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Ultrasound Guided Fine Needle Aspiration Cytology: An Effective Diagnostic Tool in Pulmonary Medicine

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ABSTRACT

Objective: To evaluate the diagnostic efficacy and safety of fine needle aspiration cytology performed under ultrasound guidance.

Study Design: Comparative prospective study.

Place and Duration of Study: Pulmonology Out-Patient Department, Gulab Devi Teaching Hospital, Lahore Pakistan, from Jun 2018 to Dec 2019.

Methodology: One hundred and twenty-four patients of age 10-80 years, with pulmonary, mediastinal, pleural or chest wall lesions, fulfilling the minimal fitness criteria were included. Aspiration was done by a 23-gauge needle, smear made, and fixed slides were sent to the Cytology Department for evaluation. Complications were monitored. Findings were recorded on preformed proforma.

Results: 121/124(97.6%) aspirates were adequate while 03 cases (2.4%) were reported not representing the lesion. Fifty cases (41.3%) showed malignant cytology, 71/121 aspirates (58.7%) were non-malignant. A specific cell type could be characterized in 84.5% non-malignant and 68.0% malignant aspirates. Complications were a few drops bleeding at needle aspiration site in 7.5 % and minor pain in 12.0 % patients.

Conclusion: Fine needle aspiration cytology under ultrasound guidance is an effective and safe diagnostic tool in pulmonary medicine.

Keywords: Cytology, Efficacy, Fine needle aspiration, Lung, Ultrasound guidance.

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INTRODUCTION

The frequency of lung and mediastinal nodules is escalating due to increasing habit of smoking, environmental pollution, occupational hazards and progressive urbanization. Bronchoscopy is not helpful in picking the peripheral lung nodules. [1] Similarly mediastinal lesion are not easily approached by this modality. Therefore, we have to go for image guided or open biopsy for tissue sampling. This procedure is highly cost-effective, easy to perform and free from the hazards of the ionizing radiations. In addition, blood vessels in the needle path are intelligently identified by ultrasound and can be saved successfully during the procedure. Similarly necrotic areas are sharply recognized by ultrasonography and avoided during sample taking.[2] FNAC is regarded as the least invasive and an effective method for diagnosing peripherally located as well as mediastinal lesions.[3] This is valuable equally for infective as well as neoplastic etiologies.[4] The first report on the use of needle puncture is referred in early writings of the Arab Medicine[5,6]. Although a core needle biopsy or bronchoscopic biopsy is more satisfying for a physician but we come across quite a significant number of patients in a busy Pulmonology Department, which are unable to be practiced by these procedures either because of location or configuration of the lesion or due to fitness issues. CT-guided FNAC/Biopsy is a high-cost procedure, not frequently available everywhere, and also requires the services of a qualified radiologist [7,8] in which patient is exposed to the risk of mutations as well due to the use of ionizing radiations.[9] On the other hand, ultrasonography can image the pleural based pulmonary nodules, pleural, mediastinal and the chest wall lesions successfully.[10]

The rationale of our study was to determine the diagnostic efficacy of FNAC in these patients with a thin bore needle which is least invasive, requiring minimal fitness with negligible expected complications and also to compare it with that of core needle biopsy result available in literature and its

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feasibility and potential for regular use, as a least invasive diagnostic tool. Purpose of the study was also to include the use of ultrasound guidance in place of Computerized Tomography, which is readily available, simple and can be used by a pulmonologist in any setting to avoid unnecessary delay due to long appointments by the radiologist and also to avoid patient exposure to radiation and contrast with relative or absolute contra-indications.

METHODOLOGY

The study was conducted at the Pulmonology OPD of Gulab Devi Teaching Hospital, Lahore Pakistan, a 1500 Bedded-Tertiary Care Hospital, from June 2018 to December 2019 after approval by the Ethical Committee of the Hospital (No. Admin/ GDEC- 415/18). Sample size was calculated using formula = (1.96)2 X P(1-P) / d2, against the prevalence of 4.6%.11

Inclusion Criteria: Patients of either gender with pulmonary, pleural, hilar, mediastinal or chest wall lesions, were included.

