

General Practice

The Radiological Features of Primary Pulmonary Tuberculosis

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SUMMARY

A very brief review is given of the pathology of primary pulmonary tuberculosis. Numerous characteristic, but not pathognomonic, radiological appearances of primary pulmonary tuberculosis are briefly described and some of them are illustrated. The final diagnosis, however, depends on correlating the radiological picture with the clinical picture and special investigations.

S. Afr. med. J., 55, 994 (1979).

Primary pulmonary tuberculosis develops when tubercle bacilli enter the body for the first time through the lung, and this may occur at any age. The tubercle bacilli are inspired and settle in a lung acinus at random, and there is no predilection for any part of the lung. At the site of lodgement the tubercle bacilli multiply and elicit an exudative and granulomatous reaction with tubercle formation, the so-called Ghon focus.

From the site of lodgement, tubercle bacilli spread within a few hours through the draining lymphatics to the regional lymph nodes where they set up a tuberculous inflammatory reaction.

At this early stage and throughout the course of the primary infection, tubercle bacilli enter the blood stream at odd intervals. In the blood stream most of the bacilli are destroyed, but some are filtered out in organs, notably the lungs, lymph nodes, liver, spleen and bone marrow. Again, in these organs most of the tubercle bacilli are destroyed, but some form a tuberculous focus which may progress, heal or remain dormant, only to flare up after many years.

What happens in each of these three sites, namely the lung, the draining lymph nodes and the peripheral organs, determines the evolution of primary pulmonary tuberculosis.

In the vast majority of cases the infection remains localized to the primary focus in the lung and to the draining lymph nodes and heals completely, so-called uncomplicated primary pulmonary tuberculosis. In a minority of cases complications develop which vary over a very wide spectrum from innocent to lethal, so-called complicated primary pulmonary tuberculosis.

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By primary pulmonary tuberculosis we understand the primary focus in the lung together with the reaction in the draining nodes and all the complications that develop as a direct result of this infection.

RADIOLOGICAL APPEARANCES

Radiography is merely a two-dimensional demonstration of a lesion in different shades of white, grey and black. If one knows what the nature of a lesion is, one can predict what the radiological picture should be.

Primary pulmonary tuberculosis produces a number of characteristic pathological appearances and one would therefore expect to find a number of characteristic radiological appearances. Such is the case and the following characteristic, although not pathognomonic, radiological appearances are found.

Normal Chest Radiograph

The Ghon focus and the infected lymph nodes are so small that they are not radiologically demonstrable. The only proof of tuberculosis in such a case is that a tuberculin-negative patient now becomes tuberculin-positive. How often a normal chest radiograph is found under these circumstances depends largely on the age of the patient. Around 2 years of age it is found in only about 20% of cases, whereas around 15 years of age it is found in about 80% of cases.

Complete Primary Complex

When the Ghon focus together with the enlarged draining lymph nodes is radiologically demonstrable, the so-called complete primary complex is seen (Fig. 1). The Ghon focus may be found anywhere in the lung, is homogeneously dense, round and fairly sharply defined, and varies in size from 1 mm to a few centimetres in diameter.

When the draining lymph nodes are radiologically detectable these are usually the ipsilateral hilar nodes and the enlargement sometimes includes the paratracheal nodes, usually those on the right side. In a small percentage of cases bilateral hilar nodal enlargement is found and, very rarely, with a Ghon focus in the left lower lobe, there may be contralateral hilar node enlargement. Very rarely also enlargement of paratracheal nodes may be found without radiologically demonstrable enlarged hilar nodes.

The nodes vary in size from hardly detectable to big masses; they may be sharply defined and lobulated or

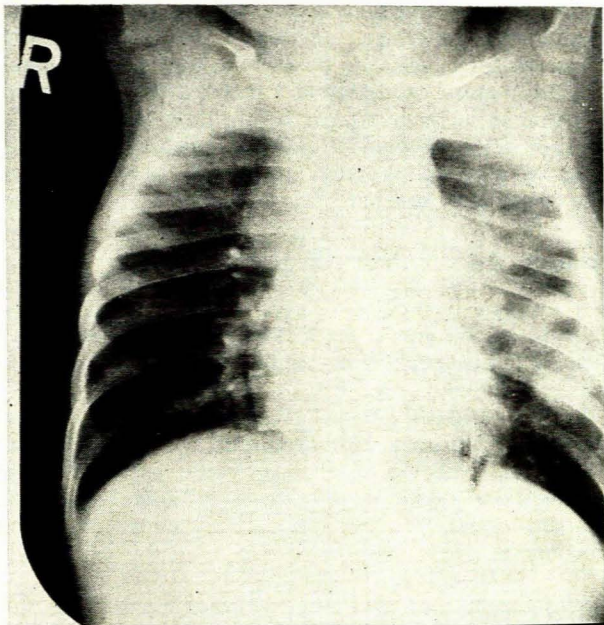


Fig. 1. Primary complex. Note Ghon focus at left base and enlarged left hilar and right paratracheal lymph nodes.

