CT Scan Directed Transbronchial Needle Aspiration Biopsy for Mediastinal Nodes*

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Study objectives: This study was performed to determine whether transbronchial needle aspiration (TBNA) biopsy under CT guidance can increase its diagnostic yield so that this technique can be used for staging of lung cancer at our institution.

Study design: After an initial unacceptable low yield of TBNA on the first 10 patients (20% positive), we switched the biopsy procedure from the bronchoscopy suite to the CT room. After each passage of the needle to the mediastinum lymph node, CT scan was performed to locate the tip of the needle. If the initial attempt was not successful, TBNA was repeated at the same setting until CT documented that the tip of the needle was exactly inside the lymph node.

Result: A total of 49 patients with 69 mediastinum adenopathies were enrolled in this study. There were 31 patients with malignant mediastinal adenopathy proven by TBNA (60% sensitivity). Fifteen patients showed normal results of needle aspiration despite the presence of primary lung cancer. Three patients showed mediastinal abscesses.

Conclusion: Despite numerous successful reports in the literature, the general application of the TBNA procedure appears to be limited because of its low sensitivity, although this could be due to numerous factors. However, using CT guidance to be sure that the tip of the needle is exactly inside the node can increase its sensitivity markedly. It may also increase the specificity of normal results of TBNA biopsy.

(CHEST 1998; 114:36-39)

Key words: CT; lymph node; transbronchial needle aspiration

Abbreviations: LN=lymph node; TBNA=transbronchial needle aspiration

This study evaluated the role of transbronchial needle aspiration (TBNA) under direct CT scan. Aspiration specimens were obtained only after the needle was confirmed in the lesion. Sixty-nine mediastinal enlarged nodes of 49 patients were sampled by TBNA under CT scan, and all patients had a final diagnosis. Mediastinal anatomy, including vascular structures and lymph nodes (LNs) are clearly imaged with CT scan during TBNA biopsy. This technique may be particularly useful in sampling smaller para-tracheal nodes.

TBNA is a safe and effective technique for sampling the mediastinal LNs.1 Puncture site is based on an approximation from the prebronchoscope imaging studies; this may reduce the accuracy to a sensitivity of 50%.2 CT scan is very sensitive for the detection of mediastinal nodes. The combination of the two techniques may increase the diagnostic yield.3 To improve accuracy of needle placement, the nodes in the mediastinum were sampled by TBNA through bronchoscopy directed by CT scanning.

MATERIALS AND METHODS

Forty-nine patients (39 men, 10 women; average age, 61±12.3 years) underwent chest CT for localizing the mediastinal adenopathy prior to bronchoscopy. All scans were performed on a scanner (Toshiba Xspeed II Scanner; Tokyo, Japan) with scan time of 3 s, using continuous 1-cm slices with adequate IV contrast enhancement in all patients. Significant mediastinal adenopathy was defined as any node >1 cm in diameter in the short axis. The adenopathy is listed in Table 1. The site for penetration (distance) was measured from chest CT scans using the carina as a reference point. Needle placement (depth and angle) was directed by using a cross section of the trachea as a 12-h clock face.

After topical anesthesia with 4% lidocaine, patients lie on the table of the CT scanner. Fiberoptic bronchoscope (Olympus BF-1T20; Tokyo, Japan) was inserted either transorally or transnasally. The TBNA was performed prior to brushing and biopsies.
in all patients to avoid contamination of the trachea with cellular material from the more distal airway. When the target area was approached, the needle tip was pushed out 3 to 5 mm and embedded and fixed into the bronchial wall; CT scan (using continuous 3-mm slices) was performed to find the needle; if the site corresponded to the nodes in the CT scan, the puncture was begun. After the penetration of the tracheobronchial wall, a CT scan was made before aspiration to locate the needle; the angle and the depth were adjusted from the CT scan (Fig 1). When the needle tip was in the lesion, the needle catheters were connected to a 50-mL syringe; the needle was then moved back and forth through the tracheal wall during continuous suction. Care was taken not to pull the needle completely out of the wall. After 20 s, suction was discontinued and the needle was withdrawn from the tracheal wall through the bronchoscope; specimens in the needle were flushed onto a glass slide and smeared. This procedure was repeated two times for better depth and angle at the same identical site. Following staging TBNA, diagnostic procedures (brushing, biopsies) were performed as indicated. Posteroanterior chest radiographs were performed in all patients following bronchoscopy.

It had been described that to penetrate the tracheal-bronchial wall, a jabbing technique or pushing technique can be used.4 Our method is that the needle tip is first lodged in the mucosa of the puncture site, after which the catheter is further advanced so that half the entire length of the needle protrudes out the tip of the bronchoscope. While under tension, an assistant fixes the proximal end of the catheter against the bronchoscope, preventing the needle catheter from sliding back when resistance is met. The bronchoscope and catheter as a unit are then pushed forward with a constant force. When the bronchial wall is penetrated, the resistance disappears. Then, the rest of the needle is pushed into the target.

