Comparison of the Results Obtained with Spiral Computerized Tomography and Fiberoptic Bronchoscopy of the Airways of Lung Cancer Patients

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Abstract

Background: Although fiberoptic bronchoscopy is a safe and effective method in diagnosis of lung carcinoma, spiral computed tomography is capable of imaging the lungs and other intrathoracic structures with excellent anatomic detail.

Objective: The present study was aimed at determining the role of fiberoptic bronchoscopy and spiral computed tomography in localization of endobronchial lesions.

Methods: Fiberoptic bronchoscopy was performed in 45 patients with suspected lung cancer. Lesions were classified as endobronchial, submucosal and peribronchial. Spiral computed tomography scan was performed in all patients after bronchoscopic examination. Two radiologists, independent to each other, reported computed tomography scans.

Results: Fiberoptic bronchoscopy and computed tomography were in concordance with each other in the demonstration of bronchial involvement, but at the fourth order or distal bronchi there was some discordance between the results of two procedures. The lesions in 11 of 13 cases whose bronchoscopic examinations demonstrated stenosis, were also reported as stenosis on computed tomography, so sensitivity of computed tomography was 85%. For submucosal lesions it was 80%, for endobronchial lesions it was 56%. There was some variability between the readers' reports.

Conclusion: Although spiral computed tomography can not replace fiberoptic bronchoscopy, it is a supplementary diagnostic method and serves as a guide for fiberoptic bronchoscopy.

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Key words: *FOB, Spiral CT, Lung cancer*

Introduction

Fiberoptic bronchoscopy (FOB) is a safe and effective method in diagnosis and staging of lung cancer, but it is an invasive method. Therefore, some other alternative noninvasive methods are being searched.

With recent improvements in scanner technology, computed tomography may be thought as an alternative method to FOB. The trachea, lobar and most part of segmental bronchi which are easily seen by bronchoscopy, are able to be visualized by spiral computed tomography (CT) using thin (0.5 mm) collimation (1,2,3,4).

A normal bronchus defined by bronchoscopy or a (-) biopsy result does not exclude tumoral infiltration of the

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bronchial wall. CT can verify invasion of tumor throughout the bronchus. Thus, substantial assesment of tumor invasion is only possible through surgical intervention (5).

In spite of its ability in localization, CT is usually considered insufficient in showing endobronchial abnormality (6,7). However, CT is helpful in determination of endobronchial filling defects or intraluminal density such as aspirated foreign bodies or broncholiths. CT may discriminate central tumor and peripheral collaps by using bolus contrast injection (7).

Many studies suggested that CT was relatively accurate in the examination of the left bronchial tree (2,5,7). The reason was oblique orientation of both the left main bronchus and lingular bronchus. However, this problem could be easily solved by thin collimation. CT may also help to visualize distal airways which are not shown by bronchoscopy because of proximal airway obstruction (7). In patients with central obstructive carcinoma, CT may estimate which patients will benefit from laser therapy since it defines extension of peribronchial tumor (8). Spiral or helical CT may be useful in the evaluation of small nodules and searching for synchronous lesions (9). Especially three dimensional (3D) views are very advantageous in future applications such as choosing bronchial endoprostheses, planning laser tests for stenoses, or calculating tumor volumes before performing brachytherapy (10). It is also suggested that demonstration of bronchial strictures associated with a variety of diseases by 3D imaging coincided with bronchoscopic view (11).

The present study was aimed at determining the ability of spiral CT in defining localization of endobronchial lesions and comparing the results of both tomography and bronchoscopy.

Materials and Methods

Fourty five patients (2 female, 43 male) who were diagnosed or suspected as having bronchial carcinoma were included in this trial. Nineteen (42%) of the patients were in their fifth decade (range 20-70 years, mean age 56±9.7 years). Eleven of the patients (14%) were nonsmokers at the admission, although all had been heavy smokers in the past. Patients underwent both FOB and CT examinations. CT was obtained after FOB examination because investigators tried to avoid the influence of CT results on bronchoscopists. The instrument used for bronchoscopic examination was Olympus 1T20 fiberoptic bronchoscope. Prior to bronchoscopy, diazepam and $^{1}/_{4}$ atropin were administered parenterally. Forceps biopsy, lavage, brushing or transbronchial needle aspiration were applied in order to achieve the diagnosis. Endoscopic lesions were classified as follows:

1) Endobronchial lesion: was characterized by infiltration of the bronchial mucosa,
2) Submucosal lesion: was characterized by loss of normal appearance of the bronchial mucosa, presence of erythema and thickening of the intact mucosa,
3) Peribronchial lesion: was characterized by bronchial stenosis or asymmetrical extrinsic compression towards the lumen.

