Clinical Imaging 39 (2015) 608–612

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: http://www.clinicalimaging.org

The usefulness of combined axial and coronal computed tomography for the evaluation of metastatic supraclavicular lymph nodes

Hyun Jin Choi [a], Kyung Hee Lee [a], Na Hee Kim [a], Jun Ho Kim [a,*], In Young Hyun [b], Jeong-Seon Ryu [c]

[a] Department of Radiology, Inha University Hospital, Inha University School of Medicine, Inhang-ro 27, Jung-gu, Incheon, Korea
[b] Department of Nuclear Medicine, Inha University Hospital, Inha University School of Medicine, Inhang-ro 27, Jung-gu, Incheon, Korea
[c] Department of Internal Medicine, Inha University Hospital, Inha University School of Medicine, Inhang-ro 27, Jung-gu, Incheon, Korea

ARTICLE INFO

Article history:
Received 11 February 2015
Accepted 10 April 2015

Keywords:
CT
Lymph node
Metastasis
PET/CT
Thoracic

ABSTRACT

The purpose is to assess the value of adding coronal images for the identification of metastatic supraclavicular lymph nodes (LNs). Two radiologists reviewed axial images and combined axial and coronal images using thoracic computed tomography (CT) of 386 patients whose maximum standardized uptake value measured in a supraclavicular LN was ≥2.0 on a positron emission tomography. We compared sensitivity and agreement between readers before and after the addition of coronal images. For combined images, agreement was almost perfect (κ=0.982), and sensitivity was significantly higher (90.4%, P<.001). Interpreting both axial and coronal images improves the diagnostic accuracy for supraclavicular metastasis.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

The supraclavicular lymph nodes (LNs) are an important component of the lymphatic drainage system and are involved in various malignancies, mostly from lung, head and neck, breast, esophageal, gastric, pancreatic, gynecologic, and prostate cancers [1–3]. Metastasis to a supraclavicular LN indicates a worse clinical prognosis and the impossibility of potentially curative treatment, particularly in patients with the primary cancer below the clavicle [4]. The detection of supraclavicular LNs in lung cancer should be more emphasized because N3 disease is inoperable [5]. Therefore, detection of these nodes before treatment or during posttreatment follow-up is very important for therapeutic control [4,5].

Although contrast-enhanced computed tomography (CECT) is one of the most widely used methods for staging primary cancer, including nodal staging, it has been found to show low diagnostic performance for supraclavicular nodal staging. Especially for supraclavicular LNs, there are substantial numbers of false-positive and false-negative results with CECT than with other imaging modalities such as ultrasonography and ^{18}F-fluorodeoxyglucose positron emission tomography (^{18}F-FDG PET) [4–9]. Despite its less accurate reflection of presence of pathologic LNs than other modalities, CT imaging is the most common imaging modality as it is relatively inexpensive and accessible within most communities [10]. Moreover, CT is the first-line imaging investigation in many cancers and especially in non-small-cell lung cancer [5]. Therefore, on thoracic CT, it is necessary to know the identification rate of supraclavicular LN metastasis and to make efforts to search for supraclavicular LN metastasis.

Currently, multidetector CT (MDCT) scanners allow thinner collimation and faster scanning, which both markedly improve scanning resolution and enable reformations in any desired plane similar spatially to reformations obtained in an axial plane [11,12]. Improved spatial resolution has resulted in high-quality multiplanar reformations, especially of coronal images [11,12].

Despite the increasing use of MDCT coronal reformation images to identify cervical LN metastasis, there is no study to our knowledge that has systematically evaluated patients with supraclavicular LN metastasis on thoracic CT. Therefore, the goal of this study was to assess the value of adding coronal reformation images to the identification of supraclavicular LN metastasis by contrast-enhanced MDCT compared with the use of axial images only for PET-detected supraclavicular LNs in cancer patients.

2. Methods

2.1. Patients

We retrospectively reviewed the medical records of 619 cancer patients who visited our institution for any purpose and underwent ^{18}F-FDG PET/CT scans that showed abnormal FDG uptake in the supraclavicular LNs from March 2008 to September 2014. The

Abbreviations: LN, lymph node; CT, computed tomography; SUV_{max}, maximum standardized uptake value; PET, positron emission tomography; CECT, contrast-enhanced computed tomography; FDG, fluorodeoxyglucose; ^{18}F-FDG PET, ^{18}F-fluorodeoxyglucose positron emission tomography; MDCT, multidetector computed tomography.

