Research Article

The evaluation of hypermetabolic mediastinal–hilar lymph nodes determined by PET/CT in pulmonary and extrapulmonary malignancies: correlation with EBUS-TBNA

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Background/aim: We aimed to define the optimal SUVmax cut-off value in determination of mediastinal–hilar lymph node metastasis, by comparing positive PET/CT results with the results of endobronchial ultrasound guided transbronchial needle aspiration biopsy (EBUS-TBNA).

Materials and methods: Thirty-one patients with malignancy whose PET/CT imaging revealed a hypermetabolic mediastinal and/or hilar lymph node and who had undergone EBUS-TBNA were evaluated retrospectively. Histopathology was regarded as the gold standard. The diagnostic role of PET/CT in mediastinal/hilar lymph node metastasis was investigated and compared with the results of contrast-enhanced CT.

Results: When a SUVmax value of 2.5 was used, the sensitivity, positive predictive value (PPV), and diagnostic accuracy of the PET/CT were 100%, 65.4%, and 65.4% respectively. In the ROC analysis, the SUVmax cut-off value with the highest diagnostic accuracy (75%) was calculated as 6.3, and when this value was considered, the sensitivity, specificity, PPV, negative predictive value, and diagnostic accuracy of the PET/CT were determined as 70.6%, 83.3%, 88.9%, 60%, and 75% respectively (AUC: 0.779). The sensitivity, PPV, and diagnostic accuracy of the thorax CT were calculated as 91.1%, 72%, and 71.1%, respectively.

Conclusion: When determining mediastinal–hilar lymph node metastasis via PET/CT, although a SUVmax cut-off value of 6.3 increases specificity and diagnostic accuracy, we think that a SUVmax cut-off value of 2.5 and above give more optimal results in routine practice.

Key words: PET/CT, mediastinal–hilar lymph nodes, EBUS-TBNA

1. Introduction

Mediastinal staging plays an important role in many pulmonary and extrapulmonary malignant neoplasms, in evaluation of suitability of patients for operation, scheduling treatment opportunities, and determination of prognosis (1). For this purpose, invasive and noninvasive methods are in use. Among the noninvasive methods are, thorax computed tomography, magnetic resonance imaging (MRI), and 18-fluorine-2-deoxyglucose-positron emission tomography/computed tomography (18F-FDG PET/CT), while transbronchial needle aspiration biopsy (TBNA), transthoracic needle aspiration biopsy (TTNA), endobronchial ultrasound guided transbronchial needle aspiration biopsy (EBUS-TBNA), endoesophageal ultrasound (EUS) guided lymph node biopsy, cervical mediastinoscopy, mediastinotomy, and video-assisted

thoracoscopy are some of the invasive methods. Thorax CT is the first method in mediastinal staging and is used for the evaluation of lymph node dimensions; however, PET/CT gives information about not only the size but also the metabolic activities of lymph nodes and is a functional alternative to contrast-enhanced CT (2). Nevertheless, these methods are not sensitive or determinant enough for the investigation of mediastinal lymph node metastasis. Thus, the diagnosis of lymph nodes that are hypermetabolic with PET/CT and larger than 10 mm in diameter with thorax CT should be corrected histopathologically with minimally invasive or invasive methods (3,4). In this study, we aimed to determine the optimal SUVmax cut-off value in determination of mediastinal–hilar lymph node metastasis by comparing positive PET/CT results with the results of EBUS-TBNA.

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2. Materials and methods

2.1. Patient selection

Thirty one patients (27 male and 4 female with a mean age of 56.1 ± 13.7 years and ages ranging from 19 to 79 years) whose PET/CT images revealed a hypermetabolic mediastinal and/or hilar lymph node were included in this retrospective study (Table 1). Following PET/CT, all patients underwent an EBUS-TBNA. Moreover, a contrast-enhanced thorax CT of all patients existed. The results of the PET/CT and thorax CT were compared with the histopathologic results obtained from the EBUS-TBNA. Histopathological evaluation was regarded as the gold standard and the optimal SUVmax cut-off value in PET/CT was investigated.

2.2. Thorax CT imaging protocol

Thorax CT was used for evaluation of the size of mediastinal–hilar lymph nodes. After the intravenous injection of contrast material into all patients, CT images with 2-mm-thick slices were taken from the supraclavicular region to the adrenal glands. The radiologists were informed about the clinic data and the results of other imaging techniques of the patients. Mediastinal lymph nodes with a short diameter larger than 10 mm were suspected of being metastatic.

