Image-guided Fine Needle Aspiration Cytology of Intrathoracic Lesions

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Abstract

Background: Percutaneous, image-guided transthoracic fine needle aspiration cytology (TTFNAC) is a rapid, yet accurate, and well-established diagnostic method used in the cytological evaluation of intrathoracic lesions. The study was done to determine the utility of image-guided TTFNAC in diagnosis of intrathoracic lesions. Subjects and Methods: A retrospective analysis of all cases who underwent image-guided TTFNAC of a suspected intrathoracic lesion, in a tertiary care hospital was done over a period of 3 years. Results: During the study period, 124 cases of image-guided FNAC of intrathoracic lesions were obtained. The mean age at presentation was 60.5 years with M:F: 3.6:1. Neoplastic lesions (71.5%) outnumbered the nonneoplastic lesions (28.5%). The most common tumor was adenocarcinoma (25%) followed by squamous cell carcinoma (SCC, 11%), and small cell carcinoma (5%). There was one case each of anaplastic carcinoma, plasmacytoma, bronchoalveolar carcinoma, and non-Hodgkin lymphoma (NHL). Most of the lesions were found on the right side and upper lobe. Among the mediastinal lesions, we found two cases of thymoma and one case each of NHL/primitive neuroectodermal tumor (PNET), NHL, and small cell carcinoma metastasis to lymph node followed by ten cases of inflammatory lesions and seven cases of tuberculosis (TB). Conclusion: Image-guided TTFNAC of intrathoracic lesions is a safe method when done by well-trained medical personnel with lesser rate of complications. An early accurate diagnosis of malignancy can be made based on the cytological features; however, further subtyping of the malignancy may sometimes be difficult due to overlapping cytological features. TTFNAC can be a diagnostic tool for identifying nonneoplastic lesion such as TB. Hence, image-guided FNAC aids in early diagnosis and management of patients with intrathoracic lesions.

Keywords: Cytology, fine needle aspiration, guided, intrathoracic, lung lesions

Introduction

Percutaneous, transthoracic fine needle aspiration cytology (TTFNAC) is a well-established diagnostic method used in the cytological evaluation of intrathoracic lesions by pathologists, radiologists, and pulmonologists. Image-guided FNAC is often the first choice of diagnostic procedure in intrathoracic lesions located in the mediastinum, pulmonary apex, medial upper lobe, or periphery, especially for evaluating small lesions of a few centimeters diameter. Even though FNAC has proven its role in the diagnosis of infections and other diffuse benign processes, the main utility is in the diagnosis of localized intrathoracic lesions, which are clinically and radiologically suspicious of being malignant, particularly when less-invasive investigations turn out to be inconclusive. Most patients with lung cancer present with advanced clinical disease and therefore are not candidates for surgery with curative intent, but are rather treated with systemic therapies. Here, the decision of chemotherapy or radiotherapy depends on the type of malignancy that can be diagnosed by FNAC. The studies have suggested FNAC to be relatively safe, with fewer complications, rapid, inexpensive, and easy to perform. It allows an almost nontraumatic, nonoperative diagnosis of thoracic masses, which outweigh the single major rare complication of pneumothorax. Mediastinal masses can also be evaluated by FNAC procedures. Among them, anterior mediastinal masses are easily accessible under image guidance as compared to other masses.
In most of the studies, FNAC has enabled to confirm the diagnosis and even tumor typing was possible. This study aimed to determine the utility of image-guided FNAC in diagnosis of intrathoracic lesions.

Subjects and Methods

A retrospective analysis of all FNAC of intrathoracic lesions obtained under the guidance of computed tomography (CT) or ultrasonography (USG), was performed in a tertiary care hospital from January 2011 to December 2013. The air-dried smears were stained with May–Grünwald–Giemsa (MGG) stain and other smears were fixed immediately in 95% ethyl alcohol and stained with Papanicolaou (PAP) stain. Special stains used were Ziehl–Nielsen (ZN) stain for detecting acid fast bacilli (AFB) and periodic acid-Schiff (PAS) for fungi when required. Aspirated materials were subjected to cytological examination by two pathologists and reported into four groups as: 1) positive for malignancy (PFM) when cytology showed diagnostically malignant cells, 2) negative for malignancy (NFM) when cytology did not reveal malignant cells or atypical cells but show only benign cells or nonspecific inflammatory cells, 3) inadequate for opinion when cellularity is inadequate for reporting them as positive or negative for malignant cells, and 4) inflammatory when is the cellularity is adequate with the predominance of inflammatory cells or/and granulomas.

