Fiberoptic Bronchoscopy in the Diagnosis of Pulmonary Fungal and Nocardial Infections*


In order to evaluate the role of fiberoptic bronchoscopic procedures in the diagnosis of pulmonary fungal and nocardial infections, we evaluated all patients seen during a 30-month period in whom Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Aspergillus fumigatus, or Nocardia asteroides were found in material obtained from the lungs. Thirty-six such patients were seen; and of these, 25 were found to have pulmonary disease related to the organism found. Ten of 11 isolations of C. neoformans were from patients with no apparent related disease. Thirteen patients underwent fiberoptic bronchoscopic examination because smears of sputum were negative or were unavailable for examination or because of active hemoptysis. In three patients the diagnosis was first made from bronchial brushings performed during a fiberoptic bronchoscopic procedure. In one patient with nocardiosis, samples of sputum were not available, and in two patients (one with blastomycosis and one with histoplasmosis), samples of sputum were not diagnostic. While examination of sputum remains the principal method of diagnosing these infections, a fiberoptic bronchoscopic procedure with proper examination of bronchial brushings may be indicated if samples of sputum are not available or if the patient is extremely ill. In such cases, it may decrease the total time of hospitalization and eliminate the need for more extensive diagnostic procedures.

Since its introduction in 1970, the fiberoptic bronchoscope has become the principal instrument used to diagnose endobronchial tumors and also has proven useful in the management of atelectasis, pulmonary abscess, and diseases of the pulmonary interstitium. A few cases have been reported in which the diagnosis of pulmonary fungal infection was made by a fiberoptic bronchoscopic procedure, however, no study has evaluated the usefulness of this procedure in a group of patients with pulmonary fungal and nocardial infections. The present study was designed to determine whether fiberoptic bronchoscopic examination contributes to the diagnostic work-up of such patients. The incidence of identification of certain potentially pathogenic fungi in the absence of disease also is discussed.

MATERIALS AND METHODS
We studied all patients seen from May 1973 through November 1976 at the Louisiana State University Medical Center, Shreveport, in whom Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Aspergillus fumigatus, or Nocardia asteroides were found in the sputum, in bronchial washings or brushings, in material from needle aspiration of the lungs, or in pulmonary tissue at autopsy. Thirty-six such patients were seen. One man with a clearly positive smear for H. capsulatum who responded to treatment with amphotericin B but whose fungal cultures were negative was included. The remaining 35 individuals all had positive cultures. The incidence of isolation of Candida or other fungi was not studied, since these fungi are frequently present in the absence of related pulmonary disease. No patients were seen with coccidioidomycosis, actinomycosis, mucormycosis, or other invasive pulmonary mycoses during this period.

Follow-up of patients of the five listed organisms, patients were seen; and charts were reviewed to determine the age, sex, duration of symptoms prior to diagnosis, source of material from which the organisms were isolated, the time and method by which the material was obtained, final diagnosis, treatment, and response to treatment. In cases where there was no evidence of related pulmonary disease, patients were followed-up for periods ranging from three months to three years in order to determine if they later developed a related disease or if they were treated.

Fiberoptic bronchoscopic procedures were performed in 13 patients because smears of sputum were negative or unavailable or because of active hemoptysis. The bronchoscope was passed transnasally under local anesthesia in 12 patients and through an endotracheal tube under general anesthesia in one patient. Bronchial brushings and washings were obtained in all cases from areas which appeared abnormal bronchoscopically or on chest x-ray films. Transbronchial biopsies were not performed on any patient in this series. Specimens from bronchial brushing were placed in alcohol and stained for histologic studies. During the third year,
additional specimens were air-dried on slides for preparations with potassium hydroxide and for Ziehl-Neelsen stains. Bronchial washings were concentrated and examined for fungi and acid-fast organisms and were cultured on a variety of standard media available at the time.

RESULTS

Thirty-six patients were studied. Fungi or Nocardia organisms were identified initially from sputum (28 patients), from bronchial washings or brushings (six patients), from material obtained by needle aspiration of the lung (one patient), or by pulmonary tissue obtained at autopsy (one patient.) Both H capsulatum and C neoformans were isolated from one patient. The most common organisms isolated were C neoformans and B dermatitidis, each of which was found in 11 cases. Histoplasma capsulatum was isolated in eight cases, A fumigatus was isolated in six cases, and N asteroides was isolated in one case.

