Cannon Ball Diagnosis and Management in a Flight Attendant Candidate

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BACKGROUND: "Cannon ball" opacities on chest X-rays are a common manifestation of hematogenous dissemination of a malignant tumor in the lungs. They indicate an advanced stage of disease with a very grim prognosis in terms of cure and survival. In aerospace medicine, this aspect means the patient is unfit for flight duties. Nonmetastatic etiologies of pulmonary nodules are rare. We report a case of cannon ball opacities discovered fortuitously during an admission visit.

CASE REPORT: A 23-yr-old flight attendant candidate came to the Aeromedical Expertise Center of the Military Hospital in Rabat for medical evaluation. He had no previous medical comorbidities and was asymptomatic. The physical examination was unremarkable. Chest X-ray revealed multiple poorly defined pulmonary nodular opacities, without mediastinal widening. After excluding other possibilities, such as infection or malignancy, the diagnosis of a pseudotumoral form of thoracic sarcoidosis was established by clinical and radiological findings, supported by histopathologic analysis.

DISCUSSION: The pseudotumoral form of sarcoidosis is rare. It is usually seen in young people who are asymptomatic. Chest X-ray shows bilateral nodular opacities of different sizes. CT scan shows snowballs, which may or may not manifest with air bronchogram or mediastinal lymph nodes. Laboratory investigations are nonspecific. Pulmonary functions are normal or may show a restrictive pattern. Evolution is spontaneously favorable and does not require any treatment in asymptomatic patients. Aeromedical fitness in sarcoidosis disease depends on several conditions. This observation affirms the benefit of routine chest X-ray during medical evaulations to detect possible entities that may endanger flight safety.

KEYWORDS: flight safety, sarcoidosis, pseudotumoral form, aeromedical fitness.

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Cannon ball appearance in a chest X-ray is a radiological term to designate multinodular pulmonary opacities.[9] They are usually manifestations of hematogenous dissemination of malignant tumors in the lungs.[9] They almost always indicate an advanced stage of the disease with a very grim prognosis in terms of cure and survival. Non-metastatic pulmonary nodules etiologies are rare.[1,10] In aircrew, cannon ball opacities constitute a problem in both etiological diagnosis and aeromedical fitness because they can be related to some diseases with potential risk to aviation safety.

In this paper, we report a case of cannon ball opacities due to a pseudotumoral form of thoracic sarcoidosis. This is a rare form of thoracic sarcoidosis[8] and the authors are aware of only a few cases that have been published to date.

CASE REPORT

A 23-yr-old man, who is a flight attendant candidate, came for an admission visit at the Aeromedical Expertise Center of Instruction Military Hospital Mohamed V, Rabat, Morocco. The patient had no previous medical comorbidities, nor a

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history of tuberculosis or TB exposure. He is a smoker of 2 pack years. He denies the use of illicit drugs. He consumes alcoholic drinks occasionally and exercises twice a week. Physical examination was entirely unremarkable.

Chest X-ray (**Fig. 1**), which is mandatory in all admission visits, revealed multiple and bilateral cannon-ball opacities characterized in computed tomography (CT) scan of the chest as multiple centrilobular ground-glass nodules and macronodules measuring 15 to 30 mm with fuzzy limits and aerial bronchogram (**Fig. 2**). The largest nodule was in the base of the right lung. Further investigation was warranted and started.

Complete blood count showed Hemoglobin of 15.4 gm/dl, TLC 7000/mm^2 (polynuclear cells 4900/mm^2 and lymphocytes 1300/mm^2) with no inflammatory syndrome. Sputum examination for acid fast bacilli was negative. Quantiferon-TB test was negative. Hydatid and HIV serology were likewise negative. The urinary screening for illicit drugs (cannabis, cocaine, heroin, amphetamines, and opiates), that we do systematically during an admission visit, was negative. Pulmonary function test was normal.

Vasculitis, such as Wegner's Granulomatosis, is one of the differential diagnoses. However, it was eliminated in this case because of the absence of sinus involvement and eosinophilia. Moreover, the antineutrophil antibody (ANCA) was negative.

The pseudotumoral form of sarcoidosis was suspected by clinical and radiological findings, as well as laboratory findings (hypercalciuria and elevated Angiotensin-converting enzyme levels). The diagnosis was confirmed by histology showing non-caseating granulomas on transbronchial biopsy.

The evolution was spontaneously favorable with an entire disappearance of X-ray opacities (**Fig. 3**) and CT scan lesions, 6 mo later.

