

In this article published in 1953, Dr. Fred Klenner reviews some of his experiences using injections of vitamin C to treat a variety of diseases including viral pneumonia and encephalitis following measles and polio. He describes how he discovered that injectable vitamin C can be used as an antibiotic to treat many diseases.—*R.D.M.*

## The Use of Vitamin C as an Antibiotic

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### **VITAMIN C—the foundation of the oxidation-redux system now through greater dosage reveals its outstanding qualities as a non-toxic antibiotic.**

On the 11th of December 1621 Edward Winslow,<sup>1</sup> one of the Pilgrim Father's, writing to a friend in England who was about to make the trip to the new world gave this advice:—"Bring juice of lemons; and take it fasting. It is of good use." Three hundred and eleven years later, 1932, and also in December, Waugh and King<sup>2</sup> found that this 'important' lemon juice contained a six carbon chain acid which is now known as vitamin C. Ascorbic acid is related to the hexuronic acids which in turn are derivatives of the simple sugars (Youmans 1941<sup>3</sup>). The value of this vitamin as an essential factor for life is universally known and accepted. The importance of vitamin C as an antibiotic and as the pre-cursor of antibody formation lack scientific appreciation because of its simplicity, and because of the reluctance on the part of the medical profession to employ it in massive doses administered like other antibiotics—around the clock. Allergy has become a major problem since the advent of the mold-derived drugs. Hippocrates did declare that the highest duty of medicine to be to get the patient well. He further declared that, of several remedies physicians should choose the least sensational.

To understand the antagonistic properties of vitamin C against the virus bodies and also against the chemical ferments of micro-organisms—the toxins and exotoxins, one must go beyond it's present academic status as a factor essential for life. A striking phenomena of vitamin C is the similarity of response either to correct pathology due to a deficiency of this compound, or to correct the pathology caused by the action of the virus bodies and other similar toxins and ferments. Within a few hours after adequate vitamin C therapy is instituted **by needle** one will find in the deficiency syndrome that fibroblasts are beginning to form normal connective tissue and that capillary buds are invading blood clots and other types of hemorrhagic areas (Youmans 1941<sup>3</sup>). Likewise when employed as an antibiotic definite clinical response is made evident by a climb-

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ing white blood count, drop in fever and general all around improvement of the patient within the same time schedule.

For many years it has been the accepted thought of the medical world that the forcing of citrus fruit juice in infections of the chest and upper respiratory areas, particularly by virus bodies, was valuable in that it produced alkalinity of the body fluids by way of its residue, the alkaline ash. This premise held that in this alkaline state greater phagocytic possibilities was allowed the leukocytes in destroying bacteria. This theory, although correct for the usual bacterial flora, was never too plausible for virus diseases since a leukopenia rather than a leukocytosis exist in these conditions. In the 1948 poliomyelitis epidemic in North Carolina we observed a greater response to vitamin C given by mouth when rutin was added.<sup>2</sup> The alkaline ash here serving as a barrier to the loss of vitamin C by way of the kidneys. Vitamin C is excreted by glomerular filtration and is resorbed by the tubules. There is a maximum rate at which the tubules can resorb, so it is real economy to keep the urine alkaline. Hawley and her associates<sup>4</sup> (1936) reported that the quantity of vitamin C excreted may be varied by merely changing the acid-base balance of the food intake.

Our interest with vitamin C against the virus organism began ten years ago in a modest rural home. Here a patient who was receiving symptomatic treatment for virus pneumonia had suddenly developed cyanosis. He refused hospitalization for supportive oxygen therapy. X-Ray had not been considered because of its dubious value and because the nearest department equipped to give such treatment was 69 miles distant. Two grams of vitamin C was given intramuscularly with the hope that the anaerobic condition existing in the tissues would be relieved by the catalytic action of vitamin C acting as a gas transport aiding cellular respiration. This was an old idea, the important factor being that it worked. Within 30 minutes after giving the drug (which was carried in my medical bag for the treatment of diarrhea in children) the characteristic breathing and slate-like color had cleared. Returning six hours later, at eight in the evening, the patient was found sitting over the edge of his bed enjoying a late dinner. Strangely enough his fever was three degrees less than it was at 2 P.M. that same afternoon. This sudden change in the condition of the patient led us to suspect that vitamin C was playing a role of far greater significance than that of a simple respiratory catalyst. A second injection of one gram of vitamin C was administered, by the same route, on this visit and then subsequently at six hour intervals for the next three days. This patient was clinically well after 36 hours of chemotherapy. From this casual observation we have been able to assemble sufficient clinical evidence to prove unequivocally that vitamin C is the antibiotic of choice in the handling of all types of virus diseases. Furthermore it is a major adjuvant in the treatment of all other infectious diseases.

