18-FDG Uptake in Pulmonary Dirofilariasis

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ABSTRACT

Solitary pulmonary nodules are a common finding on chest radiography and CT. We present the case of an asymptomatic 59-year-old male found to have a 13 mm left upper lobe nodule on CT scan. The patient was asymptomatic and the CT was performed to follow up mediastinal and hilar lymphadenopathy that had been stable on several previous CT scans. He had a history of emphysema and reported a 15 pack-year smoking history. PET-CT was performed which demonstrated mild 18-FDG uptake within the nodule. Given his age and smoking history, malignancy was a primary concern and he underwent a wedge resection. Pathological examination revealed a necrobiotic granulomatous nodule with a central thrombosed artery containing a parasitic worm with internal longitudinal ridges and abundant somatic muscle, consistent with pulmonary dirofilariasis. Dirofilaria immitis, commonly known as the canine heartworm, rarely affects humans. On occasion it can be transmitted to a human host by a mosquito bite. There are two major clinical syndromes in humans: pulmonary dirofilariasis and subcutaneous dirofilariasis. In the pulmonary form, the injected larvae die before becoming fully mature and become lodged in the pulmonary arteries.

CASE REPORT

A 59-year-old male with a past medical history of emphysema, hypertension, and dyslipidemia underwent contrast enhanced computed tomography (CT) of the chest to follow up on borderline enlarged mediastinal and left hilar lymph nodes that had been identified on previous CT (Figures 1-3). He was asymptomatic at the time of the follow up scan and denied respiratory or constitutional symptoms. He was afebrile and his lungs were clear to auscultation. The scan showed a 13 mm nodule in the periphery of the left upper lobe, which was new from a CT approximately 6 months prior. Given a reported smoking history, malignancy was a primary concern and positron emission tomography (PET) CT was performed (Figures 4-6). The lesion demonstrated mild 18-Fluorodeoxyglucose (18-FDG) hypermetabolism on PET. There were no additional suspicious lesions.

**Imaging Findings**

The patient’s CT scan demonstrated an irregularly shaped non-calcified solid nodule in the periphery of the left upper lobe, which measured approximately 13 x 10 x 10 mm in length, width, and craniocaudal dimensions respectively. Subsequent PET scan demonstrated mild 18-FDG uptake within the nodule (maximum standard uptake value (SUV)=2.2, average liver SUV=2.5). Mild 18-FDG uptake was also demonstrated in borderline enlarged mediastinal and left hilar lymph nodes (maximum SUV=2.6). These lymph
Differanial Diagnosis

The differential diagnosis of a single pulmonary nodule on radiograph or CT is vast. Some considerations could include granuloma, bronchogenic carcinoma, hamartoma, metastatic disease, arteriovenous malformation (AVM), carcinoid, and round atelectasis.

On radiograph and CT a granuloma most commonly presents as a small calcified nodule. Laminar, central, or complete calcification may be seen. No discrete enhancement is typically seen on contrast enhanced CT. 18-FDG uptake can be variable on PET scan. An AVM typically presents as a peripheral 1-5 cm nodule or mass on radiograph or CT. Occasionally multiple lesions may be seen. The finding of feeding arteries and draining veins and avid enhancement is characteristic on CT. No discrete 18-FDG uptake is typically seen. On radiograph or CT, a bronchogenic carcinoma may appear as a speculated or irregular nodule or mass. No discrete enhancement is typically seen on contrast enhanced CT. These lesions typically demonstrate 18-FDG uptake on PET scan, although a minor degree of uptake may be seen in
bronchioloalveolar cell carcinoma. On radiograph and CT, hamartomas typically present as solitary smooth rounded nodules, occasionally with popcorn-like calcification. Internal fat density may be identified on CT. They may occasionally be endobronchial. Typically, no discrete 18-FDG uptake is seen. Pulmonary metastases usually present as multiple nodules or masses on radiograph or CT. A feeding vessel can occasionally be identified on CT in the setting of hematogenous metastases and enhancement on contrast enhanced CT is variable. 18-FDG uptake is typically seen on PET-CT. Carcinoid typically presents as a centrally located smooth round mass or nodule on radiograph or CT. Association with a main, lobar, or segmental bronchus is often identified on CT. Avid enhancement is typical on contrast enhanced CT. Typical carcinoids do not demonstrate discrete 18-FDG uptake. Round atelectasis most commonly appears on radiograph and CT as a subpleural rounded, irregular, or wedge shaped mass or nodule. Adjacent pleural thickening and volume loss are associated findings. On CT, convergence of bronchovascular structures with the lesion is typical. Air bronchograms may also be seen. These lesions typically enhance homogeneously on CT. No discrete 18-FDG uptake is typically seen on PET.