* Corresponding author. Department of Radiology, Inha University Hospital, Inha University School of Medicine, Inhang-ro 27, Jung-gu, Incheon, Korea. Tel.: +82 32 890 2769; fax: +82 32 890 2743.
E-mail address: jhkim7227@gmail.com (J.H. Kim).

http://dx.doi.org/10.1016/j.clinimag.2015.04.008
0899-7071/© 2015 Elsevier Inc. All rights reserved.

institutional review board at our hospital approved this study and waived the requirement for informed consent because of its retrospective nature.

Of the 619 patients, we excluded patients who did not undergo thoracic CECT and who had undergone chemotherapy and radiation therapy during the acquisition time interval between CECT and ^{18}F-FDG PET/CT. At first, 196 patients were excluded from our study. Of the remaining 423 patients, 32 patients in whom the interval between the thoracic CT and ^{18}F-FDG PET/CT scan exceeded 12 weeks were excluded from this study. Then, 65 patients whose maximum standardized uptake value (SUV_{max}) measured less than 2.0 on ^{18}F-FDG PET/CT were excluded from our study. Therefore, the study consisted of 326 thoracic CT and ^{18}F-FDG PET examinations performed in 326 patients (225 men and 101 women; age range, 20–90 years; mean age, 65.29 years). The primary diseases were all cancers (139 lung, 39 lymphoma, 21 breast, 19 colon, 17 stomach, 13 esophagus, 11 thyroid, 8 stomach and lung, 6 cervix, 6 liver, 5 thymus, 4 ovary, 4 pancreas, 4 prostate, 3 parotid gland, 2 gallbladder, 2 hypopharynx, 2 kidney, 2 lung and colon, 2 skin, 2 testis, 1 breast and lung, 1 esophagus and colon, 1 lymphoma and stomach, 1 oropharynx, 1 stomach and colon, 1 stomach and duodenum, 1 stomach and esophagus, 1 urinary bladder, 1 uterine cancer, 1 mesothelioma, and 5 of unknown origin).

2.2. CT imaging techniques and image analysis

CT scans were performed using a 16-slice MDCT scanner (SOMATOM Sensation 16; Siemens Aktiengesellschaft, Muenchen, Bayern, Germany) or a 64-slice MDCT scanner (LightSpeed VCT; GE Healthcare, Milwaukee, WI, USA). Thoracic CT scanning was performed from the lower part of the neck to the adrenal glands. All scanning was performed after intravenous administration of contrast medium [100 ml of iopromide for the SOMATOM Sensation 16 (Ultravist 300; Bayer Healthcare Pharmaceuticals Ins., Germany) or iodixanol for the LightSpeed VCT (Visipaque 320; GE Healthcare Ireland, Cork, Ireland)] at a rate of 3 ml/s. The scanning parameters were as follows for the SOMATOM Sensation 16: 100 kVp; auto mA system (Care Dose); detector coverage, 0.75×12 mm; and pitch, 1.2. The parameters for the LightSpeed VCT were as follows: 100 kVp; auto mA system (Dose Modulation); detector coverage, 1.25×40 mm; and pitch, 0.984. A postcontrast scan performed with an 8-s delay (Bolus Tracking on the SOMATOM Sensation 16) or a 10-s delay (Smart Prep on the LightSpeed VCT) after the pulmonary artery reached 100 HU.

The axial section data were reconstructed at a 3-mm thickness and at 3-mm increments for the SOMATOM Sensation 16 or at a 2.5-mm thickness and at 2.5-mm increments for the LightSpeed VCT. The second data set was reformatted coronally at a 5-mm thickness and at 4-mm increments for both scanners.

Two radiologists with 18 years (reader 1) and 5 years (reader 2) of experience dedicated to thoracic CT imaging served as independent readers. The radiologists were not aware of the presence of abnormal FDG uptake on ^{18}F-FDG PET and expected to find metastatic supraclavicular LNs. Interpretation of the CT imaging was performed in two sessions. In the first session, the two readers independently assigned scores for the identification of metastatic supraclavicular LNs from axial images alone. In the second session, readers were blinded to the interpretations from the first session and independently assigned scores by interpreting both axial and coronal images. The two interpretation sessions were separated by a 2-week interval.

