CT SCAN EVALUATION OF PULMONARY NODULE

A. Ravi Kumar[1], B. Vinod Kumar[2], U. Syam Sunder Rao[3], G. Prathima[4]

[1]Associate Professor, Department of Radio-diagnosis, Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh.
[2]Professor, Department of Radio-diagnosis, Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh.
[3]Associate Professor, Department of Radiodiagnosis, Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh.
[4]Assistant Professor, Department of Pathology, Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh.

ABSTRACT

BACKGROUND

Lung carcinomas are quite commonly diagnosed. Thanks to the ever increasing smokers' population. Majority of the city dwellers are at a higher risk of having this disease when compared to the village counterparts. The stigma through which the person and the family have to undergo before confirming the diagnosis is enormous. So the radiographic methods of diagnosing the malignancies have to improve. Before confirming the diagnosis, the radiologists, the treating physicians should be somewhat confident about the diagnosis so as to prepare the patients and their relatives for the most probable diagnosis before the confirmatory report. The confirmatory procedures include the PET scan and the Histopathology. Both are time consuming procedures and in an economy like ours, finding a PET scanning centre is rather difficult. So the most probable diagnosis has to be thought of using minimal resource. This study puts in a sincere effort to understand and evaluate the pulmonary nodule when identified by a CT scan. This paper is intended to help the practicing radiologists and also make life easy for a practicing physician to identify correctly the lesions and also help the patients to prevent further progression of the disease.

METHODS

The study was a cross-sectional study. The sample size of the study consisted of thirty patients. CT scan was done in thirty patients who were identified to have lung nodules either by other mode of radiological studies or first time identified in a CT scan itself. The study was conducted in Fathima Institute of Medical Sciences, Kadapa. The study was conducted from 2014 to 2015.

RESULT

Non-solid nodules were more in number when compared to the solid nodules. All the non-solid nodules were confirmed to be adenomas. Eighty percent of the nodules which were more than 8 mm in size were confirmed to be malignant. One hundred percent of the spiculated border on CT was confirmed to be malignant. In the present study, the lobulated mass was confirmed to be malignant in one hundred percent of cases. One case that was infectious origin was also lobulated in appearance. In eighty percent of the confirmed malignant cases, the halo sign was negative. Calcification was negative in one hundred percent cases of confirmed malignancy and the cavitation with thick wall was seen in one hundred percent of confirmed malignancy. Air bronchogram was positive in all the cases of confirmed cases of malignancy. Increase in the size of more than 4 mm was confirmed to be malignant in one hundred percent of cases.

CONCLUSION

The different characteristic features of the presenting pulmonary nodules has been identified and discussed successfully. The different features once the lesions have been confirmed by PET and histopathological reports gives an extra edge of suspecting the cases early and also helps to diagnose the life-threatening diseases. The life-threatening diseases if diagnosed and evaluated early gives the physicians that extra precious time to respond to the needs of the patients and also in some cases to save the life of the patients.

KEYWORDS

Pulmonary Nodule, CT, Radiography, PET, Histopathology.

HOW TO CITE THIS ARTICLE: Kumar AR, Kumar BV, Rao USS, et al. CT scan evaluation of pulmonary nodule. J. Evid. Based Med. Healthc. 2016; 3(47), 2362-2366. DOI: 10.18410/jebmh/2016/521

INTRODUCTION: Pulmonary nodules are one of the common radiologic findings. Solitary pulmonary nodules are commonly isolated, spherical radiographic opacities that measure less than 3 cm in diameter and are surrounded by lung parenchyma.[1] Now a day these lesions are typically discovered incidentally. The simple chest radiography or computed tomography commonly called as CT is the modern tools where we find these lesions.

