

# Percutaneous Transthoracic Needle Biopsy of Pulmonary Lesions: a National Survey of Korean Practice<sup>1</sup>

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**Purpose:** This study surveyed the thoracic radiologists in Korea in order to determine how they performed percutaneous transthoracic needle biopsy of pulmonary lesions.

**Materials and Methods:** In February 2006, fifty questionnaires were mailed to the members of the Society of Thoracic Radiology in the Republic of Korea (KSTR), and these doctors worked in academic and community hospitals. The survey consisted of multiple-choice questions regarding the radiologist's approach to a transthoracic needle biopsy (the type of practice, the imaging guidance technique, the biopsy technique, monitoring during the procedure, the assessment of pneumothorax after the procedure and the diagnostic accuracy) on the basis of the guidelines of the British Thoracic Society (BTS) and the European Respiratory Society (ERS)/American Thoracic Society (ATS).

**Results:** A total of 39 (66.1%) KSTR members responded. For the biopsy guidance, 16(41.0%) responder performed the procedure under CT guidance, 19(48.7%) responders performed the procedure under fluoroscopy guidance only and 4(10.3%) responders performed the procedure under either CT or fluoroscopy guidance. Fine-needle aspiration was the procedure of choice for eight (20.5%) respondents, whereas 31(79.5%) preferred performing a cutting needle biopsy. Before doing the procedure, 38(97.4%) institutions performed coagulation tests. All the respondents routinely performed follow-up imaging to determine the presence of a pneumothorax. PTNB has an overall diagnostic sensitivity of 95.8%, a specificity of 100%, a positive predictive value of 100%, a negative predictive value of 93.9% and an accuracy of 92.4%.

**Conclusion:** Although the KSTR members already perform PTNB according to the BTS or ERS/ATS guidelines with excellent results, this survey could be a cornerstone for formulating PTNB guidelines (indications, contraindications, the pre-investigation and post observation after PTNB) in Korea.

**Index words :** Biopsies

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Percutaneous transthoracic needle lung biopsy (PTNB) has been the invasive procedure of choice for making the diagnosis of lung masses (1 - 5). The frequency of performing PTNB has recently increased because of the remarkable technical developments of computed tomography (CT), which have allowed increased detection of small nodules and lung masses (1 - 3, 6, 7).

In addition to the increased number of performed PTNBs, a uniform procedural approach has been recommended because a lung biopsy is performed relatively frequently with considerable benefit for patient management. However, on rare occasions, it can result in the death of the patient (8 - 13). Therefore, the guidelines for PTNB were presented at the British Thoracic Society (BTS) and the European Respiratory Society (ERS)/American Thoracic Society (ATS). These groups surveyed the thoracic radiologists in both academic medical settings and community practice on their usual approach to transthoracic needle biopsy for a routine case of a lung mass. These groups suggested formal evidence-based guidelines for those physicians referring patients for the procedure and for those physicians performing it (14 - 16).

However, there have been few reported surveys of PTNB for Asian thoracic radiologists. This study surveyed the practice of the Korean thoracic radiologist society (KSTR) on their usual approach to performing PTNB of pulmonary lesions so as to suggest guidelines for PTNB in Korea.

## Materials and Methods

Questionnaires were sent twice to the members of the Society of Thoracic Radiology (KSTR), and these members were located throughout the Republic of Korea. The first postal questionnaires were mailed out in January 2006. The criteria of the responders was determined as follows: 1) those who were experienced in percutaneous needle lung biopsy and they had performed more than 10 supervised procedures before attempting this procedure alone, 2) one responder from each hospital, who had performed at least 10 procedures a year, was selected, 3) the hospital had at least five hundred admitted patients and 4) at least two university hospitals in each province were included (14). Based on these criteria, fifty academic centers and community-based hospitals were selected. If the responders really did not perform PTNB in their hospital, then they were asked to recommend other responders who had performed

PTNB in their hospital. The questionnaire was designed so that it could be completed rapidly, and a stamped, addressed envelope for the reply was included. The questionnaire consisted of multiple choice questions on the radiologist's approach to transthoracic needle biopsy: the generalized characteristics of the responders (age, gender, department, position and the type of practice), the imaging guidance technique (fluoroscopy or CT), the biopsy technique (fine-needle aspiration or cutting needle biopsy), the needle type and size, the number of passes, monitoring during the procedure, assessment of complications after the procedure and the diagnostic accuracy. After the first questionnaire was analyzed, a second questionnaire was designed as a repeat questionnaire to determine the number of performed biopsies for improving the surveys' accuracy, to avoid seasonal variation and to compensate for the weak points of the first questionnaire that were possibly misunderstood. The second questionnaire was designed to be similar to the first questionnaire and it was sent, after 8 weeks, to only those centers that responded to the first questionnaires. A preventive medicine professor and several researchers analyzed the responses to the questionnaires.