2.3. PET/CT imaging protocol

The PET/CT imaging was performed on a high-resolution PET scanner (Siemens Biograph 6; Germany) that was integrated with a 6-slice multidetector CT. All patients were asked to fast for 6 h before the PET/CT scan and then were injected intravenously with a 0.15 mCi/kg dose of 18F FDG after their blood glucose levels were determined to be appropriate (<150 mg/dL). After a resting period of 45–60 min in a quiet and relaxing room without any activity, a whole body scan was performed using the PET/CT. The CT scans were obtained as 5-mm-thick slices, with energy of 130 KV and 90 mA. The PET emission images were obtained with approximately 5–7 bed positions for 4 min per bed position from the skull base to the mid-thigh. Fusion images were obtained after CT-based attenuation corrections and iterative reconstructions were done. By investigation of the tomographic scans, pathologic metabolic activity foci were evaluated visually and quantitatively. Lymph nodes with a higher FDG uptake from the blood pool on mediastinal backward and with a SUVmax value higher than 2.5 were suspected for metastasis.

2.4. Lymph node sampling (EBUS-TBNA procedure)

The lymph nodes observed in the thorax CT and PET/CT scans were sampled by the assistance of a convex probe EBUS (7.5 MHz, BF-UC160F; Olympus Optical Co., Tokyo, Japan) with the help of real-time imaging after conscious sedation of the patients was achieved by intermittent intravenous midazolam and/or phentanyl injections. The samples were obtained from the right and left paratracheal (2R, 2L), right and left inferior paratracheal (4R, 4L), right and left hilar (10R, 10L), right interlobar, (11R) and subcarinal (7) locations. The punctures were created using a 22-gauge EBUS needle. With the aid of Doppler ultrasound, we avoided damaging the vascular structures. We attempted to obtain at least 3 samples from each lymph node. One portion of the material on the needle was dispersed over a dry slide at room temperature while another portion was used to prepare dispersions on a formaldehyde + alcohol mixture. Another portion of it was also used for the formation of a cellular block on liquid with formaldehyde and was sent to the pathology laboratory. Immunohistochemical studies were performed when necessary. In this study, appropriate histochemical stainings such as pankeratin, TTF-1, LCA TDT, P63, CK5/6, CD3, CD20, CD30, CD15, CK7, CK20, CD56, CDX2, CD99, WT-1, CD117, S100, PSA, napsin A, fascin, ALK, EMA, granzyme B, Ki 67, desmin, myogenin, NSE, chromogranin, smooth muscle actin, cyclin-D1, synaptophysin, vimentin, surfactant, and protein A were used.

2.5. Statistical analysis

Statistical analyses were performed using SPSS for Windows, version 21.0. Numeric variations are summarized with mean ± standard deviation and (min–max) values, while qualitative variations are summarized with numbers and percentages. The power of the SUVmax value in determination of malignancy diagnosed with EBUS-TBNA is investigated with the area under the receiver operating characteristic (ROC) curve. For this value, the area under the curve (AUC) percentage is estimated. The cut-off value for SUVmax along with the sensitivity, specificity, negative predictive value, positive predictive value, and diagnostic accuracy for this cut-off point were assessed. The comparison of diagnostic accuracies of PET/CT and thorax CT were estimated with a chi-square test. The significance value was regarded as $P < 0.05$.

3. Results

In this study, 52 mediastinal–hilar lymph nodes that were hypermetabolic on a PET/CT scan and underwent EBUS-TBNA were evaluated. The lymph nodes came from 31 patients, 16 of whom were diagnosed with lung cancer while 15 had extrapulmonary cancers; the histopathological diagnoses of the patients are summarized in Table 1.

3.1. Results of EBUS-TBNA

TBNA was performed on 28 mediastinal and 24 hilar lymph nodes of 31 patients under EBUS. Eleven of the lymph nodes were paratracheal, 24 were hilar, 16 were subcarinal, and 1 was interlobar in location. Furthermore,

Table 1. Patient descriptions and characteristics of the lymph nodes.

