Fiberoptic Bronchoscopy and Culture of Bacteria from the Lower Respiratory Tract*

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Forty-five specimens were obtained by sequential translaryngeal aspiration and fiberoptic bronchoscopy from 31 clinically uninfected patients with lung cancer in order to evaluate the reliability of routine fiberoptic bronchoscopy for culture of the lower respiratory tract. Bacteria were recovered from 98 percent (44) of the specimens obtained via fiberoptic bronchoscopy and from 58 percent (26) of the specimens obtained by the preceding translaryngeal aspiration. The microorganisms grown from cultures of specimens obtained by fiberoptic bronchoscopy consisted of mixtures of both nonpathogenic and potentially pathogenic bacteria. Potentially pathogenic bacteria were present in 87 percent (39) of the specimens from fiberoptic bronchoscopy and 31 percent (14) of specimens from translaryngeal aspiration. The results of cultures from the two procedures agreed completely in only a single instance. Culture of washings or secretions obtained by routine fiberoptic bronchoscopy is not recommended because it provides inaccurate and clinically confusing information about the presence or types of bacteria in the lower respiratory tract prior to instrumentation.

A correct knowledge of the microorganisms present in the lower respiratory tract of man is often of major clinical importance. The methods used for obtaining specimens representative of the lower respiratory tract are variable. Among the most widely used techniques are (1) collection of expectorated material (sputum), (2) collection of washings through the fiberoptic bronchoscope, and (3) percutaneous translaryngeal aspiration of tracheobronchial secretions. (Our procedure, percutaneous puncture of the cricothyroid membrane, is correctly identified as translaryngeal aspiration. A similar procedure performed at a site below the larynx [subcricoid] is correctly designated as transtracheal aspiration.)

Because of the potential of contamination by bacteria from the upper airway, the accuracy with which cultures of expectorated material and washings from fiberoptic bronchoscopy reflect the microflora of the lower respiratory tract has been questioned, however, it appears to be well established that specimens for culture obtained by a properly performed translaryngeal aspiration provide more valid results.

This study was designed to determine if aerobic and anaerobic cultures of secretions aspirated through a sterile bronchoscope from patients without clinical evidence of pulmonary infection would provide accurate information about the presence or absence of bacteria in the lower respiratory tract prior to instrumentation. If this were the case, alternative or additional procedures could then be avoided. Therefore, as part of the bacterial surveillance of patients being treated for lung cancer, we compared the results of aerobic and anaerobic cultures of sequentially obtained specimens from translaryngeal aspiration and fiberoptic bronchoscopy. This report describes the results of that investigation.

**MATERIALS AND METHODS**

**Patients**

All patients eligible for a high-dose protocol of antineoplastic chemotherapy for the treatment of lung cancer were studied if there were no anatomic or coagulative abnormalities that precluded the procedures of fiberoptic bronchoscopy and translaryngeal aspiration. A total of 31 afebrile patients without clinical evidence of infection of the lower respiratory tract...
tract or recent systemic antimicrobial therapy were studied. Informed consent was obtained from each patient (approved by the institutional committee on human research). The initial study was performed prior to the institution of chemotherapy for cancer. The initial procedures were repeated in selected patients at the midpoint and the end of the six-week course of chemotherapy to induce remission of cancer. Criteria used for the selection of patients for repeat studies included acceptance by the patient and the absence of abnormalities of coagulation. There were two women and 29 men patients, who ranged in age from 48 to 69 years old. All had histologically proven malignant neoplasms of the lung; 20 had small cell carcinoma, six had adenocarcinoma, and five had epidermoid carcinoma.

**Method of Study**

In the morning the fasting patients had specimens from translaryngeal aspiration and washings from fiberoptic bronchoscopy collected sequentially as listed. The specimen from translaryngeal aspiration was aspirated into a sterile polyethylene syringe. The air was expelled, the tip of the syringe was sealed, and it was transported to the Infectious Diseases Research Laboratory immediately at the end of the procedure. The washings from fiberoptic bronchoscopy were suctioned into sterile 40-ml specimen traps (Chesbrough-Ponds Inc.), and were transported as soon as the collection was completed.