## Results

Among the fifty academic centers and community-based hospital, 39 hospitals (66.1%) responded to the questionnaire. The responding hospitals well satisfied the criteria of this survey. The responders were thoracic radiologists (97.4%) and interventional radiologists (2.6%). Fig. 1 shows the gender, age, position at the hospital and the experience of the participants. In Korea, a special radiologist (87%) who has at least one year experience in PTNB generally performs the procedure first-hand. The residents and fellows (13%) perform PTNB under supervision. The procedure was performed under CT guidance ( $n=16$ , 41%), under either CT or fluoroscopy guidance ( $n=4$ , 10.3%) and under fluoroscopy guidance only ( $n=19$ , 48.7%).

The indications for PTNB were surveyed. The major indications were a new detected nodule or a solitary pulmonary nodule (26.9%), an enlarged nodule or no change in the nodule's size during the follow-up (18.3%), persistent focal infiltration (12.6%), multiple nodules from an unknown origin (11.8%), a hilar mass (6.9%), pulmonary tuberculosis with undetermined activity (4.5%), diffuse interstitial lung disease (2%) and etc (Fig. 2). The responder answered that they audited

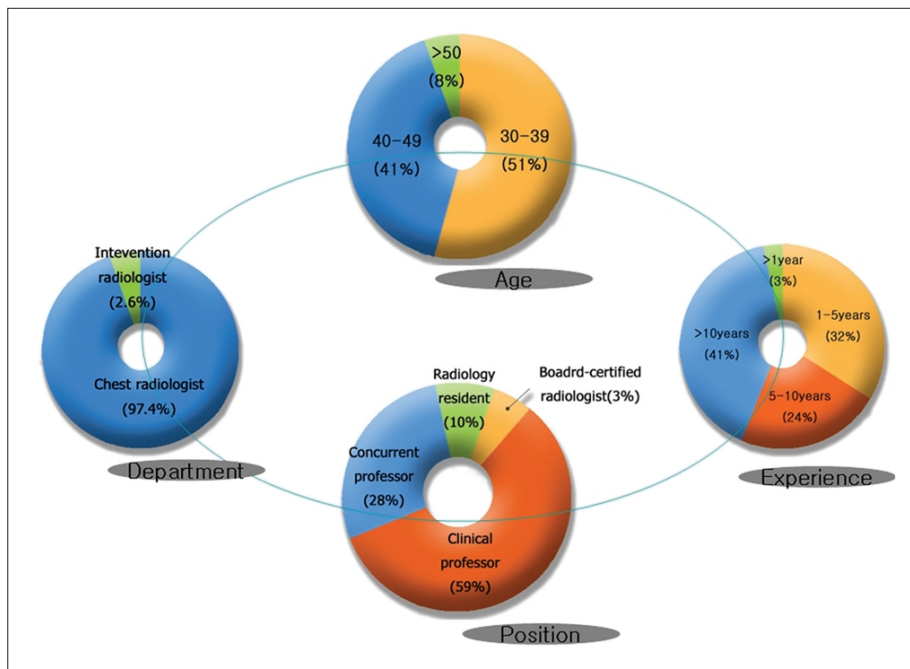


Fig 1. Diagram showing the gender, age, hospital position and experience of the participants in the survey.

their own practice and calculated the complication rate to inform the patients and their family before performing PTNB (94.8%). The prothrombin time (PT), the activated partial thromboplastin time (APTT) and the platelet count were checked within one week before PTNB (97.4%) but pulmonary function testing was done by only 41% of the responders. All the responders performed chest radiography or CT before PTNB.

Fine-needle aspiration (FNA) was chosen by only 8 (20.5%) responders, whereas 31 (79.5%) responders preferred a cutting needle biopsy. Fifty three point five percent of the responders carried out the procedure using a coaxial system and 46.5% of the responders favored a repeated pleural puncture technique. The needle size ranged from 18 to 22 gauges; a 22-gauge needle (34.5%) was the most commonly used needle for aspiration, and an 18-gauge (57.3%) guide needle was most commonly used as the outer needle in the coaxial system.

