

Diagnostic accuracy and associated complications of percutaneous computed tomography guided core needle biopsy of pulmonary lesions using coaxial technique

Amjad Sattar¹, Sohail Ahmed Khan², Nauman Al-Qamari³, Hatem Adel⁴, Syed Omair Adil⁵

Abstract

This study was conducted to determine the diagnostic accuracy of CT-guided core needle biopsy (CNB) using coaxial technique of pulmonary lesions, its complications and factors affecting them. A total of 122 patients with suspected lung malignancy underwent CT-guided CNB. Final diagnosis was confirmed by histopathology. There were 84 (89.4%) true positive while 26 (92.9%) true negative cases. Diagnostic accuracy, sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy were 97.67%, 72.22%, 89.36%, 92.86% and 90.16% respectively. Pneumothorax was the only complication observed in 10 (8.2%) patients. The odds of pneumothorax was found to be 10.72 times higher among patients with ≤ 2.5 cm of size of lesions (AOR 10.72, 95% CI 1.49-76.77) while 86% lower among patients having prone position (AOR 0.14, 95% CI 0.021-0.96). Results indicate that percutaneous CT guided biopsy of pulmonary lesions using coaxial technique is a safe procedure with a high diagnostic accuracy and lesser risk of major complications.

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Introduction

Since the advent of Computed Tomography (CT) scans, there is an increase in detection of lung lesions and most of them are neoplastic. Sometimes both neoplastic and non-neoplastic lesions may have similar clinical and radiological appearance and accurate diagnosis is necessary for correct treatment as prognosis may be different.¹

Biopsy of pulmonary lesions is frequently performed and provides great benefit to the patient. Ultrasound is serving as a diagnostic tool; however its role in chest is limited.² With advancements in radiological guided procedures, percutaneous CT guided lung biopsy is becoming the procedure of choice for taking biopsies of lung

^{1,2,3,4}Dow Institute of Radiology, Dow University of Health Sciences, Pakistan;

⁵Department of Research, Dow University of Health Sciences, Karachi, Pakistan.

Correspondence: Amjad Sattar. e-mail: amj7777@hotmail.com

parenchymal lesions. Percutaneous CT guided core needle biopsy of the lung lesion using a coaxial technique with a reported sensitivity and specificity of 93% and 98% respectively is usually preferred because it reduces the number of passes through the pleura and allows multiple sampling giving a high diagnostic yield.³ Coaxial core biopsy is also preferred over aspiration cytology of the lesions because large specimens can be obtained for histopathological and molecular diagnosis.⁴ Considering the importance of the procedure in patients with pulmonary lesions, this study was designed to determine diagnostic accuracy and factors associated with complications. Also, being reported from a developing country for the first time, this might add fresh perspective to the already available literature.

Methods and Results

This retrospective study was conducted at Dow Institute of Radiology, Dow University of Health Sciences from January 2013 to December 2016. The ethical approval was obtained from the institute prior conducting of the study (Ref: IRB-815/DUHS/Approval/2016/31). The acquisition of informed consent from patients was waived, as the data was retrospectively collected from electronic medical record. All patients who underwent percutaneous CT guided lung biopsy using coaxial technique and had normal PT/INR and platelet count at baseline were identified from the radiology database of our institute. All patients with one month old pre-biopsy review scans and biopsies performed under fluoroscopic or ultrasound guidance or CT guided lung biopsies performed without coaxial cutting needle technique were excluded.

All patients had a contrast enhanced CT scan available for review prior to the procedure. Two interventional radiologists with greater than 2 years of experience performed the procedures. All cases were performed on 16-slice multi detector spiral CT (GE Brightspeed or Siemens Somatom emotion). Biopsies were performed using a coaxial cutting needle system (18G coaxial, 20G semiautomatic trucut biopsy needle) in prone, supine or

mid-axillary positions. If formation of small asymptomatic pneumothorax was observed then patient was treated conservatively by supplemental oxygen. Follow up chest radiograph was performed to evaluate the stability of the pneumothorax. If moderate to large pneumothorax was observed or if the pneumothorax caused symptoms such as chest pain, shortness of breath or decreased oxygen saturation then chest tube insertion was done. Stable patients after biopsy were discharged 3-4 hours later and were instructed to return to the nearest emergency upon development of symptoms such as shortness of breath or chest pain.

Final diagnosis was divided into three categories: Malignant, benign and inconclusive.

The study integrated 122 patients during the study period with suspected pulmonary malignancy, preponderance of males were found higher i.e. 108 (88.5%) as compared to female 14 (11.5%) (Mean age 59.87 ± 11.69 years). There were 70 (57.4%) patients with left lung site and 52 (42.6%) patients with right lung site. Majority of the patients i.e. 70 (57.4%) had prone position, 32 (26.2%) had supine and 20 (16.4%) had mid axillary position. In majority of the patients i.e. 78 (63.9%) size of lesion was >2.5 cm whereas 82 patients (67.2%) had ≤ 2 punctures.

The histopathology report showed small cell carcinoma in majority of the patients, i.e. 38 (31.1%) whereas squamous cell carcinoma was found in 26 (21.3%), tuberculosis 24 (19.7%), adenocarcinoma 12 (9.8%), inconclusive 12 (9.8%), metastasis 6 (4.9%) whereas others 4 (3.3%).

