Vitamin Toxicity

Most people think vitamins are safe and cannot cause any harm; and in general, that is true. Water-soluble vitamins have no toxicity after an acute overdose because they are not stored in the body. Examples of such vitamins include: thiamine (B1), riboflavin (B2), cyanocobalamin (B12), pantothenic acid (B5), folic acid (B9), biotin (B7). This article will provide a rapid review of vitamins that can cause toxicity in overdoses and include vitamin C, niacin (vitamin B3), pyridoxine (vitamin B6), and fat-soluble vitamins (A, D, & E) because they can accumulate in the body.

Vitamin A
- Vitamin A is prescribed for dermatologic and ophthalmic conditions. Vitamin A toxicity often occurs in patients who continue to use the vitamin without medical supervision.
- Vitamin A is found in liver, fish, cheese, and whole milk. Vitamin A is present in two forms: preformed vitamin A (retinol) and pro-vitamin A (carotenoids) found in plants like (β-carotene).
- The recommended daily allowance (RDA) of vitamin A for an adult is 3000 IU/day (900 μg retinol/day) for men and 2300 IU/day (700 μg retinol/day) for women.
- Vitamin A is absorbed in the small intestine and excreted in the urine and feces.
- Acute ingestion of more than 12,000 IU/kg of preformed vitamin A (e.g., ingesting polar bear liver which occurred by previous explorers) is considered toxic and causes hepatotoxicity, non-cirrhotic portal hypertension, along with severe headaches, papilledema, and increased intracranial pressure.
- Chronic vitamin A toxicity is more common and happens after ingestion of more than 25,000 IU/d for 2–3 weeks.
- Chronic vitamin A toxicity causes dry skin, alopecia, and signs of increased intracranial pressure (headache, altered mental status, blurred vision [pseudotumor cerebri], and bulging fontanelles in infants).
• Ingestion of pro-vitamin A carotenoids does not cause vitamin A toxicity.

**Vitamin D**

• Vitamin D types: Ergocalciferol (vitamin D2) and Cholecalciferol (vitamin D3)
• The upper limit for daily vitamin D supply is 4000 IU/day (100 μg/day).
• Acute ingestion usually does not produce toxicity. Vitamin D doses of 50,000-600,000 IU (doses in milligrams) daily for prolonged periods may cause hypercalcemia by increasing calcium absorption from GI tract and mobilizing calcium from bone.

**Vitamin E**

• Vitamin E is an antioxidant. Vitamin E sources include non-animal products like nuts, wheat germ, whole grains, vegetable, soybean, corn, and their oils.
• Vitamin E is absorbed from the GI tract into the lymphatic circulation.
• Vitamin E side effects start to appear when daily doses exceed 400 IU/day (400 mg/day)
• High doses of vitamin E can cause nausea, headaches, and weakness.
• Vitamin E can also change vitamin K into its inactive form and can cause coagulopathy in patients taking warfarin.

**Vitamin C**

• Vitamin C is well absorbed in the upper ileum.
• Vitamin C is metabolized to oxalic acid which is renally excreted.
• Vitamin C is safe, even in high doses.
• In rare cases, chronic massive doses have been reported to cause high levels of oxalic acid which can result in nephropathy or acute renal failure.

**Niacin (nicotinic acid or vitamin B3)**

• Niacin is well absorbed from the GI tract and is renally excreted.
• Niacin is converted to nicotinamide adenine dinucleotide (NAD+) and nicotinamide adenine dinucleotide phosphate (NADP+), which are the physiologically active forms of this vitamin.
• Most common side effect from niacin use are cutaneous flushing and pruritus mediated by prostaglandin release 1 – 2 hours after ingestion. Niacin can also cause elevated liver enzymes if taken chronically in high doses 1-2 g/day which can lead to hepatic dysfunction.

**Pyridoxine (vitamin B6)**

• Pyridoxine (B6) deficiency is associated with seizures (e.g., INH use) because Vitamin B6 is required for the synthesis of γ-aminobutyric acid (GABA).
• Vitamin B6 toxicity affects the dorsal root ganglia causing ataxia, impairment of proprioception and vibratory sensation, paresthesia, peripheral neuropathy, and diminished reflexes.