# Vitamin C Therapy

## Historical Perspectives and Current Applications

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# Vitamin C:
# The Pioneer

**Frederick R. Klenner, MD** [Oct. 22, 1907-May 20, 1984]

First doctor to fully realize what high-dose vitamin C could do, and proceeded to utilize it in that manner; published 28 papers documenting his results

Documented the ability of vitamin C to reliably ***cure*** many different acute infectious diseases and to reliably neutralize ***any*** toxin treated, when sufficiently dosed and administered for a long enough period of time

http://www.seanet.com/~alexs/ascorbate/197x/klenner-fr-j_appl_nutr-1971-v23-n3&4-p61.htm [good Klenner review]

# What Has Vitamin C Already Been Proven to Do?

1. Kill/inactivate all viruses *in vitro* against which it has been tested. Prominent examples:

**A**. Poliovirus: vitamin C completely inactivated the poliovirus, ***rendering it completely non-infectious***, even when injected directly into the brains of monkeys. Jungeblut, 1935 [19870431]

**B**. Herpesviruses:

Holden and Resnick (1936) The *in vitro* action of synthetic crystalline vitamin C (ascorbic acid) on herpes virus. *Journal of Immunology* 31:455-462

Holden and Molloy (1937) Further experiments on the inactivation of herpes virus by vitamin C (*l*-ascorbic acid). *Journal of Immunology* 33:251-257

# What Has Vitamin C Already Been Proven to Do?

1. Kill/inactivate all viruses *in vitro* against which it has been tested. Prominent examples:

**C**. Vaccinia viruses:

Kligler and Bernkopf (1937) Inactivation of vaccinia virus by ascorbic acid and glutathione. *Nature* 139:965-966

Turner G (1964) Inactivation of vaccinia virus by ascorbic acid. *J Gen Microbiol* 35:75-80 [14171261]

**D**. Tobacco mosaic virus:

Lojkin M (1936) A study of ascorbic acid as an inactivating agent of tobacco mosaic virus. *Contr Boyce Thompson Inst Pl Res* 8:455

# What Has Vitamin C Already Been Proven to Do?

1. Kill/inactivate all viruses *in vitro* against which it has been tested. Prominent examples:

**E**. Bacteriophage viruses:

Murata (1975) Mechanism of inactivation of bacteriophage deltaA containing single-stranded DNA by ascorbic acid. [1214179]

Morgan (1976) The mechanism of DNA strand breakage by vitamin C and superoxide and the protective roles of catalase and superoxide dismutase. [181730]

Richter (1982) Rapid inactivation of bacteriophage T7 by ascorbic acid is repairable. [7044421]

Samuni (1983) On the cytotoxicity of vitamin C and metal ions. A site-specific Fenton mechanism. [6317379]

# What Has Vitamin C Already Been Proven to Do?

1. Kill/inactivate all viruses *in vitro* against which it has been tested.
   Prominent examples:

**F**. Enteroviruses:

Salo (1978) Inactivation of enteroviruses by ascorbic acid and sodium bisulfite. [29558]

**G**. Influenza virus:

Cheng (2012) [An *in vitro* study on the pharmacological ascorbate treatment of influenza virus]. [Article in Chinese] [22931805]

**H**. Rabies virus:

Amato G (1937) Azione dell'acido ascorbico sul virus fisso della rabia e sulla tossina tetanica. *Giornale di Batteriologia, Virologia et Immunologia* (Torino) 19:843-847; rabies virus inactivated *in vitro*

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

**A**. Polio: Vitamin C cured acute polio (60 of 60 cases) (Klenner in 1949); full article:

http://www.seanet.com/~alexs/ascorbate/194x/klenner-fr-southern_med_surg-1949-v111-n7-p209.htm

Also, vitamin C cured acute but **advanced** polio and its associated ***flaccid paralysis***: (Klenner in 1951); full article:

http://www.seanet.com/~alexs/ascorbate/195x/klenner-fr-southern_med_surg-1951-v103-n4-p101.htm )

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

Years after Klenner's experience with polio, it was demonstrated that polio responded very well to high-dose vitamin C given ***orally*** as well, with 5 patients receiving between 50,000 and 80,000 mg given at various times over a 10-day treatment period. Greer, 1955 [13279345]

Another clinician showed much lower doses of vitamin C clearly accelerated the resolution time of polio patients, including normalizing elevated temperatures. Baur, 1952 [13021801]

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

Acute hepatitis:

Dalton, 1962 [13883259] (Six daily 2,000 mg injections)

Cathcart, 1981 [7321921] (Reported that he never had a single case of acute viral hepatitis fail to respond to properly dosed IVC, and that he never had a VC-treated hepatitis patient subsequently develop chronic hepatitis)

Orens, 1983 [6573223] (IV and oral)

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed.

Dr. Klenner's approach to acute hepatitis:

Initial Rx was 500 to 700 mg of VC/kg body weight by vein, given every 8 to 12 hours. As well, a minimum of 10,000 mg VC orally every day. Routinely, resolution was seen in 2 to 4 days.

