Dynamic Chiropractic

VITAMINS / SUPPLEMENTS

The Power of Vitamin K

EVIDENCE SUGGESTS A ROLE IN CANCER PREVENTION, CARDIOVASCULAR HEALTH AND BONE MINERALIZATION.

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You may have heard rumblings in recent years that vitamin K helps reduce the risk of osteoporosis and cardiovascular disease, and is administered intravenously by some integrative medical doctors who combine it with high-dose vitamin C in cancer treatment. Our original understanding of vitamin K involves its established role as a coenzyme in specific carboxylation reactions required for the synthesis of several clotting factors. In fact, drugs such as warfarin (and related vitamin K epoxide reductase inhibitors) work by limiting the ability of vitamin K to synthesize prothrombin and several other clotting proteins (Factors VII, IX and X). As such, these drugs act as blood thinners and are accompanied by the potential for certain side effects, such as easy bruising and internal bleeding.[1] So, how then might vitamin K also be associated with osteoporosis, cardiovascular disease and cancer treatment?

Primary Forms of Vitamin K

The answer involves our emerging understanding that vitamin K also modulates the activities of osteoblasts, the matrix gla protein (MGP), and possesses some impressive anti-cancer properties. For all of this to make sense, you must first recognize that there are three primary forms of vitamin K, known as vitamin K_1, vitamin K_2 and vitamin K_3. To make it more confusing, there are several forms of vitamin K_2. Here is the overview:

Vitamin K_1: Phylloquinone is found in appreciable amounts in plant foods, especially green, leafy vegetables (broccoli, lettuce, collards, spinach, Brussels sprouts, etc.), as well as soybeans, soy products, lentils, canola and olive oil and several other foods (liver, salad dressing, coleslaw). Absorption is surprisingly low (5–20 percent, depending on the food).

Vitamin K_2 Menaquinone – There are several forms of menaquinone:

- Menaquinone-9 (MK-9) is produced by intestinal bacteria, but not absorbed to any appreciable degree by the body.[1]
- Menaquinone-7 (MK-7), derived from fermented soy (especially natto), is absorbed well and appears to play a key role in bone density via osteocalcin synthesis. MK-7 is also sold in supplement form is some countries.[2]
- Menaquinone-4 (MK-4) is formed within animal bodies, often after they are injected with vitamin K_3 (synthetic vitamin K, known as menadione). Menadione is put into poultry and swine rations, and appreciates in their tissues. These animals convert much of menadione to MK-4. Much of

the vitamin K_2 found in the body is usually from these sources (not gut bacteria-synthesized). Possibly gut-synthesized vitamin K_2 (MK-9) is synthesized too far down the intestinal tract to allow absorption, whereas MK-4 found in poultry, swine products, and MK-7 from fermented soy products (natto) and vitamin K_2 supplements (vitamin K_1, MK-7 and prescription MK-4 in Japan) are absorbed in the small intestine within chylomicrons, upon concurrent consumption of fat. MK-4 shows impressive anti-cancer properties, such as apoptosis in leukemia and other malignant cells lines, and it appears to have a stronger influence on osteoblastic activity than does phylloquinone (K_1).[1]

Vitamin K_3: Menadione is a synthetic vitamin K. Menadione is no longer administered to humans who have a vitamin K deficiency, or injected into newborns shortly after birth, because it is associated with toxicity.[1] Vitamin K does not pass from the placenta to the fetus very well. In a significant number of pregnancies, breast milk is virtually devoid of vitamin K, and newborns have no bacterial flora to synthesize their own vitamin K. Thus, classic vitamin K deficiency bleeding in the newborn usually occurs after 24 hours (usually the second day), and as late as the first week, with an incidence ranging between 0.25-1.7 cases per 100 births.[1,6]

Newborn infants were originally given an intramuscular injection of vitamin K_3, but it caused hemolytic anemia, liver damage and brain damage (from excess bilirubin) as a side effect in some cases. Vitamin K is now administered to newborns as vitamin K_1.[1,7] Vitamin K_1 is also the form of vitamin K used to correct vitamin K deficiencies in adults.[1]

However, vitamin K_3 (menadione) is the form of vitamin K used intravenously, along with high-dose vitamin C, in cancer treatment (ratio is 100:1 of vitamin C: vitamin K_3) by integrative practitioners, as discussed below.

Vitamin K in Bone Mineralization and Vascular Disease

Three vitamin-K-dependent proteins have been isolated in bone: osteocalcin, matrix gla protein (MGP) and protein S.

