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Computed Tomography (CT) Guided Interventions in Thoracic Lesions

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Abstract
Background: *CT guided interventional procedures are the most preferred procedures in thoracic lesions. Thoracic interventions like CT guided fine needle aspiration cytology and core biopsy are minimally invasive procedures.* ***Methods****: This is a hospital based observational study of CT guided interventional procedures in patients with thoracic lesions diagnosed by imaging methods like chest radiograph, CT or MRI scans. These patients were referred to the department of radiodiagnosis for CT guided thoracic interventions from the chest medicine department and other clinical departments of our Hospital AIIMS New Delhi. The duration of the study is for a period of two years.* ***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.*
Keywords*: CT Guided, FNAC, TTNB.*

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I. Introduction

CT guided interventional procedures are the most preferred procedures in thoracic lesions. Thoracic interventions like CT guided fine needle aspiration cytology and core biopsy are minimally invasive procedures. They can be done quickly on patients without causing significant morbidity when compared to open surgical interventions. The quest for accurate diagnosis of lung pathology has been there all through the history of medicine. The pathologist is the person who makes the final diagnosis, but submission of the lesion to the pathologist involves procedures, both invasive and noninvasive, like open lung biopsy (OLB), percutaneous transthoracic needle biopsy (TTNB) and fine needle aspiration cytology (FNAC). Percutaneous non-operative procedures in the chest were performed even before the advent of imaging. Leyden performed the first transthoracic needle lung biopsy in 1882 to confirm pulmonary infection. 1 In oncology practice pathological diagnosis of the disease is of paramount importance and is always considered the standard for diagnosis. 2 CT scan is the most popular guiding modality for thoracic interventions. CT offers exquisite anatomical display of the thoracic structures and allows percutaneous access. Intravenous contrast medium injection is mandatory for identification of necrosis, fluid content, normal vascular structures and also contributes to precise delineation of a lesion with regard to the anatomical environment. 1, 2 CT is particularly useful for guiding puncture of mediastinal lesions and intrapulmonary lesions that are difficult to localize. CT allows determination of an optimal cutaneous entry point in such a way as to avoid transgression of a pleural fissure or puncture of large vessels, bronchi, oesophagus and other structures. 1, 2 Post procedural complications like pneumothorax and pulmonary hemorrhage if any, are readily recognized on CT scan. 2 MRI for the evaluation of lung disease is limited by degradation of the images by respiratory motions. Techniques of MRI guided thoracic interventions need further developments. 2, 3 Ultrasound, on the other hand, is more cost effective and also free from ionizing radiation. The needle is advanced and sample is obtained under real time visualization. However, ultrasound suffers from limitation of visualization in some areas such as intrapulmonary or bone lesions as well as deep seated thoracic lesions obscured by overlying lung. Ability of TTFNAC and core needle biopsy to provide diagnosis on examination of few cells and tissue samples respectively, have made them one of the most widely used diagnostic procedures in oncology. Both FNAC and core biopsies have their own advantages and disadvantages. FNAC's are simple and safer but are more prone to false-negative diagnosis.

Objectives

To describe and assess the accuracy of CT guided fine needle aspiration cytology, automated core needle biopsy, diagnostic aspirations and drainage procedures for procurement of material (tissue) in the management of benign and malignant lesions of the thorax.

