Surgical Oncology 22 (2013) 151–155

Contents lists available at SciVerse ScienceDirect

Surgical Oncology

journal homepage: www.elsevier.com/locate/suronc

Review

Meta-analysis: Accuracy of ^{18}FDG PET-CT for distant metastasis staging in lung cancer patients

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ARTICLE INFO

Article history:
Accepted 10 April 2013

Keywords:
^{18}FDG PET-CT
Distant metastases
Lung cancer
Meta-analysis

ABSTRACT

Background: We undertook a meta-analysis to evaluate the accuracy of ^{18}FDG PET-CT for diagnosis of distant metastases in lung cancer patients.
Methods: Studies about ^{18}FDG PET-CT for diagnosis of distant metastases in patients with lung cancer were systematically searched in the MEDLINE and EMBASE databases. We calculated sensitivities, specificities, positive likelihood ratios and negative likelihood ratios, and constructed summary receiver operating characteristic curves using bivariate regression models for ^{18}FDG PET-CT.
Results: Across 9 studies (780 patients), the sensitivity, specificity, positive likelihood ratio and negative likelihood ratio of ^{18}FDG PET-CT were 0.93 (95% confidence interval [CI] = 0.88–0.96), 0.96 (95% CI = 0.95–0.96), 28.4 (95% CI = 14.0–57.5), and 0.08 (95% CI = 0.02–0.37), respectively. Overall weighted area under the curve was 0.98 (95% CI = 0.96–0.99).
Conclusion: ^{18}FDG PET-CT has excellent diagnostic performance for diagnosis of distant metastases in patients with lung cancer.

Contents

Introduction

Lung cancer is the most common cancer all over the world and is the leading cause of cancer related death in many countries [1,2]. 80%

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0960-7404/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.suronc.2013.04.001

of the lung cancers are non-small cell lung cancers (NSCLC) and 20% are small cell lung cancers (SCLC) [1]. Accurate distant staging of lung cancer is important for choosing the optimal treatment. Lung cancer patients are generally treated with curative surgery and/or chemo-radiotherapy if disease localized to lung and to mediastinal lymph nodes. In contrast, less aggressive strategies were generally used for palliative treatment of patients with distant metastases.

Combined imaging procedures (magnetic resonance imaging, computed tomography, and bone scan, et al.) are still the main imaging modalities for distant metastasis staging in patient with lung cancer, with suboptimal sensitivities [3]. ^{18}F-fluorodeoxyglucose positron emission tomography (^{18}FDG PET) is a functional imaging modality that is based on the increased glucose metabolism of malignant cells. However, anatomic information is limited on ^{18}FDG PET images. The integrated PET-CT imaging using a single machine provides the best co-registration of anatomical information obtained by CT and the metabolic information obtained by FDG-PET. In several previous studies, ^{18}FDG PET-CT was shown to be a very promising optimization tool for detection of distant metastases in lung cancer patients [4–7]. Although many previous studies about ^{18}FDG PET-CT had been done, results were still controversial. Here, we undertook a meta-analysis to evaluate the accuracy of ^{18}FDG PET-CT for diagnosis of distant metastases in lung cancer patients.

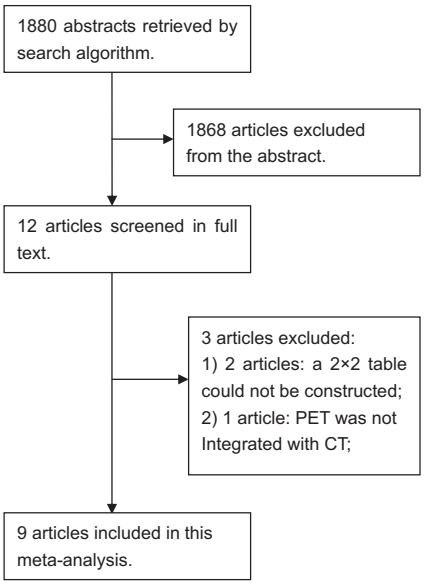

Figure 1. Figure shows the flow chart of the search for eligible studies.