Klenner also resolved acute hepatitis with 5,000 mg of VC every four hours or so orally. Complete resolution was achieved in 4 days, utilizing a total of about 120,000 mg given.

(1974) Klenner F. Significance of high daily intake of ascorbic acid in preventive medicine. *Journal of the International Academy of Preventive Medicine* 1:45-69

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

Vitamin C repeatedly cured cases of viral encephalitis, many ***presenting in coma***:


(July 1949) Klenner F. The treatment of poliomyelitis and other virus diseases with vitamin C. *Southern Medicine & Surgery* 111:209-214 [18147027]

(April 1951) Klenner F. Massive doses of vitamin C and the virus diseases. *Southern Medicine & Surgery* 103:101-107 [14855098]

(1953) Klenner F. The use of vitamin C as an antibiotic. *Journal of Applied Nutrition* 6:274-278

(1971) Klenner F. Observations of the dose and administration of ascorbic acid when employed beyond the range of a vitamin in human pathology. *Journal of Applied Nutrition* 23:61-88

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

Comatose New Zealand farmer with H1N1 “swine flu” directly prior to having life support discontinued (2010). See:

http://peakenergy.com/video.php

# What Has Vitamin C Already Been Proven to Do?

2. Resolve all ***acute*** viral syndromes for which it has been adequately dosed. Prominent examples:

**A**. Measles (simple and complicated)

**B**. Mumps (simple and complicated); Klenner, 1949 [18147027]

**C**. Herpes infections, ***acute*** (chickenpox) Dainow, 1943 68 197; Zureick, 1950 [14908970]; (1974) Klenner 1 45

**D**. Rabies: vitamin C-treated guinea pigs had improved survival Banic, 1975 [1191395]; No studies of humans infected with rabies and treated with VC found

# What Has Vitamin C Already Been Proven to Do?

3. Documented efficacy in non-viral infections.

Diphtheria, tetanus, staphylococcus, streptococcus, pseudomonas (all documented as ***curable*** with vitamin C therapy)

While vitamin C is an absolute virucide, it is:

1. ***Often*** bactericidal
2. ***Almost always*** bacteriostatic, and
3. ***Always*** strongly supportive of an optimally competent immune system. Clinically, properly-dosed vitamin C will resolve all acute and many chronic viral infections, as well as most acute infections resulting from other non-viral pathogens (Levy, 2002, *Curing the Incurable*)

# What Has Vitamin C Already Been Proven to Do?

Vitamin C cured acute rheumatic fever:
[Massell (1950) 15412682]

Published in *The New England Journal of Medicine*, the authors only wanted to conclude that vitamin C had "antirheumatic activity" but that more research was needed; no significant additional research of this clinical application of vitamin C was ever found. It very much appeared as though the authors were afraid of what would happen if they were more definitive in their conclusions.

# What Has Vitamin C Already Been Proven to Do?

3. Documented efficacy in non-viral infections.

Malaria (very positive responses to very low doses) [(1938) Lotze H. Clinical experimental investigations in benign tertian malaria. *Tropical Diseases Bulletin* 35 733]

Leprosy, typhoid fever, brucellosis, trichinosis

Dysentery (amebic and bacillary)

Trypanosomal infections (Chagas' disease); *in vitro*, VC & GSH kill trypanosomes [(1937) Strangeways W. Observations on the trypanocidal action *in vitro* of solutions of glutathione and ascorbic acid. *Annals of Tropical Medicine and Parasitology* 31 405]

# What Has Vitamin C Already Been Proven to Do?

4. Documented as the ultimate nonspecific antitoxin and poison antidote, *in vitro* and *in vivo*:

**A**. Toxic elements (mercury, lead, chromium, arsenic, cadmium, nickel, vanadium, aluminum, fluorine); [Levy, 2002, *Curing the Incurable*, pp. 280-312]

**B**. Venoms (snake, spider); Klenner (1971) Observations of the dose and administration of ascorbic acid when employed beyond the range of a vitamin in human pathology. *Journal of Applied Nutrition* 23  61; Klenner (1974) Significance of high daily intake of ascorbic acid in preventive medicine. *Journal of the International Academy of Preventive Medicine* 1 45

**C**. Alcohol; Zannoni, 1987 [3304067]

**D**. Barbiturates; (1971 & 1974, Klenner, see above), Kao, 1965 [5899011]

# What Has Vitamin C Already Been Proven to Do?

4. Documented as the ultimate nonspecific antitoxin and poison antidote, *in vitro* and *in vivo*:

**E**. Toxic mushrooms; Laing, 1984 [6200941]; effectiveness of other antioxidants, ALA: Berkson, 1979 [366411]; NAC: Montanini, 1999 [10635453] (VC & antioxidant therapy still not a routine part of mushroom poisoning [Berkson article in NEJM])

**F**. Pesticides, six different types; (2002) Levy, *Curing the Incurable*, pp. 267-271; (1971) Klenner 23 61

**G**. Strychnine, tetanus; (1937) Jungeblut 33 203 [neutralized tetanus toxin *in vitro*], Dey, 1966 [5986216] [tetanus toxin neutralization *in vivo*], Dey, 1965 [14291219] [strychnine neutralization *in vitro*], Dey, 1967 [4383547] [strychnine neutralization *in vivo*]

