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Original article

Radiography and computed tomography findings in evaluation of solitary pulmonary nodule: A descriptive study from Maharashtra

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Abstract

Introduction: Solitary pulmonary nodule is a single radiological, round, well circumscribed opacity with ≤ 3 cm in diameter. It is characterized by being completely surrounded by pulmonary parenchyma, and is not associated with atelectasis, lymph node enlargement, pneumonia and pleural effusion. Nowadays with increased utilization of computed tomography (CT) greater numbers of nodules are being discovered which fall into indeterminate category. **Objectives:** To study the chest radiography and computed tomography findings in evaluation of solitary pulmonary nodule. **Methodology:** The present descriptive observational study was carried out at Department of radiodiagnosis, Dr. N Y Tasgaonkar Medical College and Hospital Karjat, Maharashtra involving 50 cases referred to radiodiagnosis department for chest x-ray and CT scan for evaluation of SPN. **Results:** We included total 50 patients in our study. Majority of them were from 51-60 years age group i.e. 16(32%) Majority of our study participants were male i.e. 90% and 10% were females. Radiological diagnosis of SPN revealed Infective etiology in 20%, granuloma in 20%, metastasis in 26%, pneumonia in 12% and hamartoma and sarcoidosis in 8% each Radiological findings revealed prevalence of benign SPN in 74% cases and malignant SPN in 26% cases CT

report showed that benign calcification in 34% patients and stippled calcification in 6% cases. **Conclusion:** Commonly observed site of SPN was central and peripheral in 50% of cases. On CT malignancy was commonest observed etiology of SPN (32%). On X ray, granuloma and infective etiology was commonest finding in evaluation SPN (20%).

Key words: Solitary pulmonary nodule, radiology, CT findings

Introduction

Solitary pulmonary nodule is a single radiological, round, well circumscribed opacity with ≤ 3 cm in diameter. It is characterized by being completely surrounded by pulmonary parenchyma, and is not associated with atelectasis, lymph node enlargement, pneumonia and pleural effusion.[1] Lesions are subdivided according their size, so lesions < 8-10 mm (subcentimeter nodules) present with lower probability of malignancy and have different recommendations for investigation as compared with larger solitary pulmonary nodules. [2]

The classical definition of indeterminate solitary pulmonary nodule - a potentially malignant lesion - refers to pulmonary nodules that do not meet the typical radiological criteria of benignity. [3]

The term "pulmonary mass" is currently utilized for pulmonary lesions > 3 cm in diameter, whose likelihood of malignant disease is considerably increased.[2]

A lung nodule has been defined by the Nomenclature Committee of the Fleischner Society as a rounded opacity, well or poorly defined on a conventional radiograph, measuring up to 3 cm in diameter. Further subdivisions of nodules are defined as acinar, which usually measures

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5–8 mm in diameter and is presumed to represent consolidation in an acinus. On computed tomography (CT) scan, a nodule appears as a rounded or irregular opacity, well or poorly defined, measuring up to 3 cm in diameter.[4]

Solitary pulmonary nodule (SPN) is found incidentally on imaging studies unrelated to the respiratory system in 0.09–0.2% of all chest radiographs. Opacity less than 3 mm is defined as a micronodule. Mimics of pulmonary nodules include pseudonodules, which represent a rib fracture, a skin lesion, a device outside the patient, anatomic variants, or composite areas of increased opacity.[5] SPN is seen more often on CT scans. The overall reported incidence of SPN is 8–51%.[6,7]

Nowadays with increased utilization of computed tomography (CT) greater numbers of nodules are being discovered which fall into indeterminate category. According to the American College of Chest Physicians the term “indeterminate” describes a nodule that does not show a benign pattern of calcifications and has not been stable in size after >2 years of follow-up, therefore cannot be immediately categorized into benign or malignant group.[8]

Objectives: To study the chest radiography and computed tomography findings in evaluation of solitary pulmonary nodule.

Materials and Methods

Study setting: Department of radiodiagnosis, Dr. N Y Tasgaonkar Medical College and Hospital Karjat, Maharashtra.

Study population: Patients referred to radiodiagnosis department for chest x-ray and CT scan for evaluation of SPN

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Study period: January to July 2024

Study design: Descriptive observational study.

Sample size: 50

Sampling technique: Simple random sampling method

Inclusion criteria:

- All the patients with history of increased risk of developing solitary pulmonary nodule.
- Patient willing to give informed consent
- Patients of all age group & both sexes are included.

Exclusion criteria:

- Patients contraindicated for CT in case of pregnancy

Variables used in study: Age, gender, SPN, chest X ray, CT findings

Methods of data collection:

Detailed history with special reference to age; sex; smoking habit; exposure to TB / STD; occupational risk and exposure to asbestos, nickel, chromium, polycyclic hydrocarbon; previous history of TB / pulmonary mycosis, DM, immunosuppressive disease / drugs was obtained.

A thorough clinical examination with special attention to respiratory system, para-neoplastic syndromes and signs of metastasis was done. All other systems, specially, GI tract, prostate, testis, kidney, thyroid and breast & pelvis in females were carefully examined for primary lesion.

