RESEARCH ARTICLE

Analysis on Early Detection of Lung Cancer by PET/CT Scan

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Abstract

Background: This systemic analysis was conducted to to evaluate the application value of positron emission tomography/computed tomography (PET/CT) in early diagnosis of lung cancer. Methods: Clinical studies evaluating the application value of PET/CT for patients underwent PET/CT imaging. The histological diagnosis served as the standard of truth. Results: Four clinical studies which including 1330 patients with pulmonary space-occupying lesions were considered eligible for inclusion. Systemic analysis suggested that, in all 1330 patients, pooled sensitivity was 98.7% (1313.2/1330) and specificity was 58.2%(276.85/476). Conclusion: This systemic analysis suggests that integrated PET/CT imaging provides high sensitivity, and reasonably high specificity, and could be applied for early diagnosis of lung cancer.

Keywords: Early detection - lung cancer - PET/CT

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Introduction

Lung cancer is one of most common cancer in the world. And in China, more than 75% of patients with NSCLC are diagnosed at locally advanced (stage IIIB) or metastatic (stage IV) stage for which many regimens are abailable, eg., paclitaxel, docetaxel, permetrexed, targeted therapy, etc, however, treatment results still poor (Ji et al., 2014; Cui et al., 2014; Huang et al., 2014; Yan et al., 2013; Liu et al., 2013; Lu et al., 2013; Huang et al., 2013). Thus, early diagnosis of lung cancer is very important.

Pulmonary tumor is a frequent problem and could be mis-diagnosed clinically, and could be especially impportant for early detection of lung cancer. Positron emission tomography (PET) or PET/computed tomography (PET/CT) is a well-established functional imaging technique for diagnostic oncologic imaging of a variety of malignancies and has been applied for differentiation between benign and malignant lesions, particularly for patients with pulmonary lesions (Demura et al., 2003; Changlai et al., 2001; Kaira et al., 2014). However, FDG is not specific for malignant tumors and can also accumulate non-specifically in certain benign lesions, which potentially results in false-positive findings (Shreve et al., 1999; Lee et al., 2009). So, it is hypothesized in this study that the diagnostic performance of PET/CT could be useful in the diagnosis for lung cancer in patients with pulmonary lesions.

Materials and Methods

Search strategy

We searched PUBMED, by using the following search term: (early detection lung cancer) and (PET/CT). All clinical studies evaluating the impact of PET/CT on the early diagnosis for patients with pulmonary tumor published in English prior to November 1st, of 2014 were identified. If samples of two studies overlap, only the latest one was included. Additional articles were obtained from references within the articles identified by the electronic search. We did not consider meeting abstracts or unpublished reports.

Inclusion and exclusion criteria

We reviewed abstracts of all citations and retrieved studies. The following criteria were used to include published studies: (1) clinical studies, combined with pathological diagnosis; (2) The study was performed in accordance with the Helsinki Declaration (1964, amended in 1975 and 1983) of the World Medical Association. Eligibility criteria included histologically or cytologically verified with lung cancer for finally cancer diagnosis. Studies were excluded if one of the following existed: (1) duplicate data; (2) no sufficient data were reported.

Data collection and analysis

Selection of trials and data extraction: The titles and abstracts of publications identified according to the above search strategy were assessed independently for inclusion by two authors; the full text was selected for further assessment if the abstract suggests relevance. Disagreement was resolved by discussion. Data was extracted by independent authors. The following recorded data were extracted: author, publication data, and country of the first or corresponding author, the number of patients.

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Results

There were 22 papers relevant to the search words by the end of November 1st, of 2014. Via steps of screening the title and reading the abstract, 3 studies were identified (Balogova et al., 2010; Wang et al., 2011; Liu et al., 2013; Minamimoto et al., 2014) when PET/CT was used to diagnosis of lung cancer for patients with pulmonary tumors. These studies had been carried out in China, Japan, and France. The following outcomes were presented in at least all studies and extracted for combined analysis: sensitivity and specificity of the diagnosis. When PET/CT was used to diagnose lung cancer, 4 studies included in this study are presented and the sensitivity/specificity of Liu Z et al. was 96.7%/50%, of Minamimoto et al. was 100%/-, of Wang et al. was 98%/80%, and of Balogova was 82%/81%. Totally, pooled sensitivity was 98.7% (1313.2/1330) and specificity was 58.2% (276.85/476).

