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"On the So-called Vinylchloride Disease"

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Since 1958, when the first information on the hazardous health aspects to workers in the vinylchloride manufacturing industries was found, and especially since 1963, when the same effects were found affecting workers in the polyvinylchloride industry (PVC), and through further reports on this subject (3, 4, 7, 8, 12, 28), attention has been drawn to this branch of the chemical industry. This deals with a disease similar to a skin and bone affecting scleroderma, but a disease unexplainable in etiology and pathogenesis. The main symptoms of this have been the Raynaud syndrome, nodular to large area dense skin alterations and band-like osteolysis in the finger phalanges.

We could report our first observations on this disease type in Germany in 1972 (15, 16, 17). As the clinical picture was at first comparable to a specialized form of progressive scleroderma, we submitted all employees to a painstaking

the nail plate). We saw scleroderma-like skin alterations in 8 patients: small knots or more spread out; very coars and relatively sharply defined, usually covering the surface skin projecting infiltrate on the outstretched hands, the distal third of the arms under the elbow, and the area of the cheeks. Three patients had no clinical skin alterations.

The histology findings of the excision specimens (from the left or right hands) of all patients were relatively uniform. Besides hyperorthocytosis and epidermidosis, there was an expansion and increase of capillaries in the upper cutis. An increase, widening and homogenation of the collagen bundle and a clear rarefaction and fragmentation of the elastic fibers was evident. The same findings in the epidermis and the fibers of the upper cutis were proven to exist in the patients without clinical skin alterations. The histology alterations in the epidermis and the collagen connective tissues are similar to the edematosis to infiltrative stage of progressive scleroderma. Here, however, a clearly defined border is seen between that of possible but to some extent considerable injury of the elastic fibers and the vessel alterations.

So far, circulation disturbances are the most common symptoms: Nine of thirteen patients complained of this, and in fact eight of them gave this complaint as their first symptom. The degree of complaint ranged from increased sensitivity to the cold and "akrozyanose" to the Raynaud

In addition, fragmentation and border defects of the Processus unguiculares could be found in six patients. It is also possible to determine different degress of bone alteration: in light cases only a small lytic zone is visible, and in the advanced stage the phalange is almost fully destroyed and the Processus unguiculares mounts onto the basis of the phalanx cap-like. A full restitution of the bone is not to be expected based upon the facts at this time (23,24). Remarkable herein is the solid correlation of acroosteolysis and the club-like expansion of the end phalanges. Thus, the "drumstick fingers" are an expression of the lytic bone process and not of an internal disease.

An examination of the blood building system and coagulation draws our attention to this remarkable finding: all thirteen patients showed light to serious thrombopeny. The thrombozytic count lay repeatedly between 30,000 and 119,000/$\mu\ell$ (under a normal limit of 150,000/$\mu\ell$). In a sternal puncture given to six patients in search for an explanation, there resulted in no case a reference to the obstruction of the "thrombosytopoese", osteomyelofibrosis, or osteomyelosclerose. The other examinations showed no deviations from the norm, except for a slight reticulocis in eight patients (between 16 and 26 %), and a slight leukopenia in five patients (2350 to 3950 leudocytes/$\mu\ell$). Reticulosis and leukopenia may be caused by the splenomegaly in th tw lve patients. At this time, it is not clear if

been assigned to a known syndrome. It is unexplained etiologically and pathogenically.

Is it possible to obtain a certain insight in the etiology and pathogenesis by a comparison of our results with those previously recorded in literature? What is then possible to be the initiating factor?

At a simultaneous pressure and temperature increase, liquid vinylchloride is polymerized to polyvinylchloride with the addition of water and various additives, depending upon the different properties desired. In different countries, independent of the additive type, the Raynaud syndrome and acroosteolysis was present in workers cleaning autoclaves. The symptoms appear so characteristic that it lead in the past year to the disease designation of "occupationally-conditioned acroosteolysis" and was advanced to a diagnosis position (28). It is not assumed that the additives, differing by type, country of production and methods, play an important role, but the harmful combination of these with the vinylchloride can not be completely excluded. Therefore vinylchloride, the substance present in the largest amount, becomes the main point of our interests. The monomer vinylchloride is pumped over a closed system of an autoclave. The exit possibilities of the gas - and thus the inhalation possibilities - consist then in more places within the production process:

1. Permeability of the autoclaves (intake and offtake)

during polymerization and recovery processes.

2. In the discharging and opening of the autoclaves as well as in the drying process of the finished polyvinylchloride. The residual gas consists of up to 90% vinylchloride (6) and often leads to leaden tiredness and short-lasting disorientation in the employees.

3. From the polymer precipitation on the walls of the kettles.

Therefore, from the technical viewpoint, it is completely possible that vinylchloride initiates the hereby described disease.

Some facts are already known about the effect of vinylchloride on human and animal organisms. The narcotic effects have long been recognized (22). Since 1958, reports have repeatedly been made concerning the angioneurotic obstructions and the Raynaud syndrome in workers (1, 10, 21). In the literature one finds single references to the intoxication of vinylchloride, wherein a reversible dizziness, light to very noticeable giddiness, disorientation, skin appearing as a 2-degree burn, and lessened blood coagulation have been determined symptoms (6, 9, 11). One worker died as a result of poisoning.

With the use of experiments involving animals, lung odem, blood congestion in the lungs, liver, and kidneys, as well as decreasing blood coagulation could be proven (20). In long term experiments it was possible to produce centrolobular degeneration in the liver and necrosis with foamy vacuolization as well as periportal cellular infiltration (26).

prognosis and relatively high mortality (from ur investigation certainly more than 10%) has led prevailingly youn men to solicit us to place the following suggestions:

1. Execution of epidemologic and preventative medical experimental tests. In our opinion, it is not sufficient any more to search for only Raynaud syndromes and knotty skin alterations because these symptoms , as characteristic as they are, already show the advanced stage of disease. Perhaps more important, controls to determine the thrombozytic count in regular time periods should be given to all employees of PVC-producing industries. This should take workers with a constant thrombopeny out of this branch of the industry, as this appears to be the first objective symptom, before further and more serious internal damage occurs.
2. No employment given to those with liver diseases or circulatory problems.
3. Regular gas concentration measurements in different work sites to avoid exceeding the MAK limit. Experienced technical improvement with the goal of greatest possible automation, andimprovement of the ventilation conditions to reduce the possibilities of gas inhalation to the lowest amount possible.
4. Compensation to diseased workers and recognition of this disease as liable to indemnity by inclusion in the list of BKVO.
5. More research, especially with animals, using vinylchloride with special consideration to the skin, bones, lungs, liver, and spleen.

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