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EVALUATION OF FACTORS INFLUENCING THE OCCURRENCE OF PNEUMOTHORAX IN CT GUIDED PERCUTANEOUS TRUE CUT LUNG BIOPSY.

Radiodiagnosis

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ABSTRACT

With the advent of co axial automated true cut biopsy gun, the complication rate in CT guided percutaneous lung biopsy have significantly reduced and it has become an important tool in obtaining histopathological diagnosis of a lesion. In this study factors influencing the occurrence of pneumothorax after CT guided percutaneous true cut lung biopsy are evaluated. Methodology: Total of 100 cases of CT guided lung biopsy was included. Post procedure pneumothorax and its relationship with the size of lesion, depth of lesion from pleura and condition of underlying lung parenchyma are assessed.

Result & Conclusion: The chances of post procedure pneumothorax are highest with smaller size lesions (< 15 mm). Higher the depth of lesion from pleura is also associated with high chances of pneumothorax. Marginally increased chances of pneumothorax are noted in presence of emphysematous changes in underlying lung parenchyma.

KEYWORDS

Pneumothorax, Biopsy, Percutaneous.

INTRODUCTION:

Percutaneous CT-guided needle biopsy of the lung is an established, relatively safe and accurate method for diagnosing lung lesions. Compared with fine needle aspiration cytology (FNAC), coaxial core biopsy is preferred because it obtains multiple and large specimens for histopathological diagnosis and molecular analysis. Percutaneous biopsy of the lung plays a critical role in obtaining pathologic proof of malignancy, guiding staging and planning treatment. Lung biopsy can be performed as an outpatient procedure where patient monitoring and complications support are available. Usual complication of true cut lung biopsy includes pneumothorax, haemoptysis and haemothorax with rare complication including pulmonary embolism.

The frequency of pneumothorax in CT-guided percutaneous true cut biopsy is affected by many factors, including size of lesion, depth from pleural surface, number of samples obtained, numbers of pleural puncture and existence of emphysema.

The purpose of our study was to evaluate the factors influencing the occurrence of pneumothorax after CT guided percutaneous true cut lung biopsy.

MATERIAL AND METHODS:

100 cases of lung masses were included in this prospective interventional study, which were referred to the Department of Radiology, Index medical college and research centre, Indore (M.P.) from March 2019 to June 2020. The study was approved by the Institutional Ethical committee. Percutaneous true cut biopsy of lung lesions were performed and post biopsy check scans were evaluated for presence of pneumothorax. Different factors influencing the occurrence of pneumothorax were evaluated in respect to the size of lesion, depth of lesion from pleural surface, number of samples obtained, numbers of pleural puncture and existence of emphysema.

All lung biopsy procedures were performed by single experienced Radiologist. Written informed consent was obtained from all patients after explaining the benefit of histopathological diagnosis and probable complications.

Patient Selection and Pre-procedural Evaluation:

Planning of lung biopsy was done after evaluation of recent CT scan chest of patient which was not older than one month. Pre procedure laboratory investigations included platelet count, prothrombin time, international normalized ratio (INR), and activated partial thromboplastin time. If patient had INR > 1.5, it was corrected to below 1.5 before starting the procedure. Platelet counts <50,000/µL were also corrected before the procedure.

Relative contraindications to percutaneous lung biopsy were included uncooperative patients, positive pressure ventilation, small lesions close to the diaphragm, and central lesions adjacent to large vessels or bronchi. Cases with pre-existing pneumothorax were excluded form study.

CT-Guided Biopsy Techniques and Procedures:

All CT-guided biopsy procedures were conducted on 64 slice multi-detector helical CT scanner (Siemens Somatom Definition 64 Slice CT Scanner, Siemens Healthineers USA) by single radiologist, experienced in thoracic and interventional radiology. The scanning parameters were 120 kVp, 200 mA, 3- to 5-mm collimation, and 3- to 5-mm section thickness. Unenhanced CT scans were reviewed with a lung window setting (window width, 1600 HU; window level, – 600 HU) and mediastinal window setting (window width, 450 HU; window level, 30 HU).

All biopsy procedures were performed with the patient prone or supine, depending on the proximity of lesion to the chest wall and considering the number of pleural surfaces to be crossed by the needle in choosing the biopsy route. With the patient in the prone position, the shoulders were abducted to move the scapulae laterally. A pillow was routinely placed under the patient's chest to open the intercostal spaces, thereby permitting easier access to the lesions. The patient was instructed to stop breathing after normal inspiration and the importance of breath-holding was explained to each patient before starting the procedure.

