10.21761/jms.v2i02.4

ORIGINAL RESEARCH ARTICLE

Computed Tomography Correlation of Thoracic Lesions with Transthoracic Fine Needle Aspiration Cytology And Biopsy

Ashish Gupta[1], Rajneesh Madhok[2*], Lalit Singh[3], Tanu Agarwal[4]

ABSTRACT

Introduction: The study is an attempt to evaluate the sensitivity, specificity, positive predictive value, negative predictive value, p-value, and complications of CT guided thoracic interventions fine needle aspiration cytology and core biopsy, which are used for diagnosing benign and malignant thoracic lesions.

Material and Methods: The study included 102 patients (87 males and 15 females) with age group ranged from 15 to 87 years. A total of 143 CT guided interventions (84 FNAC's and 59 core biopsies) were performed in 102 patients. The tissue obtained was sent to the laboratory for histopathological and cytological analysis for a final diagnosis, which would contribute to patient management.

Results: All 59 core biopsies were successful in procuring adequate tissue for histopathological analysis and the yield of core biopsies was 100%. However, out of 84 FNAC's, only four were unsuccessful in procuring adequate tissue with a failure rate of 4.8%. Postprocedural biopsy complications were only three (2.1%), which were small pneumothorax. There were 75 malignant lesions and 23 benign lesions based on cytology, and histopathology (4 were excluded due to inadequate sample). There was good agreement between benign and malignant lesions diagnosed on CT and that diagnosed by pathology. The most common benign and malignant lesions were granulomatous lesion and squamous cell carcinoma.

Conclusion: Percutaneous CT guided interventions like core biopsy and fine-needle aspiration cytology are simple minimally invasive procedures with good patient acceptance and low morbidity and almost negligible mortality. CT guided interventions should be performed early for diagnosis of thoracic lesions.

Keywords: Computed Tomography, FNAC, Biopsy, Thoracic

How to cite this article: Gupta A, Madhok R, Singh L, Agarwal T. Computed tomography correlation of thoracic lesions with transthoracic fine needle aspiration cytology and biopsy. SRMS Journal of Medical Sciences. 2017;2(2):79-83.

Source of support: Nil

Conflict of interest: None

[1]Junior Resident, [2-4]Professor

[1,2]Department of Radiodiagnosis, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India.

[3]Department of Respiratory Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India.

[4]Department of Pathology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India.

Corresponding Author: Rajneesh Madhok, Department of Radiodiagnosis, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India, e-mail: drmadhok@gmail.com

INTRODUCTION

Computed tomography (CT) guided fine needle aspiration cytology (FNAC) and biopsy of lung is a well-established method in the correlations of thoracic benign or malignant diseases. This procedure is safe, rapid, and accurate in the diagnosis of thoracic lesions.[1,2,3] CT-guided FNAC plays a crucial role in diagnosing lung mass lesions in which accurate needle placement is possible by avoiding injury to the surrounding structures, thus, limiting the complications of the procedure.[4,5]

Contrast enhancement differentiates the low-density center from those regions, which more likely to contain viable tumor cells.[6,7]

Transthoracic FNACs is also useful for the diagnostic evaluation of lung nodules as chest infection by mycobacterium tuberculosis is known to have varied radiological manifestations, including the unusual presentation as a lung nodule or mass.[8] The special advantage of FNAC includes detection of that tumor type like small cell carcinoma, lymphoma, which is more appropriately treated by chemotherapy rather than surgery. Thus, cytological diagnosis is helpful before initiating the specific treatment or malignant disease.[9,10]

Compared with aspiration cytology, coaxial core biopsy is preferred because it can obtain multiple large specimens for diagnosis and molecular analysis. Pneumothorax was the most frequent complication of procedure.[11] Hemorrhage, hemoptysis, and chest pain were the other commonly encountered complications. FNAC is almost minimum painful non-operative procedure as compared with biopsy for diagnosis of pulmonary mass, outweighs the single major rare complication of pneumothorax.[12]

The type of needle is the most important source of variation in biopsy techniques. Fine needle aspiration cytology uses cytological techniques for analysis and whereas transthoracic needle aspiration biopsy provides larger tissue samples that are suitable for histological evaluation.[13,14]

Fine needle aspiration and core needle biopsy combined technology improved the overall diagnostic accuracy of thoracic lesions due to cyto-histopathological analysis.[15]

MATERIAL AND METHODS

The study was performed from November 2015 to December 2016 on Siemens somatom definition flash dual-source 128 slice CT scan in the Department of Radiodiagnosis, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly. The study included the patients having thoracic mass lesions suspected to be neoplastic/inflammatory by chest radiograph or CT scan. It comprised a total of 102 patients.