Number of patients (n)	31		
Male / female	27 / 4		
Average patient age; age range	56.1 ± 13.7; (19–79)		
Final histopathological diagnosis of the lung cancer and extrathoracic malignancy	Patients	MLN	BLN
	(n = 31)	(n = 34)	(n = 18)
Small-cell carcinoma	2	2	0
Nonsmall cell carcinoma (squamous cell carcinoma)	4	5	1
Nonsmall cell carcinoma(adenocarcinoma)	9	15	3
Other (nonsmall carcinoma with an unidentified subcategory)	1	0	2
Hodgkin's lymphoma	3	2	1
Non-Hodgkin's lymphoma	1	2	0
Tonsillar carcinoma		0	1
Bladder carcinoma	2	2	1
Laryngeal carcinoma	3	0	6
Breast carcinoma	1	1	1
Nasal squamous cell carcinoma	1	0	2
Rhabdomyosarcoma	1	3	0
Gastric adenocarcinoma	1	1	0
Leiomyosarcoma	1	1	0

The location and number of the suspected lymph nodes according to CT, PET/CT, and EBUS-TBNA				EBUS-TBNA	
	CT	PET/CT	EBUS	MLN	BLN
	(n = 43)	(n = 52)	(n = 52)	(n = 34)	(n = 18)
Right upper paratracheal (2R)	3	3	3	3	0
Right lower paratracheal (4R)	5	7	7	4	3
Left lower paratracheal (4L)	1	1	1	1	0
Right hilar (10R)	15	16	16	12	4
Left hilar (10L)	5	8	8	4	4
Right interlobar (11R)	1	1	1	0	1
Subcarinal (7)	13	16	16	10	6

MLN = malignant lymph node, BLN = benign lymph node, EBUS-TBNA = endobronchial ultrasound guided transbronchial needle aspiration biopsy, CT = computed tomography, PET/CT = positron emission tomography/computed tomography, and SUVmax = maximum standardized uptake value.

34 were evaluated as malignant and 18 were benign in histopathologic investigation. Among the benign lesions, 10 were compatible with anthracosis, 7 were degeneration, and one was granulomatous inflammation. The histopathological diagnosis and the distribution of malignant/benign lymph nodes according to localization are summarized in Table 1.

3.2. PET/CT imaging results

Among the 31 patients with 21 localizations in the mediastinal–hilar region, in total 140 lymph nodes with increased metabolic activity were determined with PET/CT. Among these 140 lymph nodes, 52 were sampled with EBUS-TBNA. The mean SUVmax value of these 52 lymph nodes was 8.56 ± 5.9 (min–max: 2.9–29). In 34

(65.4%) of the total 52 locations determined with PET/CT, a true positive was investigated (Figures 1A–1F). The mean SUVmax value of the 34 malign lymph nodes was calculated as 10.23 ± 6.23 (min–max: 3.1–29), while the mean SUVmax value of the 18 benign lymph nodes was 5.42 ± 3.87 (min–max: 2.9–18.5) and the difference was statistically significant (P < 0.05). The mean of the short diameters of the 52 lymph nodes sampled with EBUS-TBNA was 19.9 ± 10.7 mm (min–max: 6–46). The mean of the short diameters of the malignant lymph nodes was 24.1 ± 10.7 mm (min–max: 11–46), that of the benign lymph nodes was calculated as 12.1 ± 4.0 mm (min–max: 6–20), and the difference was statistically significant (P < 0.05). In 18 (34.6%) of the total 52 locations determined with PET/CT, a false positive was investigated. Among those 18 false positive localizations, 7 were degeneration, 10 were anthracosis, and 1 was granulomatous inflammation (Figures 2A–2D). When a SUVmax value of 2.5 is regarded, the sensitivity, PPV, and diagnostic accuracy of PET/CT in determination of malignant lymph nodes were 100%, 65.4%, and 65.4%, respectively. In the ROC analysis with the histopathologic evaluation regarded as gold standard, the SUVmax cut-off value with the highest diagnostic accuracy was calculated as 6.3; and when this value was considered, sensitivity, specificity, PPV, NPV, and diagnostic accuracy of PET/CT were determined as 70.6%, 83.3%, 88.9%, 60.0%, and 75%, respectively, and AUC was estimated as 0.779 (Table 2). Since PET/CT enables scanning of the whole body, it supplied an additional contribution to staging in 13 (41.9%) of the 31 patients with the determination of distant metastasis (Figure 2E). Moreover, in 3 patients with a diagnosis of extrapulmonary malignancies, it identified lymph node metastasis owing to a second primary lung malignancy and the last histopathologic diagnosis for those patients was reported as squamous cell carcinoma.