Financial or Other, Competing Interest: None.
Submission 06-04-2016, Peer Review 20-05-2016,
Acceptance 30-05-2016, Published 13-06-2016.
Corresponding Author:
Dr. A. Ravi Kumar,
Flat No. 106, C Block, Elite Avenue, Near Petrol Bunk,
Mydukur Road, Proddatur, Kadapa Dist.-516360,
Andhra Pradesh.
E-mail: ravikumararatluri@yahoo.com
DOI: 10.18410/jebmh/2016/521

The routine CT when carried out for some other reasons will incidentally find these lesions. The problem does not begin when the lesion is identified but instead it starts when the physicians must decide how to pursue an evaluation of a nodule once it has been identified. The lesions can be solitary or multiple. The term coin lesion is not used anymore because it implies a flat structure.[2] Any lung nodule has to be thought of as a three dimensional entity. Pulmonary nodules may be found incidentally on imaging studies of other parts of the body.[3]

Lung carcinomas are quite commonly diagnosed. Thanks to the ever increasing smokers' population. Majority of the city dwellers are at a higher risk of having this disease when compared to the village counterparts. The stigma through which the person and the family have to undergo before confirming the diagnosis is enormous. So the radiographic methods of diagnosing the malignancies have to improve. Before confirming the diagnosis, the radiologists, the treating physicians should be somewhat confident about the diagnosis so as to prepare the patients and their relatives for the most probable diagnosis before the confirmatory report. The confirmatory procedures include the PET scan and the Histopathology. Both are time consuming procedures and in an economy like ours, finding a PET scanning centre is rather difficult. So the most probable diagnosis has to be thought of using minimal resource.

In CT screening study, 13 percent of the smokers had pulmonary nodules larger than 5 mm at baseline.[4] 14.8 percent of all scans, although this included nodules smaller than 5 mm as well were reported in a study conducted by Furtado CD et al,[5] 8 to 51 percent incidence has been reported in different studies.[6,7] Lung cancer screening is not shown to prevent mortality.[8] The rationale for closely monitoring an incidentally found lesion is to monitor and prevent any undue effects of the disease.[9]

Commonest Causes of the Pulmonary Nodules Can be divided into Two Groups:

1. **Benign Causes:** Nonspecific granulomas, hamartomas and infectious granulomas.
2. **Malignant Causes Include:** Adenocarcinoma, Squamous Cell Carcinoma, Small Cell Carcinoma, Non-small Cell Carcinoma and Secondary Metastasis.

CT has a higher specificity and sensitivity than chest radiography.[2] It also allows for the assessment of surrounding structures. All patient who undergoes chest radiography and some lesions when identified should be evaluated with a CT. CT is the imaging modality of choice to re-evaluate pulmonary nodules seen on chest radiographs and to follow nodules on subsequent studies for change in size.[2] Chest CT resolution improves as slice thickness decreases; thus, thin cut sliced CT is preferred for evaluation of solitary pulmonary nodules.

Once the CT confirms then if the risk factors are more in favour of a malignancy, then PET is a non-invasive imaging study typically used in oncology for tumour diagnosis, staging, and assessment of response to therapy.

PET scan has a high sensitivity and specificity for evaluating nodules greater than 8 to 10 mm in diameter.[10] Magnetic resonance imaging (MRI) is not recommended for the evaluation of solitary pulmonary nodules, although they may be diagnosed incidentally by MRI. Even 5-6 mm lesions read on radiographs are not fool proof. One study showed that approximately 20 percent of non–small cell lung cancers were visualised retrospectively on radiographs initially interpreted as normal.[11] This study puts in a sincere effort to understand and evaluate the pulmonary nodule when identified by a CT scan. This paper is intended to help the practicing radiologists and also make life easy for a practicing physician to identify correctly the lesions and also help the patients to prevent further progression of the disease.

AIMS AND OBJECTIVES:

- To understand and evaluate the pulmonary nodules identified by CT scan.
- To identify the different radiological features in benign and malignant lesions that has been confirmed by PET or Histopathology.

MATERIALS AND METHODS: The study was a cross-sectional study. The sample size of the study consisted of thirty patients. CT scan was done in thirty patients who were identified to have lung nodules either by other mode of radiological studies or first time identified in a CT scan itself. The study was conducted in Fathima Institute of Medical Sciences, Kadapa. The study was conducted from 2014 to 2015. The patients who had other risk factors associated or who had lesions larger than 8 mm size were asked to undergo PET scan or histopathological study. The PET scan or histopathological study confirmed cases were evaluated for the CT scan lesions and has been reported.

RESULTS:

Physical Property	Solid Nodule	Non-Solid Nodule
Frequency	09 (05 Malignant lesions 04 (Non- Malignant Lesions)	16 (All Adenomas)

Table 1: Frequency of Physical Property of Nodules Encountered

Size of the Nodule	1-4 mm	4-8 mm	>8 mm
Benign	4 (Infectious cause)	Nil	Nil
Malignant	Nil	1 (Squamous cell))	4 (2 Small cell, 1 Giant cell and 1 Squamous Cell Carcinoma.)

Table 2: Evaluation of Solid Nodule Based upon the Size (After confirmation by PET/Histopathology)

Margin of the Lesion	Regular and Smooth	Spiculated
Benign	4 (All Infectious)	Nil
Malignant	Nil	5 (2 Small cell, 1 Giant cell and 2 Squamous Cell Carcinoma.)

Table 3: Evaluation of Solid Nodule Based upon the Margin of the Lesions (After Confirmation by PET/Histopathology)

Contour of the Lesion	Non- Lobular	Lobular
Benign	3 (Infectious)	1 (Infectious)
Malignant	Nil	5 (2 Small cell, 1 Giant cell and 2 Squamous Cell Carcinoma.)

Table 4: Evaluation of Solid Nodule Based upon the Contour of the Lesions (After Confirmation by PET/Histopathology)

Sign	Halo Sign Positive	Halo Sign Negative
Benign	4 (Infectious)	Nil
Malignant	1 (Giant Cell)	4 (2 Small Cell, 2 Squamous Cell Carcinoma)

Table 5: Evaluation of Solid Nodule Based upon the Halo Sign (After Confirmation by PET/Histopathology)

Calcification	Irregular	Bull's Eye Pattern
Benign	3 (Infectious)	1 (Infectious)
Malignant	Nil	Nil

Table 6: Patterns of Calcification (After Confirmation by PET/Histopathology)

Cavitation Pattern	Cavity Positive with Smooth Thin Walls	Cavity positive with thick irregular walls
Benign	4 (Infectious)	Nil
Malignant	Nil	5 (2 Small Cell, 1 Giant Cell And 2 Squamous Cell Carcinoma).

Table 6: Patterns of Cavitation (After Confirmation by PET/Histopathology)

Air Bronchogram Sign	Positive	Negative
Benign	Nil	4 (Infectious)
Malignant	5 (2 Small Cell, 1 Giant Cell and 2 Squamous Cell Carcinoma).	Nil

Table 7: Air Bronchogram Sign (After Confirmation by PET/Histopathology)

Sub-Solid Nodules	Diagnosis
16	Adenocarcinoma

Table 8: Sub-solid Nodules

Image 1: CT Showing Bulls Eye Pattern of Calcification

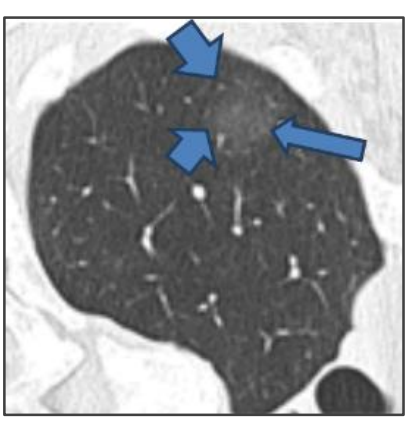

Image 2: Sub-Solid Adenocarcinoma

Image 3: Typical Carcinoma lung. Spiculated, Solid Lesion with a Halo Negative Lesion

Increase in Size	1 mm <4 mm	>4 mm
Benign	4	NIL
Malignant	Nil	5

Table 9: Increase in Size of the Lesion (<8 mm Originally)

