The Tuberculous Round Focus in Its Chronic Form*

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Since 1947, with the beginning of the immigration to Israel on a large scale, systematic x-ray examinations were done on immigrants in the reception camps. Now our mass radiographic studies include 350,000 people.

In the first years, 1947-48, the high percentage of cases with active tuberculosis of the lungs was striking (0.8 per cent), and among them we found one particular form of tuberculous lesion of the lung: the tuberculous round focus in its chronic form, a lesion which does not become apparent on clinical examination.

It is the purpose of this paper to deal with it. Those examined were new immigrants to Israel, the majority of whom came at that time from concentration camps in Germany. The minographic films showed small, dense, well defined rounded shadows situated predominantly in the upper lung fields. Their density and their well defined character made them suggestive of fibrotic lesions. But clinical, radiological, and especially bacteriological examinations, carried out over a considerable time, brought us to the conclusion that we were dealing with a chronic round focus, which in the majority of our cases turned out to be the manifestation of an active tuberculous process of latent character.

During 1947-48, 104 cases of round foci of this type were seen on minographic examination of whom 53 were males and 51 were females. More than 50 per cent (59 cases) were 20 to 30 years of age, the usual age groups mostly affected by tuberculous infection.

Of those 104 cases of round foci 85 were single, while 11 showed two foci. One case only showed more than four foci. The total number of round foci recorded was 136 of which 78 were in the right lung and 58 in the left. The most frequent localization was in the upper lung fields, particularly in the second anterior intercostal space, where 72 occurred (31 in the first intercostal space and 13 in the third). The lower lobes were the site of the lesions in 14 cases, of which six were in the apical segments.

One hundred and fourteen (83 per cent) of the lesions showed a typical rounded form, 14 were oval and eight were angular in appearance.

The lesions were relatively small. Sixty-two were 1 to 2 cm. in diameter, 52 were 1 cm., and 22 were larger than 2 cm. In 11 cases deposits of calcium were noted within the foci.

In reading the films a close search was made for additional changes within the lung fields which is important with regard to the pathogenesis of the round foci.

In 75 per cent no additional tuberculous changes were found, either in the vicinity of the round foci, or in other lung fields. In nine cases struc-

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tural intensification was noted in the vicinity of the lesions, assumed to be due to hyperaemia. This finding which was on the border between normal and pathological, deserves particular attention with regard to the clinical evaluation of the case. Clear radiological evidence of additional tuberculous changes in the vicinity of the round foci was found in 24 cases. They were generally of fibrotic character. Six cases showed additional tuberculous lesions in other lung fields, also usually of fibrotic type.

In 28 cases calcified primary complexes were seen in addition to the round foci which is of special significance with regard to the pathogenesis of the round foci.

The radiological finding of a “round-shadow” in the lung has been known to be the manifestation of various pathological processes. One of them is the early tuberculous infiltration (“Fruehinfiltat”) described by Assmann. In its usual form the lesion is ill defined, blurred at the edges, gradually fading off into the surrounding lung field, but it may appear as a well defined rounded lesion.

Another lesion which shows the same appearance on the x-ray film but differs in its pathology is the round shadow which develops if a cavity turns into a round foci, the so-called “closed type of cavity closure,” which has been described by Bobrowitz, Oleneva and Haefliger. The latter author shows 50 cases in which a rounded, well defined focus develops by cavity closure due to closure of the bronchus while the cavity persists. With complete obstruction of the draining bronchus the cavity fills from its walls—the enclosed structure may become inspissated (inspissated cavity).

It therefore follows that various pathological lesions may present themselves in the radiograph as round foci. The x-ray film shows the size and the site of the lesion. Follow-up films over a considerable period of time may reveal changes in the appearance of the foci, permitting a radiological definition of the lesion as to its pathology, but it is impossible to decide from a single film if the round focus is caused by an early infiltration (exudative lesion) or has developed by closure of a cavity.

The early infiltration (Assmann) and the round focus which develops by cavity closure usually manifest themselves by clinical signs. Those affected usually feel ill and consult the physician because of cough, fever, general malaise, etc.; because they have been suffering from acute or subacute illness.

