

# Association of HRCT findings with pulmonary PET activity in sarcoidosis

Mostard RLM<sup>1,2</sup>, Verschakelen JA<sup>3</sup>, Kroonenburgh van MJP<sup>2,4</sup>, Nelemans PJ<sup>5</sup>, Wijnen PAHM<sup>2,6</sup>, Drent M<sup>2,7</sup>

<sup>1</sup>Dept of Respiratory Medicine, Atrium Medical Centre, Heerlen, <sup>2</sup>ild care team, Maastricht University Medical Centre+ (MUMC+), Maastricht, The Netherlands

<sup>3</sup>Dept of Radiology, University Hospital Gasthuisberg, Leuven, Belgium, <sup>4</sup>Dept of Nuclear Medicine, MUMC+, <sup>5</sup>Dept of Epidemiology, University Maastricht, <sup>6</sup>Dept of Clinical Chemistry, <sup>7</sup>Dept of Respiratory Medicine, MUMC+, Maastricht, The Netherlands

## Introduction

In sarcoidosis, HRCT abnormalities appeared to be useful in evaluating parameters of disease severity and functional impairment to predict prognosis, and in assessing response to therapy.<sup>1,2</sup> However, HRCT is a purely morphological imaging technique that provides only indirect information on the underlying physiological changes. Insight in morphological changes at sites of abnormal pulmonary metabolism would be of great interest for better understanding the relation between morphological and physiological changes.

## Aim

The aim of this retrospective study was to address the association of HRCT findings with pulmonary PET activity.

## Methods

The clinical records of 95 (age: 46.1±10.7; female: 40) known sarcoidosis patients visiting the outpatient clinic between June 2005 and June 2010, who underwent a PET as well as a HRCT, were reviewed. All PET scans were interpreted by an experienced nuclear medicine physician. An experienced thoracic radiologist classified the scans of both lungs using a semi quantitative HRCT scoring system that has been described by Oberstein et al.<sup>3</sup> The included HRCT patterns were scored as thickening or irregularity of the bronchovascular bundle, intra-parenchymal nodules, septal and nonseptal lines, parenchymal consolidations, focal pleural thickening, and enlargement of the lymph nodes (all patterns 0-3 points). The total score was obtained by adding up the individual scores.

## Results

In 56/95 patients, PET positivity in the pulmonary parenchyma was found. In these patients, total HRCT score and all HRCT sub-scores were high compared with the 39 patients without PET positivity in the pulmonary parenchyma (Table 1). Furthermore, DLCO and FVC were low in patients with parenchymal PET positivity versus the patients without parenchymal PET positivity. Predictive results for PET positivity in the pulmonary parenchyma of respectively the total HRCT score, the HRCT patterns as included in this Oberstein score, and lung function test results were evaluated using the area under the curves (AUC's) from the ROC curves. These results are shown in Table 2.

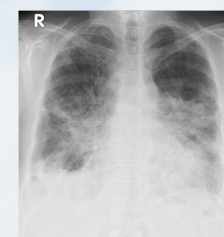
**Table 1.** Summary of relevant demographic and clinical characteristics of the studied sarcoidosis patients categorized by absence or presence of PET abnormalities in the pulmonary parenchyma.

	Pulmonary parenchyma PET - patients (n=39)	Pulmonary parenchyma PET + patients (n=56)	p value
age (yrs)	44 (22-72)	48 (24-76)	NS
sex (male)	22 (56%)	33 (59%)	NS
time since diagnosis (yrs)	2 (1-20)	2 (1-21)	NS
Chest X-ray stage 0/I/II/III/IV	22/7/2/5/3	8/9/11/5/23	<0.001
Therapy total	9 (23%)	17 (30%)	NS
FVC (% pred)	96±22	85±24	0.044
DLCO (% pred)	79±16	65±20	0.001
Total HRCT score	3.0 ±2.9	7.1±3.6	<0.001
Bronchovascular bundle score	0.4±0.7	1.3±1.1	<0.001
Parenchymal nodules score	0.6±0.7	1.3±0.9	<0.001
Septal and nonseptal lines score	0.3±0.5	0.8±0.8	0.001
Parenchymal consolidations score	0.4±0.6	1.0±0.8	0.001
Pleural thickening score	0.5±0.8	1.3±1.0	<0.001
Lymph nodes score	0.8±1.1	1.5±0.9	0.002
Tractionbronchiectasis (n; %)	5 (13)	22 (39)	0.005
Perfusion inhomogeneity (n; %)	5 (13)	11 (20)	NS
Fibrosis on HRCT (n; %)	4 (10)	22 (39)	0.002

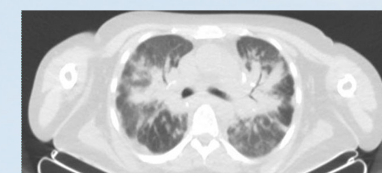
**Table 2.** Area under the curve (AUC) values for the association between PET positivity in the pulmonary parenchyma and respectively the total HRCT score, the HRCT patterns as included in the HRCT score, and lung function.

	AUC	Confidence interval
Total HRCT score	0.848	0.755-0.941
Bronchovascular bundle	0.810	0.698-0.922
Parenchymal nodules	0.696	0.559-0.833
Septal and nonseptal lines	0.714	0.580-0.833
Parenchymal consolidations	0.750	0.618-0.882
Pleural thickening	0.835	0.713-0.939
Lymph nodes	0.695	0.539-0.851
FVC	0.667	0.523-0.810
DLCO	0.725	0.593-0.858

**Figure 1.** Example of a sarcoidosis patient (male; 54 yrs) with Chest X-ray stage IV and signs of inflammatory activity on PET/CT.



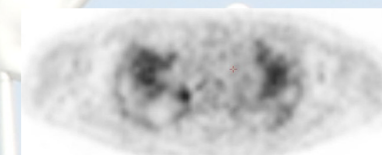
**1a.** Chest X-ray showing bilateral irregular opacities and some surrounding lung deformation.



**1b.** CT-scan image at thoracic level showing bilateral perihilar opacities, bilateral hilar and mediastinal lymphadenopathy with calcifications and deformation of the surrounding lung architecture.



**1c.** PET/CT fusion image at thoracic level showing diffuse increased FDG-uptake in the bilateral perihilar opacities.



**1d.** PET image at thoracic level showing diffuse bilateral increased FDG-uptake in the pulmonary parenchyma.

## Conclusions

- HRCT abnormalities in the pulmonary parenchyma and mediastinal lymph nodes appeared to be associated with pulmonary PET positivity in sarcoidosis
- Pulmonary inflammatory activity on PET/CT appeared to be associated with decreased pulmonary function
- Pulmonary inflammatory activity on PET/CT is an indicator of severity of pulmonary impairment
- The majority of patients with signs of fibrosis on HRCT and Chest X-ray had pulmonary PET positive findings

## References

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2. Drent M, et al. Sarcoidosis: assessment of disease severity using HRCT. *European radiology* 2003;13:2462-2471.
3. Oberstein A, et al. Non invasive evaluation of the inflammatory activity in sarcoidosis with high-resolution computed tomography. *Sarcoidosis Vasc Diffuse Lung Dis* 1997;14:65-72.