Of the 36 patients from whom fungi or Nocardia organisms were isolated, 25 were found to have clinical evidence of pulmonary disease which could be related to the infectious agent. Eleven patients had blastomycosis, eight had histoplasmosis, four had aspergillomas, one had cryptococcosis, and one had nocardial pneumonia. Potentially pathogenic fungi were isolated from 12 patients in whom no related pulmonary disease could be found. Of these patients, C neoformans was seen in ten, and A fumigatus was seen in two. It is noteworthy that in ten of 11 instances where cryptococci were found, there was no evidence of cryptococcal infection.

Results of fiberoptic bronchoscopic examination in the 13 patients who underwent this procedure are outlined in Table 1. Of this group, ten were finally diagnosed as having fungal or nocardial pulmonary infections. Four had histoplasmosis, four had aspergillomas, and one each had blastomycosis and nocardial pneumonia. In three patients the diagnosis was first made by a fiberoptic bronchoscopic procedure when prior smears of sputum were negative or unavailable. One of these patients had blastomycosis, one had histoplasmosis, and the third had nocardial pneumonia.

Four patients in this series had bronchogenic carcinoma diagnosed at bronchoscopic examination. Bronchial brushings from one man with clinical and roentgenographic evidence of pulmonary histoplasmosis contained both H capsulatum and malignant cells. Two patients with carcinoma had A fumigatus and one had C neoformans in both sputum and bronchial brushings; none of these three had clinical evidence of fungal infections.

In only one patient did both samples of sputum and bronchoscopic material fail to produce the causative organism. This elderly debilitated woman had an aspergilloma located peripherally in a cavity in the right lower lobe. She was unable to produce reliable sputum, and bronchial washings and brushings were normal. Aspiration with percutaneous needle under fluoroscopic guidance, performed on the day after bronchoscopic examination, yielded A fumigatus.

DISCUSSION

Pulmonary mycotic and nocardial infections are usually diagnosed from smears or cultures (or both) of sputum. If smears are positive, invasive diagnostic procedures are usually not indicated; however, in some cases, sputum is not available. In others, smears may not reveal the organism, although cultures reported several weeks later are positive. In severely ill patients, definitive treatment is delayed. No previous report has evaluated the usefulness of fiberoptic bronchoscopic examination in such cases.

Most reported series of patients undergoing fiberoptic bronchoscopic procedures include a few whose disease proved to be a fungal infection. Zavala's report of 600 patients included five with histoplasmosis and two with aspergilloma. Bronchial brushing was negative in all those with histoplasmosis, but one aspergilloma was diagnosed from bronchial brushings. Hanson et al reported that three of 164 patients who underwent fiberoptic bronchoscopic procedures were found to have fungal infections. Two of these patients (one with aspergillosis and one with infection with Candida) were diagnosed by transbronchial biopsy. Schoenbaum and associates described three patients with fungal infections in a series of 100 who underwent fiberoptic bronchoscopic procedures. One was found to have an intracavitary fungous ball, and two had candidal pneumonia, all diagnosed at bronchoscopic examination. Onal et al recently reported a case of disseminated blastomycosis which was diagnosed by fiberoptic bronchoscopic examination.

Transcatheter bronchial brushing has also been used in the diagnosis of pulmonary mycotic and nocardial infections. Forrest reported 25 patients with cavitory pulmonary disease who underwent bronchial brushing under fluoroscopic guidance. Of these, one was found to have histoplasmosis, one had aspergillosis, and one had a nocardial infection. Genoe et al found aspergilli in brushings from four patients with pulmonary aspergillosis. In 50 consecutive patients with other diagnoses who underwent bronchial brushings, aspergilli were not found. Willson and associates diagnosed cryp-
tococcal infection in one patient. Fennessy and Kittle\textsuperscript{10} reported “over 750 patients” who underwent transcatheter brushing, 118 of whom were subjected to thoracotomy later. Of the 750 patients, 14 were found to have “fungi,” and one had a nocardial infection.

Examination with the rigid bronchoscope has proven much less productive in diagnosing pulmonary fungal and nocardial infections, according to published reports. Saab and Almond\textsuperscript{19} found that bronchoscopic examination yielded positive information in only one of ten patients with pulmonary aspergillosis. Poe et al\textsuperscript{20} did not diagnose blastomycosis in any of the nine patients with proven disease who underwent examination with the rigid bronchoscope; moreover, in three of these patients, \textit{B dermatitidis} was isolated from the sputum. It may be that the location of these infections in peripheral areas of the lungs, frequently in upper lobes, makes them relatively inaccessible to the rigid bronchoscope. Biopsies and washings obtained during procedures with the rigid bronchoscope sample primarily material from major bronchi, and may not reach the distal areas of infection.

