

## Original Research Article

# CT guided lung biopsy complications: a single centre prospective study

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### ABSTRACT

**Background:** Computed tomography (CT) guided percutaneous transthoracic needle biopsy of lung is a routine procedure in patients with suspected malignant lung lesions which are either peripheral or not amenable to biopsy on fiberoptic bronchoscopy.

**Methods:** This prospective study was conducted to obtain complication rates based on patient and physician experience after CT guided lung biopsy of central and peripheral lung lesions.

**Results:** In our study 96 patients were included with 78 patients with peripheral and 18 patients having central lung lesions. The reported post procedural complication rates of CT guided lung biopsy were pulmonary haemorrhage 33.3 %, pneumothorax 21.9%, haemoptysis 15.6%, cough 6.3%, haemothorax 3.1% and fever 3.1%. Two patients required inter costal tube drainage. There was no reported mortality of CT guided lung biopsy in our centre.

**Conclusions:** Pulmonary haemorrhage and pneumothorax are the most common complications of percutaneous transthoracic needle biopsy of the lung, the former one is common with central and the latter one with peripheral lung lesions.

**Keywords:** CT-guided biopsy, Pneumothorax, Pulmonary haemorrhage

### INTRODUCTION

Percutaneous transthoracic needle biopsy (PCTNB) of lung is a minimal invasive procedure which has potential for complications but its usefulness in management especially diagnosis is indispensable. The awareness of complications associated with this procedure needs to be exhorted. Pneumothorax and Pulmonary haemorrhage are the most common reported complications whereas other rare less known complications include haemothorax, shock, tumour seeding and air embolism.

The most common complication of CT guided PCTNB of the lung lesion is invariably pneumothorax and its incidence has varied from 17-26.6% in series of patients<sup>1-</sup>

<sup>4</sup> However the chest tube insertion rate which ranges from 1% to 14.2% of patients, is much lower due to the fact that maximum of these pneumothorax are mild.<sup>1,4</sup> The complication rates of pneumothorax are dependent upon patient factors, lesion factors and technical factors. The patient related risk factors for pneumothorax following CT guided biopsy of lung lesions are chronic obstructive pulmonary disease (COPD) and lack of history of ipsilateral surgery.<sup>1,5</sup> Among the lesion factors are lesions that are centrally located and increased depth of the lesion from the skin or a long needle path (>4cm) is associated with an increased risk of pneumothorax.<sup>1,2,4</sup> The size of the lesion has been inversely proportional to the rate of pneumothorax complication.<sup>1,3</sup> The technical risk factors for pneumothorax following CT guided biopsy of lung

lesions are increased number of pleural punctures and more acute angle of insertion angle of the needle.<sup>2,6</sup>

Pulmonary haemorrhage following CT guided biopsy of lung lesion has the frequency ranging from 4-27% and is the second most common complication after pneumothorax.<sup>3,4</sup> The wide variability of pulmonary haemorrhage can be explained by the fact that it can be underestimated if the patients present with haemoptysis and overestimated if due to post procedural opacity around the lesion. Rarely the pulmonary haemorrhage can extend into the pleural cavity leading to haemothorax which is very rare, with an incidence of less than 0.1%.<sup>6</sup> The patient factor responsible for pulmonary haemorrhage has been proposed to be presence of emphysematous lung as it lacks the pressure effect of a normal lung which creates a mechanical tamponade and limits haemorrhage.<sup>7</sup> Another patient factor that is a risk factor for pulmonary haemorrhage is pulmonary arterial hypertension.<sup>8</sup> The most fatal complication of CT guided PCTNB lung biopsy is air embolism with a reported incidence of 0.061%.<sup>6</sup> One of the extremely rare complication of the Ct guided PCTNB of lung is the tumour seeding of the pleura or chest wall along the needle track with a reported incidence of 0.012-0.061%.<sup>6</sup> This study was conducted to evaluate the complication rates of CT guided PCTNB of lung for intrathoracic central and peripheral lung lesions in a tertiary care teaching hospital over one year.

**METHODS**

The study was conducted in department of Radiodiagnosis and Imaging in collaboration with department of General Medicine and Chest Medicine SKIMS Medical College Hospital over a period one-year form March 2017 to February 2018. Adult patients with abnormal CT Chest that was suspected to be malignant or indeterminate were included in the study. The patients were subjected to preliminary investigations like Complete Blood Count and Coagulogram. Any patient on anticoagulants and antiplatelet medications were asked to withhold the drugs for the appropriate amount of time

depending on the half-life of the medication CT guided biopsy was performed on 16 Slice CT scanner of Siemens make. Pre-procedure assessment of CT scan was done. Size and location of lesion was done and route that would least traverse the aerated lung was selected and every possible effort was done to avoid vessels and bronchus. Coaxial Biopsy needle was used 18 G and mostly 16cm length after giving local anaesthetic.

