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Ct Guided Lung Biopsy: Analysis of Factor Affecting the Complication

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Abstract

AIM: To determine various factors contributing to the complication related to CT guided lung biopsy. ***MATERIALS & METHODS:*** A cross-sectional study was conducted between September 2020 to October 2021. Total of 34 patients who had suspected radiological lung masses were included in the study. Histological sample were collected through co-axial system of core needle biopsy. Various factors affecting complication was assessed against patient showing complication.***RESULTS:***Total of 6 (17.65%) post-procedural complications were noted in study which include pneumothorax and lung contusion. Multiple risk factors affecting the rate of complication were considered like predisposed emphysema, depth of the lesion, angle of insertion of biopsy needle, gauze size of the needle used and repeatability of the procedure. "Depth of the lesion" was best predictor of complications at cut-off point of >1.1 cm. ***CONCLUSION:*** This study is an attempt to evaluate the factors contributing to the safety and complications of core needle CT guided lung biopsy. One must should keep in mind these factors to procure uncomplicated procedure.

KeyWords: Lung Biopsy, Complication, Lung Mass, Intervention Radiology

INTRODUCTION

Leyden performed the first transthoracic needle lung biopsy to confirm pulmonary infection in 1882[1]. Pulmonary biopsy was primarily used in the first part of the 20th century to establish the microbiological diagnosis of widespread infected lobar consolidation, which was simple to localize. However, chest percutaneous needle sampling has lost favor due to an intolerably high rate of problems brought on by the large gauge of the needles[1]. Pathologists remained hesitant to make a diagnosis on little samples or smears despite using smaller needles. In the 1960s, bronchial brush biopsy under fluoroscopy was first described[2]. The transthoracic fine needle sampling technique in the chest gained popularity at the same time thanks to *Nordenström* and *Zajicek's* trailblazing work at the *Karolinska* Hospital in Stockholm[3]. With the systematic use of tiny gauge needles, the risk of pneumothorax was significantly decreased. Still, the rate of insufficient cellular material or erroneous negative diagnoses in confirming malignancy remained in the 15% to 25% range. Due to its capacity to provide excellent anatomical display and guide puncture of intrapulmonary/mediastinal lesions that are challenging to locate, CT scan has recently become the most often used guidance modality for thoracic procedures. A pre-procedural contrast-enhanced CT is required to outline the lesion concerning anatomy and identify inhomogeneity and vascular structures [1][4]. Pneumothorax, pulmonary hemorrhage, hemothorax, and air embolism are only a few post-procedural problems identified[4]. Pneumothorax incidence ranges from 8 to 60%, with a mean of 20%[5][6]. In 2 to 10% of instances, hemorrhage with or without hemoptysis occurs [7]. On the other hand, air embolism is only documented in 0.02 to 0.07% of cases[8].
Large core samples can be obtained with a single penetration using recent advancements in core biopsy procedures, such as automated spring-loaded biopsy guns and coaxial needle systems[9][10]. A properly planned and carried out CT-guided biopsy aids in making an accurate diagnosis and makes it easier to start a permanent course of treatment.

MATERIALS AND METHODS

From September 2020 to October 2021, a cross-sectional study was carried out at the Radio-diagnosis department of the Medical College of Baroda & SSG Hospital, Vadodara. A total of 34 patients were included in the study.

OBJECTIVES OF THE STUDY:
1. To assess the complications of CT-guided core needle biopsy in pulmonary lesions.
2. To identify the various risk factors associated with post-procedural complications.

EXCLUSION CRITERIA:
1. Non-co-operative patients.
2. Uncorrected coagulation abnormalities.
3. Difficult access to the lesions.

EQUIPMENT USED:
1. CT machine – 16 SLICE CANON AQUILION LIGHTNING
2. Biopsy gun with Disposable Biopsy Needle (BARD MAGNUM)
4. Disposable Coaxial Biopsy needle with depth stop and Tip Stylet.
5. Hypodermic needles.

METHODS OF STATISTICAL ANALYSIS:
For the outcomes, the following statistical tests were used:
1. Independent t-test for connection between the quantitatively oriented variables.
2. Fisher's exact test was used to determine whether the qualitative factors were associated.
3. To forecast problems, the receiver operating characteristic curve was used.