Patients like these are being sent to hospitals for treatment. These presented in this paper felt completely well and had no complaints, except six cases which reported symptoms, but only after close inquiry. The round shadow on the x-ray film of the lung was the only pathological finding, and we had still to define it from the clinical and pathological point of view.

Out of 104 cases, detected during the first few months of systematic minographic examination, 82 remained under our observation and treatment.

Clinical, radiological and bacteriological examinations were done over a considerable period. In 53 cases the time of observation was one to two
years, in 19 cases more than that, 23 from 6 to 12 months, and 10 less than six months.

The radiological examinations showed that in 70 per cent of the cases there was no change in the size or the shape of lesions.

**TABLE I**

<table>
<thead>
<tr>
<th>Number of Cases: 104</th>
</tr>
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<tbody>
<tr>
<td>Male ................. 53</td>
</tr>
<tr>
<td>Female ............... 51</td>
</tr>
<tr>
<td>Age:</td>
</tr>
<tr>
<td>15-20 years .......... 29</td>
</tr>
<tr>
<td>20-30 years .......... 59</td>
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<tr>
<td>30-40 years .......... 12</td>
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<td>40- years ............ 4</td>
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The Radiological Findings:

| Right side .......... 78 |
| Left side .......... 58 |
| Site: |
| I Intercostal space ...... 31 |
| II Intercostal space ...... 72 |
| III Intercostal space ...... 13 |
| Lower lobe .......... 14 |
| Apex of lower lobe ...... 6 |

The Number of Foci in Each Case:

| 1 ................. 35 cases |
| 2 ................. 11 cases |
| 3 ................. 4 cases |
| 4+ ............... 1 case |

Shape:

| Rounded .......... 114 |
| Oval .......... 14 |
| Angular .......... 8 |

Diameter in Centimeters:

| Deposits of Calcium .......... 11 |
| Less than 1 .......... 52 |
| 1 to 2 .......... 62 |
| More than 2 .......... 22 |

Radiological Findings Additional to the Round Foci:

| In the vicinity of the foci .......... 24 |
| In other lung fields .......... 6 |
| Calcified primary infiltrate .......... 28 |
| Hyperaemia .......... 9 |

Results of Observation:

| Number of cases .......... 82 |
| Time of observation in months: |
| Less than 6 .......... 10 |
| 6 - 12 .......... 23 |
| 12 - 24 .......... 30 |
| More than 24 .......... 19 |

Symptoms: 6 cases

Tuberculosis Bacilli in Cultures of Gastric Washings:

44 positive and 38 negative

Changes of Shape of the Foci:

| Increased .......... 5 |
| Decreased .......... 10 |
| Turned into cavity .. 8 |

Treatment:

| Conservative .......... 63 |
| Pneumothorax .......... 17 |
| Phrenicotomy .......... 2 |
In a few instances the lesions disappeared by absorption, proof of its recent (exudative) character. Ten showed decrease in size, and five increased during the period of observation. We saw round foci which remained unchanged in their appearance over a long period of time and which were considered inactive, eventually change their shape. They became oval or angular. We have to assume that as long as a focus changes its shape and size it is an active lesion. As mentioned before, a number of round foci showed deposits of calcium.

We noted a number of rounded, dense, homogenous foci which showed small, mostly excentric translucent areas, representing small air-spaces within the foci.

In eight of our cases the round foci turned into cavities without any change in the clinical condition of the patients.

The single film proves only the presence of one of the many forms of a tuberculous lesion in the lungs: the round focus. On account of this single finding we cannot differentiate between a focus which will undergo absorption on the one hand, and a focus which will turn into a cavity on the other. Only serial follow-up examinations over a long period of time may reveal the underlying pathological process which causes the radiological appearance.

In addition to follow-up radiological examinations, systematic clinical investigations were carried out over a long period of time. As mentioned previously, there was nothing in the history of the cases which suggested a tuberculous infection. They did not have symptoms. The general condition of the patients did not give rise to any suspicion of disease. The blood sedimentation rate was normal. The physical examination (percussion and

![Figure 1: A round focus in the right upper lobe (Minograph film).](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21253/ on 06/26/2017)
auscultation) did not reveal any pathological signs. No toxic manifestations were found.