The CT-guided biopsy procedure was as follows. Limited CT images were obtained from the region of interest, planned on the basis of recent CT scan. Radio-opaque grid is placed on the patient's skin, positioned at the centre of the lesion using CT landmark. CT images were again obtained, and the puncture point was determined. Planning was done on CT viewing monitor. The distance from the skin surface to the pleura, the length of needle path, and the smallest angle between the pleura and the needle was calculated.

The needle path length was the length between the skin surface and the centre of the lung mass lesion. The distance from the skin surface of the initial puncture to the pleura was calculated as the distance to the pleura. The needle–pleural angle was, the angle formed between the skin surface of the initial puncture site and the biopsy needle.

Local anaesthesia: 2% Lignocain (Xylocaine 2%, AstraZeneca) was used for local anaesthesia. The distance between the skin and pleura was measured. Full care was taken that the needle tip should never advance through pleura when injecting local anesthesia otherwise, pneumothorax might develop which will make the procedure more difficult.

Coaxial Technique: The coaxial technique was used to obtain a core biopsy as it yields good stabilization in the chest wall because of the lightness of the coaxial needle and it allows multiple sampling which improves the diagnostic yield. Caution was taken, not to leave the outer cannula inside the patient body without the inner stylet, because it could lead to a devastating air embolism as a rare biopsy related complication. All CT-guided true cut biopsy procedures were performed with 18 – 20 gauge BARD Mission™ Disposable Core Biopsy Instrument Semi-Automatic needles (United States) with

needle length 6cm, 10 cm, 16 cm and 20 cm.

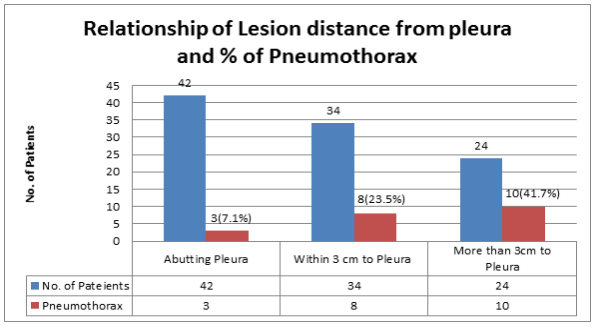
Following local anaesthesia and standard sterile precautions, the coaxial needle is advanced into the subcutaneous tissues of the chest wall without penetrating the pleura, to check the course of the biopsy needle on CT scan. If the mass lesion was on the extended course of the needle track, the biopsy procedure was continued and if the lesion was not on the extended course of the needle track, the needle was adjusted and manipulated accordingly, usually without exiting the lung. When the lesion was penetrated, the needle tip was checked on follow up scan. If the needle is placed at the centre of lesion, true cut biopsy core were obtained. If the coaxial needle is inserted to the periphery of the lesion rather than the centre, the diagnostic tissue core was obtained by aligning the coaxial needle to the lesion before biopsy. Direct inspection can confirm if the specimen is adequate. Multiple true cut tissue cores were obtained, leaving the outer cannula within the lesion. Post biopsy scanning was done to visualize the biopsy tract and to evaluate the possible biopsy related complications.

Observation And Results:

Picture 1

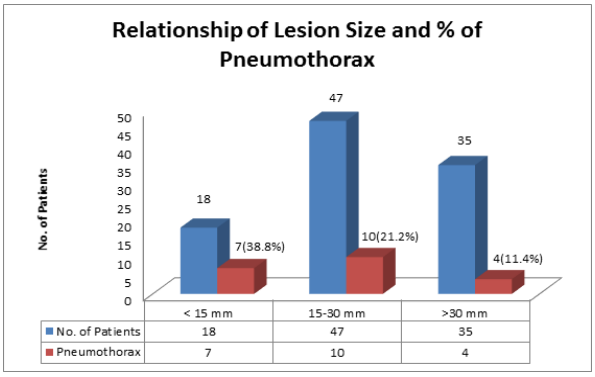
- Image showing coaxial puncture needle hitting the centre of lesion.

GRAPH 1



- Highest percentage of pneumothorax noted when the lesion is deep and least percentage of pneumothorax noted with lesions abutting the pleura.

