

# The Safety of CT-Guided Percutaneous Lung Biopsy in Elderly Patients With Solitary Pulmonary Nodules

Review began 08/09/2023

Review ended 08/17/2023

Published 08/25/2023

© Copyright 2023

Yang et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Haibo Yang<sup>1</sup>, Xiaofang Gao<sup>2</sup>

1. Department of Respiratory Medicine, Chinese People's Liberation Army 92493 Military Hospital, Huludao City, CHN  
2. Department of Lung Cancer, Beijing Arion Cancer Center, Beijing, CHN

**Corresponding author:** Xiaofang Gao, gaoxiaofang1977@163.com

## Abstract

**Objective:** Computed tomography (CT)-guided percutaneous lung biopsy is an effective diagnostic procedure for patients with solitary pulmonary nodules (SPN). The aim of this study is to evaluate the safety of this procedure for elderly patients with SPN.

**Methods:** A total of 125 patients with SPN who received a CT-guided percutaneous lung biopsy were retrospectively analyzed. Patients were divided into elderly (age 65 and above) and non-elderly groups. The patients' characteristics and procedure-related complications were compared between the two groups.

**Results:** The elderly and non-elderly groups included 74 and 51 patients, respectively. The success rate of a CT-guided percutaneous lung biopsy was 100%. The diagnosis rate of lung cancer in the elderly group was significantly higher than that in the non-elderly group (83.78% vs. 64.70%,  $p = 0.014$ ). The incidence of pulmonary hemorrhage after lung biopsy in the elderly group (44, 59.45%) was significantly higher than that in the non-elderly group (21, 41.17%,  $p = 0.044$ ), and moderate hemorrhage was the main contributor. The incidence rate of pneumothorax in the elderly group numerically increased, but the difference did not reach statistical significance.

**Conclusion:** Computed tomography-guided percutaneous lung biopsy was an efficient procedure for diagnosing SPN in elderly patients. Although complication rates were relatively higher in elderly patients, the safety of this procedure was acceptable.

**Categories:** Pulmonology

**Keywords:** geriatric medicine, pneumothorax, pulmonary hemorrhage, cancer, solitary pulmonary nodules, the elderly, percutaneous lung biopsy

## Introduction

A solitary pulmonary nodule (SPN) is defined as a relatively well-defined round or oval pulmonary parenchymal lesion equal to or smaller than 30 mm in diameter [1]. With the coming of an aging society, the number of elderly patients with SPN is increasing by the day. The tolerance of elderly patients to thoracic operations is unsatisfactory. Therefore, a preoperative, definite diagnosis to avoid unnecessary surgery is important for elderly patients with SPN [2].

Computed tomography (CT)-guided percutaneous lung biopsy is an effective diagnostic procedure for SPN, but its safety in elderly patients needs further understanding and clarification [3]. The purpose of our study was to investigate the clinical safety of CT-guided percutaneous lung biopsy of SPN in elderly patients.

## Materials And Methods

### Study population

We retrospectively collected electronic medical records of 125 patients diagnosed with SPN who underwent CT-guided percutaneous lung biopsy at the Chinese People's Liberation Army 92493 Military Hospital, Huludao City, and Beijing Arion Cancer Center, Beijing, China, from July 2022 to July 2023. The protocol of this retrospective study was approved by the institutional review board, with a waiver of informed consent obtained. Patients were divided into elderly (age 65 and above) and non-elderly groups. Patients' data about age, gender, smoking, previous chronic obstructive pulmonary disease (COPD), and pulmonary nodule size were collected.

### Biopsy procedure

The procedure of a CT-guided percutaneous lung biopsy was performed by experienced interventional radiologists. Patients received an enhanced CT scan before the procedure to avoid injury to larger vessels.

#### How to cite this article

Yang H, Gao X (August 25, 2023) The Safety of CT-Guided Percutaneous Lung Biopsy in Elderly Patients With Solitary Pulmonary Nodules. Cureus 15(8): e44105. DOI 10.7759/cureus.44105

An 18-gauge coaxial automated cutting needle and a localization needle (Bard Max-Core biopsy needle; C.R. Bard, Inc., New Providence, NJ, USA) were used for the biopsy. The patients received a repeated CT scan after the biopsy to assess procedure-related complications. The occurrence of pulmonary hemorrhage and pneumothorax after lung biopsy was confirmed by medical records and postoperative imaging. Postoperative imaging showing stripe hemorrhage along the needle tract was identified as mild hemorrhage, and flake hemorrhage was identified as moderate hemorrhage [4]. A large pneumothorax was defined on erect chest radiographs as an air space that was more than 2 cm from the pleural surface to the lung edge at the level of the hilum; otherwise, it was a small pneumothorax [5].

Statistical analysis

The patients' characteristics and procedure-related complications were compared between the elderly and non-elderly groups. Categorical variables were shown as numbers (percentages). Continuous variables were expressed as means with standard deviations. To compare the two patient groups, t-tests, and chi-square tests were used for normally distributed and nominal data between groups. Significance was defined as a p-value less than 0.05, and all tests were two-sided. Data were analyzed using the IBM SPSS software (Version 26.0; IBM Corp., Armonk, NY, USA).

