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CASE REPORT

Tennis racket sign in pulmonary tuberculosis: A case report

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Abstract

We report a case of 'tennis racket sign' in the chest radiograph of a patient with pulmonary tuberculosis (PTB). This graphic but relatively unknown sign helped us pinpoint the diagnosis. Our patient, a 24-year-old male migrant worker, presented with a five-month history of a racking cough with expectoration of blood-streaked sputum. No antecedent fever existed, but he had a concomitant loss of appetite and weight. He was seen in three different primary care facilities, and three chest radiographs were performed. These radiographs were reported as normal, with no overt evidence of pulmonary infection. Antibiotics were not useful. We believed that the history and our finding of scattered, fine crepitations in both upper zones of the lungs warranted a repeat chest radiograph. This demonstrated shadowing that we recognised as the tennis racket sign. We told the patient that the radiological shadow pointed to the diagnosis of PTB. We were able to convince the patient and his employer that the bacteriological presence of *Mycobacterium tuberculosis* needed to be confirmed by sputum acid-fast bacillus (AFB) smear and culture. Sputum AFB smears on three different days were positive. Because of financial constraints, the patient requested referral to the government Chest Clinic (Klinik Dada) for treatment. This case report highlights a good learning point for the primary care physician evaluating a chronic cough with a chest radiograph. A 'normal-looking' chest radiograph does not rule out PTB. PTB may manifest radiographic patterns we are not familiar with; the tennis racket sign is a good case in point.

Introduction

Tuberculosis (TB) is a chronic airborne infectious disease caused by *Mycobacterium tuberculosis*. According to the World Health Organization (WHO), TB was the leading cause of death among adults from a single infectious disease worldwide in 2018.[1]

Malaysia is currently classified as an intermediate TB burden country by the WHO, with an incidence rate of 92/100,000 population, but it is outranked by countries such as Thailand, Indonesia, Vietnam, Cambodia and the Philippines, which are high TB burden countries.[1,2]

In 2020, Kaur et al. reported that TB had become the leading cause of death among infectious diseases in the past ten years in Malaysia, with a mortality rate of 5.56 per 100,000 population.[1]

Since the introduction of the National Strategic Plan for Tuberculosis Control from 2011–2015, notified TB cases increased 17.2% from 20,666 cases in 2011 to 24,220 cases in 2015.[3]

In 2011–2015, non-Malaysians represented 12% to 14% of TB cases in Malaysia.[3] TB cases among non-Malaysians increased from 2,870 cases in 2011 to 2,969 cases in 2015.[3] Indonesia (33%) and the Philippines (31%) are major contributing countries for TB cases among non-Malaysians.[3] TB in Malaysia has been aptly described as a 'disease sans borders' because of the influx of foreigners, many of whom are migrant workers.

Case Presentation

A 24-year-old male migrant worker came to our clinic with the chief complaint of five months' history of cough. No antecedent fever existed, and the cough had come on insidiously. It then escalated into a racking cough that periodically brought blood-streaked sputum. He had loss of appetite, and his weight plummeted from 65 to 57 kilograms.

The patient had been seen in three different primary care facilities, and three chest

radiographs were performed. These radiographs were interpreted as normal, with no overt evidence of pulmonary infection. He was prescribed antibiotics, but with no effect.

The patient had always enjoyed good health. No one in his immediate family in his country of origin had TB. He had been working in Malaysia for three years and had three mandatory foreign workers' examinations; on all occasions, he was certified healthy. As far as he knew, none of his fellow workers had TB. He did not smoke.

On examination, auscultation of the lungs revealed scattered, fine crepitations in both upper zones of the lungs. No other abnormal finding was encountered.

Laboratory investigations

ESR 30 MM/HR, haemoglobin 14 G/DL, platelet count 269 x 10^9/L, WBC count 8.2 x 10^9/L. Differential count: neutrophil 72%, lymphocyte 12%, monocyte 12%, eosinophil 4%. FBS 5.5 mmol/L. The renal function tests, lipid profile and liver function tests were normal. Sputum acid-fast bacillus (AFB) smears were positive on three different days.

Some months before the onset of his cough, the patient had a mandatory foreign worker's medical examination. The examination included a chest radiograph, HIV, hepatitis B surface antigen and VDRL. All tests were negative, and he was certified fit.

Unfortunately, the three chest radiographs taken in his previous consultations were not in his possession and thus not available for comparison. The chest radiograph in our clinic vividly demonstrated the 'tennis racket sign'.

Because of financial constraints, the patient requested that he be referred to the government Chest Clinic (Klinik Dada) for treatment.