# What Has Vitamin C Already Been Proven to Do?

5. Definite benefits in the following:

**A**. Lyme, AIDS, ***chronic*** hepatitis

"Embedded pathogens;" vitamin C (or any other agent) cannot work optimally without physical access to the pathogen (high-dose, Multi-C approach often successful)

**B**. Common cold; a very high requirement of vitamin C needed for the total quantity of virus usually present

**C**. Tuberculosis; slow-growing, slow-reacting; massive amount of literature documenting benefits of C for this

**D**. Pertussis; combination infection/toxin

# What Has Vitamin C Already Been Proven to Do?

6. Neutralize radiation toxicity and/or repair damage from it

Just as in any other type of free radical/oxidation environment, radiation exposure results from electron loss from the affected tissues/biomolecules

Basic research: Ala-Ketola, 1974 [4450227] [vitamin C could prevent death in rats from otherwise fatal whole body ionizing radiation exposure]

Clinical research, Kennedy, 2001 [11316150] [vitamins C and E prevented side effects of pelvic irradiation in cancer patients]

# What Has Vitamin C Already Been Proven to Do?

6. Neutralize radiation toxicity and/or repair damage from it

In Japan, after the tsunami-induced nuclear plant breach, the Japanese College of Intravenous Therapy (JCIT) treated many individuals with vitamin C-centered therapies.

In an unpublished study, five Fukushima Nuclear Plant workers with heavy radiation exposure received IVC only twice monthly, along with the regular supplementation of oral liposome-encapsulated vitamin C, as well as alpha lipoic acid, selenium, and a multi-vitamin preparation. Over a two-month period, statistically significant drops were seen in a laboratory test for free DNA, as well as in a multifactorial Cancer Risk Score evaluation

# Vitamin C and Cancer

Vitamin C exerts anticancer activity both in the test tube and in the body:

[Mikirova (2008), 18789157] (full article also available)

Report on three cases reported showing vitamin C to be a very effective cancer therapy:

[Padayatty (2006), 16567755] (full article also available)

# Vitamin C and Cancer

Report on seven advanced cancer cases treated successfully with intravenous vitamin C:

[Riordan (2004), 15377059] Full article available at:

http://www.riordanclinic.org/research/articles/89023203.pdf

Many more similar scientific articles can be found reaching the same conclusions about the effectiveness of vitamin C as cancer chemotherapy.

# Vitamin C and Cancer

Higher plasma levels of vitamin C are inversely associated with risk of gastric cancer

[Jenab (2006), 16774936] Full article available

# Vitamin C and Longevity

The ***highest*** plasma levels of vitamin C are associated with the ***least*** mortality from heart disease, as well as from cancer and all other causes. In 19,496 men and women, the risk of dying in the top 20% was about ***half*** the risk of dying in the bottom 20%

[Khaw (2001), 11247548]

[Loria (2000), 10871572] reached a similar conclusion. Full article available.

# Vitamin C and Coronary Heart Disease

High plasma vitamin C levels are associated with a lowered risk of coronary artery disease, independent of classical risk factors

[Boekholdt (2006), 16925857]

# Vitamin C and Diabetes

Higher plasma vitamin C levels are inversely associated with the development of diabetes

[Sargeant (2000), 10840986] Full article available

# Vitamin C and Safety

Vitamin C has ***no known toxic dosage*** in patients without preexisting kidney disease.

"…194,054 g, or 427 lbs of IV vitamin C" were "administered to 275 patients with no sign of kidney disease, or any other significant side effects over a 16-year period."

(2002) Jackson et al. Full article available at:

http://www.riordanclinic.org/research/articles/89023765_jom.pdf

# Vitamin C and Safety

In a Harvard study on 85,557 women with no history of kidney stones, vitamin C intake was not associated with risk of developing kidney stones. The Harvard researchers advised that “routine restriction of vitamin C to prevent stone formation appears unwarranted.”

[Curhan (1999), 10203369]

# Vitamin C and Safety

Another large study, the Harvard Prospective Health Professional Follow-Up Study:

"The intake of high doses of vitamin C does not increase the risk of calcium oxalate kidney stones…" The members of the group with the ***highest*** vitamin C intake "had a lower risk of kidney stones" than those with the ***lowest*** intake.

[Gerster (1997), 9429689]

# Vitamin C and Safety

Continuous vitamin C infusions of 50 grams daily were given over an eight-week period in terminal cancer patients with no definable negative side effects.

[Casciari (2001), 11384106] Full article available

# Vitamin C and Safety

Serum vitamin C levels were examined in relation to the history of kidney stones in over 10,000 subjects, and ***no*** evidence was found to indicate that high vitamin C levels increased the prevalence of kidney stones. Conversely, the ***higher*** the vitamin C levels in the blood, the ***lower*** the incidence of kidney stones.