As discussed above, the differential considerations of a solitary pulmonary nodule on radiograph or CT are numerous. The finding of 18-FDG uptake on PET-CT would most often exclude the possibility of hamartoma, AVM, typical carcinoid, and round atelectasis. The remaining considerations can be further narrowed based on the clinical situation and additional imaging findings discussed above. Given that pulmonary dirofilariasis is usually not differentiated from malignancy, the diagnosis is typically made histopathologically.

### REFERENCES


### TEACHING POINT

Pulmonary dirofilariasis typically presents as a smooth 1 to 3 cm rounded nodule in an asymptomatic patient. 18-FDG uptake on PET-CT is variable but the lesion may demonstrate increased uptake.
Figure 1: 57 year old male with pulmonary dirofilariasis. Findings: CT demonstrates an irregular nodule within the peripheral left upper lobe measuring 13 x 10 x 10 mm. Technique: Axial (A) and coronal (B) CT, 399 mAs, 120 kVp, 2.5 mm slice thickness, 60 ml Optiray 350.

Figure 2: 57 year old male with pulmonary dirofilariasis. Findings: CT demonstrates an irregular nodule within the peripheral left upper lobe (dashed circle) with adjacent feeding artery (dashed arrow). Technique: Coronal CT, 399 mAs, 120 kVp, 2.5 mm slice thickness, 60 ml Optiray 350.

Figure 3: 57 year old male with pulmonary dirofilariasis. Findings: CT demonstrates an irregular nodule within the peripheral left upper lobe (dashed circle) with feeding artery (dashed arrow). Technique: Curved reformat axial CT, 399 mAs, 120 kVp, 2.5 mm slice thickness, 60 ml Optiray 350.

Figure 4 (right): 57 year old male with pulmonary dirofilariasis. Findings: Fused PET-CT demonstrates mild 18-FDG uptake in a left upper lobe nodule (red arrow) and left hilar lymph nodes (dashed circle). Maximum SUV of the nodule was 2.2. Maximum SUV of the left hilar lymph nodes was 2.6. Average liver SUV was 2.5. Technique: Fused axial PET-CT, 399 mAs, 120 kVp, 2.5 mm slice thickness, 60 ml Optiray 350, 14.4 mCi 18-FDG, images obtained at approximately 60 minutes.
Figure 5: 57 year old male with pulmonary dirofilariasis. Findings: Fused PET-CT demonstrates mild 18-FDG uptake in a left upper lobe nodule (red arrow) and left hilar lymph nodes (dashed circle). Maximum SUV of the nodule was 2.2. Maximum SUV of the left hilar lymph nodes was 2.6. Average liver SUV was 2.5. Technique: Fused coronal PET-CT, 399 mAs, 120 kVp, 2.5 mm slick thickness, 60 ml Optiray 350, 14.4 mCi 18-FDG, images obtained at approximately 60 minutes.

Figure 6: 57 year old male with pulmonary dirofilariasis. Findings: PET demonstrates mild 18-FDG uptake in a left upper lobe nodule (red arrow) and left hilar lymph nodes (dashed circle). Maximum SUV of the nodule was 2.2. Maximum SUV of the left hilar lymph nodes was 2.6. Average liver SUV was 2.5. Technique: Attenuation correction axial PET, 14.4 mCi 18-FDG, images obtained at approximately 60 minutes.

Figure 7: 57 year old male with pulmonary dirofilariasis. Findings: Histopathology demonstrates a granulomatous reaction surrounding a centrally thrombosed artery. Technique: Low power magnification, hematoxylin and eosin stain.

Figure 8: 57 year old male with pulmonary dirofilariasis. Findings: Histopathology demonstrates an occluded pulmonary artery containing two cross sections of a filarial nematode. Technique: 10X magnification, hematoxylin and eosin stain.