Osteocalcin is the second most prevalent protein in bone after collagen. Synthesis of osteocalcin by osteoblasts is regulated by vitamin D 1,25 dihydroxy vitamin D (calcitriol). The mineral-binding capacity of osteocalcin requires vitamin K-dependent gamma-carboxylation of three glutamic acid residues. Under-carboxylated osteocalcin is linked to increased risk for osteoporosis. MK-4 appears to be the most important form of vitamin K for osteocalcin synthesis, but the body can also use some vitamin K_1 for this purpose. The body can also convert vitamin K_1 to vitamin K_2 for this purpose, but conversion is slow and may not be sufficient for to achieve optimal bone mineral density.[1]

To consume the amount of vitamin K associated with a decreased risk of hip fracture in the Framingham Heart Study (about 250 mcg/day), an individual would need to eat a little more than 1/2 cup of chopped broccoli or a large salad of mixed greens every day, which is very attainable. This provides evidence that vitamin K_1 and vitamin K_2 from food alone, may be all that is required to support bone density function.[1] This fact is intriguing when you consider that the average intake of vitamin K from the mixed North American diet is estimated to be between 300-500 mcg per day.[3]

In Japan, oral doses of 45 mg of MK-4 are given to osteoporosis patients, which has resulted in increased bone density and/or reduced fractures, and increased markers of bone formation. The pooled evidence involving seven Japanese trials shows that vitamin K_2 supplementation has shown a 60 percent reduction in vertebral fractures and an 80 percent reduction in hip and other non-vertebral fractures. Thus, MK-4 administration to patients with osteoporosis may be an additional method to help manage their disease.[7]

MGP has been found in bone, cartilage and soft tissue, including blood vessels. The results of animal studies suggest MGP prevents the calcification of soft tissue and cartilage, while facilitating normal bone growth and development. Some evidence suggests vitamin K_2 plays a role in preventing cardiovascular disease by preventing arterial calcification.

Calcification of the fibrous cap is a late and significant step in the atherosclerosis process. Preventing arterial calcification may reduce deaths from vascular events. Once again, vitamin K_2 appears to play a more important role than vitamin K_1 in this regard.

As stated by researchers J Geleijnse, et al., "Vitamin K–dependent proteins, including matrix gla-protein, have been shown to inhibit vascular calcification." In their 7-10-year follow-up study (the Rotterdam Study), they showed that intake of phylloquinone was not related to a reduced risk of aortic calcification and coronary heart disease, whereas a significant correlation was shown for intake of menaquinone and decreased aortic calcification, coronary heart disease and all-cause mortality.[4]

As such, many vitamin K enthusiasts argue in favor of taking a vitamin K_2 supplement to help prevent, slow or reverse the development of atherosclerosis, and to prevent and treat osteoporosis. Vitamin K_2, in the form of MK-7, is available in Canada. In the U.S., only vitamin K_1 is available in supplements, according to Medline Plus (National Institutes of Health).[5]

Protein S is also synthesized by osteoblasts, but its role in bone metabolism is unclear. However, children with inherited protein S deficiency suffer complications related to increased blood clotting, as well as decreased bone density.[1]

Intravenous Vitamin K_3 in Cancer Treatment

The anticancer effects of sodium ascorbate (vitamin C) and vitamin K_3, administered separately or in combination, on human ovarian, breast, endometrial and skin cancer cells lines has been demonstrated. When given separately, vitamin C or K_3 has a growth-inhibiting action only at high concentrations, but when combined into a single lower-concentration mixture, they exhibit synergistic inhibition of cell growth that is 10-50 times greater that the single administration of vitamin C or vitamin K_3 applied individually.

Studies show that these vitamins are toxic to certain cancer cells, but not to normal human cells in experimental studies. The combination of sodium ascorbate and vitamin K_3 may also been shown to prevent metastasis in experimental studies.

Vitamin K_3 appears to kill cancer cells via a mechanism called autoschizic cell death. Autoschizis, is a novel type of cell death characterized by exaggerated cell membrane damage and progressive loss of

cell contents. During this process, the nucleus becomes smaller and cell size decreases by one-half to one-third of its original size. Co-administration of sodium ascorbate and K_3 induces a cell cycle block on cancer cells, making it harder for them to grow and divide. This is called a G1/S block.

The intravenous vitamin cocktail containing sodium ascorbate and vitamin K_3 also diminishes cancer cell DNA synthesis, increases H_2O_2 (hydrogen peroxide) production, and decreases cancer cell intracellular antioxidant defenses.[8]

Antibiotics and Vitamin K Deficiency

In children, adolescence and adults, vitamin D-responsive hypoprothrominemia (whereby low prothrombin levels rise with vitamin K supplementation or injection) is usually due to antibiotic therapy. It was originally thought that the antibiotic-killing of gut bacteria reduced synthesis of vitamin K_2, thus proving that gut synthesized vitamin K_2 (MK-9) is absorbed and important for vitamin K status and function. However, recent studies suggest antibiotics affect vitamin K homeostasis via carboxylase inhibition, or a coumarin-like effect on inhibiting vitamin K epoxide reductase.

Thus, a pre-existing low vitamin K state increases the risk of vitamin K deficiency with antibiotic use. As such, patients taking antibiotics should ensure they are eating sufficient dark green, leafy vegetables to acquire some additional vitamin K.[1] In addition, they may also be inclined to supplement with vitamin K during this period. These patients should also take a probiotic supplement to help maintain normal microflora populations, which serve a variety of important functions in human health. At the moment, it doesn't appear as if vitamin K synthesis is one of them.

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