Results

A total of 125 patients, including elderly (n=74) and non-elderly (n=51) patients, were retrospectively analyzed. There was no significant difference in gender, smoking, or nodule size between the elderly and non-elderly groups. The patients with COPD in the elderly group significantly outnumbered the patients in the non-elderly group (p = 0.038). The results are shown in Table 1.

	Male, n(%)	Age, years	Smoking, n(%)	COPD, n(%)	Nodule size, mm
Elderly, n=74	51 (69.91)	71.05±8.62	31 (41.89)	13 (17.56)	18.72±4.59
Non-elderly, n=51	32 (62.74)	51.42±8.59	19 (37.25)	2 (3.92)	17.83±5.07
p-value	0.472	<0.01	0.603	0.021	0.468

TABLE 1: Characteristics of the patients in the elderly and non-elderly group

COPD: chronic obstructive pulmonary disease

The success rate of a CT-guided percutaneous lung biopsy was 100%. In the elderly group, 62 patients were diagnosed with lung cancer after a lung biopsy. Adenocarcinoma (44, 70.96%), squamous carcinoma (11, 17.74%), and small lung cell cancer (5, 8.06%) were the top three pathological types. In the non-elderly group, 33 patients were diagnosed with lung cancer. The numbers of patients with adenocarcinoma, squamous carcinoma, and small lung cell cancer were 24 (72.72%), four (12.12%), and two (6.06%), respectively (Table 2).

	Adenocarcinoma, n(%)	Squamous carcinoma, n(%)	Small lung cell cancer, n(%)
Elderly, n=62	44 (70.96)	11 (17.74)	5 (8.06)
Non-elderly, n=33	24 (72.72)	4 (12.12)	2 (6.06)
p-value	0.856	0.474	0.721

TABLE 2: Comparison of pathological types between elderly and non-elderly patients diagnosed with lung cancer

The diagnosis rate of lung cancer in the elderly group was significantly higher than that in the non-elderly group (83.78% vs. 64.70%, p = 0.014).

The incidence of pulmonary hemorrhage after lung biopsy in the elderly group (44, 59.45%) was significantly higher than that in the non-elderly group (21, 41.17%, P = 0.044). Subgroup analysis showed the significant difference was attributed to moderate hemorrhage rather than mild hemorrhage (Table 2). The incidence rate of pneumothorax in the elderly group (31, 41.89%) was numerically higher than that in the non-elderly

group (13, 25.49%), but the difference did not reach statistical significance ( $p = 0.059$ ). Subgroup analysis of large and small pneumothorax came to the same conclusion (Table 3).

	Pulmonary hemorrhage		Pneumothorax	
	Mild, n(%)	Moderate, n(%)	Small, n(%)	Large, n(%)
Elderly, n=74	23 (31.08)	21 (28.37)	26 (35.13)	5 (6.75)
Non-elderly, n=51	17 (33.33)	4 (7.84)	11 (21.56)	2 (3.92)
p-value	0.790	0.020	0.102	0.498

TABLE 3: Comparison of complications between the elderly and non-elderly groups

Discussion

Solitary pulmonary nodules tended to be found more often in the elderly population with the development of imaging technology. Previous studies demonstrated that older patients with SPN were at higher risk of lung cancer [6]. Our study also indicated that the probability of malignancy in solitary pulmonary nodules was significantly increased in elderly patients. In light of this, using an effective method to distinguish the benign or malignant SPN was an important factor in improving the outcome of those patients [7].

Pathological examination was the gold standard for the diagnosis of SPN. A mandatory prerequisite for pathological diagnosis was to obtain tissue specimens from the lesion [8]. Computed tomography-guided lung biopsies were first reported by Haaga and Alfidi in 1976. This procedure has been constantly perfected with the development of percutaneous puncture and imaging technologies over the years [9]. However, the safety of this procedure for elderly patients still needs to be illustrated.

Pneumothorax and pulmonary hemorrhage were the main complications of a CT-guided percutaneous lung biopsy. Meta-analysis showed that the pooled complication rates of core needle lung biopsy were 38.8% (34.3%-43.5%) [10]. The risk of complications was related to the location and size of the SPN, the thickness of the puncture needle, the experience and skills of the operator, and the concomitant diseases of the patients [11].

Our study showed the occurrence rate of pulmonary hemorrhage in elderly patients significantly increased, and moderate hemorrhage was the major driving force. Gas exchange was the main function of the lung, and the blood supply was very rich in this organ. It was almost impossible to avoid pulmonary vascular injury during a percutaneous lung biopsy. In elderly patients, the increased vascular fragility and decreased vasoconstriction after puncture injury might result in an increased incidence of moderate hemorrhage [12]. In addition to this, the increasing use of aspirin in elderly patients might be another reason [13].

