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ORIGINAL ARTICLE

Diagnostic accuracy and safety of CT-guided Lung and Mediastinal biopsies: a single center study

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ABSTRACT

Background: Computed tomography (CT)-guided percutaneous needle biopsy plays a critical role in establishing tissue diagnosis of malignancy, guiding staging, and planning treatment for pulmonary abnormalities.
Aim: To determine diagnostic accuracy and incidence of complications occurring after taking percutaneous CT-guided lung biopsy.
Methodology: In this retrospective study, we evaluated 44 CT-guided chest biopsies (31 lung biopsies and 13 mediastinal biopsies) performed at our institution between September 2019 and March 2022. A coaxial core biopsy needle technique was used for all CT-guided biopsies. All procedures were performed by an experienced consultant interventional radiologist using using a commercially available helical multidetector-row CT scanner.
Results: There were 29 men and 15 women among the 44 patients, ranging in age from 25 to 65 years. We found technical accuracy (described as tip of core biopsy needle within centre of lesion) of 100% (44/44) and diagnostic accuracy (described as adequate sample for histological assessment) of 97.7% (43/44) in our study. The overall incidence of complications during the procedure were recorded including pneumothorax (n = 2, 4.5%),pulmonary hemorrhage (n = 1, 2.3%), hemoptysis (n = 1, 2.3%).
Conclusion: CT-guided chest biopsy is a safe procedure and has good diagnostic accuracy. However, radiologists approaching such interventional procedures must be experienced and well trained so that there are less chances of developing complications after the procedure.
Practical implications: We suggest physicians performing chest biopsies to adopt better techniques and use shortest path to the lesion during needle insertion. Although CT-guided chest biopsy has fewer chances of complications, however, interventional radiologists should be conscious of potential complications.
Keywords: CT-guided biopsy; Percutaneous biopsy; Imaging, Interventional radiology; Diagnosis.

INTRODUCTION

Computed tomography (CT)-guided percutaneous needle biopsy is an indispensable tool in the evaluation of pulmonary abnormalities because it plays a critical role in establishing tissue diagnosis of malignancy, guiding staging, and planning treatment.[1] Chest tumours, particularly lung cancer, continue to be one of the leading causes of cancer-related death worldwide[2]. There are two types of biopsy techniques: fine-needle aspiration biopsy (FNAB) and core biopsy (CB). These both techniques have high diagnostic accuracy for carcinomas.[3] Overall diagnostic accuracy of CT-guided coaxial core biopsy technique for malignant and benign pulmonary lesions has been reported to be ranging from 82.6% to 95%[4-7]. It has been reported that lesion size ≤1 cm is a significant factor in decreasing the diagnostic accuracy[4]. Other factors influencing the diagnostic accuracy include needle type, nature of the lesion, expertise of the interventional radiologist[4,7].

The most common indication for image-guided chest biopsy is a new or enlarging solitary nodule, and the increasing use of chest CT has resulted in incidental detection of small pulmonary nodules in multiple patients.[2] Hence, CT investigation is necessary to estimate the likelihood of malignancy[8].

In 1993 Katada et al. introduced CT fluoroscopy for interventional procedures.[9] Real-time image display with CT fluoroscopy has been shown to reduce the procedure time for the biopsy and the number of attempts of needle insertion[10,11]. However, there are chances of development of pneumothorax and other complications influenced by the procedure time and number of needle insertions[12,13].

Multiple complications can occur after lung or mediastinal biopsies, and pneumothorax has been reported to be most common having incidence of 61% with an average risk of 20%.[2,14] A meta-analysis by Heerink et al. reported pooled rate of 25.3% for CB and 18.8% for FNAB[15]. And it has been reported that CT-guided biopsy is superior than ultrasound-guided in terms of pooled diagnostic accuracy (92.1% vs 88.7%)[2].

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To the best of our knowledge, no data from Pakistan are currently available regarding the diagnostic accuracy and safety of percutaneous CT-guided chest biopsy procedures performed by interventional radiologists in our healthcare centers. This study aimed to determine diagnostic accuracy and the incidence of complications after taking a percutaneous CT-guided lung biopsy. The results of this study would help interventional radiologists to be cautious about potential complications.

