THE POSSIBILITIES OF THE NEW THORACIC IMAGERY FOR EARLY DETECTION OF INTERSTITIAL SYNDROMES AND OF SILICOSIS

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In the study of Pneumoconioses, Tomodensitometry appears much more precise (high definition—separation power = 0.17 mm^2—interseptal interstitium = 100 µm) and objective (numerical image—unstacked millimetric cross sections of the thorax) than the standard plate. We have already observed the value of the tomodensitometry for the diffuse parenchymal pathology in general.

Our study covers 59 cases of Pneumoconiosis (20 cases of silicosis, 39 cases of asbetosis). The Pneumoconios diagnostic was made in the light of several elements (exposure time, clinical data, Table I, EFR—DLCO—scintigraphy—

Table I

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DIAGNOSTICS PROCEDURES

- DURATION OF EXPOSURE
- CLINICAL EXAMINATION
- PULMONARY FONCTION TEST
- C O TRANSFERT
- B A L
- SCINTIGRAPHY
- MEDICAL IMAGERY
- PULMONARY BIOPSY

bronchiolo-alveolar flush—pulmonary imagery—pulmonary biopsy). Pulmonary imagery is not, indeed, the only method of diagnosis. It must be confronted with other non-morphological methods (for example, we carry out a prospective study on the respective contributions of tomodensitometry and of the other methods of diagnosis—DLCO—scintigraphy—LBA in early detection of the lung, of AIDS).

In our series of 50 Pneumoconiosis the pulmonary biopsy was only carried out 7 times; most of the diagnoses were made on epidemiological and clinical data, and on the results of bronchiolo-alveolar flush (28 cases).

All of these Tomodensitometric explorations were made with an apparatus from the "Compagnie Générale de Radiologie" (CGR) CE 1200. The realization protocol was as following (Table II):

Table II

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METHODS

- C.G. R. : C.E. 10 000 C.T.
- SECTION THICKNESSES : / 10 mm
- CONTIGUOUS SCANS
- "BONE" ALGORYTHM
- SUPINE OR PRONEPOSITION. IF NECESARY
- HIGHT RESOLUTION C.T. (HRCT)FOCALISED ON AREAS OF INTEREST.
  - edge to edge cross-sections of 1 cm.
  - focalized millimetric cross-sections using the high definition-algorithm for reconstruction of bone type. Table III-IV.
  - window systematically wide—250, 1800. This window gives the histologically most faithful image of the thorax (for example there are false thickenings of the bronchial walls when the so-called pulmonary window is used—700, 700). The other windows (mediastinal, parenchymal) were only used when needed (for example, in the search for calcifications).

The criteria of standard radiological interpretation were those recognized by the I.L.O. The standard plates were examined independently of the tomodensitometric documents.

Table III

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection—Pittsburgh 1988
High Resolution C. T. Scan

TECHNICAL CONSIDERATIONS

- **THIN SECTION C.T.SLICES (1 to 2 MM)**
- **LARGE WINDOW : (WIDTH OF 2000 UH)**
  (LEVEL OF -750UH)
- **HIGHEST SPATIAL FREQUENCY ALGORITHM OF RECONSTRUCTION ("BONE ALGORITHM" FOR EXAMPLE).**
- **MATRICE AND CIRCLES OF RECONSTRUCTION.**

The criteria of tomodensitometric interpretation have previously been defined in the chapter on pulmonary parenchymal pathology. Let us remember that the semiology of the interstitial syndrome is made up of several stages and expressions (Figure 1): Table V.

1. Homogenous thickening of the interstitial sector parieto-alveolar septal and peri-broncho vascular and sub-pleural; this thickening gives rise to a sign which we have described as "trussed joint". Table VI.
2. Nodular thickening micro and macro-nodular septal or parieto-alveolar; the limit of separation in high tension is 0.17 mm^2; thus a very small nodule can theoretically be detected, nevertheless, this type of lesion is indiscernible from a pulmonary vessel. Table VII.
3. Mixed lesions of interstitial thickening and of pulmonary nodule.
4. "Honey comb" lung indicating an advanced parenchymal destruction.
5. In the case of asbestosis, the sub-pleural curvilineal opacity described by YOSHIMURA, corresponding to a peripheral atelectasis zone, can be bronchiolar and premonitory, in the asbetosis but also in other chronic interstitial pneumopathies, of an evolution towards the "honey comb" lung.

The results of this series are as follows:

29 silicosis were studied, divided into three categories according to the I.L.O. classification and each examined in thoracic tomodensitometry where a score of interstitial disease was given to them (light, moderate, severe disease).

Tomodensitometry shows the parenchymal lesions better than the standard plate (Table I). Thus out of 7 patients in category 1 of the I.L.O. classification, only one shows light disease with tomodensitometry. The six others have moderate disease. Out of 10 cases in category 2 I.L.O. 7 show severe disease with tomodensitometry, only 3 moderate disease. Table VIII.