In less than 7 days after bronchoscopic examination, tomographs of patients were obtained. The instrument was spiral CT; Somatem Plus, Siemens. Patients were scanned supine and every patient received 100-150 ml. contrast agent, according to his/her weight, manually as bolus injection. Then spiral volumetric scanning was achieved in single breath hold. Two radiologists, uninformed of the results of the bronchoscopy, evaluated tomographs separately and the following were answered:

1) Were the central airways normal in appearance or not?
2) Was it a) an endobronchial mass?
   b) a stenosis?
   c) a submucosal abnormality?
3) Was there any abnormality that would be seen by the bronchoscopist?

Then CT results were compared with FOB results.
In statistical analysis, Kappa method was used to verify tomographic determination of stenosis, endobronchial lesion and submucosal lesion.

Sensitivity, specificity, accuracy, (+) estimation value and (-) estimation value were analysed statistically and confirmation was performed by Kappa test. It was considered significant when the correlation value was ≥0.70 in Kappa test.

Results

In 42 of the patients, lung carcinoma was diagnosed histologically. Histopathologic diagnoses of patients are shown in Fig 1. In two cases, pathologic examination was nondiagnostic and these patients were excluded. In one case, amyloidosis was diagnosed histologically. One of the cases which were not able to be diagnosed, stenosis was seen bronchoscopically in the superior segment of the left lower lobe. On CT scanning it was estimated to be around atelectasis adjacent to the pleura. In another case, there was stenosis in the mediobasal segment of the right lower lobe and CT evaluation was normal. In the case with amyloidosis, bronchogenic lesion was in the right intermedial bronchus and on CT scanning hyperdense lesion was defined at the same localization.

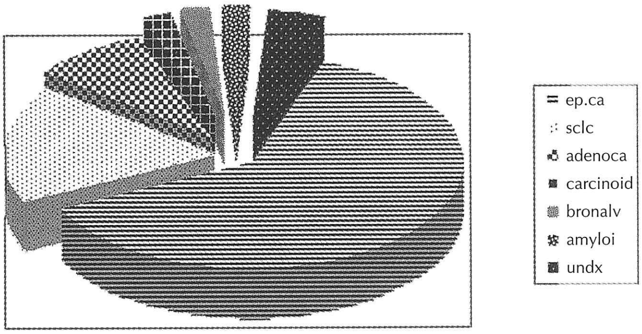

Fig. 1. Histopathologic diagnoses of patients

ep. ca: epidermoid carcinoma, n=28, 63%; sclc: small cell lung carcinoma, n=8, 18%; adenoca: adenocarcinoma, n=4, 9%; carcinoid: carcinoid tumor, n=1; bronalv: bronchoalveolar carcinoma, n=1; amyloi: primary amyloidosis, n=1; undx: undiagnosed, n=2.

In bronchoscopic examination, 52% of lesions were in the right hemithorax, 46% were in the left hemithorax, 2% were in the trachea (Table 1). There were some differences between CT and FOB results of the segmental bronchi level. One of the 2 lingular lesions and 5 of 7 lower lobe segmental lesions which were determined by bronchoscopic examination were not able to be demonstrated by CT. The readers have not been able to discriminate lesions in the segmental bronchus of the right middle lobe. However, localization of the lesions in the upper lobe segmental bronchi was succesful. CT findings of different types of bronchial lesions with (+) brushing results were shown in Table

Table 1. Localizations of the bronchial involvements in bronchoscopic epamination

	bronchial involvement	number
Right hemithorax	main bronchus	6(14)
	upper lobe bronchus	8(19)
	intermediate bronchus	4(9)
	middle lobe bronchus	2(5)
	lower lobe bronchus	2(5)
Left hemithorax	main bronchus	7(16)
	upper lobe bronchus	7(16)
	lingula bronchus	2(5)
	lower lobe bronchus	4(9)
	trachea	1(2)

Figures in parentheses are percentages.

Table 2. CT concordance of (+) bronchial brushing results obtained by FOB

CT findings	First reader	Second reader	(+) bronchial brushing
Stenosis	12 (54)	10 (45)	22
Submucosal infiltration	5 (83)	5 (83)	6
Endobronchial lesion	14 (93)	9 (60)	15

Figures in parentheses are the percentage of the CT results concordant with FOB.

Table 3. Findings obtained by CT and FOB

	First reader	FOB: Stenosis	FOB: Submucosal infiltration	FOB: Endobronchial lesion
CT	Stenosis	11	1	10
	Submucosal infiltration	1	4	1
	Endobronchial lesion	1	0	14
	Second reader	**Stenosis**	**Submucosal infiltration**	**Endobronchial lesion**
CT	Stenosis	10	1	12
	Submucosal infiltration	2	4	2
	Endobronchial lesion	1	0	11

Table is designed in columnar style, eg.: FOB showed stenosis in 13 cases, CT showed stenosis in 11 of these 13 cases. The other 2 were submucosal infiltration and endobronchial lesion.