3.3. Results of thorax CT scans
Among the 31 patients with 10 localizations in the mediastinal–hilar region, in total 75 lymph nodes larger than 10 mm were determined with thorax CT scans. Nine of the 52 lymph nodes, which were determined with PET/CT and underwent EBUS-TBNA, could not be determined with thorax CT. In that aspect, among the 75 lymph nodes, 43 were sampled with EBUS-TBNA. Among those 43 lymph nodes, 31 were malignant and 12 were benign, with a mean short diameter of 21.8 ± 10.6 mm (min–max: 10–45). The mean short diameter of the malignant lymph nodes was 25.1 ± 10.3 mm (min–max: 10–45), that of the benign lymph nodes was calculated as 13.4 ± 5.4 mm (min–max: 10–28), and the difference was statistically significant (P < 0.05). In 12 (23.07%) of the total 52 locations determined with thorax CT, a false positive was investigated. Among those 12 false positive

localizations, 6 were degeneration, 5 were anthracosis, and 1 was granulomatous inflammation. Thorax CT could not determine a total of 9 (3 malignant and 6 benign) lymph nodes (17.3%) in 5 patients, which were determined by PET/CT and diagnosed with histopathological evaluation. Thus, in this study, in total 3 lymph nodes of 2 patients, which were determined by PET/CT and diagnosed with histopathological evaluation but could not be determined in CT, were regarded as false negative (5.76%). When the short diameter is defined as 10 mm, the sensitivity, specificity, NPV, PPV, and diagnostic accuracy of thorax CT were calculated as 91.1%, 33.3%, 33.3%, 72%, and 71.1%, respectively, in malignant mediastinal–hilar lymph node determination for these 52 lymph nodes.

