

Hypervitaminosis

By: Dr: Sami Mohammed Al-gharer

College of Medicine and Surgery, King Faisal University – Saudi Arabia

Email: samialgharer80@gmail.com

Abstract:

Vitamins are readily available and sold in many different formulations and a wide variety of retail outlets. The food industry occasionally supplements foods with vitamins. When vitamins are taken in excess it will cause a case called hypervitaminosis. Vitamins can be defined as essential organic substances which are required in small amount for the metabolic functions of the body. Vitamins like folate, vitamin B12, pantothenate, and vitamin K are also synthesized by the intestinal bacterial flora. Vitamin D is synthesized from Ergocalciferol by the ultraviolet rays of sun light. Vitamins have a great role in our body metabolism, they present in two forms, either as a prosthetic group or as a co-factor of an enzyme. Many studies in the past have proved that only fat-soluble vitamins (A, D, E and K) which can be stored in adipose tissue and liver may produce toxicity. In the other hand, water soluble vitamins like vitamin C or B-complex are not causing hypervitaminosis even if ingested in excess because they are excreted from the body. Now this concept was proved to be not true, some new findings are clearly proving that hypervitaminosis occur also in water soluble vitamins. The most common causes are accidental ingestion of large amounts of vitamins, excessive feeding of food due overly solicitous parents to their children (Iatrogenic).

If food contains enough vitamins so there is no need for any vitamin supplementation, but if don't so it may be harmful. Some recommendations of the physicians are: not to consume any vitamins supplements until you return to your physician and make a prescription. Do not increase your prescribed dose written for you because this is the safest dose for your age, weight and body needs. Do not take any supplementary vitamins if you take your sufficient amount of your vitamins from food.

Keywords:

Hypervitaminosis, Vitamins, formulations, food industry, vitamin D

Introduction:

Hypervitaminosis can be defined as a condition of abnormally high storage levels of vitamins, which can lead to toxic symptoms (toxicity). Toxicities of fat-soluble vitamins can also be caused by a large intake of highly fortified foods, but foods rarely deliver dangerous levels of fat-soluble vitamins. High intake of beta-carotene (Hypercarotenaemia) can color the skin yellow, sparing the eyes. More than 60,000 instances of vitamin toxicities are reported annually to US poison control centers [1].

According to National Health and Nutrition Examination Survey (NHANES) data in 2003–2006, they found that 33% of the U.S population who are 1 year old and older took a multivitamin supplement in a given month [2]. In a 2009 survey, 56% of US consumers said they take vitamins or supplements, with 44% saying they take them daily [3]. Owing to their ability to accumulate in the body, fat-soluble vitamins have a higher potential for toxicity than do water-soluble vitamins. Usually nausea, vomiting, and diarrhea develops following by central nervous system symptoms of intense headache, vertigo, irritability, drowsiness, and coma. Peeling of skin commences after 24 hrs. Vitamin A excess causes bulging of fontonellae, papilloedema also seen in infants. High doses of vitamin A can be teratogenic [4]. Excess if vitamin A is causing intracranial hypertension. Ocular manifestations from hypervitaminosis A are varied and dose-related.

The direct effects are eyelashes loss due to increased intracranial pressure, as diplopia and strabismus. Ocular side effects are much more frequent and extensive in infants and children than in adults [12].

Statement of the Problem

This research is concerned with cases of hypervitaminosis cases of both of water and fat-soluble vitamins causing toxic symptoms and caused mainly by excessive ingestion of vitamins either in food or supplements. It also discussing the biochemical effect of the hyper-fed state and its effect on body health.

Objectives

The research aims to:

- 1- Determine the main factors causing hypervitaminosis state in patients consuming vitamins over-dose.
- 2- Classifying the different forms of hypervitaminosis.
- 3- Explain the different symptoms and ways of management.
- 4- Explaining the different forms of vitamin B-complex toxicity.

Study Questions

The research is concerned to make answers of the following questions:

- 1- What is hypervitaminosis mean?
- 2- What are the common risk factors causing it?
- 3- How can we prevent or treat it?
- 4- What are the different forms of hypervitaminosis?
- 5- What are the most common symptoms of each type?