Inclusion Criteria

- A patient who is cooperative and can hold the breath for a short while.
- New or enlarging solitary nodule or mass on the chest radiograph that is not amenable to diagnosis by bronchoscopy or unlikely to be accessible by Ultrasound.

Exclusion Criteria

- Severe chronic obstructive pulmonary disease (FEV1 < 30% predicted/Respiratory failure).
- Uncorrectable coagulopathy.
- A contralateral pneumonectomy.
- An uncooperative patient.

The CT guided FNAC/biopsy or both of thoracic mass lesions was performed by the interventional radiologist as an OPD procedure and also in the presence of experienced pathologists after explaining the risks and benefits to the patient. Informed consent was taken from each patient.

RESULTS

One hundred two patients underwent CT guided interventions, which were core needle biopsy (59)/FNAC (84) or both (42) to procure tissue.

There were 87 males and 15 females. The age group ranges from 15 years to 87 years. Maximum number of patients were in the age group of 61 to 70 years with a value of 33 (32.5% of patients)., followed by age groups of 51 to 60 years, more than 70 years, 31 to 40 years and 41 to 50, comprising of 23, 21, 12 and 7 patients corresponding to 22.5, 20.5, 11.8 and 6.9%, respectively. Only five patients and one patient were in the age group of 21 to 30 years and 11 to 20 years, corresponding to 4.9 and 0.9%, respectively.

Cough with expectoration was most common, smoking, hemoptysis, chest pain and TB components of past/personal history were seen in 91,63,32,31 and 12 patients comprising of 89.2, 61.8, 31.4, 30.4 and 11.8%, respectively.

The most common site of the thoracic lesion was in the lung parenchyma, which accounted for 92 patients (90.2%). The remaining lesions were distributed as 4 in the mediastinum, 3 each in a thoracic bony cage, and the pleural region corresponding to 3.92 and 2.94% each, respectively. On the evaluation of thoracic lesions by CT, 79 lesions were attributed as being malignant, which accounted for 77.46%, and the remaining 23 lesions were considered as benign comprising of 22.54%.

CT revealed 19 patients had lesions size of less than 3 cm which accounted for 18.63% and 83 patients had lesions size more than 3 cm (81.37%) (Table 1).

A total of 59 (41%) core biopsies and 84 FNACs (59%) were done. The procedures were done for the lesions situated at different sites in the thorax, including lung parenchyma, mediastinum, pleura, and thoracic cage.

Among the tissue obtained by transthoracic FNAC's (84 FNAC's), 20 (23.8%) lesions were reported as benign, and 60 (71.4%) as malignant. The remaining four FNAC's were inadequate as they failed to obtain tissue for cytology, which accounted for percentage failure of 4.8%. Thus, the failure rate of FNAC was not significant (Table 2).

The tissue obtained by core biopsy (59 core biopsies), 52 (88.14%) lesions were reported malignant, and 7 (11.86%) lesions reported as benign on histopathological examination. All core biopsy specimens were adequate for histopathology (Table 3).

There were 23 benign lesions; granulomatous was the most common type, which accounted for 60.87%, followed

Table 1: CT evaluation of thoracic lesions

Site	*Total number*	*Benign*	*Malignant*
Lung parenchyma	92	21	71
Mediastinum	4	1	3
Pleura	3	1	2
Thoracic cage	3	0	3
Total	102	23	79

Table 2: CT guided fine needle aspiration cytology and core biopsy

Lesion site	*FNAC*	*Biopsy*
Lung parenchyma	76	51
Mediastinum	3	3
Pleura	2	2
Thoracic cage	3	3
Total	84	59

Table 3: Pathology report of tissue obtained by FNAC and biopsy

Tissue	*FNAC n (%)*	*Biopsy n (%)*
Benign	20 (23.81)	7 (11.86)
Malignant	60 (71.43)	52 (88.14)
Inadequate	4 (4.76)	0
Total	84	59

by acute inflammatory lesions (26.08%), abscess (8.7%), and leiomyoma (4.35%).