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Sputum – Gram stain; AFB stain; fungal KOH stain; bacterial C/S; mycobacterium TB Culture- L-J medium or Liquid culture medium; fungal culture in sabourand agar medium; malignant cell examination was done.

Chest x-ray – PA view mostly, with occasional lateral view and digital enhancing x-ray as needed- size of lesion, growth rate, margin characteristics, calcification pattern were looked into for assessment and differentiation between benign / infective / malignant lesions.

CT thorax – Better visualisation and appreciation of nodule / mass is possible in CT thorax. No. and size; calcification pattern; staging for malignancy; densitometry of lesion; contrast enhancement; wall thickness; positive vessel sign was noted for differentiation between benign / infective / malignant lesions.

Statistical analysis and methods-

Data was collected by using a structure proforma. Data thus was entered in MS excel sheet and analysed by using SPSS 24.0 version IBM USA. Qualitative data was expressed in terms of percentages and proportions. Quantitative data was expressed in terms of Mean and Standard deviation. Association between two qualitative variables was seen by using Chi square/ Fischer's exact test. Comparison of mean and SD between two groups will be done by using unpaired t test to assess whether the mean difference between groups is significant or not. Descriptive statistics of each variable was presented in terms of Mean, standard deviation, standard error of mean. A p value of <0.05 was considered as statistically significant whereas a p value <0.001 was considered as highly significant.

Results

Fig 1: Bar diagram showing Distribution according to age

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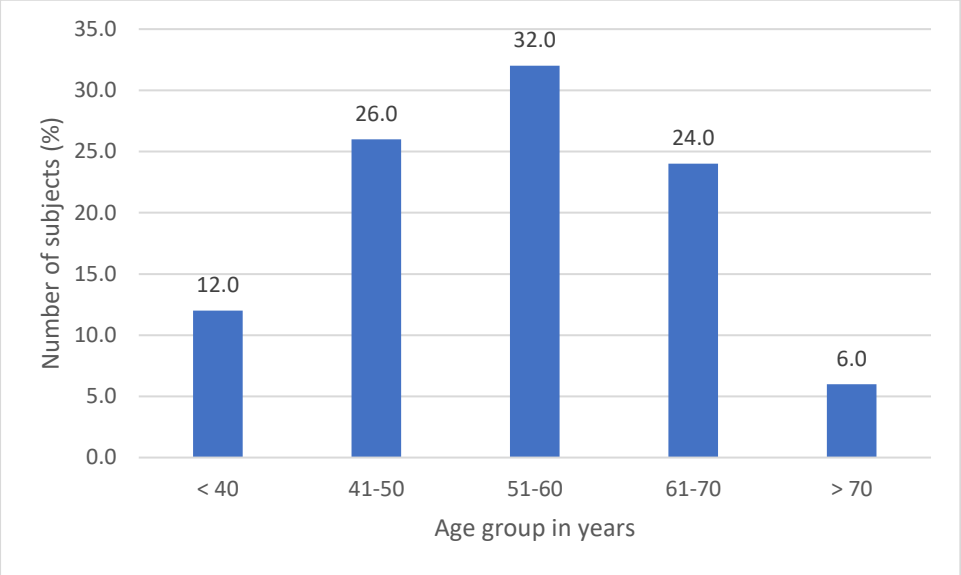

We included total 50 patients in our study. Majority of them were from 51-60 years age group i.e. 16(32%) followed by 13(26%) from 41-50 years, 12(24%) from 61-70 years, 6(12%) from less than 40 years and 3(6%) from above 70 years age group. Mean age of the study population was 53.78±13.23 years.

Majority of our study participants were male i.e. 90% and 10% were females.

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Table 1: Distribution according to radiological diagnosis

		Frequency	Percent
Radiological diagnosis	Granuloma	10	20
	Hamartoma	4	8
	Infective	10	20
	Lung abscess	1	2
	Malignant	13	26
	Mucoid impaction	1	2
	Round pneumonia	6	12
	Sarcoidosis	4	8
	TB granuloma	1	2
	Total	50	100

Radiological diagnosis of SPN revealed Infective etiology in 20%, granuloma in 20%, metastasis in 26%, pneumonia in 12% and hamartoma and sarcoidosis in 8% each

Table 2: Distribution according to radiological diagnosis

		Frequency	Percent
Radiology impression	Benign	37	74.0
	Malignant	13	26.0
	Total	50	100.0

Radiological findings revealed prevalence of benign SPN in 74% cases and malignant SPN in 26% cases

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Table 3: Distribution according to X ray report showing calcification

		Frequency	Percent
x-ray report	Yes	12	24.0
	No	38	76.0
	Total	50	100.0

X ray report showed calcification in 12 patients i.e. 24%.

