Section: Miscellaneous

Original Research Article

DIAGNOSTIC ACCURACY AND SUFFICIENCY OF PERCUTANEOUS TRANS-THORACIC COMPUTED TOMOGRAPHY-GUIDED CO-AXIAL NEEDLE TRUCUT BIOPSY IN THE MANAGEMENT OF LUNG LESIONS.

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Abstract

Background: Percutaneous trans-thoracic computed tomography guided co-axial needle trucut biopsy or CT-guided biopsy (CTB) is a readily available diagnostic modality in the management of lung lesions. Studies on diagnostic yield of CTB show satisfactorily high diagnostic yield. However the data on the diagnostic accuracy and sufficiency is scarce as well as heterogeneous in terms of the definitions of successful sampling used in the studies. In view of this ambiguity of the data, we intended to evaluate accuracy and sufficiency of CTB in the management of lung lesions. **Materials and Methods:** We did a retrospective analysis of the patients, who underwent CTB for the diagnosis of lung lesions at our Hospital between July, 2020 and June, 2024. The procedure was considered successful and sufficient if histo-pathological, immuno-histochemistry and/or microbiological evaluation of the retrieved sample by CTB along with clinical, radiological and laboratory parameters of the patients resulted in a diagnosis which was enough to start definitive treatment without need for further tissue sampling. **Results:** Data was available on 86 lung lesions sampled in 82 patients. CTB revealed complete diagnostic information in 71 lesions with a success rate of 82.55%. Out of these patients 85.71% were malignant diseases with primary adeno-carcinoma as the most common cause of lesion in 43.66%, followed by squamous cell carcinoma (19.71%), mesothelioma (5.63%) and small cell carcinoma (5.63%). Lung metastasis from colon was diagnosed in 3 (4.22%) patients, breast in 2 (2.80%) patients and prostate malignancy in 1 (1.40%) patient. Bronchial anthraco-fibrosis was the most common benign diagnosis made in 4 out of 11 cases (15.49%) followed by tuberculosis (2.80%), organizing pneumonia (2.80%), fungal pneumonia (4.22%) and sarcoidosis (1.40%). In 15 patients (17.44%) with non-diagnostic CTB only 6 patients could be diagnosed by alternative sampling methods or repeat CTB. **Conclusion:** CT guided biopsy in lung lesions is sufficient for tissue sampling of lung lesions in at least 4/5th of the patients. It should be the first choice in diagnostic tissue sampling in lung lesions.

INTRODUCTION

Lung lesions including nodules, masses and consolidations need biopsy for histo-pathological, molecular and microbiological characterization.[1] Percutaneous trans-thoracic computed tomography (CT) guided co-axial needle trucut biopsy or CT-guided biopsy (CTB) is an easily available diagnostic modality for sampling such lesions especially in the peripheral lung tissue near the pleural surfaces.[1-6] Although there is risk of pneumothorax, haemorrhage and other complications the frequency of these adverse events is very low.[1-5] The procedure can be done in daycare settings and has a relatively lower cost in most of the clinical settings.[1-5]

Literature on diagnostic yield of CT-guided biopsy shows satisfactorily high yields.[2-7] Most of the

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studies show an impressively high sensitivity as well as specificity in diagnosing lung lesions especially those with malignant pathology.[1-6] The diagnostic accuracy of CT-guided biopsy ranges from 92.7% to 99% in different case series.[1-6] However the literature on the diagnostic utility of CT-guided biopsy in lung lesions is very heterogeneous. The terms like true/false positives as well as true/false negatives has been used with varying meanings and definitions.[1-6] In a tissue sample with malignant aetiology, a complete histo-pathological and molecular characterization of the tissue is needed for diagnosis. Similarly in case of benign infective lesions some special microbiological staining techniques may be needed for complete diagnosis. The diagnostic sampling method may not be sufficient in diagnosing a tissue sample, yet may be labeled as a true positive result if it merely shows some atypical cells. There is immense variation in these definitions used for successful tissue sampling.[2-7] There is also heterogeneity in the patient populations studied.[2-7] With such lacunae in the existing literature, it is difficult to compare CTB with other diagnostic modalities in the evaluation of lung lesions.

In view of this heterogeneity and ambiguity of the data, we intended to do a retrospective analysis of the patients who underwent CT-guided biopsy for lung lesions at our centre. We intended to see the frequency of those patients where CT-guided biopsy was successful in retrieving a tissue sample which was sufficient enough to give a histo-pathological diagnosis which was enough to start disease specific treatment without a need for further tissue sampling in that patient.

MATERIALS AND METHODS

This was a retrospective analysis conducted at Khyber Super-specialty Hospital, Khayyam Srinagar, Jammu and Kashmir, India. The Hospital is a 150-bedded private multi-specialty Hospital which receives referrals from an adjoining population of 10 million. The record of the patients who underwent CTB of lung lesions in the preceding 4 years was analyzed. The record of all patients who underwent the procedure between July, 2020 and June, 2024 was retrieved from the hospital sources which included CT images, case files, procedure records, ward records and registers. All the procedures during this period were done by a team of interventional radiologists with at least 10 years' experience in CTB of lung lesions. Need for ethical committee clearance for the study was exempted in view of the retrospective nature of the study.