This experimental 'strike' on vitamin C as an antibiotic opened a new avenue of approach to the problem of dealing with the virus bodies. With a great deal of enthusiasm we decided to try its effectiveness with all of the childhood diseases. Measles was singled out more so than the others because of the knowledge that it was a small virus like the one causing poliomyelitis. It was reasonable to assume that if measles could be controlled then Poliomyelitis, too, would have a drug that could prevent as well as cure the disease. The use of vitamin C in measles proved to be a medical curiosity. For the first time a virus infection could be handled as if it were a dog on a leash. In

the Spring of 1948 measles was running in epidemic proportions in this section of the country. Our first act, then, was to have our own little daughters play with children known to be in the 'contagious phase.' When the syndrome of fever, redness of the eyes and throat, catarrh, spasmodic bronchial cough and Koplik spots had developed and the children were obviously sick, vitamin C was started. In this experiment it was found that 1000 mg every four hours, by mouth, would modify the attack. Smaller doses allowed the disease to progress. When 1000 mg was given every two hours all evidence of the infection cleared in 48 hours. If the drug was then discontinued for a similar period (48 hours) the above syndrome returned. We observed this off and on picture for thirty days at which time the drug (vitamin C) was given 1000 mg every 2 hours around the clock for four days. This time the picture cleared and did not return. These little girls did not develop the measles rash during the above experiment and although exposed many times since still maintain this 'immunity.' Later cases were given the vitamin by needle. The results proved to be even more dramatic. Given by injection the same complete control of the measles syndrome was in evidence at 24 and 36 hour periods, depending entirely on the amount employed and the frequency of the administration. Aborting of these cases before the development of the rash apparently gives no interference to the development of immunity. Recent progress on the rapidity of growth (or development) of the virus bodies by means of the electronic microscope makes intelligent the failure experienced by earlier workers when employing vitamin C on the virus organism (or bodies). Unless the virus is completely destroyed, as demonstrated in the experiments with the virus causing measles, the infection will again manifest itself after a short incubation period. Small, single daily doses do not even modify the course of the infection. From a review of the literature one can safely state that in all instances of experimental work with ascorbic acid on the virus organism, in experimental animals, the amount of virus used was far beyond the range of the administered dose of this vitamin. It is timely to note here that all of our re-search with vitamin C on the virus was done, using MAN as the experimental animal. This makes an important difference. For example the signs of acute and chronic vitamin C deficiencies in the monkey are **DISTINCTLY DIFFERENT** than in man. This may partially explain the difference observed in experimentally produced and spontaneous scurvy in man. (Shaw et al. 1945<sup>5</sup>). This would seem to disprove the opinion of Thomas M. Rivers<sup>6</sup> (1941) when he writes, "On the other hand, a few investigators (Heaslip, McCormick, Stern, Tebbutt & Helms) have recorded what might be considered very poor evidence, obtained by observations on human beings, that vitamin C deficiencies play a role in susceptibility to poliomyelitis." The accuracy of Rivers evaluation of these works relating to these observations seems questionable when he states (1941)<sup>6</sup> that Sabin (1939)<sup>7</sup> definitely demonstrated that Jungeblut's (1937<sup>8-9</sup>) claim that Vitamin C deficiency increases the susceptibility of the experimental animals to infantile paralysis is not valid. Jungeblut (1937)<sup>9</sup> stated that the parenteral administration of natural vitamin C during the incubation period of poliomyelitis in monkeys is always followed by a distinct change in the severity of the disease; that after the fifth day of the disease **LARGER** doses are required. He realized, at that early date, that for a fast progressing infection such as results from the R.M.V. strain, very large doses must be

given; for the Aycock virus with its slower infection potential small amounts of vitamin C would suffice. During the 1948 Polio epidemic in North Carolina it was our humble privilege to observe and report (1949)<sup>10</sup> that a 'period of septicemia did exist in the first few days of poliomyelitis.' It was our impression at that time that the virus multiplied on a living tissue, the blood, and that the time to destroy the virus was during this 'incubation period' which varies more with the virus strain, its virulence and power of multiplication than with the size of the initial dose. Bodian and Horstmann (1952)<sup>11</sup> confirmed our observation of the existence of a viremia phase in poliomyelitis, demonstrating that the virus was freely present in the blood of chimpanzees during the preparalytic period of the disease.