**Translaryngeal Aspiration**

Translaryngeal aspiration was performed as described by Kalinske et al., with minor modifications. After induction of cutaneous anesthesia with lidocaine, the anterior surface of the neck was cleansed with povidone-iodine solution, and the chest was draped with sterile towels. Percutaneous puncture of the cricothyroid membrane with a 14 gauge needle was then performed aseptically, followed by introduction of a 30-cm polyethylene catheter into the tracheobronchial passages. The needle was quickly withdrawn, and secretions from the lower respiratory tract were aspirated into a sterile 30-ml syringe. If secretions were not obtained with the initial aspiration, 5.0 ml of sterile preservative-free phosphate-buffered saline solution (pH 7.2) was introduced through the catheter, followed immediately by repeated aspiration. When a specimen of 2.5 ml or greater in volume was obtained, air was expelled, and the syringe was capped.

**Fiberoptic Bronchoscopy**

Following intramuscular premedication with 0.4 mg of atropine and 10 mg of diazepam, the patient’s nasopharyngeal passages were anesthetized with a spray of a 2 percent solution of lidocaine. With the patient in a sitting position, the sterile bronchoscope (Olympus BF 5B2) was passed transnasally into the tracheobronchial tree. The major bronchi were then washed with sterile preservative-free saline solution, and 10 to 20 ml of washings were collected in the sterile specimen trap. To monitor the sterility of the bronchoscope, sterile saline solution alone was collected through the fiberoptic bronchoscope and handled in a similar manner prior to 15 of the procedures.

**Anaerobic and Aerobic Bacterial Cultures**

Specimens for anaerobic culture were plated on pre-reduced Columbia agar with 5 percent sheep’s blood (sheep’s blood agar), and 0.1 ml of the specimen was introduced into pre-reduced anaerobically sterilized chopped-meat glucose and thioglycollate broths, using the Virginia Polytechnic Institute’s method. Specimens for aerobic culture were plated on sheep’s blood agar, MacConkey’s agar, and Filde’s peptic digest of blood agar; and 0.1 ml was inoculated into 10 ml of trypticase soy broth. The aerobic agar plates were placed in an atmosphere containing 10 percent carbon dioxide, were incubated at 37°C, and were examined at 24 and 48 hours and at five days. Anaerobic cultures were incubated at 37°C in an oxygen-free atmosphere and examined at 48 hours and at 7 and 14 days.

Bacteria were identified by standard microbiologic techniques. Results were reported as follows: (1) sterile, indicating no growth in liquid or on solid media; (2) broth positive, indicating growth in broth media only; (3) few bacteria, indicating less than ten colonies in the quadrant of initial streaking on solid media; and (4) l+ growth to 4+ growth (1+ growth indicating ten or more colonies present in the initial quadrant of streaking on solid media; and 4+ growth indicating growth in the initial, second, and third quadrants plus ten or more colonies in the fourth quadrant of streaking on solid media).

**Definitions**

Terms used subsequently in describing the results of this study are defined as follows: (1) insignificant growth means less than 1+ bacterial growth on solid media; (2) significant growth means 1+ or greater bacterial growth on solid media; (3) normal flora of the upper respiratory tract means bacteria is normally isolated from the oropharyngeal area or sputum of healthy adults (includes anaerobic bacteria, viridans type of hemolytic streptococci, Hemophilus and Neisseria species, coagulate-negative staphylococci, Streptococcus pneumoniae, and diphtheroids); (4) nonpathogenic bacteria means normal flora of the upper respiratory tract (exception, potential pathogens, as defined below); and (5) potential pathogens means Str pneumoniae, Staphylococcus aureus, β-hemolytic streptococci, aerobic gram-negative bacilli (including Hemophilus influenzae), and anaerobic bacteria. The definition of potential pathogens is confined to those microorganisms isolated from specimens during the course of the study.