According to this survey, 727 lung biopsies were performed at 39 hospitals over a one-month period. The average number of biopsies performed per center per month was 18.6. It is estimated that 223 PTNB were performed per center per year in Korea. FNA has an overall diagnostic sensitivity of 93.1%, a specificity of 87.2%, a positive predictive value of 90%, a negative predictive value of 84.2% and an accuracy of 90.6%. PTNB has an overall diagnostic sensitivity of 95.8%, a specificity of 100%, a positive predictive value of 100%, a negative predictive value of 93.9% and an accuracy of

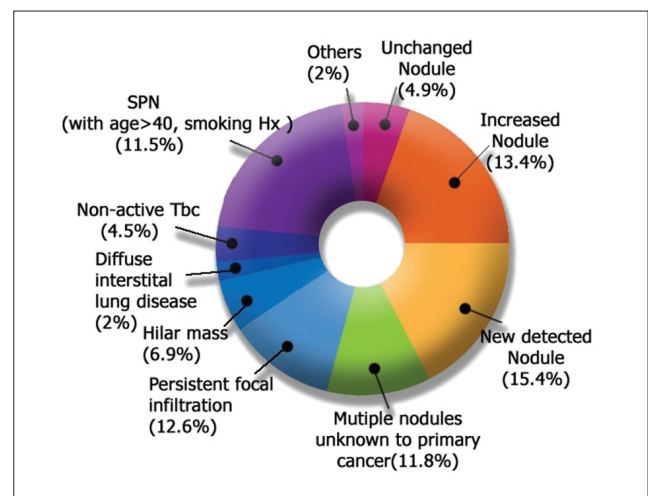


Fig 2. Diagram showing the indications for percutaneous needle biopsy in this survey.

92.4%.

Erect chest radiography (84.6%) or CT (15.4%) was performed 1 hour after or at least within 6 hours after the biopsy. The reported complications included pneumothorax, hemoptysis and death. Pneumothorax was the most common complication, and this occurred in 109 out of 727 cases (14.9%). Hemoptysis occurred in 81 out of 727 cases (11.1%). Ten out of the 727 (1.4%) cases had a severe pneumothorax or hemoptysis, and these patients underwent emergency surgery or thoracostomy. Ten Korean patients (0.01%) died during over a 5 year period after the biopsies, but the causes of death were unclear.

## Discussion

The BTS and ERS/ATS have reported their guidelines for PTNB of pulmonary lesions to decrease the complications after PTNB, and these guidelines might be beneficial to both patients and doctors, including the respiratory physicians, surgeons and radiologists who have an interest in chest diseases (14, 16 - 18). Although many surveys of PTNB have already been performed throughout the world, the KSTR still has no guideline for performing PTNB. This survey showed that the KSTR members in Korea already perform PTNB according to BTS and ERS/ATS guidelines (Table 1). A comparison of the result of this survey with the BTS guidelines has shown that KSTR members carried out preoperative studies such as determining the coagulation indices (97.4%) and post biopsy observations such as an erect chest X-ray at 1 hour after biopsy (100%). Nevertheless, a pulmonary function test before PTNB (41%) and management of acute complications (53.9%) were generally not performed. The operator's complication rate and the expected accuracy of sampling were appropriate for the BTS guideline. Especially, the mortality and morbidity in this survey were quite low.

The BTS guideline suggested that the adequacy of a sample should be > 90%, but there is no report on the national diagnostic accuracy of PTNB for pulmonary lesions even though the type of needle, the method of PTNB and the complications after PTNB have been reported (1, 5, 8, 19 - 22). In this survey, the average number of PTNBs per academic center and community-based hospital per year might be 223 in Korea, and the diagnostic results were excellent: the accuracy, sensitivity and specificity were 90.6 - 92.4%, 93.1 - 95.8% and 87.2 - 100%, respectively. In order to obtain adequate diagnostic accuracy and a low complication rate after PTNB, an experienced radiologist should perform the PTNB according to the PTNB guideline. In this survey, an adequate sample was obtained for > 90% of the procedures because most of the PTNBs were performed by an experienced special radiologist (87%) in Korea.

