Significance of CT-guided core-needle (CNB) and fine needle aspiration biopsy (FNAB) in the diagnosis of lung and mediastinum tumours: analysis of frequency and types of complications

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Aims and objectives

The Cancer Genome Atlas Research Network (Collisson E, Campbell J, Brooks A et al.[1]) has published recently that in 76% of lung adenocarcinoma they found somatic evidence of RTK/RAS/RAF activation. More complete diagnostic information derived from immunohistochemistry and molecular biology are necessary for optimal treatment in lung cancer patients. Genomic and DNA alterations can be assessed in tumor samples and can be used for early detection and planning of personalized cancer treatment [2]. The most complex diagnostic information can be established having tumor tissue sample, not a cell block only. Tissue sampling is related to some side effects due to needle puncture of diagnosed pathological structures and all normal tissues along the needle track. Larger needle larger sample but also more complications.

Purpose of the study was to analyze frequency and types of early and late complications after FNAB and CNB of intrathoracic lesions.
Methods and materials

Material and methods

In the time period between January, 2012 and August 2014, a total number of 129 core-needle biopsies of the lung (94) and mediastinum (35) performed, were included in the analysis. Another 102 FNAB were analyzed along with 51 procedures performed in patients undergoing later CNB in order to complete the diagnosis (135 of lung, and 18 of mediastinal tumors). A total of 153 FNAB of lung and mediastinal tumors were analyzed (Table 1).

Table 1. Localization of thoracic tumors, which underwent core-needle biopsy or fine-needle aspiration biopsy.

<table>
<thead>
<tr>
<th>Location</th>
<th>CNB</th>
<th>FNAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediastinum</td>
<td>35 (27%)</td>
<td>18 (12%)</td>
</tr>
<tr>
<td>Lung</td>
<td>94 (73%)</td>
<td>135 (88%)</td>
</tr>
<tr>
<td>Total</td>
<td>282</td>
<td>153</td>
</tr>
</tbody>
</table>

Core needle biopsy with CT fluoroscopy guidance is performed by a team consisting of a radiologist, technician and a nurse. Prior to core-needle biopsy, the patient is premedicated to reduce the pain, intravenous access is established and coagulation parameters are measured. Following a scan of the area containing the lesion, radiologist selects a position which provides the best view and the easiest and safest access to the lesion. Insertion site of the biopsy needle is marked on the monitor along with the distance in relation to laser guidelines originating from the CT gantry. Then, the depth of the lesion from the surface of the skin is measured and needle puncture site is marked on the patient's skin. Radiologist selects the appropriate length (9-20 cm) and thickness of the biopsy needle (14-20 G). Once a sterile field (sterile drape cover, skin disinfection) has been created, radiologist administers a local anesthetic and after a period of about 2 minutes, incises the skin with a scalpel and inserts the biopsy needle under CT fluoroscopy guidance with real-time tracking and collects tissue sample. The range of CT fluoroscopy scan is 1.5 cm (3 layers, each 5 mm thick). The images are created at a rate of 1/s. Imaging parameters are set: 120 kV voltage, initially at 15 mA current. Once the biopsy needle has been properly positioned (Fig 3), sample material is collected. It is visually inspected for quality, placed in a container with formalin and transported to the Department of Pathology where it is immersed in a paraffin block. The biopsy would be repeated if there be no or little sample obtained or lack of tissue (fluid, necrosis) withdrawn.

Fine needle biopsy with a 20G or 21G needle is performed by a team consisting of a pathologist, radiologist, electroradiology technician and a nurse. After puncture planning
the needle is introduced into the chosen place and contrôle-CT is performed. Then the aspiration is made by the pathologist and aspirated material placed on the glass slides or prepared as a cell block. This procedure needs 2-3 minutes with the needle in the lesion.

After both methods a follow-up CT imagining is performed 5 minutes post biopsy in order to identify potential early complications.

Analysis of complications

After completion the procedure, patients were evaluated for the presence of early complications related to biopsy on 5 minutes post biopsy LDCT. After 24 hours hospitalization at the Department of Thoracic and Oncologic Surgery any later complications were noted. The following complications were included: pneumothorax not requiring and requiring the drainage (Fig 1), subcutaneous emphysema, interstitial hematoma (Fig 2), pleural hematoma, hemoptysis, hemorrhage requiring the intervention, cough, air embolism, and death.
Images for this section:

**Fig. 1:** Pneumothorax after CNB (no need to drain it)

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**Fig. 2:** Interstitial haematoma after CNB. No intervention needed.

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**Fig. 3:** Core needle in the tumor

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Results

CNB was performed in 59 women and 70 men, aged 19-84 (mean age 60 years). FNAB was performed in 52 women and 101 men, aged 20-87 years (mean age 62 years). FNAB was performed significantly more frequently in men than in women. Table 2 presents data and percentage distribution of diagnoses acquired with both types of biopsy.

Table 2. Types of diagnoses made after biopsy.

