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Usefulness of chest CT scan for head and neck cancer

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ABSTRACT

Objective: Chest computed tomography (CT) is not performed routinely or worldwide as the initial diagnostic procedure for patients with head and neck cancer (HNC). The significance of the chest CT scan for HNC diagnosis has not been thoroughly defined. The present study reports findings in an effort to broaden the acceptance and application of CT for HNC.

Methods: Using medical records, we assessed initial chest CT scans of the patients with new-onset HNC between April 2004 and March 2010. The results were classified into three groups: nodules ≥1 cm, small nodules (<1 cm) that were indeterminate and normal lungs without nodules. Lung nodules that increased in size and/or number at follow-up were regarded as malignant. First, the sensitivity of X-ray and CT for detection of lung nodules in patients with HNC was compared. Second, the nodules were estimated to be malignant or not malignant by follow-up chest CT. Third, statistical analyses were performed to determine the association between variables and distant lung metastases in patients with head and neck squamous cell carcinoma.

Results: In total, 332 patients underwent a chest CT scan as part of the initial examination. Lung nodules were detected on the initial chest CT in 77 patients: in contrast, lung nodules were detected on the initial chest X-ray in only five patients. On initial chest CT scans, lung nodules ≥1 cm were observed in 10 patients, small solitary lung nodules were observed in 67 patients, and lungs without nodules were observed in 255 patients. Lung nodules were detected in 77 (23.2%) patients, 25 (32.5%) of whom had malignant lung nodules. Moreover, in 18/67 patients (26.9%), small lung nodules initially classified as indeterminate were determined as malignant at follow-up. However, 30/255 patients (11.8%) without nodules at initial diagnosis developed lung nodules at follow-up. T3 or T4 disease ($P = 0.006$), N2 or N3 disease ($P < 0.001$) and stage 3 or 4 disease ($P = 0.001$) individually and significantly correlated with the development of lung metastases. In addition, lung nodules in initial CT scans ($P = 0.004$) and other distant metastases ($P < 0.001$) were significant predictors for the development of lung metastases at follow-up.

Conclusion: Initial chest CT scan is recommended for patients with advanced HNC. Further, patients with advanced HNC with or without lung nodules, as detected on initial chest CT scans, should be followed up with additional scanning.

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1. Introduction

The presence of distant metastases, most commonly in the lung, affects treatment choices for patients with head and neck cancer (HNC) [1–4]. Therefore, it is very important to determine whether a patient with HNC has lung metastases.

Multislice computed tomography (CT) systems have recently been recognized as very useful for the screening of lung fields

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[5–8], but the chest CT scan has not yet been adopted worldwide as a part of the routine examination at the time of initial screening of patients with HNC [8–13]. Although some reports have indicated that the chest radiographs are not useful in screening lungs of patients with HNC [4,15], most patients still undergo the procedure during initial screening. One reason is that it is unknown whether the chest CT scan is a more cost-effective screening examination compared with chest radiographs for patients with HNC [14,4,15,16]. In addition, it is also unclear as to during which stage and time span the chest CT scan should be performed in patients with HNC [2,5,6,16,17].

Furthermore, with the increase in sensitivity that multislice CT systems offer, small lung nodules that were previously unidentifiable as malignant are now often being detected [6,7,18–21]. However, the origin of these small lung nodules is still unknown.

In our departments, the chest CT scan is performed during screening examinations for almost all patients with HNC. Therefore, we examined the small solitary lung nodules detected at primary screening by chest CT scans to determine whether the lung nodules were malignant or not. In particular regarding head and neck squamous cell carcinoma, we estimated the risk factors for lung metastases and when the lung metastases were revealed. The aim of this study was to clarify the significance of chest CT scans for HNC.

2. Patients and methods

A retrospective study was conducted using medical records of patients with new-onset HNC who underwent an initial chest X-ray examination and chest CT scan in our department at Tottori University Hospital, Yonago, Japan, between April 2004 and March 2010.

Chest CT scans were performed using the Toshiba Aquilion advanced multislice scanner (Toshiba Medical Systems, Ohtawara, Japan), and images from CT scans were reconstructed as 5-mm slice axial images.

First, the sensitivity of X-ray and CT for the detection of lung nodules in patients with HNC was compared.

