

Research article

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Evaluation of predicted procedure - related complications factors of computer tomography - guided lung biopsy

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Abstract

Objective: To evaluate factors predicting the potential occurrence of procedure-related complications in patients undergoing computed tomography-guided lung biopsy.

Subject and method: retrospective description. 83 patients had undergone computed tomography-guided lung biopsy in The Thoracic and Thyroid Surgery Department, Binh Dan Hospital from 2021 to 2022.

Result: The gender ratio was 2:1; 100 percent of the lesion was peripheral, and the deepest lesion was 42 mm. The average lesion size was 33.56 ± 17.57 mm. All patients in our study provided enough tissue for histopathology examination, and the re-op and post-op results were consistent with the pathological diagnosis, which was lung cancer in 63.86 percent of cases. The rate of procedure-related complications was 12%; pneumothorax occurred in 2.4% of patients, and the massive parenchymal hemorrhage rate was 9.6%. The following variables: lesion size, lesion depth, and number of punctured fissure - were risk factors for procedure-related complications. In our study, the risk factors for complications were lesion size less than 24,14 mm, lesion depth greater than 7,5 mm, and the number of punctured fissures greater than three.

Conclusion: The computed tomography-guided lung biopsy was a straightforward procedure with few complications. The potential occurrence of procedure-related complications in patients undergoing computed tomography-guided lung biopsy could be mild and predictable.

Key words: Computed tomography-guided lung biopsy, procedure-related complications, non-small cell lung cancer, lung cancer.

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1. INTRODUCTION

Lung tumors or nodules are common in clinical practice, with a malignant rate as high as 77%. Primary lung cancer is the most common cause, accounting for 50%. The direct pathological examination of a lesion is the gold standard for determining and classifying whether it is benign or malignant. There are several sampling methods available, each with advantages and disadvantages depending on the location, size of the lesion, the patient's accompanying diseases, and the facilities available at the healthcare institution. The

primary consideration is to choose the most effective method while minimizing the risk of complications for the patient. Computed tomography-guided lung biopsy is a procedure that fully meets both criteria: high efficacy with high sensitivity and specificity in diagnosis, as well as minimal invasiveness of the method. This is a relatively new diagnostic technique in Vietnam. In recent years, there have been several reports on this technique with indications, contraindications, and procedural techniques mainly focusing on sampling lung lesions located close to the chest wall, or

typically larger than 3cm in size [1] However, there are still few studies on the procedure’s complications and negative impacts. We are conducting this study to determine the frequency of procedure complications and the factors associated with the procedure: tumor depth, size, and number of needle punctures for pneumothorax, parenchymal hemorrhage, and early complications.

2. SUBJECT AND METHOD

Subject

83 patients had undergone Computed tomography-guided lung biopsy in The Thoracic and Thyroid Department, Binh Dan Hospital from January 2021 to March 2022.

Method: retrospective description.

Selection criteria:

All patients with pulmonary nodules or masses measuring 10mm or larger on chest X-ray, chest MSCT, or chest MRI and an indication for lesion biopsy underwent computed tomography-guided lung biopsy performed by the same surgical team in The Thoracic and Thyroid Surgery Department, Binh Dan Hospital from January 2021 to December 2022.

Exclusion criteria:

Patients underwent biopsy of tumors on both lungs or more than two tumors on the same side of the lung in a single procedure, or patients with accompanying lesions such as pleural effusion.

Patients underwent biopsy by a different surgical team.

Data analysis: data collected from the study’s medical records will be encoded and analyzed using statistical software SPSS 22.

3. RESULTS AND DISCUSSION

* Characteristics of the study’s group undergoing computed tomography-guided lung biopsy

Our research group included 83 patients (PTs) with lung lesions who participated in the study but did not have definitive pathological results, 45 of whom were diagnosed with lung nodules and 38 of whom had lung tumors identified on imaging.

The male-to-female ratio is 2:1. It was

discovered that 16 patients had a history of predisposing factors or radiation therapy for prior cancer (19.27%), with gastrointestinal cancer being the most common. Eight patients (9.7%) had previously received treatment for pulmonary tuberculosis.

There were 83 lesions distributed evenly across all lobes of the lungs, with the highest number found in the upper lobe of the right lung: 27 patients (32.5%). 100% of the lesions were in the peripheral region, with the furthest distance from the edge of the lesion to the chest wall being 42.00 mm. The lesion size ranged from 9.00 mm to 87.00 mm, with an average of 33.53 ± 17.57 mm. Adriano Massimiliano Priola of the University of Turin (Italy) performed computed tomography-guided lung biopsy on 124 cases of lung and mediastinal lesions over four years. Lesions located ≥ 4 cm from the chest wall and ≤ 1.3 cm in diameter resulted in a 62% accurate diagnosis. Lesions closer to the chest wall, measuring less than 4cm and larger than 13mm, had a diagnostic accuracy rate of up to 92% [4]. However, the size and depth of the lesion can impact the risk of procedural complications, which will be discussed in the next section.