Materials and methods

Search strategy

We searched for studies evaluating the accuracy of ^{18}FDG PET-CT for diagnosis of distant metastases in lung cancer patients. Articles were identified with a search of MEDLINE and EMBASE from January 1, 2000 to February 28, 2013. We used a search algorithm that was based on a combination of text words: (CT OR "computed tomography") AND (PET OR "positron emission tomography") AND "lung cancer" AND (staging OR "distant metastases"). We had no language restrictions for searching relevant studies. References of the retrieved articles were also screened for additional studies. Authors of eligible studies were contacted and asked to supplement additional data when key information was missing.

Study selection

We considered studies using ^{18}F-FDG PET-CT for diagnosis of distant metastases in lung cancer patients. Inclusion criteria were ^{18}F-FDG PET-CT used as a diagnostic tool in lung cancer patients regardless of stage and treatment status; sufficient data to reconstruct a 2×2 table for true-positive, false-negative, false-positive and true-negative values; a minimal sample size of 10 lung cancer patients, including both patients with and without distant metastases; analysis on a patient-level; studies with both retrospective and prospective design; and use of histopathologic analysis or clinical and imaging follow-up as the reference standard. We excluded studies from the same study group. We also excluded studies in which the reference standard was performed only on subsets of patients with positive PET-CT results.

Data extraction

Two reviewers (J.K.L and W.X) extracted data from eligible studies independently and resolved discrepancies by discussion. For each report, we recorded the author names, year of publication, country of origin, number of eligible patients, type of pathology (NSCLC, or SCLC), study design (prospective, or retrospective), and definition of positive PET-CT test (both qualitative and quantitative, or qualitative). For each study, we recorded the number of true-positive, false-positive, true-negative, and false-negative findings for ^{18}FDG PET-CT.

Quality assessment

We assessed the methodological quality of the studies using the quality assessment for studies of diagnostic accuracy (QUADAS) tool [8]. It is the first systematically developed evidence-based quality assessment tool to be used in systematic reviews of diagnostic accuracy studies. The QUADAS tool included 14 items. Each item was assessed as "yes" or "no".

Table 1
The clinical characteristics and study quality of the selected studies.

Study	Origin	Design	Type of pathology	No. of patients	Male (%)	Age (range or mean, y)	Analysis method	Follow-up time (m)	Prevalence (%)	QUADAS[b]
Antoch [4], 2003	Germany	Prosp	NSCLC	20	80	39–70	QL + QN	4.7[a]	25.0	12
Gerfolio [5], 2004	USA	Prosp	NSCLC	129	60	24–87	QL + QN	NR	14.7	11
Fischer [6], 2007	Denmark	Prosp	SCLC	29	38	47–77	QL	16.8[a]	70.0	12
De Wever [7], 2007	Belgium	Retro	All	50	88	26–83	QL + QN	NR	6.0	11
Ohno [12], 2008	Japan	Prosp	NSCLC	203	54	72	QL	≥12	19.7	12
Yi [13], 2008	Korea	Prosp	NSCLC	165	76	61	QL	19.7[a]	20.1	12
Plathow [14], 2008	Germany	Prosp	NSCLC	52	69	49–71	QL + QN	2.7[a]	7.7	11
El-Hariri [15], 2012	Egypt	Prosp	All	33	85	34–76	QL + QN	5–7	21.2	12
Opoka [16], 2013	Poland	Prosp	NSCLC	99	71	41–88	QL + QN	NR	18.2	11

Prosp = prospective; Retro = retrospective; QL = qualitative; QN = quantitative; NA = not acquired; NR = not reported.
[a] Mean of follow-up time.
[b] The number of items assessed as "yes" in the QUADAS tool.