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# Endobronchial squamous cell carcinoma presenting as localized, long, continuous bronchial thickening on CT

Yoonah Song[a], Yo Won Choi[a,*], Seung Sam Paik[b], Dae Hee Han[c], Kyo Young Lee[d]

[a] Department of Radiology, Hanyang University Seoul Hospital, 222-1 Wangsimni-ro, Seongdong-gu, Seoul 04763, South Korea
[b] Department of Pathology, Hanyang University Seoul Hospital, 222-1 Wangsimni-ro, Seongdong-gu, Seoul 04763, South Korea
[c] Department of Radiology, Seoul St. Mary's Hospital, 222 Banpo-daero, Seocho-Gu, Seoul 06591, South Korea
[d] Department of Pathology, Seoul St. Mary's Hospital, 222 Banpo-daero, Seocho-Gu, Seoul 06591, South Korea

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ABSTRACT

*Objective:* To report pulmonary squamous cell carcinomas presenting as localized, long, continuous, bronchial thickening on computed tomography (CT).

*Materials and methods:* This study comprised five men (mean age, 66 years; range, 60–79 years) with pulmonary squamous cell carcinoma, including two (0.6%) selected from 310 consecutive patients with the diagnosis. Inclusion criteria were as follows: histological diagnosis obtained from thickened bronchi; continuous bronchial thickening > 5 cm in longitudinal extension on CT. CT scans were retrospectively reviewed, focusing on bronchial abnormalities. They were correlated with histopathological findings in four patients who underwent lobectomy.

*Results:* On initial CT, bronchial thickening was continuous without skip area (n = 5), measured 56–114 mm in maximum longitudinal length, involved lobar (n = 3) or segmental and distal bronchi (n = 5) of the right upper (n = 4) or lower (n = 1) lobe, and was focally bulbous (n = 2). Follow-up CT before treatment, available in two, showed progression of bronchial thickening in its thickness and longitudinal length (n = 2) and a new bulbous portion (n = 1) and peribronchial nodules (n = 1) along the thickened bronchi. Cancer recurred after lobectomy in two, one of which manifested as continuous bronchial thickening extending from the bronchial stump on CT. On CT-histopathological correlation, bronchial thickening was mostly due to tumor spreading along the bronchus. A focal or short segmental tumor outgrowth from the thickened bronchi corresponded to a nodule or bulbous portion along thickened bronchi on CT, respectively.

*Conclusion:* Pulmonary squamous cell carcinoma may present as localized, long, continuous, bronchial thickening on CT, simulating benign infectious or inflammatory diseases.

## 1. Introduction

Approximately one-third of pulmonary squamous cell carcinoma is peripheral and appears as a solitary pulmonary nodule or mass. The other two-thirds are centrally located within the main, lobar, and segmental bronchi. These central squamous cell carcinomas commonly present as endobronchial polypoid masses that obstruct or narrow the bronchial lumen, and almost invariably cause total or partial endobronchial obstruction, consequently showing typical radiological features such as distal atelectasis, bronchiectasis, or obstructive pneumonia. However, they frequently grow through the bronchial wall, grossly appearing as a focal irregularity of the bronchial mucosa. These endobronchial lesions manifest with a mass within the airway, narrowing of the airway lumen, or localized peribronchial thickening on CT [1–3]. When these early endobronchial squamous cell carcinomas presented as an isolated focal thickening or irregularity in the bronchial mucosa, the involved bronchi were unexceptionally focal or limited to a short segment, being less than 2 cm in length on CT [2,3].

Localized area of long continuous bronchial thickening on CT is usually caused by inflammatory disease such as sarcoidosis [4] or infection such as tuberculous[5,6] or non-tuberculous mycobacterial [7] infection, mucormycosis [8], or aspergillosis [7]. We report five cases of primary central squamous cell carcinoma of the lung which presented as localized, long continuous bronchial thickening on CT, simulating these infectious or inflammatory diseases. To our knowledge, there has been no report of such cases.

*Abbreviations:* CT, computed tomography; HU, hounsfield unit; FDG, fluorine-18- fluorodeoxyglucose; PET, positron emission tomography

* Corresponding author.
*E-mail addresses:* cherry6541@naver.com (Y. Song), ywchoi@hanyang.ac.kr (Y.W. Choi), sspaik@hanyang.ac.kr (S.S. Paik), lepolder@gmail.com (D.H. Han), leekyoyo@catholic.ac.kr (K.Y. Lee).

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## 2. Materials and methods

This retrospective study was approved by the institutional review boards of two tertiary participating hospitals, which waived the requirement for patients' informed consents.

### 2.1. Patients

We retrospectively searched medical records of a tertiary hospital for pulmonary squamous cell carcinoma (SCC) confirmed by cytological exam of sputum or histologic study of lung specimens obtained by means of transbronchial biopsy, percutaneous needle aspiration/biopsy, or surgery during the period between January 2005 and December 2011, and identified 310 patients. Among them, two patients fulfilling the following criteria were enrolled in this study: continuous bronchial thickening more than 5 cm in longitudinal extension on CT; bronchoscopic or surgical diagnosis of squamous cell carcinoma from the thickened bronchial wall; clinical and/or histological absence of coexisting bronchial inflammatory disease such as sarcoidosis or infection. Two other patients who showed continuous bronchial thickening ranging between 2 and 5 cm in longitudinal length were excluded from the study. In addition, three patients with pulmonary squamous cell carcinoma satisfying the same selection criteria were identified from radiological teaching files of another tertiary hospital, and were also included in the study with the total case number of five. The selection criteria of 5 cm length of bronchial thickening was determined because central squamous cell carcinomas reported histologically did not exceed 5 cm in length [9–13].

