Transbronchial Needle Aspiration in Clinical Practice*
A Five-Year Experience

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We conducted a five-year review of our use of TBNA during bronchoscopic procedures, 633 patients (39 percent) had TBNA performed as part of the initial examination. Mediastinal nodes were sampled in 86 percent of the patients who had TBNA performed, and 127 (23 percent) of 547 of these aspirates were positive. Other areas of mucosal abnormality of the tracheobronchial tree were also sampled by TBNA under direct vision and showed malignant cells in 44 (25 percent) of 176 aspirates. Of 363 patients first diagnosed as having carcinoma of the lung who had TBNA of N2 nodes, 41 (59 percent) of 70 with small-cell tumors were positive, as were 83 (25 percent) of 293 with non-small-cell malignant neoplasms. Comparison of cytologic results obtained by TBNA with histologic material in 109 cases showed an excellent correlation. In 31 cases (4 percent of all TBNA), the aspirate provided the sole means of establishing the diagnosis of cancer. Two patients were thought to have false-positive aspirates. No complications of therapeutic significance were encountered. We believe that TBNA is a safe and effective way to assess mediastinal lymphatic involvement in the staging of lung cancer and that TBNA can be safely performed as part of the initial bronchoscopy examination in patients suspected of having malignant neoplasms of the chest. (Chest 1989; 96:1268-72)

Lung cancer has now become the most prevalent malignant neoplasm in our society.1 While resectional surgery still offers the best hope for cure, many cases of lung cancer are inoperable at the time of presentation.2 The need to be more discriminating in excluding patients for thoracic surgery who have mediastinal disease resulted in the introduction of mediastinoscopy by Carlens3 in 1959. The technique of TBNA, which was first introduced by Schieppati4 and more recently adapted by Wang et al5-7 for use with the fiberoptic bronchoscope, has offered a simpler method to determine the extent of malignant involvement of mediastinal lymph nodes.

The success of any technique, however, must be judged by its general applicability and acceptance by the practicing medical community at large. Since the majority of patients are cared for by private physicians in a variety of hospital settings, the utility of TBNA will ultimately be determined by the practitioner’s acceptance of its facility to stage lung cancer and to help select those patients who will benefit most from surgery. This report is intended to convey the experience of a group of privately practicing pulmonologists in the use of TBNA.

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Materials and Methods
This was a retrospective study of our use of TBNA in 633 patients (39 percent) out of a total of 1,630 who had a diagnostic bronchoscopy performed in Bangor, Me, during the five-year period from July 1983 to June 1988. The study was performed at Eastern Maine Medical Center (425 beds) and St. Joseph Hospital (130 beds).
Although nearly all of the patients suspected of having malignant disease had TBNA at the time of their initial bronchoscopy, several subsequently had repeat TBNA when they were later restudied because of the clinical suspicion of recurrence of the tumor.
Fiberoptic bronchoscopy was conducted either transorally via a 9-mm endotracheal tube or transnasally using a bronroscope (Olympus BF-1T10 or BF-482) by the four authors. The TBNA was performed using a type 1 Wang needle, which is a 22-gauge 12-mm-long needle (Mill Rose Co.). After the bronchoscope was passed into the trachea and a brief examination of the proximal portion of the trachea was completed, the needle was passed through the channel of the instrument until the needle was visualized. The stylette was then withdrawn into the needle to maintain sufficient rigidity between the needle-sheath interface to prevent buckling during puncture of the tracheal wall or lesion. This was accomplished by a rapid thrust between the tracheal rings in the infracarinal and paratracheal positions adjacent to the nodes to be sampled or into the abnormal area visualized during the course of the remainder of the bronchosopic examination. Once the needle completely penetrated the tracheal or bronchial wall, the stylette was further withdrawn into the sheath and the needle was pulled back and reintroduced a distance of approximately 3 to 5 mm several times while still positioned in the entry site as material was aspirated with maximally applied suction into a 50-ml syringe containing 3 to 5 ml of physiologic saline solution. The suction was then released before the needle was completely removed from its position so that the sample was not contaminated by intraluminal secretions. Two or three aspirates from each location were obtained and flushed.
Table 1—Incidence of Use of TBNA during Bronchoscopy

