

# Transthoracic needle biopsy of lung masses: a survey of techniques

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## KEYWORDS

Biopsies, technology;  
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Lung, biopsy;  
Pneumothorax

**AIM:** In order to assess the range and everyday use of the various techniques for percutaneous transthoracic needle biopsy of lung masses in the USA and Canada, we surveyed thoracic radiologists in academic and community practice on their standard approach to the procedure.

**MATERIALS AND METHODS:** The 300 questionnaires that were mailed to members of the Society of Thoracic Radiology throughout the USA and Canada contained specific questions on their approach to a transthoracic needle biopsy of a routine case of a 3 cm lung mass located in the right lower lobe 1 cm from the pleural surface.

**RESULTS:** A total of 140 (47%) members responded. Of the 139 responders who performed lung biopsies, 103 (74%) were located at a teaching centre affiliated to a university or medical school, and 36 (26%) were community-based radiologists. In total 97 (70%) replied that they would perform the procedure under CT guidance, 31 (22%) under either CT or fluoroscopy guidance, and 11 (8%) only under fluoroscopy. Fine-needle aspiration was the procedure of choice for the given case by 101 (73%) responders, whereas 20 (14%) preferred doing core biopsy, and 18 (13%) chose both techniques. On-site cytology confirmation for obtaining diagnostic material was available to 101 (73%) responders. Before performing the procedure, 107 (77%) verified coagulation tests whereas 32 (23%) did not. Follow-up imaging for pneumothorax assessment was not routinely performed by 15 (11%) responders.

**CONCLUSION:** The majority of radiologists performed percutaneous transthoracic needle biopsy of a lung mass under CT guidance, by fine-needle aspiration, using repeated pleural puncture technique, and with a cytologist on site. A significant minority did not obtain coagulation screening before the procedure, and a small minority did not routinely assess for pneumothorax by late chest radiography.

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## Introduction

Over the last three decades, percutaneous biopsy has emerged as the invasive procedure of choice for the diagnosis of lung cancer. The introduction of various thin-walled small-diameter needles, accompanied by increased expertise of

cytopathologists and advances in imaging guidance, have contributed to the growing acceptance of the method. Nevertheless, no single procedural approach is uniformly followed. We surveyed thoracic radiologists in academic and community practice on their usual approach to transthoracic needle biopsy of a routine case of a lung mass.

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## Materials and methods

A total of 300 questionnaires were mailed to all members of the Society of Thoracic Radiology

located throughout the USA and Canada. The list of members of the Society of Thoracic Radiology was obtained from the Society. Each radiologist was addressed individually, regardless of the number of other members affiliated to the same institution. The questionnaire was designed so that it could be completed rapidly and a stamped, addressed envelope for reply was included. The survey consisted of multiple choice questions on the radiologist's approach to transthoracic needle biopsy of a routine case of a 57-year-old male, with no smoking or medical history, who presented with a 3 cm lung mass located in the right lower lobe 1 cm from the pleural surface. Specific questions included practice type (teaching centre or community), imaging guidance technique (fluoroscopy or CT), biopsy technique (fine-needle aspiration or core biopsy), needle type and size, number of passes, cytologist assistance on site, monitoring during the procedure, and pneumothorax assessment following the procedure.

## Results

A total of 140 (47%) members responded. Of the 139 responders who performed lung biopsies, 103 (74%) were located at academic centres and 36 (26%) were community-based radiologists. The procedure was performed under CT guidance by 97 participants (70%), under either CT or fluoroscopy guidance by 31 (22%), and under fluoroscopy only by 11 (8%). One responder added CT fluoroscopy, but this option was not included in the multiple-choice questions.

Fine-needle aspiration (FNA) was the procedure chosen for the given case by 101 (73%) responders, whereas 20 (14%) preferred core biopsy, and 18 (13%) used both techniques.