P values less than 0.05 were regarded as statistically significant for analysis purposes.
The final analysis was performed using the Statistical Package for Social Sciences (SPSS) program, made by IBM and manufactured in Chicago, USA, version 21.0, after the data had been entered into a Microsoft Excel spreadsheet.

PATIENT SELECTION (Figure.01) & PREPARATION:

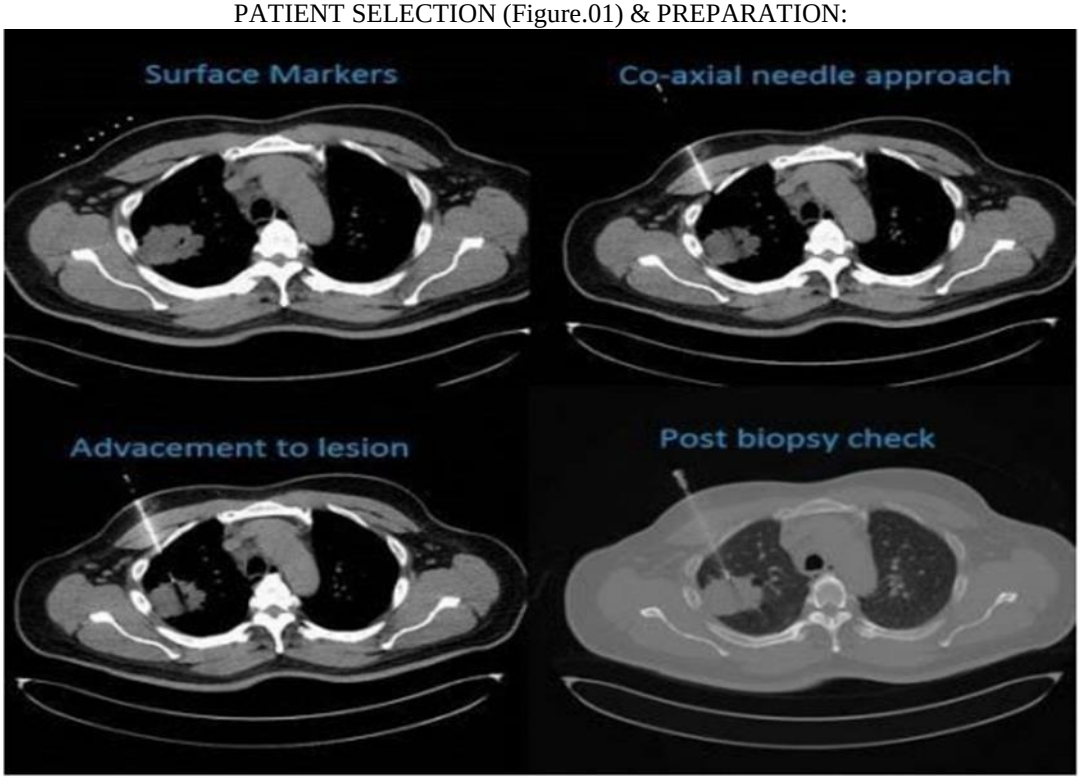

Figure 01. –Approach to Patient selection.

After taking Informed consent, the patient was positioned in the CT gantry, and the percutaneous access site was prepared. Immediate pre-procedural CT of the chest was done to delineate the thoracic lesion and to locate the needle puncture site. The point was localized and subsequently cleaned with povidone-iodine and surgical spirit. Using aseptic precautions, 2% lignocaine was utilized for local anesthesia, and the procedure was performed.

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TECHNIQUE (**Figure.02**):