[Simon (1999), 10090119]

# Vitamin C and Safety

Over 55 other factors, in addition to vitamin C, can raise urinary oxalate levels and increase the risk of stone formation, ***in patients with preexisting kidney disease***. In pregnancy, for example, the urine becomes ***as supersaturated*** with calcium oxalate as in patients with established stone disease, but there is ***no*** increased risk of stones associated with pregnancy. Elevated urine oxalate is a risk factor for stone disease ***in patients with preexisting kidney disease only***.

[Maikranz (1989), 2811052]

# Vitamin C and Safety

Even though it is not used in most hospitals currently, high dose intravenous vitamin C is used widely around the world now in doctors' clinics and offices, with no definable evidence of harm in patients without preexisting kidney disease

[Padayatty (2010), 20628650] Full article available

# Vitamin C and Safety

A person with normal kidney function can successfully kill himself with excess water ingestion. There is no established dosage at or beyond which such a person can reliably kill himself with vitamin C. Is water more toxic than vitamin C?

[Hayashi (2005), 15914312]

# Vitamin C,
# Legal Considerations

## Do you have the right to health care?

Most would say yes, in both the medical and legal arenas, but you do ***not*** have the unbridled right to health care with the following considerations:

1. Extraordinary expense (e.g., transplant)
2. Experimental and/or unproven nature
3. Substantial risk of severe side effects

# Vitamin C,
# Legal Considerations

Conversely, as a patient, you ***DO*** have the right to any therapy that is:

1. Not prohibitively expensive (or even cheap)
2. Established to be effective
3. Not prohibitively toxic, or suspected to be (or with no defined toxicity)

# Vitamin C,
# Legal Considerations

Vitamin C is:

1. Remarkably inexpensive
2. Repeatedly established to be effective for 70+ years now in the medical literature and in medical clinics for multiple decades
3. Quite possibly the ***least*** toxic supplement or drug to ever be administered to patients without preexisting kidney disease

# Vitamin C:
# Practical Considerations

Regardless of whether there exists an appropriate antibiotic or other antimicrobial agent for administration, vitamin C should ***always*** be part of ***any*** protocol for ***any*** infection, acute or chronic, because:

1. Vitamin C significantly enhances immune function, in at least 20 different ways. (2002) Levy, *Curing the Incurable*, pp. 180-3
2. Vitamin C has its own direct anti-pathogen properties (iron, Fenton reaction)
3. Vitamin C neutralizes specific endotoxins, exotoxins, and the nonspecific pro-oxidant effects associated with any infection
4. All infections consume vitamin C, so failing to supplement with vitamin C means the patient with be dealing with infection-induced pre-scurvy and even frank scurvy as well (consider making ***serial*** plasma vitamin C levels a routine part of the testing in all hospitalized patients)

# Prominent Promoters of Chronic Degenerative Diseases

1. Infections (endotoxins, exotoxins, aerobic and anaerobic metabolic byproducts, dental); documented to strongly promote oxidative stress and lessen antioxidant capacity
2. Known exogenous toxin exposures (heavy metal, pesticides, etc.)
3. Toxic iron status (most people in “normal” range are toxic); also calcium and copper
4. Dietary toxin exposures (constipated gut, *Clostridium*); inadequate/poor nutrition and/or poor digestion; poor digestion is worse than poor nutrition in terms of impact on the antioxidant capacity of the body
5. Hormone imbalances (sex, thyroid)

# Treatment Principles for All Chronic Degenerative Diseases

1. **Prevent/minimize** new daily toxin exposure (environmental, dental, dietary, digestive)
2. **Neutralize** existing toxins present in body
3. **Excrete** toxin stores in a non-toxic, or minimally toxic, manner
4. **Resolve** infections, and eliminate the reasons for contracting new infections
5. **Supplement optimally** to maximize the antioxidant/nutrient status of the body as completely as possible
6. **Address hormone imbalance**, typically deficiencies of testosterone, estrogen, and/or thyroid hormone

# Factors in the Effective Administration of Vitamin C

**The primary aim of any vitamin C protocol:**

Vitamin C, in its active, reduced form, needs to maximally accumulate inside the cells of the target tissue(s). As well, vitamin C should reach optimal concentrations in the extracellular spaces as well.

# Factors in the Effective Administration of Vitamin C

1. Dose (multigram always, except with some renal disease)
2. Route (oral, regular; oral, liposome; intravenous; intramuscular)
3. Rate (consider clinical status of patient)
4. Frequency (symptom response)
5. Duration (clinical status, symptom response)
6. Type (avoid calcium ascorbate)
7. Adjunct therapies (not usually necessary to avoid; antibiotics where appropriate)
8. Safety
9. Overall protocol of administration

# Factors in the Effective Administration of Vitamin C

## Dose

Almost all clinical failures of vitamin C administration are due to inadequate C delivery to the target tissues, usually a result of inadequate dosing. While lower doses will still be of benefit to the patient, a 30-gram IV infusion may result in little discernible clinical improvement, while a 50-gram, a 100-gram, or a 150-gram infusion could still demonstrate progressively more positive clinical responses. Tiny (<500 mg) doses of vitamin C can sometimes trigger a pro-oxidant response, due to triggering of the Fenton reaction at various sites in the body. These microdoses of vitamin C account for virtually all of the "negative" articles regularly published about the *in vitro* and *in vivo* effects of vitamin C.