Patient was subjected to post procedure check scan after taking biopsy and note of any pulmonary haemorrhage (mild less than 2cm, moderate 2-5cm and severe more than 5cm) was made. Simultaneously any evidence of pneumothorax (nil, small, significant) and haemothorax (nil, mild, moderate, severe) was noted. Patient was also assessed for any haemoptysis during or after procedure (24 hours after procedure). Note was made of cough, fever and local hematoma formation 48 hours after the procedure. Patient having significant pneumothorax or haemothorax were managed with inter costal tube (ICT) drainage. Patient were subjected to post procedure pain score at 0 hours and 6 hours utilising visual analogue scale between 0 to 10, were 0 was no pain and 10 severe pain. Patient were also subjected to post procedural breathlessness at 0 hours and 6 hours utilising visual analogue scale between 0 to 10, 0 no breathlessness and 10 severe breathlessness.

**RESULTS**

A total of 96 patients with CT chest documented lung mass lesion were included in this study with 78 having peripheral lung lesions and 18 having central lung lesions.

The post procedure pain score was comparable at 0 hours and at 6 hours in patients with CT guided lung biopsy of central and peripheral lung lesions (Table 1), however the post procedure breathlessness score was higher in patients of CT guided lung biopsy of peripheral lung lesions as compared to the central lung lesions (Table 2) owing to the fact that biopsy of peripheral lung lesion was more associated with pneumothorax.

**Table 1: Post procedure pain score at 6 hours among patients of central Vs peripheral lesions in percent.**

PPPS_6_Score	0	1	2	3	4	5	6	7	8	9	10
Central	88.9	0	5.6	0	0	0	5.6	0	0	0	0
Peripheral	91.0	5.1	1.3	1.3	1.3	0	0	0	0	0	0

**Table 2: Post procedure breathlessness score at 6 hours among patients of central vs peripheral lesions in percent.**

PPBLN_6_Score	0	1	2	3	4	5	6	7	8	9	10
Central	88.9	0	11.1	0	0	0	0	0	0	0	0
Peripheral	82.1	3.8	3.8	3.8	0	2.6	3.8	0	0	0	0

The haemoptysis rate was higher in the CT guided PCTNB of central lesions as compared to the peripheral lesions, however it was statistically insignificant (Table

3). Also, the pulmonary haemorrhage rates were higher in the central lesions as compared to the peripheral lesions; again, the results were statistically insignificant (Table 4).

**Table 3: Haemoptysis among patients of CT guided lung biopsy of central Vs peripheral lesions.**

Haemoptysis	Nil	Yes	P value
Central	15 (83.3 %)	3 (16.7 %)	0.893
Peripheral	66 (84.6 %)	12 (15.4%)	

**Table 4: Pulmonary haemorrhage among patients of CT guided lung biopsy of central Vs peripheral lesions.**

Pulmonary haemorrhage	Nil	Yes	P value
Central	10 (55.6 %)	8 (44.4 %)	0.267
Peripheral	52 (69.2 %)	26 (30.8 %)	

**Table 5: Hemothorax among patients of CT guided lung biopsy of central Vs peripheral lesions.**

Haemothorax	Nil	Mild	P value
Central	15 (83.3 %)	3 (16.7 %)	0.00
Peripheral	78 (100 %)	0	

**Table 6: Pneumothorax among patients of CT guided lung biopsy of central Vs peripheral lesions.**

Pneumothorax	Nil	Mild	P value
Central	15 (83.3 %)	3 (16.7 %)	0.553
Peripheral	60 (76.9 %)	18 (23.1 %)	

**Table 8: Overall percent distribution of various complications following CT guided lung biopsies.**

Haemoptysis	Pulmonary haemorrhage	Haemothorax	Pneumothorax	Haematoma	Fever	Cough
15.6	33.3	3.1	21.9	21.9	3.1	6.3

**Table 9: Overall percent complication in CT guided lung biopsy of central and peripheral lung lesions.**

	Haemoptysis	Pulmonary haemorrhage	Hemothorax	Pneumothorax
Central	16.7	44.4	16.7	16.7
Peripheral	15.4	30.8	0	23.1

**Table 10: Overall percent complication in CT guided lung biopsy of central and peripheral lung lesions.**

	Fever	Cough	Hematoma	ICT Drainage
Central	0	16.7	5.6	5.6
Peripheral	3.8	3.8	1.3	1.3

**DISCUSSION**

Our patient population comprised a total of 96 patients with 78 having peripheral lung lesions and 18 having central lung lesions who underwent CT guided PCTNB biopsy of lung. In our patient group, reported procedural complication rates were 33.3% for pulmonary

**Table 7: Intercostal chest tube drainage in CT guided lung biopsy of central Vs peripheral lung lesions.**

ICT drainage	Nil	Yes	P value
Central	94.4 %	5.6 %	0.253
Peripheral	98.7 %	1.3 %	

Haemothorax rates were higher in CT guided PCTNB of central lesions as compared to the peripheral lesions, a result that was statistically significant (Table 5). Pneumothorax rates were higher in peripheral lesions as compared to the central lesions but the results were statistically insignificant (Table 6). The need for intercostal tube drainage for complications of CT guided PCTNB of central lesions was higher as compared to the peripheral lesions but the results were statistically insignificant (Table 7).

