RECENT ADVANCES IN KNOWLEDGE OF SCURVY AND THE ANTI-SCORBUTIC VITAMIN

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During the past decade the advance in our knowledge of the antiscorbutic vitamin and of experimental and clinical scurvy has not been great; it has been far less, for example, than that of vitamin D or of the vitamin B complex, which is composed of the other water soluble vitamins. In the course of this period, we have gained, however, a much clearer understanding of the antiscorbutic foods, particularly in their relation to various processes and manipulations to which they are subjected in the course of merchandising.

PATHOLOGY OF SCURVY

In the field of pathology, great stress has been laid on the changes in the teeth. As early as 1919, it was shown by Zilva and Wells [1] that radical alterations in tooth structure could be brought about in guinea-pigs and in monkeys by a deficiency of the antiscorbutic vitamin. The lesions were in the nature of a fibrosis or a fibroid degeneration of the pulp. These early observations have been extended and have been made the basis of broad clinical deductions in regard to the etiology and incidence of caries. In 1924, Hoejer [2] of Stockholm published a report from Jundell's clinic which showed the possibility of making an early diagnosis of scurvy in guinea-pigs from the histologie examination of the teeth. He demonstrated, by means of convincing illustrations, that definite lesions of the teeth developed as early as the second week after the animals had been placed on a ration highly deficient in vitamin C. The characteristic and primary change he believed to be a development of active osteoblasts from normal active odontoblasts, with the consequent formation of bone in place of dentin. Early involvement of the teeth has also been emphasized by Wolbach and Howe [3] and by Meyer and McCormick [4] in their studies on scurvy, and their stand has likewise been supported by convincing illustrations. The dental lesions in scurvy will be referred to again in connection with a consideration of the newer symptomatology of this disorder.

One aspect of the pathology of scurvy to which particular attention has been devoted during the past few years is the changes in the vessels. In 1921, it was suggested that a "failure of the integrity of the epithelium of the blood vessels" occurred and that "this was due to a lesion of the endothelial cells or their cement substance." [5] A few years later, Wolbach and Howe [3] showed that the defect in the capillaries results from a failure of the endothelial cells to form cement substance and they concluded that the essential pathologic alteration in scurvy is "an inability of the supporting tissue to produce and maintain intercellular substances." They further maintained that this nutritional defect held true not only for the blood vessels but also for the connective tissue of various organs of the body, including the teeth. In the latter

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2. Hoejer, Axel: Studies in Scurvy, Acta paediat. (supp.) 3:8, 1924.
3. Wolbach, S. B., and Howe, P. R.: Intercellular Substances in Experimental Scorbutus, Arch. Path. & Lab. Med. 1:1 (Jan.) 1926.
4. Meyer, A. W., and McCormick, L. M.: Studies on Scurvy, Stanford University, Calif., Stanford University Press, 1928.
5. **Hess, A. F.: Newer Aspects of Some Nutritional Disorders, J. A. M. A. 76:693 (March 12) 1921.**

they noted, on the addition of an antiscorbutic to the dietary, a change in intercellular substance from a liquid to a solid or a jell state.

Meyer and McCormick included an examination of the nervous system in their studies and found degenerative changes in the peripheral nerves and degenerative changes in the large motor cells of the anterior horn. This is the only study that has included the nervous system in its scope and is therefore of particular interest. The only report of pathologic changes of the nervous system in human scurvy is one that I [6] published in 1918, on focal degeneration of the lumbar cord in a case of infantile scurvy. It is highly desirable, from a pathogenic point of view, that further investigation be made regarding involvement of the nervous system, both in experimental and in human scurvy.

