ORIGINAL ARTICLE

CHEST X-RAY: AN UNFAIR SCREENING TOOL

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Background: Chest radiography is considered as the sole screening tool for chest pathologies as prerequisite for overseas employment during their medical examinations. The aim was to evaluate the role of CXR as a screening tool in the diagnosis of different lung pathologies in general and TB in particular. **Methods:** In this descriptive case series, reports of 63,648 Pakistani candidates, who took chest X-rays during medical screening for employment abroad under the rules of Gulf Coordination Council (GCC), were analysed. The reports were collected over a three year period (2008–2011). All the candidates were apparently healthy males of ages ranging between 18–50 years with average age of 27.4 years. **Results:** Out of 63,648 candidates examined over a three year period, 1368 (2.15%) were declared unfit on the basis of CXR. There were 359 cases of calcified granulomas, 318 of costophrenic angle obliteration, 174 of apical scaring; 144 of pulmonary scars, 123 of fibrocalcific lesion, 82 of soft shadows in lung, 51 of nodular lung shadows, 42 of lymphadenopathy, 30 of pleural effusion, 26 of interstitial lung shadow and 19 of calcification. A closer scrutiny of these cases revealed that over 90% of the CXRs of the candidates declared as having lung pathologies displayed scars rather than active disease. **Conclusion:** A normal CXR by itself, neither categorically rules out problems in the chest nor does any finding in it confirm some disease. Unfitness on the basis of CXR alone, unless substantiated by further investigation, is questionable to say the least.

Keywords: Chest radiography, pre-employment, screening, misdiagnosis, Tuberculosis

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INTRODUCTION

Chest X-ray is a useful imaging tool and the most commonly performed radiological examination. The World Health Organization (WHO) estimates that half of all radiological procedures performed worldwide are CXR.[1] Traditionally, CXR have been taken prior to insurance, employment, surgery, during immigration and for the evaluation of lungs, heart and chest wall.

Tuberculosis, pneumonia, heart failure, emphysema, lung cancer and other medical conditions can be diagnosed on a CXR. However, from the review of the past literature it has been observed that CXRs on individuals without cardiopulmonary disease has not been shown to improve disease outcome and is not cost-effective.[2] In addition, many things seen on a CXR turn out to be artefacts or benign problems. Even many insurance companies no longer pay for these "routine" x-rays obtained in the absence of specific signs, symptoms or medical conditions.

Pakistanis seeking employment in Gulf countries of Bahrain, Kuwait, Oman, Qatar and Saudi Arabia undertake a prerequisite medical examination at any of the accredited medical clinics in Pakistan. Similar type of examination is conducted for intending immigrants to UK, USA, Canada, Australia, and New Zeeland. In some cases CXR is a requirement of visit visa also. During the medical examinations, every candidate is in routine subjected to CXR in accordance with the laid down criteria, even if no other medical indication exists.

The purpose of this study was to assess the suitability or otherwise of CXR as a sole screening tool for pulmonary related diseases. We conducted this study with the view to evaluate the utility of CXR as a screening test for declaring the candidate fit/unfit for overseas employment.

MATERIAL AND METHODS

In this descriptive case-series, data was recorded from 63,648 individuals who underwent chest X-rays from Jan 2008 to Jan 2011 at one of the accredited medical centre in Pakistan. Inclusion criteria were age ≥18 years, job seekers and male.

A total of 63, 648 chest X-ray reports of those workers going abroad from all the provinces of Pakistan, Northern areas and Azad Jammu Kashmir were studied over a period of 3 years. The centre has maintained computer database. Candidates were exposed on a 14–17 inches film. Exclusion criteria were signs or symptoms of other apparent disease like skin pathologies, gross errors of refraction, gross physical disability, varicose veins, venereal diseases and hernia.

Radiographs were exposed with the following criteria:

- Green films PA Standard view

- 20mas.80KV exposure with FFD of 1.8meters.
- Read by a qualified radiologist

The other tests like ESR, sputum for AFB, TST, PCR for TB, Mycodot test, NAA, T-Spot , Quantiferon-TB Gold, Pleural biopsy, Bronchoscopy and CT scan were not routinely done and were not included in the routine medical examination.