# Factors in the Effective Administration of Vitamin C

## Route & Form

When “regular” vitamin C is used, the intravenous route is always the most desirable (sodium ascorbate, buffered ascorbic acid); however, intramuscular is very effective as well, and was used frequently by Dr. Klenner

# Factors in the Effective Administration of Vitamin C

## Route & Form—Intramuscular

In Dr. Klenner's own words:

"In small patients, where veins are at a premium, ascorbic acid can easily be given intramuscularly in amounts up to two grams at one site. Several areas can be used with each dose given. Ice held to the gluteal muscles until red, almost eliminates the pain. We always reapply the ice for a few minutes after the injection. Ascorbic acid is also given, by mouth, as followup treatment. Every emergency room should be stocked with vitamin C ampoules of sufficient strength so that time will never be counted—as a factor in saving a life. The 4 gram, 20 cc ampoule and 10 gram 50 cc ampoule must be made available to the physician." [Typically sodium ascorbate or ascorbic acid buffered with sodium bicarbonate]

(1971) Klenner F. Observations on the dose and administration of ascorbic acid when employed beyond the range of a vitamin in human pathology. *Journal of Applied Nutrition* 23:61-88.

# Factors in the Effective Administration of Vitamin C

## Route & Form

Oral liposome-encapsulated vitamin C vs. regular C

1. Rapid and very enhanced absorption (Ling, 2006 [16556538])
2. No stomach upset & no ascorbate-induced diarrhea
3. Intracellular bioavailability (Yamada, 2008 [18655816]; (Rawat, 2007 [17944316])

# Factors in the Effective Administration of Vitamin C

## Route & Form

Liposomes orally:

4. Ultimate delivery in the reduced form (much of the doses of the other forms of regular vitamin C, including those given intravenously, need to be in the oxidized form [DHAA] to be taken into cells). This means that regular vitamin C given orally ***or intravenously*** needs to ***consume energy*** to end up inside the cell or its organelles in its active, electron-donating form. (Goldenberg, 1994 [7844110]; Liang, 2001 [11396616]; Meister, 1994 [8144521])

# Factors in the Effective Administration of Vitamin C

## Route & Form

5. Independent supplemental value of the phosphatidylcholine content of the liposome, in the following ways:

   Antioxidant (Das, 2007 [17877144])

   Anti-atherosclerotic agent (Altman, 1980 [7190404])

   Cholesterol lowering (Mastellone, 2000 [11091102])

   Treatment for liver disease (Buang, 2005 [15975496])

   Anti-inflammatory agent, protection against ischemia (Demirbilek, 2006 [16834655])

   Treatment and prevention of cell membrane damage (Lubin, 1972 [5009118])

# Liposome Biodelivery

Any drug delivery system that can achieve delivery of its payload into the cytoplasm, or even more deeply into the mitochondria, endosomes, or nuclei, is nearly always the ***most desirable*** way to put that payload into the body, especially ***without the consumption of energy***, or ***with the relatively minimal consumption of energy***.

# Liposome History

1. In 1965 it was reported that the appropriate exposure of phospholipids to excess water gives rise to lamellar structures than can effectively encapsulate the solutes present (liposomes) (Bangham, 1965 [5859039]).
2. This characteristic resulted in the adoption of liposomes as a model for the study of ***cell membrane biophysics***.
3. The concept of solute entrapment in liposomes then led to the concept of drug delivery (Gregoriadis, 1971 [11945728]; Gregoriadis, 1972 [4500958]; Gregoriadis, 1976 [958245, 785256]).
4. It was demonstrated that a large protein (insulin) taken orally in liposomes could exerting glucose-lowering effects in rats (Dapergolas, 1976 [61498]).

# Liposome History

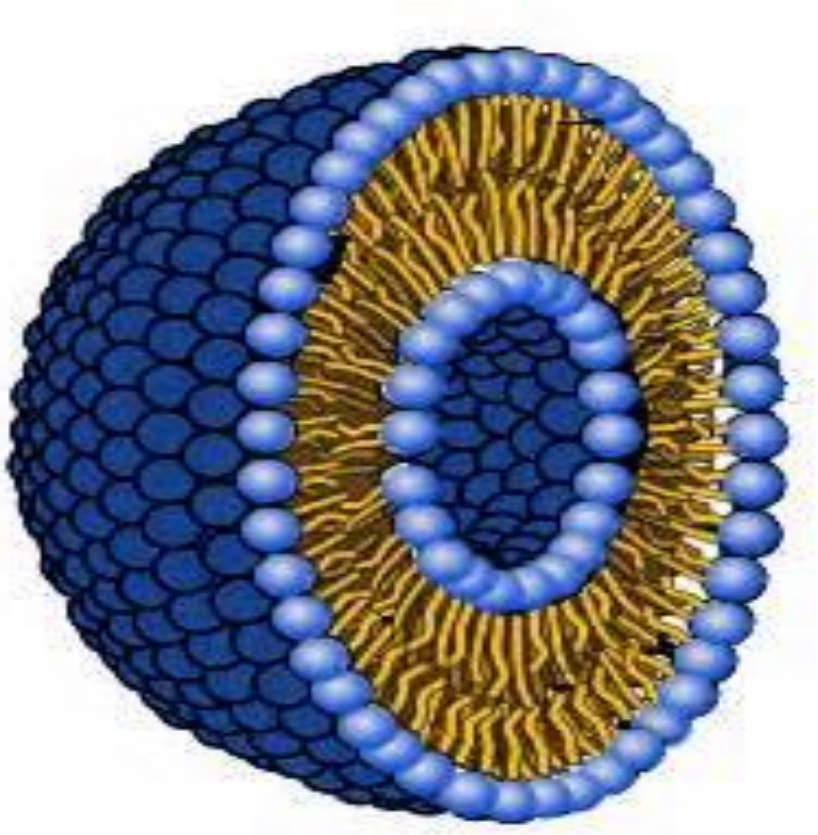
The liposome has evolved over the last 50+ years from a structural curiosity into what may now prove to be the **most significant and effective** way yet discovered to deliver nutrient or drug payloads in an optimally bioavailable manner directly into cells.

