TRANSLATION

PNEUMOCONIOSIS DEVELOPING AFTER INHALATION OF POLYVINYL CHLORIDE

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In the course of the last few decades polyvinyl chloride (PVC) has become widely used not only in industry but also in clinical medicine. Generally speaking, PVC is inert to the tissues and has been regarded as a harmless substance, and consequently it has been used as the material for medical instruments such as cannulas and catheters. Quite recently, however, some reports have appeared according to which the vinyl polymers, and in particular PVC, may be damaging to health [4,3]. In one of these publications the authors reported that granulation tissue developed around PVC particles implanted into the muscle tissue of experimental rabbits [1]. According to Roe et al. [2], subcutaneous implantation of polyvinyl plastic sponge in rats was followed by the development of sarcoma in some of the animals. As far as we know so far there have been no reports in the literature concerning the development of granulomatous changes resembling pneumoconiosis in the lungs following prolonged inhalation of PVC powder.

CASE REPORT

B.S., a man aged 31, was admitted to the clinic because of breathing difficulties. Chest X-ray: on both sides there were splintery, filamentous finely dotted shadows becoming denser toward the hilus (Fig. 1); pneumo- and angiocardiography failed to show right-sided or left-sided shunt. Respiratory function: at rest the findings were normal, but on effort the function appeared to be impaired (see table). Blood picture: erythrocytes 6,800,000, leukocytes 6000, Hb 13.5%, color index 0.9, ESR: 9 mm/h.

To investigate the changes in the lungs, biopsy was taken from the tip of

the lingula. Two light-gray pieces of lung tissue of pea size and plumstone size respectively were investigated. Morbid histological investigations of the lung samples revealed diffuse fibrosis of moderate degree and several lesions arranged in small foci.

At several points it could be seen that the center of the lesion was occupied by a foreign material. Some of this material was slightly cosinophilic and some showed weak basophilic staining. There were also parts positive to PAS. Part of the foreign material dissolved in the course of embedding and disappeared completely. No fat granules were found in sections at the various sites corresponding to the foreign material, and under the polarizing microscope the foreign material did not prove to have double refraction. Individual particles of the material did not reveal any crystal structure. They were oval or polygonal in shape and 15 - 25 μ in diameter. The foreign material was surrounded by granulation tissue consisting of histiocytes, lymphocytes, plasma cells, cosinophil cells, and foreign-body giant cells. In the same granuloma there were also connective tissue fibers, in places arranged concentrically. In other parts of the lungs numerous heart failure cells containing hemosiderin could be seen in the lumens of the alveoles (Figs. 2 and 3).

Table 1

Patient B.S. Results of examinations concerning the respiratory function before the biopsy

VC: 4600 ml (+ 10%)
FIVI*: 3950 ml (79%)
Residual volume: 730 ml
Residual volume/total capacity: 14%
Total capacity: 5330 ml (97%)
Resistance: 26.6 mm H_2O/liter/sec. C[? = 0.032 l/mm H_2O
Oxyergospirometric investigation:
45 W:

VO_2 = 900 ml
PaO_2 = 72 Hg mm
$PaCO_2$ = 41 Hg mm

At 90 W the patient becomes cyanotic and his PO_2 is equal to 49 HG mm.

*Translator's note: Abbreviation uncertain, possibly "inspiratory reserve volume"

After the arrival of the histological report the patient was questi ned and stated that about 1 year earlier he had been w rking in a plastics factory where he had to shovel PVC in the form f fine powder, generally in draughty places.

Having thus obtained additional anamnestic data, we treated the sections with 10% solutions of cyclohexanone in benzene, which is a solvent for PVC.

Under this treatment the foreign bodies completely dissolved and disappeared from the sections.

The patient was treated conservatively and kept under observation; his condition on the whole remained unchanged.

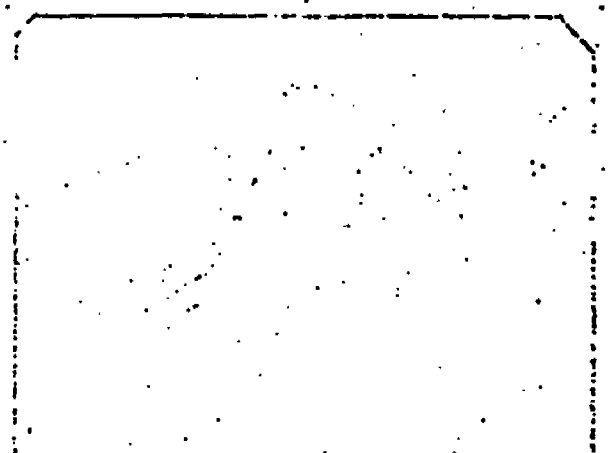

Fig. 1 - Chest X-ray of patient BS: on both sides the structure seemed to consist of strands and small dots.