In the absence of any clinical signs we were inclined to consider the lesions described to be of inactive (fibrotic) character.

Bacteriological examinations of the sputum could not be carried out because none of the cases had productive cough. Therefore, systematic bacteriological examinations of gastric washings were started. Serial bacteriological examinations on three or four consecutive days were carried out in each case. The washings were cultured for tubercle bacilli. Out of 82 cases examined this way, 44 (54 per cent) were found to be positive.

Considering the lack of clinical signs those results were unexpected and startling. If in serial radiological examinations signs of activity of the foci were noted, positive bacteriological was usually found. However, in a rather large number of cases in which the round foci remained radiologically unchanged over a long period of time, positive bacteriological findings by gastric lavage were recorded.

The number of colonies of Koch bacilli which grew in cultures, varied. Sometimes, only one or two, again many colonies were found. It happened that in the same patient one series of bacteriological examinations gave negative results while a second series, carried out after two months, turned out to be positive. In bacteriological examinations of this type the evaluation of the results is done by determination of the number of colonies growing in a culture. Though this cannot be looked upon as a mathematical method, the number of colonies grown appears to be an important factor in the evaluation of a case from the clinical point of view. The fact that cultures grown from the gastric juice are found positive for Koch bacilli proves that we deal with a case of active tuberculosis even if there are no other clinical signs apart from the radiological findings of a round focus.

It follows from the above mentioned observations that the clinical evaluation of those 82 cases in which the radiograms showed round foci must differ from that of a round infiltration (Assmann) as well as from the round focus which developed by cavity closure. The latter two lesions which

*FIGURE 2*  
*Figure 2:* Round foci in the third intercostal space, left.

*FIGURE 3*  
*Figure 3:* Multiple round foci in both upper lobes.
have been clearly defined in the literature, are the manifestation of an acute or subacute disease. The round foci which we have encountered in mass radiographic examinations and which we try to define in this paper may be called the tuberculous round foci in its chronic form, its main feature being the absence of clinical signs apart from the positive bacteriological finding of Koch bacilli in gastric washings.

Every chronic tuberculous process, in whatever form it may appear, must have been preceded by an acute stage which may have passed without having been noted at that time. The same applies to the chronic round focus which has been defined in this paper as a clinical entity. The origin must have been one of the forms of an acute tuberculous lesion.

Bobrowitz concludes as a result of his clinical and pathological review of 55 cases that all round foci represent closed cavities. This assumption may be correct with regard to the cases which he describes. However, we believe that there cannot be a single cause only for the development of those round foci. It may be assumed that there are two alternative causes in the development of a round focus: It may either develop from an early round infiltration of exudative-pneumonic character or by closure of a cavity.

FIGURE 4: Tomogram of round foci with a small translucent area within.
The histological examinations carried out by Assmann in connection with his "Early Round Infiltration" (Freuhrinfiltrat) revealed an exudative or caseating lesion surrounded by a fibrotic cover. According to Simmons the round foci have to be considered as the rare forms of early infiltrations which develop by encapsulation of the caseous nucleus which undergoes inspissation. Koch examined histologically eight cases of round foci post mortem. He emphasizes the presence of remnants of elastic fibres within the caseous tissue. Ellinger classified round foci into two forms according to their histological appearance: the caseous and the indurative forms. The results of the pathological examinations done by Oleneva are not uniform. This author describes the round foci on the one hand as lesions surrounded by a fibrotic capsule containing caseous tissue of soft consistency, which may be liquefied, and on the other hand as encapsulated foci with inspissated contents which may contain deposits of calcium. Auerbach and Green and Oleneva have published pathological findings of round foci which were known to have developed by cavity closure ("inspissated cavities"). Auerbach and Green describe their pathological findings as follows: "The foci, on necropsy, have been shown to be spherical bodies of thick caseo-calcified, structureless material enclosed in a dense connective tissue or hyalinized capsule of varied width, demarcated sharply, without surrounding tissue reaction or associated hilar node enlargement."

The pathological findings as reported by Oleneva are similar. She stresses the obliteration of the drainage-bronchus.

The tuberculous round foci in its chronic form may be defined from the pathological point of view as a lesion surrounded by a capsule of connective tissue, the histological architecture of its contents varying according to its pathogenesis. The clinical and the radiological appearance does not reveal the pathogenesis of the lesion. This can be evaluated only by pathological examination. If this examination shows that there are remnants of elastic lung structures present within the lesion, then it is highly probable that the round foci developed from a round infiltration.

If elastic fibres are not found within the contents of the round foci it may be assumed that the foci has been preceded by a cavity and has developed by the closed method of cavity closure. The pathological investigation of the lesion reveals the process which led to the development of the round foci. It may also show signs permitting evaluation regarding the future of the round foci. Such foci may undergo absorption or heal by fibrosis (replacement by connective tissue) and thus become a scar. There may occur caseation of the lesion within its capsule with consecutive liquefaction and so turn it into a cavity or the caseous material may clarify and thus heal by calcification.

In the round foci of the inspissated type ("inspissated cavity") the contents may turn into fibrous tissue. The foci may decrease in size, may change its shape, may become oval or angular, usually triangular, in appearance. This is the indurative stage of the round foci. There is, however, another possibility: the contents may undergo caseation and eventually heal by calcification, or the caseous structures within the foci liquefy, the
draining bronchus opens and the foci turns again into an open cavity.

Some immunological considerations may be indicated. The development of a capsule built of connective tissue surrounding the lesion may be regarded as a manifestation of a local and general resistance. The fact that there was a strikingly small number of negroes among the patients of Bobrowitz in the United States, confirms this opinion, as it is known that the negro are of lesser immunity against tuberculous infection than the white. The cases reported by us were found among immigrants who survived in spite of worse conditions and under nourishment in the German concentration camps. That can only be explained by their natural immunization against the tuberculous infection. There is no doubt, that an overwhelming great number of camp prisoners, lacking this immunity, fell victim to tuberculosis.

It is well known that the round foci may appear as manifestation of the primary tuberculous infection. But it is typical for the primary infiltration that it nearly always involves the regional lymph nodes. We have reviewed our 104 cases in this direction. In none of our cases radiological evidence of involvement of the hilar glands was found. However, in 28 (approximately 30 per cent) of the cases, we did observe in addition to the round foci, calcified lesions in other lung fields, sometimes with calcifications in the respective hilum which we considered to be the calcified primary complex.

These points are suggestive that the chronic tuberculous round foci is to be considered as a manifestation of a post-primary tuberculosis and belongs in the third stage of tuberculosis according to Ranke's classification (the tertiary tuberculosis of the adult).

One question remains to be answered: Is the chronic round foci the result of an exogenous-bronchogenic infection or is it an endogenous-hematogenous infection? Jaffe believes in the hematogenous origin of the round foci. It must be admitted that in certain cases of pulmonary tuberculous lesions it is difficult to decide by the x-ray film if the lesion is of bronchogenous or of hematogenous origin.

But if we take into consideration that in 85 of our 104 cases a single lesion only could be recorded and no other pulmonary tuberculous manifestation was present, the conclusion may be permitted that the round foci are bronchogenous in origin. However, we saw also cases with multiple round foci in both lung fields. In the literature too, cases like those have been reported by Bobrowitz and Albert, but they are rare. It may well be that those are of hematogenous character. We believe that the single round foci will have to be looked upon as being of bronchogenous origin (bronchogenous re-infection).

The prognosis of the chronic round foci has been found to be more favorable than that of the acute or subacute round lesion. As has been pointed out, observation and investigation over a long period of time brought us to the conclusion that the foci under discussion represent a tuberculous lesion of latent character. However, because the foci may become a source of dissemination we have to be cautious with regard to its
prognosis and the patient has to remain under observation over a long period because the latent (closed) foci may turn into an active (open) lesion.