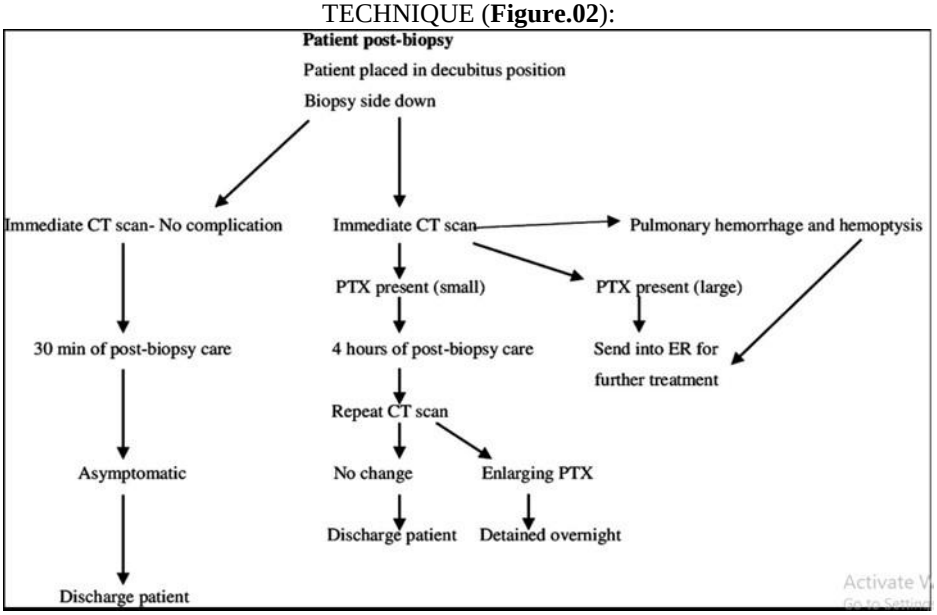

Figure 02. –Technique

A coaxial needle was used for PLB of lung lesions. A second CT scan was taken to ensure the needle was inserted in the right place for each patient. A further CT scan verified that the needle was positioned appropriately to reach the lesion [11]. A biopsy gun with a needle affixed to it was fired to acquire a tissue core of about 2 cm in length after being inserted through the coaxial needle to reach the lesion. The obtained tissues were subsequently sent for histological analysis in a 10% formalin solution.

POST PROCEDURAL CARE (**Figure. 03**):

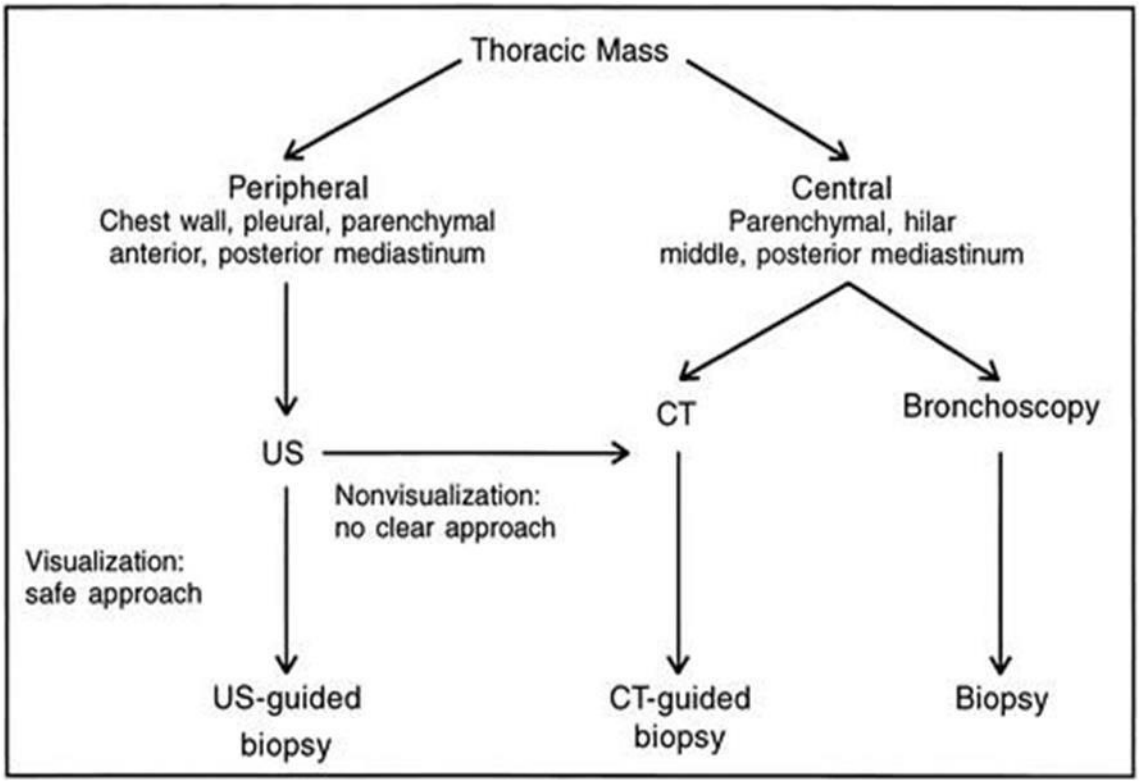

Figure 03. –Approach to Patient management

Before the patient was moved to the wards, a CT scan of the complete thorax was performed to look for potential problems, such as pneumothorax and hemothorax. A period of bed rest is advised, as well as regular observation for some hours after the procedure.

