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Original Article

Computed tomography and PET/CT features of pulmonary hamartomas

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Abstract

Introduction: In this study, we aimed to examine the computed tomography (CT) and 18F-fluorodeoxyglucose positron emission tomography/computerized tomography (FDG PET/CT) findings of the pulmonary hamartomas.

Methods: Following surgical excisional, transbronchial, or transthoracic biopsy, histopathologically proven pulmonary hamartomas were retrospectively reviewed between 2007 and 2013. The CT and PET/CT images were interpreted regarding the lesion diameter, number, location, components, and standardized uptake values (SUVmax).

Results: A total of 22 hamartomas including 2 endobronchial and 20 parenchymal hamartomas were detected in 21 patients (11 males and 10 females). Among them, one patient had both endobronchial and parenchymal lesions. Right lung involvement (63.7%) was more common than left lung (36.4%) and upper lobes involvement (50%) than lower lobes (25%). Of all lesions, 54.5% had smooth margins while 40.9% had lobulated contour and 4.5% had irregular margins. Fat density was observed in 54.5% and calcification in 40.9%. In 18.2% of the lesions neither fat density nor calcification was seen. There was no FDG uptake in 5 lesions. Mean SUVmax value was 1.6±1.0 (range between 0 and 3,2). A SUVmax value > 2.5 was observed in 5 lesions.

Conclusion: Our results were generally consistent with previous reports, but we found a higher female/male ratio and a more common upper lobes involvement of pulmonary hamartomas.

Introduction

Pulmonary hamartoma is the most common benign tumor of the lung which is composed of various amounts of cartilage, bone, calcification, fat, fibromyxoid tissue, and muscle. Its incidence in general population is 0.25% and accounting for 6% of solitary pulmonary nodules.[1] They are usually seen as peripheral parenchymal solitary pulmonary nodules with smooth margins; however, rarely endobronchial hamartomas can be detected. Computed tomography (CT) is the most important imaging modality to detect calcifications and adipose tissue within the lesion.[2] In this study, we aimed to present CT and 18F-fluorodeoxyglucose positron emission tomography/computerized tomography (FDG PET/CT) features of histopathologically proven hamartomas in our institution.

Materials and methods

Patients who were histopathologically diagnosed with intrathoracic hamartoma between 2008 and 2013 and had both thoracic CT and PET/CT examinations before surgery or biopsy were included in this retrospective study. Data were gathered from the hospital database, and radiology and nuclear medicine department records. The patients who have comorbid conditions such as malignancy, infectious disease, systemic diseases affecting lungs, and a previous thoracic surgery history were excluded from the study. Demographical data including age and gender of the patients were recorded.

All the procedures followed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Biopsy Techniques

The methods used to obtain the specimens for the histopathological examination were analyzed. The number of patients who underwent a surgical excisional biopsy, a transthoracic needle biopsy, or a transbronchial cryobiopsy were calculated.

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CT Technique

CT images were acquired using Somatom Emotion 6 scanner (Siemens Medical Systems, Forchheim, Germany), with a 6x3 mm collimation, a pitch of 0.75, and a reconstruction thickness of 10 mm. An intravenous iodine contrast agent (ioheksol-300) was used in all patients with a dose of 1.3-1.5 ml/kg. Image withdrawal was started at 40 sec. Two radiologists with 15 and 12 years of experience in thoracic imaging, interpreted the images regarding the features below.

CT Features

The maximal dimensions of the lesions on axial, coronal, or sagittal reformatted images were measured. Lesions located in lung parenchyma were described as intraparenchymal and the ones arising from the bronchus as endobronchial hamartomas.

The location of the lesions were determined as right/left hemithorax and also as upper/middle/lower lobes.

The lesions were identified as with smooth margins if it is well-circumscribed with no lobulation. Lobulated lesions were described as a lesion with one or more lobulation with regular margins. The lesions with not regular margins were identified as with irregular margins.

The lesions that had focal or diffuse hypodense (< -40 HU) areas were described as a fat-containing hamartoma.

The punctate calcifications in the lesions were described as micro and the coarse and pop-corn shaped ones were identified as macrocalcifications. Lesions were evaluated regarding micro/macrocalcifications.