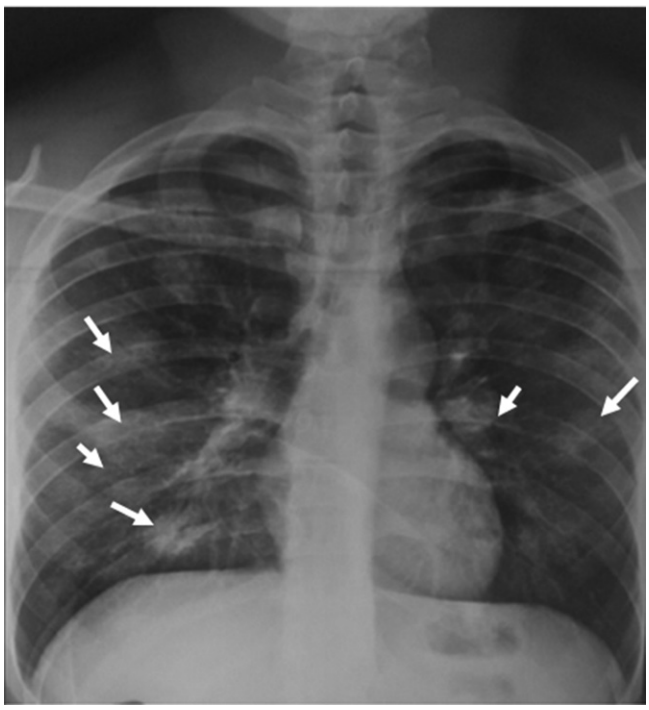

Fig. 1. Chest X-ray shows poorly-defined multiple pulmonary nodular opacities in the bilateral middle and lower zones; no mediastinal widening.

Fig. 2. Chest CT scans showing "snowball" lesions with different sizes in the tissue window.

DISCUSSION

Cannon ball opacities are typically described as multiple round homogenous opacities measuring 2 to 5 cm with sharply defined margins.[10] They have a multitude of causes. Undoubtedly, the most common ones are from metastatic diseases.[9,10] The diagnosis becomes a challenge when the primary site is not established because the list of etiologies is almost endless.

Differential diagnosis of nonmetastatic cannon ball opacities on chest X-ray includes infectious diseases (pulmonary TB, hydatid diseases, fungal infection like histoplasmosis, coccidioidomycosis, nocardiosis, parasitic disorders) and others (vasculitis, autoimmune disorders like Rheumatoid nodule, sarcoidosis).[5,10]

Fig. 3. Normal chest X-ray.

The introduction of positron emission tomography using a fluorodeoxyglucose/computed tomographic [FDG-PET/CT] scan has greatly enhanced the diagnosis of cannonball opacities by differentiation of benign and malignant nodules and measuring the metabolic activity of these lesions.[3] But this exploration was not performed in our case.

Pulmonary metastases in adults usually come from breast, kidney, gut, testis, head and neck tumors, lymphomas, and a variety of sarcomas.[1,9] Clinical symptomatology is often nonspecific and it is marked by a deterioration of the patient's general condition, whereas in primary cancers, it is usually clinically evident.

The basic sign of hematogenous pulmonary metastases is marked by the appearance of one or more discrete pulmonary nodules. The nodules are usually spherical and well-defined. But, they may also be of any shape, and can occasionally have very irregular edges, especially in adenocarcinoma.[1]

Among infectious etiologies, the most possible is pulmonary tuberculosis which is highly endemic in developing countries like Morocco. Patients usually present with weight loss and marked respiratory symptoms of chronic cough, dyspnea, low-grade fever, night sweats, and occasionally hemoptysis. However, cannon ball opacities are a very rare presentation of atypical pulmonary tuberculosis in healthy individuals[10] and are frequently found in patients with immunocompromised conditions such as diabetes, chronic liver disease, anemia, renal diseases, and in patients on immunosuppressive drugs.[5] In our case pulmonary TB is ruled out because the patient was asymptomatic, and all laboratory tests, including Quantiferon TB testing, were negative.

Another rare cause is pulmonary hydatid disease.[5] The diagnosis of this disease is relatively easy. Patients are usually from rural areas and are exposed to animals such as dogs. Diagnosis is confirmed by imaging (CT) and hydatid serology.

Staphylococcus septicemia, fungal and parasitic infections seen among drug addicts and immunocompromised patients, may be manifested with multiple pulmonary nodules.[5,9]

Arterio-venous malformations[4] and some immunological diseases like rheumatoid nodules and Wegener's granulomatosis[5] have been reported in the literature as other rare etiologies of cannon ball opacities.

