Radiological Findings in Sarcoidosis

Michael Avital MD¹, Irith Hadas-Halpern MD¹, Maher Deeb MD² and Gabriel Izbicki MD³

¹Department of Radiology, ²Thoracic Surgery Unit, and ³Pulmonary Institute, Shaare Zedek Medical Center and Hebrew University Medical School, Jerusalem, Israel

Abstract

Background: Sarcoidosis is a multisystemic disorder of unknown cause that primarily affects the lungs. The diagnosis is based on the clinical manifestations, radiological findings and histological examination.

Objectives: To review and illustrate the typical and atypical radiological findings of sarcoidosis in the chest.

Methods: We analyzed the radiographic thoracic findings of all patients who had biopsy-proven sarcoidosis over the last 10 years.

Results: There were 100 consecutive patients (36 men and 64 women, age 20–84 years) with an established diagnosis of sarcoidosis. Thoracic lymphadenopathy was detected in 89 patients (89%). Lung parenchyma involvement was found in 60 patients. These changes were variable and included: ground-glass attenuation (n=39), multiple small nodules (n=44) and irregular thickening of the interlobular septa (n=16). Larger nodules (1–3 cm) were identified in 12 patients and frank consolidations were seen in 12 patients. Pleural thickening with subpleural nodules was identified in 17 patients.

Conclusions: Sarcoidosis has a wide variety of radiological manifestations in the chest. Familiarity with the various radiographic findings is important for diagnosis and management.

Sarcoidosis is a systemic disease of unknown etiology with a wide variety of clinical and radiological manifestations [1]. This disease is characterized by non-caseating granulomas with proliferation of epitheloid cells. Morbidity and mortality are closely related to pulmonary manifestations. There is spontaneous remission in about two-thirds of the patients and progression in 10–30%. Fatalities occur in 1–5% owing to respiratory insufficiency, central nervous system involvement or myocardial involvement. Almost all organs may be affected, however intrathoracic involvement is the most common, affecting up to 90% of patients [1,2]. Certain radiographic findings, although not diagnostic, are highly suggestive of sarcoidosis. The finding of enlarged bilateral and symmetric bronchopulmonary and paratracheal lymph nodes has been recognized in sarcoidosis since at least 1940 [3]. The parenchyma of the lung may be normal or may demonstrate a variety of abnormalities [4]. The typical radiographic manifestations of sarcoidosis are generally recognized, however, there are many unusual manifestations, which are presented in this study.

Patients and Methods

In a retrospective study of the period 1994–2004, 100 consecutive patients with biopsy-proven, newly diagnosed pulmonary sarcoidosis were studied for their clinical symptoms, X-ray findings and pulmonary function. The diagnosis was made in 98 patients in our institution, based on mediastinoscopy and mediastinal lymph node biopsy, bronchoscopy and transbronchial biopsy, computed tomography-guided biopsy from lung nodules and ultrasound-guided biopsy from enlarged peribronchial lymph nodes. The remaining two patients had been diagnosed by bronchoscopy elsewhere prior to admission. We reviewed the chest radiographs and CT examinations of all the patients.

Table 1. Lung function test of 10 patients with pulmonary sarcoidosis

<table>
<thead>
<tr>
<th>Patient #</th>
<th>FEV1 Post-BD</th>
<th>FEV1</th>
<th>TLC</th>
<th>DLCO/VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47</td>
<td>16%</td>
<td>90</td>
<td>81</td>
</tr>
<tr>
<td>2</td>
<td>97</td>
<td>8%</td>
<td>116</td>
<td>104</td>
</tr>
<tr>
<td>3</td>
<td>82</td>
<td>ND</td>
<td>70</td>
<td>33</td>
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<tr>
<td>4</td>
<td>47</td>
<td>14%</td>
<td>83</td>
<td>78</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>20%</td>
<td>92</td>
<td>67</td>
</tr>
<tr>
<td>6</td>
<td>61</td>
<td>18%</td>
<td>85</td>
<td>ND</td>
</tr>
<tr>
<td>7</td>
<td>87</td>
<td>1%</td>
<td>89</td>
<td>101</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>22%</td>
<td>92</td>
<td>87</td>
</tr>
<tr>
<td>9</td>
<td>106</td>
<td>ND</td>
<td>116</td>
<td>97</td>
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<tr>
<td>10</td>
<td>80</td>
<td>4%</td>
<td>88</td>
<td>118</td>
</tr>
</tbody>
</table>

FEV1, TLC and DLCO/VA are expressed as % of predicted values.
Post-bronchodilator FEV1 is expressed as % improvement after BD, as compared to pre-BD value.
FEV1 = forced expiratory volume in 1 second, TLC = total lung capacity, DLCO/VA = Diffusion capacity of the lung for carbon monoxide corrected for alveolar volume, ND = not done.
in our patients, detected in 89 (89%). CT revealed bilateral hilar, paratracheal and aortic pulmonary window lymph node enlargement. Bilateral hilar with right paratracheal was the most frequent nodal enlargement, demonstrated in 66% of the patients [Figures 1A and B]. Lymph node calcifications were rare, detected in only three patients.

Lung parenchymal involvement was seen in 60 patients (60%). These changes were variable and included ground-glass attenuation (n=39), multiple small nodules typically in a peribronchovascular distribution (n=44), irregular thickening of the interlobular septa (n=16) [Figure 2], larger nodules (1–3 cm) (n=12), and frank consolidations larger than 3 cm (n=12) [Figure 3A]. In the majority of cases with lung parenchymal changes theirs was an upper lobe predominance (83%). Three of the patients with consolidations presented with cavitary masses [Figure 3B]. Forty-one patients (41%) had both, lymphadenopathy and lung parenchymal changes. Pleural thickening with subpleural nodules was identified in 17 patients.