As lung compliance gradually reduces with age, emphysema and other lung problems in elderly patients also increase [14]. Our study showed that the number of patients with COPD in the elderly group significantly increased. Previous studies indicated that the risk of pneumothorax after percutaneous lung biopsy significantly increased in patients with COPD, pulmonary bulla, and pulmonary fibrosis [15]. In our study, the incidence rate of pneumothorax in the elderly group was numerically higher than that in the non-elderly group, but the difference did not reach statistical significance. The higher incidence of pneumothorax might be associated with the higher prevalence of COPD in elderly groups.

Our study has several limitations that should be taken into account. For example, complete data collection is impaired by a retrospective study design, which in turn leads to the impossibility of exploring the risk factors associated with the complications. The present study is representative of a small group of elderly patients, and further large-scale clinical trials with prospective designs should be carried out to confirm the findings.

Conclusions

A CT-guided percutaneous lung biopsy was an efficient procedure for diagnosing SPN in elderly patients. Although complication rates were relatively higher in elderly patients, the safety of CT-guided percutaneous lung biopsy was acceptable, and most of the complications were mild adverse events. There should be no hesitation in performing a CT-guided percutaneous lung biopsy in elderly patients with SPN because of the irreplaceable role of this procedure in pathological diagnosis.

Additional Information

Disclosures

**Human subjects:** Consent was obtained or waived by all participants in this study. Chinese People's Liberation Army 92493 Military Hospital, Huludao City, and Beijing Arion Cancer Center, Beijing issued approval N/A. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

## References

1. Truong MT, Ko JP, Rossi SE, et al.: Update in the evaluation of the solitary pulmonary nodule . Radiographics. 2014, 34:1658-79. [10.1148/rg.346130092](#)
2. Cruickshank A, Stieler G, Ameer F: Evaluation of the solitary pulmonary nodule . Intern Med J. 2019, 49:306-15. [10.1111/imj.14219](#)
3. Reid CE, Wallis AG: Percutaneous image-guided lung biopsy. Br J Hosp Med (Lond). 2017, 78:C178-82. [10.12968/hmed.2017.78.12.C178](#)
4. Tai R, Dunne RM, Trotman-Dickenson B, Jacobson FL, Madan R, Kumamaru KK, Hunsaker AR: Frequency and severity of pulmonary hemorrhage in patients undergoing percutaneous CT-guided transthoracic lung biopsy: single-institution experience of 1175 cases. Radiology. 2016, 279:287-96. [10.1148/radiol.2015150381](#)
5. Sakai M, Hiyama T, Kuno H, et al.: Thoracic abnormal air collections in patients in the intensive care unit: radiograph findings correlated with CT. Insights Imaging. 2020, 11:35. [10.1186/s13244-020-0838-z](#)
6. Honguero Martínez AF, Godoy Mayoral R, Genovés Crespo M, et al.: Analysis of solitary pulmonary nodule after surgical resection in patients with 18F-FDG positron emission tomography integrated computed tomography in the preoperative work-up. Med Clin (Barc). 2021, 156:535-40. [10.1016/j.medcli.2020.05.061](#)
7. Mazzone PJ, Lam L: Evaluating the patient with a pulmonary nodule: a review . JAMA. 2022, 327:264-73. [10.1001/jama.2021.24287](#)
8. Lin Y, Liu L, Pu Q: Mini-invasive diagnosis and synchronous treatment of solitary pulmonary nodule . Asian Cardiovasc Thorac Ann. 2013, 21:306-12. [10.1177/0218492312452268](#)
9. Kuban JD, Tam AL, Huang SY, et al.: The effect of needle gauge on the risk of pneumothorax and chest tube placement after percutaneous computed tomographic (CT)-guided lung biopsy. Cardiovasc Intervent Radiol. 2015, 38:1595-602. [10.1007/s00270-015-1097-0](#)
10. Heerink WJ, de Bock GH, de Jonge GJ, Groen HJ, Vliegenthart R, Oudkerk M: Complication rates of CT-guided transthoracic lung biopsy: meta-analysis. Eur Radiol. 2017, 27:138-48. [10.1007/s00330-016-4357-8](#)
11. Wu CC, Maher MM, Shepard JA: Complications of CT-guided percutaneous needle biopsy of the chest: prevention and management. AJR Am J Roentgenol. 2011, 196:W678-82. [10.2214/AJR.10.4659](#)
12. Sharma A, Shepard JO: Lung cancer biopsies. Radiol Clin North Am. 2018, 56:377-90. [10.1016/j.rcl.2018.01.001](#)
13. Bingham BA, Huang SY, Chien PL, Ensor JE, Gupta S: Pulmonary hemorrhage following percutaneous computed tomography-guided lung biopsy: retrospective review of risk factors, including aspirin usage. Curr Probl Diagn Radiol. 2020, 49:12-6. [10.1067/j.cpradiol.2018.10.007](#)
14. Cortopassi F, Gurung P, Pinto-Plata V: Chronic obstructive pulmonary disease in elderly patients . Clin Geriatr Med. 2017, 33:539-52. [10.1016/j.cger.2017.06.006](#)
15. Zhou M, Wang T, Wei D, et al.: Incidence, severity and tolerability of pneumothorax following low-dose CT-guided lung biopsy in different severities of COPD. Clin Respir J. 2021, 15:84-90. [10.1111/crj.13272](#)