نهى خليل ابراهيم الخطيب

جامعة تكريت/ كلية العلوم

دبلوم العالي تحليلات المرضية

Vitamin D and Hypoweight Child

Vitamin D

Vitamin D long recognized as the "sunshine vitamin", is an essential nutrient that has two major forms: D2 (ergocalciferol) and D3 (cholecalciferol). While sunlight is the dominant source of vitamin D, vitamin D can also be obtained from diet. There are only a few natural foods high in vitamin D. These include oily fish (salmon, trout, mackerel, etc.), cod liver oil, shiitake mushrooms, and to a lesser extent, egg yolk. Vitamin D is converted from 7- dehydrocholesterol to 25-hydroxyvitamin D3 when it is transported to the liver by a binding protein 25-hydroxyvitamin D is further converted to 1, 25(OH) 2D in the kidney as the final step in the activation of vitamin D. When there is not enough sun exposure, serum 25-hydroxyvitamin D decreases gradually, with a half-life of at least 2 months. The maximum number of days for serum levels of the [25(OH) D] metabolite after getting the highest sun exposure in the summer is about 30 – 60 days.

Source and Synthesis of Vitamin D

Vitamin D is a generic term for vitamin D2 (ergocalciferol), vitamin D3 (cholecalciferol), and their metabolites. Vitamin D2 is derived from the yeast and plant sterol, ergosterol, and is the form widely used in pharmaceutical preparations. Vitamin D3 is mainly produced from exposure to sunlight. Skin exposure to solar UV-B radiation is a

significant source of vitamin D. Because of the shorter atmospheric distance between the earth's surface and the sun (which is directly above the Equator) and the ozone layer being naturally thinner in areas close to the Equator (which make it easy to absorb UV radiation), the geographic regions around the Equator which include Middle Eastern countries have the greatest UV rays.

The enhanced fat solubility and decreased bioavailability of vitamin D produce low serum vitamin D levels with obesity. Exposing the skin to sunlight to absorb vitamin D is a major factor in increasing the body's circulating serum vitamin D. In addition, there are different factors that affect the amount of vitamin D synthesized by the skin through sunlight exposure such as individual, geographical and seasonal variations. The pathways of vitamin D synthesis are shown in figure (1).

Vitamin D Metabolism

Vitamin D is metabolized in the liver to 25-hydroxyvitamin D [25(OH)D], which is the major circulating and storage form that is delivered to tissue for further activation. This enzymatic process is poorly regulated, but seems to be of first order magnitude when the substrate concentration is low (serum vitamin D below 15 nmol/L, corresponding to 25(OH)D below 80-100 nmol/L), and zero order above (higher substrate concentrations. Thus, excess vitamin D3 has been widely believed to be sequestered and stored in adipose tissue, which also might explain a consistently described inverse relation between body mass index (BMI) and serum 25(OH)D. Some 25(OH)D is converted in the kidney to a biologically active hormonal form, 1,25-dihydroxyvitamin D [1,25(OH)2D]. A variety of factors, including serum phosphorus and PTH, regulate the renal production of 1,25(OH)2D. The 1,25(OH)2D

regulates calcium metabolism through its interaction with the major target tissues, the bone and the intestine .

Vitamin D concentration and parathyroid hormone (PTH) play important roles in calcium regulation. PTH secretion is mainly regulated by calcium. Low levels of calcium lead to increase PTH secretion. PTH regulates the serum calcium level by increasing calcium reabsorption in the kidneys and by increasing the release of calcium from the skeleton . The conversion of 25(OH)D to its active form 1,25(OH) 2D is also stimulated by PTH. An increase in 1,25(OH) 2D leads to increased calcium absorption in the gut, increased calcium resorption from bone and reduced excretion in the kidneys, which results in increased serum calcium .

2-10-3 Vitamin D Deficiency

Vitamin D deficiency is highly prevalent in the United States and worldwide . Although 1,25(OH)2D is the active form of vitamin D, its serum levels do not correlate with the overall vitamin D status and are generally not clinically useful . On the other hand, serum 25(OH)D concentrations reflect both vitamin D intake and endogenous production and are more reflective of an individual’s overall vitamin D status. Hence serum 25(OH)D levels are frequently used in clinical settings to assess vitamin D status. Although a consensus regarding the optimal level of serum 25(OH)D has not been established, most experts define 25(OH)D deficiency as a level