The most common complications in both central and peripheral PCTNB were pulmonary haemorrhage (33.3%), pneumothorax (21.9%), haemoptysis (15.6%), cough (6.3%), haemothorax (3.1%), fever (3.1%) and haematoma (2.1 %) at local site (Table 8). Pulmonary haemorrhage, haemoptysis, haemothorax, cough, haematoma and ICT drainage were seen more frequently as a complication of CT guided PCTNB of central lung lesions and pneumothorax and fever were associated with CT guided PCTNB of peripheral lung lesions (Table 9 and 10). There was no reported mortality in any patient of central or peripheral lung lesion undergoing CT guided PCTNB in our study. All patients were discharged in stable condition.

haemorrhage, 21.9% pneumothorax, 15.6% haemoptysis and 3.1% haemothorax. Only 2 patients (2.1%) required an intercostal chest tube drain. The most common post-procedural complication reported worldwide is pneumothorax followed by pulmonary haemorrhage, haemoptysis and haemothorax.<sup>1-4</sup> Pulmonary haemorrhage has been reported between 4% to 27% and

our reported incidence of pulmonary haemorrhage was 33.3% which is slightly higher.<sup>3,4</sup> This can be explained by the fact that pleural haemorrhage can be overestimated due to post procedural opacity around the lesion. In a study conducted in Lucknow, India the incidence of pulmonary haemorrhage after CT guide PTCN was reported to be 3.4% which is much lower than that reported from our study.<sup>9</sup>

The second reported complication in our study was pneumothorax (21.9 %) which is in accordance to study conducted earlier (17-26.6%).<sup>1-4</sup> However pneumothorax rate of 9.4 % had been reported from Lucknow, India.<sup>9</sup> The reason behind lower rate of pneumothorax may be inclusion of mediastinal biopsies in which chances of involvement of aerated lung is lesser. Pneumothorax rate of 19.6% was reported in a study conducted in Chennai using an automated guiding apparatus which is in accordance to our study.<sup>10</sup> Pneumothorax was predominantly reported in patients with peripheral lung lesions as compared to pulmonary haemorrhage which was reported predominantly in central lung lesions undergoing PCTNB. Intercostal tube drainage was needed in 2 (2.08 %) patients developing pneumothorax which is lower than the observations reported earlier, the world wide ICT insertion rate ranges from 1-14%.<sup>1-4</sup> Mild haemoptysis was reported in 15.6% of patients which is slightly higher than the reported incidence from Lucknow (3.4%).<sup>9</sup> There was no reported case of air embolism or tumour seeding which could be because of lesser number of patients in our sample size. The incidence of haemothorax reported was 3.1% which is slightly higher than reported incidence of 0.4% in study conducted in Lucknow.<sup>9</sup> However, none required an ICT and recovered spontaneously. Mild cough was reported in 6.3% of patients after 24 hours of procedure which eventually remitted after one week.

CT guided lung biopsy is a safe procedure and is generally well tolerated. Some patients may experience significant and lasting pain and therefore should be counselled about this pre-procedure. In our study, the post procedural pain score was 0 in almost 90% of patients at 6 hours and same was the true for post procedural breathlessness score at 6 hours. There was no case of post procedural pain lasting for more than 24 hours in our study. CT-guided PCTN lung biopsies have become everyday clinical practice. In times of target therapy, there is a growing demand for re-biopsies as well as for high-quality and quantity tissue samples enabling extensive panels of molecular pathology and mutation testing. In this context, one must not forget that especially core biopsies bear a substantial risk of complications.<sup>11</sup>

There was a positive correlation of post-procedural pain and shortness of breath showed with time, and none patient experienced prolonged pain. Retrospective review of hospital data has been found to be similar with the patient reported complication rates in one of the study

emphasizing the fact that over a short period of time the complications are same.<sup>12</sup> An estimated pneumothorax rate of 12-45 % and a chest tube placement rate of 2-15% are the recommended guidelines for improving quality in percutaneous needle biopsy of lung lesions.<sup>13</sup> Our estimates of complication rate are better as far as pneumothorax and ICT insertion rates are concerned. However, operator experience which is thought to influence complication rate should have been an individual factor in evaluating the complication rates in comparing two different studies. Similarly, the technique and the use of coaxial needles, which has the advantage of decreasing the number of pleural prick, should also be included in comparing the complication rates of this procedure. The disadvantage of coaxial needle is that it results in a prolonged connection with the pleura which might lead to increased parenchymal damage due to respiratory motion.

The limitation of our study is that it could not determine the rate of complications that occur infrequently or require a long-term follow-up of the patient, such as death, air embolism and needle tract seeding. For CT-guided lung biopsy the overall complication rate is acceptable, and the major complication rate is low. Minor complications occur more often. Risk factors for major complications are different from anatomical point of view with peripheral lesions leading to more of pneumothorax and central lesions leading to pulmonary haemorrhage. CT-guided lung biopsy can be an important diagnostic tool with a low major complication rate, however long-term complications need to be elucidated.

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