RESULTS

Table 1:-Distribution of Age of study subjects

Demographic characteristics	Frequency (Age(years))
Mean ± SD	56.88 ± 13.2
Median (25th-75th percentile)	58.5(46.25-65)
Range	18-77

Table 2:-Distribution of Gender of study subjects

Gender	Frequency	Percentage
Total	34	100.00%

Table 3:-Distribution of complications of study subjects.

Complications	Frequency	Percentage
No	28	82.35%
Yes	6	17.65%
Total	34	100.00%

Table 4:-Distribution of type of complications of study subjects.

Type of complications	Frequency	Percentage
Contusion	1	2.94%
Pneumothorax	6	17.65%

Table 5: -Association of factors affecting complications with complications.

Factors affecting complications	No complications(n=28)	Complications present(n=6)	Total	P value
Emphysema				
No	17 (94.44%)	1 (5.56%)	18 (100%)	0.078*
Yes	11 (68.75%)	5 (31.25%)	16 (100%)	
Angle				
<90	2 (40%)	3 (60%)	5 (100%)	0.029*
90	26 (89.66%)	3 (10.34%)	29 (100%)	
Gauze				
12G	12 (75%)	4 (25%)	16 (100%)	0.504*
14G	15 (88.24%)	2 (11.76%)	17 (100%)	
16G	1 (100%)	0 (0%)	1 (100%)	
Number of attempts				
1	23 (82.14%)	5 (17.86%)	28 (100%)	1*
2	5 (83.33%)	1 (16.67%)	6 (100%)	
Depth(cm)				
Mean ± SD	0.44 ± 1.26	1.15 ± 0.99	0.56 ± 1.24	0.206†
Median (25th-75th percentile)	0(0-0)	1.4(0.3-1.6)	0(0-0.375)	
Range	0-6	0-2.5	0-6	