Discussion

It is estimated that appropriate cancer screening, an investigation on a group of individuals in order to detect cancer, could prevent 3-35 % of deaths caused by cancer. Thus, it is suggested that cancer screening might decrease cancer morbidity because of more mild treatment for earlier-stage cancers. In this field, PET/CT is considered to play an important role in differentiating between benign and malignant tumors, staging cancers, evaluating the effectiveness of treatment, and predicting prognosis. PET/CT can provide whole-body imaging, and have the potential to reveal malignancies anywhere in the body. Cancer screening using PET/CT has become widespread at present. However, the performance profile of PET/CT cancer screening regarding sensitivity and specificity are inconsistent.

Liu et al. to evaluate the application value of PET/CT in early diagnosis of lung cancer, retrospectively analysed 347 people with pulmonary tumor at Zhongshan Hospital of China (Liu et al., 2013). The diagnostic validity of PET/CT and fluorodeoxyglucose maximum standardized uptake value (SUVmax) of lesions were compared respectively. Among different morphological characteristics, pathologic types and levels of tumor markers. The diagnostic value of PET/CT was also evaluated along with serum tumor markers for lung cancer. Their results suggested that UVmax was positively correlated with lesion size ($r = 0.484$, $P < 0.05$) and negatively with tumor differentiation degree ($r = -0.232$, $P < 0.01$) (Liu et al., 2013). It was significantly higher in tumor marker positive group than the negative group (10.6 ± 5.5 vs 7.6 ± 5.4, $P < 0.05$). The diagnostic specificity, sensitivity and accuracy of PET/CT were 50.0%, 96.6% and 89.3% in lung cancer. And the greater the lesion, the higher the diagnostic accuracy ($P < 0.05$) (Liu et al., 2013). PET/CT plus serum tumor markers could boost the diagnostic specificity of lung cancer by 30% ($P < 0.01$). Thus, in conclusion, Liu et al.suggested that PET/CT has high diagnostic values for lung cancer in those with early stage pulmonary nodules, and combined use of serum tumor markers and PET/CT increases early diagnostic specificity of lung cancer (Liu et al., 2013).

Japanese authors aimed to analyze PET scan for a program of lung cancer screening in asymptomatic individuals (Minamimoto et al., 2014). They focused on a total of 153, 775 asymptomatic individuals underwent this screening program; and 854 cases with findings that indicated suspected lung cancer by any detection method were analyzed. Among these 854 cases, 319 were verified as lung cancer. The sensitivity and positive predictive value (PPV) of PET were 86.5% and 38.9% for lung cancer, respectively. The sensitivity of PET/CT was higher than that of PET (100.0% vs. 63.2%), indicating that CT imaging was effective for lung cancer screening (Minamimoto et al., 2014). They found that majority of lung carcinomas detected by PET screening were UICC stage IA or IB (Minamimoto et al., 2014). In conclusion, they suggested that PET screening program in Japan could detect lung cancer at an early stage (Minamimoto et al., 2014).

Wang et al. to evaluate the clinic value of (18) F-FDG PET/CT imaging in differentiation of malignant from benign disease in lung, enrolled 188 patients who underwent PET/CT (Wang et al., 2011). The standardized uptake value (SUV) and retention index (RI) of region of interesting were calculated. The histological diagnosis or clinical findings in a 12 months follow-up period served as a standardized diagnosis (Wang et al., 2011). In their result, 114 patients with malignant disease and 74 patients with benign disease were diagnosed (Wang et al., 2011). The sensitivity, speciality and accuracy of PET/CT in differentiation of cancer from benign lung nodules (diameter more than 10 mm) were 98.2%, 80.0%, and 96.6%, in mediastinal lymph nodes and were 95.7%, 41.7%, and 84.8%, respectively. The sensitivity of PET imaging for lung nodules (diameter less than 10 mm) was lower than CT (Wang et al., 2011). Thus, they included that integrated PET/CT imaging provides high sensitivity, specificity and reasonably high accuracy for lung cancer (Wang et al., 2011).

Our current systemic analysis focused on 4 clinical studies which including 1330 patients with pulmonary space-occupying lesions and considered eligible for inclusion. Our results suggested that in all 1330 patients, pooled sensitivity was 98.7% (1313.2/1330) and specificity was 58.2% (276.85/476). Thus in conclusion, we suggest that integrated PET/CT imaging provides high sensitivity, and reasonably high specificity, and could be applied for early diagnosis of lung cancer.

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