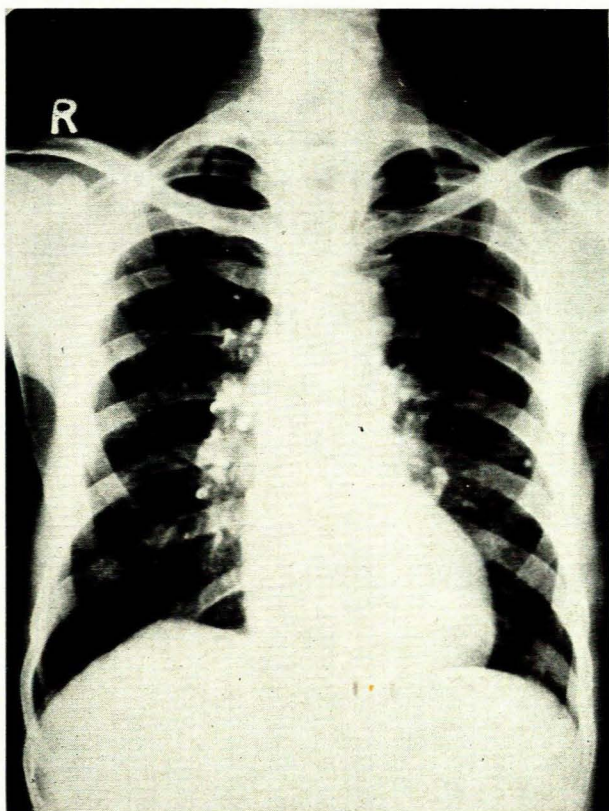


Fig. 2. Calcified primary complex. Note calcified Ghon focus in periphery of left mid-zone together with calcified left and right hilar nodes.

smooth, or they may be ill-defined. The lymph node component of the primary complex is always much more conspicuous than the Ghon focus.

Even with chemotherapy the Ghon focus and the lymph nodes show little change in size for 3-4 months. When healing occurs the chest radiograph may be normal, but sometimes, after 12 months or so, a small area of calcification in the lung field and spots of calcification in the hilar nodes may testify to the original caseation in the Ghon focus and nodes (Fig. 2).

Enlargement of Nodes without Ghon Focus

Radiologically demonstrable enlargement of nodes, even gross enlargement, without a detectable Ghon focus is a common finding and probably the most common radiological abnormality in uncomplicated primary pulmonary tuberculosis. The Ghon focus in these cases is too small to be demonstrable or it is placed in such a position that it is difficult to detect in routine views, e.g. behind the heart or near a posterior costophrenic sulcus (Fig. 3).

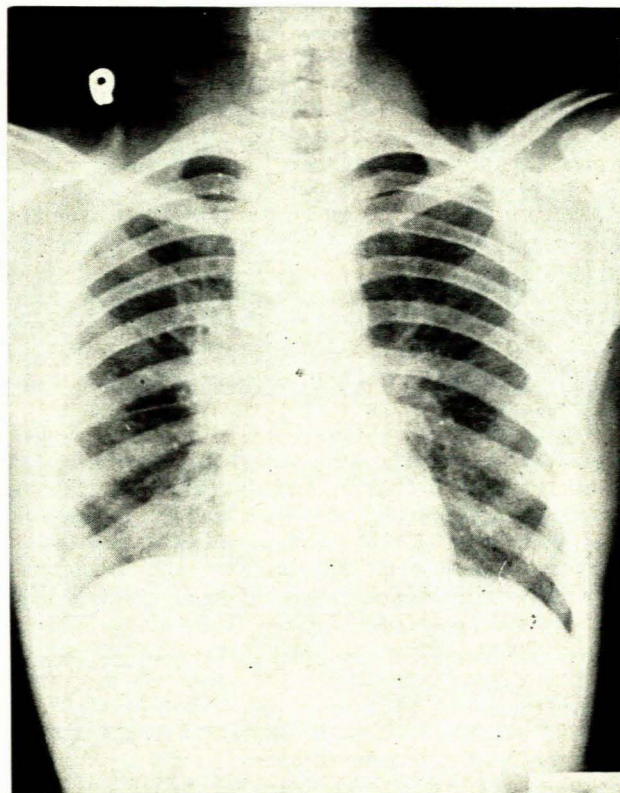


Fig. 3. Primary pulmonary tuberculosis with enlarged right hilar and right paratracheal nodes, but without a radiologically demonstrable Ghon focus.