One of the most unfortunate mistakes in all of the research on poliomyelitis was Sabin's UN-SCIENTIFIC attempt to confirm Jungeblut's work with vitamin C against the Polio virus in monkeys. Jungeblut in infecting his Rhesus monkeys used the mild 'droplet method' and then administered vitamin C by needle in varying amounts up to 400 mgm/day. Even this method did not give him absolute control over the degree of infection that would result. However, his antibiotic (vitamin C) remained relatively constant. With almost infinitesimal amounts, as we at present recognize, he was able to demonstrate in one series that the non-paralytic survivors was six times as great as in the controls. On the other hand, Sabin, in infecting his monkeys did not follow the procedure given by Jungeblut who's experiments he was attempting to repeat, but instead employed a more forceful method of inoculation which obviously resulted in sickness of maximum severity. Sabin further refused to follow Jungeblut's suggestion as to the dose of vitamin C to be used. By Sabin's actual report the amount given was rarely more than 35 per cent of that used by his associate. Sabin makes this significant statement (1939)<sup>7</sup>, "One monkey was given 400 mgm of vitamin C for one day at the suggestion of Jungeblut who felt that large doses was necessary to effect a change in the course of the disease." Yet on the basis of Sabin's work the negative value of vitamin C in the treatment of virus diseases has been for years accepted as final.

For some unexplained reason vitamin C has been 'tied up' with scurvy to the exclusion of its many other functions. Those who would have us believe that this vitamin serves no other purposes argue that there is no evidence to substantiate the claim that malnutrition plays a definite role in susceptibility to the virus infections. We are invited to read what Aycock wrote in 1937 concerning "the tendency of poliomyelitis to occur in children who are large, healthy and well nourished." What is important we are not told. Of course, Polio, like any other childhood disease, is not dependent on specific personalities or certain constitutional types. The real reason for it developing and doing so in varying degrees is due to some other cause. Surely measles doesn't limit its attack to the frail, unstable child or adult.

The exact incident of vitamin C deficiency is unknown. No accurate way of determining whether a deficiency of vitamin C exists in the body tissues has been developed (Thewlis Clinic<sup>12</sup> 1953). There is increasing evidence to indicate that a relatively large number of persons have hypovitaminosis C (Vitamin C deficiencies) and that these include individuals whose diets are generally considered satisfactory (Youmans 1941<sup>3</sup>). The National Research Council recommends 75 mgm./day as the minimum requirement

(1945). This is only a measure of the amount necessary to prevent gross disease and is not a measure of the amount needed to maintain good health. Kline and Eheart<sup>13</sup> (1944) reported wide variations in the need for vitamin C in normal individuals. Jolliffe<sup>14</sup> (1945) suggested that the optimum requirements may actually be ten or more times the recommended minimum daily requirements. Under certain conditions 1000 mg. to 3000 mg. per day were found by Kyhos et al.<sup>15</sup> (1945) to be necessary to keep the body saturated. There is a wide individual variation in the renal threshold for vitamin C. Many patients receive as much as 1500 mg. of vitamin C per day without significant urinary loss (Shaw 1945)<sup>5</sup>. All of us have witnessed 'nose bleed' in certain children sick with measles who prior to taking the disease were apparently healthy. Epitaxis (nose bleed) is one of the signs of scurvy. Is this true scurvy? Crandon<sup>16</sup> (1940) states that scurvy develops slowly in man. He found the vitamin C level of the blood plasma to be zero for 90 days before there was frank clinical evidence and that this was as long as 132 days before the first signs appeared. He reported that 1000 mg. of vitamin C was given daily for two weeks to clear skin petechiae. I have, many times, stopped nose bleed in children, sick with measles, with one single dose of 2 gms. Vit. C.