4. Discussion
The cytological and histological diagnosis of suspected mediastinal and/or hilar lymph nodes is critically important in staging, planning treatment, and determining prognosis in pulmonary and extrapulmonary malignancies. Though histopathology is the gold standard in evaluation of lymph node metastasis, imaging techniques also play an important role. In this study, it was aimed to determine the diagnostic role of PET/CT in the evaluation of mediastinal–hilar lymph node metastasis in pulmonary and extrapulmonary malignancies and to compare that with contrast-enhanced CT, where histopathologic investigation with EBUS-TBNA is regarded as the gold standard. The most commonly used standard method in mediastinal staging is the thorax CT. With respect to the anatomical imaging, lymph nodes larger than 10 mm in CT are suspected of having malignant infiltration (5). However, it has been determined that micrometastasis may be present in 20% of lymph nodes smaller than 10 mm while larger lymph nodes may actually be benign (6). In this study, false positivity was determined in 12 of 52 lymph nodes evaluated with EBUS-TBNA. In a mean follow-up of 15 months with clinical and radiological evaluations done every 3 months, no increase in the size of lymph nodes or progression has been determined in this group of patients. On the other hand, thorax CT could not identify 9 (3 malignant, 6 benign) lymph nodes in 5 patients, which were determined by PET/CT and proved histopathologically. Thereby, in this study, 3 lymph node metastasis in 2 patients, defined in PET/CT and diagnosed as malignant histopathologically but could not be determined in CT, were evaluated as false negativity (5.76%). When the EBUS-TBNA data of these patients were evaluated, it was determined that one was diagnosed with adenocarcinoma and the diagnosis of the other patient was squamous cell carcinoma. When the sizes of lymph nodes were evaluated, it was determined that all 3 malign lymph nodes were larger than 10 mm. Benign lymph nodes were smaller than 10 mm and 3
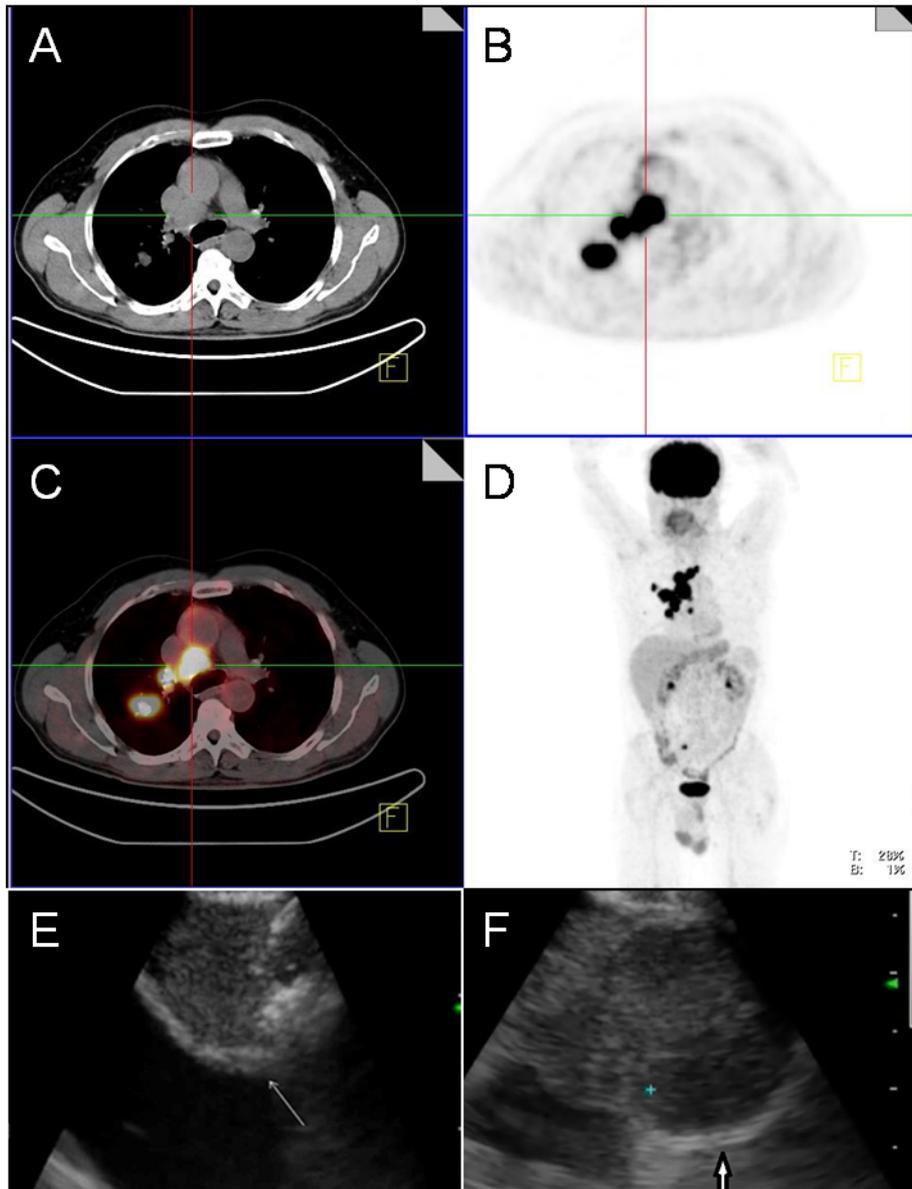
Figure 1. A representative case of true positive mediastinal PET/CT scan findings, with mediastinal metastases detected by EBUS-TBNA. **A:** The transaxial CT scan of a 54-year-old man with adenocarcinoma in the right upper lobe. The right lower paratracheal lymph node (4R) measures 32 × 37 mm. The right hilar lymph node (10R) was 18 mm in diameter. Both lymph nodes were considered positive for metastasis from CT. **B:** The transaxial PET scan demonstrates pathologic FDG uptake in the right upper lobe tumor (T), right lower paratracheal (4R), and right hilar (10R) lymph node. **C:** The transaxial PET/CT fusion scan demonstrates pathologic FDG uptake in the right upper lobe tumor (T), right lower paratracheal (4R), and right hilar (10R) lymph nodes. **D:** The PET/CT MIP scan also demonstrates pathologic FDG accumulation in the tumor (T), mediastinal lymph nodes suggesting another mediastinal lymph node, and distant metastasis (sacral). **E:** EBUS-TBIA of the right lower paratracheal (4R) **F:** The right hilar (10R) lymph node showing a needle within the lymph node. Based on the final histopathologic diagnosis, the result of the PET/CT scan was a malignant lymph node.

