

The Roentgenogram in So-Called "Acute" Silicosis*

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THE recent literature contains several references to an acute form of silicosis. In dealing with a disease which is by definition chronic in its course, the designation "acute" is ambiguous, but it has been employed to indicate that the process develops within a period of a few months or years. It has been my privilege to examine a series of roentgenograms of persons said to be suffering from this condition. One set was from a small group of sand blasters and another from a group of colored laborers who had been engaged in the boring of a tunnel through rock of a very high silica content. Some of these persons have died and were autopsied. The pathological aspects will be illustrated by Dr. Gardner, while I will attempt to describe the roentgenograms in the living members of the group.

Before considering the roentgenological appearances of this disease, it is of prime importance to consider the roentgenologic technic. In an acute silicosis we would presumably be dealing with deposit in the lymphatics and regional lymph nodes of particulate matter which is capable of provoking an acute reaction in these tissues. We have reason to assume that in the early phase of the disease the physical changes in the lungs would be so slight that they would not produce recognizable shadows. To demonstrate such minute changes it is necessary to give especial

attention to the factors involved in the making of the roentgenograms. I do not hesitate to say that stereo-roentgenograms are necessary if we are interested in the early manifestations. With properly taken films, one can, in the interpretation, eliminate disturbing extrapulmonary shadows and also evaluate slight intrapulmonary variations due to movement. The X-ray tube should be of the line-focus copper-backed-target type, with a focal spot not greater than 10/64", the tube-film distance not less than 4' and the time of exposure (which should be carefully checked) not slower than 1/10 sec., or preferably 1/20 sec. Longer exposures permit of too much movement of the intrapulmonary shadows. Obviously there are many other factors which, if neglected, will make interpretation more difficult. These are too numerous to mention. Probably the most important is the blur due to screen-film contact and movement. All of these factors are specifically mentioned because of the fact that a larger focal spot, a longer exposure time, and a shorter distance, may produce variations in the shadows that can be very misleading.

In considering the very slight alteration in the pulmonary field which such insignificant anatomical changes produce, one must bear in mind certain manifestations of the normal chest: The movement of the pulmonary markings at the left base due to the heart beat may well be mistaken for the

* Read before the Industrial Hygiene Section of the American Public Health Association at the Sixty-second Annual Meeting in Indianapolis, Ind., October 9, 1933.

cloudiness expected in early silicosis. Similarly the shadow of the margin of the pectoralis muscle is not unlike that shadow seen in cases of beginning fibrosis. However, the shadow of the muscle is situated more peripherally and continues beyond the pulmonary field while the intrapulmonary haziness of silicosis is usually more centrally located. Also, in the case of the pectoralis muscle the lung markings are visible through the shadow of the muscle, whereas the enveloping intrapulmonary infiltration produces cloudiness which tends to obscure the vascular ramifications. In general, if the cloudiness, which has not yet assumed the nodular appearance, is confined to the region of the pectoralis muscle or to the left base, and if no alteration of the pulmonary pattern is seen above this level, we may not be justified in believing we are dealing with a pathological process.

Of a large series of roentgenograms of miners who have been exposed to silica for varying periods of time, in general, the shadow changes in the roentgenogram increase with the length of exposure. Roentgenograms of a certain quality or character, that is, those in which there was loss of detail due to movement, or large focal spot, or short tube-film distance, or a too contrasty film, or a combination of these, may have such a shadow complex as to be mistaken for such pathological changes that take place before obvious nodulation has appeared.

After the stage of nodulation has been reached it is not difficult to recognize the characteristic mottling. If we are to be guided by experience in other acute pulmonary diseases, that is, pneumonia or pulmonary tuberculosis, we have reason to believe that in "acute" silicosis, serial roentgenograms taken at short intervals will or should show obvious changes in the shadows during the period of progression. Monthly roentgenograms should reveal

a rapid increase of shadows until the climax is reached, when the process should pass into the chronic stage, which form is now well recognized.

I think it might be postulated that if serial roentgenograms fail to reveal obvious, rapidly changing shadows, and by that is meant shadows changing from month to month or week to week, one is not justified from a roentgenological point of view, in considering a silicotic process as acute. Undoubtedly there are persons exposed to heavy concentrations of silica for short periods who exhibit various symptoms of acute disease, but the serial roentgenograms which I have seen did not confirm the diagnosis of uncomplicated silicosis.

At this juncture it is highly important to consider from a roentgenographic standpoint the presence of an infectious process superimposed upon a preëxisting silicosis, or *vice versa*. Here we have (according to the experimental work of Gardner) reason to expect reasonably rapid changes to take place in the processes. If the picture changes with extreme rapidity it is hard to conceive that these alterations are due only to the inhaled silica; it is more probable that one is dealing with a complicating infection.

In general, two types of this so-called infection picture were present in the roentgenograms studied: (1) that which resembled very closely the characteristic shadows of a pulmonary tuberculosis—in some instances even to the extent of having cavity formation and in which there was no diffuse nodulation; and (2) those which presented the above characteristic shadow-complex of a tuberculosis plus a diffuse nodulation. To this latter group might be added another type. A diffuse nodulation of a distinctly fluffy character—diffuse cotton ball appearance, unlike the longstanding nodulations of the non-infective group. The inferred infective process, in a few instances, was so advanced as

to make the interpretation of an associated silicosis uncertain. In not a few of those cases who probably had an infection it was not improbable that some had a degree of silicosis that was not yet recognizable by roentgen examination.

There is reason to expect, in any acute process, shadows of a rather characteristic nature. In practically all cases the one outstanding feature of the roentgen shadow complex is its cottony or fluffy appearance and its ill-defined margins. It is not to be forgotten that in the earliest phase of such processes, there may be no discernible shadow in the lung field. The cellular reaction may be sufficient to produce pronounced subjective symptoms, but for the time being there is not sufficient loss of air space to be recognizable on the roentgenogram. If the disease progresses this condition does not last long and the next roentgenogram of the series will show a change. I believe until serial roentgenograms reveal rapidly progressive or retrogressive shadows, and also the stigma of an infection be satisfactorily excluded, one is not justified in interpreting the roentgenogram as rapid uncomplicated silicosis.

Gardner writes "In most instances authors claim that fibrosis of the lungs

develops after a few short inhalations of dust over a period of weeks or months." Further he states that "in order to produce significant changes, animals must be exposed for periods measurable in years to concentrations of dust no heavier than those in the worst industrial condition."

In the rabbit it has been demonstrated that silicosis is a progressive disease. After 13 months of exposure the animals were set aside in a normal atmosphere. The resulting progressive changes that occurred were the development of proliferative nodules. No mention is made of acute silicosis.

Rabbits exposed to a high concentration of quartz dust for 13 months revealed at autopsy only many small proliferative nodules in and about the pulmonary lymphoid tissues. The X-rays revealed barely detectable shadows.¹

There is one pertinent point, however, that needs to be cleared up before one can exclude the possibility of acute silicosis, and that is, in many cases apparently suffering from silico-tuberculosis or tuberculo-silicosis, tubercle bacilli are not demonstrated.

REFERENCE

1. Gardner, Leroy U. *J. Indust. Hyg.* Jan., 1932.