All of the five were men with a mean age of 66 years and age range between 60 and 79 years. They had squamous cell carcinoma in the right upper (n = 4) or lower lobe (n = 1), which was confirmed by bronchoscopic biopsy (n = 5) and surgery (n = 4). The lung was primary in origin in all of the five patients. All were current or ex-smokers with a mean pack-year of 45 years (range, 40–50 years). They had coexisting chronic lymphocytic leukemia (n = 1), silicosis and rheumatoid arthritis (n = 1), asthma (n = 1), chronic obstructive pulmonary disease (n = 1), and laryngeal squamous cell carcinoma (n = 1). The case with squamous cell carcinoma in the larynx was included in the study because pulmonary squamous cell carcinoma was far apart from the former and, thus, was not considered metastatic from but synchronous with it. Initial presenting symptoms were blood tinged sputum or hemoptysis (n = 2) or chronic cough (n = 3).

### 2.2. Image acquisition and analysis of CT and PET-CT

All of the five patients had chest CT scans taken before treatment including operation (n = 4) and radiation therapy (RT) (n = 1). Two of them each had a follow-up CT taken before treatment, and the two CT was taken five and a half and one and a half months after the initial CT. Accordingly, all of the five had chest CT scans taken less than 22 days before treatment. All of the five had follow-up CT scans taken one to four and a half years after treatment. We reviewed all of the 12 CT scans. All CT examinations were performed with the administration of intravenous contrast material (Ultravist 300; Bayer Schering Pharma AG, Berlin, Germany). CT was performed with various scanners with 16-detector rows (Sensation 16, Siemens Medical System, Erlangen, Germany), 64-detector rows (Somatom definition, Siemens Medical System, Erlangen, Germany), or 128-detector rows (Definition AS+, Siemens Medical System, Erlangen, Germany) at one breath hold. Scans were obtained from the level of lung apices to adrenal glands with scan parameters of 120kVp, 51–267 mAs, and variable scan thickness of 0.75, 1, or 5 mm without scan interval. Both mediastinal (window level, 40 HU; window width, 440 HU) and lung window images (window level, −700 HU; window width, 1500 HU) were reviewed.

Chest CT scans were analyzed for the location, longitudinal continuity, and maximum longitudinal length of bronchial thickening (Figs. 1–3), lung nodule (3 mm or more and less than 3 cm in diameter) (Fig. 2) or mass (3 cm or more in diameter), bronchiectasis or centrilobular micronodules (less than 3 mm in diameter) distal to bronchial thickening, pleural effusion or thickening, air-space consolidation, ground-glass opacity, and atelectasis [2]. One of the authors manually measured the maximum longitudinal length of bronchial thickening on preoperative CT scans three times using a three-dimensional software (Rapidia, Infinitt, Seoul, Korea), and their average value was used. The maximum longitudinal length was obtained as follows; when one places and clicks a cursor along thickened bronchi on any of consecutive axial, coronal, or sagittal CT images, the three-dimensional software automatically indicates the distance between the first and last marks in a three-dimensional space. It was determined whether there was a focal bulbous contour bulging of thickened bronchi (Fig. 3). If a lung nodule or mass was present, its longest diameter, location in relation to thickened bronchi, and presence of internal cavity were analyzed. Enlarged mediastinal or hilar lymph nodes with a short axis diameter of 10 mm or more were also determined.

All of the five patients had fluorine-18- fluorodeoxyglucose (FDG) positron emission tomography (PET)-CT scans taken 3–30 days before treatment. The scans were acquired with a Discovery STE (GE Healthcare, Milwaukee, WI) or Biograph 6 or 40 (Siemens Medical Solutions, Erlangen, Germany) scanner after 70 min of incubation following the intravenous administration of 3 MBq/kg of $F^{18}$-FDG. For FDG PET-CT images, standardized uptake value (SUV) data were overlaid on conventional plain multidetector CT images with the mediastinal window set for an FDG PET-CT section thickness of 5 mm. On PET-CT, the maximum SUV of more than 3.0 was considered to characterize malignancy. Areas of FDG uptake on PET-CT were correlated with abnormalities identified on chest CT. All chest CT and PET-CT scans were retrospectively reviewed by two chest radiologists who were unaware of the location and histopathologic findings of a tumor, and findings were recorded by consensus.

### 2.3. Histopathological evaluation

Four patients underwent lobectomy of the involved lobes no later than 22 days after CT studies. Two experienced pathologists, one each from two participating hospitals, retrospectively reviewed histopathologic findings of the lung specimens from corresponding hospitals. At histopathologic examination, the gross pathologic appearance and location of bronchial abnormalities, a tumor's differentiation, the largest diameter and location (in relation to adjacent bronchus) of pulmonary nodule or mass (if present), and the maximum depth of tumor invasion into the bronchial wall were evaluated. The depth of tumor invasion into the bronchial wall was determined in its deepest point and defined as follows: epithelial, subepithelial, cartilaginous, extracartilaginous, and extrabronchial [9,14]. The maximum longitudinal length of endobronchial cancer was not measured because lobectomy specimens were not cut along the bronchus. However, histopathological examination of all grossly abnormal or thickened bronchi in the specimen was done. Lymph node metastasis and pulmonary pathological findings other than cancerous changes were also noted. Histopathological and CT findings were correlated, focusing on pulmonary nodules or masses and bronchial abnormalities, and a radiologist and two pathologists made decisions on correlation in consensus.

### 2.4. Clinical findings

Medical records of the patients were reviewed for stage of the cancer and site of metastasis at the time of diagnosis, type of treatment, associated tuberculous or non-tuberculous mycobacterial infection, and clinical course after treatment. Lung cancer TNM staging was made according to the seventh edition of Cancer Staging Manual of the American Joint Committee on Cancer [15]

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