A repeated pleural puncture technique was favoured by 74 (54%) responders, and 65 (46%) conducted the procedure using a coaxial system. Of those who performed only FNA, 72 (71%) preferred a repeated pleural puncture technique. Of those who carried out core biopsy (alone or in addition to FNA) the coaxial system was preferred by 36 (95%). The Chiba needle was most frequently used for aspiration, although other needle designs featured as well (Table 1). Needle sizes ranged from 17 to 22 gauge; the 22-gauge needle was the most frequently used for aspiration and the 19-gauge guide needle was the most frequently used as the outer needle in the coaxial system. Figs. 1 and 2 show the distribution of needle sizes used for FNA and core biopsy, respectively. The mean number of pleural passes

**Table 1** Preferred needle type for fine-needle aspiration

Needle type	Number of radiologists (%)
Chiba	56 (47%)
Westcott	22 (18%)
Franseen	7 (6%)
Spinal	7 (6%)
Turner	3 (3%)
Crown	2 (2%)
Other	9 (7%)
No response	13 (11%)
Total responders	119

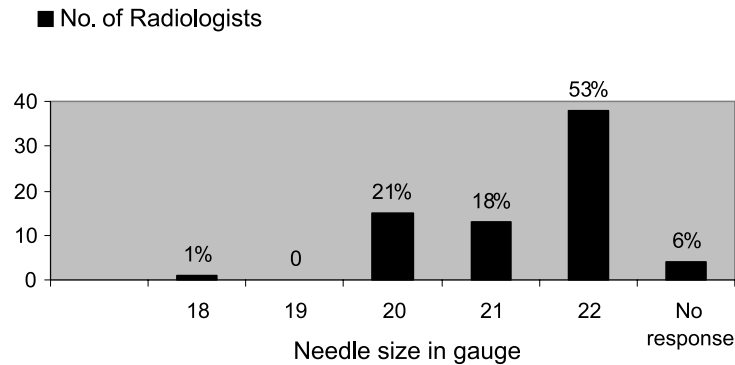
was 1.8 (range 1-4) when the coaxial system was not used and 1.0 when it was used.

On-site cytology confirmation for obtaining diagnostic material was routine for 101 (73%) responders. No cytologist was available on site for 38 (27%), but 17 (12%) could have this service upon special request. Of the 101 responders who routinely had a cytologist on site, 85 (84%) carried out FNA, 7 (7%) performed core biopsies and 9 (9%) used both techniques. In contrast, among the 38 responders who did not routinely have a cytologist on site, 17 (45%) performed core biopsies, 13 (34%) performed FNA and 8 (21%) used both techniques.

Before the procedure, 107 (77%) radiologists verified coagulation tests whereas 32 (23%) did not. All those who verified coagulation functions reported that they used PT, PTT or INR levels. Platelet numbers were verified by 88 (82%) responders, and 11(10%) checked the bleeding time as well.

All the responders perform the procedure under local anaesthesia, and 26 (19%) gave additional intravenous sedation.

Most responders (81, 58%) used a monitoring device; 90 (65%) had a specially assigned nurse for monitoring the patient; and 49 (35%) monitored the patients themselves. Immediate pneumothorax assessment was carried out using the imaging technique that guided the biopsy. Additional immediate chest radiography was obtained by 22 (23%) of the responders who performed the biopsy under CT guidance, by 15 (56%) of the responders who performed the biopsy under CT or fluoroscopy, and by all the responders who performed the biopsy only under fluoroscopy guidance. When a pneumothorax was not evident at the end of the procedure, 15 (11%) did not obtain any routine follow-up imaging. One follow-up chest radiograph was obtained within a mean of 2.4 h (range 0.5-6.0 h) after the end of procedure by 96 (69%) of the responders. Two follow-up chest films were routinely obtained by 27 (19%), the first within a mean of



**Figure 1** Needle size used for FNA with repeat pleural punctures.

1.1 h and the second within a mean of 3.2 h after the procedure.

## Discussion

Although many aspects of percutaneous needle biopsy of pulmonary lesions have already been addressed in the literature, our survey provides a glimpse of the actual everyday practice of this procedure.

