Can HRCT distinguish between sarcoidosis and pneumoconiosis presenting with hilar/perihilar masses?

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Sarcoidosis and pneumoconiosis are two diseases with a different etiology and clinical course. The former is a systemic disorder of unknown cause characterized by the presence of noncaseating granulomas and it may involve almost any organ however lungs are affected in 90% of patients. The latter instead, results from inhalation of different organic dusts. Sarcoidosis and silicosis or coal worker's pneumoconiosis show at HRCT small nodular opacities. In sarcoidosis the distribution of nodules is perilymphatic whereas both perilymphatic and centrilobular nodules can be observed in pneumoconiosis. In the latest stages these two entities have some overlapped findings such as the upper lobes involvement with a posterior predominance of lesions and the presence of large masses in upper lobes. The purpose of our study was to retrospectively evaluate the accuracy of HRCT in distinguishing sarcoidosis from pneumoconiosis in presence of hilar/perihilar nodules or masses ("mass-like sarcoidosis and pneumoconiosis").
Methods and Materials

Patients

We retrospectively evaluated 54 patients, 31 had pneumoconiosis and 23 patients had sarcoidosis. The diagnosis was confirmed by history of exposure to silica or coal dust for pneumoconiosis and by broncoalveolar lavage (n=18) or surgical biopsy (n=5) in sarcoidosis. The mean age of the 54 patients (42 men and 12 women) was 70.6 years ± 13.8 (standard deviation), (range 43-100 years).

Patients with pneumoconiosis were all men (mean age 78.35 years ± 7.25), whereas patients with sarcoidosis were 12 women and 11 men (mean age 60.2 years ± 12.2).

CT scanning protocol

All patients evaluated had undergone HRCT scans of the chest at our institution with a Somatom Volume Zoom Tomography (Siemens Medical Systems-Forchheim, Germany). Chest CT examinations were obtained from the apex of the lung to the diaphragm, in the supine position at full inspiration. HRCT scans were performed with 4x1 mm collimation, 0.5 s rotation time, a slice width and increment of 1.25 mm and 10 mm, respectively. Images were reconstructed by using a high-spatial-frequency algorithm.

Image analysis

The HRCT scans were evaluated independently by two readers including an experienced chest radiologist and a fourth year resident. The observers were blinded to clinical information and final diagnosis. All images were reviewed at a work station at window setting optimized for assessment of lung parenchyma (width, 1600 HU; level, -600 HU). Images were assessed for the presence of large pulmonary masses (diameter>3cm) and their site that could be unilateral or bilateral. Readers also assessed a cranio-caudal predominance and an axial zone predominance. Cranio-caudal predominance was assessed to being apical, medio/basal or both; the apical lung zone predominance was considered present when the abnormalities were most extensive above the tracheal carina and medio-basal when they were most extensive below these level. Axial zone predominance was assessed to being anterior, posterior or both; it was considered anterior when abnormalities involved more extensive the anterior segments of lung parenchyma and posterior if they were more present in the posterior segments of the lung.

The anatomic distribution of lesions was also assessed and classified as peribroncovascular if there was a predominance of abnormalities along the bronchi and
vessels, peripheral if there was a predominance of the abnormalities in the outer third of the lung and mixed if there were both distributions.

The readers also evaluated displacement of the hila and if present its cranial, posterior and cranial/posterior displacement. The absence or presence of paracicatritial emphysema was also determined.

Readers provided a first choice diagnosis for each patient and graded the degree of confidence as high or low sarcoidosis or pneumoconiosis. When the CT findings did not fit into any of the two diagnoses the first choice was indeterminate.

**Statistical analysis**

The accuracy of CT in differentiating mass-like sarcoidosis and pneumoconiosis was obtained by comparing the first choice diagnosis made by the observers with the known diagnosis of the patient obtained by the clinical history, bronchoscopy with BAL or surgical biopsy.

Agreement between the observers in the assessment of the CT diagnosis was assessed by using weighted k statistics. The interobserver agreement was classified as follows: poor, $K = 0.0-0.20$; fair, $K = 0.21-0.40$; moderate $K = 0.41-0.60$; good $K = 0.61-0.80$; and excellent $K = 0.81-1.00$. 
Results

Bilateral distribution of masses results more frequent for both diseases; in particular bilateral masses were described in 41/46 readings (89%) in sarcoidosis and in 51/62 readings (82%) in pneumoconiosis (Tab.1).

Table 1: Tab.1: LUNG INVOLVEMENT. The table show the number of cases identified by each observer.

References: Dept. of Radiology, University "G. d'Annunzio" - Chiety/IT

The two diseases did not show a statistically remarkable difference in terms of cranio-caudal predominance (apical vs medio-basal localization) (Tab.2) and axial predominance (anterior versus posterior localization) (Tab.3).

Table 2: Tab.2: CRANIO-CAUDAL PREDOMINANCE. The table show the number of cases identified by each observer.

References: Dept. of Radiology, University "G. d'Annunzio" - Chiety/IT
Table 3: Tab.3: AXIAL PREDOMINANCE. The table show the number of cases identified by each observer.

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Patients with pneumoconiosis were more likely to have a peripheral (20/62 readings, 32%) and mixed (29/62 readings, 47%), distribution of abnormalities while sarcoidosis tends to have a peribroncovascular distribution (28/46 readings, 61%), and this difference was statistically significant (p<0.05) (Tab.4).