Compared with fluoroscopic biopsy, CT-guided needle biopsy is a widely accepted technique because many small pulmonary nodules can be easily detected by a CT examination in daily clinical work (2, 21, 23 - 25). However, the responders to this survey preferred a fluoroscopic guided biopsy. The reason was that CT guided biopsy is time-consuming and it is very difficult to book

**Table 1.** Comparison Summary of the Recommendations of the BTS and ERS/ATS with the Korea National Survey for Percutaneous Transthoracic Needle Lung Biopsy

| Summary of recommendation   | BTS and ERS/ATS  | Korea National Survey |
|---|------------------|-----------------------|
| Mortality and morbidity   |                  |                       |
| Pneumothorax  | < 20.5%          | 14.2%                 |
| A chest drain   | < 3.1%           | 1.1%                  |
| Hemoptysis  | < 5.3%           | 11.1%                 |
| Death   | < 0.15%          | 0.01%                 |
| Indication for lung biopsy :<br>discussed respiratory physician and radiologist | should be        | 74.3%                 |
| Preoperative investigation :<br>coagulation indices (PT, APTT, platelet count)  | should be        | 97.4%                 |
| Preoperative investigation :<br>pulmonary function                              | should have      | 41%                   |
| Preoperative investigation :<br>Chest X-ray and CT (recent)                     | should be review | 86.1%                 |
| Informed consent :<br>written information                                       | should be        | 94.8%                 |
| Expected accuracy of sampling   |                  |                       |
| False positive  | < 1%             | 7%                    |
| Adequacy  | > 90%            | 90 - 91%              |
| Sensitivity for malignancy  | 85 - 90%         | 87 - 93.3%            |
| Post biopsy observation   |                  |                       |
| Erect chest X-ray (1 hour after the biopsy)                                     | should be        | 100%                  |
| Informed of the risks   | should be        | 79.5%                 |
| Management of acute complication  | should be        | 53.9%                 |
| Pulse, blood pressure, oxygen saturation  |                  |                       |

an appointment time in a CT room. However, it is believed that CT guided biopsy might replace fluoroscopic biopsy in the near future because a CT-guided biopsy is more accurate for small pulmonary nodules. The preoperative investigation and post-biopsy observation in this survey were performed according to the BTS guideline, but a small minority of responders did not routinely perform a coagulation test before the biopsy, nor did they test for a pneumothorax with using late chest radiography.

Compared with the BTS guidelines, this survey recognized some points that require improvement before and after performing PTNB in Korea. First, the BTS guideline suggests that all the patients should have a recent pulmonary function test before lung biopsy, but only 41% of the responders in this survey performed a pulmonary function test before PTNB (16). If the FEV1 is very low, then the risks of complications after PTNB increase with the increasing time for the procedure. Second, the incidences of a pneumothorax (14.2%), us-



ing a chest drain (1.1%) and death (0.01%) were low enough to satisfy the BTS guideline. However, the incidence of hemoptysis of this survey was two times higher than the BTS guideline (11.1% vs 5.3%, respectively). Therefore, there is a need to examine the cause of hemoptysis after PTNB to decrease the incidence of hemoptysis in the near future. Third, in spite that the management of acute complication is very important, the responder's interest in this was very low (53.9%). We suggest that operators in Korea should have an increased interest for the post-biopsy complications and they should be ready to identify and manage the complications after lung biopsy.

This is the first Asian study of the PTNB guidelines based on a large number of biopsy cases and using a multi-center survey. Many authors have reported on what kind of patients underwent PTNB for lung masses, on which technique was selected during the PTNB (either FNA or a cutting needle biopsy), on the diagnostic accuracy after PTNB and on the complications after PTNB [3, 6, 8, 11, 22, 26 - 32]. Although Tomiyama et al [25] reported a survey of CT-guided needle biopsy of lung lesions in Japan, the paper usually reported there were severe complications after PTNB. Our survey showed that the guidelines for PTNB in Korea were similar to the guidelines of the BTS and ERS/ATS, yet the KSTR can produce their own guidelines for PTNB based on this survey in the near future, and this would help to formulate guidelines for the PTNB of lung masses throughout Asia.

This survey was limited by only selecting members of the KSTR and it was probably biased toward a more academic-based and community-based survey. In addition, the rate of responses was not excellent. However, it is believed that the responders in this survey do reflect most of the current approaches to PTNB in Korea, and the results of this survey can contribute to producing guidelines for PTNB in Korea. In conclusion, this survey might help formulate the PTNB guidelines (indications, contraindications, pre-investigation and post observation after PTNB) in Korea, even though the KSTR members already perform PTNB according to the BTS or ERS/ATS guidelines.

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