Discussion

Symptoms of Individual Hypervitaminosis:

The features of hypervitaminosis are usually due to exaggerations of their normal physiological and biochemical actions.

1. Hypervitaminosis A:

It may occur as acute and chronic. In acute cases the features of hypervitaminosis are mainly due to exaggeration of their normal physiological and biochemical actions. Features in acute case are dizziness, headache, and lassitude, Irritability, pain abdomen, nausea, visual disturbances like diplopia, and bulging fontanel in infants, pruritus and excoriation of skin all over the body. Chronic cases are manifested by low grade fever, alopecia, dry fissured lip, ache in bones and joints, hyperostosis, anorexia, weight loss, hepatosplenomegaly, papilloedema, pseudotumour cerebri, if daily 25,000 IU or more vitamin A is consumed for many days.

Other features suggestive of raised intracranial pressure, such as bulging fontanel (in an infant), papilloedema and diplopia, may also occur. Anemia and thrombocytopenia have also been described [5]. Complications include: Hypocalcaemia, Hypercalciuria and renal stones. It may be unwise to give vitamin A supplements to older patients with good diets, particularly if at risk of osteoporosis. Experimentally chronic condition is produced when we take in excess of 50,000 units/day for more than three months. Management is by stopping the supplements. As far as prognosis is concerned, mortality is rare. Once identified, the prognosis is good. The yellow coloration of skin will reverse with time [2].

2. Hypervitaminosis D:

Usually this is caused by excessive ingestion or over prescription of medications, especially when prescribing calcium with vitamin D together. occasionally there is increased calcitriol production as in hyperparathyroidism or malignancy including some renal adenomas, sarcomas and lymphomas. In sarcoidosis, there is a hypersensitivity to vitamin D.

Vitamin D toxicity do not result from excessive exposure to sunlight due to further breakdown of D3 into products which have no effect on calcium metabolism.

Most symptoms occur because of secondary hypercalcaemia with increased bone resorption and hypercalciuria. They include: Polyuria, Polydipsia, Vomiting, Anorexia, and Lethargy, Dehydration, Constipation, Hypertension, Tetany, Seizures can be fatal. Hypervitaminosis D is also recognized as a cause of depression. In children it can result in dental enamel hypoplasia and focal pulp calcification. Investigations include serum calcium and phosphate and 25 hydroxy-vitamin D and 1, 25 dihydroxy-vitamin D levels [11].

Management is by stopping the supplements and treats the cause. Bisphosphonates such as pamidronate may be used to treat hypercalcemia. Complications may include nephrolithiasis, nephrocalcinosis, calcinosis of the joints and peri articular tissues, and chronic kidney disease. As far as prognosis is concerned renal disease is usually reversible if recognized early. An outbreak of hypervitaminosis D associated with the over fortification of milk from a home-delivery dairy [11].

3. Hypervitaminosis E:

Vitamin E is present in a great many foods, particularly vegetable oils, unprocessed cereal grains, nuts and seeds. There is no evidence of any adverse effects from consuming vitamin E in food. However, high doses of alpha tocopherol supplements can affect blood clotting inhibit platelet aggregation and cause hemorrhage. Vitamin E, 3 or 4 decades ago it appeared to be 'a vitamin in search of a deficiency. Vitamin E (alpha tocopherol) is a fat-soluble vitamin which acts as an antioxidant and disposes of free radicals. Problems only usually occur after a very large overdose. The recommended daily dose is 30 mg per day, and side-effects are usually experienced at doses above 1 g/kg. Excess of vitamin E inhibits vitamin K, causes increased bleeding and impaired immune system leading to necrotic enterocolitis. Platelet thromboxane production is also reduced. Some studies have also reported fatigue, weakness, headache and gastrointestinal upset. Management includes stop the supplements. Consider vitamin K if prothrombin time is prolonged [6].

4. Hypervitaminosis B-complex: [7][2]

In many cases there are skin changes, intestinal ulcers, fatty liver, hyperglycemia, hyperuricaemia, nausea and indigestion are found.

