Diagnosis of Peripheral Lung Cancer Using a New Type of Endoscope*

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A new fiberoptic bronchoscope, the BF-2.2T, has been designed to go through the 2.6-mm channel of the conventional fiberoptic bronchoscope (Olympus BF-1T20). It measures 2.2 mm in outer diameter; it has a visual angle of 75°, a range of observation of 3 to 50 mm, an effective length of 1,150 mm, and a total length of 1,400 mm. It bends at 120° in an upward direction and at 120° in a downward direction. The 2.2-mm tip of the BF-2.2T bends like a conventional fiberoptic bronchoscope, and this is the main characteristic of this instrument. The BF-2.2T facilitates clinically satisfactory observation and photography, as a method for detecting peripheral lung cancer. (Chest 1990; 97:1231-34)

The development of the fiberoptic bronchoscope has provided an increase in diagnostic visual range. Better resolution owing to improvements in this device has resulted in marked improvement in the rate of identifying of central-type lung cancer. Therefore, a large number of reports on such cancers have appeared, especially those dealing with lesions localized in the mucosa.1-3 Therapeutic results for lung cancer can be improved by detection and definite diagnosis in the early stage of the disease,4-5 however, even now, with this improvement in diagnostic methods, it is occasionally difficult to obtain a definite diagnosis of peripheral lung cancer. Cytodiagnosis by curet biopsy and brushings facilitates relatively easier collection of specimens than is the case with transbronchial lung biopsy, but despite the presence of cancers, the rate of false-negatives with this technique is still considerable. The diagnosis of peripheral lung cancer is difficult because it is impossible to observe the lesion directly by fiberoptic bronchoscopy. We have therefore developed a new type of fiberoptic bronchoscope, which facilitates clinically satisfactory observation and photography as a method for determining morphologic changes in peripheral lung cancer, and have produced it on a trial basis. An outline is described herein.

**Materials and Methods**

**Characteristics and Potential**

The tip of the BF-2.2T fiberoptic bronchoscope measures 2.2 mm in outer diameter and has a visual angle of 75° under direct vision. The range of observation is 3 to 50 mm, and the effective length is 1,150 mm. Its total length is 1,400 mm, with no channel system. The BF-2.2T bends at 120° in an upward direction and at 120° in a downward direction. The 2.2-mm tip of the BF-2.2T bends like a standard fiberoptic bronchoscope, and this is the main characteristic of this instrument. The fact that the tip bends greatly in a downward direction is particularly helpful for avoiding artificial damage to the bronchial mucosa and for decreasing the amount of hemorrhage due to contact during insertion of the BF-2.2T. The axis of the BF-2.2T is appropriately elastic, presenting no problem with manipulation. The fiberoptic bronchoscope is also durable, although the durability is inferior to that of the conventional type. It gives satisfactory resolution and produces only slightly distorted images. The BF-2.2T is composed of about 3,000 glass fibers. A camera (Olympus SC-16-10) is utilized with the EE system for photography.

**Examination Methods**

The sites of lesions were preliminarily located on chest x-ray films, chest CT scans, and so on. Either of two fiberoptic bronchosopes Olympus BF-1710 or Olympus BF-1T20, both of which contain a channel over 2.2 mm in diameter and which are routinely used in clinical cases, was wedged into a target bronchus. Then the BF-2.2T was inserted through the channel of the other fiberoptic bronchoscope. While the sites were located under x-ray TV illumination, the BF-2.2T was inserted into the site of the lesion. The BF-2.2T was slowly inserted in the same way as a biopsy forceps. When the bronchoscope was observed to approach the site of the lesion, the tip of the bronchoscope was bent so to approach the lesion while observing the bronchial lumen with the BF-2.2T. This procedure is easier than that in which biopsy forceps are used to gain access to the site of a lesion.

**Subjects**

The peripheral lung cancers of the present study were lesions which were located in distal parts of the tertiary bronchi (subsegmental bronchi) and could not be observed by standard fiberoptic bronchoscopy. They were eight patients with lung cancer of the peripheral type, including one with metastatic lung cancer, one with tuberculosis, and one with inflammatory changes located in the lung field and differentiated from lung cancer with difficulty by
CASE Diagnosis

In a 63-year-old woman, the chest roentgenogram and chest x-ray CT revealed a coin lesion in the right medial segment of the mediobasal region, with vascular uptake and induration. The bronchogram showed that the lesion was located in the right middle lobe, with a width of 1.5 cm. Histopathologically, the lesion was diagnosed as moderately differentiated adenocarcinoma.

CASE 2

In a 72-year-old woman, the chest roentgenogram and chest x-ray CT revealed a coin lesion in the right posterior basal segment, with vascular uptake and induration. The bronchogram showed that the lesion was located in the right middle lobe, with a width of 1.5 cm. Histopathologically, the lesion was diagnosed as moderately differentiated adenocarcinoma.

Figure 1. Chest roentgenogram revealed an irregularly margined coin lesion in right lateral segment of the mediobasal region.