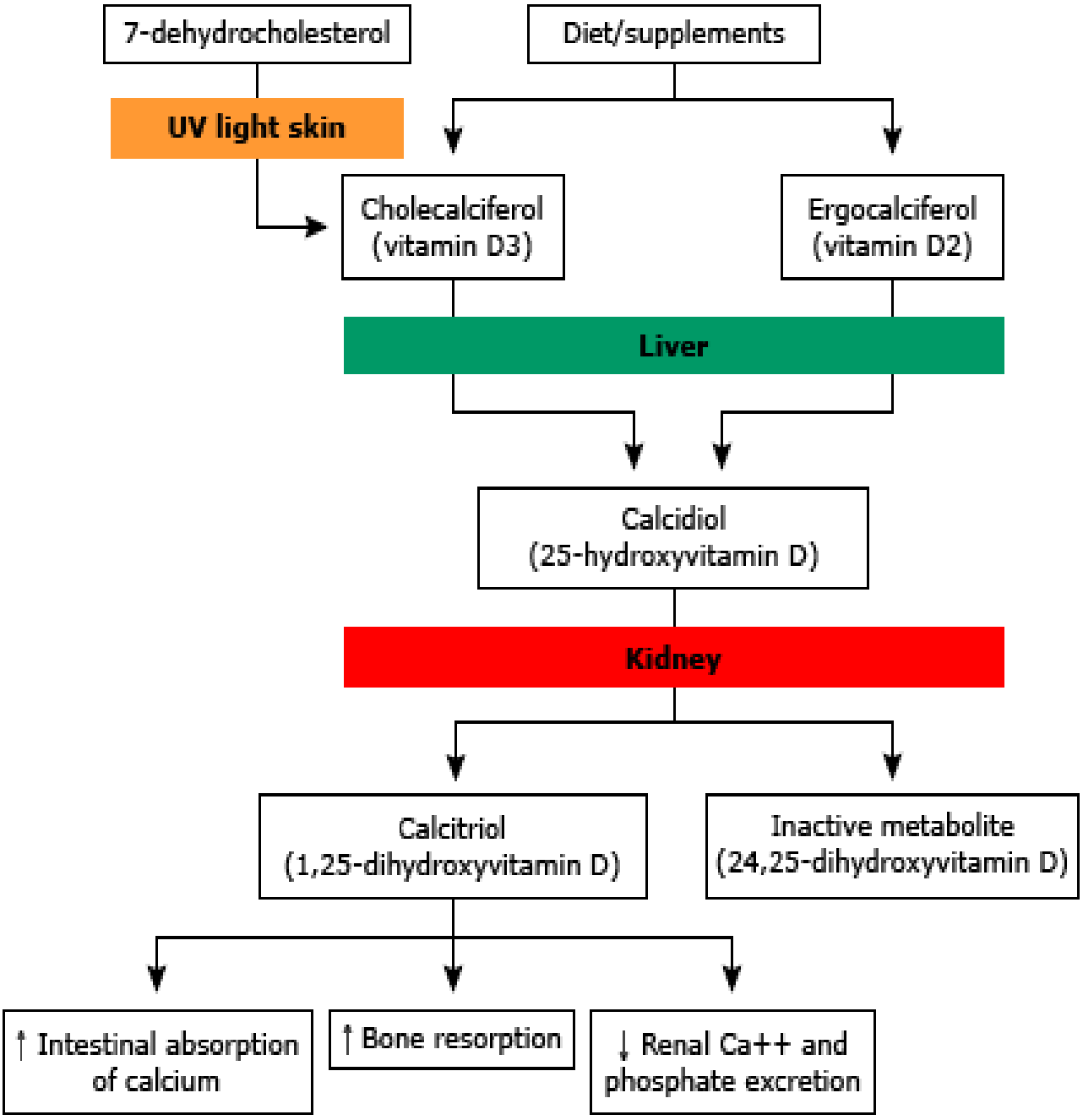

Figure (1) Vitamin D synthesis pathways

People who suffer from severe serum vitamin D deficiency experience some symptoms of numbness, paresthesia (abnormal or impaired skin sensation), muscle cramps, laryngospasm, tetany and seizures, while those with minor deficiency may complain from having muscle weakness or pain. In addition, a deficiency may cause rickets,

osteomalacia, osteoporosis, multiple fractures, and growth retardation , Other studies show that vitamin D deficiency is associated with several chronic diseases such as cancer, infection, asthma, and dermatopathies (skin problems of unknown etiologies) , insulin, resistance, diabetes and related microvascular complications and retinopathy . Vitamin D deficiency and the attendant secondary hyperparathyroidism cause defective mineralization of the bone matrix lain down by osteoblasts .

The 1,25(OH)2D plays a role in reducing the risk of developing common autoimmune diseases. The 1,25(OH)2D interacts with its VDR in immune cells and it is a potent immunomodulator.