<table>
<thead>
<tr>
<th>Type of diagnosis</th>
<th>CNB</th>
<th>FNAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Non-diagnostic</td>
<td>6 (4.7%)</td>
<td>9 (6%)</td>
</tr>
<tr>
<td>II. Cellulae carcinomatosaes</td>
<td>4 (3.1%)</td>
<td>77 (50%) *</td>
</tr>
<tr>
<td>III. Fully diagnostic</td>
<td>119 (92.2%)</td>
<td>67 (44%) *</td>
</tr>
<tr>
<td>- Ca (no immunohistochemistry)</td>
<td>40 (31%)</td>
<td>0 *</td>
</tr>
<tr>
<td>- Ca with immunohistochemistry</td>
<td>39 (30%)</td>
<td>0 *</td>
</tr>
<tr>
<td>- No cancer cells</td>
<td>17 (13%)</td>
<td>46 (30%) *</td>
</tr>
<tr>
<td>- Benign changes</td>
<td>23 (18%)</td>
<td>21 (14%)</td>
</tr>
<tr>
<td>Total</td>
<td>129</td>
<td>153</td>
</tr>
</tbody>
</table>

*) Statistically significant difference

Table 3 presents data and percentage distribution of early and late complications according to the biopsy method.

Table 3. Early post biopsy complications

<table>
<thead>
<tr>
<th>Type of complication</th>
<th>CNB</th>
<th>FNAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax (no drainage)*</td>
<td>21 (16%)</td>
<td>12 (8%)</td>
</tr>
<tr>
<td>Pneumothorax (drainage)*</td>
<td>5 (4%)</td>
<td>0</td>
</tr>
<tr>
<td>Subcutaneous emphysema</td>
<td>2 (1.5%)</td>
<td>0</td>
</tr>
</tbody>
</table>
Interstitial hematoma * 20 (16%) 7 (4%)
Hemoptysis * 7 (5,5%) 0
Pleural hematoma 0 0
Hemorrhage 0 0
Pain 0 0
Air embolism 0 0
Cough 2 (1,5%) 0
Death 0 0
Total * 57 (44%) 19 (12%)

*) Statistically significant difference

The CNB is related to significantly more frequent early complications, such as pneumothorax, interstitial hematoma and hemoptysis. In 44% patients after CNB we have noted some early complications, when after FNAB in 12% only. None of them needed surgical intervention.

Table 4 presents types of the late complications and their frequency according to the biopsy method.

We have noted significantly more frequent later complications after CNB (33%) than after FNAB(14%). They were pneumothorax and pain needing analgesia.

Table 4. Late post biopsy complications.

<table>
<thead>
<tr>
<th>Type of late complications</th>
<th>CNB</th>
<th>FNAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumothorax (no drainage)</td>
<td>7 (5,5%)</td>
<td>4 (2,5%)</td>
</tr>
<tr>
<td>Pneumothorax (drainage)</td>
<td>9 (7%)</td>
<td>8 (5%)</td>
</tr>
<tr>
<td>Pain *</td>
<td>17 (13%)</td>
<td>4 (2,5%)</td>
</tr>
<tr>
<td>Other</td>
<td>7 (5,5%)</td>
<td>4 (2,5%)</td>
</tr>
<tr>
<td>Cough</td>
<td>3 (2%)</td>
<td>2 (1,5%)</td>
</tr>
<tr>
<td>Total *</td>
<td>43 (33%)</td>
<td>22 (14%)</td>
</tr>
</tbody>
</table>

*) Statistically significant difference

Discussion

Personalized treatment of thoracic tumors needs more precise diagnostic method. Tissue sample can be taken by surgeon after mediastinoscopy, thoracoscopy and open surgery,
but these are the procedures related to significant complications, frequently treated by surgery.

Development of both methods, fine needle aspiration biopsy (FNAB) and core needle biopsy (CNB) leads to larger sample volume in FNAB and lower needle size in CNB. In several papers, a comparison of efficacy of percutaneous CNB and FNAB of the chest tumors was performed. In both, prospective and retrospective analyses, it was found that accuracy of CNB (67-97%) is significantly higher than for FNAB (40-92%). The highest accuracy of 87-97% resulted in pathomorphological evaluation of both, FNAB and CNB specimen. The published results are different, and related to individual experience of radiologist and pathologist involved in the diagnostic process. The best results have been published for US-guided biopsies due to the shortest procedure time and better visualization of puncture place (lower probability of necrotic sample or blood within it). US-guidance of percutaneous transthoracic approach needs however direct contact of the tumor and the chest wall. In deeper lung parts or mediastinal tumor an X-ray guidance is necessary. The optimal guidance methodology seems to be a CT-fluoroscopy in near real-time. The most frequent post biopsy complications in thoracic region are pneumothorax and interstitial hematomas. Less frequent but quite important complication is hemoptysis. All of these complications were significantly more frequent after CNB, but none of them needed surgical intervention.

In the literature, the pneumothorax rates were reported between 0.0% and 35.1% for FNAB and 0.0%-28.6% for CNB. Anderson et al. [3] and Lourenco et al. [4] even reported that, compared with FNAB, CNB had a lower pneumothorax rate. No study showed a significant difference for rates of pulmonary hemorrhage and hemoptysis between the two procedures. The highest pulmonary hemorrhage rate was 25.4% (35 patients), which occurred in one study in which FNAB and CNB were performed on the same patients [5]. In addition to the most common complications of pneumothorax, pulmonary hemorrhage, hemoptysis, and subcutaneous hematoma reported in the eligible studies, Staroselsky et al. [6] also reported 5 patients (2.7%) with chest pain, successfully treated with analgesics. In this work, we found significantly higher frequency of early and late complication after CNB.
Conclusion

Conclusions

Despite an increased risk of some complications, core-needle biopsy is highly useful in the diagnosis of lung and mediastinal tumors, and helps in planning of personalize cancer treatment.
References

References:


