http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v7i7.148

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Selenium in Dermatology

Authors
Aditi Sharma[1], Himang Jharaik[2*], Rajni Sharma[3]
[1]Dermatology Department, Civil Hospital Theog, Ditrict Shimla 171201 Himachal Pradesh, India
[2*]Obstetrics and Gynecology, Department, Civil Hospital, Theog, District Shimla 171201 Himachal Pradesh, India
[3]Indira Gandhi Medical College Department of Dermatology Shimla 171001, Himachal Pradesh, India
*Corresponding Author
Himang Jharaik
Obstetrics Deptt, Civil Hospital Theog, District Shimla 171201. Himachal Pradesh, India

Abstract
Selenium is a trace element that is present in many foods and is available as a dietary supplement. It is essential for humans and is a constituent of seleno-proteins that plays critical role in protection from oxidative damage and DNA synthesis. Skin diseases due to selenium deficiency, its role in skin immunity and other disorders have been reviewed.
Keywords: *Selenium, micronutrients, antioxidants.*

Micronutrients, are chemical elements or substances required in trace amount for the normal growth and development of living organisms. Many of them are necessary for providing energy, building and maintaining body organs, and for various metabolic processes. **Antioxidants** are molecules capable of inhibiting the oxidation of other molecules. They are of two types; (a) Enzymatic antioxidants and (b) Non enzymatic antioxidants. Glutathione peroxidase, catalase are enzymatic antioxidants whereas carotenoids, bilirubin, glutathione, α-lipoic acid, vitamin E, vitamin C and uric acid etc. are non-enzymatic. Antioxidants perform numerous functions and thus have beneficial effects. In the skin, antioxidant molecules such as glutathione, vitamin E, and vitamin C interact with the reactive oxygen species (ROS) or their by-products to either eliminate them or to minimize their deleterious effects and thus boost our immune system. Certain phyto-chemicals have beneficial effects on heart diseases by lowering the level of LDL cholesterol. They are beneficial in cancer prevention by neutralizing the substances that can damage the genetic material by oxidation.

Selenium is an essential trace element and is proved to be an antioxidant responsible for tissue elasticity. It acts in two ways to prevent damage to the body from free radical (a) it is incorporated into proteins to form seleno-proteins which acts as antioxidant (b) it helps body to manufacture its own antioxidant glutathione. It is an essential constituent of the enzyme glutathione peroxidase, which in the presence of reduced glutathione, breaks down, damaging the reactive peroxides. Dietary sources of selenium are wheat germ,

seafood such as tuna and salmon, garlic, Brazil nuts, eggs, brown rice, and whole-wheat bread. The recommended intake is 50-200 µg per day and the average British diet contains 60 µg of selenium per day. Selenium is well absorbed and in normal circumstances 55-60% is excreted in urine and the rest in faeces. The associated skin signs of its deficiency include hypopigmentation of the skin and hair, and whitening of the nails. It may play an important role in preventing skin cancer, by protecting the skin from damage from excessive ultraviolet light.[1] The deficiency of selenium reduces the activity of the selenium-dependent enzyme glutathione peroxidase (GSH-Px). A reduction in GSH-Px activity leads accumulation of hydroxyl radicals. The adverse effects due to selenium deficiency can be lessened by vitamin E.[2]

Selenium deficiency

The following groups are among those most likely to have inadequate intakes of selenium. People living in selenium-deficient areas People in some countries whose diet consists primarily of vegetables grown in low-selenium areas are at risk of deficiency. The lowest selenium intakes in the world are in certain parts of China, where large proportions of the population have a primarily vegetarian diet and soil selenium levels are very low. Similarly average selenium intakes are also low in some European countries, especially among populations consuming vegan diets.[3]

