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THE PHYSIOLOGICAL BASIS OF THE ACTION OF VITAMIN C

Primarily vitamin C is known as a protector of endothelial and connective tissue. *(Dalldorf, Gilbert, The Pathology of Vitamin C Deficiency, The Vitamins, A Symposium, American Medical Association, Chicago, 1939.)* Observers of scurvy usually call attention to the marked deterioration of the mucous membrane and gum tissues of the mouth which become lacerated with the slightest stress. We now know that this is brought about through the loss of activation of the constructive phase of the protein-building enzymes, which activation is normally furnished by vitamin C. *(Editorial, Journal of the American Medical Association, 117, 11:937-938, September 13, 1941.)*

In Time Magazine, Nov. 17, 1941 page 60, the experience of Dr. Bartlett, of Harvard, shows that wound healing with plenty of vitamin C present is several times faster than in deficient tissue and the tensile strength of the new skin is much greater. Drs. Hartzell and Stone of Detroit, are also quoted as stating that vitamin C aids in weaving cells more tightly together.

This protein protecting and building effect is quite likely the reason why vitamin C is so effective in combating the destructive action of bacterial infections. These bacterial toxins produce their damage through their proteolytic effect. The leucocyte carries more vitamin C than any other cell in the body. It is thereby enabled to protect its own protein structure. It also attempts to digest the foreign bacterium which is at the same time fighting for its life by secreting proteolytic enzymes designed to act upon its enemies and not upon itself.

It has been demonstrated that bacterial toxins produce deamination, decarboxylation, and oxidation of the amino acids and proteins in the blood stream. *(Peters, John P., and Van Slyke, Donald D., Quantitative Clinical Chemistry, page 298, Williams and Wilkins Company, Baltimore, 1935.)* This action can be achieved either through the action of the toxins themselves as destructive proteolytic enzymes, or more probably through the activation of the destructive phase of the reversible enzymes present in the blood stream.

It must not be forgotten that most, if not all, enzymes may be either constructive or destructive depending upon the relative concentration of activators, end products, and nutrient in the substrate. *(Waksman, Selman A., and Davison, Wilburt C., Enzymes, page 31, Williams and Wilkins Company, Baltimore, 1926.)*

The vitamin C present in the white cell is really its armor to maintain its own protein controlling enzymes in the constructive phase in the face of the attack of the bacterial toxins which tend to augment the destructive phase. This, in effect, gives us a better insight into the biochemical battle between the leucocytes, the defenders of the body, and the invading microorganisms.

The following statement to the effectiveness of Catalyn in combating the toxicity of arsphenamines was made by a physician in Ohio (1938):

> ". . . You can get a very severe condition of dermatitis, in those patients susceptible to neosalvarsan. . . . I had a patient that showed this susceptibility, and I was afraid that we were going to have to stop the administration, and therefore leave her with syphilis. . . . I gave her Catalyn, and she is able now to take the full dosage of neosalvarsan and the last report we got was that it was effective . . . the point is that we would have had to stop that treatment unless we had found some way of rendering her less susceptible to the neosalvarsan. . . . She takes just two tablets the day before her injection . . . and then she maintains it . . . for two or three days. . . . That alleviates all her sickness. . . ."

In this connection it is interesting to note the article in a recent Journal of the American Medical Association describing experiments showing that vitamin C tends to prevent the toxic effects of neoarsphenamine and marpharsen, the anti-syphilitic drugs. *(Journal of the American Medical Association, 117, 20:1692, Nov. 15, 1941.)* Other publications have shown similar results.

French investigators have also shown that vitamin C prevents the reactions to arsphenamines. It is interesting to note that this effect may be due to two factors of the vitamin C complex. *(Dainow, I., Intolerance of Arsphenamines and Vitamin C, Presse Med. 45:1670-1672, Nov. 24, 1937.)*

Physicians reporting from clinical experience have noticed that although the use of the sulfa-drugs is spectacular in combating the primary infection, oftentimes the patient develops a secondary infection, sometimes difficult to locate.