METHODOLOGY

This study was approved by the institutional review board committee of Pakistan Kidney and Liver Institute and Research Center (Reference num: PKLI-IRB/AP/86). No personal information has been included in the manuscript which could lead to the identification of the patient and all patients gave informed consent for CT-guided biopsy. In this retrospective study, we evaluated 44 CT-guided chest biopsies (31 lung biopsies and 13 mediastinal biopsies) performed at our institution between September 2019 and March 2022. A coaxial core biopsy needle technique was used for all CT-guided biopsies

All procedures were performed by an experienced consultant interventional radiologist using using a commercially available helical multidetector -row CT scanner. In patients with more than one lung nodule, the largest and most accessible nodule was chosen. Based on CT scan findings, the shortest distance that was technically feasible from skin to the lesion was selected, entry point was determined and marked on the skin. Non-contrast CT images were obtained through the region of interest with a section thickness of 2.5 mm. Unless the treating interventional radiologist deemed it necessary (e.g., nodules abutting the diaphragm), routine breathing instructions were not given during preliminary imaging or during the biopsy. After cleaning and covering with sterile drapes, 2% lidocaine hydrochloride was administered for local anesthesia. For lung lesions and mediastinal lesions, 20 Gauge and 18 Gauge needle system was used, respectively. One pleural entry was made in all the biopsies, tissue samples were

taken and fixed in 10% formalin for histopathologic examination. After the biopsy, all patients were closely monitored for 4 hours, and the presence of a pneumothorax was noted on an immediate post biopsy CT. Thoracostomy tube was inserted to treat symptomatic or expanding pneumothorax. If the follow-up radiographs showed that the pneumothorax had not resolved, the thoracostomy tube was removed. All minor and major complications were documented. Descriptive statistics were applied using IBM SPSS version 20.

RESULTS

Of 44 patients, 29 were male and 15 were female, with age range of 25-65 years. In this study, technical accuracy (described as tip of core biopsy needle within centre of lesion) of 100% (44/44) while diagnostic accuracy (described as adequate sample for histological assessment) of 97.7% (43/44) was achieved. One lung biopsy sample was not adequate for histological assessment so repeat CT-guided procedure was advised by the pathology department.

Of 44 CT-guided biopsies, few complications were noted after the procedure. The overall incidence of pneumothorax (Figure 1), pulmonary hemorrhage (Figure 2), hemoptysis, and infection (fever of 102F remained for two days after procedure and then settled) were 2(4.5%), 1(2.3%), 1(2.3%), and 1(2.3%) respectively (Figure 3). One of the two patients developed major pneumothorax, requiring chest tube insertion (Figure 1). All these complications occurred during lung biopsies, and no complication was noted in patients who undergone mediastinal biopsies.

Figure 1. CT-guided chest biopsy of a pulmonary lesion. Figure 1A: Axial CT image before the procedure showing a pulmonary lesion in the right lower lobe. Figure 1B: Post-procedure axial CT image demonstrates pneumothorax that requires chest tube insertion.

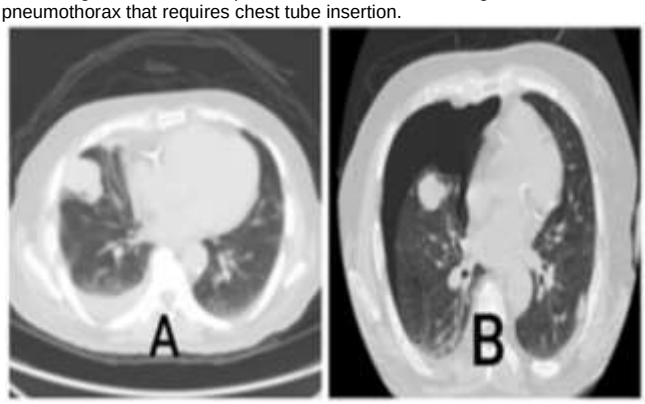


Figure 2. CT-guided chest biopsy of a pulmonary lesion. This demonstrates post procedure perilesional haemorrhage as ground-glass opacity adjacent to the lesion.