People undergoing kidney dialysis

Selenium levels are significantly lower in patients undergoing long-term haemodialysis as hemodialysis removes some amount of selenium from the blood, in addition, haemodialysis patients are at risk of low dietary selenium intakes due to anorexia resulting from uremia and dietary restrictions. Although selenium supplementation increases blood levels in haemodialysis patients, more evidence is needed to determine whether supplements have beneficial clinical effects in these individuals.[4]

People living with HIV

Selenium levels are often low in people living with HIV, possibly because of inadequate intakes, excessive losses due to diarrhoea, and malabsorption. Observational studies have found an association between lower selenium concentrations in people with HIV and an increased risk of cardiomyopathy, death, and, in pregnant women, HIV transmission to offspring and early death of offspring.[5,6]

Selenium and total parentral nutrition

The possibility of selenium deficiency should always be considered in malnourished patients who receive parenteral nutrition, even for a limited period and despite supplementation with trace elements. Selenium status should be monitored in all such patients with serum selenium levels and erythrocyte glutathione peroxidise activity measured at initiation of intravenous feeding. Patients with borderline or low selenium status should receive supra-normal trace element supplementation. Enzyme activity and serum selenium should be checked after initiation of parenteral nutrition to ensure adequate replacement.[7]

Selenium in various dermatological conditions

Selenium in Psoriasis

Psoriasis is a common, chronic, immune mediated, inflammatory disease of the skin, and is characterized by production of reactive oxygen species due to the activation of tumor necrosis factor alpha (TNF-α), which is thought to be an important factor in inducing and maintaining psoriatic lesions. Oxidative stress and production of oxygen radicals are involved in the pathogenesis of ultraviolet light-induced inflammation. Reduced concentrations of selenium along with reduced red cell GSH-Px have been found in whole blood, plasma and white cell in patients with psoriasis.[2] Antioxidants such as vitamin C, vitamin E, β-carotene and selenium are helpful to prevent an imbalance of oxidative stress and antioxidant defence in

psoriasis.[8] By changing the expression of cytokines and their receptors selenium influence immune response or it makes immune cells more resistant to oxidative stress. It was reported that selenium supplementation had inhibitory effects on TNF-α levels in patients with psoriasis, selenium compounds are also known to prevent the in vitro release of UVB-induced pro-inflammatory cytokines by inhibition of mRNA in human keratinocytes. Fairris et al. reported that after 12 weeks supplementation of selenium and vitamin E, the patients mean whole blood, plasma and platelet selenium concentrations, platelet GSH-Px activity and plasma vitamin E concentration had risen significantly from the baseline values but their mean skin selenium concentration and red cell GSH-Px activity remained unchanged. The mean white cell selenium concentration rose only in the group receiving selenium alone. Neither supplementation regimen reduced the severity of psoriasis or produced side-effects.[2]

Selenium in eczema

Concentrations of selenium in whole blood, plasma and leucocytes were found to be significantly reduced in patients of eczema similar to patients of psoriasis in a study by Hinks et al. These finding were in relation to the effect of free radicals on skin.[9]

Selenium in alopecia areata

Alopecia areata (AA) is an immune mediated disease that affects the genetically predisposed individuals. Oxidative stress and apoptosis are the key mechanisms involved in the pathogenesis. Selenium (Se), an essential trace element, has an immunomodulatory effect mainly by stimulating the high-affinity interleukin 2 receptor on activated T lymphocytes and natural killer cells, leading to their clonal expansion and differentiation into cytotoxic T lymphocytes, thereby preventing oxidative stress induced damage to immune cells. Tahlawi et al. reported, the significantly lower serum Se levels in patients with AA in comparison to control group and suggested that the low Se levels in the serum of patients with AA can be attributed to the inflammatory character of AA. A greater decrease was found in the more severe forms in comparison to mild form of AA in the same study. In a similar study, Eken et al. reported the elevated risks of AA in patients with low levels of blood Se, and this was also explained by the anti-inflammatory role of Se.[10]