The procedure was done using a 16 slice (Philips Healthcare, Suzhou Co Ltd, China) CT machine. The biopsy tool was an automated Bard mission biopsy gun with an 18-gauge needle. At least, 3 passes were taken from each lesion in most of the patients. The specimens were fixed in 10% formalin and were then immediately transported to the pathology department. After the procedure, the patient underwent CT scan to exclude pneumothorax or bleeding. The patients were discharged only after 24 hours of monitoring in the Hospital for any potential complications.

The CTB procedure was considered successful if histo-pathological, immuno-histochemistry and/or microbiological evaluation of the retrieved sample along with clinical, radiological and laboratory parametres of the patients resulted in a diagnosis which was enough to start definitive treatment without need for further tissue sampling using a repeat CT-guided biopsy procedure or any other diagnostic method like surgical open lung biopsy, video-assisted thoracoscopic surgery (VATS) guided biopsy or radial endo-bronchial ultrasound (EBUS) guided biopsy with rapid on-site evaluation. Procedures leading to samples being reported merely as malignant or benign without further characterization of histo-pathological type which needed further diagnostic sampling or were diagnosed after surgical excision of the lesions were not considered to be successful/sufficient.

RESULTS

During the specified time period, 98 lung lesions in 93 patients were sampled by CT-guided biopsies at our centre. Out of these, complete information could be retrieved in only 82 patients in whom 86 lung lesions were sampled. Most of the lesions were more than 5 cm in size (60.46%). Majority of the lesions ((87.20%)) were situated in the peripheral 1/3rd of the lungs and were located in the right lower lobe (24.41%). CT-guided biopsy revealed complete diagnostic information in 71 lesions with a success rate of 82.55%. [Table 1]

Out of the patients diagnosed by CT-guided biopsy, 85.71% were malignant diseases with primary adeno-carcinoma as the most common cause of lesion in 43.66%, followed by squamous cell carcinoma (19.71%). There were 4 (5.63%) cases each of mesothelioma and small cell carcinoma. A total of 6 patients had secondary lung deposits from colon, breast and prostate malignancies diagnosed by CT-gilded biopsy. All six had diagnosed malignant disease at the time of CT guided biopsy. [Table 2]

Bronchial anthraco-fibrosis was the most common benign diagnosis made in 4 out of 11 cases (15.49%) with benign conditions. Other benign diseases diagnosed by CT-guided biopsy were tuberculosis (2.80%), organizing pneumonia (2.80%), fungal pneumonia (4.22%) and sarcoidosis (1.40%). The diagnosis of all these patients with benign lung lesions was made after clinical, radiological and laboratory investigations were considered in addition to the histo-pathological results of the tissue sampling by CT-guided biopsy.

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No additional tissue sampling after CT-guided biopsy was needed in these patients. [Table 2]

Out of 15 instances (17.44%) where CT-guided biopsy of the lung lesion could not finalize the diagnosis, 6 patients were diagnosed on alternative tissue sampling methods or repeated CT-guided biopsy of the same or different lesion. The diagnostic modalities which diagnosed diseases in patients in whom CT-guided biopsy failed were VATS guided lung biopsy (4 patients: 2 adeno-carcinoma, 1 squamous cell carcinoma and 1 benign leiomyoma) and Radial endobronchial ultrasound (EBUS) guided biopsy with on-site evaluation by a pathologist (1 patient with tuberculosis). One patient was diagnosed after a repeat CT guided biopsy of another nodule in the opposite lung (adeno-carcinoma with background bronchial anthraco-fibrosis). Even after repeated attempts or alternative sampling methods, 5 patients did not get a complete diagnosis. A total of 4 patients were lost to follow up after initial inconclusive CT guided biopsy. [Table 3]

Table 1: Demography of patients, radiological location and size of lung lesions in patients who underwent CT-guided biopsy

Number of patients	**82**
Number of biopsies done	86 (2 nodules sampled in 4 patients each)
Age (mean ± standard deviation)	54.6±24.3
Age range	21-79
Males	44 (53.65%)
Females	38 (46.34%)
Right upper lobe lesions	11 (12.79%)
Right middle lobe lesions	7 (8.13%)
Right lower lobe lesions	21 (24.41%)
Left upper lobe lesions	9 (10.46%)
Left lingular lobe lesions	2 (2.32%)
Left lower lobe lesions	29 (33.72%)
Nodules/consolidations in peripheral 1/3rd	75 (87.20%)
Nodules/consolidations in central 2/3rd	11 (12.80%)
Nodule size: less than 20mm	7 (8.13%)
Mass/consolidation size: 2-5 cm	27 (31.39%)
Mass/consolidation size: greater than 5 cm	52 (60.46%)
Definite diagnosis made after CT guided biopsy	71 (82.55%)

Table 2: Diagnosis in patients where CT guided biopsy of lung lesions was accurate and sufficient in the management (N= 71)