Exclusion Criteria: Patients having central deepseated nodules not clearly outlined by ultrasound, unfit for the procedure were excluded. Platelet count <100,000/ ml, APTT, PT ratio >1.4, FEV1 <35% predicted, lack of the safe pathway to the lesion and inability of the patient to co-operate with to be positioned or breath-holding for the procedure were utilized to determine the fitness. After history and physical examination, PT, APTT and INR reports were consulted. Fresh chest x-ray PA and Lat. views and available CT-scan films were reviewed. The patients with a nodule on imaging were subjected to ultra-sonography for disease localization with (Toshiba) 3.5–5.5 MHz convex probe. The fit patients underwent FNAC while unfit followed other diagnostic options. Sputum examination for AFB smear, culture, Gene-Xpert, Cytology and pyogenic culture sensitivity were done.

Fine needle aspiration was done by using a 23-gauge needle mounted on a 10cc disposable syringe under local anesthesia and aseptic scenario after obtaining an informed consent. The probe was placed in the inter-costal space in firm contact with the skin and the needle was advanced into the lesion during suspended respiration, under real-time visualization. After the needle tip was confirmed in the non-necrotic area, 2—3 rocking movements were given, material was aspirated, smear made and fixed. Six slides were prepared for each procedure, labeled and transported to the pathology department for evaluation.

The patients were kept under observation and underwent an expiratory chest x-ray one hour after the procedure to monitor the complications. The adequacy of the sample was determined by cytology report. The samples not representing the lesion were regarded as inadequate. Malignant and non-malignant cases were isolated. Specific disease characterization was calculated for each group. The patients with malignant etiology were transferred to oncology ward while non-malignant cases were treated in pulmonology department. Patients were followed up for six months and the response to treatment was recorded in pertinent cases. FNAC diagnosis was compared with final clinical diagnosis. All study findings were recorded on pre-formed pro-forma. Data was organized, summarized and statistical analysis was done to make inference.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Diagnostic parameters were calculated using a 2x2 contingency table. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined by using the standard formulae.

RESULTS

One hundred and twenty-four patients were enrolled. The age range was 10-80 years. The maximum number of patients were in the age group of 47-60 years with mean age 30.6+11.3 years. The majority of the patients complained of chest pain, cough, fever and hemoptysis as shown in Table-I.

Table-I: Clinical Features of Patients (n=124)

Clinical Features	n (%)
Chest Pain	101(81.45%)
Cough	96(77.41%)
Fever	90(72.58%)
Hemoptysis	76(61.29%)
Weight Loss	99(79.83%)
Shortness of breath	58(46.77%)

Out of 124, three aspirates were declared inadequate while 121 were adequate. Adequacy of sampling was 97.6%, 50(41.3%) aspirates showed malignant while 71(58.7%) aspirates displayed non-malignant cytology. Out of 121 adequate aspirates, 93(76.9%) had pulmonary and chest wall lesions.

Mediastinal aspirates were 28(23.1%) while 25(89.3%) had anterior mediastinal and 3(10.7%) had posterior mediastinal pathologies. Anterior mediastinal aspirates included 17(68.0%) malignant and 8(32.0%) were non-malignant. Eight cases (32.0%) were reported as caseating granuloma, 6(24.0%) malignant cells, 4(16.0%) small cell carcinoma, 3(12.0%) Ewing sarcoma, 2 cases (8.0%) Lymphoblastic lymphoma and 2 cases (8.0%) as Malignant spindle cell tumors. The three posterior mediastinal aspirates included, caseation necrosis one case, second was reported as cold abscess which was later on diagnosed and treated as Pott's disease while the third one was an acute inflammatory aspirate. As 6 malignant aspirates (35.29%) from anterior mediastinum were not assigned any tumor type, specific disease characterization for malignant disease was 64.71% while all non-malignant aspirates from anterior mediastinum were reported as caseating granuloma, concluding specific disease characterization 100%. Similarly, specific disease characterization was 100% for posterior mediastinal aspirates.