Doldorf<sup>17</sup> (1945) reported that many conditions may be present in the body that call for a greater supply of vitamin C. He lists fever, infection, physical stress, gastrointestinal disorders, diarrhea, anorexia, and vomiting along with many others. It is of more than academic interest to observe that all of the above listed conditions are usually found in severe cases of poliomyelitis. One wonders whether or not these are manifestations of vitamin C deficiencies or true findings of the Polio syndrome. Certainly we do see several, if not all, of these symptoms associated with other childhood diseases. We have also found that like epistaxis all of the above mentioned conditions can be relieved with one or two injections of vitamin C, the amount ranging from one to four grams depending on the age of the patient. These manifestations represent acute vitamin C loss and is Nature's way to ask for help. There exists a possible avenue of escape from this clinical pattern and that is to watch for the sign post that reveal pre-existing chronic vitamin C deficiencies. Shaw<sup>5</sup> (1945) states that food deposits on our teeth and dental tartar represents this condition. People who find that they are counted in this group should supplement their diet with at least two grams of vitamin C each day, or drink not less than three, 200 c.c. size, glasses of orange juice for the same period.

To support our findings that massive doses of vitamin C is a potent antibiotic several case histories follow:—

**Case I**—Measles in a ten-months-old baby. The infant had a fever of 105(R) F., redness of eyes and throat, catarrh, spasmodic bronchial cough and Koplik spots. 1000 mg. of vitamin C was given intramuscularly every four hours. After 12 hours the fever was 97.6 (R) F., the conjunctivitis and red throat had cleared, there was no cough. The sudden drop in the fever curve was thought to be explainable on one of three grounds: 1) Common night drop. 2) Due to the antibiotic action of vitamin C. 3) Even if the vitamin C injections had been continued, a moderate rise might have occurred in the late afternoon of the second day, granting a highly virulent organism and a poorly resisting host. To determine which of these deductions was valid, vitamin C was discontinued for a period of eight

hours. At this point the rectal temperature reading was 103.4 F. Vitamin C therapy was resumed and instead of the expected 8 P.M. climb, the fever was down to 99.2 (R). The 1000 mg. injections were continued as before, the baby made an uneventful recovery and was discharged 60 hours following hospital admission. No measles rash developed. Four years have now elapsed and there has been no measles.

**Case II**—A case of virus pneumonia with typical consolidation of an entire lung field. Patient colored female, age 28. Relative gave history of chills, fever, head and chest cold for past 14 days. In stupor when first seen, eye lids closed, a white foam at the mouth which she periodically tried to spit out. Fever by axilla 106.8 F. (corrected). Dehydration was much in evidence, breath sounds diminished to absent, tactile fremitus increased over the entire right side. The sulfa drugs, penicillin and streptomycin with supportive treatment had been exhausted by the referring physician. Four grams of vitamin C was given intravenously along with 1000 c.c. dextrose 5 in saline solution. Temperature dropped to 100 (Ax.) corrected within eleven hours. Four hours later, vitamin C was resumed, the dose ranging from 2 to 4 grams every two to three hours depending upon the response. After 72 hours the patient was awake, sitting up in bed and taking fluids freely by mouth. There was no fever at this time, nor for the remainder of the time in hospital. Vitamin C was continued for two weeks; the frequency was cut to every 12 hours, two grams at a dose. The rationale of this continued use of vitamin C was to assist the body to clear up the debris in the right lung field. Although the patient was clinically recovered, it required three months to clear the lung by X-ray. In this Nature was merely duplicating a stage in the metamorphosis of the frog in getting rid of its tadpole tail.

**Case III**—A case of encephalitis following measles and mumps. This was a lad of eight years first seen with a fever of 104 F. He was lethargic, very irritable when molested as in simple physical examination. His mother said he had gradually developed his present clinical picture over the preceding four or five days. His first symptom was anorexia which became complete 36 hours before his first visit. He next complained of a generalized headache, later he became stuporous. Although very athletic and active, he voluntarily took to his bed. He was given 2000 mg. of vitamin C intravenously and allowed to return home because there was no available hospital accommodations. His mother was asked to make an hourly memorandum of his conduct until his visit set for the following day. Seen 18 hours after the initial injection of vitamin C, the memorandum revealed a quick response to the antibiotic—after two hours he asked for food and ate a hearty supper, then played about the house as usual and then, for several hours, he appeared to have completely recovered. Six hours following the initial injection, he began to revert to the condition of his first visit. When seen the second time temperature was 101.6 F, he was sleepy but he would respond to questions. The rude irritability shown prior to the first injection of vitamin C was strikingly absent. A second injection of 2000 mg. was given intravenously and 1000 mg. of 'C' prescribed every two hours by mouth. The next day he was fever- and symptom-free. As a precautionary measure a third 2000 mg. was given with directions to continue the drug by mouth for at least 48 hours. He has experienced no residual cerebral pathology as determined by examination five years

following this episode. (Similar cases seen in the interim have shown more dramatic response when the drug was given by needle every two to four hours.)