FDG PET/CT Imaging

Whole-body 18F-DG PET/CT was performed using dedicated PET/CT scanner, Siemens, Biograph-6-HI-REZ (Siemens Medical Solutions, Knoxville, TN USA). All patients had to fast at least 6 hours before the examination. After confirmation of an acceptable peripheral blood glucose level (<180 mg/dL), patients were given an intravenous injection of 370-555 MBq (10-15 mCi) FDG and rested for 60 minutes before the scanning. PET data were acquired from the top of skull to mid-thigh with the arms up position at 6–8 fields of view (3 min/field). CareDose (Siemens) CT scan was performed with automatic real time dose modulation amperage. The CT scan was used for attenuation correction of PET data and images were reconstructed using a standard iterative algorithm. The SUVmax value of the lesions measured on PET-CT was recorded.

Ethical approval

This retrospective observational study was approved by the institutional review board of our institution with the number of 005078 on the 22.08.2013. No written informed consent could be obtained from reviewed subjects due to the retrospective nature of the investigation.

Statistical analysis

Descriptive statistics for studied variables (characteristics) were presented as the mean ± standard deviation, minimum and maximum values.

Results

A Total of 22 histopathologically proven (Figure 1) hamartomas in 21 patients (A total of 22 hamartomas including 2 endobronchial and 20 parenchymal hamartomas were detected in 21 patients (11 males and 10 females). Among them, one patient had both endobronchial and parenchymal lesions.) were included in this study. The mean age of the patients was 53±11.73 (range between 31-74 years) and the male (n:10) /female (n:11) ratio was 0.91.

Diagnostic Work-up

For the 22 lesions, the diagnosis was made based on histopathological examination of the specimens obtained from transbronchial cryobiopsy in 2 lesions(9.1%), transthoracic needle biopsy in 4 lesions(18.2%) (Figure 2), and surgical excision in remained 16 (72.7%) ones.

The sizes of the lesions

The mean of the largest dimension of the lesions was 26.05±11.49mm (range between 10-60 mm).

Parenchymal-endobronchial

Twenty parenchymal (90.9%) and two endobronchial lesions (9.1%) were detected. Among 21 patients, a solitary parenchymal hamartoma lesion was detected in 19 (90.1%), a solitary endobronchial in one patient (4.8%), and a solitary parenchymal plus a solitary endobronchial in remained one patient (4.8%) (Figure 3).

Right-Left Lung

The hamartoma was located in right lung in 14 (63,7%)

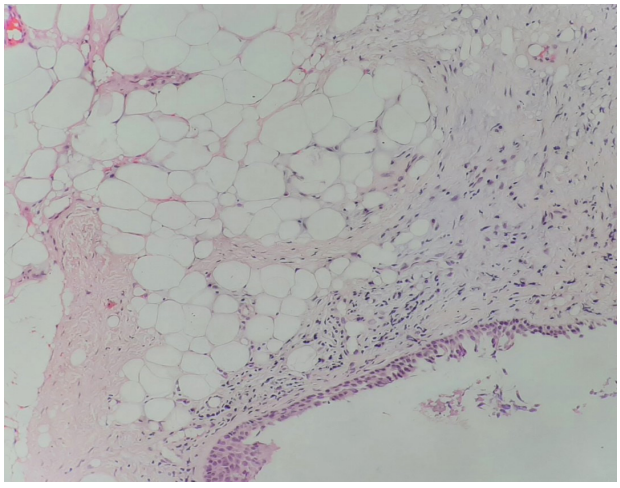

Figure 1: Histopathological appearance of a pulmonary hamartoma with adipose tissue adjacent respiratory epithelium (HEX200)

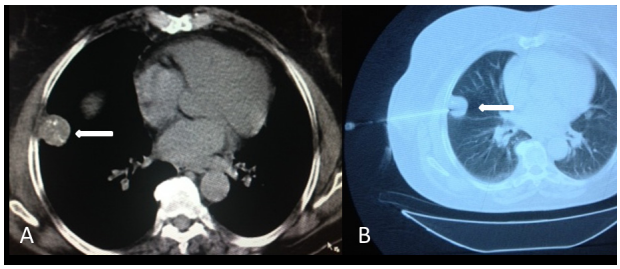

Figure 2: Axial CT image demonstrates a peripheral located lesion with smooth margins havingcoarse calcifications- fat density (A). Computed tomography guided transthoracic fine needle biopsy of the lesion is seen (B)