Our patient presented with cannon ball opacities and no significant clinical signs or symptoms. After ruling out other diseases aforementioned, the diagnosis of thoracic sarcoidosis in pseudotumoral form was established by clinical biological and radiological data. It was confirmed by histology showing noncaseating granulomas on transbronchial biopsy.

The pseudotumoral form of sarcoidosis is a rare form of sarcoidosis (1 to 4%),[2,11,12] first described by McCord and Hyman in 1952.[6] This form pertains to stage II (B) of the pulmonary sarcoidosis classification. It concerns young people from 20 to 40 yr of age;[8] our patient is 23 yr old. Patients are often asymptomatic, as was our case (3/5 in Marques' study[8] and 21/33 in Battesdi's study of 746 patients with sarcoidosis[2]). Abnormalities are often detected incidentally on chest radiography, and the difference between clinical symptoms and imaging findings is usually clear. Chest radiograph shows bilateral nodular opacities with different sizes from 1 cm to several centimeters in diameter, the nodules are generally poorly defined, they may or may not be associated with mediastinal widening, and unilateral forms are also described.[8] Computed tomography scans show snowballs aspect,[12] confluent, bilateral, infiltrative predominant in periphery with fuzzy limits, and air bronchogram indicating its alveolar type; mediastinal or hilar adenopathy can be absent.[8]

Biological abnormalities are nonspecific and the pulmonary function test is normal, as in our case, or can show a restrictive pattern. Bronchial or transbronchial lung biopsy can lead to histologic confirmation of sarcoidosis revealing noncaseating granuloma.[8]

Evolution is spontaneously favorable, radiologic lesions need 1 to 2 yr to disappear[12] and they do not require any treatment for asymptomatic forms.[8–12] When the diagnosis of the pseudotumoral form of sarcoidosis is established by clinical biological radiological data and confirmed by histology, other sites of sarcoidosis involvement such as heart, eye, brain, and kidney must be researched, especially for the aeromedical environment.[7] They can be asymptomatic but can also be a source of latent damage in flight.

Cardiac sarcoidosis can cause severe arrhythmias or the possibility of conduction defects. These abnormalities can cause malaise, syncope, or even sudden death which can reveal sarcoidosis. Simple cardiac explorations may discover this localization, in particular by echocardiography, showing septal abnormalities, conductive disorders, or ventricular extrasystoles on resting ECG, rhythmic Holter or exercise ECG test. More specific explorations, such as Sestamibi myocardial scintigraphy or cardiac MRI, are sometimes needed.[7] Ocular involvement requires a complete eye examination, including visual acuity test, segment anterior exam with a slit lamp, and posterior segment examination in the fundus of the eye, a color vision test, and a visual field test.[7] Similarly, central nervous system involvement can cause seizures, headaches, etc. Brain MRI with gadolinium injection is the most sensitive imaging test for neurosarcoidosis diagnosis. Finally, kidney disease in chronic sarcoidosis is also a factor that threatens flight safety[7] with a risk of renal colic in flight (hypercalciuria promotes lithogenesis). Urinary tract utrasonography shows sufficiently large lithiasis. Microlithiasis will be seen only in the kidney scan without contrast.

Moroccan aeromedical standard and fitness for civilian personnel refers to the Minister of Equipment and Transport's decree of May 13th, 2009. A diagnosis of evolutive sarcoidosis is disqualifying for flight at both the admission stage and during routine medical examinations. A waiver is possible if management of the condition is favorable, including not involving a location that could be dangerous or cause in-flight incapacitation, such as the eye, heart or brain, or where treatment is either not necessary or the corticotherapy is a low dose of less than 10 mg per day.

Concerning our flight attendant candidate, he will become an aircrew member and will be expected to help manage the

aircraft cabin, amenities and passengers before, during, and after flights, being ready and able to take action in the event of an in-flight or on-ground emergency. Through his admission visit we discovered that he has an asymptomatic pseudotumoral form of thoracic sarcoidosis with no dangerous localization that may cause sudden or subtle in-flight incapacitation (brain MRI, echocardiography, Holter ECG, exercise ECG test and eye examination are normal). Evolution was spontaneously favorable. His waiver request was accepted with annual clinical and radiological control.

In conclusion, the pseudotumoral form of thoracic sarcoidosis is a rare cause of cannon ball opacities. This observation shows the benefit of routine chest X-ray during the fitness medical visit. It also demonstrates that "cannon ball" does not always mean a serious illness and the end of an aircrew member's aviation career. Rather, it may be related to a benign pathology where a waiver is possible without putting flight safety at risk.

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