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Table 4: Tab.4: DISTRIBUTION OF LESIONS. The table show the number of cases identified by each observer. Note: PB:peribronchovascular; P:peripheral; M:mixed.

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Displacement of hila was absent in 45/62 readings (72%) of pneumoconiosis and present in 27/46 readings (59%) of sarcoidosis (p> 0.05) (Tab.5).
### Table 5: Tab.5: DISPLACEMENT OF THE HILA. The table show the number of cases identified by each observer.

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Moreover, displaced hila in patients with sarcoidosis showed a more cranial/posterior location which was present in 14/27 readings (51%), (p<0.05) (Tab.6).

### Table 6: Tab.6: DISTRIBUTION OF DISPLACED HILA. The table show the number of cases identified by each observer.

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Paracicatritial emphysema was much more commonly seen in pneumoconiosis (38/62 readings, 61%) than in sarcoidosis (12/46 readings, 26%), (p<0.05) (Tab 7).

<table>
<thead>
<tr>
<th>Pneumoconiosis</th>
<th>Sarcoidosis</th>
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<tbody>
<tr>
<td><strong>Absent</strong></td>
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<tr>
<td><strong>Ob A</strong></td>
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<td><strong>Present</strong></td>
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<tr>
<td><strong>Ob A</strong></td>
<td>11</td>
</tr>
<tr>
<td><strong>Ob B</strong></td>
<td>13</td>
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</table>
Table 7: Tab.7: PARACICATRITAL EMPHYSEMA. The table show the number of cases identified by each observer.

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A correct first choice diagnosis of pneumoconiosis was made by observer A for all patients whereas observer B correctly identified 27/31 patients (Fig. 1 on page 9), four patients were considered indeterminate.

A correct first choice diagnosis of sarcoidosis was made in 20/23 patients by observer A and in 15/23 patients by observer B (Fig. 2 on page 9).

Observer A incorrectly evaluated three patients with sarcoidosis as pneumoconiosis (one patient) and indeterminate (two patients) cases (Fig. 3 on page 9).

On the other hand the observer B made an incorrect diagnosis of pneumoconiosis in three patients with sarcoidosis (Tab.8) and he considered five cases of sarcoidosis as indeterminate.

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<tr>
<td>Ob B</td>
<td>27/31</td>
<td>15/23</td>
<td>9</td>
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Table 8: Tab.8: CORRECT FIRST CHOICE DIAGNOSIS FOR BOTH OBSERVERS. Numbers represent the correct first choice diagnosis made with a high or low degree of confidence.

References: Dept. of Radiology, University "G. d'Annunzio" - Chiety/IT

There was good interobserver agreement for overall CT diagnosis (K=0.64).

In our study a high level of confident first-choice diagnosis was made in 73/108 readings (67.6%) and was correct in 70/73 (95.8%) of these readings.

Diagnostic accuracy for a correct diagnosis was 92% for observer A and 72% for observer B. Sensitivity and specificity were 87% and 97% for observer A and 65% and 87%, respectively for observer B.
Fig. 1: A 83-year-old-man with history of exposure to silica. HRCT scans at the level of the aortic arch (A) and the pulmonary trunk (B) show the presence of bilateral masses with a peripheral distribution. Some small centrilobular and subpleural nodules are also evident, and paracicatritial emphysema as well. The two observers made a correct first choice diagnosis of mass-like pneumoconiosis.

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Fig. 2: A 54-year-old woman with biopsy-proven sarcoidosis. HRCT scans at the level of the aortic arch (A) and tracheal carina (B) show peribronchovascular consolidation with dilated bronchi and cranial displacement of the hila. The two observers made a correct first choice diagnosis of mass-like sarcoidosis.

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Fig. 3: A 65-year-old woman with diagnosis of sarcoidosis obtained with BAL. HRCT scans at the level of the main bronchi show cavitated peribroncovascular masses with small nodules and paracicatritial emphysema. This case was considered indeterminate by both readers.

Table 1: Tab.1: LUNG INVOLVEMENT. The table show the number of cases identified by each observer.

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<tr>
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<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Ob A</td>
<td>3</td>
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</tr>
<tr>
<td>Ob B</td>
<td>3</td>
<td>2</td>
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**Table 2:** Tab.2: CRANIO-CAUDAL PREDOMINANCE. The table show the number of cases identified by each observer.

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<td>Post</td>
<td>Ant/post</td>
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**Table 3:** Tab.3: AXIAL PREDOMINANCE. The table show the number of cases identified by each observer.

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<td><strong>Ob A/Ob B</strong></td>
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<td>17/11</td>
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<td>3/4</td>
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<tr>
<td><strong>M</strong></td>
<td>16/13</td>
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<td>3/8</td>
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Conclusion

HRCT allows to distinguish "mass-like" sarcoidosis and pneumoconiosis with a good level of confidence.

Most useful HRCT findings for differentiating mass-like sarcoidosis and pneumoconiosis include the distribution of lesions, and paracicatritial emphysema. A peribronchovascular distribution of lesions is much more commonly seen in patients with sarcoidosis while patients with "mass-like" pneumoconiosis tend to have a more peripheral and mixed distribution. Paracicatritial emphysema, when present, is almost indicative of pneumoconiosis. Hilar displacement when present in patient with sarcoidosis shows a more cranial and posterior location.
References

Personal Information

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