Tomodensitometric detection in pneumoconiosis due to amorphous silica: correlation between conditions of exposure and radiological patterns.

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"Liparitosi" is a pneumoconiosis due to inhalation of pumice powder, an amorphous silica material, derived from mining processes implemented on the island of Lipari (Aeolian Islands, Sicily).

This pathological entity, described for the first time by E. Castronovo in 1953, differs from the more known silicosis, the latter being a pneumoconiosis due to inhalation of silica in crystalline form.

Amorphous silica, in its various natural and artificial forms, has had over time an increasingly wide use in industrial field so, although liparitosi is a disease with a local incidence, it can however be considered representative of pneumoconioses caused by inhalation of non-fibrous compounds containing amorphous silica.

Pumice is in fact a complex silicate consisting of 70% silicon oxide (SiO$_2$) and the remaining percentage oxides of elements such as aluminum (12%), titanium (0.1%), iron (2%), manganese (0.1%), sodium (3.6%) and potassium (4.5%) whose presence in ionic form prevents the formation of a crystalline structure so that the mixture is present in amorphous form.

The purpose of this study is to identify the CT features of pleural, mediastinal and parenchymal damage in subjects occupationally exposed to inhalation of pumice powder and to match the results to different kinds of exposure.
Methods and Materials

Patients:

36 workers exposed to inhalation of pumice on the island of Lipari were retrospectively tested by assessing chest CT follow-up of at least five years.

They were only male subjects, mean age 68.06 ± 11.93 years, whose occupational exposure to pumice results from work history with special regard to the duration and modalities of work in the quarries. The subjects had worked in the quarries of Lipari for an average of 27.51 ± 13.06 years. No worker had a previous history of domestic or occupational exposure to asbestos or other mineral dusts other than pumice.

Study Mode:

Subjects included in the study were classified as smokers, former smokers and nonsmokers.

Each of them has undergone clinical evaluation followed by spirometric examination, standard radiography and then computed tomography of the chest.

ILO method (International Labor Office) was used for radiological assessment of parenchymal lesions.

Based on results of the first standard chest radiographs, the study protocol included for the acquisition of CT images with high spatial resolution algorithm in patients without evidence of pleuro-pulmonary damage or radiographic findings of pleural plaques, in order to exclude parenchymal involvement.

The follow-up CT was performed annually for the first 3 years, then subjects were monitored after five years. All tomodensitometric examinations included in the study were obtained without administration of contrast media.

Analysis of variance was used to determine the significance of differences between groups in relation to lung function, smoking habits and years of exposure to pumice powder.

We also carried out a statistical analysis using the Spearman test in order to assess the correlation between CT findings and the measurements of pulmonary functions, number of cigarettes per day and years of exposure to pumice dust.
Results

Among 36 workers examined, we identified four CT patterns:

A. No damage (occupational activities carried out in safe conditions); it was found in 22/36 cases, representing 61.11%, which ILO classification is in the degree 0/0-1;

B. presence of pleural plaques (exposure to high concentrations of dust); this pattern was present in 6/36 workers, representing 16.67% and classified as ILO ac/1-3 type (Fig.1, 2);

C. perihilar masses with characteristic reticular calcifications without diffuse parenchymal micronodules (exposure to high concentrations of silica at high temperature); this CT finding was detected in 6/36 subjects, representing 16.67%, with ILO type AC (Fig. 3, 4, 5);

D. perihilar masses with characteristic reticular calcifications and diffuse parenchymal micronodules (exposure to massive concentrations of silica at high temperature), found in 2/36 subjects, equivalent to 5.55%, with ILO-type AC (Fig. 6);

Statistical analysis showed a significant difference between groups in relation to the time of exposure, but not in relation to smoking.

Spearman test detected a significant correlation of CT findings in groups A, B, C and D both with lung function parameters and with duration of exposure.

The smoking habit was not correlated with CT findings.

In no case it was proven evolution of CT findings in the follow-up to 5 years.
Fig. 0: CT scan with lung window. Presence of bilateral pleural plaques in absence of parenchymal lesions.