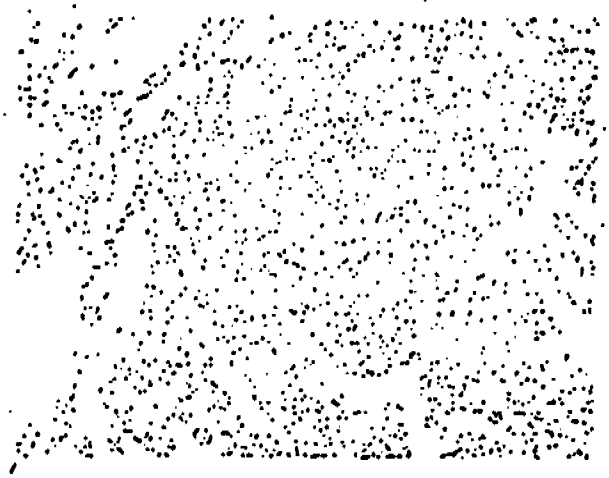

Fig.2 - Foreign-body granuloma in the lung tissue (H.E. x 100)

Discussion

On the basis of the case history and the histological picture we regarded the lesions as pneumoconiosis caused by aspiration of PVC dust. The shape and the staining properties of the foreign-body particles seen in the center of the granulomas did not resemble any other particles known to cause pneumoconiosis. There is no specific stain suitable for the histological demonstration of PVC, but the successful dissolution of the foreign material with cyclohexanone suggested that the material was indeed PVC.

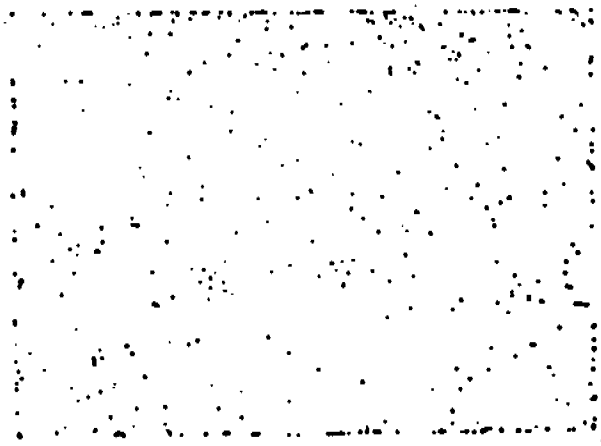

Fig. 3 - The granuloma under higher power. Foreign material and the surrounding cellular elements are clearly visible (H.E. x 450)

As it seemed impossible to demonstrate even by chemical means the presence of PVC in the lung samples investigated by us, we collected samples of PVC dust from the place where the patient had been working. Microscopic examination of the dust particles showed them to be morphologically similar to the foreign-body particles found in the lungs. This material is treated with solvents and stabilizers only at later stages of the production, and thus the harmful influence of these factors, assumed by other authors [1], could not possibly play a part in our case.

We believe that the best approach to this problem would be aspiration of the PVC dust in question by experimental animals followed by histological investigation of their lung tissue, and we are now carrying out experiments in this direction. Our present observations can of course only be confirmed by experimental investigations and possibly further observations in human patients. On the basis of the information available so far it may well be asked whether PVC dust can cause pneumoconiosis, which would mean that the group of pneumoconiosis-causing agents could be enlarged by inhaled PVC. Such lesions could be important not only from the point of view of differential diagnosis but also as regards industrial hygiene.

It should be emphasized that in our case the foreign bodies found in the lung tissue -- presumably PVC -- were surrounded by a marked and severe tissue reaction: this indicates that the material can irritate the tissues. It can be assumed that after prolonged exposure the described process may end in scar tissue formation. In our case the dyspnea, the secondary polyglobulia, as well as the impairment of the respiratory function indicates the severity of the disorder.

Summary

Lung biopsy on a 31-year-old male patient who over a period of a year had been exposed to the aspiration of PVC dust, revealed changes corresponding to foreign-body granulomas. The authors raise the assumption that aspiration of PVC dust may lead to pneumoconiosis.

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References

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VC Pneumoconiosis

PVC INDUSTRY

Dispersion PVC resin particle size ranges from 10 microns maximum to less than 1 micron.

Surfactants are present on the resin particle in a 1 to 2% by weight concentration.

Surfactants used are:

1. TERGITOL 08
   sodium 2 ethyl hexyl sulfate
2. TERGITOL 4
   sodium tetradecyl sulfate
3. Sodium Lauryl Sulfate
4. Lauryl Alcohol - usually as a modifier
5. Aerosol OS-10
   sodium dodecyl benzene sulfonate
6. Aerosol OT
   sodium dioctyl sulfosuccinate
7. Aerosol ?
   sodium dihexyl sulfosuccinate
8. Ammonium laurate
9. Mersolat K-30
   alkyl sulfonate (13-17 carbons)
10. TERGITOL NPY
    Polyoxethylene nonylphenyl ether
11. Tenneco - Wacker
    Maleic acid epoxidized. ammonium salt