# Liposome Structure

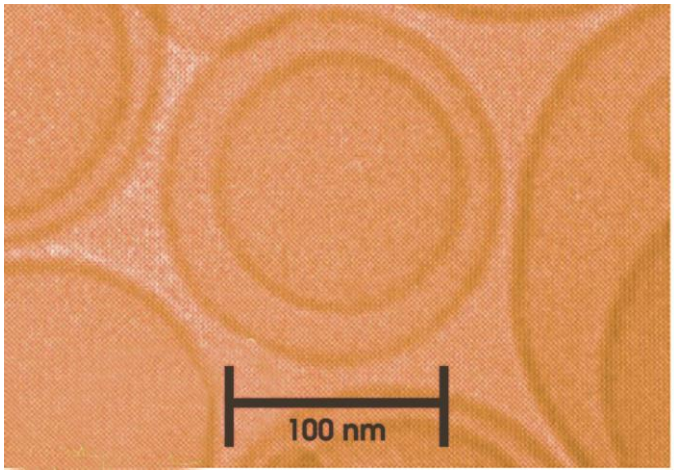
1. A microscopic sphere (nanometers) of a phospholipid bilayer that is stable in water and able to contain water-soluble substances
2. In unmodified liposomes, the phospholipid is typically phosphatidylcholine
3. The conformation and content of the phosphatidylcholine in the liposome wall is virtually identical to the walls of the cells in the body and the walls of important subcellular organelles
4. A liposome can be viewed as an **laboratory model for a cell** in the body

# Liposome Structure

5. A phospholipid is an elongated molecule with a water-soluble (or water-seeking) end [polar] and a fat-soluble (or fat-seeking) end [non-polar]
6. When in water with the appropriate energy/force applied, the fat-seeking ends of the phospholipid molecules align against each other to avoid the water, forming a bilayer of molecules that subsequently “collapses” into a sphere with the water-soluble ends of the molecules lining both the inside of the sphere’s cavity as well as covering the outside of the sphere
7. Whatever was dissolved in the water ends up inside the liposome as its encapsulated payload



# Liposome




Under the electron microscope

# Liposomes, Designed by Nature

**Extracellular Vesicles** are important naturally-occurring players in intercellular communication (Kittel, 2013 [24265924]; Raposo, 2013 [23420871]; Rajendran, 2014 [25392515]), and they have been found in substantial quality in all of the body fluids tested (Fais, 2016 [26978483]). These vesicles are bilayer spheres with variable contents derived from nearly all cells, with both ***physiological and pathological*** purposes (Lo Cicero, 2015 [26001269]). The membrane structure is the ***same*** as the cell membrane or that of a subcellular organelle. (Danesh, 2013 [24335232]) They are also known to help convey immune responses (Thery, 2009 [19498381]).

# Liposomes, Designed by Nature

**Extracellular vesicles** (membrane vesicles) consist mainly of:

1. Exosomes
2. Microvesicles
3. Apoptotic bodies
4. Liposomes

# Liposomes, Designed by Nature

**Exosomes**

Discovered about 30 years ago, but only seriously studied in the last 10 years; originally considered cellular "garbage cans," now recognized as being critical in intercellular communication (Thery, 2011 [21876726])

40 to 100 nm in diameter and homogeneous in shape, involved in protein storage, transport, and release. Secreted by many cell types, and present in sperm, urine, plasma, and bronchial lavage fluid (Borges, 2013 [24141609]); also present in colostrum to modulate immune function (Admyre, 2007 [17641064]; Sun, 2013 [23483481])

# Liposomes, Designed by Nature

**Microvesicles**

Secreted from cells as vehicles to transfer proteins, lipids, mRNA, and microRNA to distant cells. Stem cells use microvesicles to repair damaged tissues as well. (Sabin, 2013 [24231336])

100 to 1000 nm in diameter, with variable shapes, formed by the regulated, outward budding of the cell membrane (Borges, 2013 [24141609])

Also allow the dissemination of lysosomal components out of the cell. (Canfran-Duque, 2013 [24288129])

# Liposomes, Designed by Nature

**Apoptotic Bodies**

Larger vesicles, distinct from exosomes, resulting from the process of programmed cell death (apoptosis).