There were 74 malignant lesions; only one was a secondary tumor. This was a squamous cell carcinoma from the cervix. The remaining 74 lesions were primary tumors.

Squamous cell results were the most common cell type among the primary tumors, which accounted for 33.33%. This was followed by adenocarcinoma (22.66%), non-small cell carcinoma (20%), small cell carcinoma (12.03%), lymphoma (5.33%), large cell carcinoma (2.66%), carcinoid tumor (1.33%), plasmacytoma (1.33%), and secondary carcinoma (1.33%).

The specific signs of malignancy, lymphadenopathy (78) corresponding to 76.5%, the irregular borders (74) accounting for 72.55%, and necrosis (42) comprising of 41.18% were the most common features followed by vascular invasion (24), bronchial obstruction(19), pleural effusion (18),bone erosion(11) and metastasis(1) corresponding to 23.52, 18.63, 17.65, 10.78 and 0.98% respectively, were taken into consideration.

Complications of Procedures

One hundred and two patients with thoracic lesions underwent 143 CT guided interventional procedures. There were no intra or post-procedural complications in 99 patients. Only three patients had small pneumothorax post-biopsy (1–2 mm in maximum dimension). However, biopsy successfully procured adequate sample. These patients were hemodynamically stable in the observation period, and pneumothorax resolved spontaneously. In ours study the rate of complications for CT guided biopsy in thoracic lesions = No. of complications/total number of procedures × 100= 3/143 × 100 = 2.1%.

No obvious complication was noted in CT guided FNAC.

The Yield of CT Guided Fine Needle Aspiration Cytology of Thoracic Lesions

A total number of FNAC's performed for thoracic lesions were 84, of which four were unsuccessful in terms of inadequate sample for cytological analysis. These four patients did not go under biopsy as well due to the refusal by them.

Yield of CT guided FNAC = Total number of FNAC performed – number of FNAC failed/total number of FNAC's performed= 84 – 4/84 × 100 = 95.2%

Hence, yield of CT guided fine needle aspiration cytology of thoracic lesions in this study was 95.2%, with a failure rate of 4.8%.

The Yield of CT Guided Core Needle Biopsy of Thoracic Lesions

A total number of core biopsies performed for thoracic lesions were 59; all were successful in procuring adequate samples for histopathological analysis.

Yield of CT guided core biopsy = Total number of biopsies performed-number of biopsies failed/ Total number of biopsies performed = 59 – 0/59 × 100 = 100%

Hence, the yield of CT guided core needle biopsy of thoracic lesions in this study was 100%, with no failure rate.

Comparison of CT Imaging with a Pathological Diagnosis for Benign Lesions (Table 4)

CT sensitivity for benign lesions- 16/16 + 7 × 100 = 69.57%, CT specificity for benign lesions- 71/71 + 4 × 100 = 94.66%, Positive predictive value of CT-16/16 + 4 × 100 = 80%, Negative predictive value of CT- 71/71 + 7 × 100 = 91.02%, p-value is 0 which is significant at p = 0.05.

Comparison of CT Imaging with a Pathological Diagnosis for Malignant Lesions (Table 5)

CT sensitivity for malignant lesions – 71/71+4 × 100 = 94.66%, CT specificity for malignant lesions- 16/16+7 × 100 = 69.57%, positive predictive value of CT- 71/71+7 × 100 = 91.02%, negative predictive value of CT- 16/ 16+4 × 100 = 80%, p value is 0, which is significant at p = 0.05.