RESULT

Data were extracted from the database and analysed. On average 2–3 candidates were declared unfit on a daily basis over a 3 year period. During this study period about 1368 candidates were declared unfit on radiological grounds alone. Candidates were males of ages ranging from 18–50 years. Average age was 27.4 years. Approximately 70–80 candidates were exposed daily. Majority of the candidates belonged to lower socioeconomic status and were mostly skilled/un-skilled labourers, with few educated beyond high school levels. Mostly were married. Majority were smokers. Hardly anyone disclosed history of TB if it is present in the family. (History of cancer among first-degree relatives was not asked in the centre).

All the candidates declared unfit were further investigated through ESR and specially obtained lateral & oblique views examined by a panel of doctors headed by Head of Radiology, Holy family Hospital, Rawalpindi to substantiate the corresponding P/A view CXR findings. Based on detailed examination of these views, symptoms, detailed history, ESR and CBC, the panel ruled out active TB infiltrate in 90% of the unfit candidates. Rather than being active infiltrates the lesions detected in their PA views were merely scars attributed to some old lesion/infection.

Over 90% of unfit candidates had scars rather than active disease. The list of abnormalities detected with their percentage is shown in Table-1.

Table-1: Distribution of detected abnormality

Detected Abnormality	**Cases**	**Percentage**
Calcific granuloma in the lung	359	26.24
Minimal costophrenic angle obliteration	318	23.25
Moderate apical scarring	174	12.72
Solitary fibrotic lesion/pulm scar	144	10.53
Fibrocalcific lesion in lung	123	8.99
Active pulmonary infiltration by soft shadows in lung	82	5.99
Nodular lung shadow	51	3.73
Lymphadenopathy	42	3.07
Pleural Effusion	30	2.19
Interstitial lung shadowing..	26	1.90
Hilar Calcification	19	1.39

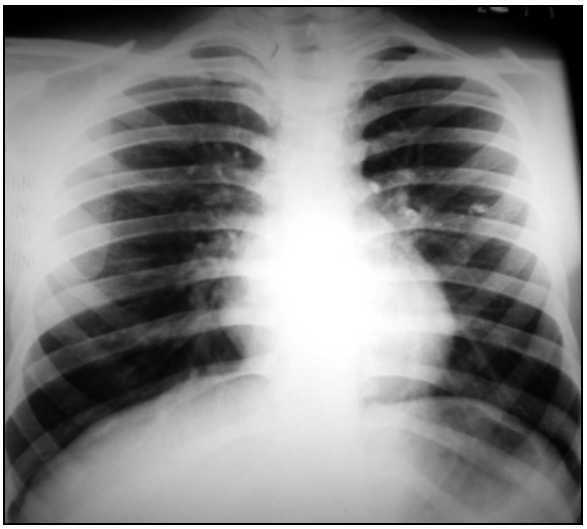

Figure-1: Para-hilar calcification

Figure-2: Apical scarring

Figure-3: CP angle obliteration

DISCUSSION

Pulmonary diseases continue to be a menace in the developing world for quite some time. Over the last few years, there has been a dramatic increase in their incidence. In the developed world, this increase could be attributed to compromised immune systems, immunosuppressive drugs, substance abuse or AIDS and immigration. The increase in their incidence is more pronounced in the countries of developing world like Pakistan due to additional contributory primary risk factors like poverty, malnutrition and overcrowded living conditions etc.

Due to high prevalence of pulmonary diseases in developing countries, screening for these diseases is a major component of any pre-employment medical examination. CXR forms an integral part of any such medical screening regimen. According to the WHO's Global Tuberculosis Control[3], Pakistan in 2009 ranked eighth in the world on the list of 22 high-burden tuberculosis countries. As its prevalence is high, the main focus of screening via CXR in Pakistan is detection of TB. However, the suitability of CXR for this purpose is debatable to say the least.

In this study we would like to discuss the effectiveness of CXR for screening different lung pathologies in general and TB in particular.

Here we would like to emphasize that CXR alone cannot be used as a screening test for any of the lung pathology due to its low specificity on one hand and low sensitivity on the other hand.

