range, 26-83 years). Systemic 18F-FDG PET-CT examination was performed for all the patients, and the follow-up data were analyzed and summarized. The study was approved by the Medical Ethical Committee of Shaanxi Provincial People's Hospital.

2.2 Preparation before PET-CT Examination

All patients underwent whole-body ^{18}F-FDG PET-CT examination using the Ingenuity TF PET-CT scanner produced by Philips in the Netherlands for diagnosis. Prior to the examination, patients were instructed to fast for 8 hours and their blood sugar levels were controlled below 11.0mmol/L to improve the quality of the examination; Then, the patient was given intravenous injection of ^{18}F-FDG at a dose of 0.10-0.15MBq/kg, keeping the patient rest for 60 minutes. Before the examination, 500ml of water was consumed to fill the gastric cavity, and PET-CT examination then could be performed.

2.3 PET-CT Examination

The patient is placed in a supine position, in the center of the examination bed, with both hands holding their heads and breathing calmly. The routine examination scanning range is from the top of the skull to the middle level of the femur (if lesions are found in the lower

limbs, the scanning range can be expanded to the soles of the feet). First, low-dose CT localization scanning is performed, followed by PET scanning. The layer thickness is controlled at 2.0mm during the examination. After the whole-body PET-CT scanning was completed, and the fused images obtained.

2.4 Imaging Analysis

2 attending radiologists used a double-blind method to read the film, and a combination of visual inspection and Standardized Uptake value (SUV) analysis was used to make judgments. The maximum standardized uptake value (SUV max) was selected as the criteria for judging malignant lesions, and a conclusion was drawn. When the conclusions were inconsistent, they were discussed together to reach a consensus.

2.5 Data Processing

Count data is expressed in percentage (%).

3. Results

Table 1. Pathological Types and Proportions of Primary Lesions

Pathological types of primary lesions	Cases	Proportions (%)
Lung adenosquamous carcinoma	5	19.23
Lung squamous cell carcinoma	3	11.54
Small intestine adenocarcinoma	2	7.69
Adenocarcinoma of colon	3	11.54
Nasopharyngeal squamous cell carcinoma	2	7.69
Gastric adenocarcinoma	2	7.69
Gastric signet ring cell carcinoma	1	3.84
Adenocarcinoma of esophagus	2	7.69
Esophageal squamous cell carcinoma	2	7.69
Pancreatic adenocarcinoma	2	7.69
Undifferentiated thyroid carcinoma	1	3.84
Endometriosis clear cell carcinoma	1	3.84

Based on pathological results confirmed, ^{18}F-FDG PET-CT found 26 patients with primary focus, 2 patients with no obvious primary focus, 7 patients with multiple myeloma, 8 patients with lung cancer, 5 patients with intestinal cancer, 2 patients with nasopharyngeal cancer, 3 patients with gastric cancer, 4 patients with esophageal cancer, 2 patients with pancreatic cancer, 1 patient with thyroid cancer, and 1 patient with endometriosis clear cell cancer (Table 1). The positive rate was 74.29% (26/35), the specificity was 87.28%, the sensitivity was 85.43%, and the accuracy was 88.73%. The positive predictive value is 92.31% (24/26). ^{18}F-FDG PET-CT provides a higher detection rate for metastatic squamous cell carcinoma and metastatic adenocarcinoma, with rates of 85.36% and 82.41%, respectively.

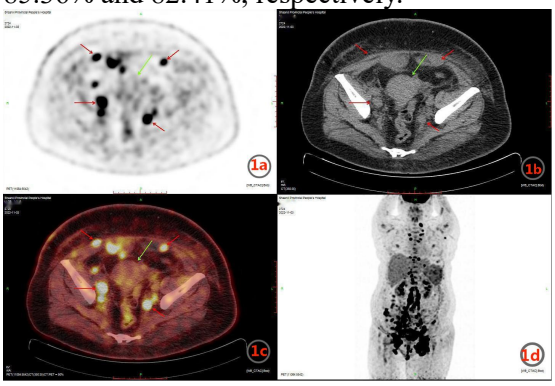

Figure 1. PET-CT Examination for a 40y-Female with Lower Pelvic Wall Mass and Pain. 1a: PET Images Showed Multiple Hypermetabolic Lesions in the Pelvic Wall and Bilateral Iliac Vessels (Red Arrow), with No Abnormal Metabolism Observed in the Uterine Region (Green Arrow); 1b: The Image Showed Normal Size and Morphology of the Uterus (Green Arrow), with Multiple Nodular Shadows on the Pelvic Wall and Bilateral Iliac Vessels; 1c: The Fused Axial Image Showed No Hypermetabolic Lesions in the Uterine Region, but High Metabolism in Pelvic Wall and Iliac Vascular Nodules; 1d: PET-MIP Images Displayed Multiple High Metabolic Lesions Throughout the Body.