DISCUSSION

The CT is the most commonly used imaging modality for thoracic interventions like CT guided transthoracic lung biopsy and transthoracic fine-needle aspiration cytology and has have become very popular for the diagnosis and management of thoracic lesions, and hence, more invasive procedures such as thoracoscopy, mediastinoscopy, and thoracotomy can be avoided.[16]

In this study of 102 patients, the maximum number of patients was in the age group of 61 to 70 years, comprising 33 (32.5%). The median age for their group is 51. This is comparable with Jayashankar *et al*., which included 60 patients and maximum were in the age group of 61 to 70 comprising of 21 patients (35%).[17]

Table 4: Comparison of CT Imaging with a pathological diagnosis for benign lesions

CT imaging	*Positive cyto histo*	*Negative cyto histo*	*Total*
Positive	16	4	20
Negative	7	71	78
Total	23	75	98

Table 5: Comparison of CT Imaging with a pathological diagnosis for Malignant Lesions

CT Imaging	*Positive cyto histo*	*Negative cyto histo*	*Total*
Positive	71	7	78
Negative	4	16	20
Total	75	23	98

The lesion size was divided into less than or more than 3 cm. On CT evaluation, there were 19 lesions less than 3 cm, and the rest 83 lesions were more than 3 cm in size. Out of 19 patients in lesions less than 3 cm, eight patients proved to show benign lesions, and eight patients showed malignant lesions, and three patients had inconclusive reports on pathological analysis. Murmann GB *et al*., in their study, showed 80% of benign nodules are less than 2 cm in diameter. However, small size alone does not exclude lung cancer because 15% of malignant nodules are less than 1 cm in diameter and approximately 42% are less than 2 cm in diameter which was similar to our study (50%).[18]

Khan *et al*., in their study, showed lesions > 3 cm in diameter could be considered malignant.[19] In our study, less than 3 cm lesions were 83 (81.37%), out of which 75 patients showed malignant lesion and the average size of lesions was 4-5 cm.

Out of 102 patients, the most common thoracic site of lesion was in the lung parenchyma accounting for 90.2% with a value of 92. In a study by Basnet SB *et al*. in 2008, on 82 patients, showed 75 (91.4%) patients had lung parenchyma lesion which is comparable to our study.[9]

Thoracic CT revealed 23 Lesions as benign and 79 lesions as malignant based on certain imaging signs such as irregular borders, necrosis, lymphadenopathy, bone erosion, chest wall invasion, vascular invasion, bronchial obstruction, etc., which were common in these malignancies. Irregular borders of the nodule contour was a feature predominantly associated with malignancy, both primary and metastatic. Rib erosion and mediastinal invasion were seen to be highly specific for malignant lesions.

In a study conducted by JP Singh[1] on 34 patients, included necrosis, irregular borders, size, rib erosion, and mediastinal invasion as associated features of malignant lesions. Chang Su *et al*.[20] conducted a study on 45 patients, included displacement of vessels, pleural effusion, and bone erosion. These features are comparable to our study.

All (59) the core biopsies are done were adequate in procuring tissue for histopathological analysis. Among the 59 core biopsies, 52 lesions were typed as being malignant and seven as benign. Thus, all of the core biopsies were successful in procuring tissue. Serifbeslac *et al*. conducted a study on 242 patients who had a success rate of 96.85% in procuring tissue.[21] This was almost similar to our study (100%). However, the difference in percentage may be due to variation in the size of the study. Out of the 84 trans thoracic fine needle aspiration cytology performed, only four were failed in procuring adequate tissue for cytological analysis accounting for 4.8 %. It was due to blood in the syringe means unsatisfactory aspirate. The study conducted by Madan *et al*. in 2010 on 40 patients showed 5% as the failure rate which is comparable to this study.[22]

A total of 23 benign lesions were diagnosed based on the pathological analysis. There were; 14 granulomatous, 2-abscess, 1-leiomyoma, and 6 showed acute inflammatory lesions. There were a total of 75 malignant lesions which included 74 primary tumors and 1 secondary tumor. This secondary tumor was poorly differentiated squamous cell carcinoma of the left lung, which was a metastasis from squamous cell carcinoma of the cervix.

In our study among the malignant tumors squamous cell carcinoma was the most common type, which accounted for 33.33%. With a value of 25 followed by adenocarcinoma and non-small cell carcinoma, which accounted for 22.66, 20% with a value of 17 and 15, respectively. The results were comparable to study conducted by Singh JP *et al*.[1] on 34 patients, the squamous cell carcinoma, and adenocarcinoma as the most common primary malignancies and four cases secondary malignancies from the cervix as squamous cell carcinoma.[1] The study conducted by Saha A. *et al.* in the year 2009,[5] in 57 patients, also found that the most common type of lung tumors was squamous cell carcinoma (42.6%), followed by adenocarcinoma (29.6%) and 9.3% of small cell carcinoma.