The supraclavicular nodal area was defined as the region that lies above the manubrium on the same image as the clavicle, lateral to the medial edge of the common carotid artery, and medial to the clavicle and lateral rib margin [13,14]. If a metastatic supraclavicular LN was detected, the case was labeled 1; if not, it was labeled 2. When metastatic supraclavicular LNs were identified, a confidence score for the identification of a metastatic supraclavicular LN was obtained for each finding on a scale of 1–3 (1, indeterminately malignant; 2, probably malignant; 3, definitely malignant). For cases in which a metastatic supraclavicular LN was not identified, the score was 0.

The short-axis diameter of the supraclavicular LN was recorded. When multiple enlarged LNs were present, the largest node was measured.

2.3. ^{18}F-FDG PET/CT acquisition and image analysis

All patients fasted for at least 6 h, and blood glucose levels were checked before the administration of ^{18}F-FDG. Fasting blood glucose levels were less than 150 mg/dl. Approximately 4.07 MBq of ^{18}F-FDG per kilogram of body weight was injected intravenously, and patients were advised to rest for 1 h before PET/CT image acquisition. PET/CT scans were performed using a 64-slice CT Discovery 690 scanner (GE Healthcare, Milwaukee, WI, USA). A low-dose CT scan for attenuation correction was acquired without contrast enhancement from the skull base to the thigh with a maximum voltage of 120 kV, a maximum intensity of 80 mAs, and a slice thickness of 3.27 mm. PET scans with a maximum spatial resolution of 3.27 mm were also obtained from the skull base to the thigh for 2 min per bed position. PET images obtained using the Discovery PET/CT scanner were reconstructed with a 128×128 matrix, an ordered subset expectation maximum iterative reconstruction algorithm (4 iterations and 9 subsets), a Gaussian filter of 5.0 mm, and a slice thickness of 3.27 mm.

^{18}F-FDG PET/CT data sets were evaluated by one nuclear medicine physician. For imaging interpretation, positive uptake in the supraclavicular LNs was considered as glucose uptake greater than that of the surrounding tissue.

The standardized uptake value of each FDG-positive focus was determined on attenuation-corrected images. The SUV_{max} was determined according to the classical formula: SUV_{max}=(the radioactive concentration (MBq/kg) in the voxel containing the highest activity×the total body mass (kg)/injected activity (MBq)).

2.4. Statistical analysis

Agreements between the readers for the identification of metastatic supraclavicular LNs on axial images alone and combined axial and coronal images were determined using the κ statistic. A κ value of 0–0.20 indicates slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; and 0.81–1.00, almost perfect agreement. For each reader, differences in the confidence scores for the identification of metastatic LNs between axial images alone and both axial and coronal images were determined using the Wilcoxon signed-rank test. The correlation between SUV_{max} and LN size was tested using Spearman's rank correlation coefficient. We investigated the number of diagnosed metastatic supraclavicular LNs on axial images only and on both axial and coronal images. We compared the diagnostic sensitivity before and after adding coronal reformation images from the more experienced radiologist's review (reader 1) using McNemar's test. To demonstrate the potential effect of different SUV_{max} ranges, patients were categorized into two different SUV_{max} groups (2.0–3.5 and >3.5), and McNemar's test was also used to calculate the sensitivity. Differences with a P value <.05 were considered statistically significant. The statistical analysis was carried out using the SPSS statistical software package for Windows (version 18.0.0; SPSS Inc., Chicago, IL, USA).

3. Results

For axial images alone, agreement between the readers for the identification of metastatic supraclavicular LNs was almost perfect (κ=0.851). Moreover, the agreement was also almost perfect (κ=0.982) when both axial and coronal images were reviewed.

Pearson correlation coefficient between LN size and SUV_{max} was 0.553. There was a significant correlation between nodal short-axis diameter on CT and SUV_{max} on PET (P<.01) (Fig. 1).

Download English Version:

https://daneshyari.com/en/article/4221155

Download Persian Version:

https://daneshyari.com/article/4221155

Daneshyari.com