Over a broad range of values; a negative CXR does not eliminate the diagnosis of tuberculosis, pneumonia, asthma, pulmonary embolism, lung carcinoma etc. For example a negative CXR does not exclude exposure to TB bacteria; patients with asthma exacerbations can have a normal CXR, there are some cancers that are too small or are difficult to visualize and may not be identified; and pulmonary embolism cannot be seen on chest x-rays and require additional study. These examples elaborate that some conditions of the chest will not show up on the image. The existing literature is replete with references that highlight this insensitivity or false negativity. Thirumaran and colleagues have described their experience with a group of patients evaluated for haemoptysis who had a normal CXR.[4] According to Brigg *et al* due to the low sensitivity of CXR, there is no clear indication for obtaining a pre-employment CXR to screen for tuberculosis.[5]

It has been found that CXRs are inadequate for diagnosing lung pathologies at an early stage, when they are treatable. X ray screening of patients with high risk for lung cancer (e.g., smokers) has not been found to lead to a reduction in cancer mortality and is not considered beneficial.[6] It has been seen that by the time lung cancers are discovered on CXR, the tumour is often far too advanced to allow the patient to be cured with surgery or radiation therapy.

In our study we came to know from the feedback of Gulf countries that every year, some of them declared fit on this account, were subsequently detected for pulmonary diseases within a few months after arriving abroad. The scrutiny of all these cases from database maintained at GCC revealed that they had absolutely normal CXR images at the time of medical screening. We infer that they were carrying disease at the time of screening but were erroneously declared fit because the CXR did not show it.

According to a latest study also, Universal chest radiography in a large pre-employment TB screening program was of low yield in the detection of active TB and it provided no assistance in deciding which individuals to prioritize for treatment.[7] The fact that routine pre-employment CXR gave false sense of security and is of little value is thus well established.

Conversely, CXR images may give false alarm of lesion, when none exist. For example lung fibrosis, scarring, pleural thickening, diaphragmatic tenting or blunting of costophrenic angle when usually visualized by CXR could usually be suggestive of TB; where most of the time no TB exists at all. (Figure-1, 2 and 3). According to one study when CXR was used for screening for active TB in a foreign-born population, the vast majority of positive results were false positive.[8]

Our study of examinees at one of the GCC's clinic for the last three years revealed that a significant portion (around 2.15%) was declared unfit on the basis of these CXRs alone and ruled out for employment opportunities abroad. GCC criteria for declaring a candidate medically unfit includes CXR with lesions showing active/or past evidence of old TB with even minimal fibrosis, pleural thickening, costophrenic angle obliteration, moderate apical scarring, tiny calcific granuloma in the lung, calcification, solitary fibrotic lesion, active pulmonary infiltration by soft shadows, hilar/mediastinal lymphadenopathy, nodular lung shadow, pleural effusion and interstitial lung shadowing. However, only 2 of these stated conditions, i.e., active pulmonary infiltration by soft shadows in lung and nodular lung shadow may be actually indicative of TB. The rest of the conditions, point towards non-specific or healed conditions in majority of cases and need to be investigated further. We discovered the same in our study when the

candidates declared unfit on the basis of CXR P/A view were examined in detail. However, since the GCC protocol dictated so, these, otherwise fit candidates, had to be declared unfit. Our contention that this rejection was unfair was supported by the panel which examined the unfit candidates in detail. The opinion of the panel however, was predominantly by the experienced radiologist who was sure of not missing active infiltrates through examination of P/A, lateral and oblique CXR views. Since internationally the experts have serious doubts about CXR as a screening tool for pulmonary diseases, more deterministic test like PCR could have given more credence to our study. We leave the expensive tests to some later studies possibly funded by GCC etc.

According to an international source, following findings on CXR are minor and not suggestive of TB disease and require no follow-up evaluation after resettlement of the applicant.

- Pleural thickening.
- Diaphragmatic tenting
- Blunting of costophrenic angle (in adults). Blunting can be related to a small amount of fluid in the pleural space or to pleural thickening and by itself, is a non-specific finding .In contrast a large pleural effusion, or the presence of a significant amount of fluid in the pleural space, may be a sign of active TB at any age.
- Solitary calcified nodules or granuloma- Discrete calcified nodule or granuloma, or calcified lymph node. The calcified nodule can be within the lung, hila, or mediastinum.
- Minor musculoskeletal or cardiac findings. need no follow-up.[9]

In a study it was stated that many immigrants and refugees who underwent follow-up evaluation after their arrival in the USA, active pulmonary TB was diagnosed in only 7% of those who had received pre immigration diagnosis of inactive TB. In the post-arrival follow-up evaluation, no TB was diagnosed in 26.4% of immigrants and refugees who had smear negative TB[10], suggesting that TB might have been over-diagnosed in native countries.