The results of this study indicate that fiberoptic bronchoscopic procedures with proper examination of material from brushings and washings can aid in the diagnosis of pulmonary fungal and nocardial infections when smears and cultures of sputum are negative. It is useful to obtain at least three samples of sputum prior to bronchoscopic examination if the situation permits. It is sometimes advisable to wait for reports of fungal cultures prior to subjecting patients to bronchoscopic examination; however, in many cases, it is unwise to delay treatment for a month or longer while waiting for reports of cultures or serial serologic tests (for example, when the patient has hemoptysis, is extremely ill, or is deteriorating clinically). Sometimes reliable specimens of sputum cannot be obtained. In such cases, bronchoscopic examination should be done because it may result in an earlier diagnosis. The earlier diagnosis may be lifesaving if the patient’s condition is deteriorating rapidly, and such diagnosis will decrease the total time of hospitalization and eliminate the need for more extensive procedures, such as thoracotomy. An additional indication for bronchoscopic examination is an atypical clinical or roentgenographic appearance or a failure to respond to appropriate treatment. As shown in Table 1, four of the patients who underwent bronchoscopic procedures had bronchogenic carcinoma; one man had concomitant histoplasmosis.

Transbrachial biopsy may also increase the diagnostic yield. We are currently evaluating the contribution of transbrachial biopsy to the diagnosis of these infections.

\textbf{ACKNOWLEDGMENT:} We are indebted to Mr. Arnold Oberle and Ms. Marie Bruce for their technical assistance.

\begin{table}[h!]
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\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
\textbf{Case} & \textbf{Organism Isolated} & \textbf{First Isolation} & \multicolumn{2}{c|}{\textbf{Sputum*}} & \multicolumn{2}{c|}{\textbf{Bronchoscopic Material*}} & \textbf{Final Diagnosis} \\
\hline
1 & \textit{B dermatitidis} & Bronchoscopy & – & – & + & + & Blastomycosis \\
2 & \textit{N asteroides} & Bronchoscopy & 0 & 0 & + & + & Nocardial pneumonia \\
3 & \textit{H capsulatum} & Bronchoscopy & – & – & + & – & Histoplasmosis \\
4 & \textit{A fumigatus} & Bronchoscopy & + & + & + & + & \textit{Mycobacterium intracellulare} and aspergilloma \\
5 & \textit{A fumigatus} & Bronchoscopy & + & + & + & + & Carcinoma of lung \\
6 & \textit{C neoformans} & Bronchoscopy & + & – & + & + & Carcinoma of lung \\
7 & \textit{H capsulatum} & Sputum & – & + & – & – & Histoplasmosis \\
8 & \textit{A fumigatus} & Sputum & + & + & + & + & Aspergilloma \\
9 & \textit{A fumigatus} & Sputum & + & + & + & + & Carcinoma of lung \\
10 & \textit{H capsulatum} & Sputum & – & + & – & + & Histoplasmosis and carcinoma of lung \\
11 & \textit{A fumigatus} & Sputum & + & + & + & + & Aspergilloma \\
12 & \textit{H capsulatum} & Sputum & – & + & + & + & Histoplasmosis \\
13 & \textit{A fumigatus} & Pulmonary aspirate & 0 & 0 & – & – & Aspergilloma \\
\hline
\multicolumn{7}{l|}{* – , Negative; +, positive; and 0, no specimen available.} \\
\end{tabular}
\caption{Results of Fiberoptic Bronchoscopic Procedures in 13 Patients}
\end{table}
REFERENCES

17 Willson JKV, Eskridge M, Scott EL: Transbronchial biopsy of benign and malignant peripheral lung lesions. Radiology 100:541-546, 1971

Symposium on Pediatric Otorhinolaryngology

The Second International Symposium on Pediatric Otorhinolaryngology will be held March 8-11 at Children’s Mercy Hospital, Kansas City, Missouri, under sponsorship of the hospital. For information, contact Dr. B. Jazbi, Children’s Mercy Hospital, Kansas City, Missouri 64108.

Postgraduate Course in Bronchoesophagology

Drs. Charles M. Norris, Gabriel F. Tucker, Jr., John A. Tucker and Bernard R. Marsh will present a Postgraduate Course in Bronchoesophagology at Temple University (Chevalier Jackson Clinic), Philadelphia, March 6-16. For further information, write to: Chevalier Jackson Clinic, Temple University Hospital, 9401 North Broad Street, Philadelphia 19140.