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Bronchoscopic Procedures</th>
<th>No. with TBNA (percent)</th>
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<tbody>
<tr>
<td>1983 (6 mo)</td>
<td>155</td>
<td>54 (35)</td>
</tr>
<tr>
<td>1994</td>
<td>264</td>
<td>194 (47)</td>
</tr>
<tr>
<td>1985</td>
<td>309</td>
<td>132 (43)</td>
</tr>
<tr>
<td>1986</td>
<td>332</td>
<td>121 (36)</td>
</tr>
<tr>
<td>1987</td>
<td>307</td>
<td>146 (37)</td>
</tr>
<tr>
<td>1988 (6 mo)</td>
<td>173</td>
<td>56 (32)</td>
</tr>
<tr>
<td>Total</td>
<td>1,630</td>
<td>633 (39)</td>
</tr>
</tbody>
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Small-cell carcinoma was recovered most frequently from the mediastinum and represented 32 percent of the positive mediastinal aspirates. Finally, areas of mucosal abnormality that did not appear to be obviously neoplastic on gross inspection were also sampled, and 44 (25 percent) of 176 returned positive for malignant disease.

Because the most important application of this technique is in the determination of N2 disease, the results of individual bronchoscopists were additionally scrutinized and are reported in Table 2. These data show that there were clear-cut differences among the four physicians in their use of TBNA. Doctors "W," "X," and "Y" employed the technique more frequently than did Dr. "Z." In addition, the degree of positivity also was significantly different. Dr. "Z" had the highest percentage of positive returns, while Dr. "Y," who had the lowest number of positives, sampled paratracheal locations less frequently in assessing mediastinal disease than the other three physicians.

The value of TBNA is particularly evident in those cases in which this technique provides the sole cytologic or histologic evidence for malignant disease of the chest. Over the course of five years, we have noted 31 cases (4 percent of all TBNA procedures performed, or 18 percent of all positive TBNA procedures) in which this procedure provided the sole means of making the diagnosis of cancer. These results are shown in the following tabulation:

Table 2—Use of TBNA in N2 Disease

<table>
<thead>
<tr>
<th>Physician</th>
<th>No. of Bronchoscopic Procedures</th>
<th>No. with TBNA (percent)</th>
<th>No. Positive (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. W</td>
<td>363</td>
<td>119 (33)</td>
<td>30 (25)</td>
</tr>
<tr>
<td>Dr. X</td>
<td>575</td>
<td>226 (39)</td>
<td>54 (24)</td>
</tr>
<tr>
<td>Dr. Y</td>
<td>303</td>
<td>122 (40)</td>
<td>19 (16)</td>
</tr>
<tr>
<td>Dr. Z</td>
<td>389</td>
<td>80 (21)</td>
<td>24 (30)</td>
</tr>
<tr>
<td>Total</td>
<td>1,630</td>
<td>547 (34)</td>
<td>127 (23)</td>
</tr>
</tbody>
</table>
The other 82 percent of the patients with cancer had positive biopsies during the same bronchoscopic examination in which the TBNA showed malignant cells. Two cases of lymphoma were diagnosed on cytologic grounds alone. Both were patients with a previous diagnosis of lymphoma who had been treated with chemotherapy and were believed to be free of disease. Subsequent clinical suspicion of recurrence was then definitively demonstrated by TBNA. One additional patient with lymphoma is not included in these statistics, since his diagnosis was confirmed by thoracotomy at a time when we were first developing familiarity with the technique. One patient had both small and large malignant cells seen on his aspirate.