Table 4: Evaluation parameters of CT in the determination of bronchial abnormalities according to Kappa method						
	First Reader			Second Reader		
	Stenosis (%)	Submuc. (%)	Endobr. (%)	Stenosis (%)	Submuc. (%)	Endobr. (%)
Sensitivity	0.85	0.80	0.56	0.77	0.70	0.40
Specificity	0.63	0.95	0.94	0.43	0.95	0.83
Accuracy	0.70	0.93	0.72	0.53	0.86	0.58
(+) estimation value	0.50	0.66	0.93	0.37	0.33	0.77
(-) estimation value	0.90	0.97	0.60	0.81	0.90	0.50
Kappa	0.40	0.69*	0.47	0.16	0.18	0.21

Submuc: Submucosal lesion; Endobr: Endobronchial lesion; *: Correlation is accepted as significant

2. CT showed tumoral lesions adjacent to the distal trachea or main bronchi in 6 cases, but these lesions could have not been determined in bronchoscopic examination because of the absence of stenosis, submucosal infiltration or endobronchial lesion. In these patients diagnosis was achieved by biopsies of the lesions which were localized in the other parts of the bronchial tree. In 17 cases there were more than one bronchial involvement which were not determined by the bronchoscopist due to occlusion of the proximal bronchi. On the other hand, two cases with (-) biopsy result were not localized on CT scan, and 1 lesion in the lingula was not recognized by the readers. There was CT defined stenosis in 11 of 13 cases which were also defined as stenosis in bronchoscopic examination (Table 3). The sensitivity of CT scan in determination of stenosis was 85%. The sensitivity was found to be 80% in the submucosal lesions. In the endobronchial lesions sensitivity decreased to 56%; because most of these lesions were assessed by readers as stenosis, correlation in Kappa test was significant in the submucosal lesions (Table 4).

Discussion

In the present study, the lingular segment bronchus could not be demonstrated by CT in one case. Previous studies suggested that the main bronchi, intermediate and lobar bronchi could be seen in all cases on CT, but the lingular or segmental bronchi could not be discriminated sufficiently (2,5).

According to Gaeta et al. (12), thin section CT is useful for revealing the type of tumor-bronchus relationship. Similarly, in the present study, the sensitivity of spiral CT was found high in submucosal lesions and stenosis (80%, 85%, respectively). However there was some variability between the readers in the present study as it was also documented by Webb et al. that average agreement among 4 seperate readers was 80% in detection of bronchial involvement (13,14).

Naidich, Webb, Henschke et al. compared CT and bronchoscopy in bronchial diseases. They reported that the sensitivity of CT in endobronchial lesions was 63-85%, while specificity was 61-67%, and accuracy was 68-73% (6,15,16). In this study, as shown in Table 3 and 4, the sensitivity of CT to demonstrate stenosis and submucosal lesions was relatively high but it was found lower in endobronchial lesions. One of the most important reason of this decline was thought to be due to localization of these endobronchial lesions rather than at the fourth order or distal bronchi.

CT is available as guidance for transbronchial needle aspiration demonstrating tumor adjacent to the central airway (17,18,19). In more than 80% of the patients with mediastinal lymphadenomegaly CT guidance is very important in order to get diagnostic material (20). Recently, new developments to increase the effectiveness of CT are being studied. Ketai et al. (21) reported the enhancement of mediastinal lymph nodes by spiral CT after endobronchial instillation of iodinated nano- particles in dogs. In the review by Colice (22), it was stated that the major advantages of CT over FOB were its ability to image the extraluminal components of the tumor and the bronchial tree distal to an area of airway obstruction. In this paper, CT was able to localize lesions involving the main bronchi with infiltration into either the proximal main bronchi or distal trachea, more accurately than FOB, particularly when the infiltration was extraluminal. As correlated with the present study's results, it was suggested in the previous study that this noninvasive technique which can succesfully demonstrate stenoses in the bronchial tree was likely to be useful for diagnosis and follow-up (23).

Usuda et al. (24) stated that in patients with occult carcinoma more than 20% of lesions could have not been determined on CT. It has been shown in another study that FOB was more valuable than CT in determination of prognosis in patients with endobronchial lesions (25). Similarly, in the present study CT was able to detect only 33% of the endobronchial lesions. CT could be more suitable than FOB particularly in young patients with low probability of endobronchial lesions (infection, hemoptysis, etc.) (26). Mc Guinnes et al. (1) evaluated both CT and FOB in 57 patients with hemoptysis, and found that diagnostic yield of CT was 61% and of FOB was 43%. CT and FOB are complementary, not competing modalities (7). In planning endobronchial treatments pulmonologists can obtain information from both CT and FOB (10).

In conclusion, although spiral CT can not replace bronchoscopy, the combination of these two procedures would be useful for diagnostic and therapeutic manipulations.

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