Majority 94 (77%) were malignant on percutaneous CT guided core needle biopsy using coaxial technique while 28 (23%) were benign. Histopathology reported 86 (70.5%) malignant, 36 (29.5%) benign. Comparison of CNB with histopathology have showed true positive cases in 84 (89.4%) patients, true negative 26 (92.9%), false positive 10 (10.6%) while false negative in 2 (7.1%) patients. Sensitivity was found to be 97.67%, specificity 72.22%, positive predicted value 89.36%, negative predicted value 92.86% while overall diagnostic accuracy 90.16% (Table 1).

Complications were observed in 5 (8.19%) patients and all were pneumothorax. Univariate analysis revealed that gender, size of lesion, prone position and puncture were significantly associated with pneumothorax. Male gender were 85% (OR 0.15, 95% CI 0.03-0.61), having prone

Table-1: Comparison of Core Needle Biopsy (CNB) with final diagnosis (n=122).

CNB Diagnosis	Histopathology		Total	p-value*
	Malignant n (%)	Benign n (%)		
Malignant	84 (89.4)	10 (10.6)	94 (100)	<0.001
Benign	2 (7.1)	26 (92.9)	28 (100)	
Total	86 (70.5)	36 (29.5)	122 (100)	

*Chi-square test applied taking p-value significant at <0.05

Table-2: Regression analysis for variables associated with Pneumothorax (n=122).

	OR (95% CI)	p-value	AOR (95% CI)	p-value
Age (in years)	0.95 (0.89-1.01)	0.128		
Gender				
Male	0.15 (0.03-0.61)	0.008	0.15 (0.018-1.21)	0.074
Female	1		1	
Site				
Left	1.13 (0.30-4.21)	0.861		
Right	1			
Size of Lesion (in cm)				
≤ 2.5	8.44 (1.71-41.80)	0.009	10.72 (1.49-76.77)	0.018
>2.5	1			
Position				
Supine	0.15 (0.028-0.87)	0.134	0.16 (0.018-1.35)	0.093
Prone	0.07 (0.013-0.38)	0.002	0.14 (0.021-0.96)	0.045
Mid Axillary	1		1	
Puncture				
≤ 2	0.10 (0.02-0.49)	0.005	0.23 (0.04-1.48)	0.123
>2	1			
Puncture Angle				
90	0.37 (0.09-1.39)	0.141		
<90	1			

OR: Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence Interval

position were 93% (OR 0.07, 95% CI 0.01-1.38), and ≤ 2 puncture were 90% (OR 0.10, 95% CI 0.02-0.49) less likely to have pneumothorax whereas patients having ≤ 2.5 cm lesion size were 8.44 times more likely to have pneumothorax (OR 8.44, 95% CI 1.71-41.80).

In multivariate analysis, however, except size of lesion and prone position, insignificant association was observed in all variables. Patients with ≤ 2.5 cm of size of lesions were 10.72 times more likely (AOR 10.72, 95% CI 1.49-76.77) and patients having prone position were 86% less likely (AOR 0.14, 95% CI 0.021-0.96) to have pneumothorax after adjusting for other variables (Table 2).

Discussion

In this study, CT was found to be a safe and successful guiding modality for biopsy of lung lesions. However, lack of real time lesion visualization and use of ionizing radiations are major restriction of CT guided biopsy. The findings of this study has reported higher diagnostic

accuracy of CT guided core needle biopsy using coaxial technique in establishing the diagnosis of malignancy which is found almost similar to accuracies reported in several previous studies.^{5,6} In our study, only two false negative cases were observed. To achieve low false negative cases, repetition of imaging after conservative treatment is recommended in false negative cases. In the current study, no bleeding complication was observed. Although, the incidence of pneumothorax was observed in few patients but none of them was significant enough to require chest tube drainage. Pneumothorax was also reported in another study as the most common complication of the procedure.⁷

Patients with lesser lesion size were found more at risk of developing pneumothorax as compared to the patients with larger lesions in this study. This may be due to the reason that most of the lesions were located deep in the lung parenchyma and needle path from skin to the lesion was increased. This correlates with the previous studies in which long needle path or increase in lesion depth is associated with increased risk of pneumothorax.^{8,9} It has also been reported that lesion size of less than equal to two cm has highest rate of pneumothorax development.¹⁰ Hence, the decision to perform a percutaneous biopsy of lung masses depends upon the site of the lesion, patient status and co-morbidities as well as outcome and its impact on patient management. CT scan provides excellent contrast and resolution for needle placement and is widely used for percutaneous lung biopsies. CT guided lung biopsies also play a major role in personalized treatment.

The main limitations of the current study identified were: firstly, five of the lesions were regarded as undetermined. Secondly, the needle path and exact puncture angle were difficult to determine based upon the preference of the individual radiologist. Thirdly, since this being a retrospective study a predetermined concept may have existed.

Conclusion

Percutaneous CT guided biopsy of pulmonary lesions using coaxial technique is a safe procedure with a high diagnostic yield and lesser risk of major complications with pneumothorax being the most common complication. Small sized lesions and increased needle path from the skin to the needle were identified as the main factors affecting pneumothorax.

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