The other malignant tumors were 9 (12.03%) small cell carcinomas, 4 (5.33%) lymphoma, and 2 (2.46%) large cell carcinoma. The rest of the malignant tumors were 1 each of the following: plasmocytoma, carcinoid tumor, and metastatic squamous cell carcinoma, as described above with a value of 1.33% each.

Thus, the total number of malignant lesions in this study is 76.5% with a value of 75 patients and 23.5% of benign lesions with a value of 23 patients. 4 patients with inadequate samples were excluded. The study conducted by Khouri NF *et al*, on 650 patients, lesions were malignant in 486 patients comprising of 77.8% and benign in 137 patients (22.2%). The 27 patients with an unproven diagnosis were not included in their discussion.[23] This was comparable to our study.

All the patients tolerated the procedure well. The most common complaint was a pain at the puncture site, which lasted for a few hours (4–8 hours). Small post-biopsy pneumothorax occurred in 3 (2.1%) cases of total CT guided procedures (143), which resolved. Gangopadhyay *et al*. conducted a study on 127 cases in which no major complication was noted. Small pneumothorax was noted in 1.5% cases similar to our study.[24]

The sensitivity, specificity, positive predictive value, and negative predictive value for diagnosing benign lesions of the thorax were 69.57, 94.66, 80, and 91.02%, and for malignant lesions of the thorax were 94.66,

69.57, 91.02, and 80%. Begum AN[25] in their study on 127 patients, showed sensitivity and specificity of benign lesions were 68 and 100%. Basnet SB *et al*.[9] conducted a study on 100 patients, in which sensitivity, specificity, positive predictive value, and negative predictive value of malignant lesions were 88, 84 (66–97%), 90, and 81%.

CONCLUSION

CT evaluation and CT guided interventions are effective tools in the diagnosis and management of patients with thoracic lesions allowing prompt documentation of both benign and malignant lesions with small failure rate of approx 4.8%.