All patients in our study had sufficient sampling for pathological diagnosis, as shown in the table below.

Table 1. Pathological biopsy findings

	The number of patients	Per %
Chronic inflammation tissue	14	16,9
Pulmonary tuberculosis	14	16,9
Primary lung cancer	42	48,2
Secondary lung cancer	13	22,6
Total	83	100%

38 patients (45.8%) underwent surgery, and postoperative pathological results were recorded.

Table 2. Postoperative pathological findings

	The number of patients	Per %
Pulmonary tuberculosis	8	9,6
Primary lung cancer	24	28,9
Secondary lung cancer	6	7,2
Total	38	45,8%

Computed tomography-guided lung biopsy plays an important role in determining the characteristics of the lesion, which informs decision-making and treatment options. Computed tomography-guided lung biopsy has been demonstrated to have a sensitivity of 82-99%, specificity of 86-100%, and an accurate diagnostic value for malignancies of up to 97% [5]. When we compared the results of CT-guided lung biopsy to the final histopathological results after surgery in 38 surgically treated patients (achieving 100% accuracy), we discovered histological concordance. However, determining the procedure's sensitivity and specificity requires additional research.

***Identifying the incidence of complications and side effects of Computed tomography-guided lung biopsy.**

	The number of patients	Per %
No	58	69,9
Mild	23	27,7
Moderate	2	2,4
Total	31	100,0

	The number of patients	Per %
No	34	41,0
Type I	14	16,9
Type II low grade	27	32,5
Type II high grade	8	9,6
Total	31	100,0

Table 3. Complication rate after biopsy

No cases of hemothorax or air embolism were observed postoperatively.

The rate of early postoperative complications in our study, including parenchymal hemorrhage and/or pneumothorax, was 12% (10 patients)..

Michele Anzidei and colleagues identified two risk factors for computed tomography-guided lung biopsy: post-biopsy pneumothorax (PNX) and high-grade parenchymal hemorrhage (Type II high-grade PPH), which are related to lesion size, number of needle punctures, and depth of the lesion within the chest cavity during biopsy [7].

Assessing the relationship between prognostic factors and early complications:

We examined how tumor size, depth, and number of needle punctures affect early procedural complications. ROC analysis indicated that tumor size, tumor depth, and the number of needle punctures were all associated with early complications of the procedure, with ROC values of 71.8%, 73.6%, and 83.9%. The following threshold values for complications were determined: tumor size of 29.79 mm, tumor depth of 9.5 mm, and 3.5 needle punctures.

- Tumors smaller than 29.79 mm (44 patients) and larger than 29.79 mm (39 patients) showed a statistically significant difference in the risk of early complications: $p = 0.012$ and $OR = 9.77$. Therefore, tumor size smaller than 29.79 mm is statistically associated with early complications after biopsy.

- Tumors with a depth smaller than 9.5 mm (47 patients) and larger than 9.5 mm (36 patients) showed a statistically significant difference in the risk of early complications: $p = 0.02$ and $OR = 0.065$. Therefore, tumors located deeper than 9.5 mm are statistically associated with early complications after biopsy..

- The number of needle punctures less than or equal to 3 times (51 patients) and more than 3 times (32 patients) showed a statistically significant difference in the risk of early complications: $p < 0.001$ and $OR = 0.051$. Therefore, undergoing more than 3 needle punctures is statistically associated with early complications after biopsy.

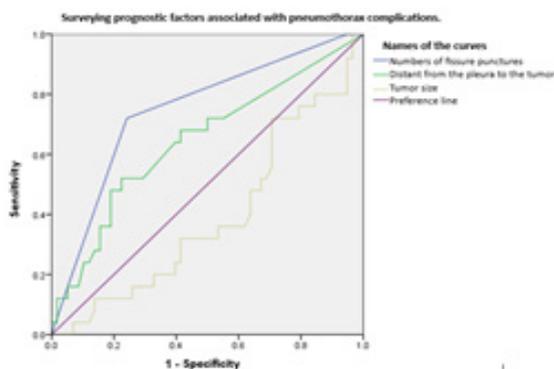
Assessing the association between prognostic factors and pneumothorax complication:

The diagnostic capability increases with the number of biopsies, but so does the rate of complications. The number of needle punctures has a direct impact on the occurrence of pneumothorax complications, according to a study published by author Carol Wu and colleagues [8].

In our study, we utilized ROC curves to analyze the relationship between prognostic factors and pneumothorax complications:

- The number of needle punctures correlates with pneumothorax complications (ROC = 74.7%, $p < 0.01$), with a cutoff threshold of 3.5 times. The study found a statistically significance in the risk of pneumothorax complications between two groups: those with 3 or fewer needle punctures (51 patients) and those with more than 3 (32 patients), with $p < 0.001$ and OR = 0.124. As a result, we conclude that performing more than three needle punctures increases the risk of pneumothorax complications following biopsy. To reduce the risk of pneumothorax complications, we recommend limiting the number of needle punctures to three.

