Some clinical features of occupational diseases in workers engaged in the production of triarylphosphates

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Some clinical features of occupational diseases in workers engaged in the production of triarylphtosphates

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Triarylphtosphates (TAR) are organophosphorus softeners which make things more flexible and durable. They are extensively used in the production of polymers, varnishes, fire-resistant oils and other materials.

This report is based on investigations conducted at 2 large Soviet enterprises which manufacture triarylphtosphates (tricresyl-, triphenyl- and trixylylenylphosphates). During a study of labour hygiene conditions (V.S. Aizenshtadt et al.), it was established that the chemical factor was the most unfavourable. The workers of both enterprises were periodically subjected to the chronic effect of highly concentrated vapors of cresols, phenols and end product. In addition, within the narrow confines of the manufacturing area this effect was intensified by highly concentrated vapors of phosphorus oxychloride. Besides having an inhalational

*The numbers in the right-hand margins are the pages of the Russian text - translator.
effect, cresol and tricresylphosphate affected the skin (detected in the water in which the hands and face were washed).

127 workers (77 women and 50 men) of the first enterprise and 124 (49 women and 75 men) of the second were kept under observation throughout the investigation period. The majority of the examinees at the first enterprise were between 20 and 40 years of age, their exposure to triarylphtoxates not exceeding 9 years. Most of the examinees at the second enterprise had a working record of 7-18 years, and one-third of them were between the ages of 40 and 50. For the control, we examined 127 healthy workers (70 from the first and 57 from the second enterprise) who corresponded to the groups studied in age and sex ratio, but worked at other jobs that did not bring them into contact with the harmful chemicals.

Approximately two-thirds of the workers at each enterprise complained of headache, dizziness when straightening up abruptly, stabbing pains around the heart, insomnia, undue fatigability and irascibility, poor appetite, nausea and pain in the epigastric region. These complaints combined with high tendon reflexes, tremor of extended fingers, instability in Romberg's position, the uni- or bilateral palm-chin reflex, a change in postural reflexes, and a sudden drop in the pressure of the brachial artery as one stands up corresponded to the vegeto-neurasthenic and angiodystonic syndromes. At the same time, 45 workers (35%) of the first enterprise were found to have a low pressure in the temporal arteries and a low temporobrachial ratio, while the same indices in one-half of the long-time workers of the second enterprise were high, and the arterial pressure in 30 (24%) of the workers was between 140/80 and 160/90 mm.
Besides the indicated symptoms, 16 workers (13%) of the first enterprise and 48 workers (39%) of the second complained of pains, numbness and tingling in the distal parts of the hands and feet, as well as cramps in the calves and feet. Meanwhile, objective changes indicating impairment of the peripheral innervation were observed in 135 workers of both enterprises, already appearing during the first years of work; in 71 of the workers, these changes did not cause subjective disorders and were characterized by distal hyper- and hypalgesia, acrohyperhidrosis and capillaroscopic changes. Capillary spasm was observed in those who had been working at the enterprise for up to 4 years, spastico-atonia predominated in those with a longer period of service, and atonia of the capillaries with a noticeable curtailment of the Nesterov-Lang test was observed in those working for over 14 years. These changes were accompanied by a considerable decrease in the time required to obtain a specific amount of white precipitate and diffused reactive hyperemia, as compared with the control, and hypothermia of the skin on the hands, forearms and feet. All this permitted a diagnosis of vegetative polyneuritis in 10 (8%) of the workers of the first enterprise and in 32 (26%) of those at the second enterprise. In addition, a foot dynamometer helped to establish a decrease in the strength and a tendency towards a decrease in the endurance of the extensor hallucis among the long-service personnel. The absence of significant differences in the dynamometric indices for the hands as well as literature data on the capacity of triarylp phosphates to primarily induce pareses of the feet extensors (L.N. Gratsianskaya; K.V. Tsomaya; V.G. Artamonova and Y.E. Shvartsman; Hees and White, and others) lead us to believe that this symptom is caused by occupational toxicants. This is also substantiated by symptoms
of concurrent polyneuritis observed in 7 of the workers, the decrease in feet extensor strength being accompanied by minor muscular hypotonia, an increase in the knee jerk reflex and inhibition of the Achilles tendon reflex.

In the workers of the first and second enterprises, there was considerable inhibition (averaging 27 and 31% respectively) of the activity of plasma choline esterase, as compared with the control. A study of this index in 17 workers before and after a shift showed that it decreased by 28-73% in 12 of them.