REFERENCES

1. Singh J P, Garg L, Setia V. Computed tomography (Ct) guided transthoracic needle aspiration cytology in difficult thoracic mass lesions-not approachable by USG. Indian J Radiol Imaging. 2004;14:395-400.
2. Sarjer RN, Rabbi AF, Hossain A, Quddus MA, Chowdhury N, Sarker T, et al. Computed tomography guided transthoracic fine needle aspiration cytology in the diagnosis of Sonographically non-approachable intrathoracic masses–A study of 100 cases. Journal of Dhaka Medical College. 2011;20(1):25-31.
3. Piplani S, Mannan R, Lalit M, Manjari M, Bhasin TS, Bawa J. Cytologic-radiologic correlation using transthoracic CT-guided FNA for lung and mediastinal masses: our experience. Analytical Cellular Pathology. 2014 Nov 25;2014.
4. Mondal SK, Nag D, Das R, Mandal PK, Biswas PK, Osta M. Computed tomogram guided fine-needle aspiration cytology of lung mass with histological correlation: A study in Eastern India. South Asian Journal of Cancer. 2013 Jan;2(1):14.
5. Saha A, Kumar K, Choudhuri MK. Computed tomography-guided fine needle aspiration cytology of thoracic mass lesions: A study of 57 cases. Journal of Cytology/Indian Academy of Cytologists. 2009 Apr;26(2):55.
6. Haramati LB. CT-guided automated needle biopsy of the chest. AJR. American journal of roentgenology. 1995 Jul;165(1):53-55.
7. Li H, Boiselle PM, Shepard JO, Trotman-Dickenson B, McLoud TC. Diagnostic accuracy and safety of CT-guided percutaneous needle aspiration biopsy of the lung: comparison of small and large pulmonary nodules. AJR. American journal of roentgenology. 1996 Jul;167(1):105-109.
8. Tan KB, Thamboo TP, Wang SC, Nilsson B, Rajwanshi A, Salto-Tellez M. Audit of transthoracic fine needle aspiration of the lung: cytological subclassification of bronchogenic carcinomas and diagnosis of tuberculosis. Singapore Medical Journal. 2002 Nov;43(11):570-575.
9. Basnet SB, Thapa GB, Shahi R, Shrestha M, Panth R. Computed tomography guided percutaneous transthoracic fine needle aspiration cytology in chest masses. JNMA; journal of the Nepal Medical Association. 2008;47(171):123-127.
10. Shrestha MK, Ghartimagar D, Ghosh A. Computed tomogram guided fine-needle aspiration cytology of lung and mediastinal masses with cytological correlation: a study of 257 cases in Western region of Nepal. Nepal Med Coll J. 2014 Sep;16(1): 80-83.
11. Tsai IC, Tsai WL, Chen MC, Chang GC, Tzeng WS, Chan SW, Chen CC. CT-guided core biopsy of lung lesions: a primer. American Journal of Roentgenology. 2009 Nov;193(5):1228-1235.
12. Guimarães MD, Marchiori E, Hochhegger B, Chojniak R, Gross JL. CT-guided biopsy of lung lesions: defining the best needle option for a specific diagnosis. Clinics. 2014;69(5):335-340.
13. Prashant RC, Pattbhiraman R, Suresh AV. Feasibility, safety, and efficacy of the CT guided fine needle aspiration cytology (FNAC) of lung lesions. Indian J Med Paediatr Oncol. 2007;28:16-25.
14. Haaga JR, Alfidi RJ. Precise biopsy localization by computed tomography. Radiology. 1976;118:603-607
15. Laurent F, Labtrabe V, Vergier B, Michel P. Percutaneous CT-guided biopsy of the lung: comparison between aspiration and automated cutting needles using a coaxial technique. Cardiovasc Intervent Radiol. 2000;23:266-272
16. Sanjay T. Image guided biopsy procedures. Indian journal of medical and pediatric oncology 2007;28(2):5-6
17. JayaShankar E, Pavani B, Chandra E, Reddy R *et al*. CT guided percutaneous thoracic: FNAC in lung and mediastinum. J CytolHistol 2010;1:107-110.
18. Murrmann GB, van Vollenhoven FH, Moodley L. Approach to a solid solitary pulmonary nodule in two different settings—"Common is common, rare is rare". Journal of thoracic disease. 2014 Mar;6(3):237.
19. Khan AN, Al-Jahdali HH, Irion KL, Arabi M, Koteyar SS. Solitary pulmonary nodule: A diagnostic algorithm in the light of current imaging technique. Avicenna journal of medicine. 2011 Oct;1(2):39.
20. Ahn CS, Kim SJ, Choe KO. CT findings of small cell bronchogenic carcinoma. Journal of the Korean Radiological Society. 1991 May 1;27(3):358-362.
21. Beslic S, Zukic F, Milisic S. Percutaneous transthoracic CT guided biopsies of lung lesions; fine needle aspiration biopsy versus core biopsy. Radiology and oncology. 2012 Mar 1;46(1):19-22.
22. Madan M, Bannur H. Evaluation of fine needle aspiration cytology in the diagnosis of lung lesions. Turk J Pathol. 2010 Jan 1;26:1-6.
23. Khouri NF, Stitik FP, Erozan YS, Gupta PK, Kim WS, Scott Jr WW, Hamper UM, Mann RB, Eggleston JC, Baker RR. Transthoracic needle aspiration biopsy of benign and malignant lung lesions. American journal of roentgenology. 1985 Feb 1;144(2):281-288.
24. Gangopadhyay M, Chakrabarti I, Ghosh N, Giri A. Computed tomography guided fine needle aspiration cytology of mass lesions of lung: Our experience. Indian journal of medical and paediatric oncology: official journal of Indian Society of Medical &Paediatric Oncology. 2011 Oct;32(4):192.
25. Begum AN, Ekram AR, Uddin D, Islam QT, Alam MM, Hoque MA, Hussain QM, Bhaduri J, Hossein SZ. Ultrasound and computed tomographic guided fine needle aspiration cytology of intrathoracic lesions. TAJ: Journal of Teachers Association. 2007;20(2):110-115.