GRAPH 2



- Smaller size lesion associated with higher percentage of pneumothorax as compared with larger size of the lesion.

TABLE 1

Number of pleural puncture				Lung condition			
Pleural puncture	**No. of patients**	**Pneumothorax**	**%**	**Lung**	**No. of patients**	**Pneumothorax**	**%**
Single puncture	73	8	10.9%	Normal lung	64	13	20.3%
More than 2 punctures	27	13	48%	Emphysematous lung	36	9	25%
Total cases	100	21	21%	Total cases	100	21	21%

- More number pleural punctures and emphysematous changes in lung are associated with higher percentage of pneumothorax.

DISCUSSION:

First CT-guided biopsy was reported by Haaga and Alfidi [1] in 1976, since than the techniques of transthoracic CT guided biopsy and biopsy related gadgets have improved a lot and now the scope of thoracic lesions that are amenable to transthoracic biopsy have expanded. Percutaneous transthoracic needle biopsy is a relatively safe and accurate method for diagnosing benign and malignant lesions of the chest. Before performing the transthoracic needle biopsy, its accuracy and possible complications must be explained carefully to the patients and referring physicians.

Lung biopsy related complication includes pneumothorax, haemoptysis, haemothorax, pulmonary embolism with rarest possibility of procedure related mortality. The commonest complication of transthoracic needle biopsy is pneumothorax. The risk of pneumothorax is related to various factors including lesion size, proximity to the pleura and emphysema in underlying lung parenchyma. Risk of pneumothorax increases significantly if the lesion is not abutting the pleura and directly correlates with increase in the needle path through aerated lung. [2] In one series using CT guided coaxial cutting needle biopsy, the highest number of pneumothoraces occurred when the lesions were away from the pleura, and increases further were the lesion were more than 2 cm depth from the chest wall. Other work has also shown that perihilar biopsy is also more likely to cause pneumothoraces because of the distance of lung crossed**.**

Pneumothorax is the most common complication of CT guided percutaneous lung biopsy, with a reported rate of 17 to 26.6% based in part on technique. [3] In our study of 100 patients, pneumothorax developed in 21 patients (21%). Although some studies demonstrated a pneumothorax rate of 33 to 60% for lesions <2 cm, another study showed no difference in pneumothorax rate for lesions less than or greater than 2 cm.[4,7] As described earlier, biopsy of smaller lesions is technically more difficult, requiring longer procedure times and potentially more needle adjustments that can result in higher complication risks. Lesion depth also affects pneumothorax rate, although this is debated in the literature. In our study 18 patients had lesion size less than 15 mm and pneumothorax developed in 7 patients (38.8%).

Yeow et al [4] demonstrated a significant increase in pneumothorax rates from 13% for lesions abutting the pleural surface to 29% for lesions where the needle traverses aerated lung, which is likely due to decreased stability of the needle in a short intrapulmonary course leading to pleural tears.

Others support that a needle path >4 cm is associated with a higher incidence of pneumothorax. In our study 42 patients had lesions abutting the pleura with no intervening aerated lung and pneumothorax developed in only 3 patients (7.1%). 24 patients had deep situated lesions (more than 3 cm deep to pleura) lesion and out of them 10 developed pneumothorax (41.7%).

Imaging findings and pulmonary function tests suggestive of chronic obstructive pulmonary disease increase the risk of pneumothorax to 47% from 7% in patients without such findings.[5] In our study 20.3% patients with normal underlying lung developed pneumothorax while it is mildly increased to 25% in patients with underlying COPD changes in lung.

The rate of pneumothorax is also increased by procedural factors such

as increased number of pleural punctures and needle insertion at an angle other than perpendicular to the pleural surface. [6] In our study we succeeded to biopsy 73 patients in single pleural puncture and out of them pneumothorax developed in 10 patients (10.9%). More than 2 pleural puncture was needed in 27 patients and out of them 13 developed pneumothorax (48%).

CONCLUSION:

Transthoracic CT-guided lung biopsy is a relatively safe, effective and highly accurate method of getting tissue samples for the diagnosis of indeterminate pulmonary lesions. Pneumothorax remains the most frequent complication of transthoracic CT-guided lung biopsy. Smaller the size of lesion and increased depth from pleura are associated with higher chances of pneumothorax. Appropriate pre procedural planning, proper patient preparation, and adherence to strict procedure protocol can minimize the risks associated with lung biopsy.

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