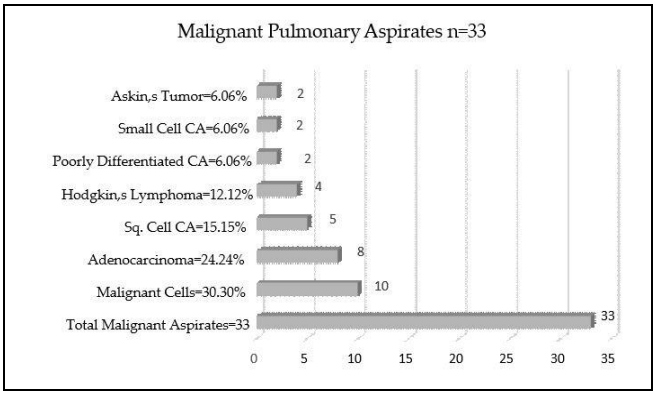

Figure-1: Frequency of Malignant Pulmonary Aspirates

Pulmonary and chest wall aspirates were 93(76.9%). In this group, 35.5% were malignant as illustrated by Figure-1, 60(64.5%) were non-malignant (Figure-2). The sensitivity and specificity for a malignant process was 100% (Table-II).

Table-II: Diagnostic Accuracy Table (n=124)

Diagnostic Parameters		Clinical Diagnosis	
		Yes	No
FNAC Diagnosis	Yes	TP=60	FP=00
	No	FN=00	TN=33
Sensitivity=100%	Specificity=100%	PPV= 100%	NPV= 100%

TP: True positive, FP = False positive, FN: False negative, TN = True negative, PPV: Positive predictive value, NPV: Negative predictive value

Ten out of 33 cases (30.3%) were not assigned a specific tumor type. Therefore, specific diseases characterization was 69.7%.

In 60(64.5%) aspirates, malignancy has been totally ruled-out with 100% Sensitivity and specificity. All aspirates had assigned specific disease except 11 cases, which were reported as non-specific chronic inflammation (Figure-2). Specific disease characterization was 81.66% for non-malignant aspirates.

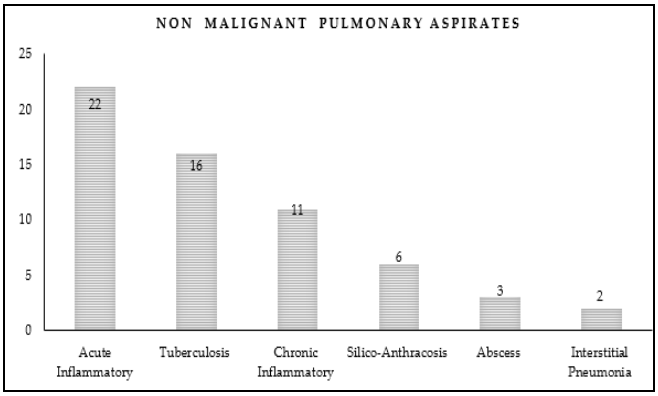

Figure-2: Frequency of Non-Malignant Pulmonary Aspirates

No major complication was encountered. Only minor pain and a few drops bleeding at puncture site were found in 12.0% and 7.5% cases respectively. On the whole, the specific disease characterization for malignant and benign pathologies was 68.0% and 84.5% respectively.

DISCUSSION

We aimed to evaluate the diagnostic value of FNAC in pulmonary medicine by using real-time US-guidance to avoid the hazards of exposure to ionizing radiations, to overcome the unavailability of CT guidance, expertise and also to evaluate the usefulness of this procedure in a resource limited setting.

The age of the study population (n=124) ranged between 10 to 80 years. Mean age was 30.6±11.3 years, which is comparable to the report of Saha and co-authors and Modi and associates. [13-14] This distribution may be due to increased incidence of malignancy and infections in this age group. The studies of Abraham *et al*., Saha *et al*. and Mondal *et al*. showed increased prevalence of neoplasm after the age of 50 years. [3,13,15]

In this study, FNAC under ultrasonography has emerged as an accurate and safe method for the evaluation of lung, mediastinal and chest wall lesions with 97.6% sampling success rate while Konjengbam *et*

al. showed 91.80% and Jain *et al*. displayed 95.87% success rate.[16-17] This good diagnostic yield was likely owing to ultrasonography which discriminated accurately between necrotic and solid areas and provided high sampling success rate from non-necrotic part of the lesion.

