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Vascular protection by herbal antioxidants; recent views and new concepts

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Core tip

Endothelial cells play critical role in maintenance of vascular hemostasis through endothelial-derived nitric oxide (EDNO) regulated processes. Several abnormalities contribute in blood flow disturbance by triggering oxidative stress interrupted nitric oxide metabolism. It is known various natural bioactive compounds that can alter endothelial signaling pathways to survive cells under stress state abnormalities.

Introduction

The distribution of nutrients and waste metabolites between interstitial space and blood are provided by suitable cardiovascular function. Endothelial cells play critical role in maintenance of vascular homeostasis through endothelial-derived nitric oxide (EDNO) regulated processes. Several abnormalities contribute in blood flow disturbance such as diabetes mellitus, hyperlipidemia and hypertension by triggering overproduction of radicals. They cause interrupted nitric oxide metabolism which promotes thrombosis, proinflammatory responses, as well as disruption of blood flow and arterial flexibility. In diabetic state, No formation is decreased by down-regulating insulin stimuli expressed endothelial-NO synthase (e-NOS) and converting of e-NOS to enzymes which promote superoxide radical generation. In addition, NO can react with reactive species and form peroxynitrite that lead to attenuate NO bioavailability (1). Thus, these mechanisms can cause vasoconstriction and insulin resistance enhancement. Hyperlipidemia, hyperglycemia, and enhancement of Oxidized low-density lipoprotein (Ox-LDL) exacerbate inflammation and oxidative stress. Hyperglycemia activates glycolytic intermediates associated injurious mechanisms such as hexosamine, polyol pathways and advanced glycation end products formation (2). Conversely, there are several mechanisms that elevate endothelial survival under oxidative condition including expression of endothelial vascular growth factors, are able to prevent apoptotic pathways, sustain normal mitochondrial structure and electron transport chain (3). Likewise, it is known various natural bioactive compounds that can alter endothelial signaling pathways to survive cells under stress state. Polyphenolic constituents of plants and fruits are wide groups of chemicals that have biological actions. They contain flavonoids, lignins, tannins, coumarins and stilbenes which possess numerous subfamilies. Among their beneficial impacts of these substances include the increased expression of coding gene of vasodilator agents such as eNOS and regulation of inflammatory responses. In addition, they are effective to up-regulate endogenous antioxidant pathways (4).

Isoflavones are phytoestrogen compounds that provide chemoprotection against endothelial dysfunction by promoting NO generation, up-regulating signaling transduction pathways such as Nrf2 factors, as a crucial regulator of cell recovery, declining reactive species production in glycolytic pathways (5). Furthermore, resveratrol is a flavonoid constituent in grape skin and peanut. It has been indicated to be cytoprotective and vasodilator agent. Although, the exact protective mechanisms have not been elucidated, however, it has been suggested resveratrol is capable to promote eNOS, vascular endothelial growth factor (VEGF) expression and down-regulate NADH oxidase, activate estrogen receptors that lead to expression of endogenous antioxidant enzymes and mitochondrial biogenesis and improvement of glucose metabolism in diabetes induced endothelial dysfunction. Also, this substance possesses hydroxyl groups in molecular structure which are able to scavenge radicals. Moreover, it has been found it are able to enhance NO generation by blood platelets

through modulating PI3K/AKT signaling pathway, causing the vasodilator phosphoprotein activation and p38MAPK prevention, therefore avoiding platelet activation and reactive oxygenated species generation (6,7).

Likewise, anthocyanins are other bioactive substances that can recover endothelial dysfunction in atherosclerotic patient through protecting endothelial progenitor cells against oxidative damage to replace dysfunctional endothelial cells. Interestingly, it can stimulate adipocytes secreted adiponectin to increase eNOs activity via activating cAMP-dependent protein kinase A signaling pathways (8,9).

Lipid-soluble vitamins are other nutritional components in plants that represent evident targets for examination on the relation between antioxidant treatment and protection of endothelial dysfunction. Many previous studies of vitamin E supplementation and its impacts on endothelial dysfunction indicated vitamin E reduces cholesterol level on animal models and alleviates susceptibility Ox-LDL-C that leads to form atherosclerotic plaque. Furthermore, it has been shown prolonged vitamin E and/or C supplementation can be efficient to prevent endothelial dysfunction in type 2 diabetic patients (10,11).

In summary, these presented data highlights the results of experimental studies that are indicated nutritional components mediate multiple signaling pathways, lead to prevent endothelial dysfunction progression.

Authors' contribution

FDS was the single author of the paper.

Conflicts of interest

The author declared no competing interests.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the author.

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