Out of 82 cases which remained under observation and treatment, 63 received conservative treatment, 17 were treated by pneumothorax and two in which the lesion was situated in the lower lobes by phrenicotommy. The comparison of the results of the conservative treatment on the one hand and the collapse therapy on the other showed that there was no difference in the behaviour of those lesions treated by pneumothorax and those which received conservative treatment. That means that collapse therapy did not yield better results than conservative treatment. It may be said that those results could have been anticipated because a lesion surrounded by a fibrotic capsule, cannot be expected to change by collapse therapy. In the cases treated by phrenicotommy no change in the appearance of the round foci was noted. Due to the elevation of the diaphragm after phrenicotommy the foci may change its site, foci in the apical segment of the lower lobe may become hidden behind the shadow of the hilus in the postero-anterior film, but the lateral or oblique film shows it unchanged in size and shape.

According to Olenova, pneumothorax treatment brought about increased density of the foci. Bobrowitz advocates conservative treatment; only in cases with progressive lesions did he try pneumothorax.

Recent advances of excision surgery in the treatment of tuberculous lesions of the lungs have changed our attitude towards collapse therapy in general. Well known authors express their doubts on the value of the intrapleural pneumothorax even in recent tuberculous lesions, that means doubt in a method which up till recently was considered the method of choice in the treatment of a large group of tuberculous lesions of the lungs. Reports from foremost chest clinics suggest that there has been a growing tendency to reduce also the use of thoracoplasty which for many years has been regarded as the most effective surgical method to achieve a stable collapse of the affected lung. A number of leading chest clinics seem to prefer excision.

It cannot be the task of this paper to express definite views on the value of these methods of treatment. We only wish to stress that close evaluation of the pathological and physiological factors of each individual case will enable us to decide on the way of treatment: resection or collapse therapy.

Regarding the chronic round focus with its defined pathological character it may be said that we do not think that treatment by pneumothorax can be successful. If active treatment becomes necessary, the most promising method of treatment will be resection.

Before considering the differentiation of the lesion from other pulmonary diseases it seems worth while to deal in short with "tuberculoma" of the lung. "Tuberculoma" does not differ in its pathology from the chronic round foci, i.e., a lesion surrounded by a capsule built of connective tissue containing mainly caseous structures which sometimes are partly calcified lying within normal surrounding lung tissue. The term "tuberculoma" is liable to misinterpretation because it gives rise to the association
with a "tumor" while, in fact, we deal with the manifestation of a certain phase of a tuberculous process of the lung. Indeed, the tuberculoma is to be considered as identical in its pathology with the chronic tuberculous round foci.

Not only tuberculous lesions differing in their pathology, but also other diseases of inflammatory, non-specific character may appear in the radiograph as rounded, homogenous, dense shadows. Lobar pneumonia, infiltration of tropical eosinophilia, eosinophylic infiltration (Loeffler), pulmonary lesion of Queensland fever, etc., but they tend to be ill defined and the follow-up of the lesion in connection with the clinical signs usually clarifies the disease.

Differentiation from chronic pulmonary diseases of non-specific character which may also appear on the radiogram as rounded, well-defined shadows will be more difficult. They are: cystic lung tumors, e.g., the hydatid cyst of the lung, benign solid tumors, malignant tumors (carcinoma and sarcoma), primary or metastatic, etc. In a certain number of cases it will be possible to arrive at a correct diagnosis by clinical diagnostic methods. But there remain many cases in which the examination will not yield conclusive results even if all modern clinical and radiological methods of examination are applied. Sometimes, tomography may reveal a central translucent area within the round foci. Though this may point in favor of a tuberculous lesion it cannot exclude a tumor. One should not lose time in cases in which a diagnosis cannot be established in spite of the employment of all modern diagnostic methods. In such cases thoracotomy should be performed. With the great advance of chest surgery the danger of the operation is smaller than that of missing the right time for surgical intervention, e.g., in a malignant tumor.

SUMMARY

In the course of mass-radiographic examinations of new immigrants, carried out in reception camps in Israel, 104 cases were recorded within a short period, showing the radiological finding of a "round-shadow" within the lung. In the early stages of the examinations the lesions were considered of fibrotic (scarring) character.