Challenges we faced

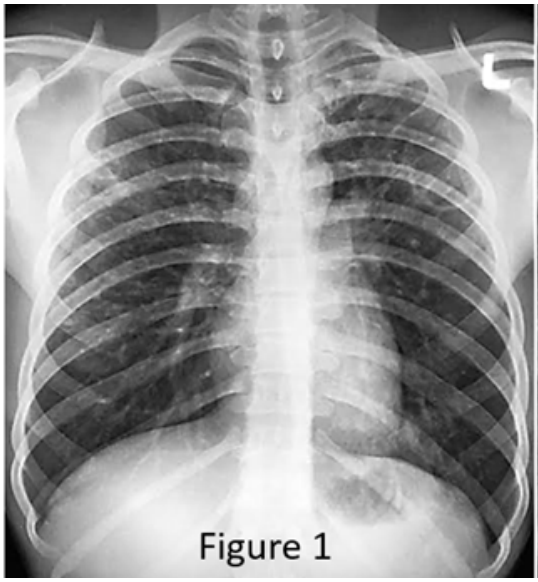
For this patient, we faced several challenges. The first was communication. The patient did not have a good command of Bahasa Malaysia, and we were not conversant with his native tongue.

Secondly, the employer was sceptical of our diagnosis of PTB. Three previous radiographs were read as normal by three primary care physicians, and the patient had a recent mandatory examination that certified him fit and free of infectious disease.

Thirdly, investigations such as the sputum AFB smear and culture were costly and would involve more trips (and lost working days) to our clinic. He had to come to our practice on three days from a plantation more than an hour's drive away.

However, when we showed the migrant worker and his employer the pictorial outline of a tennis racket on the chest radiograph, they agreed to sputum AFB smears.

Chest radiograph



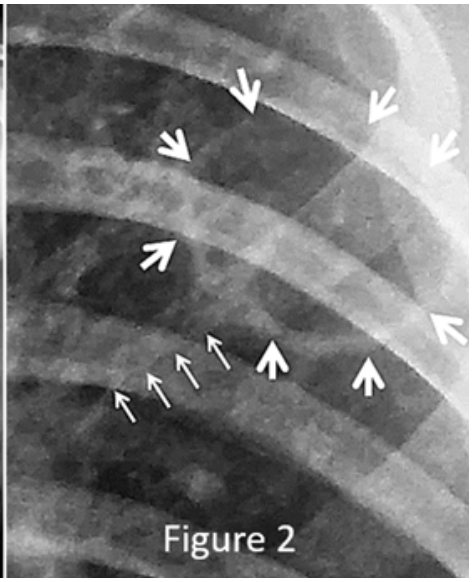


Figure 1. Chest radiograph shows 'tennis racket sign' in the left upper zone. A small cavity is present in the right upper zone. **Figure 2.** 'Tennis racket sign', magnified view.

In **Figure 1**, two distinct cavities are seen. The smaller of the two is situated in the periphery of the right rib cage and overlies the fourth rib. In the left lung is a much larger cavity; its upper border reaches the fourth left rib, and the lower border sits in the intercostal space between the fifth and sixth rib. No patchy parenchymal opacity exists in the upper zones of both lungs. The radiological pattern on the left upper zone is the tennis racket sign.

In **Figure 2**, the bold arrow heads outline the circumference of the tennis racket head; thin arrows point to the tennis racket handle, which extends medially towards the hilum. These two features fuse to form the tennis racket sign (**Figure 3**).

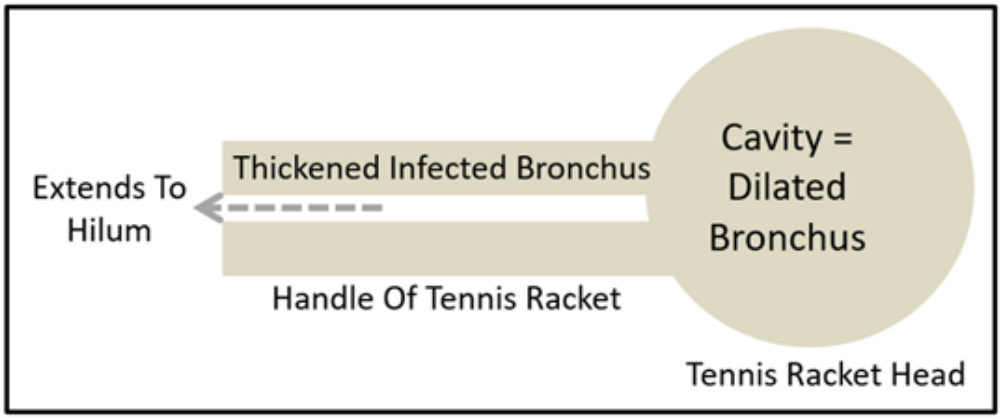


Figure 3. Diagrammatic representation of the 'tennis racket sign'.

