

Therapeutic and Preventive Efficacy of Vitamins in the Treatment of Intoxication Cases

Said Said Elshama*

Department of Forensic Medicine and Clinical Toxicology, College of Medicine, Suez Canal University - Taif University, Ismailia City, Egypt

Abstract

It is known that vitamins play a key role in many physiological processes in the human body such as metabolism and immunity. Several of the recent studies revealed that a number of vitamins may use as an alternative or adjuvant therapy or preventive agent in the numerous cases of drugs and chemicals intoxication. Vitamins C, E, and A were known to possess antioxidant properties and various studies indicated that these vitamins have the ability to scavenge the reactive oxygen species generated in the body due to toxicant exposure. In addition, few of the findings proved the potential and clinical utility of vitamins B and D in treating the cases of toxicity.

Keywords: Intoxication; Vitamins; Treatment; Prevention

Introduction

Vitamins have an important role in the body functions to promote human health wherein they play a key role in the metabolism, immunity, and digestion. There are essential vitamins such as A, C, D, E, K and B that are necessary as daily dietary supplements for the growth and development of the body systems [1]. Vitamins A and C are essential for the immune system while vitamin B12 is required for the red blood cell formation and the neurological function. Vitamin D is important for bone growth while vitamin E acts as a protector of the body cells from the damage and promotes the mental function. Vitamin K is essential for healthy bones, blood clotting and other body functions [2].

In spite of the essential need of the human body for vitamins, vitamins poisoning become a clinical problem may face the physicians. Fat soluble vitamins are potentially toxic because it can be stored in the body by the high toxic levels through high vitamins overdoses such as vitamins A, E, D, and K. Vitamin toxicity is usually not from the dietary intake but it is considered a malpractice issue [3].

In another view, many published articles revealed that a number of vitamins may use as curative or protective agents to treat and prevent the toxicity of many drugs and chemicals. Therefore, this article tries to present an overview of the use of vitamins as an alternative or adjuvant therapy in treatment or prevention the toxicity of some toxic agents.

Vitamin C (Ascorbic Acid)

Vitamin C is considered as an antioxidant agent that captures the reactive oxygen species (ROS) which are produced by a normal metabolic respiration [4]. It was used in much research as a curative or preventive agent to modulate or attenuate the resulting toxicity from drugs or chemicals that affect many systems and organs such as liver, kidney, and testes. It was used individually or in a combination as an adjunctive or complementary agent based on its antioxidant activity.

Many research proved that vitamin C may provide a hepatoprotection against different toxic agents induced hepatotoxicity. Mohsenikia et al. [5] suggested that the individual administration of vitamin C can exert a prophylactic effect on cyclosporine A-induced hepatic toxicity while Osman et al. [6] referred to the role of vitamin C as an antioxidant on modulation the hepatotoxicity of chronic use of monosodium glutamate. In the same context, Layachi and Kechrid [7] indicated that concurrent use of vitamins C and E can do a protective effect on cadmium-induced oxidative liver damage while Magdy et

al. [8] showed that the combination of vitamins C and E have also an ability to improve hepatic and renal functions via amelioration the oxidative stress that results from toxicity of macrocyclic lactone insecticide (abamectin).

Moreover, Cekic et al. [9] proved that treatment via vitamin C may retrieve the cellular glutathione content in thymocytes that was depleted as a consequence of amiodarone toxicity. On the other hand, Paunović et al. [10] suggested that the combined administration of vitamin C and quercetin is haematoprotective against nicotine-induced toxicity and then it may be useful as a supportive therapy for the tobacco smokers who are exposed to nicotine. In addition to, Ekaluo et al. [11] indicated that the attenuating role of vitamin c on the toxicity of the male reproductive system and sperm that were induced by monosodium glutamate.

According to the study of Suresh et al. [12] Co-administration of ethanol and vitamin C can protect against ethanol-induced toxicity via enhancing the scavenging enzymes that reduce the lipid peroxidation beside an improvement in the liver function tests and triglycerides levels. Later, Ahmadizadeh et al. [13] proved that the ability of vitamin C to prevent the toxicity of another organic solvent such as styrene wherein it can prevent hepatotoxicity and nephrotoxicity of styrene by decreasing all hepatic and renal biochemical parameters significantly.