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Fig. 0: CT scan with mediastinum window. Presence of bilateral pleural plaques in absence of parenchymal lesions.

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**Fig. 0:** CT scan with mediastinum window. Right perihilar masses in the context of which there are appreciable fine calcifications with reticular appearance and distortion, limited to certain segmental bronchi.

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**Fig. 0:** CT scan with lung window. Right perihilar masses in the context of which there are appreciable fine calcifications with reticular appearance and distortion, limited to certain segmental bronchi. No appreciable lesions of lung parenchyma.

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Fig. 0: CT scan with mediastinal window. Presence of bilateral perihilar masses with calcifications, more plentiful on the right side where they assume reticular appearance.

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Fig. 0: Axial CT scan with parenchymal window. It can be detectable the presence of bilateral perihilar masses with diffuse parenchymal nodules in both lungs.

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Conclusion

Liparitosis is characterized by chronic evolution in 20-30 years.

Clinically it is almost silent, vaguely simulating a catarrhal bronchitis.

Some characteristics of this disease suggest to consider it as a separate pneumoconiosis.

From a radiological point of view, the evolution of the disease has been described as a thin reticulation that goes up to a massive fibrosis.

Today, probably due to the substantial improvement of the technological processes of extraction and processing, which occurred in 1985, the massive form is still visible in only a few retired workers with more than 20 years of work;

The average levels of inspirable dust measured in 1997 were, in fact, equal to less than 1/3 compared to 1981.

All workers hired after 1985 and only two workers previously employed were classified in group A and showed no pleuro-pulmonary damage.

Conversely, workers of groups B, C and D had carried out their activities in the pre-technology period. In particular, groups C and D, with over twenty years of work, were exposed to large amounts of heated pumice.

It can therefore be assumed that the heat drying of pumice would reduce the aerodynamic diameter of particles, allowing them to penetrate deeper into the airways.

The perihilar masses observed in liparitosis seem to have different histopathological features and, presumably, different pathogenesis than the progressive massive fibrosis, typical of silicosis.

The silicotic mass follows the confluence of sclerohyaline pulmonary nodules.

Whereas, in liparitosis the major morphological feature is due to the massive deposit of dust in the peribronchial and perivascular connective tissue.

This infiltrate, covering the stroma of blood vessels, may appear in the histological image as a two-dimensional nodular structure with a central branch of the bronchiolar vessels.

The nodular structures are formed by macrophages without signs of necrosis.

When these nodules are very close together, they can assemble into a fibrous mass with irregular shape.
The difference with silicosis can be explained by the modest cytotoxicity exerted by pumice on alveolar and interstitial macrophages and mononuclear phagocytes; pumice dust accumulates in the cells without causing their necrosis, responsible for the release of interleukins and other mediators that determine the fibrotic reaction.

Consequently pumice, either free or contained in macrophages, follows an efficient lymphatic drainage to the pleura and mediastinum, resulting in chronic fibrosis only after passing a threshold of dust deposition.

The only two cases in which we found diffuse parenchymal micronodules in combination with perihilar masses are related, in fact, to the exposure to massive concentrations of silica at high temperature, that overcomes the possibility of lymphatic drainage, resulting in parenchymal deposit.

The Spearman test revealed the existence of a valid correlation between the four CT patterns and parameters of lung function and it has also shown a significant difference in the duration of exposure; however, it has not detected a statistical correlation between CT findings and the number of cigarettes smoked per day.

In conclusion, the results obtained show characteristic CT patterns entirely different from those resulting from the most common inhalation of crystalline silica (silicosis), correlated with the duration and intensity of exposure.

Considering the chemical nature of pumice, we suggest that chronic inhalation of this powder can be paradigmatic of occupational and environmental exposure to non-fibrous amorphous silicates. Because of wide industrial use of amorphous silica compounds, the knowledge of clinical and CT features of "liparitosis" could be useful both for radiologist, pneumologist and occupational physicians.
References


-Castronovo E. Radiological features of pumice pneumoconiosis (liparitosis) and its pathogenic interpretation. Riv Inf Mal Prof 1953; Suppl. 278-289.
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