Fig. 1

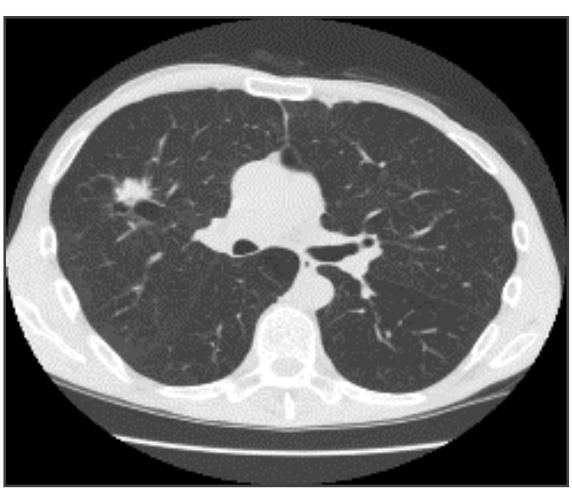

Fig. 2

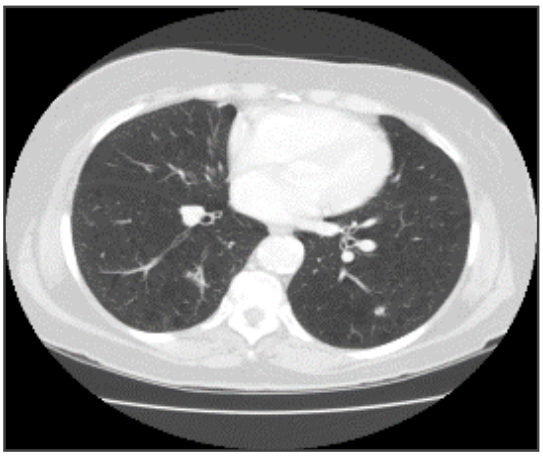

Fig. 3

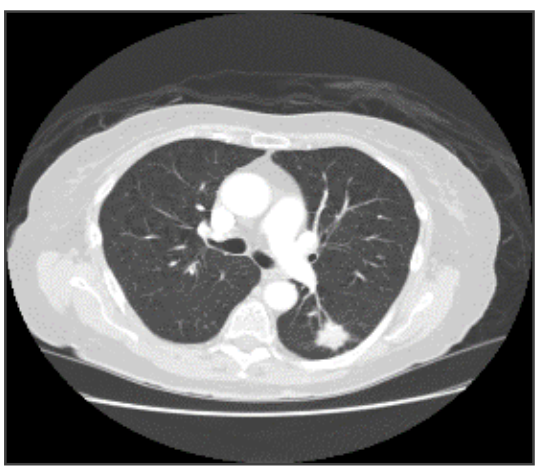

Fig. 4

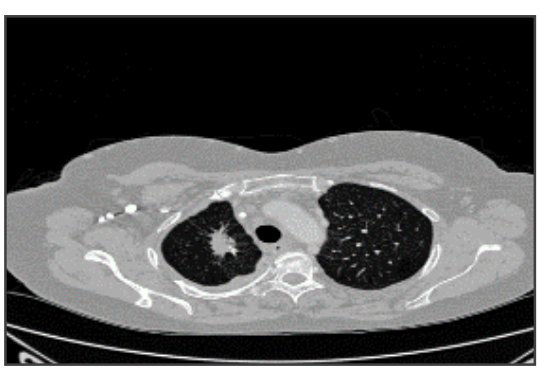

Fig. 5

DISCUSSION: In the present study, non-solid nodules were more in number when compared to the solid nodules. All the non-solid nodules were confirmed to be adenomas. Eighty percent of the nodules which were more than 8 mm in size were confirmed to be malignant. One hundred percent of the spiculated border on CT was confirmed to be malignant. In the present study, the lobulated mass was confirmed to be malignant in one hundred percent of cases. One case that was of infectious origin was also lobulated in appearance. In eighty percent of the confirmed malignant cases, the halo sign was negative. Calcification was negative in one hundred percent cases of confirmed malignancy and the cavitation with thick wall was seen in one hundred percent of confirmed malignancy.

Air bronchogram was positive in all the cases of confirmed cases of malignancy. Increase in the size of more than 4 mm was confirmed to be malignant in one hundred percent of cases. Solid and semi-solid pulmonary nodules are detected with increasing frequency. This may be because of the widespread use of CT scan. Although most such nodules are benign, lung cancer is a clinically important entity in the differential diagnosis of pulmonary nodules. In a developing economy like ours, it should be made mandatory to have a screening test and save as many lives as possible. To ensure that appropriate treatment is initiated in a timely way, the aim in evaluating pulmonary nodules is to correctly differentiate malignant and benign lesions. Clinical assessment of patients' risk factors for malignancy, including age, smoking history, and history of malignancy, is important.