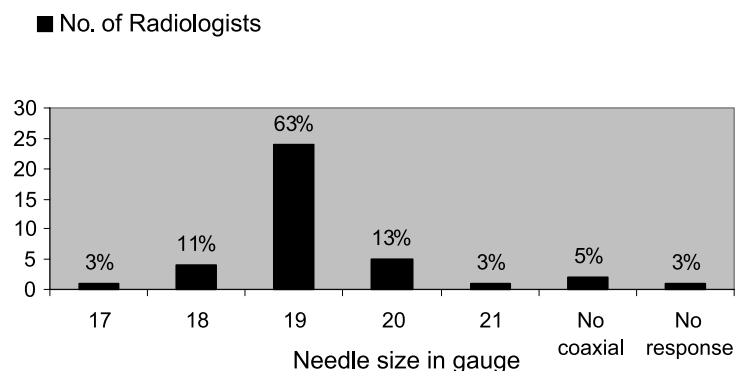
CT has been used for lung biopsy guidance for two decades and was the preferred technique of the majority of responders to our survey. Similar support for CT guidance can be found in the new guidelines for radiologically guided lung biopsy of the British Thoracic Society (BTS),<sup>1</sup> which proposes CT as the preferred imaging technique for lesions that are not suitable for ultrasound guidance. CT permits planning a trajectory that minimizes passage through an aerated lung, avoids bullae, fissures and vessels, and allows access to central lesions and smaller lesions.<sup>2,3</sup> CT can unequivocally document the needle tip within the lesion, a feature which has major value in the interpretation of the absence of malignant cells.<sup>4</sup>

The main disadvantage of CT guidance is the

length of procedure. The recent development of continuous CT fluoroscopy allows real-time visualization of the lesion and biopsy needle, and thereby has the potential for improving diagnostic accuracy while considerably shortening duration.<sup>5</sup> Although CT fluoroscopy has the advantages of both methods, it is associated with increased radiation<sup>6</sup> and is not yet widely available.

Fluoroscopic guidance has been the traditional imaging technique for percutaneous lung biopsy, with the advantages of short duration, real-time visualization of needle advancement and low cost. It was routinely used as the only method or as an alternative to CT by approximately one third of the radiologists in our study. Disadvantages of fluoroscopically guided percutaneous lung biopsy include difficulty visualizing small lesions on orthogonal projections and inability to visualize bullae or vascular structures in the anticipated needle path, thus limiting the ability to sample central lesions safely.<sup>7</sup>

The choice between FNA and core biopsy is controversial and depends upon personal experience and the availability of a pathologist on site. Lung cancer was the most probable diagnosis in the case we used for the survey, and the literature suggests the use of FNA first when there is a strong



**Figure 2** Outer (guide) needle size used for core biopsy.

suspicion of malignancy and a pathologist is available on site.<sup>8</sup> Cutting needles, however, have been shown to be more accurate in the specific diagnosis of benign lesions, lymphoma and in the absence of a cytopathologist on site.<sup>9-12</sup> Whereas some authors found no difference in the complication rate of these two methods,<sup>8,10,11</sup> others reported an increased rate of haemorrhage when cutting guns were used.<sup>13-15</sup> In our survey, 73% of the responders would have used FNA for the illustrative case. A large survey of percutaneous lung biopsy practice in the UK, which was based on 5444 biopsies,<sup>16</sup> showed that only about one half (49%) of the participating centres mainly used the FNA technique, whereas almost one third (31%) mainly performed core needle biopsy.

The BTS guidelines<sup>1</sup> state that the choice between the biopsy methods will vary according to both lesion and operator variables, and no one technique is unequivocally recommended as being safer or providing higher yield. The choices of the responders in our survey seemed to correspond with the position of the BTS guidelines.

Approximately two thirds of the radiologists we queried had a cytopathologist present during percutaneous transthoracic lung biopsy, in order to ensure that an adequate tissue sample was obtained with the minimum number of needle passes. Although this approach, particularly as it relates to FNA, is supported by some studies,<sup>17,18</sup> others found that immediate cytological evaluation improved results only marginally, with increased procedure duration and number of needle passes.<sup>19</sup> One UK survey<sup>16</sup> reported having cytological assistance on site in only 42% of the centres. The wider use of FNA in North America may, therefore, be related to the greater availability of cytologists at the biopsy site.