Segmental Lesion

So-called segmental lesions, endobronchial tuberculosis or lymphobronchial tuberculosis, are common radiological findings. All these terms refer to a wide spectrum

of pathological and radiological pictures which are confined to a bronchopulmonary segment, a lobe or a lung and which are the direct result of involvement of a bronchus by a tuberculous infected lymph node. This is the type of lesion previously known as epituberculosis (Fig. 4).

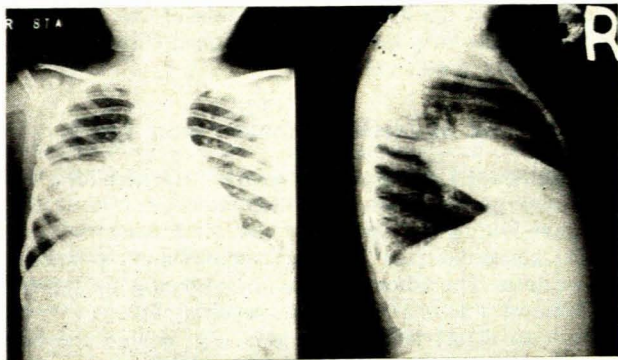


Fig. 4. Typical lymphobronchial tuberculosis (segmental lesion, endobronchial tuberculosis, epituberculosis) with homogeneous consolidation of the right middle lobe and with enlarged right hilar nodes.

The characteristic radiological picture is that of a segment, lobe or lung of more or less normal size which is homogeneously consolidated together with enlarged nodes; a narrowed or occluded bronchus is often demonstrable. Early in its evolution the lesion may be a little bigger or a little smaller than normal for that segment, lobe or lung. Early in the course of the lesion and also as the lesion clears up it may not be homogeneously dense. Enlargement of the nodes and narrowing or occlusion of a bronchus are usually, but not always, demonstrable, and to show these features tomographs are most helpful.

These lesions are chronic, and even with treatment, show very little change from week to week or even from month to month. Over a period of months two concurrent changes usually take place, namely, collapse and re-aeration; that is, the lesion decreases in size and in density. In the vast majority of cases (80% or more), a permanently damaged segment, lobe or lung with a rather characteristic appearance remains. The segment, lobe or lung is diminished in size, has a streaky appearance due to fibrosis and crowding of lung markings, may show areas of increased translucency due to bronchiectasis, and areas of calcification in the lesion and in the draining nodes testifying to original caseation.

Around this characteristic lesion the radiological picture varies from one extreme to another. If more or bigger areas of caseation develop, the lesion takes longer to clear, and a more severely damaged segment, lobe or lung with a more severe degree of bronchiectasis is left. The caseation may progress to cavity formation, so that within the opacity a cavity or cavities may be seen. If there is total bronchial obstruction without much infection distal to the obstruction, uncomplicated collapse develops. If there is total bronchial obstruction with little infection

distal to the obstruction, a combination of collapse and consolidation develops, so-called collapse-consolidation. If there is total bronchial obstruction with a large amount of inflammatory exudation and mucus retention, the consolidated segment or lobe is bigger than normal and the adjacent fissure bulges. If there is partial bronchial obstruction with valve action, overinflation of a segment, lobe or lung may develop.

Primary Tuberculous Pleural Effusion

A primary tuberculous pleural effusion develops when tubercle bacilli reach the pleura of a patient who is tuberculin-positive. Much of the fluid is the result of allergic reaction.

The tuberculous pleural effusion is usually the only radiological evidence of tuberculosis and looks like any other pleural effusion of whatever cause. Sometimes other radiological evidence of tuberculosis is found, for example, enlarged nodes, a lymphobronchial lesion or miliary tuberculosis.

Miliary Tuberculosis

Classic miliary tuberculosis develops when there is a massive invasion of the blood stream by tubercle bacilli in a single incident. Classic miliary tuberculosis is but a small segment of a wide spectrum of appearances which can develop through haematogenous dissemination of tubercle bacilli.

