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Original Research Article

Computed tomography guided fine needle aspiration cytology of thoracic lesions: 10 year experience of an interventional pulmonologist

Varinder Saini[1], Kranti Garg[1]*, Uma Handa[2], Surabhi Jaggi[1], Ravi Kumar Garg[3]

[1]Department of Pulmonary Medicine, [2]Department of Pathology, Government Medical College and Hospital, Sector 32, Chandigarh, India
[3]Medical Officer (Specialist), District Hospital, S.A.S Nagar, Punjab, India

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***Correspondence:**
Dr. Kranti Garg,
E-mail: drkrantigarg@yahoo.com

ABSTRACT

Background: Diagnosis of thoracic lesions may be challenging, due to various factors associated with the lesion and subsequent invasive investigations. Computed tomography guided fine needle aspiration cytology (CT-guided FNAC) is a minimally invasive method for thoracic lesions considered non approachable by other modalities.
Methods: Retrospective analysis of patients subjected to CT-guided FNAC during year 2004 to 2014 was done. In these patients, non-invasive and invasive methods like fibre-optic bronchoscopy/ ultrasound guided FNAC were inconclusive/ expected to be inconclusive. Records were statistically analyzed for patient related, lesion related and procedure related factors, and their effect on yield and complications.
Results: 435 patients underwent CT-guided FNAC. Age ranged from 10 to 95 years, with male preponderance. Diagnostic yield was 80.2%. Neoplastic lesions (255/435 (58.6%)) were most commonly diagnosed with majority (206/255 (80.8%)) being non-small cell lung cancer (NSCLC). This was followed by non-neoplastic lesions (94/435 (21.6%)) with Tuberculosis (42/94(44.7%)) being most common in this group. In 227/435 patients, other details like side and size of the lesion, position of patient during the procedure, depth of lesion from skin surface, number of passes undertaken and complications, if any, were also available. They were separately analyzed. Mean size of lesion was 5.7575 X 5.4173cms (maximum vertical X maximum horizontal diameter). Mean depth to which needle was inserted was 5.6663cms. Mean number of passes per patient were 1.98. Right sided lesions were more commonly sampled than left. Supine positioning was most commonly employed. Overall complication rate was 4% (9/227).
Conclusions: CT-guided FNAC for thoracic lesions can serve as early diagnostic tool and guide in planning effective management strategies.

Keywords: CT-guided FNAC, Thoracic lesion, Pneumothorax

INTRODUCTION

A pulmonologist in day to day practice comes across a variety of thoracic lesions which are difficult to diagnose on routine non interventional investigations. In such patients, various interventional measures like fibreoptic bronchoscopies, fine needle aspiration cytologies (blind/ image guided) and transthoracic biopsies may be required to confirm the exact nature of the lesion, differentiate between benign and malignant lesions and thus reach at a final diagnosis.

When it comes to the sampling of thoracic lesions, blind/image guided transthoracic fine needle aspiration cytology (FNAC) is one of the well-established, minimally invasive and cost effective methods and is associated with minimal complications.[1] Tumour typing is also possible by FNAC. Hence, it leads to early

diagnosis and helps in formulating early and effective management modalities. When done under computed tomography (CT) guidance, it increases the safety of the procedure, helps in better localization of the site of puncture and allows for evaluation of small and deep seated lesions as well.[1,2]

CT-guided FNAC is one of the routine modalities used for diagnosis of thoracic lesions which can't be approached either through a fibre-optic bronchoscope, or through ultrasonographic guidance, in our department of Pulmonary Medicine, Government Medical College and Hospital, Chandigarh. We present here a retrospective analysis of the patients who were subjected to CT-guided FNAC from the year 2004 to 2014, by a single interventional pulmonologist.

As the skill and knowledge regarding the procedure grew over time from 2004 to 2014, the records of the patients were also better maintained. For the initial few years, only the records of the demographic profile and the diagnosis so reached at, were available. However, during the later years, further details like side and size of the lesion, the position of the patient while doing the procedure, number of passes which were undertaken and complications, if any, were also recorded. The data so obtained was critically analyzed and henceforth presented.