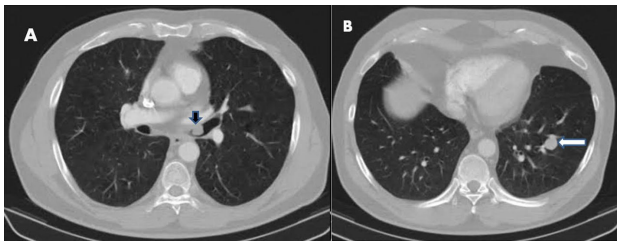

Figure 3: Axial CT image shows an endobraonchial lesion within left main bronchus (A) (Arrow) and a parenchymal hamartoma in left lower lobe (B) (Arrow) in the same patient

and in left lung in 8 (36,4%) patients as it was detected markedly higher in right lung than left lung.

Among 20 pulmonary parenchymal lesions, 10 (50.0%) were seen in upper lobes, 5 (25.0%) in lower lobes and 5 (25.0%) in middle lobe of right lung. The most common involved lobe was right upper lobe (n:6, 30.0%) and hamartoma was detected less in left lower lobe (n:2, 10.0 %).

Of the two endobronchial hamartomas, one was seen in the left main bronchus(50.0%) and the other one in the left upper lobe bronchus (50%). All the endobronchial hamartomas were seen on left side.

Solitary-Multiple

We detected solitary lesions in 20 (95.2%) patients while two lesions in one patient. We did not observe multiple lung parenchymal lesions in patients but detected a left lung paranchymal and a left endobronchial hamartoma in a 59 year-old male.

Margin Characteristics of Lesions

Among 22 lesions, 12 (54.5%) of them had a smooth oval or round margin without lobulation.Nine (40.9%) had lobulated contours while one (4.5%) had irregular margins. One of the endobronchial lesions had smooth margins without lobulation while the other one had a lobulation.

Fat content

Of the 22 lesions, 12 lesions (54.5%) contained various amounts of fat and the remained 10 (45.5%) did not have fat component. All the two endobronchial hamartomas contained fat in this study.

Calcification

Calcification was observed in 9 (40.9%) lesions while 13 lesions (59.1%) had no calcification. Among 9 calcifications, 7 (77.8%) of them were macro- and 2 (22.2%) were microcalcifications. Six macro and 2 microcalcifications were detected within parenchymal hamartomas. Macrocalcification was seen in one of two endobronchial lesions.

Three (13.6%) lesions had both fat content and calcifications while two of them was intraparenchymal and the remained one was endobronchial hamartoma. Fifteen (68.2%) lesions had either fat or calcification. Among these 15 lesions, 13 were intraparenchymal and two of them were endobronchial hamartomas. Four (18.2%) lesions had neither fat nor calcification while all of them was intraparenchymal lesions.

PET-CT Results

There was no FDG uptake in 5 lesions. Average SUVmax value in remained 17 lesions (range between 0.91-3.20) was 2.09±0.6. Among 17 lesions, SUVmax values were <1 in one, 1-2 in 8 and >3 (Figure 4) in one patient. There was no uptake in one endobronchial lesion while the SUVmax value was 2.64 in the other endobronchial hamartoma.

Discussion

Pulmonary hamartoma is the most commmon benign lesion of the lungs in adults which contains a mixture of various amounts of mesenchymal structure including muscle, bone, cartilage, adipose, and fibromyxoid tissues.[3] Although it can be seen in all age groups, most of them

