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Low grade FDG uptake on the rim of "doughnut" in PET-CT in an asymptomatic Hydatid cyst: is inflammatory activity a determinant of symptoms?

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Running title: **Intensity of FDG uptake in Hydatid cyst**

Abstract:

Herein we present an untreated asymptomatic incidentally diagnosed suspected case of pulmonary hydatid cyst with its atypically low grade ^{18}F-FDG uptake on the peripheral rim of the cyst with minimal increase on dual point imaging of ^{18}F-FDG- PET-CT. The patient underwent ^{18}F-FDG-PET/CT for characterization of solitary lung lesion on chest X-ray and inconclusive ceCT features. While the diagnosis was confirmed by serum IHA positive for echinococcus granulosus, the low grade ^{18}F-FDG uptake in the context of asymptomatic presentation of the disease is noteworthy, that could be related to minimal active inflammation. When placed in context of similar published reports, it could be hypothesized that the inflammatory ^{18}F-FDG uptake could be an additional determinant of symptoms in this group of patients.

Introduction:

Hydatid disease is a parasitic infestation caused by *Echinococcus granulosus*. Hydatid cysts are common in the Mediterranean countries, the Middle and Far East, Europe, Asia, South America and Australia. It presents as a solitary lesion/multiple cystic lesions/giant cystic lesions in the lung and liver. A higher proportion of lung cases are discovered incidentally on a routine x-ray evaluation; the majority of infected people remain asymptomatic until the cyst enlarges sufficiently to cause symptoms. The majority of symptoms are caused by mass effect from the cyst volume; the presence of complications caused by cysts changes the clinical presentation; the principal complication is cyst rupture, producing cough, chest pain and hemoptysis. Diagnosis is obtained by imaging evaluation (Chest X-ray or CT scan), supported by serology in the majority of cases. Chest X-ray and CT are the conventional diagnostic modalities which are utilized till now. However, we herein report inflammatory activity assessed by ^{18}F-FDG-PET/CT imaging could also be potential determinant for symptom in an individual.

Case Presentation: A twenty-one years old male patient living in a village, was referred to our institution for further evaluation of incidentally detected finding of a cystic lesion on his chest radiograph done as a part of his routine pre employment medical examination. On enquiry he gave history of symptom of 10 days duration of mild cough with mucoid expectoration salty in taste. He was non addict and there was no past history of any respiratory disease or therapy for the same. He also gave history of frequent exposure to cattle in the fields in his native place from childhood. His general physical and systemic examination was within normal limits

Chest Radiograph revealed a cystic lesion in the right lower lobe (Figure 1). Contrast enhanced computed tomography (CECT) of thorax (Figure 2) revealed smooth cavity measuring 4.8x3.3cms in the right lung lower lobe with rounded dependent soft tissue mass in both supine and prone positions- suggestive of a Fungal ball or Detached membranes of Hydatid cyst. Sputum microscopic examination revealed no evidence of structures resembling scoliosis or cysts of Echinococcus granulosus.

The ^{18}F-FDG PET/CT scan was done in our institution with 305 MBq of ^{18}F-FDG with a whole body full ring dedicated Lutetium Yttrium Orthosilicate (LYSO) based time of flight PET/CT

scanner (Gemini TF PET/CT, Philips Healthcare, USA). Images were acquired using 3D PET protocol and data were reconstructed using iterative row-action maximum likelihood algorithm (RAMLA) algorithm and attenuation correction by using low dose CT. Dual point images are acquired with base line images at 1h and 3h after injection. Baseline PET/CT scan showed a soft tissue lesion 3.3x4.5x4.3cm with central cavitation and peripheral rim of ^{18}F-FDG uptake (SUVmax-2.56gr/mL). There was evidence of communication of the cyst with the right bronchus (Figures 3 and 4). Low grade ^{18}F-FDG uptake in bilateral axillary lymph nodes with maintenance of fatty hilum was seen. Dual point imaging after 3h showed the peripheral rim of ^{18}F-FDG uptake minimally increased (SUVmax-2.98gr/mL). The lesion was diagnosed as a hydatid cyst with a doughnut sign and minimal uptake at the periphery of the rim. Serum IHA was positive for echinococcus granulosus. The patient was advised to start treatment with tablet Albendazole 400 mg orally once daily for a duration of 12 months.

Discussion:

^{18}F-FDG PET/CT is a relatively new diagnostic imaging modality commonly used in oncology. However in non oncological practice the use of PET-CT is being investigated for evidence base for its indication in clinical scenario [1]. PET-CT with ^{18}F-FDG has an advantage to define the functional characteristics of the pathology e.g. inflammatory activity due to its functional imaging capability [1]. When there is no other modality to specifically characterize the undiagnosed disease condition, repeated studies are done regularly to support the prior studies' findings.

In our case the X-rays features were not typical and CT features were suspicious of a hydatid cyst. Characteristic signs of a hydatid cyst on CECT like air-bubble sign, water lily sign or meniscus sign were not seen in this case. Sputum examination was negative for echinococcus remnants.