1. Thiamine (B1): Over-dose produce curare like action, paralysis. Blocks nerve transmission. Restlessness, convulsions, labored respiration, death (respiratory paralysis and cardiac failure).
2. Riboflavin (B2): Over-dose produces bright yellow urine, fatigue, vomiting, itching, numbness, burning or prickling sensation, sensitivity to light and hypotension occurs.
3. Niacin (B3): Overconsumption of niacin causes flushing syndrome, hyperemia of skin, Pruritus, GIT disturbances and acanthosis nigricans. More than 3gm niacin daily causes aggravation of bronchial asthma, gout and fasting hyperglycemia. Low blood pressure, light headedness, insomnia, liver damage, peptic ulcer, skin rash, altered liver function tests may occur.
4. Pantothenic acid (B5): Overdose produce diarrhea, GIT problems, water retention may occur.
5. Pyridoxine (B6): Vitamin B6 is a water-soluble vitamin and one of eight B vitamins. It might be considered safe, but at doses over 200 mg/day it can cause neurological disorders when taken over a prolonged period.

It used to be prescribed extensively for carpal tunnel syndrome and premenstrual tension. A sensory neuropathy mimicking multiple sclerosis may be seen, if B6 more than 2 gm is taken daily Progressive ataxia, impaired vision and vibration senses, and loss of deep tendon reflexes are seen. Preserved motor strength, perioral numbness and clumsy limbs are present. Loss of appetite, stomach pain and skin lesions also occur. However, long-term use of supplements can cause severe and progressive sensory neuropathy with ataxia. The severity of symptoms is dependent, and the symptoms usually stop when the supplements are discontinued. Other adverse effects of excessive vitamin B6 intake include painful skin rashes, photosensitivity, nausea and heart burn.

Symptoms include excessive doses damage sensory nerves. This can cause paraesthesia in the hands and feet, difficulty walking (poor co-ordination,

'staggering'), reduced sensation to touch, temperature, and to vibration and tiredness. Management is by stopping the vitamin B6 resolves symptoms in all cases. Failure to do so suggests another cause for symptoms. Vitamin B6 has main function in protein and amino acid metabolism. Pyridoxine is the treatment for isoniazid overdose. It is also used by body builders with varying results, depending on dosage.

6. Biotin (B7) (vitamin H): Biotin causes Scurfy skin due to hyperkeratosis of superficial follicular epithelium.
7. Folic acid (B9): Folic acid is useful for the RBC and DNA production. Over dosage produce convulsions in epileptics. Inhibit hepatic alcohol dehydrogenase. Stomach, sleep and skin problems occurs.
8. Cobalamine (B12): Over-dose of B12 causes reduction in size of vascular controlled reflexes, palpitation, tingling sensation and numbness of limbs.
9. Ascorbic acid (C): Vitamin C is found in citrus fruits and vegetables. An antioxidant and reducing agent, its controversial uses include treatment of upper respiratory tract infections and cancer. The worst effect is the formation of oxalate stone in the kidney. It may also cause uricosuria. Large doses if taken by pregnant women that induce the metabolic enzymes in the fetus and this may lead to rebound scurvy. Absorption of vitamin B12 is interfered with high doses of vitamin C. Vitamin C interferes with healthy antioxidant, pro-oxidant balance in body. In thalassemia or hemochromatosis increased iron overload occurs. Premature infants get hemolytic anemia due to the fragility of RBC.
10. Choline: More than 3.5 gm/day in take causes skin rash and increased blood sugar.

In self-limiting acute illness spontaneous recovery occurring in an otherwise healthy individual who has ingested a large quantity of vitamin A over a short period is characteristic of acute hypervitaminosis A. In this case, the symptoms of nausea, vomiting, headache, visual disturbances, vertigo associated with papilloedema and followed by exfoliation of skin. It has been estimated that acute poisoning in adults may be expected with over-doses over 1,000,000 IU.

Acute and chronic symptoms like pruritus and exfoliation are producible experimentally. Acute syndrome in children includes increased CSF pressure, papilloedema can occur and the mechanism is not known [8].

Vitamin D3 seems to decrease mortality in elderly people living independently or in institutional care [8]. Studies have shown that antioxidant supplements, including vitamin A and vitamin E, do not possess preventative effects and may be harmful with unwanted consequences to our health, especially in well-nourished populations. Vitamin A and E supplements may even increase mortality [9]. Toxicity from excess of vitamins A and D and E can occur but it is important not to exaggerate the risk. However, the belief that vitamins are good, therefore lots of vitamins are even better is inaccurate and simplistic. This may help to inform on better diets and better dietary supplementation. Vitamin C supplementation has not been shown to reduce the incidence of colds in the general population. Regular supplementation trials have shown that vitamin C reduces the duration of colds, but this was not replicated in therapeutic trials [10].

