Extrapleural paravertebral CT-guided fine needle biopsy of subcarinal lymph nodes

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Purpose

To report our experience in CT guided extrapleural paravertebral subcarinal lymph biopsy using a thin 25 gauge (25 G) thin needle without the need of injection of saline to widen the mediastinum.
Methods and Materials

Patient selection

This is a prospective study that was performed during the period from January 2007 through October 2009. One hundred and forty one patients were included [74 females (56.5%), 57 males (43.5%), age range of 6-76 years, (mean 36.6)]. All patients had subcarinal mediastinal lymphadenopathy and were referred from different specialties, mostly from the pulmonologist for CT guided biopsy. All had a written consent to undergo the biopsy.

Procedure

Reviewing of all available previous imaging studies (including previous plain chest X-ray, CT scans and MRIs) of the patients was done to evaluate the patient's condition and to choose the shortest route to avoid injury of important structures. The procedures were performed on a Philips Tomoscan single slice AVP1 helical machine (Philips, Healthcare). Preparatory pre-procedural imaging included a first helical non-contrast acquisition, in 1) prone, or 2) prone oblique or 3) lateral decubitus positions, in a descending order of preference, as much as the condition of the patient permits. The prone position found to be the best to keep the patient in a motionless status, and gives the chance for a better torque for the needle placement. After acquiring the scan, we analyzed the acquired images for monitoring the disease progression, and consequently choose the target lymph node. The following CT parameters were used: 3-5 mm slice thickness, 200-mm anatomic coverage, 1.0 pitch, and 350-500 mm field of view, with a kV of 120 and mAs of 125-225.

Several sequential series of 3- to 5-mm-thick images centered on the target were obtained at the interventional radiologist's demand to monitor needle progression throughout the procedure.

The shortest path through the skin, subcutaneous fat, posterior mediastinal fat, avoiding vital structures was selected. All procedures were performed without the need for local anesthesia, however basal sedation was needed in few pediatric and unsteady patients. A 25G spinal thin needle, with a length of 9-12 cm (Spinocan, Sonderkanüle, B.Braun, Mestungen, AG) was used for aspiration of the lymph node for cytopathological samples (Figure 1,2). Gradual insertion of the 25G needle was performed under CT guidance in a plane between endothoracic fascia and parietal pleura in a direct paravertebral path with bevel of the needle looking towards the vertebrae, which makes it easier to glide over it. When the narrowest point between the vertebrae and lung was reached, bevelling of the needle was turned towards the lung to avoid its injury. We tried to pass along superior edge of the rib and above the transverse process to avoid injury of intercostal vessels.
If this window was found narrow or closed for any reason, other window approach can be used (for instance below the rib approach). Because the needle is so thin, chances of nerve or vessel injury is little and negligible.

No artificial widening of the mediastinum using saline injection was required. The progression in fat usually required gentle pressure but was usually painless. Resistance or significant pain during needle progression indicated that an unexpected structure was encountered. In these cases, several sequential CT series were performed to reach proper position, to avoid transgression of the pleura or lung. Negotiation and reposition of the needle were sometimes needed when osteophytes (Figure 3), hypertrophied costo-transversus, and costo-vertebral joints (Figure 4) were encountered, permitted by the malleability and resilience of the 25G needle. The 23G needle was used in other cases (not included in the study), and being a little more stiff may cause lung transgression by hitting bone and changing direction instead of gliding on it. We more often used right paravertebral in 93 patients (Figure 1) than the left paravertebral retroaortic approach in 48 patients (Figure 2). Choice of the approach side depended on the width of the extrapleural paravertebral space, alignment of the lesion with the entry point, and the trajectory length and presence of vital structures in the path. In right sided approach, particular care to structures such as azygous vein was given, on the left sided approach, care to descending aorta, superior, hemi-or accessory azygous vein and oesophagus was given. In some cases, we were obliged to traverse or violate these structures (but not the aorta), using this thin narrow-bore needle with no significant complications (Figure 5). A multislice 16 rows CT machine with CT fluoroscopy was available during the 2nd half of the study period and used in the cases with no much added values. The study was performed in the presence of a cytopathologist. Cytopathological assessment of adequacy of aspirated material was confirmed during aspiration and repetitions were needed in hypocellular aspirates.

Complications were documented for each case especially pneumothorax and hemorrhage. If the procedure is uneventful, the patient is monitored for 2-4 hours before discharge. Patients, with expected possible complications (e.g. transgression of vital structures) were followed for 3-4 hours after the procedures by an hourly limited non-contrast CT, and the patients were then discharged if no complications were found. Those having minor complication were demanded to be followed by non-contrast CT every other day for a week.