In our total series of 171 positive TBNA procedures (from both N2 nodes and other areas of the tracheobronchial tree), there were 109 cases in which there was coexistent histologic material obtained at bronchoscopy that also demonstrated malignant tissue. Thirty-one additional cases had cytologic material recovered from another airway site during the bronchoscopic examination that was confirmatory. In all but three cases, the transbronchial aspirate showed cells that were either identical or compatible with the histologic diagnosis. In two of these patients, TBNA showed large-cell carcinoma while the biopsy showed small-cell carcinoma in one and mixed large-cell and small-cell carcinoma in the other. In the former, the chemotherapeutic response was good and in the latter poor. In the third case the TBNA showed mixed small-cell and large-cell carcinoma, the biopsy showed small-cell carcinoma, and the patient's condition responded to chemotherapy.

Over the course of five years, there were 13 patients who had cytologic reports that were interpreted as being suspicious. In each case, additional tissue proved that these individuals did, in fact, have a malignant neoplasm of the chart. Six other patients with TBNA of mediastinal nodes had an aspirate in which only a few malignant cells were noted. In view of the report by Cropp et al., which demonstrated contamination of the mediastinal aspirate by tumor present in the airway, these patients were also subjected to additional review. Two had small-cell carcinoma on the bronchial biopsy and did not undergo further investigation. Two patients had good clinical evidence for mediastinal disease; one with large-cell carcinoma had a paralyzed vocal cord and enlarged lymph nodes on CT scan, and the other with squamous cell carcinoma also had a paralyzed vocal cord and a recently elevated ipsilateral diaphragm. The other two patients were believed to be true false-positives. One had a necrotic endobronchial squamous cell carcinoma in the left upper lobe and had a radical pneumonectomy with a negative mediastinal exploration, and the other had simultaneous bilateral upper lobar lobectomies for adenocarcinoma without demonstrable tumor in the mediastinum and is now three years past surgery without evidence for recurrent disease.

No complications of significance were encountered. Although some minor bleeding was noted, neither dyspnea nor ventilatory compromise occurred. In addition, there were no reports of pneumothorax, pneumomediastinum, or bacteremia, as had been noted in other studies. One patient who inadvertently underwent TBNA while receiving anticoagulants developed mild swelling in the distal membranous portion of the trachea at the termination of bronchoscopy; however, observation following the procedure failed to reveal any significant bleeding or airway compromise, and the patient's postoperative course remained completely uneventful.

**DISCUSSION**

This report was intended to review our experience with TBNA over a five-year period. Our results of 124 positive mediastinal aspirates (34 percent) in 363 patients with newly diagnosed cancer of the lung is comparable to other authors. Also not surprising is the fact that this procedure is twice as likely to be positive in small-cell carcinoma as in non-small-cell tumors, since the former is well known for its central origin and aggressive behavior; however, positive mediastinal aspirates were still recovered in 28 percent of the cases of non-small-cell malignant neoplasms.

Although we have used this technique in 39 percent of our diagnostic bronchoscopic procedures, there is justification for its active implementation, since two studies have shown that TBNA of N2 nodes was positive not only when the tracheobronchial anatomy failed to show extrinsic compression, but also when the chest roentgenogram did not show mediastinal adenopathy. Three physicians routinely employ it 35 to 40 percent of the time, which undoubtedly represents frequent use of TBNA. The lower incidence of use by Dr. "Z," coupled with the highest rate of positive returns, suggests that this individual employed it primarily in patients with more clinically evident mediastinal disease. It is entirely possible, therefore, that rates of positivity may be higher in the hands of others, particularly if TBNA is reserved for use in patients who have demonstrable mediastinal disease.

Initially, paratracheal and subcarinal specimens were collected separately, but since this practice did not materially alter our decisions regarding the patient's care during the initial review of our data, this distinction was not continued; however, the experience of others who have shown that positive subcarinal nodes and multiple areas of nodal involvement portend an especially poor prognosis suggests that the separation of specimens may be helpful.
In our five-year experience, cytologic material obtained by TBNA was generally in close agreement with the findings noted on biopsy. In view of the potential for false-positive results, we consider all scanty specimens or suspicious cytologic findings to be negative and require independent histologic confirmation. In addition, the report by Schenk et al of a right upper lobe tumor adjacent to the trachea in a patient who had a false-positive paratracheal aspirate has also made us reluctant to preclude surgery on the basis of a positive TBNA alone in patients with tumors in this location. In these cases, we cannot be sure that the aspirate is truly sampling mediastinal nodes unless lymphocytes are also seen in the specimen.

