

General Review

ROLE OF VITAMIN C IN RESISTANCE

DAVID PERLA, M.D.

AND

JESSIE MARMORSTON, M.D.

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(Concluded from page 575)

VIII. EFFECT OF INSUFFICIENCY OF VITAMIN C ON ACQUIRED RESISTANCE TO EXPERIMENTALLY INDUCED INFECTION

Mycobacterium Tuberculosis.—The effect of chronic latent scurvy on the course of an existing infection with *Myco. tuberculosis* has been investigated.

The acquired resistance of tuberculous guinea-pigs that were well fed except in regard to vitamin C was in general considerably less than that of normally fed infected animals of almost any age, according to Bieling.⁷⁷ It was not the undernutrition itself, he maintained, which was the factor in early death but the absence of vitamin C in the diet, for the depression in resistance was observed even if the guinea-pig remained constant in weight. In guinea-pigs with chronic tuberculosis the effects of withdrawal of vitamin C were more pronounced than in the uninfected. He observed no disturbance in the consumption of oxygen in scorbutic animals as determined by the Benedict apparatus.

Many of his guinea-pigs had chronic tuberculosis of two years' duration. Within from five to nine days after such animals were placed on a scorbutic diet, they died. It seemed unlikely that death occurring in so short a period was the result of a break in the mechanism of resistance with reactivation of the tuberculous process. At autopsy no evidence of fresh miliary dissemination of tubercles was noted, so that the tuberculous infection did not apparently flare up under the influence of the deficient diet. There was no sudden increase in the virulence of the tubercle bacilli. The possibility of the effect of toxemia either from the tuberculous process or from the undernutrition was excluded, as no symptoms of this were present. Chronically tuberculous guinea-pigs died before any symptoms of scurvy developed when such animals were placed on a diet deficient in vitamin C. These observations may explain in part the increased mortality

77. Bieling, R.: (a) *Ztschr. f. Hyg. u. Infektionskr.* 101:442, 1923; (b) 102:568, 1924.

IX. EFFECT OF EXCESS OF VITAMIN C ON NATURAL RESISTANCE
TO TOXINS, SPONTANEOUS INFECTIONS AND
INDUCED INFECTIONS

The growing interest in the importance of vitamins in the diet in the bodily well-being, and the accumulation of evidence of the intimate dependence of natural resistance to infection on dietary factors, have led investigators to test the value of an excess of such factors on resistance. Much of this work has been disappointing. It may be that deficiency of a factor essential to normal cellular metabolism results in depression of the organism to abnormal stimuli, as infection, toxemia and the like. It does not necessarily follow that an excess above the bodily requirements increases the natural resistance of the host. That is, there is probably an optimal effect of any nutritional factor, and an excessive intake may not result in raising the optimal effect. However, in the case of vitamin C, sufficient evidence; has accumulated to suggest the importance of cevitamic acid in oxidation-reduction processes in cellular metabolism, and it is conceivable that increase in its availability raises the capacity of the tissues to destroy toxic substances introduced into the body. On the other hand, certain dangers in experiments of this type should be emphasized. The animals used should be of the same stock, the history of which should be known. The dietary regimen of the mother as well as of the experimental animal since birth should be under control and adequate in vitamin content. Relative deficiency during the early months of life may cause permanent impairment in resistance regardless of a subsequent normal diet. A rise in the natural resistance of a group of animals given a vitamin in excess, above that of a control group, may not indicate an increase above the normal optimum but may suggest that a relative deficiency of the vitamin had previously existed in both groups. With these points in mind, it is difficult to evaluate the data in this field. Is one certain of the optimal vitamin requirements? Can the criteria of growth, progressive increase in weight and absence of clinical evidences of deficiency be accepted as adequate? Is it not possible that all these may be present and still, under a given stress, such as invasion with micro-organisms or injections of poisons, the apparent optimal amounts do not prove to be so?

For these reasons it is difficult to apply the implications of experimental evidence of effects of a temporary excess of a vitamin on resistance in animals of unknown source directly to human infection. In view of these remarks, the least one may demand of experiments of this type is, first, rigid control of the stock from which the experimental animals are drawn; second, the use of a strain of animals raised under ideal laboratory conditions, with a constant complete dietary for more than one generation; third, adequate controls in sufficient numbers to eliminate chance variations; fourth, statistically significant differences between the results in the group given the excess vitamin and the controls.

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