Table 4: Distribution according to CT location of nodule

		Yes		No	
Location of nodule on CT	Right UL	19	38.0	31	62.0
	Right ML	2	4.0	48	96.0
	Right LL	7	14.0	43	86.0
	Left UL	13	26.0	37	74.0
	Left LL	9	18.0	41	82.0
	Central	25	50.0	25	50.0
	Peripheral	25	50.0	25	50.0

The site if SPN was found central and peripheral in 50% of cases. This is followed by Right Upper lobe in 38% cases, left upper lobe in 26%, left lower lobe in 18% cases.

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Table 5: Distribution according to CT report showing calcification

		Frequency	Percent
CT report	Benign calcification	17	34
	Stippled calcification	3	6
	No calcification	30	60

CT report showed that benign calcification in 34% patients and stippled calcification in 6% cases.

Discussion

Age and sex:

In this study the average age was 53.7 years, which was quite similar to other studies. Both infective and malignant causes rise with increasing age. It is now more common to come across cases of carcinoma of lung from fifth decade onwards with increasing environmental pollution and smoking habits.

In this study, male patients were in overwhelming majority. Only 5 female patients were present in our study out of which three were diagnosed with infective etiology and two people were diagnosed with malignancy.

Diagnosis and evaluation of SPN on radiology

In our study, CT evaluation of SPN etiology was found to be malignant in 16(32%), infective in 14 patients (28%), idiopathic in 18%, inflammatory in 8% and benign in 6% cases. Radiological diagnosis of SPN revealed Infective etiology in 20%, granuloma in 20%, metastasis in 14%, malignancy and pneumonia in 12% each. Radiological findings revealed prevalence of benign SPN in 74% cases and malignant SPN in 26% cases. CT report showed that benign calcification in 34% patients and stippled calcification in 6% cases. X ray report showed calcification in 12 patients i.e., 24%.

Henschke et al[9] reviewed the distribution of SPN of lung cancers diagnosed in repeat annual CT screening check-ups in the International Early Lung Cancer Action Program (I-ELCAP. The most common type of cancer was adenocarcinoma (50%), followed by squamous cell carcinoma (19%), small cell carcinoma (19%) and others. 99 of the 111 cancers demonstrated as solid nodules (of all cell types), and only 12 manifested as subsolid lesions (exclusively adenocarcinomas). Lung cancers appearing as subsolid nodules were found to have significantly longer VDTs than solid lung cancers. The main conclusion of the study was that VDTs of lung cancers identified by CT screening and of those detected incidentally in the absence of screening, are quite similar.

A study by **Naidich *et al***[10] found that all lesions with a wall thickness of 1 mm were benign. Among tumors with wall thickness between 5 and 15 mm, 51% were benign, whereas with wall thickness over 15 mm, 95% were malignant.

Görich J et al[11] examined 100 cavitating lung masses by CT with histopathological correlation. Three pathological subsets were identified: bronchial carcinomas, lung metastases, and benign lesions. The incidence of cavitation was significantly higher in malignant tumors.

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Cavitation in malignant tumors was thick walled and often associated with radiation of tumor tissue, mediastinal lymphadenopathy, ipsilateral displacement of the mediastinum, and intrapulmonary satellite foci and infiltration of the thoracic wall. Primary tumors were distinguished from metastases by their ill-defined outer contours. Eighty per cent of cavitating lung tumors were squamous cell carcinomas, the remaining 20% consisted of adenocarcinomas and large cell carcinomas. Small cell carcinomas practically never show cavitation.

Xu DM et al[12] retrospectively evaluated 372 SPNs to investigate whether baseline nodule density or changes in density or nodule features could be used to discriminate between benign and malignant solid indeterminate nodules. They concluded that baseline nodule density and changes in nodule features cannot be used to discriminate between benign and malignant solid indeterminate pulmonary nodules, but an increase in density is suggestive for malignancy and required a shorter follow-up or a biopsy.

Yi CA et al[13] studied 131 patients with SPNs to evaluate enhancement dynamics of SPNs at multidetector row CT and to correlate results with extent of tumor angiogenesis in pathologic specimens. Their study revealed that dynamic enhancement with multidetector row CT shows high sensitivity and negative predictive values for diagnosis of malignant nodules but low specificity because of highly enhancing benign nodules. They showed that the extent of enhancement reflected the underlying angiogenesis, which is considered an indicator of malignancy in SPNs.

Jeong et al[14] studied 107 patients with SPNs by analyzing combined wash-in and wash-out characteristics at dynamic contrast-enhanced multidetector row CT showed 92% accuracy for distinguishing benign nodules from malignant nodules.

Bayraktaroglu et al[15] drew a similar conclusion in their study of 45 SPNs where there was a significantly greater enhancement in malignant nodules than in benign ones. Lung nodule enhancement of 15 HU or less strongly indicates benignity.

Conclusion:

- SPN was commonly seen in 41-60 years age group (58%)
- SPN was commonly seen in males (90%)
- Commonly observed site of SPN was central and peripheral in 50% of cases.
- On CT malignancy was commonest observed etiology of SPN (32%)
- On X ray, granuloma and infective etiology was commonest finding in evaluation SPN (20%)

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