Discussion

Pulmonary involvement is reported in as many as 90% of patients with sarcoidosis. The presence of bilateral and symmetric paratracheal and hilar lymph nodes enlargement, with or without parenchyma abnormality, is highly suggestive, although not diagnostic, of sarcoidosis. There is often an apparent predominance of right hilar and paratracheal lymph nodes, as left-sided nodes are obscured by other structures. The lateral chest X-ray may be helpful in identifying the presence of increased densities in the hilar area. In a Swedish study covering the years 1966 to 1980, a total of 57% of cases were detected by mass chest radiographs. In a Japanese survey, a 50% prevalence rate of asymptomatic cases was found [5]. The findings on chest X-ray form the base for staging, which relates to prognosis. The outcome, expressed either as spontaneous remission or as 5 year mortality, is closely related to the radiological stage.

the 5 year mortality being 0% in stage 1, 11% in stage 2, 18% in stage 3, and more than 50% in stage 4 [6]. The ACCESS study [7], a case-controlled, multicenter study, involved 10 centers in the United States between 1997 and 1999. Incident cases and matched controls were compared regarding the prevalence of various exposures. Cases were confirmed by tissue diagnosis, compatible clinical course, and exclusion of other possible causes of granulomas. Altogether, 736 patients were enrolled, 63.6% female, 36.4% male, 53.4% white and 44.2% black. The peak age and gender affected were females aged 35–39 years. Lung involvement was seen in 95% of patients, skin involvement other than erythema nodosum in 16%, extrathoracic lymph node involvement in 15%, eye involvement in 11.8%, and liver involvement in 11.5%. Among the characteristics of lung involvement in patients enrolled in the study was the fact that 8% of the patients had stage 0, 40% stage 1, 36% stage 2, 10% stage 3, and 5% stage 4.

Sarcoidosis accounts for a wide variety of radiological manifestations [8-11]. High resolution CT is performed in most cases as it is highly sensitive for adenopathy and parenchymal changes. In our group of patients, mediastinal and bilateral hilar adenopathy with or without parenchymal changes were the most frequent finding (89%), correlating with the findings reported in the literature [2,4,7]. The most common nodes were the hilar and right paratracheal, observed in 66% of cases. Parenchymal findings con-
stitute a large spectrum and have a tendency to involve mostly the upper lobes (83%). The sarcoid granulomas are distributed along the lymphatic vessels and this is well demonstrated by high resolution CT. CT revealed widespread small nodules with a perivascular distribution in 44%. Nodules may also be evenly distributed throughout both lungs with predominance of the upper and middle lung zones or, more commonly, in the perihilar and peribronchovascular region. Thickenend interlobular septum, seen in 16% of our patients, is a characteristic finding [5,9]. Large nodules or conglomerate masses are much less common, resulting from coalescence of granulomas [12]. Attention should be paid to the cavitary nodes which present a rare form of the disease – in our study 3%. Ground-glass attenuation, although not common in sarcoidosis, was demonstrated in 39% of our patients. Approximately 20% of patients develop some pulmonary fibrosis, which may lead to honeycombing and parenchymal distortion [1]. Our cases, as well as those described in the literature, demonstrate the variability of sarcoidosis patterns and the resemblance – in many cases – to other diseases like tuberculosis, lung malignancies or lymphoproliferative diseases. It is especially confusing in patients who already suffer from malignancy, as occurred in some of our cases with breast carcinoma or lymphoma who developed lung nodules, interlobular septal thickening or mediastinal lymphadenopathy. The radiographic findings were suggestive of sarcoidosis, however metastatic disease could not be excluded and histological diagnosis was therefore necessary. The diagnosis of sarcoidosis can be suggested radiologically; however, in many cases a histopathological examination is required in order to demonstrate the typical non-caseating epitheloid cell granulomas and exclude other disorders. This can be done by endobronchial or transbronchial biopsy as the airways mucosa is often infiltrated by sarcoid cells, even in radiological stage I. Lymph node biopsy can be performed whenever adenopathy is present, either by bronchoscopic transbronchial needle aspiration and biopsies or by mediastinoscopic biopsies. In some cases, especially where peripheral lung nodules or consolidations are present, imaging-guided percutaneous biopsy is the preferred procedure.

Familiarity with the common and rare manifestations of pulmonary sarcoidosis and with the variable combinations of the radiographic signs may assist in diagnosing this disease and may reduce the delay to diagnosis and, if necessary, treatment.

References

Correspondence: Dr G. Izbicki, Pulmonary Institute, Shaare Zedek Medical Center, P.O. Box 3235Jerusalem 91301, Israel.
Phone: (972-2) 666-6278
Fax: (972-2) 666-6772
e-mail: izbicki@szmc.org.il

Capsule

Glial cell function

Astrocytes are the major class of non-neuronal cells in the brain and account for close to half the cells in the mammalian cerebral cortex, yet their function is virtually unknown. Evidence is now accumulating for an active role of astrocytes in brain function. Schummers et al. investigated astroglial calcium responses in the visual cortex of the ferret by two-photon laser-scanning microscopy. Visual cue-induced calcium signals were monitored in neurons and astrocytes simultaneously at high temporal and cellular resolution. The receptive field properties (response kinetics, orientation, and localization) of the astroglial network consistently followed neuronal activity. Simultaneous recordings of hemodynamic signals and calcium responses in neurons and astroglia revealed that astrocytes have a key role in coupling neuronal activity to vascular signals critical for non-invasive brain imaging.

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