Review Article

Ophthalmic manifestations of nutritional deficiencies: A mini review

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Abstract

Balanced nutrition is crucial for a healthy eye and vision. Many nutritional deficiencies can result in vision impairment. This article reviews the ocular manifestations of vitamin deficiencies, including vitamin A, vitamin B1 and B12, vitamin C, vitamin D, and vitamin E, and minerals such as zinc. It discusses different ophthalmic symptoms and signs, including dry eye disease, corneal xerosis, decreased night vision, subconjunctival hemorrhage, and retinal changes similar to retinitis pigmentosa. We strongly recommend using multi-vitamin supplements for treating many diseases such as age-related macular degeneration.

Keywords: Nutritional deficiency, ocular symptoms, ophthalmology, vitamins

Introduction

It has been long understood that there is a link between nutritional deficiency and the overall health status of an individual.[1] The human body requires a wide variety of vitamins and minerals to function optimally. It was found that long-term health implications, which may be simple or complex, could be explained by nutritional deficiency, which raises the awareness toward better management. Nutritional deficiencies, including vitamins and minerals, can affect the whole body adversely. For instance, nutritional deficiencies in young children can drastically affect growth and development and result in rickets, obesity, iron deficiency anemia, coronary artery disease, iodine deficiency disorder, and many others.[1] Eyes might also be affected by any nutritional deficiency.[2] Therefore, ocular manifestations can be used as a clue raising the suspicion for secondary underlying systemic diseases such as malabsorption, inflammatory bowel diseases, and alcohol abuse as well.[3] Hence, understanding the background of nutritional health can navigate us more toward effective management of various ocular conditions. In this article, we reviewed different nutritional deficiencies that may manifest as ocular symptoms. These include deficiency of fat-soluble vitamins such as vitamin A, vitamin D, and vitamin E or water-soluble vitamins such as vitamin B1 (thiamine), vitamin B12, and vitamin C.[4]

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Ocular manifestations of vitamin A deficiency

Vitamin A deficiency could be presented as ocular manifestations, including corneal xerosis,[1] Bitot's spots,[1] or corneal ulceration.[2] In addition, vitamin A deficiency can result in decreased visual acuity (VA) or night blindness.[5] Venkataswamy *et al*.[5] showed that adding vitamin A into a diet completely resolves Bitot's spots and night blindness in children. Furthermore, the results

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showed that consuming vitamin A on a daily basis resulted in improvement of ocular symptoms.[5] Also, they recommended introducing screening tests as early as possible for neonates, which would eventually help in the prevention of the possible complications of nutritional deficiencies.[5]

Ocular manifestations of vitamin D deficiency

Brown *et al.*[6] showed that low vitamin D levels are associated with posterior subcapsular cataracts (PSCs). In addition, the study showed that vitamin D supplementation would decrease the risk of developing PSCs.[6] Moreover, vitamin D deficiency would cause dry eye disease by changing the osmolarity of the tear film, resulting in tear film dysfunction.[7]

Ocular manifestations of vitamin E deficiency

Vitamin E has a vital role in the vision process as it is crucial for rod photoreceptor membranes in order to provide the precise microenvironment for the proper function of the visual pigment rhodopsin.[8] Vitamin E deficiency may result in decreased night vision by causing retinal changes described as pigmentary degeneration similar to retinitis pigmentosa.[9]

Ocular manifestations of vitamin B1 deficiency

The eye might be affected by Wernicke's encephalopathy because of acute deficiency of thiamine (B1) vitamin.[10] This can occur under conditions of malnutrition such as chronic alcoholism. Other documented ocular signs include fatigue and paralysis of the external rectus muscles, paralysis of conjugate horizontal gaze, loss of visual acuity, and papilledema.[10] Nystagmus is one of the earliest helpful signs indicating that a patient may have Wernicke's encephalopathy.[10] Timely recognition of the ocular symptoms in Wernicke's encephalopathy can save from fatal outcomes.

Ocular manifestations of vitamin B12 deficiency

Vitamin B12 is an essential vitamin for hematological and neurological functions.[11] Cyanocobalamin, a form of vitamin B12, is an essential mediator of some enzymatic reactions in humans, including converting methyl malonyl-coenzyme A to succinyl coenzyme A and the conversion of homocysteine to methionine.[11] Vitamin B12 deficiency may impair succinyl-CoA synthesis, which can result in optic neuropathy and dry eye disease.[11]

Ocular manifestations of vitamin C deficiency

Vitamin C deficiency also may involve the eyes.[12] Risk factors that may result in vitamin C deficiency include a poor diet, alcoholism, anorexia, smoking, and dialysis.[12] Ocular symptoms of vitamin C deficiency include dry eyes, scleral icterus, and subconjunctival hemorrhage.[12]

Ocular manifestations of zinc deficiency

Studies showed that zinc has a fundamental role in light photodynamics.[13] Zinc interacts with taurine and vitamin A in the retina modifying plasma membranes of the photoreceptors, which regulates the light-rhodopsin reaction within the photoreceptors and modulates synaptic transmission.[13] Furthermore, many pieces of research revealed that zinc has neurodegenerative implications over eyes.[13] Carmody *et al.*[14] reported that zinc chloride deficiency could result in apoptotic photoreceptor death in an *in vitro* model of retinitis pigmentosa.

Ocular manifestations of malabsorption

Fousekis's review suggested a relation between celiac disease and ocular manifestation onset.[15] Celiac disease is one of the leading causes of fat-soluble vitamin malabsorption, which can be presented as ocular signs and symptoms. Reported ocular manifestations include occipital calcifications causing impaired vision, uveitis, and dry eye disease.[15] In addition, central retinal vein occlusion can be the first presentation of celiac disease. These ocular signs could help in establishing the diagnosis earlier; thus, better care can be received.[15]

Take-home messages

1. Ocular manifestations could be a sign of underlying nutritional deficiencies such as vitamin A, B1, B12, C, D, and E.
2. Using nutritional supplements such as multi-vitamin tablets may help in addressing ocular symptoms and complaints. For instance, a zinc supplement would help in reducing age-related macular degeneration severity.
3. Many systemic diseases such as celiac disease, Wernicke's encephalopathy, and inflammatory bowel disease may present initially as ocular symptoms or signs. Knowing this would navigate the management plan as fast as possible and help in better care delivery for patients by the primary care physicians.

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Conflicts of interest

There are no conflicts of interest.

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