II. Review of Literature

During the first half of the twentieth century, lung biopsy was mainly used to establish the microbiological diagnosis of extensive infectious lobar consolidation, which was easy to localize. Percutaneous needle sampling in the chest however, fell into disrepute, due to an unacceptable high rate of complications, caused by the large calibre of needles. 1 Despite the use of smaller needles; pathologists remained reluctant to formulate a diagnosis on small samples or smears. Fluoroscopically guided bronchial brush biopsy was described in the nineteen sixties. 17 At the same time, the innovating work of Nordenström and Zajicek at the Karolinska Hospital in Stockholm popularized the technique of transthoracic fine needle sampling in the chest. 18 The rate of pneumothorax was dramatically reduced with the systematic use of small gauge needles, although the rate of inadequate cellular material or false negative diagnoses in the confirmation of malignancy persisted in the 15% to 25% range. False positive diagnoses did not exceed 2%. 18 Transthoracic needle biopsy of mediastinal lymph nodes was described by a transjugular, a paraxiphoid or a paravertebral approach. 19, 20 These transthoracic approaches were adopted on a routine basis, when computed tomography (CT) became available. Percutaneous TTNB's of the lung are increasingly being performed using CT guidance. 3, 21 Percutaneous lung biopsy under CT guidance is safe, effective and accurate with a reported sensitivity of 90% for malignant lesions and slightly less for nonmalignant lesions. 22 There is little dispute that for lesions smaller than 1.5 cm, CT is the imaging technique of choice. Two studies have documented technical success rates varying from 74% to 93% for CT guided TTNB of small lung nodules. 23, 24 From a technical standpoint, CT guided TTNB has the advantage of allowing an accurate choice of needle access by avoiding bones, adjacent organs, pulmonary vessels, bullae, and fissures and also accurately depicts the final needle position. 25 Avoidance of systemic vessels such as internal mammary vessels, intercostals, and pericardial vessels is particularly important because injury to these can result in significant hemorrhage. A single needle or a coaxial needle can be used for TTNB of lung and mediastinal lesions. The coaxial system involves inserting a needle through the cannula of a slightly larger needle and into the thoracic lesion, the advantage being limiting the number of pleural punctures, thereby decreasing the risk of the most common complication which is pneumothorax. The patient is positioned in the CT so that the skin entry site allowing the shortest, most vertical part that avoids bullae, interlobar fissures or pulmonary vessels is placed upright. Localization of the puncture site is done by thin CT axial sections and the sections showing the most peripheral extent of the lesions are chosen to select the site for puncture. As the progression of pulmonary malignancy is high, pulmonary lesions need to be diagnosed early. Granulomas and bronchogenic cancers constitute the vast majority of pulmonary nodules. The incidence of malignant disease ranges from 10 to 70% with an average of 40%. 12-14, 98 Other common causes of pulmonary nodules are hamartomas, metastases, infarcts, vascular malformations, focal inflammatory masses and lipoid pneumonia etc. in decreasing order of frequency. Various primary and secondary tumours can affect ribs, causing localized lesions. Benign primary tumours are infrequent, and of these, the cartilaginous tumours like chondromas and osteochondromas are the most common. They are predominantly located anteriorly and may show characteristic cartilaginous calcification.

III. Material And Methods

This is a hospital based observational study of CT guided interventional procedures in patients with thoracic lesions diagnosed by imaging methods like chest radiograph, CT or MRI scans. These patients were referred to the department of radiodiagnosis for CT guided thoracic interventions from the chest medicine department and other clinical departments All India Institute of medical Sciences, New Delhi. Study duration of two years. **Inclusion Criteria:** Patients with thoracic lesions referred for CT guided core biopsy, fine needle aspiration cytology or drainage.

Exclusion Criteria: Non co-operative patients incapable of adequate breath-holding. 2. Uncorrected coagulation abnormalities. 3. Patients at high risk for pneumothorax or haemothorax due to difficult access to the lesions.