1000 to 5000 nm in diameter, containing intact organelles, DNA, and histones (Kerr, 1972 [4561027]; Kerr, 2002 [12505355]). They form as the cell contracts and squeezes blebs in the cell membrane, which break off and contain the breakdown products of the dying cell. They work to minimize the surrounding inflammation that results from cell death via necrosis and rupture. The apoptotic bodies are engulfed by phagocytic cells (Wickman, 2013 [23787996]).

# Liposomes, Designed by Nature

**Liposomes**

Able to be produced artificially, but structurally very similar to the other extracellular vesicles previously described; a liposome utilizes the properties of naturally-occurring extracellular vesicles to transport its payload into the cytoplasm of target cells. There is some debate over whether liposomes are completely man-made extracellular vesicles or occurring naturally inside the body as well.

Multiple sizes and modifications can be made to liposomes, with a wide variety of payloads, both in the core and in the membrane

# Factors in the Effective Administration of Vitamin C

## Rate

This factor pertains to intravenous forms of vitamin C. Rate is determined by many factors, most importantly whether the patient is ***critically (acutely) ill***, or ***chronically ill***. Imminently life-threatening situations may require rapid infusion (for example, 50 grams in 20 to 30 minutes) or ***even IV push*** (several grams in a minute or two)

# Factors in the Effective Administration of Vitamin C

## Rate

In Klenner's words:

> In a cyanotic, acutely-poisoned patient who felt he way dying, Klenner wrote: "Twelve grams of vitamin C was quickly pulled into a 50 c.c. syringe and with a 20 gauge needle was given intravenously as fast as the plunger could be pushed. Even before the injection was completed, he [the patient] exclaimed, 'Thank God.'" (Venom of the Puss Caterpillar, resembling a mouse and later identified at Duke University)

(1971) Klenner F. Observations of the dose and administration of ascorbic acid when employed beyond the range of a vitamin in human pathology. *Journal of Applied Nutrition* 23:61-88

# Factors in the Effective Administration of Vitamin C

## Rate

Be aware that IV push or very rapid infusions of multi-gram amounts of vitamin C will reliably produce some degree of ***hypoglycemia***. The pancreas "views" the large amount of vitamin C in the blood as glucose, as vitamin C and glucose are very similar molecules, and a substantial amount of insulin is then reflexly released by the pancreas. However, the vitamin C does ***lessen the clinical impact*** of the hypoglycemia, as glucose levels of 20 to 25 can actually be tolerated for extended periods of time. This can be effectively viewed as a "protected hypoglycemia."

# Factors in the Effective Administration of Vitamin C

## Rate

Multi-gram doses of vitamin C given IV push, or even infused at a rapid rate, can be considered, both theoretically and from a clinical point of view, as an ***endogenously-induced*** form of ***insulin potentiation therapy (IPT)***. For more information on IPT: (Ayre, 1986 [3526099])

# Factors in the Effective Administration of Vitamin C

## Frequency

The frequency of vitamin C dosing in any of its forms is a completely clinical, symptom-response factor in vitamin C therapy.

For very acute infectious diseases, Dr. Klenner would give additional large doses of vitamin C after the initial dose when vital signs and the patient's reported sense of well-being were not clearly improving. With improvement, follow-up dosing could be of lesser amounts on a less urgent schedule of administration. Nearly all docs today use higher doses less frequently (daily or less), since they are practicing out of their offices, without the benefit of hospitalization, and clinical responses are not as profound and rapid as Dr. Klenner reported.

# Factors in the Effective Administration of Vitamin C

## Duration

The duration of an acute vitamin C administration protocol needs to be long enough to allow complete eradication (infection) and/or neutralization (toxin) of the disease/pathology being treated.

For life-threatening or otherwise severe infectious diseases, continue vitamin C at high, frequent doses for ***at least 24 hours***, and probably for at least 48 hours ***after*** you feel the patient has already reached clinical normalcy. Otherwise, a complete clinical relapse is possible. (For similar reasons, antibiotics are often prescribed for 10 to 14 days, usually many days after the appearance of clinical normalcy.)

# Factors in the Effective Administration of Vitamin C

## Type

The essence of vitamin C is its **ascorbate anion**. The associated cation may be any of the following:

- Hydrogen (ascorbic acid)
- Sodium
- Calcium
- Magnesium
- Potassium
- Manganese
- Zinc
- Molybdenum
- Chromium
- Other (such as ascorbyl palmitate)

# Factors in the Effective Administration of Vitamin C

## Type

Hydrogen ascorbate (excellent; can upset stomach)

Sodium ascorbate (excellent; no problem with hypertension or congestive heart failure (Kurtz, 1983 [6648527]; Kurtz 1987 [3309653]); no problem with stomach upset

Calcium ascorbate ("buffered" vitamin C; not recommended due to calcium content)

Potassium ascorbate (OK in small amounts; large amounts of potassium are potentially fatal)

Other mineral ascorbates (good supplements, but needlessly expensive, with risk of too much of a specific mineral)

# Factors in the Effective Administration of Vitamin C

## Adjunct Therapies

Unless another therapy is inherently pro-oxidant and toxic, vitamin C will only augment the desired effects. And even with highly toxic agents, proper vitamin C administration can help produce the desired outcome by reducing otherwise unavoidable and therapy-limiting side effects.