Since the treatment of small-cell carcinoma is clearly different from that of other types of lung cancer, we were initially reluctant to accept the cytologic results of TBNA in these cases as providing sufficient evidence with which to initiate chemotherapy; however, our oncologic colleagues believed that if a patient's response to treatment was not prompt, additional tissue could be obtained. Clinical follow-up of the 11 patients with small-cell carcinoma diagnosed by TBNA alone has confirmed that the original cytologic diagnosis was correct. On the basis of these findings, we believe that it is reasonable to begin initial chemotherapy for patients with small-cell carcinoma diagnosed only by TBNA, with the understanding that additional histologic confirmation may be necessary if there is no response to treatment.

Although the degree to which mediastinal involvement will prognosticate outcome is not altogether clear, it has been established that a normal chest x-ray film or CAT scan by no means excludes mediastinal malignant adenopathy. In our previous experience, TBNA procedures were positive 46 percent of the time when the chest x-ray film did not indicate mediastinal disease and 38 percent of the time when the tracheal anatomy at the time of bronchoscopy was believed to be normal. These data, as well as the frequency with which small-cell carcinoma may alone be diagnosed by this technique, indicate its utility during the initial bronchoscopic examination.

The sensitivity of TBNA to demonstrate N2 disease reported in the literature varies from 50 percent noted by Schenk et al to 77 percent reported by Wang et al. Specificity as determined by these authors was 96 percent and 100 percent, respectively. Because ours was a retrospective clinical study, the sensitivity and specificity of our use of TBNA could not be determined. Since a false-negative TBNA is not uncommon, surgical exploration is necessary to establish the presence of mediastinal disease. Although false-positives are infrequent, they are not rare, and we were able to identify two cases in 129 reported positive N2 aspirates that had a negative mediastinal exploration at thoracotomy. Careful adherence to proper technique, therefore, is essential to prevent the misinterpretation of positive results, particularly if only a few malignant cells are seen.

We did not note any significant complications with the use of TBNA. The experience of numerous observers has also demonstrated the benignity of this technique. In particular, fears of experiencing significant bleeding when puncture of the great vessels occurs have not materialized. This is not surprising if one recalls that a percutaneous approach for aortography and needle puncture of the left main-stem bronchus to obtain left atrial pressures in patients with mitral stenosis were standard techniques by physicians of a previous generation.

It is now appreciated that in patients with mediastinal disease, four factors indicate a poor prognosis: (1) positive subcarinal nodes; (2) contralateral involvement; (3) multiple levels of nodal involvement; and (4) extracapsular extension of tumor. Transbronchial needle aspiration provides valuable diagnostic data in three of these four categories and can do so accurately, safely, and with minimal additional expense. Whether patients with non-small-cell carcinoma whose N2 nodes are positive by TBNA but are without radiographic evidence of mediastinal tumor will have a better prognosis than those with a positive mediastinal TBNA as well as roentgenographic evidence of malignant disease is currently uncertain.

A positive aspirate, therefore, may be interpreted in several ways. In cases of small-cell carcinoma, it establishes the diagnosis, precludes surgery, and indicates the therapeutic course. In otherwise healthy individuals with a non-small-cell aspirate and a roentgenographically normal mediastinum, surgery remains an option. Similarly, in patients with a tumor contiguous with the trachea, mediastinal exploration may still be necessary, since one cannot be certain that the mediastinal lymphatic nodes have been sampled unless lymphocytes are seen in the specimen. In many patients, significant coexistent pulmonary, cardiac, or vascular disease is such that these problems, along with the demonstration of frankly malignant cells in the mediastinal lymph nodes, are often sufficient to preclude further surgery; however, in all cases, we believe that the finding of a positive TBNA should be considered an important contribution to the decision-making process, rather than an absolute arbiter of an individual's fate.

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