The study includes patients with thoracic lesions situated in the lung parenchyma, mediastinum, pleura, bony thoracic cage and soft tissues of the thorax for diagnostic cytology or biopsy under CT guidance. Subjects were selected by preprocedural imaging diagnosis using chest radiography, computed tomography, magnetic resonance imaging, or sonography. Bleeding and clotting parameters in the form of clotting time, bleeding time, prothrombin time and activated partial thromboplastin time (aPTT) were determined in all patients. Subjects with normal bleeding and clotting parameters were included in the study and the rest were excluded. Detailed history of patients was collected including medical history, occupation, and personal. The patients were

admitted before the procedure. No fasting was advised. The patient was positioned in the CT gantry and the percutaneous access site was prepared. Immediate preprocedural topogram and CT of the chest were done from the neck base upto the domes of the diaphragm to delineate the thoracic lesion and to locate the percutaneous site of needle puncture. The point was localized with laser lights located in the CT gantry and marked with a permanent skin marker. The local area was cleaned with povidone iodine and surgical spirit. Using aseptic precautions 2% lignocaine was utilized for local anesthesia and one of the following procedures was performed. Aspiration under CT guidance was done for pleural effusions.18 to 20 gauge aspiration needles were used for aspiration. If pus was aspirated, about 10 ml to 20 ml was sent for smear, gram-stain, culture and sensitivity tests to identify the causative organism. If hemorrhagic fluid was aspirated, the aspirate was also sent for cytology. Patients were followed up by CT immediately to identify complications like pneumothorax.

IV. Results

This was a hospital based observational study of patients with varying diagnosis of thoracic lesions subjected to imaging studies like chest radiographs and CT scan to determine the nature of the lesion. These patients then underwent CT guided interventions, most of which were core needle biopsy and fine needle aspiration cytology to procure tissue which was sent for cytopathological and histopathological analysis for diagnosing benign and malignant lesions of the thorax. This hospital based observational study had 26 patients, of which 13 were males and the remaining 13 were females. The age group of the patients in the study ranges from sixteen years to eighty years. Maximum numbers of patients were in the age group of 51 to 60 years with a value of 7, accounting for 27% of patients. This was followed by age groups of 41 to 50 years and 61 to 70 years, each of which comprised of 6 patients. Only one patient was in the age group of 11 to 20 years and no patient was aged below 10 years of age.

In this study which comprised of 26 patients, the most common site of the thoracic lesion was in the lung parenchyma which accounted for 17 patients with a percentage of 65.38. The remaining lesions were distributed as follows - 4 in the mediastinum, 2 in the pleura and 3 in the bony thoracic cage (thoracic vertebrae). The most common age group of distribution was 51 to 60 years in whom there were 7 lesions (5 in the lung parenchyma, 1 each in the mediastinum and pleura and none in the thoracic cage), There were 28 interventional procedures in the study for thoracic lesions which were done under CT guidance. The interventions done were core biopsies and FNAC's. A total of 21 core biopsies (75 %) and 7 FNAC's (25 %) were done. The procedures were done for lesions situated at different sites in the thorax including lung parenchyma, mediastinum, pleura and thoracic vertebrae. Total number of FNAC's performed for thoracic lesions were 7, of which 5 of them were unsuccessful in terms of inadequate sample for cytological analysis. Most of these samples were hemorrhagic. Out of 5 patients in whom FNAC failed to obtain adequate tissue for cytological analysis, 2 patients had also undergone biopsy under CT guidance by which adequate tissue sample was obtained for histopathological analysis which were reported as Aspergilloma and fibrosis. This patient was a 58 year old female who had bilateral pulmonary opacities on chest CT. The patient was subjected for CT guided FNAC from the right upper lobe pulmonary opacity. However FNAC failed in procuring adequate sample as only hemorrhagic smears were obtained by which no definite cytological opinion was possible. Hence a repeat CT guided core biopsy was performed from the right upper lobe, which was successful in procuring adequate tissue sample for histopathological analysis and the lesion was reported as fibrosis.