Current study shows that FNAC has successfully drawn a clear-cut line of demarcation between benign (71 cases) and malignant (50 cases) processes with 100% sensitivity and specificity in mediastinal, pulmonary and chest wall pathologies. While Gango-padhyay and colleagues displayed 96% sensitivity and 100% specificity in diagnosing lung tumors.[18]

On the whole, 50(41.32%) malignant aspirates were obtained in our study which is in fair agreement with the results of Pandey *et al*. Adler *et al*. and Jareb *et al*. [19-21] While 6 cases of anterior mediastinum and 10 pulmonary aspirates were reported as "malignant cell", these were classified as malignant pathologies but no tumor type had been assigned, that is why specific disease characterization for the malignant pathologies is 68.0%. Adenocarcinoma was the most commonly diagnosed malignancy (24.24% of all malignant aspirates) which is supported by Madan *et al*. and Sagar *et al*.[22,23]. This could be explained by the fact that adenocarcinoma are usually peripherally located that is why more often picked by trans-cutaneous FNAC.[24]

FNAC has diagnosed metastatic deposits successfully, in lung and mediastinum, thus is of significant value in staging of lung cancer. Similarly, it has classified small cell and non-small cell carcinoma and lymphoma successfully and played a pivotal role in treatment planning without any further need of highly invasive diagnostic procedure. In this way, it not only saves the revenue of the patient, rather eliminates the need of surgical staging of lung cancer and helps in early start of treatment with curative intentions. Our results are fairly comparable to the reports of previous authors. [3-16-17]

This study exhibited superior diagnostic yield to all above mentioned reports owing to the use of ultrasound guidance. It is very pertinent to make a note here that current study was performed on patients who were not fit for biopsy procedure. However, results indicate that this procedure can be practiced using lesser invasive modality before highly invasive techniques. Although biopsy procedure provides more satisfaction to the physician, but it is much more expensive and traumatic to the patient without any substantial advantage over ultrasound guided FNAC. It can be reserved for those cases where ultrasound guided FNAC fails to provide adequate diagnostic details.

As far as complications are concerned, 5-10% pneumothorax is documented in various studies.[19,24] Hemoptysis and vaso-vagal shock are also documented in the literature but we did not encounter any pneumothorax, hemoptysis, vasovagal shock or air-embolism in this study. The only complications encountered were puncture site pain in 12% cases which was relieved by over-the-counter painkillers. Similarly, a few drops of bleeding was noted in 7.5% cases at puncture sites for which only a Band-Aid dressing and reassurance was sufficient. This data shows negligible complication rate and excellent safety. Similarly, real-time sampling from the non-necrotic area enhanced the diagnostic yield and minimized the chances of pneumothorax. Thus, this procedure is capable of resolving cases of PUO, cough, hemoptysis, chest pain and shortness of breath as seen in our patients. It can be utilized in remote areas with confidence where facilities for CT-scan are not available and also enables us for diagnostic work-up of pregnant and pediatric patients for which CT-guidance is not safe. Similarly, patients unfit for biopsy and immobile ICU patients can also be helped by this technology. The main disadvantage of this test is that it depends upon the expertise of the operator. Therefore, it is suggested that before going for ultrasound guided trans-thoracic FNAC, an adequately trained operator must be sought.

Ultrasound guided FNAC bears superior diagnostic efficacy, excellent safety and significant feasibility as compared to several core needle biopsy studies under US/CT-guided procedures. Therefore, it is more cost effective, portable, safer, faster, providing high diagnostic yield, low complication rate and at least as accurate as a CT-guided biopsy.

Our study results can find applications in resource-limited populations where availability of CT-guidance is a hindrance.

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CONCLUSION

Fine needle aspiration cytology under US guidance is simple, safe, cost effective, readily available and valuable diagnostic tool in any pulmonary set-up. It is extremely

helpful for early diagnosis, staging and starting of treatment with curative intentions in pulmonary medicine. It can be a tremendous tool for non-ambulatory and serious patients.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

ARQ & BM: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

ZA & ZA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MS & MA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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