other lymph nodes were thought to be undetermined due to their localization. This indicated that thorax-CT could not determine 6 of the 52 lymph nodes even though they were larger than 10 mm in size. In many studies and meta-analyses, it has been determined that thorax CT has a limited sensitivity (43%–81%) and accuracy (59%–85%) ratios while its specificity is lower in mediastinal staging (7). In our study, the sensitivity and diagnostic accuracy of thorax CT in the determination of malignant mediastinal–hilar lymph nodes were estimated as 91.1% and 71.1%,
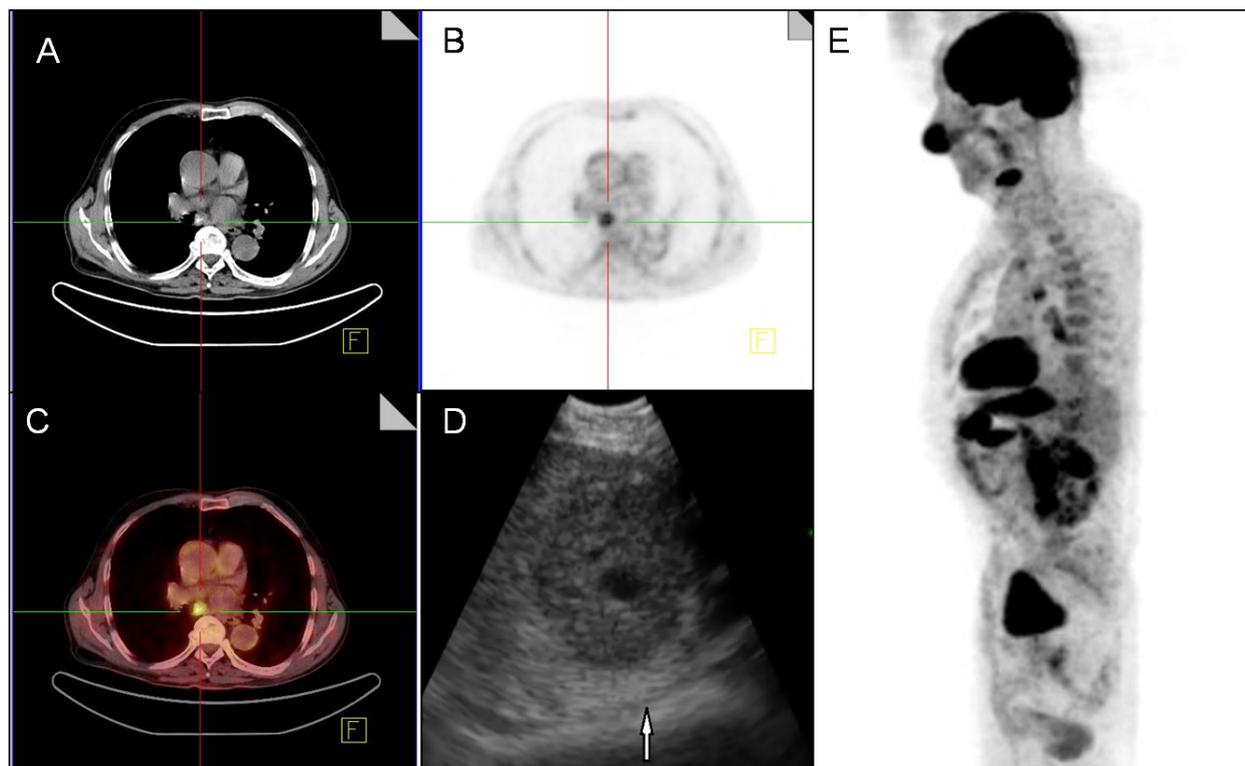
Figure 2. A representative case of false positive mediastinal PET/CT scan findings, with EBUS-TBNA histopathologic results consisted with degenerative lymph nodes. **A:** The transaxial CT scan demonstrates that the calcified subcarinal lymph node (7) was 20 mm in diameter. **B:** The transaxial PET scan demonstrates the pathologic FDG uptake in the subcarinal (7) lymph node. **C:** The transaxial PET/CT fusion scan demonstrates the pathologic FDG uptake in the subcarinal (7) lymph node. **D:** EBUS-TBIA of the subcarinal (7), showing a needle within the lymph node. Based on the final histopathologic diagnosis, the result of the PET/CT scan was a false positive lymph node. **E:** The PET/CT MIP scan also demonstrates pathologic FDG accumulation in the primary tumor (nasal SCC).