Discussion

Genesis of tennis racket sign

The TB disease is predominantly in the bronchus; the infected walls of the bronchus are thickened, with narrowing or occlusion and dilatation beyond. The cavity is in fact the dilated bronchus, reminiscent of a tennis racket head. Microscopic studies have shown that the wall of the cavity or the tennis racket head has bronchial wall histological features, with or without tuberculosis foci in it.[4,5]

The rest of the dilated bronchus extends medially towards the hilum. This infected bronchus graphically mimics the narrow shaft or handle of the tennis racket. This draining bronchus of the tuberculous cavity is either concurrently or secondarily infected.

The dilated bronchus (head of tennis racket) and the draining bronchus (handle of tennis racket) come together to form the tennis racket sign (**Figure 3**).[4,5]

Tennis racket sign as an aid to the diagnosis of post-primary PTB

The chest film is the mainstay in the radiologic evaluation of suspected PTB. However, this tool has limitations. A normal chest radiograph does not rule out tuberculous infection. The picture of PTB in the chest radiograph can be variable. Radiographic shadowing can range from typical upper lobe infiltrates to atypical solitary lower lobe opacity. Atypical morphological characteristics are often seen in the chest radiographs of the immunocompromised population with PTB.

Reading chest radiographs is also fraught with high inter- and intra-reader variation. Most cases of post-primary PTB are easily recognised by the bilateral, patchy, ill-defined parenchymal opacities, located in the apical and posterior segments of the upper lobes, followed in frequency by the superior segment of the lower lobes and the anterior segment of the upper lobes.[6] The hallmark of post-primary PTB, the cavities, are the ring shadows sitting amidst the fluffy cotton wool opacities. In our patient, no parenchymal opacities were visible, and this was perhaps the stumbling block to early diagnosis. In the absence of florid parenchymal infiltrates in the radiographs, the sighting of the tennis racket sign (in addition to the history and physical findings) prompted us to look for *Mycobacterium tuberculosis*.

Tennis racket sign and high grades of bacteriological presence

Shital4 believes that the tennis racket sign is a strong predictor of active pulmonary TB. Takhar5 asserts that "the presence of

'tennis racket' sign endorses higher grades of bacteriological presence". In our patient, who was not previously treated for TB, the tennis racket sign was seen, and tubercle bacilli were demonstrated in the sputum AFB smear tests.

Studies have found that the number of tubercle bacilli in different types of tuberculous lesions varied substantially. The number of bacilli in an encapsulated solid nodule, 2 cm in diameter, having no communication with the bronchus, ranged from about 100 to not more than a few thousand. However, a cavitary lesion of the same dimensions may harbour astronomical figures of bacilli, ranging from 10 million to 1 billion bacilli.[4,5] Of course, such cavities are likely to discharge enormous quantities of bacilli and facilitate diagnosis by the sputum AFB smear examination. Shital noted that the tennis racket cavity was not commonly described in the literature as a predictor of active pulmonary TB. They confirmed higher grades of bacteriological yields in AFB smear examination in cases with this cavity.[4]

Thus far, we have only been able to locate a few single case reports of the tennis racket sign with documented bacteriological presence of Mycobacterium tuberculosis. We have not been able to find other literature to confirm that the tennis racket sign is a strong predictor of active pulmonary TB.

Conclusion

In general practice, easy access and low cost make the chest radiograph the usual initial investigative modality in a patient with the provisional diagnosis of PTB. Primary care physicians must be aware that the radiographic picture of PTB may be atypical. The chest radiograph with a tennis racket sign is an aid to the diagnosis of post-primary PTB, and the bacteriological presence of Mycobacterium tuberculosis must be confirmed.

Conflict of Interest

The authors declare they have no conflict of interest that are directly or indirectly related to the report.

Ethical Statement

Informed consent has been obtained from the patient prior to the writing of this report for publication purposes.

Funding Sources

No funding was received for this report.

What is the implication to patients?

Awareness that radiographic pictures of PTB may be atypical is especially relevant for the immunocompromised, the paediatric age group and adults with primary PTB.

The cavity is the hallmark of post-primary PTB. This case report of the tennis racket sign demonstrates a cavity that is different from the usual ring shadows. This picture of a tennis racket sign is a useful aid in the diagnosis of post-primary PTB.

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