According to one source, abnormalities on CXRs may be suggestive of, but are never diagnostic of TB. However, CXRs may be used to rule out the possibility of pulmonary TB in a person who has a positive reaction to the Tuberculin skin test (TST) and no symptoms of disease.[11]

According to different researches the Tuberculin skin testing could reduce the number of chest X-rays, and identify more candidates for prophylaxis.[12] Because of the high incidence of TB after immigration to Canada, critics have suggested that the current CXR screening program, implemented over 50 years ago, be replaced with Tuberculin skin test screening.[13] Tuberculin screening has been suggested because of its greater sensitivity than chest radiography for the detection of tuberculosis infection.[12]

California law requires TB screening for employment in health care facilities. Such examination must include a TST and no CXR is required for a person with tuberculin negative. So according to the author, routine pre- employment CXR did not produce compliance with the tuberculosis laws, was contrary to established occupational medicine practice guidelines, and was unnecessary and wasteful.[14]

We however, have reservations about positive TST finding as a pre requisite for CXR. Studies carried out in some developing countries have revealed that the role of TST is also controversial as it is not very sensitive either. The explanation for this probably lies in routine BCG vaccination at birth, as well as exposure over the years to the tubercle bacilli. This is in contrast to what is obtained in the developed world where BCG is not given at birth.

In one such study conducted in Nigeria, it was found that a sizeable number of their population were exposed to the tubercle bacilli without developing lung parenchymal disease, and showed a positive tuberculin reaction with normal CXRs. This therefore suggests that in developing countries, there may not be a need for follow-up CXR for every case of asymptomatic positive tuberculin reaction. The study also found increasing positivity to TST with increasing age.[15] The study found a low correlation between abnormal chest X-ray findings and positive reactions to TST in asymptomatic subjects. On the basis of similarities it could be inferred that TST may not be suited as a diagnostic tool in other developing countries like Pakistan.

We are also aware of the hazards of out rightly rejecting CXR as a diagnostic tool. Benefits of CXR cannot be denied as these may provide important information regarding the size, shape, contour, and anatomic location of the heart, lungs, bronchi, great vessels (aorta, aortic arch, pulmonary arteries), mediastinum and the bones (cervical and dorsal spine, clavicles, shoulder girdle, and ribs).In the case of diseases this imaging tool is still helpful for the detection of findings like cardiomegaly, thickening of left ventricle, history of CABG etc. However, it must be emphasized that assessment of the activity of TB cannot be made accurately on the basis of a single radiograph alone. It is unfair to declare a person unfit on the basis of CXR if he had a disease/lesion in any part of life which was cured/ healed with or without treatment.

As a way forward we suggest that if there is any suspicion of active TB on CXR, sputum smears and TST, though themselves non reliable, must be obtained for cross check and borderline cases should be given some time before declaring them unfit. Some effusion, pleural thickening may be due to non-tuberculosis reasons like acute pneumonitis or some fungal infections which can be cured after 2 weeks of treatment. They should be called for follow up after 1-2 months if suspected as TB.

Another way of helping rejected employee with scars is to offer them a CT scan. The differential for lung findings is very broad and can defeat even the most experienced radiologist. It is seldom possible to reach a diagnosis on the basis of the CXR alone: high-resolution CT of the chest is usually required and sometimes PCR of bronchoalveolar lavage (BAL) or lung biopsy is indicated. Consequently, the early use of PCR on BAL allows diagnoses more rapidly than using any other test.[16]

Another important test is adenosine deaminase (ADA). There is considerable evidence to support the use of ADA in pleural fluid samples for the diagnosis of pleural TB, where sensitivity was very high. In pleural TB, ADA tests had higher sensitivity than any other tests.[8]And this is a very useful test to exclude TB in our community.

This increases the expense and complexity of any screening programme. However, these new technologies have not been evaluated for screening purposes and, at the present time, are generally more costly than CXR or TST, so their utility and cost-effectiveness remain unclear at this time. But we are recommending these tests only for those individuals who were declared unfit on the basis of these CXRs alone and ruled out for employment opportunities abroad. We strongly suggest that GCC should follow the international protocol.

CONCLUSION

Findings in the CXR for confirming or ruling out pulmonary related diseases could be inconclusive, to say the least. Denying employment opportunities merely on the basis of inconclusive evidence therefore, seems manifestly unjust. Conversely, declaring examinees free from pulmonary diseases merely on this basis is also improper.

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