**Results**

The results of the aerobic and anaerobic cultures for all bacteria isolated from the 45 paired specimens obtained by translaryngeal aspiration and fiberoptic bronchoscopy are presented in Table 1. A

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**Table 1—Aerobic and Anaerobic Culture of 45 Paired Specimens Obtained via Translaryngeal Aspiration and Fiberoptic Bronchoscopy**

<table>
<thead>
<tr>
<th>Results of Culture</th>
<th>Translaryngeal Aspiration</th>
<th>Fiberoptic Bronchoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile or growth &lt; 1+</td>
<td>35 (78)</td>
<td>11 (24)</td>
</tr>
<tr>
<td>Sterile</td>
<td>19 (42)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Growth &gt; 1+</td>
<td>10 (22)</td>
<td>34 (76)</td>
</tr>
</tbody>
</table>

*Table values are numbers of specimens; numbers within parentheses are percentages.  
**Growth < 1+ means less than ten bacterial colonies grown on solid media (see definitions).  

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total of 45 strains of bacteria were grown from the specimens obtained by translaryngeal aspiration, as compared to 150 strains grown from the washings of fiberoptic bronchoscopy. These microorganisms included 36 aerobic and nine anaerobic strains from the specimens obtained by translaryngeal aspiration and 114 aerobic and 36 anaerobic strains from the specimens obtained by fiberoptic bronchoscopy. The specimens obtained by translaryngeal aspiration were sterile more frequently than those obtained by fiberoptic bronchoscopy. The bacteria in the cultures of specimens from translaryngeal aspiration were most often present in insignificant concentrations (see definitions). The reverse was true for cultures of washings from fiberoptic bronchoscopy, even though a larger amount of diluent (10 to 20 ml) was used for collection of these specimens, as compared to the specimens from translaryngeal aspiration (0 to 5 ml).

Similarly and more important, 73 strains of potentially pathogenic bacteria were isolated from the specimens obtained by fiberoptic bronchoscopy, as compared to 21 strains isolated from the specimens obtained by translaryngeal aspiration (Table 2).

The degree of agreement between the two methods of obtaining material for culture is illustrated in Table 3. There was complete or partial discordance when either the specimen from translaryngeal aspiration (19 specimens) or fiberoptic bronchoscopy (one specimen) was sterile or contained only non-pathogens (one specimen). For example, in two instances when the specimen from translaryngeal aspiration was sterile the first paired washing from fiberoptic bronchoscopy grew 2+ viridans type of hemolytic streptococci, 2+ Gemella haemolysans, 1+ Sta epidermidis, 1+ Bacteroides melaninogenicus, and few Klebsiella pneumoniae; the second paired specimen from fiberoptic bronchoscopy grew 2+B melaninogenicus, 2+ Staphylococcus aureus, and 1+ viridans type of hemolytic streptococci. In the one instance when the washings from fiberoptic bronchoscopy were sterile, the specimen from translaryngeal aspiration grew viridans type of hemolytic streptococci in the broth culture only.

Cultures of 23 of the paired specimens grew mixtures of both nonpathogenic bacteria and potentially pathogenic bacteria (Table 3). For these cultures, there were no instances of complete agreement between the two methods, although in one instance, there was agreement about the potentially pathogenic bacteria present in both. For example, in one pair the specimen from translaryngeal aspiration grew 1+ Pseudomonas aeruginosa and few Staphylococcus epidermidis, while the specimen from fiberoptic bronchoscopy grew 2+B melaninogenicus, 2+ H parainfluenzae, 1+diphtheroids, 1+ nonpathogenic Neisseria, few viridans type of hemolytic streptococci, and K pneumoniae and Ps aeruginosa in the broth culture only. In another pair, the specimen from translaryngeal aspiration grew 4+B influenzae and 2+Streptococcus pneumoniae, while the specimen from fiberoptic bronchoscopy grew 2+ viridans type of hemolytic streptococci, 2+ nonpathogenic Neisseria, and few Proteus mirabilis.

In only one out of the 45 paired cultures was there complete agreement about the bacteria present. In this pair the specimen from translaryngeal aspiration grew 1+ Streptococcus pneumoniae and few Proteus mirabilis, while the specimen from fiberoptic bronchoscopy grew 1+ each of these bacteria.

All procedures were free of complications, other than mild transient hemoptysis or minimal subcutaneous emphysema. There was one instance of clinical infection of the lower respiratory tract that
occurred 14 days following the procedures. The causative microorganism, isolated from cultures of the blood, was one of two potentially pathogenic bacteria grown from the specimen from the preceding translaryngeal aspiration and one of three potentially pathogenic bacteria grown from the paired specimen from fiberoptic bronchoscopy. The sterile saline solution aspirated through the fiberoptic bronchoscope prior to 15 of the procedures and cultured in the same manner as the specimens grew no bacteria. Only one patient had to be excluded because the catheter for translaryngeal aspiration passed cephalad into the pharynx during the procedure.