Furthermore, Huq et al. [14] indicated also that administration of vitamin C alone or in a combination with vitamin E has a protective role against the harmful effects of heavy metal poisoning such as mercury. In the related context, Muthu and Krishnamoorthy [15] showed the antioxidant effects of vitamin C and E wherein they can improve the levels of antioxidant enzymes in the testicular tissues that are reduced as a result of mercuric chloride toxicity.

*Corresponding author: Elshama SS, Department of Forensic Medicine and Clinical Toxicology, College of Medicine, Suez Canal University, Ismailia City, Egypt; E-mail: saidelshama@yahoo.com

Received October 22, 2018; Accepted October 14, 2018; Published October 21, 2018

Citation: Elshama SS (2018) Therapeutic and Preventive Efficacy of Vitamins in the Treatment of Intoxication Cases. World J Pharmacol Toxicol 2: 105.

Copyright: © 2018 Elshama SS. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Finally and For example but not limited to, there are many studies that were conducted to investigate the role and efficacy of vitamin C in the treatment or prevention of the toxicity of different agents. Some of these studies were carried out on the drugs intoxication such as the study of El-Ridi and Rahmy [16] who indicated that the highest dose of vitamin C protects against hepatorenal toxicity that is induced by acetaminophen overdose while Beata et al. [17] showed that vitamin C can suppress the platelets oxidative stress that is caused by cisplatin toxicity. In addition, Uboh et al. [18] reported that vitamin C is also able to ameliorate or prevent the toxicity effect of gasoline vapor on the female reproductive function.

Vitamin E (Alpha Tocopherol)

Alpha-tocopherol is considered the most common and biologically active form of vitamin E that can interrupt the free radical chain reactions via capturing the free radical showing its antioxidant effect. Vitamin E is considered a powerful lipophilic antioxidant because it is one of the most potent lipid soluble free radical scavengers that limit the lipid peroxidation which is initiated by the free radicals [19].

In the last years, insecticides have been extensively used in the world especially the developing countries. So, the prolonged environmental and occupational exposure of insecticides represents a major health problem that causes an oxidative stress leading to the serious health hazards to human beings. Recently, a lot of studies proved that the efficacy of vitamin E as a therapeutic or protective agent that can ameliorate the toxicity manifestations (oxidative damage) of a number of insecticides. Olsvik et al. [20] showed that vitamin E can modify chlorpyrifos toxicity wherein vitamin E supplementation may protect cells against chlorpyrifos-induced toxicity via restoring the dipeptide levels, preventing the lipids accumulation and modifying carbohydrate metabolism. Moreover, Elblehi et al. [21] proved that the concurrent administration of vitamin E and selenium can improve cypermethrin-induced oxidative damage and toxicity; they alleviate the detrimental effects of cypermethrin on the liver, kidney, brain, and heart depending on scavenging the reactive oxygen species.

In addition, Halvaei et al. [22] investigated the therapeutic effect of vitamin E in acute aluminum phosphide poisoning and proved its efficacy as a novel treatment for this type of poisoning. Furthermore, Nagda et al. [23] showed the preventive role of vitamin E wherein the supplementation of diet with vitamin E for the exposed workers to endosulfan can minimize its toxicity.

In the related context, Zaahkouk et al. [24] referred that administration of vitamin E or vitamin A alleviate the toxic effect of carbamate on biochemical parameters and different organs such as heart, kidney, and liver wherein the antioxidant property of vitamin E and vitamin A is responsible for the protection against carbamate intoxication.

In another context, many research indicated to the use of vitamin E in treating or preventing the toxicity of some chemotherapeutic agents that are used as a cancer treatment. According to Mufazalova et al. [25] the concurrent use of vitamin E and T-activin can modify the hematologic toxicity of cyclophosphamide and prevent the suppression of hemopoiesis without any effect on the efficacy of cyclophosphamide.

Vitamin E has also a protective role in heavy metals toxicity that induces reactive oxygen species causing an imbalance between pro-oxidant and antioxidant homeostasis (oxidative stress). Individual or combined administration of vitamin E provides a nephroprotective and

hepatoprotective role by reducing the blood biomarkers levels which are the signs of heavy metal toxicity [26,27].