In India, majority of the young population smokes and this is not going to show effects immediately but as the population begins to age, it always turns out to be unnecessary avoidable burden. In terms of imaging evaluation, obtaining prior radiographs or chest CT images is useful to determine nodule growth. Further imaging evaluation, including CT enhancement studies and PET/CT, helps determine the malignant potential of solid pulmonary nodules. For solid nodules, CT enhancement of less than 15 HU and low or no glucose which has been tagged with radio-active isotope uptake at PET/CT suggest benignity. Awareness of potential pitfalls in nodule enhancement and PET/CT evaluation of pulmonary nodules that result from infectious or inflammatory conditions is important to avoid misinterpreting imaging findings. The unnecessary tension has to be avoided in the patients and their family by bringing down the possibilities of the false negativity. For subsolid nodules, CT enhancement studies are not applicable, and PET imaging is of limited use because of their low metabolic activity.

Because of the likelihood that persistent semi-solid nodules represent adenocarcinomas with indolent growth, serial imaging reassessment for a minimum of two years and obtaining tissue samples for histologic analysis are recommended. At imaging follow-up of semi-solid nodules, growth manifesting as an increase in size, an increase in attenuation, development of a solid component, or an increase in the size of a solid component is suspicious for malignancy. Stratified according to patient risk factors for malignancy and nodule characteristics, evidence-based clinical guidelines and recommendations for the evaluation of solid and semi-solid pulmonary nodules are useful in decision analysis. These management algorithms will continue to evolve as data from the lung cancer screening trials are analysed and further studies are performed.

CONCLUSION: The different characteristic features of the presenting pulmonary nodules has been identified and discussed successfully. The different features once the lesions have been confirmed by PET and histopathological reports gives an extra edge of suspecting the cases early and also helps to diagnose the life-threatening diseases.

The life-threatening diseases if diagnosed and evaluated early gives the physicians that extra precious time to respond to the needs of the patients and also in some cases to save the life of the patients.

REFERENCES

1. Tuddenham WJ. Glossary of terms for thoracic radiology: recommendations of the nomenclature committee of the Fleischner society. AJR Am J Roentgenol 1984;143(3):509-517.
2. Gould MK, Fletcher J, Iannettoni MD, et al. Evaluation of patients with pulmonary nodules: when is it lung cancer? ACCP evidence-based clinical practice guidelines (2nd edn). Chest 2007;132(suppl 3):108S-130S.
3. Holin SN, Dwork RE, Glaser S, et al. Solitary pulmonary nodules found in a community-wide chest roentgenographic survey. Am Tuberc Pulm Dis 1959;79(4):427-439.
4. Henschke CI, Yankelevitz DF, Libby DM, et al. Survival of patients with stage I lung cancer detected on CT screening. N Engl J Med 2006;355(17):1763-1771.
5. Furtado CD, Aguirre DA, Sirlin CB, et al. Whole-body CT screening: spectrum of findings and recommendations in 1192 patients. Radiology 2005;237(2):385-394.
6. Gohagan J, Marcus P, Fagerstrom R, et al. Baseline findings of a randomized feasibility trial of lung cancer screening with spiral CT scan vs chest radiograph: the lung screening study of the national cancer institute. Chest 2004;126(1):114-121.
7. Swensen SJ, Jett JR, Hartman TE, et al. Lung cancer screening with CT: mayo clinic experience. Radiology 2003;226(3):756-761.
8. Bach PB, Silvestri GA, Hanger M, et al. Screening for lung cancer: ACCP evidence-based clinical practice guidelines (2nd edn). Chest 2007;132(suppl3):69S-77S.
9. Steele JD, The solitary pulmonary nodule. Report of a cooperative study of resected asymptomatic solitary pulmonary nodules in males. J Thorac Cardiovasc Surg 1963;46:21-39.
10. Gould MK, Maclean CC, Kuschner WG, et al. Accuracy of positron emission tomography for diagnosis of pulmonary nodules and mass lesions: a meta-analysis. JAMA 2001;285(7):914-924.
11. Quekel LG, Kessels AG, Goei R, et al. Miss rate of lung cancer on the chest radiograph in clinical practice. Chest 1999;115(3):720-724.