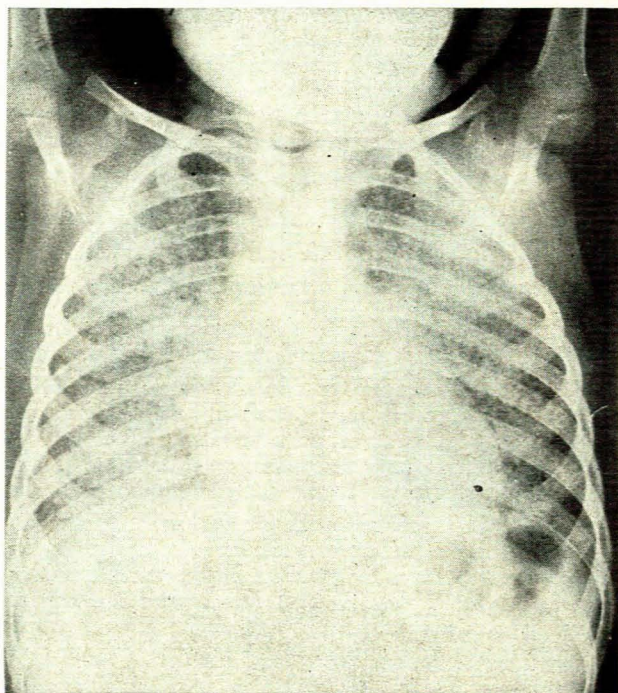


Fig. 5. Classic miliary tuberculosis. Innumerable tiny round opacities, all of the same size, are evenly distributed throughout both lungs with obliteration of the vascular markings.

The classic radiological picture is that of innumerable tiny, sharply defined, round opacities widely and symmetrically distributed throughout both lungs. From patient to patient these tiny opacities vary in size from pin-prick size to 1-2 mm in diameter, but it is characteristic of miliary tuberculosis that in any individual patient all the opacities are of the same size. Innumerable opacities obscure the vascular markings in the lungs (Fig. 5).

The classic picture is radiologically obvious, but it is sometimes difficult or impossible to be sure whether a slightly stippled appearance of the lung is due to miliary tuberculosis or whether it is still within normal limits. It must also be remembered that a patient may die of miliary tuberculosis before the lungs show a radiologically detectable miliary pattern.

Primary Cavitating Tuberculosis

A cavity in the lung may form in the course of primary pulmonary tuberculosis when a lymphobronchial lesion breaks down, when a Ghon focus breaks down, when tuberculous bronchopneumonia breaks down or when a haematogenous lesion breaks down. The cavity so formed looks like any other cavity and the radiological diagnosis can be made only when there are other radiological manifestations of tuberculosis.

Tuberculous Bronchopneumonia

This develops when tubercle bacilli become disseminated through the bronchial tree, either from the cavity of primary cavitating tuberculosis or from rupture of a liquified tuberculous lymph node into a major bronchus or trachea.

The radiological picture of tuberculous bronchopneumonia is similar to that of bronchopneumonia of any other aetiology. Although the tuberculous nature may sometimes be suspected because the lesions are rather dense and well defined, a radiological diagnosis cannot be

made in the absence of other radiological manifestations of tuberculosis.

Late Segmental Lesions

The late result of a so-called segmental lesion, endobronchial tuberculosis or lymphobronchial tuberculosis presents a rather characteristic appearance, as already described. The importance of this lesion and of its separate classification lies in the fact that it must be regarded as the late result of tuberculosis and not confused with and treated as active pulmonary tuberculosis.

Mixed Patterns

Combinations of any of the above patterns may be found. For example, lymphobronchial tuberculosis with miliary tuberculosis, primary cavitating tuberculosis with tuberculous bronchopneumonia, a primary complex with a pleural effusion, lymphobronchial tuberculosis with cavitation or tuberculous bronchopneumonia, etc.

Unclassified Patterns

Rarely a radiological appearance is found which does not fit into any of the patterns just described and which cannot be classified. One must, however, guard against diagnosing primary pulmonary tuberculosis unless the radiological pattern fits one of the above patterns and unless one can explain the radiological pattern on the known pathogenesis and pathology of primary pulmonary tuberculosis.

CONCLUSIONS

The radiological appearances of primary pulmonary tuberculosis extend over a very broad spectrum and include numerous diverse appearances which, although characteristic, are not pathognomonic. The radiological picture must always be correlated with and interpreted with due regard to the clinical picture and special investigations.

Boeke Ontvang : Books Received

Studies in Neurophysiology: Presented to A. K. McIntyre. Ed. by R. Porter. Pp. xiv + 440. Illustrated. £32,50. Cambridge: Cambridge University Press. 1978.

Dermatoglyphics: An International Bibliography. By J. Mavalwala. Pp. 306. DM 80,-. The Hague: Mouton Publishers. 1977.

Regional Anatomy: Multiple Choice Questions for Self-assessment and Self-improvement. By T. R. Murphy. Pp. 158. £3,50. London: Lloyd-Luke Medical Books. 1978.

Lecture Notes on Endocrinology. 2nd ed. By R. F. Fletcher. Pp. iv + 219. Illustrated. £3,80. Oxford: Blackwell Scientific Publications. 1978.

Advances in Obstetrics and Gynecology. By R. M. Caplan and W. J. Sweeney. Pp. xv + 710. Illustrated. \$49,50. Baltimore: Williams & Wilkins. 1978.

The HLA System (British Medical Bulletin, Vol. 34, No. 3). Ed. by W. F. Bodmer. Pp. 213-324. Illustrated. £5,00. London: British Council. 1978.