Selenium and the nails

Nails are an important aspect of the external appearance, they also act as mirrors of the internal constitution and nutritional status. Leukonychia; leuko (white), onyx (nail) is divided into 2 major types: true leukonychia, which involves the nail plate, and apparent leukonychia, which involves the nail bed.[11] A significant positive correlation between plasma selenium levels and nail has been found in various studies. The deficiency is seen in patients on prolonged total parenteral nutrition (TPN). There are reports of cases where the fingernails turned white in association with low serum and urinary selenium levels and the changes resolved dramatically after selenium therapy was instituted.[12] A patient with true leukonychia in association with Crohn disease as well as selenium deficiency was reported by Hasunuma et al.[11]

Selenium in various non-dermatological conditions

Selenium and Rheumatoid Arthritis

Recently, low levels of serum Se were reported in patients with inflammatory diseases such as rheumatoid arthritis. Significant correlation was found between serum selenium and the number of joints with limitation of motion, number of joints with active arthritis, haemoglobin concentration and IgG concentration however, no correlation was found between serum selenium and disease duration, morning stiffness, ESR, C-reactive protein, rheumatoid factor titre, serum albumin, IgM and IgA. Selenium, is an essential constituent

of the enzyme glutathione peroxidase, that catabolizes peroxides which are suggested to be actively involved in inflammation. A low selenium level is one of the factors in the pathogenesis of rheumatoid arthritis.[13]

Selenium and Crohn's disease

Trace element deficiency is caused by reduced intake, decreased absorption, or increased loss. Deficiency of copper and zinc seems most likely to occur when extensive disease is present, however selenium seems to be reduced in patients with relatively stable disease. Reduced concentrations of selenium were observed in whole blood, plasma, and leucocytes in the patients of Crohn's disease whether or not they were receiving steroids. Jacobson et al reported low plasma and erythrocyte selenium concentrations in Crohn's disease, although these patients were with severe disease about to undergo preoperative total parenteral nutrition.[14] Further investigations are required to know more about the clinical importance of lowered selenium concentrations in these patients.

Selenium and cardiomyopathy

Selenium deficiency is well documented to cause cardiac disease both endemically as Keshan disease, and in patients receiving long-term intravenous feeding. It has been found that In cattle combined vitamin E and selenium deficiencies can induce preferential degeneration and necrosis within the cardiac conducting system. Selenium deficiency is endemic in regions of China and it causes a dilated cardiomyopathy known as Keshan disease which can be prevented by selenium supplementation. Similarly myocardial impairment and arrhythmias manifesting as ventricular tachycardia and fibrillation have been associated with selenium deficiency in the setting of long-term parenteral nutrition.[7]

Selenium and Cognitive Decline

As serum selenium concentrations decreases with age, marginal or deficient selenium concentrations might be associated with age-related declines in brain function, possibly due to decreases in selenium's antioxidant activity. However the results of observational studies are mixed. In two large studies, participants with lower plasma selenium levels at baseline were more likely to experience cognitive decline over time whereas an analysis of NHANES data on 4,809 elderly people in the United States found no association between serum selenium levels (which ranged from lower than 11.3 to higher than 13.5 mcg/dL) and memory test scores.[15,16]

Selenium and Thyroid disease

Selenium concentration is higher in the thyroid gland than in any other organ in the body, and, like iodine, selenium has important functions in thyroid hormone synthesis and metabolism. Epidemiological evidence supporting a relationship between selenium levels and thyroid gland function includes an analysis of data on 1,900 participants in a study reported an inverse relationship between serum selenium concentrations and thyroid volume, risk of goiter, and risk of thyroid tissue damage in people with mild iodine deficiency.[17]

Selenium and Cancer

Because of the effects of selenium on DNA repair, apoptosis, and the endocrine and immune systems as well as other mechanisms, including its antioxidant properties, selenium might play a role in the prevention of cancer. Epidemiological studies have suggested an inverse association have been suggested between selenium status and the risk of colorectal, prostate, lung, bladder, skin, esophageal, and gastric cancers in various epidemiological studies.[18,19,20]