The high resolution tomodensitometric semeiological study shows nodular disease for all cases, which concords well with the fundamental histological lesion (silicotic nodule), a diffuse disease of the interstitium often occurs also in 25 cases out of 29. The "honey comb" lung is clearly shown in 5 cases as compared to only 2 visible in standard radiography. With tomodensitometry accompanying lesions show up much better than with standard radiography (Table IX).

- 15 cases of emphysemias in smokers as against only 5 detectable with standard radiography.
- 14 cases of associated bronchiectasis invisible with standard radiography.

Table IV

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection—Pittsburgh 1988
High Resolution C. T.

CIRCLE OF RECONSTRUCTION / MATRICE	525	393	262	131	87 H R
256/256	2 MM2	1,4 MM2	1 MM2	0,5 MM2	0,34 MM2
512/512	1 MM2	0,7 MM2	0,5 MM2	0,25MM2	0,17 MM2

Table V

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection —Pittsburgh 1988, High Resolution C. T.

SEMEIOLOGY (INTERSTITIAL SYNDROME)
- HOMOGENEOUS THICKENING OF INTERSTITIUM
- NODULAR
- MIXED (THICKENING AND NODULAR)
- "HONEY COMBING" LUNG.

Table VI

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection —Pittsburgh 1988, Semeiology Homogeneous Thickening

- INTERLOBULAR SEPTA
  - SHORT LINES - ASPECT OF "TRUSSED JOINT".
  - LONG LINES
  - MACRORETICULATION - DRAWNING OF SEPTA ARCHITECTURE.
- INTRALOBULAR LINES - MICRORETICULATION.
- BRONCHIAL VISIBLE MORE PERIPHERALLY WITH THICK IRREGULAR WALL
- HAZINESS OUTLINES OF THE VESSELS.
- VISCERAL PLEURAL THICK AND IRREGULAR

Table VII

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SEMEIOLOGY

- NODULAR

- MACRO-NODULES :

  DIFFERENTIAL DIAGNOSIS : ALVEOLAR NODULES.

- MICRO-NODULES :

  DIFFERENTIAL DIAGNOSIS : NORMAL VESSELS.

Table VIII

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose
Early Detection—Pittsburgh 1988

SILICOSIS (N = 29)

COMPARAISON OF I L O / U C RADIOGRAPHIC WITH H R C T SCORE

I L O SCORE	NO OF SUBJECTS	H R C T SCORE		
		LIGHT	MODERATE	HIGHT
1	7	1	6	
2	10	0	7	3
3	12	0	0	12

Table IX

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose
Early Detection—Pittsburgh 1988

ABNORMALITIES ON H R C T IN SUJECTS WITH SILICOSIS (N = 29)

BRONCHO-PARENCYMAL FINDINGS	HRCT SCORE
- HOMOGENEOUS INTERSTITIAL THICKENING	25
- NODULAR INTERSTITIAL	29
- MIXED (THICKENING AND NODULAR)	16
- "HONEY COMBING"	5
- EMPHYSEMA	15
- BRONCHIECTASIS	14
- NEOPLASM	2 (WITH BIOPSY ON CT)

- 8 pseudo-tumoral masses, 4 of which were necrosed.
- 2 peripheral bronchio neoplasms, the histological diagnosis of which was carried out by puncture under tomodensitometric control.

30 cases of asbetoses were studied with the following final diagnosis (Table X):

- pleural disease alone: 11 cases.
- parenchymal disease alone: 1 case.
- associated pleural parenchymal disease: 18 cases.

Table X

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection—Pittsburgh 1988

ABESTOSIS (N = 30)	
FINAL DIAGNOSIS	
– PLEURAL DISEASE ALONE	11
– PARENCHYMAL DISEASE ALONE	1
– PLEURO-PARENCHYMAL DISEASE	18

Where pleural disease is concerned (Table XI), the inadequacies of standard radiography as compared with tomodensitometry are obvious since 50% of the cases showing pleural disease (asbetiosic plaques and benign pleuresy) are retrospectively invisible in standard radiography and evident in tomodensitometry. The same applies for the pleural calcifications easily discerned with tomodensitometry.

In the case of associated parenchymal interstitium disease tomodensitometry has a higher score than standard radiography since it reveals, in 5 cases, a disease of the pulmonary parenchyma associated to a pleural disease whereas the standard plates showed a pleural disease alone (certain in 3 cases, uncertain in 2). In these 5 cases, showing up a pulmonary interstitial syndrome allowed for the diagnosis of associated parenchymal disease which was confirmed by the other methods of diagnosis (bronchiolo-alveolar flush in particular) and by pulmonary biopsy in one case. Table XII.

Interstitial disease of the pulmonary parenchyma in asbestosis shows up in our cases mainly through homogeneous thickening of the pulmonary interstitium of the diffuse alveolar fibrosis type whereas nodular disease is more scarce and more tardy. The curvilineal sub pleural line described by YOSHIMURA was observed in 4 cases, 2 of which "honey combed" towards the lung.