METHODS

On retrospective analysis of the records of a single interventional pulmonologist from the year 2004 to 2014, it was found that 435 patients underwent CT-guided FNAC.

All the patients where thoracic lesion was found to be non-diagnostic by routine non-invasive means like sputum examination and radiology were subjected to CT-guided FNAC. The patients in whom Fibreoptic bronchoscopy (FOB) was either not possible due to peripheral location of the lesion or was non-conclusive, were also subjected to the procedure. The patients whose lesion was found to be non-approachable under ultrasound guidance also underwent the CT-guided FNAC.

After taking an informed consent and ruling out any bleeding diathesis, patient was taken up for CT-guided FNAC. The procedure was done on outpatient basis. Maintaining proper asepsis, 22 gauge lumber puncture needle was used for aspiration after positioning the patient in the desired position and choosing the shortest distance of the lesion from the skin surface, keeping in mind that least amount of normal lung parenchyma was thus traversed. After inserting the needle with the stylet into the lesion, computed tomography cuts were taken to confirm the position of the tip of the needle into the lesion. Once the needle was confirmed to be in the lesion, after jabbing and/or to and fro rotating motion of needle within the lesion, stylet was removed and 20 ml syringe was attached to the needle for aspiration. Aspirated material was spread on slides and needle hub was also sent for cytological evaluation. On an average, 1 to 3 passes from each patient were taken. Various stains like hematoxylin and eosin, Papanicolaou, May- Grunewald-Giemsa, gram stain, Ziehl- Neelsen, Gomori methanamine silver stain, Periodic acid Schiff staining was done as per the clinical and radiological suspicion. Patient was kept under observation for two hours in the ward after the procedure. After the patient was found to be clinically stable, and the check chest radiograph ruled out any pneumothorax, the patient was sent home. Final diagnosis was reached at, after studying the slides with respect to clinical, radiological and cytological data.

Initial 208 patients were reviewed for their diagnosis with respect to age and sex as per the data available. Since in addition to the age, sex and diagnosis, other details like side and size of the lesion which was targeted, position of the patient during the procedure, depth of the lesion from the skin surface, number of passes undertaken and complications, if any, were also available in rest of the 227 patients, they were tabulated, statistically analyzed and are thus presented.

Statistical analysis: Discrete categorical data were presented as *n* (%); continuous data were given as mean±SD & range or median and interquartile range, as appropriate. Normality of quantitative data were checked by measures of Kolmogorov Smirnov tests of normality. For normally distributed data, means of sub groups of diagnosis were compared using One-Way ANOVA followed by Post Hoc Multiple Comparisons test. For skewed data, Kruskal-Wallis test followed by Mann-Whitney test for two groups was applied. For normally distributed data, Student t-test was applied to compare the 2 groups (complications present/absent). Proportions were compared using Chi square or Fisher's exact test whichever applicable. All statistical tests were two-sided and performed at a significance level of p=0.05. Analysis was conducted using IBM SPSS statistics (version 22.0).

RESULTS

Total of 435 patients underwent CT-guided FNAC, in a single setting, for thoracic lesions during the study period. Age of the patients ranged from 10 to 95 years. 63.7% of the patients were found to be between 41-70 years (Table 1). Male preponderance was seen in our patients (Table 2).

There was a diagnostic yield of 80.2%, with the various diagnosis achieved being tabulated in Table 3. The diagnosis was classified into three main groups; (1) neoplastic lesions; (2) non-neoplastic lesions; (3) negative/ inconclusive. Neoplastic lesions (255/435 (58.6%)) were most commonly diagnosed with majority (206/255 (80.8%)) being non-small cell lung cancer (NSCLC). This was followed by non-neoplastic lesions

(94/435 (21.6%)) with tuberculosis (42/94 (44.7%)) being most common in this group.

Table 1: Age distribution.