Cell blocks were prepared for further immuno-staining if needed. A complete panel of markers was available for confirmation of the diagnosis. Sensitivity and specificity rates were calculated.
Images for this section:

**Fig. 1:** Right paravertebral extrapleural approach for CT guided biopsy of subcarinal lymph node using a 25G needle (white arrow), choosing the shortest path and avoiding vital structures

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Fig. 2: Left paravertebral extrapleural approach avoiding aorta (white arrow)

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Fig. 3: Negotiation through osteophytes (white arrow)

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Fig. 4: Negotiation through hypertrophied costo-transversus and costo-vertebral joints (white arrow).

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Fig. 5: Lung window image presenting needle transgression of azygous vein (white arrow) and oesophagus by a 25G needle resulting in small hematoma from which the patient recovered completely.

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Results

Reaching the subcarinal lymph nodes target was successful in all 141 procedures. A cytopathological diagnosis was reached in all cases. A single entry was performed for 97 cases (68.8%) and repeated in the same setting twice in 39 cases (27.7%) and for 3 times in 5 cases (3.5%).

All re-aspirations were done in the same session to reach a primary diagnosis at the time of the biopsy. A primary cytopathological diagnosis was achieved in all cases. Immunophenotyping study was needed in 94 cases to confirm the primary diagnosis and to classify the malignant lesions.

After adding the information of immunophenotyping and culture to the cytopathological diagnosis, the final diagnosis of the cases were: 32 benign cases, out of them, 22 were diagnosed of tuberculous etiology, 9 cases of sarcoidosis and one case of toxoplasmosis (Table 1), and 109 malignant cases (56 out of them were Non-Hodgkin's lymphoma, 28 metastasis, and 25 Hodgkin's disease). In metastatic lesions, the primary site of origin was clearly defined in 24 out of 28 cases using cytopathological criteria and documented by immunophenotyping in 12 cases (Tables 1 and 2).

FNAC result showed a sensitivity of 97.2% and specificity of 100%. Immunophenotyping allowed us to reach a final diagnosis in all cases which was confirmed by histopathology, surgery, or response to medical treatment (Table 3).

No pneumothorax was encountered and only few cases complicated with a small hematoma - 5 cases (3.5%). All hematomas were resolved spontaneously. Transgression or violation of important structures e.g. oesophagus (16 cases), azygous (26 cases) and hemi- or accessory azygous (7 cases) was experienced in 46 cases (two structures were transgressed in 3 cases). Non had an arterial structure transgression (e.g. Intercostal or paravertebral artery). The venous transgression resulted in the mention small hematoma in 5 cases, followed for a week by non- contrast CT scan, and resolved spontaneously. Transgression of the oesophagus with the very thin needle did not result in any post-procedural cellulitis or mediastinitis, as confirmed by imaging and clinical follow ups (Table 4).

In 4 cases we found that the extrapleural paravertebral biopsy approach to an enlarged lymph node in the subcarinal region was a good alternative to transgression of an emphysematous lung for a primary lung lesion diagnosis, thus avoiding the possibility of secondary massive pneumothorax which may occur (Figure 6,7).
Table 1: Distribution of benign cases diagnosed primarily by fine needle aspiration cytology (FNAC), before and after adding culture/immunophenotyping information modifying the diagnosis.

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Table 2: Distribution of malignant cases diagnosed primarily by fine needle aspiration cytology (FNAC), before and after adding culture/immunophenotyping information modifying the diagnosis.

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Table 3: Number of false -ve and false +ve FNAC cases after immunophenotyping in benign and malignant cases of subcarinal lymph nodes.

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## Table 4: Distribution of violation of important structures during the procedures (46 cases)\(^a\)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Frequency</th>
<th>Complications</th>
<th>Follow up results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oesophagus</td>
<td>16</td>
<td>No complications</td>
<td>Normal follow up</td>
</tr>
<tr>
<td>Azygos</td>
<td>26</td>
<td>4 small hematomas</td>
<td>Spontaneous resolution of hematomas on follow up</td>
</tr>
<tr>
<td>Hemiazygos</td>
<td>7</td>
<td>1 small hematoma</td>
<td>No follow up</td>
</tr>
</tbody>
</table>

\(^a\) Transgression of two important structures occurred in 3 cases.
Fig. 6: A case of right bronchogenic carcinoma in a significantly emphysematous lung.

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Fig. 7: Case of right bronchogenic carcinoma showing the path of a 25G needle although transgressing the esophagus however avoiding the danger of massive pneumothorax using this route. This way a diagnosis is confirmed in addition to staging of the condition.

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Conclusion

Fine needle aspiration cytology (FNAC) using a 25 gauge needle for subcarinal lymph nodes via a percutaneous extrapleural paravertebral CT guided approach is a safe, minimally invasive, and tolerable procedure yielding a high sensitivity and specificity rates without the need of artificial widening.
References


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