Table 2. The sensitivity, specificity, diagnostic accuracy, and negative/positive predictive values of PET/CT according to SUVmax cut-off values.

PET/CT SUV max cut-off	Sensitivity %	Specificity %	NPV %	PV %	Diagnostic accuracy %	AUC (%)
2.5	100	–	–	65.4	65.4	77.9
6.3	70.6	83.3	60	88.9	75	

PET/CT = positron emission tomography/computed tomography, SUVmax = maximum standardized uptake value, NPV = negative predictive value, PPV = positive predictive value, and AUC = area under curve.

respectively. The reason for the high sensitivity determined in our study was that only lymph nodes determined as positive in the PET/CT were included in the study. It is difficult to identify lymph nodes smaller than 10 mm in PET/CT.

PET/CT is a noninvasive imaging technique that is used in mediastinal staging, follow-up, determination of recurrences after treatment, investigation of distant metastasis, investigation of responses to treatment, and prognosis of both pulmonary and extrapulmonary malignancies. It allows whole body scanning and it can give both anatomical and functional data together (8). Toloza et al. have found the sensitivity, specificity, PPV, and NPV of PET/CT in the determination of malignant mediastinal–hilar lymph nodes to be as high as 84%, 89%, 79%, and 93%, respectively (9). Recently, many studies on the place of PET in determination of mediastinal metastasis that compare PET with other conventional imaging

techniques have been performed; PET/CT has been reported to be superior to CT in many studies and meta-analyses, especially in mediastinal staging of operable nonsmall cell lung cancer (9,10). However, since FDG is not specific to the tumor, high false positivity ratios are reported in PET/CT studies due to some benign conditions, especially including active tuberculosis, sarcoidosis, coccidioidomycosis, aspergillosis, histoplasmosis, other fungal infections, and reactive hyperplasia secondary to pneumonia. This ratio is reported as 16%–55% in the literature (9,11). In another study, it has been determined that not only the active inflammation, but also the healed or inactive pulmonary diseases (antecedent tuberculosis, silicosis, anthracosis) may potentially result in increased FDG capture in hilar or mediastinal lymph nodes (12). False positivity was determined in 34.6% of lymph nodes detected in PET/CT imaging in our study group. The reasons for the false positivity were anthracosis, degeneration, and granulomatous inflammation. The existence of lymph nodes with FDG emission owing to anthracosis and degeneration in our study support the data that inactive pulmonary processes may also result in false positivity. Navani et al. performed TBNA under EBUS to the mediastinal lymph nodes in a study of 161 patients; in the patients who were not diagnosed with malignancy or any other specific diseases, they performed mediastinoscopy or they followed up with clinical and radiological findings for 15 months as in our study. The sensitivity, negative predictive value for malignancy, and overall accuracy for EBUS-TBNA were 87%, 73%, and 88%, respectively (13). In another study, Chhajed et al. determined that EBUS-TBNA has a good diagnostic yield on conventional TBNA negative mediastinal–hilar lymphadenopathy (14). At an average of 5%–8%, false negative results have been achieved in bronchoalveolar carcinoma, carcinoids, in some tumors with high mucin levels but low metabolic activity, lesions smaller than 10 mm, and hyperglycemic patients (12). Since we included PET/CT scans of hypermetabolic lymph nodes in our study, we could not evaluate the causes of false negativity. In staging studies comparing standard PET with combined PET/CT methods in lung cancer, it has been determined that PET/CT is more accurate in T staging; however, there is no significant advantage between these two methods in regards to nodal staging (15). In a study by Bellek et al. in which the presence of N2 disease determined the decision of surgical resection, no advantages of PET/CT compared with CT were established and the contribution of both methods to staging was determined to be equal (16). In our study, similar accuracy ratios between CT and PET/CT were determined and a significant superiority of one these methods over the other has not been established (P > 0.05). PET/CT identified 9 lymph nodes (3 malignant and