Figure 9 (right): 57 year old male with pulmonary dirofilariasis. Findings: Histopathology demonstrates a filaria in cross section with a multilayered cuticle with an internal cuticular ridge and abundant somatic muscle, consistent with D. immitis. Technique: 20X magnification, hematoxylin and eosin stain.
Etiology | *Dirofilaria immitis*
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Incidence | Unknown, approximately 180 reported cases
Gender Ratio | Approximately 2 times more common in males
Age predilection | Most common between ages 40 and 60
Risk factors | Residence in an area endemic for canine dirofilariasis
Treatment | Usually no treatment is necessary. Typically resected because of concern for malignancy
Prognosis | Excellent

**Imaging Findings** | Typically smooth rounded peripheral lung nodule. Most common in the right lower lobe. 18-FDG uptake can be seen on PET-CT.

**Table 1:** Summary table of pulmonary dirofilariasis.

<table>
<thead>
<tr>
<th>Pulmonary Dirofilariasis</th>
<th>CT</th>
<th>PET</th>
</tr>
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<tbody>
<tr>
<td>-Solitary smooth 1-3 cm peripheral nodule</td>
<td>-Can see adjacent feeding artery</td>
<td>-Can see 18-FDG hypermetabolism</td>
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<tr>
<td>Arteriovenous Malformation</td>
<td></td>
<td></td>
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<tr>
<td>-Smooth 1-5 cm peripheral nodule or mass</td>
<td>-Smooth 1-5 cm avidly enhancing peripheral nodule or mass</td>
<td>-No discrete 18-FDG uptake</td>
</tr>
<tr>
<td>-Feeding artery draining and vein</td>
<td>-Occasionally lobulated</td>
<td></td>
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<tr>
<td>Primary Bronchogenic Carcinoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Solitary pulmonary nodule or mass.</td>
<td>-May see necrosis</td>
<td>-Typically demonstrate 18-FDG hypermetabolism</td>
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<tr>
<td>-Often irregular/spiculated</td>
<td>-Usually no avid enhancement</td>
<td></td>
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<tr>
<td>Pulmonary Metastasis</td>
<td>- Usually multiple masses/nodule(s)</td>
<td>-Occasional feeding vessel in hematogeneous metastases</td>
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<tr>
<td>-May have popcorn like calcification</td>
<td>-Variable enhancement</td>
<td>-Typically demonstrate 18-FDG hypermetabolism</td>
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<tr>
<td>Hamartoma</td>
<td></td>
<td></td>
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<tr>
<td>-Solitary smooth peripheral nodule</td>
<td>-May contain fat</td>
<td>-No discrete 18-FDG uptake</td>
</tr>
<tr>
<td>-May have popcorn like calcification</td>
<td>-Occasionally endobronchial</td>
<td></td>
</tr>
<tr>
<td>Typical Carcinoid</td>
<td>-Centrally located smooth rounded mass/ nodule</td>
<td>-Typically associated with main, lobar, or segmental bronchus</td>
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<tr>
<td></td>
<td>-Usually avid enhancement</td>
<td>-No discrete 18-FDG uptake</td>
</tr>
<tr>
<td>Round Atelectasis</td>
<td>-Subpleural rounded, irregular, or wedge shaped mass(es)/nodule(s)</td>
<td>-Often contain air bronchograms</td>
</tr>
<tr>
<td>-Associated pleural thickening</td>
<td>-Distortion and convergence of vessels with nodule(s)/mass(es)</td>
<td>-No discrete 18-FDG uptake</td>
</tr>
<tr>
<td>-Associated volume loss</td>
<td>-Homogenous enhancement</td>
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<tr>
<td>Granuloma</td>
<td>-Smooth rounded nodule(s), typically less than 1 cm.</td>
<td>-Laminar, complete, or central calcification</td>
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<tr>
<td></td>
<td>-Typically calcified</td>
<td>-No discrete enhancement</td>
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**Table 2:** Differential diagnosis table for pulmonary dirofilariasis on radiograph, CT, and PET.

**ABBREVIATIONS**

18-FDG = 18-Fluorodeoxyglucose  
CT = Computed Tomography  
PET = Positron Emission Tomography  
SUV - Standardized Uptake Value

**KEYWORDS**

Pulmonary dirofilariasis; zoonoses, canine heartworm; solitary pulmonary nodule; *Dirofilaria; D. immitis; zoonotic*