V. Discussion

Image guided thoracic interventions are the result of advancements in crosssectional imaging. CT is the most commonly used imaging modality for thoracic interventions. These minimally invasive thoracic interventions like CT guided transthoracic lung biopsy and transthoracic fine needle aspiration cytology 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. 1-3 This study was designed to determine the efficacy and safety of CT guided interventional procedures for the diagnosis of benign and malignant lesions of the thorax. In this hospital based observational study, the total number of patients was 26, of which 13 patients were males and the remaining 13 were females. The age group of the patients ranged from 16 years to 80 years. Maximum number of patients were in the age group of 51 to 60 years, with a value of 7 accounting for 27% of the total patients. This was followed by age groups 41 to 50 years and 61 to 70 years, each of which had 6 patients. There were 4 patients aged above 70 years. Age groups of 11 to 20 years, 21 to 30 years and 31 to 40 years had 1 patient each. There was only one pediatric patient, who was a female aged 16 years. The 26 patients underwent imaging investigations like chest radiograph and CT scan for diagnosis of thoracic lesions. Then CT guided interventions which comprised of percutaneous transthoracic core needle biopsy and transthoracic fine needle aspiration cytology were done after the patients gave written consent for the procedure and after through patient preparation was done as described previously. The patients were also explained in their own language the type of procedure including risks and the complications like pneumothorax

and pulmonary hemorrhage which may arise after the procedure. All patients were subjected for bleeding and clotting parameters in the form of clotting time, bleeding time, prothrombin time and activated partial thromboplastin time. Subjects with normal clotting and bleeding parameters were included in the study and the rest were excluded. Out of the 26 patients, the most common site of the thoracic lesion was in the lung parenchyma as revealed by imaging accounting for 65.38% with a value of 17. The remaining lesions were distributed as follows- 4 in the mediastinum, 2 in the pleura and 3 in the thoracic vertebrae. The maximum number of patients, with thoracic lesions was in the 51 to 60 years age group which comprised of 7 patients. Thoracic CT revealed 16 lesions as being malignant based on certain imaging signs such as irregular borders, necrosis, bone erosion, chest wall invasion, vascular invasion, bronchial obstruction etc. which were more common in these malignancies. Malignant lesions usually have irregular borders and areas of necrosis when seen on imaging. Among the malignant tumours adenocarcinoma was the most common type which accounted for 28.57% with a value of 4. This was followed by squamous cell carcinoma contributing to 21.43% with a value of 3. The rest of the malignant tumours were 1 of each of the following – large cell carcinoma, small round cell tumour, malignant thymoma, malignant mesothelioma, carcinoid tumour, plasmacytoma and metastatic squmaous cell carcinoma as described above Based on the review of literature adenocarcinoma is the most common malignant tumour of the lungs. This is followed by squamous cell carcinoma. 98-102 There was very good agreement between the lesions diagnosed by CT and those by pathology. Out of the 16 lesions attributed as being malignant based on CT findings, 14 were proved to be malignant by pathology. Among the 8 lesions attributed as being benign based on CT, 7 were proved to be benign lesions. In this study benign lesions were most commonly situated in the upper lobe of the right lung and malignant lesions in the lower lobe of the left lung . The age group of 51 to 60 years was commonest for benign lesions in which there were 4 patients, accounting for 57% of patients. For malignant lesions the most common age group was 61 to 70 years which had 5 patients accounting for 64%. Malignancies were most common in males accounting for 64% with a value of 9. In this study the yield of CT guided TTFNAC was very low, as 5 of the 7 FNAC's failed in procuring adequate tissue for cytological diagnosis and consequently the yield was only 28.57% with a failure rate of 71.43%. However CT guided core biopsy had a yield of 100% without any failures as all the 21 core biopsies were successful in procuring adequate tissue for histopathological analysis. Core needle biopsy is more accurate in obtaining adequate tissue for pathological analysis when compared to fine needle aspirations.

VI. Conclusion

it was observed that the yield of CT guided core biopsy and CT guided fine needle aspiration cytology (FNAC) is 100% and 28.57% respectively without any failure rate for core biopsy and a 71.43% failure rate for FNAC. 3. The failure rate of CT guided FNAC being 71.43%, suggests that FNAC has a poor value for procuring adequate material (tissue) in the diagnosis of benign and malignant lesions of the thorax. 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.