Clinical details of the patient were collected from medical records department. Histopathological correlation was done whenever available. The study protocol was approved by the Institutional Ethics Committee. Data analysis was done by putting tabular columns and calculating the mean, median, minimum, and maximum values.

Results

In the present study, 124 cases of image-guided TTFNAC of intrathoracic lesions were reviewed and the frequency of various cytological diagnoses of intrathoracic lesions was analyzed. The imaging technique used was CT in 120 cases (96.7%) and ultrasound in 4 cases (3.3%).

Of the 124 cases, 117 cases were FNAC of lung and 7 cases were from the mediastinum lesions. Among the 117 lung lesions, 91 patients (77.7%) were males and 26 (22.3%) were females. The male to female ratio was 3.5:1 with mean age of presentation at 60 years. Most of the lung lesions were found in the age group of 60–69 years. Both the youngest and the oldest of the patients were male aged 29 years and 86 years, respectively.

Similarly, among the seven cases of mediastinal lesions, five cases (71.4%) were males and two cases (28.5%) were females. The male to female ratio was 2.5:1 and mean age at presentation was much younger as 39 years. The youngest patient was 12 years old, whereas the oldest patient was 71 years old.

Various cytological diagnoses among the intrathoracic lesions are given in Table 1. The diagnostic yield among the intrathoracic lesions is 76.6%. Neoplastic lesions (68 cases, 71.5%) were more common than the nonneoplastic lesions (27 cases, 28.5%). Among the neoplastic lung lesions, adenocarcinoma (25%) was the most common followed by SCC (11%), small cell carcinoma (5%), poorly differentiated carcinoma (3%), and metastatic carcinoma (4%) [Figure 1]. Among the mediastinal lesions, we found two cases of thymoma and one case each of NHL, peripheral neuroectodermal tumor (PNET)/Ewings sarcoma [Figure 2], small cell carcinoma metastasis to lymph node [Table 3]. Two cases showed inadequate material for opinion. We found ten cases of inflammatory lesions, which composed of seven cases of tuberculosis (TB). Both neoplastic cells or atypical cells but show only benign cells or nonspecific inflammatory cells, and 4) inflammatory when is the cellularity is adequate with the predominance of inflammatory cells or/and granulomas.

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Table 1: Various cytological diagnoses among the intrathoracic lesions

| Intrathoracic lesions         | No. of cases | %   |
|-------------------------------|--------------|-----|
| Inadequate for opinion        | 29           | 23.4|
| Negative for malignancy       | 10           | 8.1 |
| Inflammatory lesions          | 17           | 13.7|
| Malignant lung lesions        | 63           | 50.8|
| Malignant mediastinal lesions | 5            | 4.0 |
| Total                         | 124          | 100.0|

Table 2: Cytological diagnoses among the malignant lung lesions

| Cytological diagnosis of lung tumors | No. of cases | %   |
|-------------------------------------|--------------|-----|
| Adenocarcinoma                      | 31           | 49.2|
| Squamous cell carcinoma             | 14           | 22.2|
| Small cell carcinoma                | 6            | 9.5 |
| Poorly differentiated carcinoma     | 4            | 6.3 |
| Metastasis to lung                  | 4            | 6.3 |
| Anaplastic carcinoma                | 1            | 1.5 |
| Plasmacytoma                        | 1            | 1.5 |
| Non-Hodgkins lymphoma               | 1            | 1.5 |
| Bronchoalveolar carcinoma           | 1            | 1.5 |
| Total                               | 63           | 100 |

