CT-guided transthoracic lung biopsy: a comparison of a co-axial core biopsy with non co-axial fine needle aspiration biopsy and factors influencing complications

Poster No.: C-2636
Congress: ECR 2018
Type: Scientific Exhibit
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Keywords: Interventional non-vascular, Thorax, Oncology, CT, Biopsy, Cancer, Tissue characterisation, Hemorrhage

DOI: 10.1594/ecr2018/C-2636

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Aims and objectives

Lung cancer is one of the most common causes of cancer-related death worldwide. With the widespread use of CT, increasing number of lung lesions are detected and histological diagnosis is often necessary to determine the most appropriate management of these lesions (1). Computed tomography (CT)-guided percutaneous needle biopsy has been a well-established method for obtaining a histopathological diagnosis of lung lesions for decades (2). Although non-co-axial fine needle aspiration biopsy (FNAB) has been used frequently for many years, the use of co-axial core biopsy has recently increased. Lesion dimensions and complication risks may play a role in the selection of the method. FNAB is commonly used for diagnosing small pulmonary lesions more frequent than core needle biopsy. However, recent studies have demonstrated decreased diagnostic success for small lesions (2,4,5).

Although both methods have high diagnostic accuracy, co-axial core biopsy has many advantages. FNAB only shows the cytological features of the lesion, but not the tissue architecture and also has the risk of insufficient tissue sampling. Core needle biopsy is a more accurate method of tissue sampling than FNAB because it can obtain multiple large specimens for histopathology diagnosis (3). Also, molecular testing can be performed on the material obtained by core needle biopsy when targeted therapies are available including epidermal growth factor receptor mutations in lung cancer or oestrogen and progesterone receptor status in breast cancer metastases (6).

Pneumothorax is the most common complication of percutaneous lung biopsy occurring in 17-60 %. The minority of procedures chest tube requires drainage (1-14.2%). The second most common complication is parenchymal haemoraji and reported rates are between 4-27 % (7,8,9). In the literature, it is reported that lesion size, lobe, the trans-parenchymal distance of the needle, needle-pleural angle, patient position, age, gender and the presence of emphysema are the factors that affect the complication rates (9,10). But the extrapleural distance of needle pathway, the presence of pleural effusion and whether the lesion is cavitary have not been discussed previously.

The aim of this study was to compare diagnostic success and complication rates of co-axial core biopsy and non-co-axial fine needle aspiration biopsy (FNAB) also to study factors that may influence complication rates.
Methods and materials

A retrospective evaluation of PACS was performed for patients who underwent CT guided lung biopsy between January 2009 and September 2017 at Dokuz Eylul University Hospital. Patients who underwent non-co-axial core biopsy and extra-parenchymal lesions were excluded from the study. CT investigations were evaluated by two independent radiologists. Measurable data like lesion size and distance from the pleura were evaluated with an arithmetic average of two observer's measurement.

159 patients who underwent CT-guided lung biopsy were analyzed retrospectively. 78 were co-axial core biopsy and 81 were non-co-axial FNAB. A coaxial needle was 18G and a fine needle was 22G. We considered enough material for pathology as diagnostic success and compared between two technique. Also, pneumothorax and parenchymal haemoraji rates were compared. Pneumothorax was assessed on control CT that performed immediately after biopsy as a control. Ground glass opacities on needle tract were diagnosed as parenchymal haemoraji (fig 1).

Age, gender, the presence of emphysema and the presence of pleural effusion were recorded as patient characteristics. Emphysema was evaluated in two ways as general emphysema in lung and emphysema on needle tract. Lesion features are size, distance from pleura, lobe and whether the lesion is cavitary were recorded. Lesion size recorded two axis perpendicular to each other from the axial section where the maximum dimension is measured. These two lengths were summed and divided in half to record the average length. The distance from the pleura is measured as the distance from the side to the visceral pleura where the lesion is closest to the visceral pleura. The trans-parenchymal distance of the needle, an extrapleural distance of needle pathway, needle-pleural angle and patient position were evaluated as technical features. The trans-parenchymal distance of the needle was measured as the distance the needle passed through the lung parenchyma (fig 2). An extrapleural distance of needle pathway was measured from visceral pleura to the skin (fig 3). A line was drawn tangential to the pleura at the point of needle puncture and the needle-pleural angle was determined by the angle between the needle route and that line (fig 4). The patient position was marked as supine, prone or lateral decubitis.

Diagnostic success rate and complication rates were compared between two technique. The complications were correlated with patient, lesion and procedure-related variables.

Statistical evaluation
SPSS 22.0 software was used for statistical analyses. Chi-Square tests, Fisher’s Exact test and independent samples tests were used for statistical analysis. P value #0.05 was considered significant.
Fig. 1: 69 years old female patient, parenchymal haemoraji occurred after non-co-axial FNAB to right lower lobe lesion in prone position.

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**Fig. 2:** 57 years old female patient, co-axial core biopsy performed to the lesion in the upper lobe of the right lung on lateral decubitus position. The trans-parenchymal distance was measured.

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Fig. 4: 57 years old female patient, co-axial core biopsy performed to the lesion in the upper lobe of the right lung on lateral decubitus position. Needle-pleural angle was measured.

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Fig. 3: 72 years old male patient, a co-axial core biopsy performed on the lesion in the upper lobe of the right lung in the prone position. The extra-pleural distance of needle pathway and trans-parenchymal distance of the needle were measured.

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Results

159 patients who underwent CT-guided lung biopsy, 78 co-axial core biopsy and 81 non-co-axial FNAB were evaluated. Characteristics of 159 patients, lung lesions and biopsy procedures are shown in table 1.