References

[1]. Ghaye B, Dondelinger RF. Image guided thoracic interventions. European respiratory journal 2001; 17:507-528.
[2]. Sanjay T. Image guided biopsy procedures. Indian journal of medical and pediatric oncology 2007; 28(2): 5-6.
[3]. Klein JS, Zarka MA. Transthoracic needle biopsy. Radiol Clin North Am 2000; 38(2):235-266.
[4]. Pan CY. Ultrasound-guided transthoracic biopsy of the chest. Radiol Clin North Am 2000; 38(2):323-331.
[5]. Mullar DA, Carraso CH, Katz RL. FNAB: The role of immediate cytological assessment. AJR 1986; 147:155-158.
[6]. Moullen IS, Merc PR. Percutaneous coaxial biopsy technique with automated biopsy needle - value in improving accuracy and negative predictive value. Radiology 1993; 186:515-522.
[7]. Inderbir S. Pal GP. Human Embryology.8 th edition, Macmillan, New Delhi 2007; 175-182.
[8]. Bruce IB, Victoria HO. Integrated anatomy and embryology, Elsevier, Philadelphia 2007; 35-37.
[9]. Teresa B, Carmen M, Susana N, Julia G, Antonia A, Nieves GL. Congenital anomalies of the tracheobronchial tree, lung and mediastinum:Embryology, radiology and pathology. Radiographics 2003; 24:17-20.
[10]. Standring S. Gray's Anatomy – Anatomical basis of clinical practice.40 th edition, Elsevier, Churchill Livingstone 2008; 909-914, 917-928,954-956
[11]. Paul B, Adam WM, Harold E. Applied radiological anatomy.1 st edition, Cambridge University Press, Cambridge 2005; 121-147.
[12]. Adam A, Dixon AK, Grainger RG, Allison DJ. Diagnostic Radiology-A textbook of medical imaging. 5 th edition, Elsevier, Churchill Livingstone 2008; 187-350, 1461-1485.
[13]. Sutton D. Textbook of radiology and imaging.7 th edition, Elsevier, Churchill Livingstone 2003; 1-128, 247-262.
[14]. Haaga JR, Vikram SD, Michael F, Robert CG, Hyun KH, Murali S. CT and MRI of the whole body. 5 th edition, Elsevier, Philadelphia 2009; 927-958, 2462- 2486.
[15]. Camilla RW, Sameer K, Graham JM, Sisa G. A diagnostic approach to mediastinal abnormalities. Radiographics 2007; 27:657-671.
[16]. Suwatanapongched T, Gierada DS. CT of thoracic lymph nodes. Part 1: anatomy and drainage. BJR 2006; 79:922-928.
[17]. Hattori S, Matsuda M, Sugiyama T. Cytological diagnosis of early lung cancer: brushing methods under X-ray television fluoroscopy. Diseases of the chest 1964; 45:129-135.
[18]. Dahlgren S, Nordenstrom B. Transthoracic needle biopsy. Almquist and Wiksell, Stockholm 1966:1-32.
[19]. Nordenstrom B. Transjugular approach to the mediastinum for mediastinal needle biopsy. Invest Radiol 1967; 2:134-140.
[20]. Khouri NF, Stitik FP, Erozan YS et al. Transthoracic needle aspiration biopsy of benign and malignant lung lesions. AJR 1985; 144:281-288.

[21]. Greene R, Szyfelbein WM, Isler RJ, Stark P, Jantsch H. Supplementary tissue core histology from fine-needle transthoracic aspiration biopsy. AJR 1985; 144:787-792.
[22]. Westcott JL. Percutaneous needle aspiration of hilar and mediastinal masses. Radiology 1981; 141:323-329.
[23]. Kazerooni EA, Lim FT, Mikhail A et al. Risk of pneumothorax in CT-guided transthoracic needle aspiration biopsy of the lung. Radiology 1996; 200:675- 697.

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