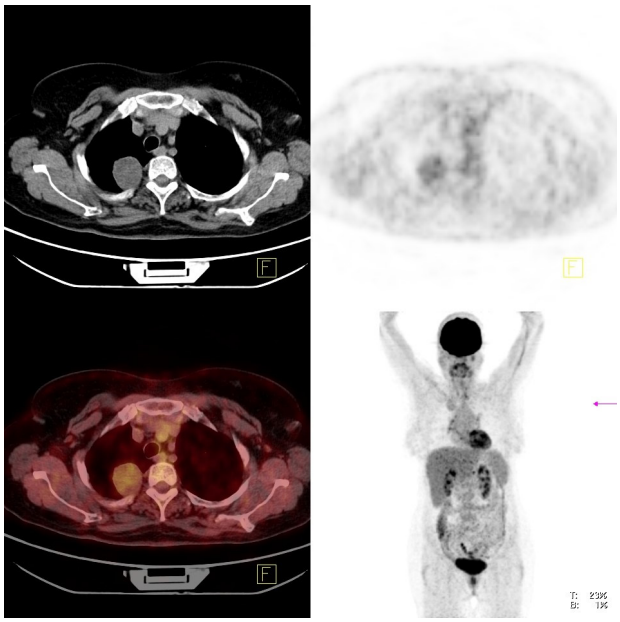

Figure 4: PET-CT image shows increased FDG uptake (SUVmax:3.2) of a 4 cm lesion in upper lobe of right lung

are detected in sixth or seventh decades of life.[4] Consistent with previous studies, the mean age was 53.0 ± 11.45 in our study. Previous studies suggested a 1.6-4 fold male predominance of pulmonary hamartoma.[5,6] But in our study female (n:10) and male (11) patient numbers were very close as the male/ female ratio was 1.1.

In a study by Esme et al[5] histopathological diagnosis was made after surgical excision in 16 (66.7%), transthoracic fine needle biopsy in 6 (25.0%) and bronchoscopic biopsy in 2 (8.3%) of their 24 patients. Similarly in our study, most of lesions (n: 16, 72.8%) were diagnosed with the histopathological evaluation of the surgical excision; while four of them were diagnosed with a transthoracic needle biopsy and two of them with a transbronchial cryobiopsy. All four lesions underwent a transthoracic needle biopsy located peripherally within the lungs. One of the two endobronhcial hamartomas underwent transbronchial cryobiopsy and was detected within left main bronhcus and the other one was within left upper lobe bronchus.

It is reported that hamartomas can vary in diameter from a few millimeters to 20 cm.[7] In a study, the mean diameter of 19 hamartomas was 2 ±2.14 (0.5–13 cm).[8] Lien et al[6] reported a mean diameter of 62 hamartomas in their study as 1.8 cm (range between 0.5-5 cm) Consistent with previous studies, the mean diameter of the lesions was 26.05± 11.49 mm (range between 10-60 mm). The average diameter of two endobronhcial hamartomas in our study was 14.0 mm.

It was reported that approximately 90% of pulmonary hamartomas were parenchymal and 10% were endobronchial.[9] Lien et al[6] reported 4 (6.4%) endobroncial and 58 (93.6%) parenchymal hamartomas in their study. In our study, 20 of 22 lesions were located in the lung parenchyma and remained two lesions were within the bronchus. Our endobronchial/parenchymal lesion ratio (10%) was compatible with previous studies.

Lien et al[6] reported 30 right (51.7%) and 28 left (48.3%) lesions. Esme et al[5] also reported 17 right (70.8%) and 7 left (29.2%) lung involvement in their patients with hamartoma. Haberal et al[10] observed right lung involvement in 16 (66.7%) and left involvement in 8 (33.3%) patients among their 24 patients. Similarly, we detected 14 right (63.7%) and 8 (36.4%) left side located hamartomas in this serie. Cosío et al[11] identified 43 endobronchial hamartomas in their patients. Among them, 4 (9.3%) were located in trachea, 19 (44.2%) in right main bronchus and its branches, 20 (46.5%) in left main bronchus and its branches. The left and right side involvement rates were very close. The most common involved tracheobroncial tree parts were bilateral upper lobe bronchus and their branches (n:8 for right (18.6%) and n:8 for left (18.6%)). The left main bronchus hamartoma was detected in 6 (13.6%) cases. In our study, no tracheal or right-sided endobronchial hamartoma was seen. One of the two endobroncial hamartomas was located in left main (50.0%) and the other one in the left upper lobe bronchus (50.0%). Although the case number is very small, this data can support the upper lobe bronchus involvement predominance in the patients with hamartoma. It is also compatible with previous study which reported frequent (n:6 13.9%) left main bronchus involvement.

Most of the pulmonary hamartomas are solitary lesions while rarely occur as multiple lesions.[12] Lien et al[6] identified solitary lesion in 60 patients and two parenchymal lesions in one patient. So, they reported two lesions in 1.6% of their patients. Ekinci et al[13] reported multiple lesions in one (7.7%) of 13 patients with parenchymal or endobronchial hamartoma. In our study, an endobronchial hamartoma within left main bronchus and a parenchymal hamartoma in left lower lobe was detected in one patient (4.8%).