Table 1—The Node Location in Mediastinum

<table>
<thead>
<tr>
<th>LN Location*</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ant carina</td>
<td>25</td>
</tr>
<tr>
<td>Post carina</td>
<td>3</td>
</tr>
<tr>
<td>R paratrachea</td>
<td>21</td>
</tr>
<tr>
<td>L paratrachea</td>
<td>7</td>
</tr>
<tr>
<td>R main bronchus</td>
<td>7</td>
</tr>
<tr>
<td>L main bronchus</td>
<td>3</td>
</tr>
<tr>
<td>R upper hilar</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
</tr>
</tbody>
</table>

*Ant=anterior; post=posterior; R=right; L=left.

A total of 49 patients with 69 mediastinum adenopathies were enrolled in this study. The most commonly involved LNs are the anterior carina group and the right paratracheal group followed by the left paratrachea and the right main bronchus LN (Table 1). The final diagnosis of the mediastinal adenopathy that was obtained by TBNA under CT scanning is reflected in Table 2. There were 31 patients with malignant mediastinal adenopathy proven by TBNA, including 2 lymphomas without a primary lung lesion. Of the remaining patients, eight showed inflammatory LNs despite the fact that all the eight patients had primary lung cancer proven by means other than TBNA, three patients had abscesses without any lung lesion, and seven patients were reported to have normal LNs with proven primary lung cancer.

No complications of significant bleeding were encountered; neither dyspnea nor ventilatory compromise occurred. There were no complications of pneumothorax, pneumomediastinum, or bacteremia.

**Discussion**

The TBNA technique has expanded the role of the bronchoscope from diagnosis to staging. It permits assessment of mediastinal contents at the time of diagnostic bronchoscopy. In our study, there were 31 positive aspirates from 49 patients with a sensitivity of 60%. Cystic lesions have been approachable by TBNA. Three mediastinal abscesses in our study were punctured both diagnostically and therapeutically. Fifteen patients had normal mediastinal aspirations with proven cancer of the lung. The specificity of this negative result cannot be determined but most likely it does represent a true negative from a clinical presentation.

Enlarged lymph node by radiograph or CT scan usually indicates metastases.5 However, radiographic

**Figure 1.** Left: the tip of the needle is medial to the node. Right: the tip of the needle is in the node.
false positive resulting from reactive lymph nodes do occur frequently in bronchogenic carcinoma. Therefore, the presence of metastatic nodes must be confirmed by the pathology department before a curative surgery is denied. Small nodes may harbor metastases and large nodes can be benign. In addition to metastases, abnormal size nodes may be caused by reactive changes from atelectasis, postobstructive pneumonitis, or prior granulomatous disease. In our study, there were eight inflammatory and seven normal mediastinal nodes with a proven malignant lesion in the lung.

It is important to know the location of the nodes in planning of TBNA, especially for the smaller nodes (<1.5 cm) and the nodes adjacent to the major blood vessels (Figs 2 and 3). CT scan guided TBNA can visualize the needle and select an optimal site for needle penetration and can confirm the depth and angle in real-time during the biopsy, thus ensuring that one is indeed sampling the lesion. Furthermore, the relationship of LNs and vascular structures can be clearly defined by this technique to avoid possible complications. A significant correlation was seen between the success of TBNA and mediastinum LN size. This confirms the difficulty in taking biopsy specimens of mediastinum nodes of smaller size when using an approach guided by endoluminal landmarks and prebronchoscopy chest CT. CT-guided or ultrasound-guided TBNA has been used to perform TBNA. In our study, to improve the accuracy of needle placement, several CT scans were done during TBNA to adjust the angle and depth from CT image and to help the operator reach the exact location. Sometimes, two to three punctures had to be done following the CT physician’s guidance. CT-guided TBNA may be most useful when sampling smaller (<1.5 mm) nodes to avoid a mediastinoscopy. Furthermore, a mediastinoscopy cannot assess the posterior subcarinal and left paratracheal/aortopulmonary window regions. TBNA, particularly with CT mapping of associated vascular structures, can be used to sample these regions. Some of the mediastinal nodes we sampled were in these difficult locations. As stated by Wang, the sequential use of the two relatively new techniques, the CT scan and TBNA, has retained the sensitivity of the CT scan in discovering abnormal LNs and the specificity of TBNA to diagnose the cell type of a metastatic lesion in the LN. After failure or very low yield of an initial attempt of the TBNA technique at our institution (20%), we switched to CT-guided TBNA. In our study, the simultaneous use of these two techniques has dramatically increased the yield of TBNA from 20 to 60% compared with our initial experience of TBNA without CT guidance. This is due to confirmation of the exact placement of the needle into the lesion under CT guidance.

Furthermore, if blood was aspirated into the syringe, the procedure need not be terminated if CT scan ensures that the needle is in the lesion. Abundant cancer cells were found on the smear of the bloody specimens in several cases.

We conclude that although TBNA is a very useful procedure to some experts, general application of this procedure is limited due to its low yield. CT guidance has enabled us to apply TBNA for staging of lung cancer at our institution.
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