The Chiba needle is the most frequently used among our responders. However, the large variability in needle design in use by the responders clearly reflects that there is no single type of needle design of proven superiority to other types in terms of diagnostic yield and complication rate.<sup>2,13</sup> Moreover, needle size does not seem to influence pneumothorax rates.<sup>20</sup> All responders to our survey used needle sizes of 18-22 gauge, most frequently 22-gauge, reflecting the data in the literature.<sup>7,13,21</sup>

The coaxial system, which permits obtaining multiple samples through a single pleural puncture, is frequently used although several studies failed to show any correlation between the number of pleural passes and the rate of pneumothorax.<sup>20-23</sup> Performing lung biopsy under local anaesthesia is a globally accepted standard of care followed by all

responders. This is also reflected in the combined ESR/ATS guidelines and in the BTS guidelines.<sup>1,24</sup> In our survey, 19% of the participants would have offered intravenous conscious sedation in addition to local anaesthesia, but the BTS recommendation<sup>1</sup> is that virtually all biopsies should be performed without sedation.

A bleeding diathesis with an international normalized ratio (INR) of  $>1.3$  or a platelet count of  $<50,000$  is cited as a relative contraindication to transthoracic needle biopsy of the lung:<sup>7</sup> 23% of our responders, however, did not check any coagulation functions before the procedure. A large UK survey revealed similar rates of clotting screening.<sup>16</sup> The BTS guidelines<sup>1</sup> conclude that PT, APTT and platelet count are desirable and are required whenever the patient has risk factors for bleeding.

The immediate postoperative pneumothorax assessment was usually carried out with the same imaging guidance as the biopsy. Some radiologists who performed the biopsy under CT guidance, however, obtained an immediate chest film as well, probably in order to have a better comparison of pneumothorax size in sequential films. The timing of postoperative chest radiography was variable, reflecting different approaches. Following 673 transthoracic needle biopsies, Perlmutter et al.<sup>25</sup> found that 89% of pneumothoraces were detected immediately after the transthoracic needle biopsy, a further 9% were seen after 1 h and only 2% were first seen at 4 h. All pneumothoraces that required chest tube drainage were detected within 1 h of biopsy. In another study of 121 lung biopsies, Kazerooni et al.<sup>23</sup> reported that 91% of pneumothoraces were depicted on chest film 1 h after the procedure, and only 9% were first depicted 3 h after the procedure. None of the pneumothoraces detected 3 h after biopsy required chest tube insertion. Two cases of pneumothorax developing 24 h after transthoracic lung biopsy are reported in the literature,<sup>26</sup> but there are no reports of deaths attributed to delayed pneumothorax. The practice of follow-up chest radiography 30-60 min after percutaneous lung biopsy, followed by discharge, was associated with little morbidity and no mortality in another recent study.<sup>27</sup> Our survey demonstrates that most radiologists take precautions and follow their patients with a chest film 2-3 h after the procedure. On the other hand, a minority of responders did not endorse routine late follow-up chest radiography. The new BTS guidelines recommend an erect chest radiograph at 1 h after the biopsy without follow-up radiography for uncomplicated cases.<sup>1</sup>

Our survey was limited by the selection of members of the Society of Thoracic Radiology and

thus probably was biased towards more academically oriented radiologists. Since the responders were located at health centres throughout the USA and Canada, we believe that their replies do reflect most of the current approaches to percutaneous transthoracic lung biopsy. Practical detailed guidelines cannot be drawn from the questionnaire, which was designed to identify the general approach to the procedure in current practice. Clearly, each patient should be assessed individually, tailoring the procedural technique to the specific clinical setting.

In summary, the majority of radiologists who responded to our survey performed percutaneous transthoracic needle biopsy of a lung mass under CT guidance, by FNA, using repeated pleural puncture technique, and with a cytologist on site. A significant minority did not obtain coagulation screening before the procedure, and a small minority did not routinely assess for pneumothorax by late chest radiography. This survey presents the range of techniques used in performing transthoracic needle biopsy in the USA and Canada.

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