Clinical, radiological and bacteriological investigations, particularly cultures grown from gastric washings, however, revealed that we were dealing with chronic round foci, which in the majority of cases turned out to be the manifestation of an active tuberculous process of latent character.

A clinical definition of the "tuberculous round focus in its chronic form" has been given and the differential characteristics from the tuberculous round lesion in its acute or subacute form ("early infiltration," Assmann) have been shown, the relationship to the "inspissated cavity" has been discussed.

The pathology of the chronic round foci is assumed to be a lesion surrounded by a capsule of connective tissue containing material of differing histological architecture, in the majority of cases the enclosed materials
being predominantly caseous. The pathogenesis of the lesion is considered to be that of a bronchogenous reinfection.

The treatment is chiefly conservative. If active treatment becomes necessary, resection is preferable to collapse.

The term “round-shadow” is a definition of a radiological appearance which is common to many differing pulmonary diseases. The differential diagnosis of these may be complicated.

**RESUMEN**

Durante los exámenes de los nuevos inmigrantes en los campos de recepción de Israel, se encontraron en poco tiempo ciento cuatro casos de hallazgos radiológicos de una “mancha redonda” en el pulmón.

Al principio de los exámenes, las lesiones fueron consideradas como de carácter fibroso (cicatriciales).

Sin embargo, las investigaciones clínicas, radiológicas, bacteriológicas y particularmente los cultivos a partir de lavados gástricos, revelaron que se trataba de focos redondos que en la mayoría de los casos resultaron manifestaciones de una tuberculosis activa de carácter latente.

Se da una definición clínica de la “tuberculosis de focos redondos de forma crónica” y las características diferenciales de las lesiones de focos redondos en su forma aguda o subaguda (infiltrado precoz de Assmann) se han demostrado; la relación con la “caverna empastada” se discute.

Se supone que la anatomía patológica del foco redondo crónico, es una lesión rodeada por una cápsula de tejido conectivo que contiene un material de arquitectura histológica varía; siendo en la mayoría de los casos, el material incluido de naturaleza gaseosa.

La patogenia de la lesión se considera que es la reinfección broncógena.

El tratamiento es principalmente conservador. Si se hace necesario un tratamiento activo, la resección es preferible al colapso.

El término “mancha redonda” es una definición de una apariencia radiológica que es común a muchas enfermedades pulmonares. El diagnóstico diferencial de estas enfermedades, puede ser complejo.

**RESUME**

A l'occasion d'examens radiographiques systématiques, pratiqués pour les nouveaux immigrants dans les camps d'accueil en Israel, l'auteur constata 104 cas pour lesquels existaient une opacité arrondie intra-pulmonaire, et ceci en une courte période d'observation. Dans les premiers moments où furent faits ces examens, il eut tendance à considérer ces lésions comme cicatricielles.

Toutefois, les études cliniques, radiologiques et bactériologiques, et surtout les cultures des tubages gastriques, montrèrent que l'on considéra comme des foyers ronds chroniques des cas qui, dans la majorité, se montrèrent être une manifestation de tuberculose active, mais latente.

L'auteur donne une définition clinique des foyers ronds tuberculeux, dans leur forme chronique, et en montre les caractères différentiels des formes arrondies tuberculeuse, de caractère aigu ou subaigu (infiltrat précoce
d'Assmann). Il discute les relations de ces lésions avec les cavités "épaisses."

L'anatomie pathologique des foyers ronds chroniques se montre être des lésions entourées d'une capsule de tissu conjonctif contenant des éléments d'aspects histologiques divers. Dans la majorité des cas, la partie centrale est constituée par de la matière caséeuse. Au point de vue pathogénique, l'auteur considère que ces lésions sont dues à une réinfection bronchogène.

Le traitement est essentiellement conservateur. Si un traitement actif se montre nécessaire, il faut préférer l'exérèse à la collapsothérapie.

Le terme d'opacités arrondies est une définition radiologique qui peut appartenir à différentes affections pulmonaires. Le diagnostic différentiel peut en être complexe.

REFERENCES