In our case PET-CT played an important role in taking a further step to characterize the lesion by its dough nut characteristics. This case also strongly proves that antecedent history of exposure to cattle can assist in suspecting the diagnosis of Hydatid cyst in right clinical context. The serum Indirect haemagglutination (IHA) is strong evidence supporting the diagnosis along with the PET-CT findings in our case where the chest radiograph and CECT features were not very typical. A number of reports [*2-7*] have reported ^{18}F-FDG PET/CT imaging appearance in the context of hydatid cyst with most of them demonstrating intense ^{18}F-FDG uptake in the periphery. Kadam et al [*2*] described the "doughnut sign" of hydatid cyst in their case record, which was matching with the PET-CT images in our case, however, there was a striking difference in the intensity of ^{18}F-FDG activity in both these cases. Demir et.al [*3*] described a lesion in the liver on PET-CT images with peripheral ^{18}F-FDG uptake with central photopenia and hypodense areas. After resection of the lesion it proved to be Hydatid cyst. On the other hand, Kurt et al [*4*] reported no ^{18}F-FDG uptake in their study for pulmonary nodules; however after resection it proved to be Hydatid cyst.

Thus, while ^{18}F-FDG-PET-CT can play a role in establishing a diagnosis of hydatid cyst (ruptured or infected or both), along with its use in determining the extent of disease and monitoring treatment response, the inflammatory component that could be assessed by this modality can be regarded as a determinant for symptoms in an individual.

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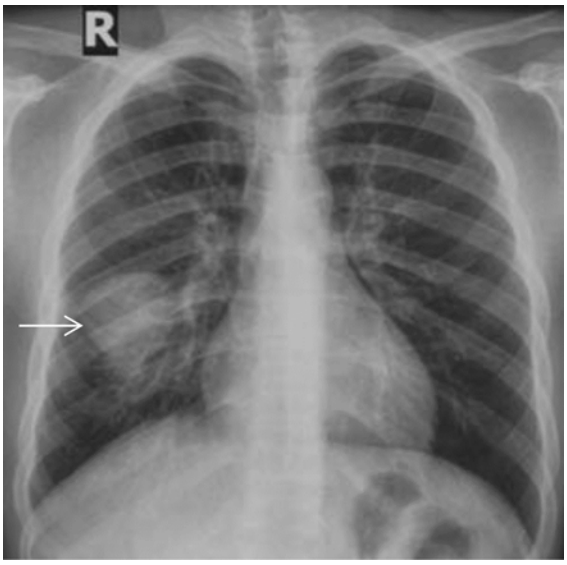

Fig 1: Chest X-ray (CXR) showing homogenous round opacity in the right lower lobe