- There was no statistically significance relationship between the depth and size of the lesion and pneumothorax complications.



Previous studies has shown that smaller lesions, deeper parenchymal involvement, and more pleural punctures during CT-

guided lung biopsy increase the risk of pneumothorax. The majority of these risk factors are consistent with previous research, but our study noticed statistically significance differences only in the number of needle punctures [3],

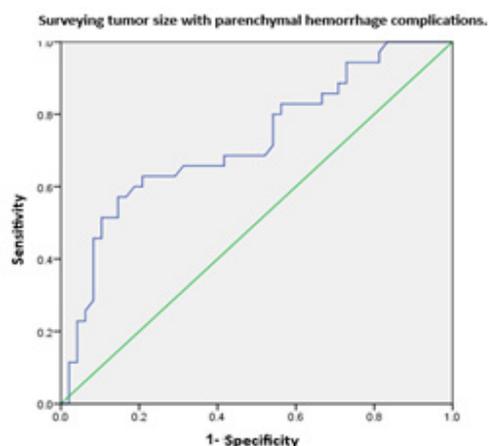
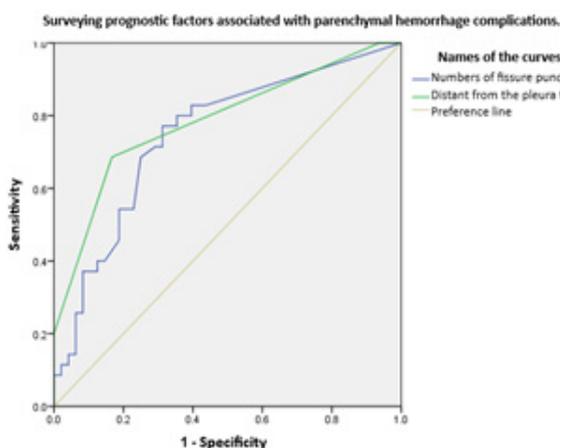
Assessing the association between prognostic factors and parenchymal hemorrhage complication:

We used ROC curve analysis to investigate the relationship between parenchymal hemorrhage complications and prognostic factors such as tumor size, tumor depth, and number of needle punctures, which yielded ROC values of 72.4%, 74.8%, and 78.6%. The following threshold values for complications were determined: tumor size of 24.14 mm, tumor depth of 7.5 mm, and 3.5 needle punctures.

- The risk of early complications differed statistically significantly between tumors smaller than 24.14 mm (27 patients) and larger than 24.14 mm (56 patients), with $p < 0.01$ and OR = 7.81. As a result, tumor size less than 24.14 mm increases the risk of parenchymal hemorrhage complications following biopsy.

- Tumors with a depth smaller than 7.5 mm (41 patients) and larger than 7.5 mm (42 patients) showed a statistically significant difference in the risk of early complications: $p < 0.01$ and OR = 0.135. Therefore, tumors located deeper than 7.5 mm are a risk factor for parenchymal hemorrhage complications after biopsy.

- There was a statistically significant difference in the risk of early complications between patients with 3 or fewer needle punctures (51 patients) and those with more than 3 punctures (32 patients) ($p < 0.01$ and OR = 0.092). As a result, undergoing more than three needle punctures increases the risk of parenchymal hemorrhage complications following biopsy.



The study by Nour-Eldin A, which involved 650 patients, yielded similar results regarding parenchymal hemorrhage. The incidence of parenchymal hemorrhage was found to be 19.6%, and it was recommended to maintain a maximum distance of 20 mm to minimize complications. [8]. Author M. Anzidei’s analysis identified the depth of the lesion as a risk factor for parenchymal hemorrhage following CT-guided lung biopsy. Our study produced similar results [2]. In a multicenter study conducted by author S. Yoon and colleagues, risk factors for post-biopsy bleeding complications were identified, including lesions smaller than 2 cm and lesions located deep within the body. This is consistent with our study findings, which show that these factors increase the risk of post-biopsy bleeding complications [6].

All patients in our study had chest X-rays performed 3 hours after the procedure and were closely monitored clinically. There were no late post-operative complications recorded.

4. CONCLUSION

Early complications occurred in 12% of the procedures in our study cohort, with the majority of these complications being mild and requiring just observation without intervention. The average incidence of pneumothorax was 2.4%, and parenchymal hemorrhage occurred at a rate of 9.6%. We identified factors associated with complications, including depth of lesion, number of needle punctures, and lesion size.

Our findings indicate that lesions larger than 24.14 mm, lesions beneath 7.5 mm from the chest wall, and a maximum of three needle punctures produce the best results, lowering the risk of complications such as pneumothorax and parenchymal hemorrhage after the procedure.

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