**Discussion**

The results of this study demonstrate that culture of bronchial washings or secretions obtained by routine fiberoptic bronchoscopy provide misleading information about the presence and types of bacteria in the lower respiratory tract prior to instrumentation. These data are in agreement with the conclusions reached by Bartlett et al.\(^8\) Their study reported the results of aerobic and anaerobic cultures of specimens of washings obtained by fiberoptic bronchoscopy through a sterile endotracheal tube from 16 clinically uninfected patients. Although isolates of cultures of specimens from the throat or sputum were not reported, the majority of the 85 strains of aerobic and anaerobic microorganisms grown were those normally found in the upper respiratory airways. Cultures from seven additional patients who underwent a companion translaryngeal aspiration four hours to seven days prior to fiberoptic bronchoscopy were also reported. In this group, specimens from fiberoptic bronchoscopy usually yielded the same bacterial species recovered in translaryngeal aspiration; however, two or more additional species were always present in the specimen from fiberoptic bronchoscopy. Culture of the 45 prebronchoscopic specimens obtained via translaryngeal aspiration in close temporal relationship to bronchoscopy in our patients confirms that the multiple bacteria grown from the washings from fiberoptic bronchoscopy were not present prior to the bronchoscopic procedure.

These observations are further supported by the studies of Wanner and associates.\(^14\) using a bedside technique for fiberoptic bronchoscopy and introducing through the aspiration channel a polyethylene catheter containing a retracted wire loop. Their population under study included 14 patients with noninfected pulmonary disease, in addition to 30 patients with pneumonia and eight patients with chronic obstructive pulmonary disease. Cultures obtained through the bronchoscope from the noninfected group revealed oropharyngeal commensal bacteria in the trachea of all 14 patients and in the bronchi of ten of these patients. Additionally, even using less than optimal techniques for anaerobic culture, identical results were obtained for the isolation of anaerobic bacteria from this same group.\(^14\)

Nonpathogenic bacteria were present in 26 and potential pathogenic bacteria in 14 of the cultures of specimens from translaryngeal aspiration, without initial or immediately subsequent clinical evidence of infection. These findings indicate that colonization or transient contamination of the lower respiratory tract occurs in this population with underlying pulmonary disease. Additionally, these data suggest that the recovery of bacteria without other evidence of infection does not necessarily predict active or incipient pulmonary infection.

The bacteria cultured from the specimens obtained by fiberoptic bronchoscopy may have been introduced in part during passage of the bronchoscope through the upper respiratory tract; however, it seems apparent from the previously cited report that bacterial contamination of the lower airways may also accompany the procedure of inducing anesthesia. In that study, methylene blue sprayed on the oropharynx of ten patients prior to instrumentation was detected in eight instances in the subsequent aspirate obtained by fiberoptic bronchoscopy. Since the fiberoptic bronchoscope was introduced through a sterile endotracheal tube, it would suggest that modification of the bronchoscopic procedure, short of eliminating topical anesthesia, is unlikely to affect favorably the accuracy of cultures obtained through the bronchoscope. Furthermore, it is of interest that commonly used local anesthetics have been shown to inhibit or kill both bacteria and acid-fast bacilli in concentrations reached during induction of topical anesthesia.\(^6,15\)

As a result of our data, we no longer recommend culture of specimens obtained by routine fiberoptic bronchoscopy. A recent comparative study of cultures of specimens obtained by translaryngeal aspiration and percutaneous pulmonary aspirates in acute pneumonia has demonstrated a degree of discordance between the two procedures.\(^8\) The usefulness and accuracy of the fiberoptic bronchoscopic procedure in the presence of infection of the lower respiratory tract has not been addressed in the current report; however, it presently would appear to be prudent to obtain prebronchoscopic specimens via translaryngeal aspiration or pulmonary aspirates for culture when an etiologic diagnosis of active pulmonary infection is important.

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