**Case IV—POLIOMYELITIS.** A boy of eight years was brought to my office with a history of having had 'flu' for a period of one week. Four days before this office visit he developed photophobia, conjunctivitis, sore throat, back-of-the-eyes type headache, nausea and vomiting. The headache was of such intensity that adult doses of aspirin given by his mother had no effect. While on the examining table the boy was either rubbing his neck on the left side or holding his head between his hands, begging for something to relieve his pain. The fever was 104.4 (Ax.) F. He was tender in the lumbar region and he had a drawing sensation referred to the hamstring attachments at the left knee. Two grams (2000 mg.) of vitamin C was given intravenously while in the office. He was sent to the local hospital where he received, promptly, a second injection of 2 grams of the vitamin, after which it was given every four hours. Six hours after commencing therapy the neck pain was gone, the headache completely relieved (he did not receive pain relieving medication), he could tolerate the ceiling light, his eyes were dry and the redness was definitely clearing. Nausea and vomiting had disappeared, the fever was down to 100.6 (Ax.) F., and he was sitting up in 'a straight positioned bed' in a jovial mood while he drank a glass of lime ade. He was discharged from the hospital after receiving 26 grams of vitamin C in 48-hour period, clinically well. Vitamin C was continued by mouth, 1500 mg. every two hours taken with citrus fruit juice. This schedule was followed for one week after which time a change was made to Vitamin B<sub>1</sub>, 25 mg. before meals and bed hour. Vitamin B<sub>1</sub> was given in view of McCormick's<sup>18</sup> (1938-1939) theory that inflammatory and degenerative diseases of the nervous system is due to an avitaminosis of this particular vitamin. Vitamin B<sub>1</sub> in these cases should be continued for a period of at least three months as nerve tissue is slow in recovering from even mild damage.

The amount of vitamin C for optimum effect will vary greatly with the individual. The type of the disease and the degree of toxemia (or viremia) are important guides in determining the dosage. Although the usual dose of vitamin C is calculated on the basis of 65 mg. per Kg. of body weight, and given every two to four hours by needle, under certain conditions larger single injections can be used to good advantage. In using 'C' as an adjuvant in the treatment of infections caused by the more common bacteria the single 250 mgm. per Kg. of body weight injection behaves like other synergistic drug combinations. Likewise when treating an upper respiratory infection, this one single massive 'shot' will precipitate the pathology. A report from the Thewlis<sup>12</sup> Clinic (1953) is interesting in this respect—"Upper respiratory tract infections may severely tax the vitamin C reserve. It is usually during or following a cold that patients have epistaxis or cough up blood-streaked sputum. Local inflammation and **depletion** of vitamin C may be responsible for this hemorrhagic tendency. On numerous occasions, we have observed a dramatic alleviation of symptoms of [an] upper respiratory tract infection after an injection of 500 mgm. of ascorbic acid (vitamin C)." Vitamin C response when taken by mouth is not predictable. Wright and Lilienfeld<sup>19</sup> (1936) reported that the ascorbutic

state could develop even though the patient was taking large doses of vitamin C by mouth. In the opinion of Musser<sup>20</sup> (1945) poor absorption and equally poor storage are cardinal factors in leading to vitamin C deficiencies. It was our privilege to observe this mechanism in one of our daughters several years ago. She had contracted chicken-pox. Vitamin C was started on this child when the macules first put in their appearance. In spite of the fact that she was given 24 grams every 24 hours there was no interruption in the progress of the disease. Itching was intense. One gram administered intravenously stopped the itch within 30 minutes and she went on to peaceful sleep for the next eight hours. Although feeling fine, a second injection was given at this time, following which there were no new macules and recovery was fast and uneventful. In the past few years we have noted that in chicken-pox when massive injections are employed there is no repeating waves of macules, and the usual seven to nine days required for crusting is reduced to less than twenty-four hours. Large doses parenterally are effective when oral administration fails (Youmans 1941)<sup>3</sup>.