No need to avoid antibiotics; vitamin C works very well in enhancing their antimicrobial effects (many antibiotics are little more than iron chelators, lessening the ability of pathogens to proliferate)

Chemotherapy (pro-oxidant & toxic); vitamin C will neutralize only if taken ***simultaneously*** (encountering it in the blood); otherwise, vitamin C works well in correcting the damage done by chemotherapy to normal, non-tumor tissue, although vitamin C loading will protect normal cells better if given before chemo.

# Factors in the Effective Administration of Vitamin C

## Safety

According to Dr. Klenner:

"Ascorbic acid is the safest and the most valuable substance available to the physician. Many headaches and many heartaches will be avoided with its proper use."

An assertion now completely validated after countless intravenous administrations over the last 65 years.

(Padayatty, 2010 [20628650])

# Factors in the Effective Administration of Vitamin C

## Intravenous Vitamin C: Dose

In general, for any given administration of IVC, give from 1 to 1.5 grams per kilogram of body weight; 50 grams might be perfect for a 110-pound woman, but not remotely enough for a 250-pound man. Most children will do well on 25 to 50 grams infused at a time.

Also, the extent of infection and/or the degree of toxin accumulation and ongoing toxin exposure/production will ***greatly*** affect what your proper dose of vitamin C should be.

# Factors in the Effective Administration of Vitamin C

## Intravenous Vitamin C: Rate

Anywhere from IV push to a four-hour infusion; the rate depends upon:

1. How clinically stable the patient is
2. Localized or systemic condition
3. Infectious disease
4. Toxin exposure
5. An acute illness or a chronic degenerative disease (such as cancer or coronary atherosclerosis)
6. Comfort of the infusion (must be adjusted so that **no pain** is present)

# “Mop-Up” IVC

When patient feels worse after IVC or even highly-dosed oral vitamin C, a “Herxheimer-like” reaction is often the cause. This can be due to an accelerated release of stored intracellular toxins at a rate in excess of what the ongoing VC being administered can neutralize. It can also be secondary to a massive kill-off of pathogens, with substantial amounts of reactive iron and other pro-oxidant “debris” in the lymphatics and blood. Similarly, it can be due to a massive kill-off of susceptible cancer cells, along with substantial amounts of reactive iron and pro-oxidant “debris” being released as well.

# “Mop-Up” IVC

When such a “Herxheimer-like” or perceived detox reaction occurs and the patient feels poorly, with a recrudescence of symptomatology of any of a number of underlying disease processes, the IVC being administered should either be stopped (or finished, if close to the end of the infusion). This should be immediately followed by a low-dose, slow-flow (“Low & Slow”) infusion of vitamin C. This low and slow infusion immediately neutralizes circulating pro-oxidant debris in the blood (and lymph), while not further stimulating an increased kill-off or detox that is associated with the higher-dosed, rapidly flowing infusion of vitamin C.

# “Mop-Up” IVC

A good rule of thumb is to follow the therapeutic VC infusion with a Mop-Up IVC that is ***at most*** less than one-half the therapeutic dose and ***at most*** infused at less than one-half the initial therapeutic dose rate. If clear improvement does not occur within 15 to 20 minutes, slow the rate of the Mop-Up infusion again by 50%.

For example, a patient who does not tolerate 50 grams given over one hour well will probably respond very well within 20 to 30 minutes to 10 to 20 grams infused at a rate to go in over 2 hours. When symptom relief appears complete, the IV can be discontinued and oral forms can be administered.

Although seemingly counterintuitive, the Mop-Up IVC works very well in clinical practice, making for a happier patient and improved doctor/patient relationship.

# Factors in the Effective Administration of Vitamin C

## Multi-C Protocol

1. Oral liposome-encapsulated vitamin C (for optimal ***intracellular*** access by ascorbate)
2. Multigram doses of sodium ascorbate powder, taken several times daily, up to or reaching bowel tolerance (in order to minimize gut toxicity & support ***extracellular*** access by ascorbate) (Cathcart, 1981 [7321921]; Cathcart, 1984 [4069036])
3. Oral administration of ascorbyl palmitate (for optimal ***fat-soluble*** access by ascorbate) (Pokorski, 2004 [15209539]; Pokorski, 2003 [12595755]; Ross, 1999 [9890643])
4. Intermittent IV administration of ascorbate (to optimize ***extracellular*** access by ascorbate, as well as to further ***support*** intracellular pools of ascorbate)

# In the Words of Mark Twain

**“Be careful in reading health books. You may die of a misprint.”**

or, perhaps more accurately,
and NOT in the words of the venerable Mark Twain:

**“Be careful in reading health books. You may die from something printed as intended.”**

***Ignorance, as well as misinformation, is often deadly.***