Table 3: Cytological diagnoses among the malignant mediastinal lesions

| Cytological diagnosis of mediastinal lesions | No. of cases | %   |
|---------------------------------------------|--------------|-----|
| Thymoma                                      | 2            | 40  |
| Non-Hodgkins lymphoma                       | 1            | 20  |
| Ewings/PNET                                  | 1            | 20  |
| Metastasis from small cell carcinoma        | 1            | 20  |
| Total                                       | 5            | 100 |
Figure 1: (a-c) Squamous cell carcinoma showing malignant squamous cells in sheets and singly scattered. Dyskeratotic cells are also seen (a,b: Papanicolaou stain x 40; c: MGG stain x 100). (d-f) Adenocarcinoma showing tumor cells arranged in glandular pattern (d,e: Papanicolaou stain x200; f: MGG stain x 400). (g-i) Small cell carcinoma showing tumor cells arranged in clusters having scant cytoplasm, round nucleus with fine chromatin (g: Papanicolaou stain x100; h: Papanicolaou stain x 200; i: MGG stain x 200)

Figure 2: (a-c) Ewings sarcoma/primitive neuroectodermal tumor of the mediastinum showing sheets of dyscohesive small round blue cells with scant cytoplasm, round nucleus with stippled nuclear chromatin (a: MGG stain x 100; b: Papanicolaou stain x 100). PAS stain showed cytoplasmic positivity in tumor cells (c: PAS stain x 400). (d-f) Anaplastic carcinoma of lung showing dyscohesive singly scattered cells with bizarre nucleus (d: Papanicolaou stain x100; e: Papanicolaou stain x200; f: MGG stain x200). (g-i) Plasmacytoma of the lung showing sheets and single scattered of plasma cells and plasmablasts (g: MGG stain x100; h-i: MGG stain x400)
as well as nonneoplastic lesions were most commonly encountered in the age group of 60–69 years.

In the lung, most of the lesions were found on the right side and upper lobe. There were ten cases with pleural lesions out of which 22% occurred on the right side and 11% on the left side.

A total of 63 cases of neoplastic lesions of lung were diagnosed by FNAC, out of which 26 cases (41.3%) had histopathological correlation. Concordance was seen in 25 cases (96.1%) of the neoplastic lesions and was discordant in one case (3.9%). The sensitivity is 94.3% and specificity is 75%. The diagnostic accuracy of guided FNA in neoplastic lung lesions is 96.1%. Of the seven mediastinal lesions diagnosed by FNAC, three cases had histopathological correlation. Among these, two cases (66.67%) were found to be concordant whereas one case (33.33%) was discordant.

Among 27 cases that were inadequate on cytology, a transthoracic percutaneous biopsy was done in 17 cases to know the exact pathology.

**Discussion**

FNAC of the intrathoracic lesions is mainly useful in localized lesions of lung and mediastinum, as compared to its significance in diagnosis of diffuse parenchymal lung diseases. The major role of guided FNAC is to diagnose malignancy however it can also be used for definitive diagnosis of some benign neoplasms and infections such as TB.[1]

In the present study, among the total of 124 cases, 77.42% were male and 22.58% were female. Male preponderance was found in most of the studies.[1,2,4,9,10] This difference is explained on the basis of higher incidence of predisposing factors like smoking, COPD, etc., in males.[1] However, the percentage of male patients was found to be higher in other studies than in our series, that is, 80%, 84%, 78.9%, 88%, 80.6%, and 59.2% in these studies,[1,4,9,12] respectively.

The mean age of presentation was 59 years in our study with an age range of 12–86 years and most cases were encountered in the age group of 60–69 years. This was comparable with other studies.[1,2,4,11,12] It was found that most of lung and pleural lesions (both nonneoplastic as well as neoplastic) were found in the age group of 60–69 years, whereas mediastinal tumors were seen mostly in the age group of 30–39 years followed by 10–19 years. Mediastinal tumors such as thymoma or NHL presents in childhood but sometimes the symptoms may be seen only in the 2nd and 3rd decade of life that can explain the clustering of cases in the age group of 30–39 years. In the present study, most of the lung lesions were found in the right lung and mostly in the upper lobe, which was comparable with a study by Saha et al.[9]

The diagnostic accuracy of FNAC in mediastinal tumors was found to be 94.5%.[17] Based on the site of lesion among mediastinal tumors, more tumors were found in the anterior mediastinum (42.86%) followed by superior mediastinum (28.57%), and least occurrence in posterior and middle mediastinum. This correlated with several studies,[6,10,14] where the tumors were found to occur more in the anterior mediastinum, less in the posterior and very few in the middle compartment. Few authors[3,16] include only lesions in the anterior mediastinum as they are more frequent and easily accessible by the percutaneous route, making it possible to carry out ultrasound-guided procedures if they are in contact with the chest wall.