Age (in years)	Number of patients	Percentage
≤20	19	4.4
21-30	34	7.8
31-40	49	11.3
41-50	72	16.5
51-60	104	23.9
61-70	101	23.2
71-80	42	9.7
>80	14	3.2
	435	100

In the 227 patients who were separately analyzed because of the availability of other details as well, it was seen that the mean size of the lesion was 5.7575X5.4173 cms (maximum vertical x maximum horizontal diameter). The depth to which the needle was inserted ranged from 2 to 11 cms as measured from the skin surface, with the mean depth being 5.6663 cms. Number of passes per patient ranged from 1 to 3, with mean number of passes being 1.98. In majority of the patients (70%), 2 passes were taken (Table 4).

Table 2: Sex distribution.

Sex	Number of patients	Percentage
Males	317	72.9
Females	118	27.1
Total	435	100.0

Table 3: Various diagnosis achieved (number of patients=435).

Diagnosis	Number of patients (%)		Number of patients (%) in the subsequent subgroup		Number of patients(%) in the subsequent subgroup
Neoplastic	255/435 (58.6%)	NSCLC*	206/255 (80.8%)	Adenocarcinoma	81/206 (39.3%)
				Squamous cell carcinoma	68/206 (33%)
				NSCLC poorly differentiated	50/206 (24.3%)
				Large cell carcinoma	4/206 (1.9%)
				Carcinoid	2/206 (1%)
				Adenoid cystic carcinoma	1/206 (0.5%)
		SCLC†	30/255 (11.8%)		
		Lymphoma	11/255 (4.3%)	NHL‡	8/11 (72.7%)
				Hodgkin's lymphoma	3/11 (27.3%)
		Sarcoma malignant	3/255 (1.2%)		
		Thymoma	2/255 (0.7%)		
		Round small cell tumour	1/255 (0.4%)		
		Ewing Sarcoma	1/255 (0.4%)		
		Melanoma	1/255 (0.4%)		
Non Neoplastic	94/435 (21.6%)	Tuberculosis§	42/94 (44.7%)		
		Non specific inflammation	37/94 (39.4%)		
		Chondroid hamartoma	5/94 (5.3%)		
		Benign cyst	4/94 (4.2%)		
		Hydatid cyst	1/94 (1.1%)		
		Sarcoidosis	1/94 (1.1%)		
		Fungal	4/94 (4.2%)	Aspergilloma	3/4 (75%)
				Mucormycosis	1/4 (25%)
Negative/ inconclusive	86/435 (19.8%)				

*Non-small cell lung cancer, †: Small cell lung cancer; ‡: Non-Hodgkin's Lymphoma; §: Granulomatous inflammation consistent with Tuberculosis/ Stain for Acid Fast Bacilli Positive.

Table 4: Size of the lesions, depth of the needle from the skin surface and number of passes undertaken per person during the procedure (number of patients=227).

	Mean
Vertical diameter	5.7575 cms
Horizontal diameter	5.4173 cms
Depth	5.6663 cms
Number of passes	1.98

When the side of the lesion targeted by FNAC was analyzed in these 227 patients, right sided lesions were much more sampled than the left sided. Analyzing the positioning of the patients for the procedure, it was seen that supine position was the most common, and it was followed by prone position (Table 5).

Table 5: Side of the lesions sampled, and the positioning of the patient during the procedure. (number of patients=227).

		Number of patients	Percentage
Side of lesion	Left	78	34.4
	Right	149	65.6
Position of patient	Supine	108	47.5
	Prone	96	42.3
	Right lateral	9	4.0
	Left lateral	14	6.2

Overall complication rate was 4% with 9/227 patients developing pneumothorax. These patients were subsequently managed either conservatively or with intercostal chest tube drainage but with no mortality. No other major complication was encountered which could necessitate inpatient admission or active management.

When the size of the lesion, depth of the needle from the skin surface or the number of passes was compared to the diagnostic yield, it was found to be statistically non-significant. Complication rate was also not found to correlate with the sex, age group or position of the patient, side of the lesion or the number of passes and the differences were statistically non-significant. However, there was statistically significant increase in chances of pneumothorax when the size of the lesion was small.