6 benign), which were proved histopathologically but could not be detected by thorax CT with its hybrid imaging advantage and multislice CT component. Moreover, PET/CT identified distant metastasis in 41.9% of the patients since it allows scanning of the whole body and contributed in staging. In three patients with known extra pulmonary malignancies, it determined lymph node metastasis due to the second primary malignancy in lung. Since PET/CT may give false positive results, surgical treatment should not be avoided in any patients with lymph nodes determined in PET/CT. The PPV of PET/CT in this study was 88.9%. Therefore, positive lymph nodes in PET/CT should be confirmed histopathologically with minimal invasive methods. The gold standard method for the diagnosis of mediastinal lymph nodes is the mediastinoscopy. However, it is an invasive procedure and usually requires general anesthesia and hospitalization. Because of this, less invasive potentially alternative methods such as TBNA, TTNA, EBUS-TBNA, and EUS-NA have been developed (17). EBUS-TBNA is one of the invasive mediastinal staging methods that are used after PET/CT scanning according to the current guidelines (18). In a meta-analysis including 11 studies on the role of EBUS-TBNA in mediastinal staging with 1299 cases, the sensitivity, specificity, and diagnostic value of EBUS-TBNA were determined to be 93%, 100%, and 89%, respectively (19). In one study, EBUS-TBNA was performed on the mediastinal–hilar lymph nodes of patients with known extrapulmonary malignancies for diagnostic purposes and the sensitivity, specificity, PPV, NPV, and diagnostic accuracy of EBUS-TBNA were determined to be 97.4%, 100%, 100%, 87.5%, and 97.7%, respectively (20). In the literature, there are many studies reporting that the success rate of TBNA increases when performed under PET/CT guidance. In a study of Hsu et al. on 19 patients and 25 lymph nodes determined with PET/CT, the sensitivity, specificity, and diagnostic accuracy of TBNA biopsy was determined to be 81.8%, 100%, and 84%, respectively (21). Cömert et al. compared the results of EBUS-TBNA and PET/CT in the determination of malignant mediastinal lymph nodes and estimated the sensitivity, specificity, diagnostic accuracy, NPV, and PPV as 94.3%, 100%, 95.8%, 85.9%, 100%, respective for EBUS-TBNA and 89.4%, 18.3%, 71.2%, 37.5%, and 76.0%, respectively, for PET/CT (22). On the other hand, Yasufuku et al., comparing the sensitivity, specificity, and diagnostic accuracy of CT, PET, and EBUS-TBNA, determined the results as 76.9%, 55.3%, and 60.8% for CT, 80.0%, 70.1%, and 72.5% for PET, and 92.3%, 100%, and 98.0% for EBUS-TBNA (23). In malignant–benign differentiation of PET/CT, together with visual evaluation, a SUVmax value that shows the FDG activity and provides a semiquantitative analysis is also used. In many studies, the lesions with a

SUVmax value lower than 2.5 have been determined to be benign with a 96% sensitivity and in malignant–benign differentiation, high sensitivity and specificity ratios were reported when the SUVmax value is equal to or higher than 2.5. In a study of histopathological correlation of mediastinal lymph nodes determined with PET/CT, when the SUVmax cut-off value was regarded as 2.5, the sensitivity and specificity of PET/CT were estimated as 93% and 40%, respectively; when SUVmax cut-off value was defined as 6.2 in regression analysis, the sensitivity, specificity, and diagnostic accuracy of PET/CT were assessed as 87%, 70%, and 77% respectively (24). In our study, 52 lymph nodes with a SUVmax value >2.5 in PET/CT were evaluated and among them, 18 were histopathologically determined to be benign. At that value, the sensitivity, PPV, and diagnostic accuracy of PET/CT for malignant lymph node detection were determined to be 100%, 65.4%, and 65.4% respectively. In the ROC

analysis, the SUVmax cut-off value with the highest diagnostic accuracy (75.0%) was assessed as 6.3 (AUC: 0.779). However, if the SUVmax cut-off value was determined to be 6.3, 10 (29.4%) of the lymph nodes that had SUVmax values higher than 2.5 and also proved to be malignant histopathologically could not be detected. Because of this, though 6.3 is a cut-off value that increases specificity and diagnostic accuracy, we think that a SUVmax cut-off value of 2.5 results in more optimal consequences in routine practice.

In order to determine mediastinal–hilar lymph node metastasis in PET/CT, even though a 6.3 SUVmax cut-off value increases specificity and diagnostic accuracy, we think that SUVmax cut-off values of 2.5 and higher give more optimal results in routine practice. In addition, as PET/CT has the advantage of scanning the whole body at once and detecting distant metastasis, it plays a supplemental role in staging.

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