It is not uncommon to find a patient sick with a virus disease that is also being subjected to the effects of the toxins of a 'secondary invader.' This problem of mixed infection is usually found in virus pneumonia and infectious mumps. The mouth, nose and naso-pharynx represent 'living space' for many micro-organisms. Therefore it is possible to have parotitis secondary to buccal surgery without virus contamination, but it is never possible to have infectious parotitis (mumps caused by the virus organism) without secondary invading pathogenic organisms. In treating virus pneumonia and 'Virus' mumps it is necessary either to give one or two injections of penicillin along with the vitamin C or comparable sulfa therapy. In the case of mumps it would seem from an academic point of view that Aureomycin would serve this purpose better since it does have antibiotic possibilities with the **large** virus organisms. The antibiotic power of vitamin C can also be augmented by other biochemical fractions. One of these is a colloidal solution of denatured proteolytic enzyme called 'PROTAMIDE.' In Herpes Simplex and Herpes Zoster this 'enzyme' proved to be of definite value, and in Herpes Zoster (Shingles) did influence the dorsal nerve root pain. Of course it is common knowledge that vitamin C, especially when injected intramuscularly, possesses these same anti-neuritic properties. Vitamin C, itself, can be called a 'cousin' of the proteolytic enzymes. This suggested that vitamin C and protamide should be used at the same time. The clinical results justified this assumption. Cures were obtained in from one to three days. Vitamin C was given as usual, but protamide was limited to one ampule per day. The same 'improved' results were obtained in influenza and definite synergistic action was seen in one case of poliomyelitis in a boy of ten years. Calcium, too, is a good adjuvant especially in treating influenza. In vivo calcium duplicates the chemical behavior of vitamin C in many respects. Whether the virus has some destructive influence over the calcium ions is a matter of debate. From our experience it would seem that the inclusion of at least one 10 c.c. vial of calcium gluconate or calcium levulinate in the treating of a virus infection is good therapeutics. Levulinate must be injected at a slower rate than Gluconate. Calcium gluconate can be injected intramuscularly, in adults, if veins are at a premium, but it must be placed deep in the gluteal muscle. Vitamin C and D.C.A. 2 mg. to 5 mg. (the latter once/day) proved to have definite value against the influenza virus in recent tests.



We reported in 1951 and 1952 that a constant laboratory finding in virus infections was a positive, qualitative Benedict's reaction. It is necessary to make a correction of that finding. This Benedict's reaction was based on the admission urine specimen of patient's admitted to our local hospital. About six months ago it came to my attention that this particular urine specimen is collected anytime from the admission of the patient to the hospital until some 18 hours thereafter. This, obviously, nullifies the laboratory report since medication given to the patient in the interim would alter the chemical findings. Vitamin C being a powerful reducing agent could account for some of the Benedict urine reports. It, therefore, makes void the contention that this laboratory test is an index when to discontinue the use of vitamin C. The deduction, however, is correct. We have ascertained during the past six months that this glycosuria ranges from a quantitative increase over a given patient's normal range to a qualitative 2 plus. The majority of severe virus infections will show a strong trace Benedict's qualitative reaction. Individual kidney threshold for sugar and/or vitamin C is probably a factor in the higher readings.

Pathologic changes due to excessive amounts of vitamin C are unknown. Plasma concentrations twenty times normal have been obtained without any ill effects (Youmans<sup>3</sup> 1941). Occasionally there may be a sensitivity to common foods rich in vitamin C and constitutional idiosyncrasies to ascorbic acid [do] exist. These minor complications are Diarrhea, Induration (only when intramuscular injections are given too close to the surface), Endothelial irritation, Venous thrombosis (only when the concentration of the solution is 500 mg. per c.c. or greater), Syncope (only in patients over 50 years of age if the injection is made too rapid), Rash and vulvitis and puritis. This last factor was seen in  $\frac{1}{2}$  of 1% of children given massive therapy of the vitamin by mouth over a long period of time. Derma medicone ointment will control these symptoms. The vitamin should be discontinued by mouth, if this occurs, and given by needle. We have found that a No. 23 G needle  $\frac{3}{4}$  inch long is ideal for intravenous use and a No. 22 G needle one inch long for the intramuscular routes. A needle  $1\frac{1}{2}$  inches long if the latter route is employed in adults.