Esme et al[5] reported 14 patients with lower lobes, 9 with upper lobes and one with right middle lobe hamartomas. In the study of Lien et al[6], lesion was detected in lower lobes in 26 (44.8%) patients, in upper lobes in 26 (44.8%) patients and in right middle lobe in 6 (10.3%) patients among their 58 patients with parenchymal hamartoma. Ekinci et al[13] studied 14 hamartomas in 13 patient with a mild predilection of lower lobes (57.1%). However, 10 (50%) of 20 parenchymal lesions were in the upper lobes, 5 (25%) were in the lower lobes, and 5 (25%) were in the right middle lobe in our study.

In the study of Esme et al[5] the edges of 17 (70.8%) cases were rough and the 7 (29.2%) ones were smooth. We observed that among 22 lesions, 12 (54.5%) had a smooth oval or round margins without lobulation. Nine (40.9%) lesions had lobulated contour while one (9.1%) had irregular margins. Compared with previous study, hamartomas in our study were more likely to have smooth margins. Also, we observed a hamartoma with irregular margin which can mimic a neoplastic lesion.

Calcification and adipose components can be seen within the hamartoma. Computed tomography is superior to plain radiographs for the detection of calcification and fat within the hamartoma. In a study by Ekinci et al[13] calcification was observed in 15.4% of their patient with hamartoma while none of them was seen on X-ray. Pop-corn calcification was detected on 12.5% and patching calcifications in 24.5% of the pulmonary hamartomas. In our study, macrocalcifications (31.8%) were more common than patching microcalcifications (9.1%). In the study of Esme et al[5], the fat density was observed in 29.1% of the patients. However, the rate of presence of fat density in the lesions was more prominent in our study (54.5%). Finally, calcification was observed in 40.9%, either calcification or fat density in 68.2%, both calcification and fat density in 13.6% and none of them in 18.2% of the patients. So, 81.8 % of the lesions had at least one of calcification or fat density.

Ergonul et al[8] studied PET/CT of their 19 hamartoma cases and reported SUVmax values between 0 and 4.5. They concluded that SUVmax value of hamartomas was lower when compared to the other benign conditions

Study Highlights

- A higher frequency of upper lobes involvement of pulmonary hamartomas was observed
- A relative higher female/male rate than previous studies was found in the patients with pulmonary hamartomas
- Also CT images of a very rare case with concurrence of an endobronchial and a pulmonary parenchymal hamartoma were presented.

including granulomatous lung disease, reactive lymph nodes and interstitial lung disease. Jiang et al[14] analysed PET/CT images of 14 patients with hamartoma and found mean SUV max value as 1.5±0.6 (range between 0.7 and 2.6). In our study, mean SUVmax value of 22 lesions was 1.6±1.0 (range between 0 and 3.2). A SUVmax value>2.5 was observed in 5 lesions (22.7%) (2.55, 2.64, 2.7, 2.9 and 3.2).

In this study, consistent with previous studies, most of the hamartomas were detected in the patients in their 6th decade of life. Also, the rates of the biopsy techniques in this study were consistent with literature. The diameters, endobronchial/ parenchymal, and right/left location rates of the lesions were similar with previous reports. The mean SUV max value of the lesions in our study was close to the results reported in literature. Contrary with previous studies, we found a relative higher female/ male ratio. In addition, there was a predilection of hamartomas for upper lobes of the lungs in our study. Moreover, hamartomas in our study were more likely to have smooth margins than lobulations.

Conclusion

Computed tomography and PET-CT findings of pulmonary hamartomas must be well known for accurate differentiation from malignant conditions and upper lobe involvement and concurrence of multiple lesions must be kept in mind.

Conflict of Interest

We declare no conflict of interest in this study.

Ethics Approval

This retrospective observational study was approved by the institutional review board of our institution with a number of 005078 on the 22.08.2013.

Authors' Contributions

YD and SÖ contributed to design of the study. SÖ contributed to literature review. YD, FD and ÖÖ contributed to data interpretation. YD and SÖ drafted the first manuscript. All authors reviewed and approved the final version of the article.

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