Finally, Gawad et al. [28] recommended giving vitamin E concomitantly with amiodarone to reduce its pulmonary toxicity while the study of Oyeyemi et al. [29] demonstrated that vitamin E supplementation with nicotine may ameliorate the deleterious effect of nicotine on male reproductive hormones and sperm indices. In another context, Alpsoy et al. [30] showed that vitamin E, A, and C can exert protective effects in human lymphocytes against the reactive oxygen species generation that are induced via aflatoxin B1.

Vitamin B

In the previous years, some research was also carried out on vitamin B to explore its role in the treatment of toxicity. Several years ago, Bratton et al. [31] indicated that the therapeutic dose of thiamin B1 is useful in treating or preventing the lead poisoning wherein vitamin B1 prevents the lead deposition in the soft tissues such as kidney, liver, central and peripheral nervous system. Additionally, Khan et al. [32] reported also that vitamin B-complex has a protective and curative effect in lead toxicity because it can normalize the levels of haematological and biochemical parameters that are altered due to the lead intoxication.

Moreover, Amagon et al. [33] showed that vitamin B-complex and methionine combination can modulate hepatic, renal, hematological, antioxidant indices and other toxic effects that are observed in the patients who are exposed to antitubercular drugs leading to an improvement in the treatment outcome of tuberculosis patients.

Vitamin D and A

Until now, a few numbers of the published articles that investigated the efficacy of vitamin D and vitamin A in the treatment of toxicity in spite of their known antioxidants properties. For example, the study of Zhang et al. [34] who reported that vitamin D may have a role for prevention the side toxic effects of chemotherapy such as bleomycin. So, vitamin D attenuates bleomycin-induced pulmonary fibrosis via delaying or suppressing ultrastructural changes as well as inhibiting the myfibroblastic proliferation. In another context, Elshama et al. [35] conducted a study on the role of vitamin A as a treatment for the intoxication and showed that vitamin A has a protective effect in the modulation of hypervitaminosis D3 short-term toxicity without depending on its antioxidant effect.

Vitamins as Antidotes

Antidotes play an important role in clinical toxicology because of their ability to lessen the severity of toxicity or shorten its duration; they are life-saving agents increasing the chances of the intoxicated patient recovery and improve his prognosis [36]. Some vitamins are well-established antidotes in the treatment of some poisoning cases. Vitamin B1 (Thiamine) is a necessary antidote in the cases of acute alcohol intoxication and Wernicke's encephalopathy syndrome [37] while vitamin B6 (Pyridoxine) is considered the only antidote for isoniazid toxicity [38]. Furthermore, vitamin B12 (Hydroxocobalamin) is well-known cyanide antidote; it is used to treat the cyanide intoxicated cases without compromising the oxygen-carrying capacity of hemoglobin wherein it binds with cyanide to form a non-toxic cyanocobalamin [39]. In addition, vitamin C is recommended as an antidote in the cases of methemoglobinemia wherein it can reduce the methemoglobin formation at a high dose administration [40]. In the related context, vitamin K1 (Phytonadione) is utilized as an antidote to warfarin toxicity (vitamin K antagonists) and other warfarin-like compounds such as

anticoagulant rodenticides wherein warfarin intoxication cause vitamin K deficiency leading to a lack of clotting factors and the increased risk of severe bleeding [41].

Conclusion

Many research revealed that a number of vitamins may use as curative or protective agents for the numerous cases of drugs and chemicals intoxication. Vitamins A, C, and E are considered antioxidant agents that capture the reactive oxygen species which are produced via toxicity. They were used in much research as individually or in a combination as complementary or preventive agents based on their antioxidant activity. Some few researches proved also the efficacy of vitamins B and D in the treatment of toxicity.

Recommendation

Further research should be achieved on the human in the future to verify the efficacy of diverse vitamins as curative and protective agents in the various toxicities of drugs and chemicals because of the shortage of studies on the human.

Conflict of Interest Statement

There are no conflicts of interest.