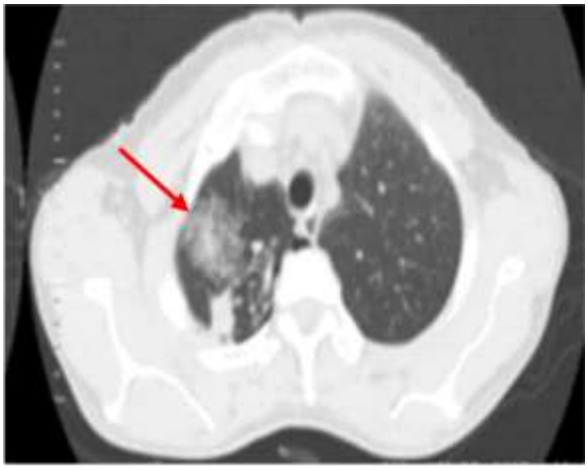
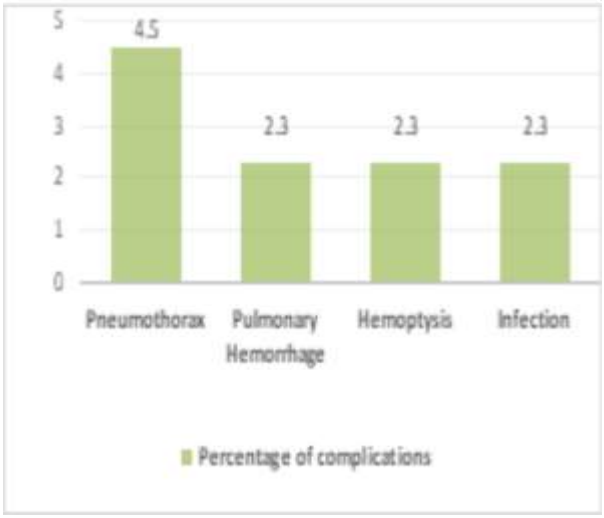


Figure 3: Overall incidence of complications during CT- guided biopsies.



DISCUSSION

Percutaneous biopsy of intrathoracic lesions is primarily performed with CT and ultrasound (USG) guidance, because these techniques allow precise localization of the biopsy needle and target lesion[16,17]. Inadequate acoustic window is a common problem with USG guidance, limiting its use for the selected cases only[16,18]. CT-guided chest biopsies also have potential risks and limitations, e.g., the parasternal approach is associated with the risk of hemorrhage from the injury to the internal mammary vessels lateral to the border of sternum[16]. A systematic review by Dibardino et al. reported the overall pooled diagnostic accuracy of 92.1% and the sensitivity for detecting malignancy of 92.1% in CT-guided transthoracic needle aspiration.[1] In this study, we found 97.7% diagnostic accuracy of CT-guided chest biopsies. Similarly, Sarajlic et al.[4] reported overall diagnostic accuracy of 95.5% and our results were also comparable to other previously published studies[19,20]. Diagnostic accuracy was 98% for lesions 35-50 mm and 93.9% for lesions greater than 50 mm[4].

In contrast to our study, Sarajlic et al[4], Kathory et al[21], and Hiraki et al[13] reported higher incidence of pneumothorax i.e., 19%, 34.5%, and 42.3%, respectively. Dibardino et al.[1] reported pneumothorax to be the most common safety issue in CT-guided transthoracic needle aspiration. The pooled incidence of pneumothorax was 20.5%, and the overall pooled incidence of pneumothorax-related chest tube placement was 7.3%, but it

varied greatly (range, 0 - 31.1%), most likely due to different and evolving management strategies.[1] Risk factors for development of pneumothorax include smaller lesion size, wider trajectory angle, a higher forced vital capacity, longer puncture time, emphysema within biopsy path, and number of punctures[1,22-25]. There are several risk factors for chest tube insertion when someone develops pneumothorax, including history of chronic obstructive pulmonary disease, emphysema within biopsy path, smoking history, lesion depth, and wider trajectory angle[1,26,27]. The difference in results between our study and other studies might be due to the experience of the interventional radiologist performing biopsy procedure in our setup, or due to the larger sample size in previously published studies.

There are some limitations in this study. This was a retrospective study and hence has the limitations inherent to all such studies and an unknown bias. Risk factors could not be evaluated because of limited available data of the patients. We performed chest biopsy with conventional CT, so results could differ if CT fluoroscopy was used. Sample size was small because of limited number of patients undergoing CT chest biopsy in our center.

CONCLUSION

In conclusion, CT-guided chest biopsy is a safe procedure and has good diagnostic accuracy. It is the investigation of choice in lung and mediastinal tumours where histopathological correlation is necessary. However, radiologists approaching such interventional procedures must be experienced and well trained so that there are less chances of developing complications after the procedure. We suggest physicians performing chest biopsies to adopt better techniques and use shortest path to the lesion during needle insertion. To our best knowledge, this is the first such study reporting diagnostic accuracy and safety of CT-guided chest biopsy from Pakistan, hence, it would be quite convincing for radiologists especially working in underdeveloped and developing countries.

Conflict of interest: Nil

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