A clinical examination of 62 workers suspected of occupational poisoning confirmed the occupational etiology of the disease in 52 of them. Indications of this, besides poor labour hygiene, were the onset and progressive nature of the disease during work in the shop, the absence in the anamnesis of any other causes for the disease, the massiveness, similarity and gradual aggravation of neurological symptoms, and the insufficient or temporary effectiveness of the treatment administered in the process of work. In 35 persons, a concomitant neurological change was chronic gastritis which in 21 of the workers was accompanied by secretory insufficiency; changes in the biliary tract were observed in 15 persons, hypochromemia in 7, low activity of the plasma choline esterase in 23 and of erythrocytes in 8 persons. Vegetative-vascular disorders were found in all 52 of the workers and, apart from the disorders mentioned earlier, were accompanied by a change in the hypothalamic tests, including abatement of ultraviolet erythema, by subfebrility, changes in Shcherbak's heat regulation reflex and the nature of the sugar curve, curtailment of the hydrophilic test (less than 40 min) and an increase in basal metabolism. We noted a disturbance in the ratio of the
types of local dermography (intensity and stability of the red, and a weakness or absence of the white). In 4 of the workers, the changes were of an organic nature. In three persons, a change in personality (emotional lability, confliction) combined with diffuse organic symptoms indicated toxic encephalopathy.

Rheography of the extremities, performed with 49 workers, revealed a drop in the blood-content of the forearms as compared with 36 healthy workers of the same age (0.62 ± 0.02, and 0.70 ± 0.03 in the control; p < 0.05). During mechanocardiography, it was established that the mean dynamic pressure in the majority of the examinees exceeded the age norms, the mean value being noticeably higher than in the control (92 ± 2 and 82 ± 1 mm; P < 0.05). Besides, a study of the blood circulation of the brain by means of rheoencephalography and simultaneous bilateral temporal tensiography (V.S. Aizenshtadt and A.A. Samarin) showed a considerable decrease in the blood-content of the brain (0.72 ± 0.04, and 1.08 ± 0.03 in the control; p <0.05), dystonia of the brain vessels and pressure asymmetry. In one-third of those with functional disorders, the pressure in the temporal arteries showed a tendency to decrease, dropping to 40-25 mm of the mercury column during the orthostatic test with the temporobrachial ratio diminishing to 0.22-0.35.

The workers with symptoms of organic impairment of the nervous system were found to have persistent temporal arterial hypertension (70-90 mm).

Therefore, chronic intoxication by the products produced in the manufacture of triarylphosphate's is characterized mainly by neurological symptoms, as well as by concomitant chronic gastritis with secretory insufficiency and inhibited

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1The ratio of maximum pressure in the temporal artery to the maximum pressure in the brachial artery is, according to most authors, equal to 0.40-0.65 in healthy people.
plasma choline esterase activity. The early symptoms of nervous breakdown, which correspond to the 1st stage of intoxication, are peripheral vegetative vascular disorders which first appear as a spasm, and are later manifested in spastico-atonia and atonia of the nailbed capillaries, acrohyperhidrosis, curtailment of Lang's test and diffused reactive hyperemia and a decrease in the blood-content of the forearms. A drop in the strength of the feet extensors may be observed as a concomitant of these changes in workers who have been on the job for a long time. The angiodystonic or vegeto-neurasthenic syndrome develops parallelly or at a later time. We observe a change in the functions of the hypothalamus, an increase in the mean dynamic pressure and a decrease in the blood-content of the brain and the temporo-brachial ratio. These changes are clearly observed with the help of special tests (orthostatic test, the sugar and heat tolerance tests). During the progression of a pathological process, there is a possibility of the development of vegetative vascular forms of the hypothalamic syndrome, toxic encephalopathy and concurrent polyneuritis, which are characteristic of the 2nd stage of the disease. Regional arterial cerebral hypertension is observed during this period.

The indicated clinical characteristics should be taken into account in the early diagnosing of chronic occupational poisoning with products produced in the manufacture of triarylphosphates.

Conclusion. The clinical course of chronic intoxication with products produce in the manufacture of triarylphosphates consists of two stages. The 1st stage, which may develop over a period of 2-3 years of work in the shop, is characterized by the perivascular form of vegetative polyneuritis with a noticeable drop in the strength of the feet extensors, as well as by
the vegeto-neurasthenic or angiodystonic syndrome. These changes are frequently accompanied by inhibited plasma choline esterase activity and chronic gastritis with secretory insufficiency; the 2nd stage of the disease manifests itself in toxic encephalopathy, the vegetative vascular form of the hypothalamic syndrome and concurrent polyneuritis.

The nature and tendency of the changes permit us to recommend treatment with drugs which regulate the function of the diencephalon, improve the peripheral and cerebral blood circulation, and have a weakly defined cholinolytic effect.

References


SOME FEATURES DISTINGUISHING THE CLINICAL PICTURE OF OCCUPATIONAL DISEASES IN WORKERS ENGAGED IN THE PRODUCTION OF TRIARYLPHOSPHATES

V. S. Aizenshtadt

Summary

An examination of 251 workers brought evidence that chronic poisoning with triarylphosphate industry products has as its implication a lesion of the nervous system, the development of chronic gastritis with secretory insufficiency and depression of the plasma cholinesterase activity. Besides peripheral vascular disorders in the picture of vegetative polyneuritis a declined force of the feet extension is conspicuous. Among specific features are also vegeto-neurastenic or angiodystonic syndromes, modified functions of the hypothalamus and reduced blood filling of the brain. With the pathological process progressing a rise of the arterial pressure and organic neurological symptoms are noted. The mentioned changes should be taken into consideration in diagnosing and treatment of occupational poisonings.