Selenium toxicity

Selenium toxicity occurs with acute or chronic ingestion of excess selenium. The symptoms of

selenium toxicity include nausea; vomiting; discoloration, brittleness, and loss of nails; hair loss; fatigue; irritability; and foul breath often described as "garlic breath". Selenium is found in the soil, soils of certain areas such as Great Plains, western United States have high concentrations of selenium, which are taken up by plants. Henceforth, chronic selenium toxicity was endemic in parts of China. Outbreaks of acute selenium poisoning are rare, but have been reported; last occurred in 1983 and involved 12 persons who had consumed inappropriately potent selenium tablets as a dietary supplement. A single case of selenium poisoning in 1996 was attributed to elevated amounts of selenium in vitamins. Occasionally cases of acute selenium poisoning caused by unintentional or suicidal ingestion have been reported. Excessive amounts of selenium commonly cause gastrointestinal effects which manifests as diarrhoea and vomiting. Its subsequent distribution into musculoskeletal tissues has been reported to cause muscle pain and cramps as well as joint pain. No proven antidotes or curative treatments are available for selenosis. Stopping the exposure and providing supportive care for symptoms is the only available treatment.[21]

Interactions with Medications

Selenium can interact with medications, and some medications can have an adverse effect on selenium levels. Cisplatin, an inorganic platinum chemotherapy agent, is used to treat various malignancies can reduce selenium levels in hair and serum but whether these reductions have a clinically significant impact is not known. Some small studies have shown that selenium supplementation can reduce cisplatin's toxicity however the authors of a Cochrane review concluded that the evidence that selenium supplementation alleviates the side effects of chemotherapy is insufficient.[22, 23,24,25]

Conclusion

Selenium is an essential micronutrient and is important for life. It is responsible for tissue elasticity and is amongst the important antioxidants. There has been a surge of interest in selenium due to its anti-carcinogenic, anti-inflammatory and antioxidant properties. Selenium seems to prevent the production of immunosuppressive cytokines, thus increasing both humoral and cellular immunity. Few reviews have associated adequate selenium levels to the prevention of cancers, cardiovascular and autoimmune diseases. However further studies are required to know its exact role in health and various disease states.

Bibliography

1. Basavaraj K H, Seemanthini C, Rashmi R. Diet in dermatology: present perspectives. Indian J Dermatol 2010;55:205-10.
2. Fairris G M, Lloyd B, Hinks L, Perkins P J, Clayton B E. The effect of supplementation with selenium and vitamin E in psoriasis. Ann C in Biochem 1989; 26: 83-8.
3. Sunde RA. Selenium. In: Coates PM, Betz JM, Blackman MR, et al., eds. Encyclopedia of Dietary Supplements. 2nd ed. London and New York: Informa Healthcare; 2010:711-8.
4. Tonelli M, Wiebe N, Hemmelgarn B, Klarenbach S, Field C, Manns B, et al. Trace elements in hemodialysis patients: a systematic review and meta-analysis. BMC Med 2009;7:25.
5. Burbano X, Miguez-Burbano MJ, McCollister K, Zhang G, Rodriguez A, Ruiz P, et al. Impact of a selenium chemoprevention clinical trial on hospital admissions of HIV-infected participants. HIV Clin Trials 2002;3:483-91.
6. Hurwitz BE, Klaus JR, Llabre MM, Gonzalez A, Lawrence PJ, Maher KJ, et al. Suppression of human immunodeficiency virus type 1 viral load with selenium supplementation: a randomized controlled trial. Arch Intern Med 2007;167:148-54.
7. Levy JB, Jones HW and Gordon AC. Selenium deficiency, reversible