DISCUSSION

CT-guided transthoracic FNAC is a simple, rapid, minimally invasive, cost effective, safe and accurate method of diagnosis with minimal complication rates in evaluation of thoracic lesions non-approachable by other interventional modalities. When the cytological picture in conjugation with clinical and radiological data is interpreted, it can help in an early diagnosis, guide us in planning effective management strategies, and help in avoiding unnecessary surgeries.[3] It also saves the patient from unnecessary and more invasive procedures like thoracotomies, biopsies etc. This procedure, because of its associated advantages, is finding its role in diagnosis of extra thoracic lesions like liver, thyroid, spleen, pancreas etc. as well.[4]

The diagnostic yield achieved by a single interventional pulmonologist in our centre during the study period came out to be 80.8%. It is comparable to other studies and encourages us to use it as a diagnostic entity wherever feasible.[1,2,5,6]

Age of the patients ranged from 10 to 95 years, and is in comparison with other studies.[1,3,7] This is explained by the fact that the diagnosis varied from a variety of benign entities to malignancies, as per the susceptibility of a particular age group to a particular disease. However, there are studies where only adult patients were subjected to the procedure, as per the clinical suspicion of malignancies and a limited number of benign conditions.[2,6,8]

Male preponderance seen in our patients is in concordance with other studies.[2,3,6,7] This could be explained by the fact that smoking, chronic obstructive pulmonary disease, occupational exposures etc. are more common in males, thus increasing the susceptibility of the males to the occurrence of intrathoracic lesions, especially malignancies.

When sex distribution was compared with age distribution, it was seen that majority of the females (60.1%) belonged to the age group of 31-60 years while majority of the males (66.3%) belonged to the age group of 41-70 years.

When the diagnostic yield was compared with the age group of the patients, it was seen that as the age of the patients increased, there was higher likelihood of getting a positive yield, and the values were found to be statistically significant (p=0.022).

When the diagnostic yield was analyzed, it was seen that neoplastic lesions (255/435(58.6%)) were most commonly diagnosed, and is in concordance with other studies.[1-3,6] Amongst the neoplastic group, NSCLC ((206/255(80.8%))) predominated. Amongst the NSCLC group, adenocarcinoma was most common, followed by squamous cell carcinoma. This is again in concordance with other studies.[2,3,9,10] However, there are studies where squamous cell carcinoma was more commonly seen than adenocarcinoma.[6,11,12] The varied results so obtained can be an early marker of adenocarcinomas overtaking squamous cell carcinomas as a major subtype of NSCLC, and needs to be studied in detailed epidemiological studies.

Tuberculosis predominated the non-neoplastic group (42/94 (44.7%)), as was expected in a high burden country like ours. This also reinforces the atypical presentations of Tuberculosis and guides us to keep its possibility in mind even when the characteristic clinical and/or radiological features are absent.

In 19.8% of the patients, diagnosis could not be achieved at, either the material aspirated was inadequate, or the slides were reported as negative.

Right sided lesions were much more sampled than the left sided, and results are comparable with other studies.[3,6]

Diagnostic yield was not found to have any correlation with the depth of the lesion, size of the lesion or the number of passes, henceforth implying that even deep seated lesions, small size of the lesion or increasing the number of passes does not affect the diagnostic yield.

Overall complication rate was 4% and was comparable with other studies.[3,12,13] Complication rate was also not found to correlate with the sex, age, position of the patient or side of the lesion. Also, it did not correlate with the depth of penetration by the needle, number of passes and size of the lesion. This is in concordance with other studies.[3]

However, there was statistically significant increase in chances of pneumothorax when the size of the lesion was small, i.e. 4.13X 3.644 cms, hence warning us to be careful when CT-guided FNAC from small lesions is done.

Rapid on site evaluation of the sample was not done to check for adequacy of the aspirate which could be treated as a limiting factor. It is implicated that, if available, it can further add to the diagnostic yield, as this will ensure a better aspirated material during the procedure, and can even decrease the number of needle passes per patient.

CONCLUSION

CT-guided FNAC should be routinely used in the evaluation of thoracic lesions non-approachable by other interventional modalities, as it is associated with an encouraging diagnostic yield. It can serve as an early diagnostic tool and guide us in planning effective management strategies.

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