† **Independent t test,** * **Fisher's exact test**

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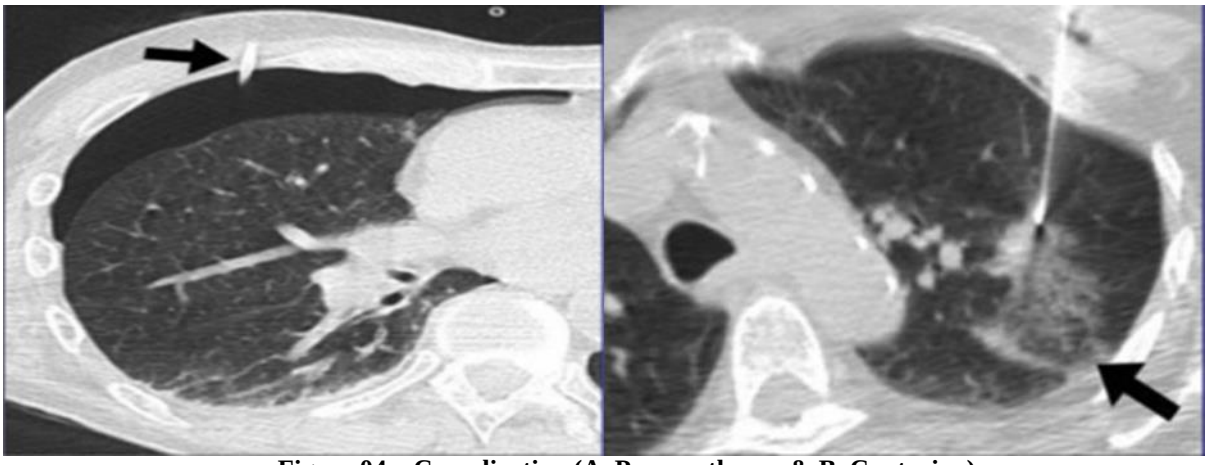
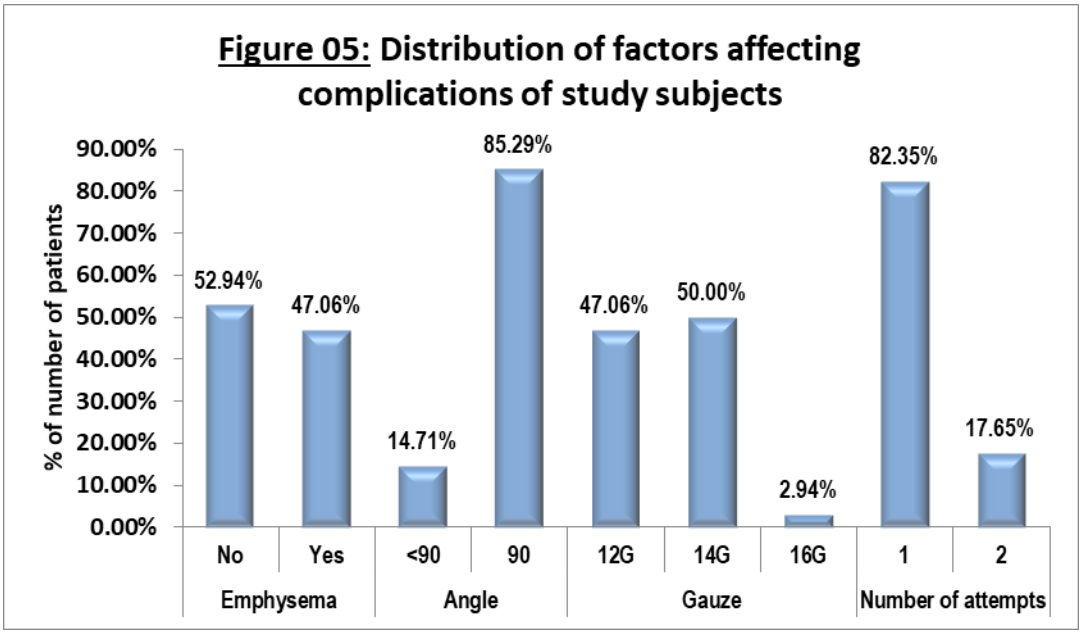
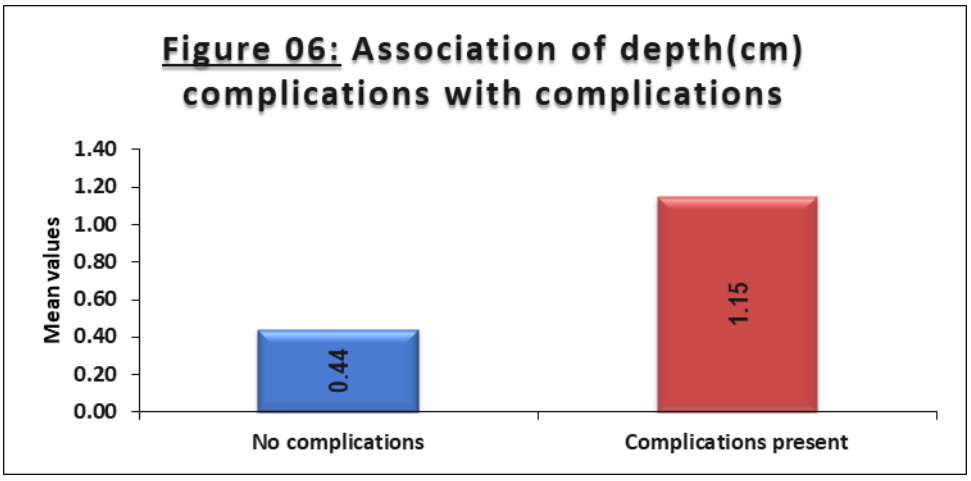


Figure 04. –Complication (A. Pneumothorax & B. Contusion)