SYMPTOMATOLOGY

In regard to symptomatology it was hardly to be expected that much new data would be forthcoming, but it was to be anticipated that endeavors would be directed toward a recognition of the earliest symptoms of the disorder, of the condition designated as "latent scurvy." [7] This clinical condition has also been termed "praeskorbut," a designation which is not pertinent as it conveys the impression that the nutritional disturbance is of a nature different from scurvy. In connection with latent scurvy the greatest importance must be attached to the assertion that dental caries is the outstanding sign of this type of the' disorder. As is well known, Hanke[s] and others believe that the distinctive sign of a deficiency of the antiscorbutic vitamin is caries of the teeth; in fact, that this widespread dental disorder is due mainly to a lack of vitamin C in the dietary. Accordingly, they advise that the daily dietary should include a pint of orange juice and the juice of one lemon, as well as lettuce and cabbage. In my opinion, these deductions are far too sweeping and are not supported by the geographic distribution of dental caries or by a study of individual cases, which all indicate some other dominant etiologic factor.[9]

ASSOCIATION OF SCURVY WITH INFECTIONS

Another point that has been brought into prominence in connection with adult as well as infantile scurvy is its intimate association with the infectious process. In 1917 I[10] stated that "one of the striking and important symptoms of scurvy is a susceptibility to infection (furunculosis, nasal diphtheria, grippe, etc.)." In this connection it may be mentioned that nasal diphtheria was noted among a group of scorbutic infants in spite of the fact that many of them gave a negative Schick reaction. Findlay,[11] attacking the problem from an experimental standpoint, showed that guinea-pigs which suffered from chronic scurvy and showed but few clinical symptoms manifested a decreased resistance to bacterial infection; this he attributed to degenerative changes in the bone marrow. About this time Cramer and Kingsbury [12] emphasized the importance of vitamin A in warding off infections, associating this susceptibility with a decrease in the number of platelets of the blood. Abels,[13] in a monograph on scurvy, stressed this relationship of the scorbutic state to infection, giving the name "dysergie" to the nutritional disturbance which occasions the heightened susceptibility. Recently, Minot and his colleagues [14] came to the conclusion that adult scurvy can be precipitated by infectious processes; in other words, that latent scurvy can by this means be changed to manifest scurvy. In general, therefore, investigations in the laboratory as well as clinical observations are in agreement in stressing the interrelationship of scurvy and bacterial infection.

THE CAPILLARY RESISTANCE TEST

The involvement of the blood vessels in scurvy has been stressed in connection with the newer pathology of this disorder. A clinical application of this pathologic condition is the "capillary resistance test" introduced by Hess and Fish [15] in 1914. This is a test of the ability of the small blood vessels to withstand increased intravascular pressure, which is brought about by means of a tourniquet applied to the arm. Clinical studies of this aspect were published' by Meyer [16] in 1923, by Ohnell[17] in 1928 and by Goethlin[18] in 1931. The title of the latter paper, "A Method of Establishing the Vitamin C Standard and Requirements of Physically Healthy Individuals by Testing the Strength of their Cutaneous Capillaries," indicates the author's extreme point of view. He found that in Sweden, during April and May, the school children in some country districts gave a positive "capillary resistance test" in 18 per cent of the cases. In nA experience there are decided individual variations in pigard to the reaction to this test, so that although it is true that petechial spots are far more numerous in individuals suffering from latent or active scurvy, the reaction cannot be used as evidence of a deficiency in vitamin C intake. Occasionally edema rather than hemorrhage has been found in the scurvy of adults and of infants. The cause of these extravasations, which have been noted most often at the ankles, is not known. It would seem most likely that it is associated with a retention of sodium chloride.

INVOLVEMENT OF THE NERVOUS SYSTEM

In infantile scurvy there are definite clinical evidences of an involvement of the nervous system, more particularly of the vagus, as manifested by excessive rapidity of the pulse and of the respirations, symptoms that yield promptly on the addition of antiscorbutic fooji to the dietary. In 1925, Stewart[19] reported the neurologic symptoms of 150 cases of scurvy which he had observed during the World War. He recorded various indications of sensory disturbances—paresthesia of several forms, pain, hyperalgesia, patchy anesthesia on one or both tegs which were symmetrical in a few cases, knee jerks which were

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