Figure 2. Observation of periphery of lateral bronchus of mediobasal region revealed obstruction, stenosis, irregularity of bronchial mucosa, and reddening.

Figure 3. Tumor measured 1.5 x 1.5 cm and was diagnosed as poorly differentiated adenocarcinoma.

Diagnosis of Peripheral Lung Cancer (Tanaka et al)
Discussion

Bronchoscopy was originally developed by Killian, and the bronchoscopes in present use are based on the instrument devised by Jackson. Thereafter, various improvements were made, resulting in the development of the fiberoptic bronchoscope currently in use in a wide variety of clinical fields. The type of fiberoptic bronchoscope used generally can be inserted only as far as the segmental bronchus (second bronchus) and makes it possible to visualize at least the subsegmental bronchus (third bronchus).

Recently, a fiberoptic bronchoscope with a thin tip (3.5 mm in diameter) has also come into use, resulting in an increase of the diagnostic visual range. These fiberoptic bronchoscopes all have channels, and their tips can bend. The thinnest fiberoptic bronchoscopes that can be clinically used at present are those with tips 1.2 mm and 1.8 mm in outer diameter (BF-1.2T and BF-1.8T), which we have developed; however, the BF-1.8T has no channel, and the tip cannot bend. The BF-1.8T is appropriate for observing peripheral airways in diffuse diseases such as diffuse pulmonary diseases, although it is difficult to carry out observation and photography using the BF-1.8T in regional lesions such as peripheral-type lung cancer because of the rigidity of the tip. The BF-2.2T contains glass fibers equal in number to those in the BF-1.8T. The minimum diameter of a fiberoptic bronchoscope for which the tip can bend is 2.2 mm, i.e., the same as that of a lung biopsy forceps (Olympus FB-20 C). If an ultrathin fiberoptic bronchoscope under 2.2 mm in diameter were to be produced, the presently used method of manufacture would have to be essentially changed, although this appears physically impossible in many respects. The BF-2.2T with a bendable tip is the thinnest one providing a satisfactory image that can be produced by existing manufacturing techniques. The BF-2.2T cannot provide any channel, and even if this were possible, the bronchoscope would not be usable from a physical viewpoint because of its extremely small diameter. Since the photographs obtained using an ultrathin endoscope like the BF-2.2T are greatly influenced by the extent and type of light and other factors determining color tone, we used test charts to control the color tone so that photographs would show a natural color. Particular attention was paid to cases where the distance between a photographed object and the lens was decreased, and the characteristics of the BF-2.2T were determined. According to the morphometry of airway dimensions, the fiberoptic bronchoscope can be inserted into seven branches at most. The fact that the tip can bend prevents the bronchoscope from hitting the bronchial wall and thus interfering with visualization. Taking into consideration the diameters of the bronchi for expired and inspired gas, nine branches at most can be observed and photographed. When the bronchoscope was used practically, the BF-2.2T reached peripheral lesions in our present cases, probably suggesting that at least bronchioles were satisfactorily observed. Although no definite conclusion could be made because of the small number of patients examined, the endoscopic findings of peripheral-type lung cancer seem to be fundamentally the same as those of lung cancer of large airways. However, endoscopic observation occasionally revealed some sites of whitish bronchial mucosal surface before peripheral findings were obtained. Endoscopic findings of peripheral-type lung cancer will be further studied in more patients.

It is relatively difficult to insert the BF-2.2T when a lesion is located in the right apicalis segment or the left apicodorsalis segment, because the instrument cannot be freely inserted or removed due to the bend of the tip of the conventional type at a steep angle. Observation is easier when the lesion is located at a site where the degree of branching is low.

Main methods presently used for examining peripheral lung cancer include chest roentgenography, tomography, chest CT scanning, cytodiagnosis by curet biopsy and brushings, transbronchial lung biopsy, and needle lung biopsy. The usefulness of the chest x-ray CT is increasing with improvements in the diagnostic ability of this procedure, but it is difficult to use CT for analysis of peripheral lung cancer and differential diagnosis, i.e., qualitative diagnosis. As for cytodiagnosis by curet biopsy and brushings, which is a useful method, the incidence of lung cancer is still high among patients who show negative results. Accordingly, there are many patients who undergo surgery without a specific diagnosis. Such differential diagnosis is difficult because it is impossible to observe the lesion directly by fiberoptic bronchoscopy. Observation and photography by the BF-2.2T seem to be useful for detection of T1N0M0 peripheral lung cancer, in which radical therapy is mostly expected. In other words, new methods will be added for examination of lung cancer and will be expected to take an important role in determining the extension of a lesion and its differentiation, possibly providing highly reliable information in the pathologic examination of lung cancer.

The BF-2.2T (the same as the BF-1.8T) can probe into small airways to the areas which have so far been observable. Cases in which an abnormal shadow on the chest roentgenogram appears to be located on small airways are indications for use of the BF-2.2T. The BF-2.2T will be widely applied to obtain decisive information on the peripheral airways.

ACKNOWLEDGMENT: We appreciate the assistance of Chikao Torikata, M.D.

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REFERENCES