Fortunately vitamin C is a vitamin supplied by Nature in a variety of foods. Foods rich in vitamin C are citrus fruits (lemons, limes, oranges, and grapefruit), tomatoes, pineapples, currants, raspberries, strawberries, green vegetables such as peas, beans, lettuce, asparagus, broccoli, brussel sprouts, young cabbage, cauliflower, chard, collards, kale, parsley, kohlrabi, peppers, squash, turnips, and greens of various kinds. Milk is only a fair source of vitamin C. Vegetables should be eaten raw when possible; when this is not feasible they should be cooked in as short a time as possible and in a small amount of water, which should be boiling before foods are added. Raw cabbage is an excellent source, but if allowed to stand will rapidly lose its vitamin content. Storage, processing, cooking and the variability of different samples of fruits are factors of importance. Storage and handling have relatively little effect on such fruits and vegetables as oranges and tomatoes if the protective rind and the cell membranes are not ruptured. Storage, bruising, handling, and crushing of many of the vegetables and fruits greatly reduce their vitamin C content. This trauma causes the liberation of enzymes (oxidases) which in the

presence of air catalyze the oxidation of ascorbic acid (Kertesz<sup>21</sup> et al 1936; Johnson et al<sup>22</sup> 1937). This is a rapid reaction and may lead to complete inactivation of the injured tissue in a few minutes. Modern cold storage and canning, if properly performed, affect the vitamin C content relatively little. Even if kept at ice box temperatures, canned foods if allowed to stand after opening will result in considerable destruction of the vitamin C content. Long stewing or boiling, cooking in open containers or containers made of copper (the presence of air and the merest traces of copper lead to complete inactivation often in a few minutes), over salting and the use of soda all tend to increase the loss of this important vitamin. The addition of soda to cooking vegetables may produce a better color but will lead to increased loss of vitamin C. In general, vitamin C is less subject to oxidation in those fruits and vegetables which are acid. Baked and boiled potatoes are reported (Wood<sup>23</sup> 1935) to show only small losses unless overcooked. Fruit jellies and jams are usually low in vitamin C. Warmed over foods are practically free from this vitamin. There is a growing tendency to omit foods which have a high ascorbic acid content. An analysis of the diet of 50 patients was made at the Thewlis Clinic at Wakefield<sup>12</sup>, R. I. Their report showed that 18 per cent were taking over 500 mg. of vitamin C per week. 10 per cent of the diets contained no vitamin C. 34 per cent were taking less than 200 mg. per week. Since this vitamin cannot be supplied from within, and since there is no appreciable store in the body it is little wonder that we are easy 'prey' for the virus and other bacteria.

The requirements of vitamin C depend not only on weight but also on metabolic activity in which growth plays a large part. Poor hygiene, overcrowding, dampness, cold and physical work (which includes play) favor the development of a shortage. The relatively small store of ascorbic acid maintained by the body even under good conditions, the relatively narrow margin between health and pathological changes and the evidence of a considerable incidence of hypovitaminosis C combine to emphasize the importance of prevention by an adequate dietary. Parents must learn that commercial orange drinks which do not contain freshly prepared orange juice are practically free from ascorbic acid. The trend must be away from the carbonated soft drinks and back to the 'old fashion' days of citrus fruit juices. If parents will make their children drink as many glasses of citrus fruit juice each day as they now allow them bottle's of carbonated drinks, Polio and disease in general will rapidly assume a less important role in our lives.

#### SUMMARY

Vitamin C possesses abilities which are characterized by its capacity to antagonize many of the pharmacological effects of histamine. It should be employed with the antihistamine drugs in all allergic states. It is because of this factor that it serves so well in the treatment of acute rheumatic fever. Aside from this and the virus diseases it is of tremendous value in all diseases in which an exotoxin is produced. It also has a specificity for SNAKE BITE except for the cobra and the coral. It neutralizes all exotoxins. It is directly concerned with antibody formation and this in turn leads to an increase in gamma globulin of the blood serum. It joins with the virus to form a new compound which is destroyed by oxidation. It makes all body cells more permeable which allows entrance of immune factors otherwise denied. It prevents or lessens tissue damage. It serves as a hydrogen

transport in cellular respiration. It functions as a dehydrator and diuretic. It is the KEY to good health. Don't lose THIS key for it might lock or unlock your life.