Second, the nodules were estimated to be malignant or not malignant by follow-up chest CT. Except for lung consolidations, solitary nodules detected on chest CT scans were carefully examined. When the nodules were over 1 cm, we generally verified their diagnoses. Thus, the nodules were divided into three groups: nodules $\geq$1 cm, small nodules ($<$1 cm) that were indeterminate, and no nodules. Qualified radiologists and respiratory physicians reviewed chest CT scans. In clinical medicine, we generally diagnose lung metastases on chest CT findings and do not perform biopsies for pathological examination for all cases that were suspected of lung metastases. Reports have also suggested the possibility of characterizing lung nodules as malignant in follow-up chest CT scans [11,20,21]. Thus, in this study we determined lung metastases with lung nodules that had obviously increased in size and/or number during the follow-up period, and we pathologically confirmed lung nodules that were difficult to diagnose as lung metastases on chest CT.

Third, statistical analyses were performed using a statistical software (SPSS ver.18; SPSS, Inc., Chicago, IL) to determine the association between variables and distant lung metastases in patients with head and neck squamous cell carcinoma (HNSCC). Variables analyzed were primary tumor location, pathology of primary tumor, T and N classification, stage, presence of lung nodules at initial CT, distant metastases to sites other than the lung, and the presence of second primary cancer. Staging was performed according to the fifth edition of the Union for International Cancer Control (UICC) classification of malignant tumors. Lastly, we examined how long patients were revealed with the lung metastases after first visit.

3. Results

Out of 371 patients, 332 (89.5%) underwent chest CT scans and all patients underwent a chest X-ray at the initial examination. The patient population consisted of 253 males and 79 females, with a mean age of 64 years (range: 24–94 years). Their clinical and demographic data are presented in Table 1.

Lung nodules were detected on the initial chest CT in 77 patients: in contrast, lung nodules were detected on the initial chest X-ray in only five patients. Consequently, out of the 77 patients whose lung nodules were detected by chest CT, the lung nodules were metastases of HNC in 20 patients and were primary lung cancers in five patients. Out of the five patients whose lung nodules were detected by chest X-ray, the lung nodules were metastases of HNC in two patients and primary lung cancer in one patient. The sensitivity, specificity and positive and negative predictive values of the chest CT scan for detection of malignant lung nodules were 45.5%, 81.8%, 32.5%, and 88.2%, respectively; in contrast, the values for chest X-ray were 5.5%, 99.3%, 60%, and 84.1%, respectively.

On initial chest CT scans, lung nodules $\geq$1 cm were observed in 10 patients, small solitary lung nodules diagnosed as indeterminate were observed in 67 patients, and lungs without nodules were observed in 255 patients. Overall, lung nodules were revealed in 77/332 (23.2%) patients on the initial chest CT. These results are presented in Fig. 1.

Regarding lung nodules $\geq$1 cm, the breakdown for the 10 patients was as follows: five patients had lung metastases, two patients had primary lung cancers, and three patients were diagnosed as benign. In 6/10 patients, the characteristics of lung nodules were ascertained pathologically; in 2/10 patients, the lung nodules were diagnosed with metastases by the undeniable increase; and in 2/10 patients, lung nodules were diagnosed as tuberculosis due to the signature calcification.

Regarding small lung nodules, initially classified as indeterminate, 18/67 patients (26.9%) had nodules that were found to be malignant at follow-up, 15 were diagnosed with lung metastases and the remaining 3 with primary lung cancers.

Regarding patients without lung nodule on initial chest CT scans, 30/255 patients (11.8%) had lung metastases at follow-up.

Overall, 20/77 patients (26.0%) with lung nodules detected on the initial CT had metastases, and 30/255 patients (11.8%) without lung nodule on the initial CT were eventually diagnosed with lung metastases. In addition, 40/50 patients with lung metastases were

Table 1
Clinical and demographic data of 332 patients with HNC who underwent initial chest CT scan.

Chest CT was performed/new-onset HNC, No. (%)	332/371 (89.5)
Sex, number (%)	Male, 253 (76.2); Female, 79 (23.8)
Age	Range: 24–94 years old; mean: 64
Primary site number (%)	Larynx: 85 (25.6) Hypopharynx: 60 (18.1) Oral: 54 (16.3) Oropharynx: 33 (9.9) Thyroid: 31 (9.3) Nasopharynx: 20 (6.0) Epipharynx: 15 (4.5) Salivary gland: 14 (4.2) Ear: 10 (3.0) Occult: 7 (2.1) Others: 3 (0.9)

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