<table>
<thead>
<tr>
<th>Table 1: Characteristics</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>n(%)</td>
</tr>
<tr>
<td>Male</td>
<td>121 (76.1)</td>
</tr>
<tr>
<td>Female</td>
<td>38 (23.9)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>66.2±11.4</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>26-89</td>
</tr>
<tr>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Lesion size (mm)</td>
<td>40.5±20.2</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>14-125.5</td>
</tr>
<tr>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Lesion location</td>
<td>n(%)</td>
</tr>
<tr>
<td>Right upper lobe</td>
<td>32 (20.1)</td>
</tr>
<tr>
<td>Right middle lobe</td>
<td>26 (16.4)</td>
</tr>
<tr>
<td>Right lower lobe</td>
<td>30 (18.9)</td>
</tr>
<tr>
<td>Left upper lobe</td>
<td>54 (34.0)</td>
</tr>
<tr>
<td>Left lower lobe</td>
<td>17 (10.7)</td>
</tr>
<tr>
<td>Patient position</td>
<td>n(%)</td>
</tr>
<tr>
<td>Supine</td>
<td>51 (32.1)</td>
</tr>
<tr>
<td>Prone</td>
<td>98 (61.6)</td>
</tr>
<tr>
<td>Lateral decubitus</td>
<td>10 (6.3)</td>
</tr>
<tr>
<td>Emphysema on general lung</td>
<td>68 (42.8)</td>
</tr>
<tr>
<td>Emphysema on needle tract</td>
<td>42 (26.4)</td>
</tr>
</tbody>
</table>
Lesion distance from pleura (mm)  
Mean±SD 12.2±14.4  
Range 0-67

Trans-parenchymal distance of the needle (mm)  
Mean±SD 24.6±14.0  
Range 5-64

Extrapleural distance of needle pathway (mm)  
Mean±SD 42.6±14.9  
Range 15-86

Needle-pleural angle  
Mean±SD 66.8±16.4  
Range 29-90

Pleural effusion 10 (6.3)  
Cavitary lesion 16 (10.1)  
Pneumothorax 58 (36.5)  
Parenchymal haemoraji 39 (24.5)

Diagnostic success rates were 67.9% for non-co-axial FNAB and 98.7% for co-axial core biopsy and this difference is statistically significant (p<0.001) (Table 2)

<table>
<thead>
<tr>
<th>Table 2 n(%)</th>
<th>Enough material for diagnosis</th>
<th>Non-diagnostic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-axial core biopsy</td>
<td>77 (98.7)</td>
<td>1 (1.3)</td>
</tr>
<tr>
<td>Non-co-axial FNAB</td>
<td>55 (67.9)</td>
<td>26 (32.1)</td>
</tr>
</tbody>
</table>

Pneumothorax developed in 22 patients with the co-axial core biopsy and 36 patients with FNAB (Table 3). Pneumothorax rate was less in co-axial core biopsy and this difference was statistically significant (p=0.033).
Parenchymal haemorrhage occurred in 16 patients with the co-axial core biopsy and 23 patients with FNAB (Table 3). There was no statistically significant difference between groups (p=0.248).

<table>
<thead>
<tr>
<th>Table 3 n(%)</th>
<th>Pneumothorax (+)</th>
<th>Pneumothorax (-)</th>
<th>Parenchymal haemorrhage (+)</th>
<th>Parenchymal haemorrhage (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-axial core biopsy</td>
<td>22 (28.2)</td>
<td>56 (71.8)</td>
<td>16 (20.5)</td>
<td>62 (79.5)</td>
</tr>
<tr>
<td>Non-co-axial FNAB</td>
<td>36 (44.4)</td>
<td>45 (55.6)</td>
<td>23 (28.4)</td>
<td>58 (71.6)</td>
</tr>
</tbody>
</table>

There was a positive correlation between the development of pneumothorax and smaller lesion diameter (p<0.001), a longer trans-parenchymal distance of the needle (p<0.015) and emphysema on needle tract (p=0.002). The significant risk factors affecting the incidence of parenchymal haemorrhage were smaller lesion diameter (p<0.005) and longer trans-parenchymal distance of the needle (p<0.0001). There was no correlation between complication rates and extrapleural distance of needle pathway, needle-pleural angle, position, age, gender, lobe, general emphysema, the presence of pleural effusion and whether the lesion is cavitary.
Conclusion

The diagnostic success rate of a co-axial core biopsy was higher as expected, due to multiple and larger material acquisition. Interestingly, although the needle was thicker, the rate of pneumothorax was lower in co-axial core biopsy and there was no difference the rate of pulmonary haemoraji. This may be due to the fact that more pleural passes have been made to obtain the material in sufficient quantities in non-co-axial FNAB. In this study we have not considered the number of pleural passes made in each patient for technical reasons and this was the main limitation of our study.

Smaller lesion diameter, a longer trans-parenchymal distance of the needle and emphysema on needle tract were risk factors for complications in our study in accordance with previous studies (7,8,9,10). The needle-pleural angle was defined as a risk factor in previous studies but not statistically significant in our study. In our study, there was no correlation between complication rates and an extrapleural distance of needle pathway, the presence of pleural effusion and whether the lesion is cavitary however these have not been discussed previously in the literature.

Diagnostic success rates were 67.9% for non-co-axial FNAB and 98.7% for co-axial core biopsy; pneumothorax rate was 44.4% in non-co-axial FNAB and 28.2% in co-axial core biopsy. Smaller lesion diameter, a longer trans-parenchymal distance of the needle and emphysema on needle tract were risk factors for complications.
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References

REFERANSLAR