References

1. Vitamin and mineral requirements in human nutrition (1998) joint FAO/WHO expert consultation, Bangkok, Thailand.
2. Oyarzun MT, Uauy R, Olivares S (2001) Food-based approaches to improve vitamin and mineral nutrition adequacy. *Arch Latinoam Nutr* 51: 7–18.
3. Hassan BAR (2012) Vitamins (Importance and Toxicity). *Pharmaceut Anal Acta*, 3: e125.
4. Arrigoni O, De Tullio MC (2002) Ascorbic acid: much more than just an antioxidant. *Biochim Biophys Acta*, 1569: 1-9.
5. Mohsenikia M, Hajipour B, Somi MH, Khodadadi A, Noori M (2012) Prophylactic effect of vitamin C on cyclosporine A-induced liver toxicity. *Thrita Stud J Med Sci* 1: 24-6.
6. Osman HEH, Elshama SS, El-Kenawy AE (2012) Study Role of Antioxidant (Vitamin C) on Modulation Toxicity of Chronic Use of Monosodium Glutamate in Liver of Albino Rats. *Ain-Shams J Forensic Med* 19: 75-87.
7. Layachi N, Kechrid Z (2012) Combined protective effect of vitamins C and E on cadmium induced oxidative liver injury in rats. *Afr J Biotechnol* 11: 16013-16020.
8. Magdy BW, Mohamed FE, Amin AS, Rana S (2016) Ameliorative effect of antioxidants (vitamins C and E) against abamectin toxicity in liver, kidney and testis of male albino rats. *J Basic Appl Zool* 77: 69-82.
9. Cekic S, Pavlovic D, Sarac M, Kamenov B, Dimic A, et al. (2010) The effect of vitamin C on amiodarone-induced toxicity in rat thymocytes, *Cent Eur J Med* 6: 58-63.
10. Paunovic MG, Ognjanovic BI, Matic MM, Stajn AS, Saicic ZS (2016) Protective effects of quercetin and vitamin C against nicotine-induced toxicity in the blood of Wistar rats. *Arh Hig Rada Toksikol* 67: 304-310.
11. Ekaluo UB, Ikpeze EV, Ibiang YB, Amaechina OS (2013) Attenuating role of vitamin C on sperm toxicity induced by monosodium glutamate in albino rats. *J Biol Sci* 13: 298-301.
12. Suresh MV, Menon B, Indira M (2000) Effects of exogenous vitamin C on ethanol toxicity in rats, *Indian J Physiol Pharmacol* 44: 401- 410.
13. Ahmadzadeh M, Abdolkany E, Afravy M (2015) The preventive effect of vitamin C on styrene-induced toxicity in rat liver and kidney. *Jundishapur J Health Sci* 7: e26849.
14. Huq MA, Awal MA, Mostofa M, Ghosh A, Das AR (2008) Effects of vitamin E and vitamin C on mercury induced toxicity in mice. *Progress Agric* 19: 93-100.
15. Muthu K, Krishnamoorthy P (2012) Effect of vitamin C and vitamin E on mercuric chloride -induced reproductive toxicity in male rats. *Biochem Pharmacol* 1:102.
16. El-Ridi MR, Rahmy TR (2000) Action of vitamin C against acetaminophen - induced hepatorenal toxicity in rats. *J Toxicol Toxin Rev* 19: 3-4. 275-304.
17. Beata OI, Barbara W, Andrzej SB (2000) Vitamin C suppresses the cisplatin toxicity on blood platelets. *Anticancer Drugs* 11: 487-493.
18. Ubong F, Ebong P, Udosen E (2010) Effect of vitamin C on gasoline vapor-Induced Reproductive toxicity in female rats. *Turk J End Met* 14: 26-30.
19. Gavazza, MB, Catala, A (2006) The effect of alpha-tocopherol on lipid peroxidation of microsomes and mitochondria from rat testis. *Prostaglandins Leukot Essent Fatty Acids* 74: 247-254.
20. Olsvik PA, Berntssen MHG, Søfteland L (2015) Modifying effects of vitamin E on chlorpyrifos toxicity in atlantic salmon. *PLoS ONE* 10: e0119250.
21. Elblehi SS, Oda SS, Tohamy HG, Elmanakhly EM (2015) Protective effect of vitamin E and selenium combination on cypermethrin-induced toxicity in male rats. *Alexandria J Vet Sci* 47: 158-165.