Apparently such drugs deplete the vitamin C reserves of the tissues and leucocytes with resultant infections and other symptoms of vitamin C deficiency. It should be emphasized that rational therapy demands the addition of vitamin C concentrate schedule whenever the sulfa- drugs or arsphenamines are used.

It should be borne in mind that our comments are confined to natural vitamin C complex consisting of more than one factor. In most cases synthetic vitamin C (ascorbic acid) does not have the same effect as the natural complex. We may point out the experience of Szent-Gyorgyi, where he discovered that synthetic vitamin C will not cure scurvy. (Szent-Gyorgyi, Oxidation, pp. 73-74, Williams and Wilkins, Baltimore, 1939) and also the above described comment of Dainow that two factors of the C complex have the detoxifying effect on arsphenamine.

The useful action of vitamin C in combating the toxic effects of hyperthyroidism has been reported to us by many physicians. It may be remembered that thyrotoxicosis is merely another name for the deamination of proteins by thyroxin. *(Muyer, Hans H., and Gottlieb, F., Experimental Pharmacology, p. 387, J. B. Lippincott, Philadelphia, 1926.)* Thus the protein-maintaining effect of vitamin C also explains the oft reported clinical value of vitamin C in thyrotoxicosis.

Today it is a demonstrated principle that the production of histamine and other end products from deaminized cell proteins released by injury to cells, such as trauma or burns, are a cause of shock. The well-demonstrated clinical value of vitamin C in combating shock is explained when we realize that the deaminizing enzymes from the damaged cells are inhibited by vitamin C. *(Editorial, Journal of the American Medical Association, 117, 11:937-938, September 13, 1941.)*

It has been shown that mechanical damage to a cell results in pH changes which reverse the destructive phase of the cell enzymes from constructive to destructive activity. These pH changes spread to other cells. *(Chambers, R., and Pollock, H., Journal of General Physiology, 10:739, 1927.)* This destructive activity releases histamine and other shock producing end products. The presence of vitamin C inhibits this enzyme transition into the destructive phase.

("Vitamins for Pain and Shock" was briefly discussed on page 5 of "Vitamin News" in this file, published September 4, 1933, and "Vitamins and Resistance to Infections," was discussed on page 7, published September 18, 1933.)

Another protein protecting effect of vitamin C is seen in its demonstrated effect of preventing the decomposition of adenyl-pyro-phosphoric acid of heart muscle as a result of undue thyroid stimulus. *(Berg, H., Arch. Exptl. Pharmakol., 185:359-367, 1937, abst. Chem. Abstracts, 32, 16:6297, August 20, 1938.)* Vitamin C in this action evidently combats thyroid tachycardia.

The utilization of oxygen is impaired in vitamin C deficiency. The capacity of the blood to carry oxygen is apparently lowered. *(Peterson, J. M., Science News Letter, 40, 9:137, August 30, 1941.)* This explains the exceptionally good clinical results vitamin C complex and Catalyn have produced during the past eleven years which have been particularly obvious in coronary cases. The first issue of "Vitamin News" *(August 7, 1933, page 1 of this folder)* makes the statement that shortness of breath and rapid heart action are the specific consequences of vitamin C deficiency in the heart patient; the tachycardia, being due to aggravation of thyrotoxicosis, is caused by a lack of vitamin C. Here is a good example of how clinical facts antedate explanations.

Clinical facts are often put to work and justly deserve to be, whether or not the explanation is known. In checking through the older literature, we are struck with the canny powers of observation the oldtimers possessed. For example, the early mariners preferred the water of the central lake in the Great Dismal Swamp, of Virginia, for their stock of drinking water when starting on a long voyage. They found that their crews remained free of disease for longer periods than if well water were used. This water, brown with vegetable extractives, no doubt, contained appreciable quantities of vitamin C. *(The Great Dismal Swamp, Webster, Prof. N. B., The American Naturalist, May, 1875, page 262.)*

If you care to follow this idea further we refer you back to page 127 of "Vitamin News" entitled, "Food Facts or Theories—Which to Follow? . . . The wrong path leads to an untimely death."

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