Definite Malignant diagnosis after CT guided biopsy		**58 (81.69%)**
Primary lung malignancy	Adeno-carcinoma	31 (43.66%)
	Squamous cell carcinoma	14 (19.71%)
	Small cell carcinoma	4 (5.63%)
	Mesothelioma	4 (5.63%)
	Neuro-endocrine tumour	1 (1.40%)
	Nerve sheath cell tumour	1 (1.40%)
Secondary metastatic lung deposits	Colon carcinoma	3 (4.22%)
	Breast adeno-carcinoma	2 (2.80%)
	Prostate carcinoma	1 (1.40%)
Definite Benign diagnosis after CT guided biopsy		11 (15.49%)
Bronchial anthraco-fibrosis		4 (5.63%)
Tuberculosis		2 (2.80%)
Organizing pneumonia		2 (2.80%)
Fungal pneumonia/invasive mycosis		3 (4.22%)
Sarcoidosis		1 (1.40%)

Table 3: Final diagnosis in patients (with alternative diagnostic methods) where CT-guided biopsy was not accurate/sufficient in the management of lung lesions (N = 15)

No diagnosis by CT guided biopsy – number of biopsies	**15**
No diagnosis made even after alternative diagnostic methods after failed CT guided biopsy	5
Patients lost to follow up after inconclusive CT guided biopsy	4
Diagnosis made after alternative diagnostic methods	6
Repeat CT biopsy of another nodule/mass/consolidation	1
Adeno-carconoma and bronchial anthracofibrosis	1
VATS guided lung biopsy	4
Adeno-carcinoma lung	2
Squamous cell carcinoma	1
Benign leiomyoma	1
Radial EBUS guided biopsy with rapid onsite evaluation	1
Tuberculosis	1

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DISCUSSION

Lung is a unique spongy tissue with movements and morphological changes occurring with every breath. Patient cooperation is therefore very essential for the procedure. The proximity to large vessels, heart and nerves also makes the procedure risky and decreases the margin of error.[1] In large heterogeneous lesions with areas of necrosis, atelectasis, pneumonia and fibrosis, CT-guided biopsy may lead to false negative results. Unsuccessful sampling increases morbidity, risk of complications as well as healthcare costs.[1,7-9] There is also loss of crucial time in initiating treatment in these patients. Invasive procedures like VATS guided lung biopsy, open surgical lung biopsy and Radial EBUS guided biopsy may be needed in case CT-guided biopsy fails.[1-9]

The generic terms of true or false positive, diagnostic accuracy, sensitivity or specificity may be misleading in case of diagnostic methods where tissue sampling is required. Most of the studies have considered a mere characterization of lung lesion as malignant or benign as a true positive result.[1-6] This has inflated the diagnostic yield claim of CT guided biopsy in lung lesions in most of the studies.[1-6] A pathological sampling method cannot be considered successful if the result merely points to the benign or malignant nature of the lesion without accurately delineating the exact histopathological type of malignancy. Similarly terming a diagnostic test as "true positive" carries no meaning in clinical perspective if further sampling is needed to start specific treatment in a patient.

In our study, the success rate of CT-guided biopsy is more than 80% even when a strict definition of "accurate diagnostic result without need for further tissue sampling" is taken into consideration. We did not find any other study with similar definition of a successful diagnostic CT-guided biopsy in literature. Given this high success rate of CT guided biopsy and low cost of this procedure at our centre as compared to Radial EBUS-guided biopsy as well as VATS guided biopsy, CT guided biopsy should be the first choice for tissue sampling in the investigation of lung lesions. In addition to histo-pathological diagnosis, CT-guided biopsy sample is usually sufficient for immuno-histochemistry and molecular characterization of the tissue.

The procedural success rate of the CT-guided biopsy procedure has been seen to increase with use of larger bore of the biopsy needle as well as increased number of passes on each lesion.[7] Concurrent use of PET CT with the aim of visualizing FDG avid areas have also been used to increase the yield.[10]

The incidence of serious complications is low with CT guided biopsy. However massive haemrrhage, haemoptysis, pneumothorax and even death have been reported.[3-5,7] Large diameter needles with longer portion in normal lung parenchyma, smoking are risk factors for both hemorrhage and pneumothorax.[3-5,7] Decubitus position is an additional risk factor for pneumothorax.[4,5] The procedure however can be done without general anaesthesia in day care settings with short post-operative hospital stay.[1-5] The appropriate diagnostic choice for evaluation of lung lesions should therefore be individualized keeping in view the size and location of the lung lesion, patient condition as well as expertise and equipment available in the centre.

Our study has certain limitations. First it is a retrospective analysis. Second the frequency of small lesions (less than 2 cm) as well as centrally located lesions is very small in our cohort. The accuracy of CT-guided biopsy in these lesions is expected to be even less.[7-9] We have not analyzed the success rate of CT-guided biopsy separately for these lesion characteristics. Nor have we analyzed the success rate of the procedure in different lobes of the lung. Third our Hospital is a private centre which caters to a very specific high socio-economic section of the surrounding population. Our data may therefore not be very representative of the entire surrounding population.

CONCLUSION

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Conflicts of Interest: None.

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