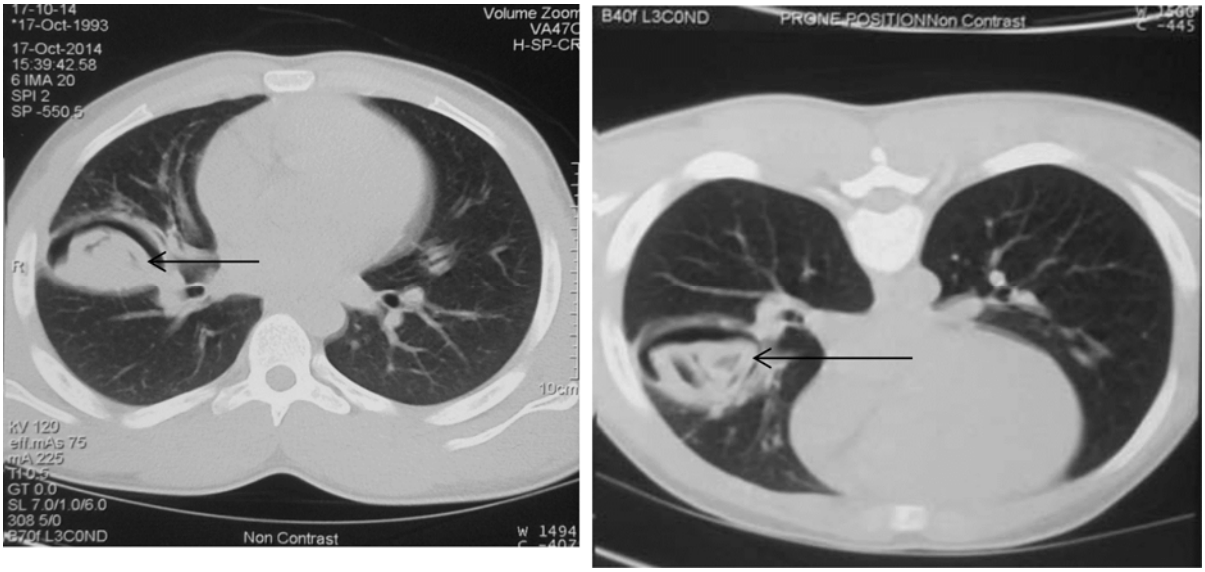

Fig 2: CT scan supine and prone showing cavity with mobile soft tissue within it

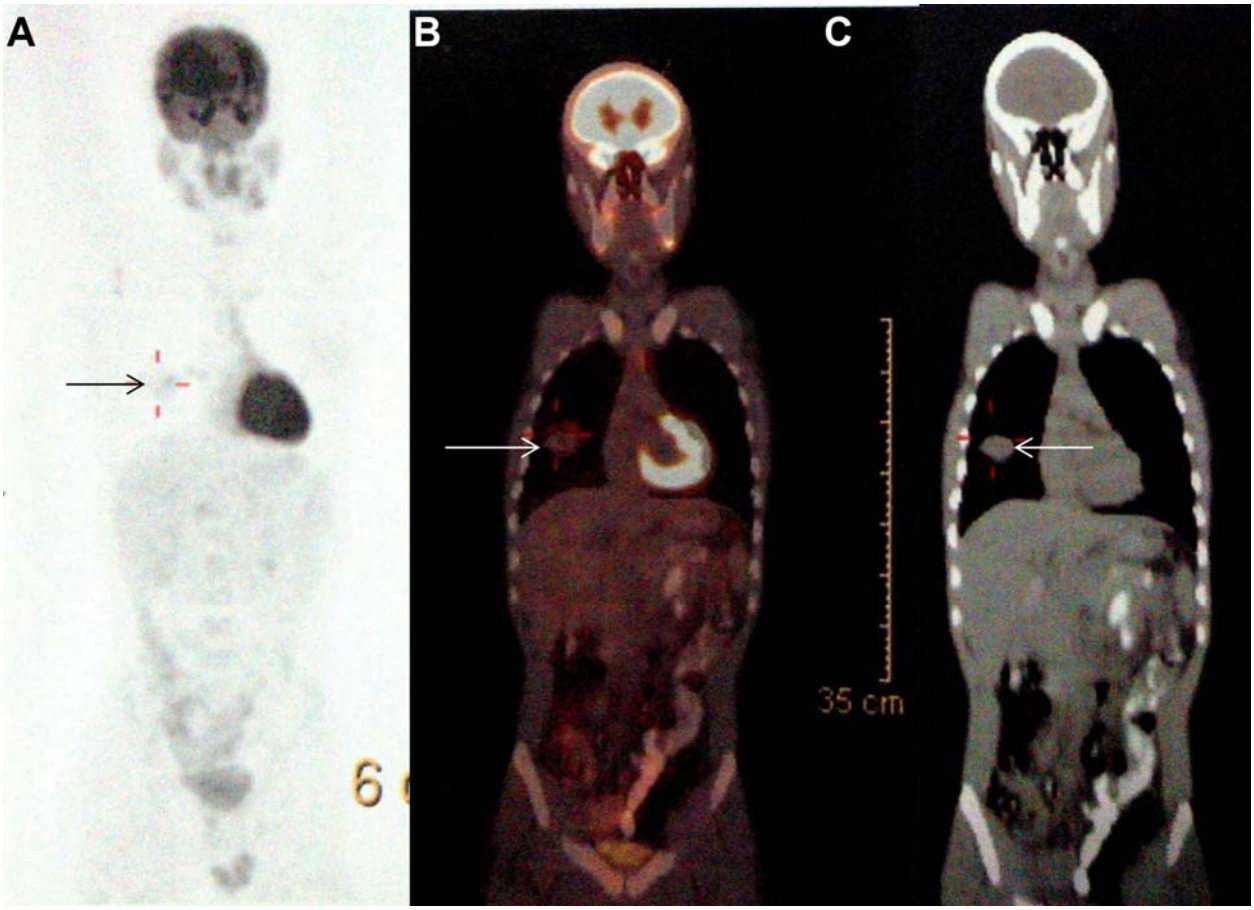

Figure 3. a) Shows peripheral low-grade ^{18}F-FDG uptake with central photopenia appearing as doughnut sign. b) Shows central cavitatory lesion on CT images. c) Shows peripheral ^{18}F-FDG uptake and central cavitatory hypodense area.

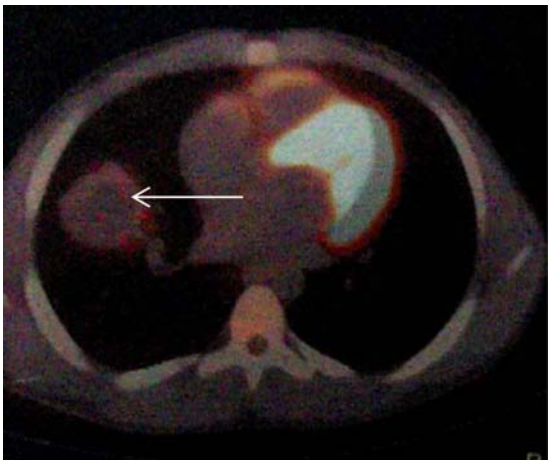

Figure 4: Transaxial fused images show peripheral FDG uptake and central hypodense area with cavitation. The lesion appears to be communicating with the bronchus.