Cardiac myocytes have cytosolic vitamin D receptors (VDR)4 that bind active vitamin D (1,25 dihydroxy vitamin D), but unlike vascular smooth muscle cells, cardiac myocytes lack 1α-hydroxylase activity , an enzyme that converts inactive vitamin D(25 hydroxy vitamin D) to active vitamin D. Hence cardiac muscle is strongly dependent upon circulating active vitamin D or calcitriol levels. In the past, several in vitro studies have shown that calcitriol regulates intracellular calcium metabolism and thus myocardial contractility . Consequently, 25(OH)D deficiency has been associated with aberrant cardiac contractility, cardiomegaly, and increased ventricular mass due to myocardial collagen deposition .

Tuberculosis

The standard TB medical therapy for decades in the pre-antibiotic era was based on rest in a sanatorium at an elevation where UV light was amply prevalent. In retrospect, this suggested a linkage between vitamin D status and the disease of TB. In the 1940s a high dose vitamin D supplementation was introduced for patients with TB. In the past decade epidemiological studies have linked inadequate vitamin D levels [low

serum concentrations of 25(OH)D] to a higher susceptibility of immune-mediated disorders, including chronic infections and autoimmune diseases. In 2006 new data supported a link between tuberculosis and vitamin D-deficiency as determined by the blood levels of 25(OH)D and by activation of the innate immunity system via production of antimicrobial peptides (AMPs) which can kill the Mycobacterium tuberculosis.

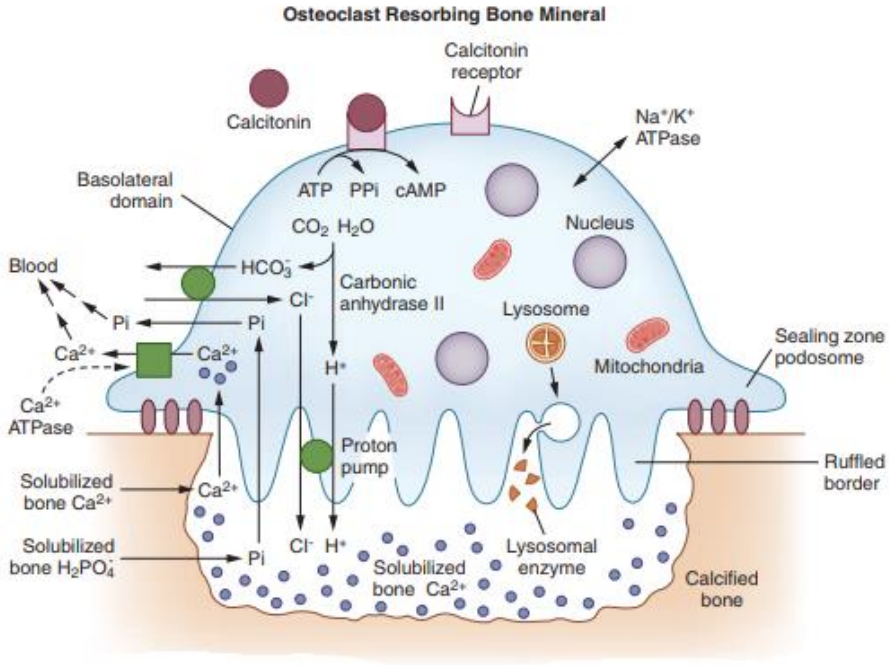

Figure (2) The Activities of an Osteoclast Schematic Illustration Vigorously Engaged in Bone Resorption.

Rickets

Bone growth is abnormally and irregular due to lack of vitamin D in children is called rickets caused by vitamin D deficiency during long periods of great growth in children and first discovered rickets is Mellanby in 1918. Craniotabes is the sign of rickets, where he discovered in children under 12 months of age as other areas are mostly in the skull

also perforation Ribs after six months of age because of bulging chest and cartilage endings of bone may be funnel-shaped, which may lead to an imbalance in breathing and when the child begins to skip it puts the weight of his body on the legs leading to curvature of the femur and knee and separations may lead to fractures sometimes also causes a lack of vitamin D in children lack teeth formation.

Osteomalacia

Bone defects term called in adult situations that result from a lack of vitamin D in addition to acute intestinal disturbances and renal hepatic, this occurs mainly in the elderly the most important clinical symptoms of osteoporosis Osteomalacia are structural pain and muscle weakness as the disease progresses Bone necrosis occurs may cause fractures and calcium and phosphate levels in the plasma is low and vulnerable groups that are least exposed to sunlight as in Canada and Northern Asia and Europe .