Conclusion & Recommendations

Both fat-soluble and water-soluble vitamins are not safe if taken in excess. Fat soluble vitamins are stored in the body and they are not excreted in urine. So, even excessive amount for a short period shows toxicity. Contrasts, water soluble vitamins being water soluble are readily excreted in urine by the kidneys. Therefore, massive amount of water-soluble vitamins for a long period is required to show toxicity. Hence, toxicity of fat-soluble vitamins occurs earlier than the water-soluble vitamins. The adverse effects are reversible in early case. Vitamins must be given with caution. Physician's role is marked in the prevention of these emergencies.

The doctors recommend the following points:

- 1- To consume most of our vitamins from diet, because this is the most healthy way to be safe.
- 2- Do not consume any vitamins supplements until you return to your physician and make a prescription.
- 3- Do not increase your prescribed dose written for you because this is the safest dose for your age, weight and body needs.

- 4- Do not take any supplementary vitamins if you take your sufficient amount of your vitamins from food.
- 5- If you -as a consumer- found any symptoms referring to toxicity signs so you must go to hospital immediately, especially if mental signs of hypervitaminosis A.

References:

- [1] America Association of Poison Control Centers 'National Poison Data System (2014). Annual Reports. Available at: <http://www.aapcc.org/annual-reports>. Accessed Oct 13, 2014.
- [2] G.Elango, D.D.Venkataraman, S. Venkata Rao and V.S. Ravi Kiran (2015). Hypervitaminosis. International Journal of Biomedical Research 2015; 6(03): 151-154.
- [3] JAMES B. MOWRY, PHARMD, DANIEL A. SPYKER (2014). 2014 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 32nd Annual Report. Clinical Toxicology (2015) 53(10): 962–1146. DOI: 10.3109/15563650.2015.1102927
- [4] Collins MD, Mao GE (1999). Teratology of retinoids. Annu Rev Pharmacol Toxicol. 1999;39:399-430
- [5] Perrotta S, Nobili B, Rossi F, et al (2002). Infant hypervitaminosis A causes severe anemia and thrombocytopenia: evidence of a retinol-dependent bone marrow cell growth inhibition. Blood 2002 Mar 15; 99(6):2017-22. DOI: 10.1182/blood.V99.6.2017
- [6] Bjelakovic G, Nikolova D, Gluud C (2014). Antioxidant supplements and mortality. Curr Opin Clin Nutr Metab Care. 2014Jan; 17(1):40-4. doi: 10.1097/MCO.000000000000009. .
- [7] Fritz H, Flower G, Weeks L, Cooley K, Callachan M, Mc Gowan J et al (2014). Intravenous Vitamin C and cancer: A Systemic review. Integr cancer Ther. May 26 2014; 13(4):280-300. (Medline).
- [8] Bjelakovic G, Gluud LL, Nikolova D, et al (2011). Vitamin D supplementation for prevention of mortality in adults. Cochrane Database Syst Rev. 2011 Jul 6;(7):CD007470. doi: 10.1002/14651858.CD007470.pub2
- [9] Bjelakovic G, Nikolova D, Gluud LL, et al, (2012). Antioxidant supplements for prevention of mortality in healthy participants and patients with various diseases. Cochrane Database Syst Rev. 2012 Mar 14; 3:CD007176. doi:10.1002/146518

[10] Hemila H, Chalker E (2013). Vitamin C for preventing and treating the common cold. Cochrane Database Syst Rev. 2013 Jan31; 1:CD000980. doi: 10.1002/14651858.CD000980.pub4.

[11] David Feldman, Srilatha Swami (2013). Vitamin D Toxicity, Hypercalcemia, and Hypercalciuria. Osteoporosis (Book, 4th edition). <https://doi.org/10.1016/C2011-1-04566-6>

[12] Frederick T. Fraunfelder (2008). Herbal medicine and dietary supplement induced ocular side effects. Clinical Ocular Toxicology,2008.