#### REFERENCES

1. Arber, E. *The Story of The Pilgrim Fathers*, 1897.
2. Waugh, W. A. and King, C. G., The Isolation and Identification of Vitamin C, *J. Biol. Chem.* 97:325 (July) 1932.
3. Youmans, J. B., *Nutritional Deficiencies*, 1941.
4. Hawley, E. E.; Frazer, J. P.; Button, L. L.; Stevens, D. J., The Effect of the Administration of Sodium Bicarbonate and of Ammonium Chloride on the Amount of Ascorbic Acid Found in the Urine. *J. Nutrition*, 12:215 (August) 1936.
5. Shaw et al: Acute and Chronic Ascorbic Deficiencies in Rhesus Monkeys. *J. Nutrition*, 29:365, 1945.
6. Rivers. T. M., Immunological and Serological Phenomena in Poliomyelitis Lecture III. *Infantile Paralysis*, 1941.
7. Sabin, A. B., Vitamin C in Relation to Experimental Poliomyelitis. *J. Exper. Med.*, 69:507, 1939.
8. Jungeblut, C. W., Vitamin C Therapy and Prophylaxis in Experimental Poliomyelitis. *J. Exper. Med.*, 65:127, 1937.
9. Jungeblut, C. W., Further Observations on Vitamin C. Therapy in Experimental Poliomyelitis. *J. Exper. Med.*, 66:459, 1937.
10. Klenner, F. R., The Treatment of Poliomyelitis and Other Virus Diseases With Vitamin C. *S. Med. and Surg.* Vol. 111, #7, July 1949.
11. Bodian, D. and Horstmann, D., Review of their work. *J.A.M.A.* Vol. 149, # 18, Aug. 30th, 1952.
12. Thewlis Clinic, Vitamin C and P in Cardiovascular Disease. *Geriatrics* Vol. 8, #2 (February) 1953.
13. Kline, A. B. and Eheart, M. S., Variations in the Ascorbic Acid Requirements for Saturation of Nine Normal Young Women. *J. Nutrition* 28:413, 1944.
14. Jolliffe, N., Preventive and Therapeutic Use of Vitamins. *J.A.M.A.* 129:613, 1945.
15. Kyhos, E. D.; Sevringhaus, E. L.; Hagendorn, D. R., Large Doses of Ascorbic Acid in Treatment of Vitamin C Deficiencies. *Arch. Int. Med.* 75:407, 1945.
16. Crandon, J. H.; Lund, C. C.; Dill, D. B., Experimental Human Scurvy. *N. Eng. J. of Med.* 223:353, 1940.
17. Dalldorf, G., *Vitamin C in Health and Disease*. W. B. Saunders, 1945.
18. McCormick, W. J., Vitamin B. Therapy in Inflammatory and Degenerative Diseases of the Nervous System. *Med. Rec.* 150: 303, 343, 1939.
19. Wright, I. S.; Lilienfeld, A., Pharmacologic and Therapeutic Properties of Crystalline Vitamin C. *Arch. Int. Med.* 57:241, 1936.
20. Musser, J. H., *Nutrition in the Aged*. W. B. Saunders Co., 1945.
21. Kertesz, Z. I.; Dearborn, R. B.; Mack, G. L., Vitamin C in Vegetables: IV, Ascorbic Acid Oxidase. *J. Biol. Chem.* 116:717, Dec. 1936.
22. Johnson. S. W.; Zilva, S. S., The Oxidation of 1-Ascorbic Acid by Plant Enzymes. *J. Biochem.* 31:438, March 1937.
23. Wood, E., The Vitamin C Content of the Russel Burbank Potato of Idaho. *Bull. 219 U. of Idaho A. Exp. S.*, June 1935.
24. Klenner, F. R., Massive Doses of Vitamin C and the Virus Diseases. *J. S. Med. and Surg.* Vol. 113, #4, April 1951.
25. Klenner, F. R., The Vitamin and Massage Treatment for Acute Poliomyelitis. *J. S. Med. and Surg.* Vol. 114, #8, Aug. 1952.
26. Marsh, Wm. C Commander (MC) U.S.N., The Treatment of Herpes Zoster With Protamide, *U.S. Armed Forces Medical Journal* 1:1045, Sept. 1950.