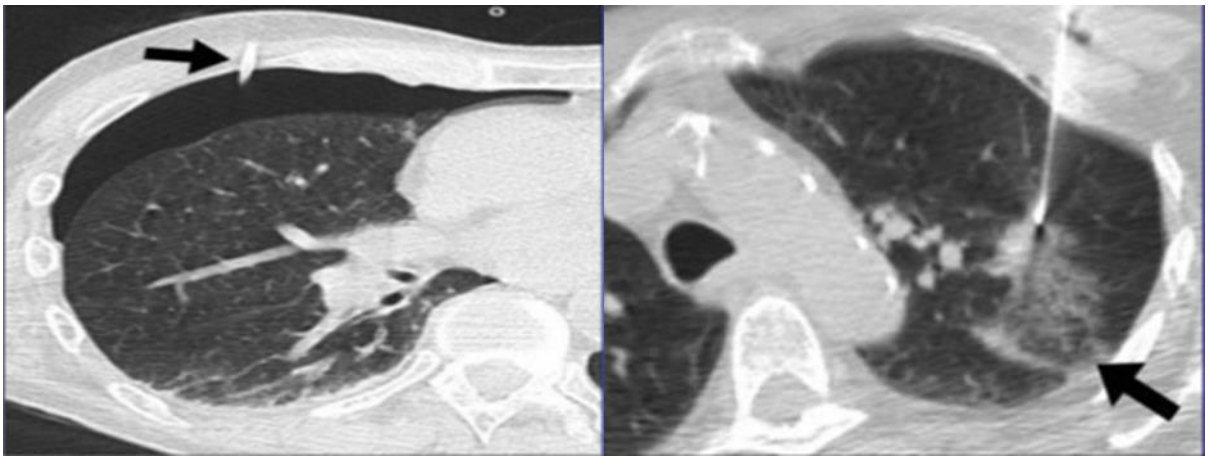


Figure 07. –ROC Curve

A total of 34 CT-guided biopsies were performed, of whom 29 (85.29%) were males, and 5 (14.71%) were females. The age group of the patients ranged from 18 years to 77 years, with a mean value of 56.88 ± 13.2 (Table.01-02& Figure. 04).
This study had 6 post-procedural complications (17.65%), including pneumothorax and lung contusion (Table.03-04).

Various factors (Figure.05& Table.05) contributing to complications were considered. Among these, Emphysema was present in 16/34 patients (47.06%). Angle (of biopsy needle insertion) was <90 in only 5/34 patients (14.71%). The gauze used was 14G (50%), followed by 12G (47.06%) and 16G (2.94%). In the majority (82.35%) of patients, the number of attempts was 1. The number of attempts was 2 in only 6 out of 34 patients (17.65%). The mean value of depth (cm) of study subjects was 0.56 ± 1.24.
The distribution of complications was comparable with Emphysema. (No emphysema (5.56%) vs. Emphysema (31.25%)) (p value=0.078). The proportion of patients with complications was significantly higher at an angle of <90(60%) as compared to an angle of 90(10.34%). (p value=0.029) The distribution of complications was also comparable with gauze size. (12G (25%) vs 14G (11.76%) vs 16G (0%)) (p value=0.504). The distribution of complications was comparable with the number of attempts. (1(17.86%) vs 2(16.67%).) (p value=1).
Among all the parameters, depth (cm) was the best predictor of complications (Figure.06-07) at a cutoff point of >1.1, with a 74.10% chance of correctly predicting complications. The number of attempts had a sensitivity of 83.33%, followed by depth (cm) (66.67%) and gauze (66.67%). On the other hand, depth (cm) had a specificity of 89.29%, followed by gauze (57.14%) and the number of attempts (17.86%). In the prediction of complications, the number of attempts had the lowest specificity of 17.86%. The highest positive predictive value was found in depth (cm) (57.10%), and the highest negative predictive value was found in depth (cm) (92.60%).

DISCUSSION

This study attempts to evaluate the factors responsible for the safety and complications of core needle CT-guided lung biopsy. Our study concluded that among all the factors considered, "Depth of the lesion" was the best predictor for complication. Heernik et al., 2016 published a meta-analytic study that concluded that increased traversed lung parenchyma is one of the factors responsible for the complication in FNAC of lung lesions. However, no risk factors were found in the core biopsy [12]. In our study, it is clear from the data that the depth of the lesion or increased traversed lung parenchyma plays a crucial role in complicating the core needle biopsy.
Gauze size and the number of attempts also play a crucial role in predicting complications. Considering so many valuable factors in one study was a solid attempt to move forward for further research and detailed evaluation in a large sample size study. However, this study gives a broad and basic idea about all the factors needed to be considered before going into the procedure.

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