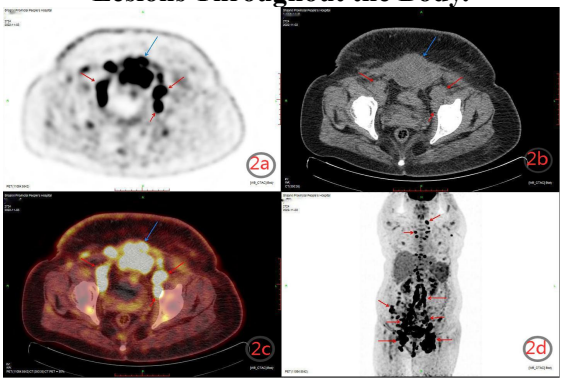

Figure 2: Further Examination Results of PET-CT and Pathologically Confirmed As

Endometriotic Clear Cell Carcinoma of the Anterior Pelvic Wall. 2a: PET Images Show High Metabolism in the Pelvic Wall (Blue Arrow), and Multiple High Metabolism Lesions Near the Pelvic Wall and Bilateral Iliac Vessels (Red Arrow); 2b: The Image Shows Sub Soft Tissue Shadows (Blue Arrows), Multiple Nodules of Varying Sizes on the Pelvic Wall and Bilateral Iliac Vessels; 2c: The Fused Image Shows High Metabolism of the Pelvic Wall Soft Tissue (Blue Arrow), and High Metabolism of the Pelvic Wall and Iliac Vascular Nodules (Red Arrow); 2d: PET-MIP Images Show Multiple Hypermetabolism Throughout the Body.

4. Discussion

At present, PET-CT is an important methos for staging diagnosis, primary lesion identification, and treatment efficacy evaluation of malignant tumor lesions, and has been widely used in clinical work [6-8]. As the most common nuclide tracer, ^{18}F-FDG imaging principle is due to the increased glucose uptake and high uptake of most malignant tumors, resulting in a large accumulation of F-FDG within tumor cells. Because the primary and metastatic lesions of malignant lesions belong to the same tumor nature and exhibit similar metabolic states [9]. PET-CT combines CT and PET examinations, which can make judgments on the condition of the lesion from both anatomical and functional aspects. It has obvious advantages in searching for the primary lesion and can provide assistance for the diagnosis and treatment of patients. In clinical work, the confirmation of the primary lesion of malignant lesions is crucial, and the choice of treatment options for different tumors will change accordingly. PET-CT can not only help identify the primary lesion, but also provide a more accurate and comprehensive assessment of the overall condition of the tumor, discovering lesions that have not been detected by traditional imaging examinations.

This study retrospectively analyzed 35 patients with multiple metastases. PET-CT found 26 primary lesions, with a positive rate of 74.29%, similar to domestic literature reports [10], but with significant differences from foreign literature reports [11]. The reasons for the differences may be related to the following factors: firstly, PET-CT has a higher cost, a higher prevalence rate in foreign countries than in China, earlier clinical application and more extensive development, a larger number of patient examinations, and a higher detection rate of positive patients than in China. Secondly, foreign literature reported that the proportion of primary tumors in the neck was higher than that in China, which may be related to the incidence rate of different tumors in different populations. In this study, the number of primary tumors was lung cancer, and there were only 3 patients with nasopharyngeal carcinoma as primary tumors.

In this study, there were 12 patients with digestive tract malignant tumors as the primary focus, including 5 cases of intestinal cancer, 3 cases of esophageal cancer, and 3 cases of gastric cancer, which was similar to the domestic literature reports [12-15]. This is in line with the national situation of high incidence of digestive tract malignant tumors in our country. Factors such as diet structure, living habits, and smoking are the reasons for the high incidence of digestive tract malignant tumors.

The primary malignant lesions were confirmed by pathology to be mainly squamous cell carcinoma and adenocarcinoma, which is consistent with the epithelial origin of malignant tumors such as lung cancer, esophageal cancer, gastric cancer, colon cancer, and nasopharyngeal carcinoma [16,17]. Other rare types of malignant tumors such as clear cell carcinoma, hepatocellular carcinoma, and signet ring cell carcinoma have a lower positive detection rate of PET-CT due to factors such as easy necrosis, abundant mucus components, and cell membrane transporters.

There're two patients underwent whole-body PET-CT examination and did not find any primary lesions, which may be due to the fact that the primary lesions were relatively hidden and had similar uptake levels to surrounding normal tissues, thus masking the detection of primary lesions [18,19]. This study found one patient with endometriotic clear cell carcinoma, with the primary lesion located in the anterior pelvic wall and multiple systemic metastases (Figure 1,2).

In addition, 7 patients were ultimately diagnosed with multiple myeloma through pathological examination. Multiple myeloma belongs to malignant lesions of the hematological system, with no clear primary

lesion. Typical imaging manifestations include multiple bone penetrating bone destruction throughout the body. It is difficult to distinguish between traditional imaging and multiple bone metastases. On PET-CT images, multiple myeloma generally has low metabolic levels, which is inconsistent with common osteoclastogenic metastases with high metabolism.

5. Conclusions

PET-CT is a systemic examination method that can provide both anatomical imaging and functional imaging. It has significant advantages in searching for the primary lesion of malignant lesions and evaluating the overall condition. It can help formulate clinical treatment plans and evaluate the treatment effect of patients better.

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