The account of these results caused much comment and questions from the audience. All of which may be resumed as follows:

1. Nobody doubts the superiority of Tomodensitometry over standard radiography in early detection of Pneumiconioses. This kind of exploration, however, must be carried out correctly (centimetrical edge to edge cross-sections then orientated usage of millimetric cross-sections and of high resolution). This superiority is clearly illustrated in Asbestosis (early detection of pleural plaques and of parenchymal disease). Other authors on important series (GISSEROT) underline, as we do, this interest of Tomodensitometry. By using Tomodensitometry the pre-radiological phase of the Pneumoconioses is reduced.

Table XI

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose Early Detection—Pittsburgh 1988, Asbestos (N = 30) Comparison of Pleuro-Parenchymal Involvement on Chest Radiographs and HRCT Scans

	C.R.	H R C T
PLEURAL INVOLVEMENT	15	30
PARENCHYMAL INVOLVEMENT	10	15

Table XII

New Thoracic Imaging, Interstitial Syndromes, Pneumoconiose
Early Detection—Pittsburgh 1988
Asbestosis (N = 30)

PLEURO–PARENCHYMAL ABNORMALITIES ON H R C T SCANS.

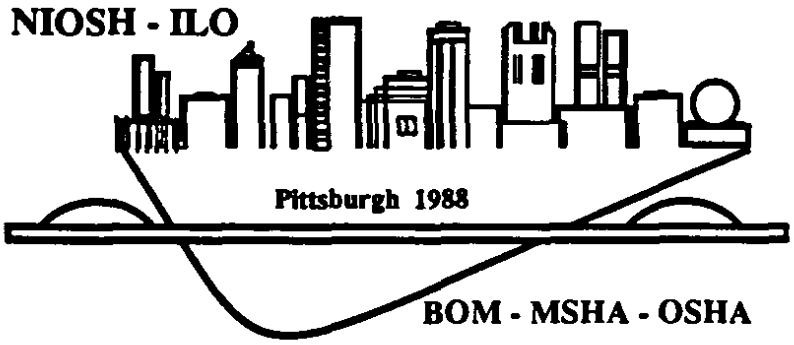
– PLEURAL		
BEGNIN	PLAQUES	29
	EFFUSION	6
	MESOTHELIOME	2
– PARENCHYMAL		
– THICKENING INTERSTITIUM		19
– NODULAR		7
– MIXED (THICKENING AND NODULAR)		5
– CURVULIGNE SUB PLEURAL LINES		4
– HONEY COMBING		3

2. As well as early detection, Tomodensitometry allows for a better morphological and topographical appreciation of the lesions (for example: pseudo mass—lesions of focalized fibroses or "honey combing" in general sub pleural postero-inferior latero-vertebrals), a better study of the associated lesions and of the complications (emphysemia, bronchial dilatation, bronchial or pleural neoplasm, secondary infection, tuberculosis). This morphological and topographical precision of the lesions will surely guide the pulmonary biopsy when necessary whether it be carried out by surgery or by puncture under tomodensitometry as was the case in 2 bronchial peripheral neoplasms in our series.

3. Tomodensitometry presents two disadvantages inherent to Medical Imagery in general:
   - The histological non specificity of the lesions. Numerous interstitial syndromes of various etiologies resemble each other even if that of silicosis is more nodular than that of asbestosis which is more linear. The finding of such lesions must therefore be confronted with the other methods of diagnosis (bronchiolo-alveolar flush and pulmonary biopsy if necessary). At the limit of high definition it is impossible to distinguish between a micro-nodule and an intra-lobular vessel. Other arguments must therefore be taken into account (the number of "vessels" per surface unit of the parenchyma for example). Nevertheless, allow us to point out that if the tomodensitometrical lesions are not very specific, those observed with standard radiography are even less so, harder to interpret in the face of artefacts linked to superpositions and to the technical realization of the plates.
   - The difficulty of quantifying the parenchymal disease. Interesting work is being done in this field (BERNADAC—GRENIER) using computerized mathematical analysis.

In conclusion, in the light of the various works, the possibilities which Tomodensitometry offers for the study of Pneumoconioses are far superior to that of the standard plate which, nevertheless, remains very useful for monitoring these lesions for example. The I.L.O. classification will certainly have to be revised or completed in the light of Tomodensitometry. In this type of pathology, the place of this examination is yet to be defined for, in spite of the present diffusion of the appliances, tomodensitometric exploration is still more expensive and harder to get than a simple standard plate.

Proceedings of the VIIth International Pneumoconioses Conference | *Part* **I**
Transactions de la VIIe Conférence Internationale sur les Pneumoconioses | *Tome*
Transaciones de la VIIa Conferencia Internacional sobre las Neumoconiosis | *Parte*



Pittsburgh, Pennsylvania, USA—August 23–26, 1988
Pittsburgh, Pennsylvanie, Etats-Unis—23–26 aout 1988
Pittsburgh, Pennsylvania EE. UU—23–26 de agosto de 1988

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September 1990

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DHHS (NIOSH) Publication No. 90-108 Part I