22. Halvaei Z, Tehrani H, Soltaninejad K, Abdollahi M, Shadnia S (2017) Vitamin E as a novel therapy in the treatment of acute aluminum phosphide poisoning. *Turk J Med Sci* 47: 795-800.
23. Nagda G, Bano H, Bhatt DK (2011) Protective effect of vitamin E on endosulfan induced testicular toxicity in swiss mice (mus musculus). *J Exp Sci* 2: 29-34.
24. Zaahkook SAM, Helal EGE, Abd-Rabo TEI, Rashed SZA (2000) Carbamate toxicity and protective effect of vit. A and vit. E on some biochemical aspects of male albino rats. *Egypt J Hosp Med* 1: 60-77.
25. Mufazalova NA, Treshchalina ID, Treshchalina EM, Sedakova LA, Andronova NV (2004) Effects of T-activin and vitamin E on toxicity and antitumor activity of cyclophosphamide. *Bull Exp Biol Med* 1: 37-39.
26. Ebuehi OA, Ogedegbe RA, Ebuehi OM (2012) Oral administration of vitamin C and vitamin E ameliorates lead induced hepatotoxicity and oxidative stress in the rat brain. *Nig Q J Hosp Med* 22: 85-90.
27. Nishad P, Mohini (2017) Effect of vitamin E supplementation on heavy metal induced renal toxicity in rat model. *Int J Food Sci Nutr* 2: 77-79.
28. Gawad FA, Rizk AA, Jouakim MF, Abd El Halem MZ (2018) Amiodarone-induced lung toxicity and the protective role of Vitamin E in adult male albino rat. *Eur J Anat* 22: 323-333.
29. Oyeyemi WA, Shittu ST, Kolawole TA, Ubanecheand P, Akinola AO (2015) Protective Effect of Vitamin E on Nicotine Induced Reproductive Toxicity in Male Rats, *Nig J Basic Appl Sci* 23: 7-13.
30. Alpsay L, Yildirim A, Agar G (2009) The antioxidant effects of vitamin A, C, and E on aflatoxin B1-induced oxidative stress in human lymphocytes. *Toxicol Ind Health* 25: 121-127.
31. Bratton GR, Mudzk J, Bell MC, Warnock LG (1981) Thiamin (vitamin B1) effects on lead intoxication and deposition of lead in tissues: therapeutic potential. *Toxicol Appl Pharmacol* 59: 164- 172.
32. Khan MSH, Mostofa M, Jahan MS, Sayed MA, Hossain MA (2008) Effect of garlic and vitamin B- complex in lead acetate induced toxicities in mice. *Bangl J Vet Med* 6: 203-210.
33. Amagon KI, Awodele O, Akindele AJ (2017) Methionine and vitamin B-complex ameliorate antitubercular drugs-induced toxicity in exposed patients. *Pharmacol Res Perspect* 5: e00360
34. Zhang Z, Yu X, Fang X, Liang A, Yu Z, et al. (2015) Preventive effects of vitamin D treatment on bleomycin-induced pulmonary fibrosis. *Sci Rep* 5: 17638.
35. Elshama SS, Osman HEH, El-Kenawy AE, Youseef HM (2016) Comparison between the protective effects of vitamin K and vitamin A on the modulation of hypervitaminosis D3 short-term toxicity in adult albino rats. *Turk J Med Sci* 46: 524-538.
36. Haines JA, Meredith T, Jacobsen D, Pronczuk de Garbino J (1997) International evaluation of antidotes, Introduction. *J Toxicol Clin Toxicol* 35: 125-126.
37. Thomson AD, Cook CCH, Touquet R, Henry JA (2002) The royal college of physicians report on alcohol: guidelines for managing wernicke's

- encephalopathy in the accident and emergency department. *Alcohol Alcohol* 37: 513-521.
38. Bhise SB (2017) Isoniazid toxicity. *J Drug Des Res* 4: 1060-1068.
39. Hamel J (2011) A review of acute cyanide poisoning with a treatment update. *Crit Care Nurse* 31: 72-82.
40. Lee KW, Park SY (2014) High-dose vitamin C as treatment of methemoglobinemia. *Am J Emerg Med* 32: 935-942.
41. Nelson LS, Lewin NA, Howland MA, Hoffman RS, Goldfrank LR, et al. *Goldfrank's toxicologic emergencies*, 9th Edition, New York, McGraw Hill, 2011: 1940.