cardiomyopathy and short-term intravenous feeding. Postgrad Med J 1994; 70: 235 -6.
8. Kaimal S, Thappa DM. Diet in dermatology: Revisited. Indian J Dermatol Venereol Leprol 2010;76:103-15.
9. Hinks LJ, Young S, Clayton B. Trace element status in eczema and psoriasis. Clinical aaand experimental dematol 1987;12:93-7.
10. Samar M. R. El-Tahlawia, Amany Z. El-Ramlya, Eman El-Nabarawya, Nagwa Abd El-Ghaffarb, Hanaa Emamc and Maha M.S. Husseinc. Serum selenium levels in alopecia areata. J Egypt Women Dermatol 2012;9:174–7.
11. Hasunuma N, Umebayashi Y, Manabe M. True Leukonychia in Crohn Disease Induced by Selenium Deficiency. JAMA Dermatol 2014;150:779-80.
12. Seshadri D, De D. Nails in nutritional deficiencies. Indian J Dermatol Venereol Leprol 2012;78:237-41.
13. Tarp U, Overvad K, Hansen JC, Thorling EB. Low selenium level in severe rheumatoid arthritis. Scand J Rheumatol 1985;1:97-101
14. L J, Inwards K D, Lloyd B, Clayton B. Reduced concentrations of selenium in mild Crohn's disease. J Clin Pathol 1988;41:198-201.
15. Akbaraly TN, Hininger-Favier I, Carriere I, Arnaud J, Gourlet V, Roussel AM, et al. Plasma selenium over time and cognitive decline in the elderly. Epidemiology 2007;18:52-8.
16. Shahar A, Patel KV, Semba RD, Bandinelli S, Shahar DR, Ferrucci L, et al. Plasma selenium is positively related to performance in neurological tasks assessing coordination and motor speed. Mov Disord 2010;25:1909-15.
17. Derumeaux H, Valeix P, Castetbon K, Bensimon M, Boutron-Ruault MC, Arnaud J, Hercberg S. Association of selenium with thyroid volume and echostructure in 35- to 60-year-old French adults. Eur J Endocrinol 2003;148:309-15.
18. Allen NE, Appleby PN, Roddam AW, Tjonneland A, Johnsen NF, Overvad K, et al. Plasma selenium concentration and prostate cancer risk: results from the European Prospective Investigation into Cancer and Nutrition (EPIC). Am J Clin Nutr 2008;88:1567-75.
19. Combs GF, Jr and Gray WP. Chemopreventive agents: Selenium. Pharmacol Ther 1998; 79:179-92.
20. Dennert G, Zwahlen M, Brinkman M, Vinceti M, Zeegers MP, Horneber M. Selenium for preventing cancer. Cochrane Database Syst Rev 2011:CD005195.
21. Jennifer K. Farquhar M,. Broussard DL, Melstrom P, Hutchinson R, Wolkin A, , Martin C et al. Acute Selenium Toxicity Associated With a Dietary Supplement Intern Med. 2010;170: 256-61.
22. Sieja K, Talerczyk M. Selenium as an element in the treatment of ovarian cancer in women receiving chemotherapy. Gynecol Oncol 2004;93:320-7. [PubMed abstract]
23. Vernie LN, de Goeij JJ, Zegers C, de Vries M, Baldew GS, McVie JG. Cisplatin-induced changes of selenium levels and glutathione peroxidase activities in blood of testis tumor patients. Cancer Lett 1988;40:83-91. [PubMed abstract]
24. Hu YJ, Chen Y, Zhang YQ, Zhou MZ, Song XM, Zhang BZ, et al. The protective role of selenium on the toxicity of cisplatin-contained chemotherapy regimen in cancer patients. Biol Trace Elem Res 1997;56:331-41. [PubMed abstract]
25. Dennert G, Horneber M. Selenium for alleviating the side effects of chemotherapy, radiotherapy and surgery in cancer patients. Cochrane Database Syst Rev 2006:CD005037.