Among the neoplastic lung lesions, adenocarcinoma was the most common malignancy (49.2%) in the present study followed by SCC (22%). This was also found to correlate with the finding in the study conducted by Madan et al.[11] where adenocarcinoma was more common followed by SCC, whereas other studies[5,8,12,13] show higher incidence of SCC as compared to adenocarcinoma. Studies have indicated that adenocarcinoma have overtaken the incidence of SCC that was previously considered to be the most common tumor of the lung.[1]

Metastasis was noted in five cases in our study. Among them, adenocarcinoma metastasis was seen in three cases. One case showed features of neuroendocrine metastasis to lung but the other case showed features of small cell carcinoma metastasis to mediastinal lymph node. Metastatic carcinoma comprised an adequate number of cases ranging from 2.5% to 38% in many other studies.[3,8,9,12,14]

Literature reports diagnostic accuracy ranging from 65% to 97% for CT-guided percutaneous FNAC of lung nodules.[1,4,10] In the present study, the accuracy of guided-FNAC for the diagnosis of intrathoracic neoplastic lesions was found to be 96.1%, which is comparable with other similar studies.

Among the lesions in the lung, we had a 52-year male with a mass in the lung with lytic lesions in the left ribs. The cytology showed sheets and singly scattered plasma cells and plasmablasts that was diagnosed as plasmacytoma [Figure 2g–h]. He had associated anemia and elevated erythrocyte sedimentation rate. The diagnosis of extramedullary plasmacytoma was confirmed by histopathology and similar cases were reported in the literature.[15,16]

We encountered a case of 12-year-old boy who came with complaints of progressive breathlessness since 1 month with significant weight loss. CT scan showed a large mass in the mediastinum, with mediastinal shift. They also found a small nodule in base of the left lung associated pleural effusion. FNAC of the mediastinal mass showed sheets of dyscohesive small round blue cells with scant cytoplasm, round nucleus with stippled nuclear chromatin. PAS stain showed cytoplasmic positivity in tumor cells [Figure 2a–c]. Hence, a differential diagnosis was of NHL and PNET/Ewings sarcoma was given. Histopathology confirmed the diagnosis of PNET/Ewings sarcoma. This is a rare entity and few cases have been reported in the literature.[17-19]

In our study we encountered seven cases of TB. TB can be diagnosed accurately on FNAC and immediate treatment...
can be started in these patients. Other studies have also found TB ranging from 5% to 7%.\[^{12,13}\]\[^{12,13}\] Similarly, we encountered ten cases of inflammatory lesions in our study. The antibiotic treatment was started based on our reports and patients improved without requiring any further invasive investigations.

It was notable that the specimen for FNAC was inadequate for 25 (20.16%) of the cases, which mainly is attributed to the site of the lesion and the skill of the medical personnel taking the specimen. Hemorrhagic smears were noted in 2.5% of cases and 3.2% was inflammatory that can again hinder the accuracy of the diagnosis. In a study done by Prashant et al.\[^{8}\] it was found that the yield of the specimen which in turn affects the accuracy of diagnosis and the rate of complications were comparatively lesser when done by an expert medical personnel. It also pointed out that deeper lesion had a higher complication rate.\[^{8}\]

The limitations of this study were the retrospective nature of the study and follow up on treatment of all patients was not available. Exhaustive work up including histopathological correlation of all cases and recent advances such as immunocytochemistry was not done.

**Conclusion**

To conclude, image guidance with either an ultrasound or a CT scan has enabled the accurate localization of small lesions, which were previously inaccessible by older radiological techniques. It is indeed a safe method when done by well-trained medical personnel and has a lesser rate of complications. An early accurate diagnosis of malignancy can be made based on the cytological features; however, further subtyping of the malignancy may be sometimes difficult due to overlapping cytological features. Immunocytochemistry will be useful in definite subtyping of tumors. Accuracy of diagnosing nonneoplastic lesions such as TB by FNAC is higher and can be aided by cytochemical stain (AFB) for infectious organisms. FNAC, as a diagnostic tool, has reduced the interval of detecting various diseases thus hastening the time at which therapy is initiated. Image-guided FNAC thus aids in early diagnosis and management of patients with intrathoracic lesions.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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