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From oxidative stress to endothelial cell dysfunction

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Core tip

Endothelial cells are an important part of cardiovascular compartment and its health is critical for normal blood circulation. In much literature has been conducted oxidative damage of endothelial cell causes abnormal nitric oxide (NO) bioavailability.

Due to oxygen presence in the earth has been possible aerobic metabolism. However, this molecule can participate in adverse reactions for biological systems that promote oxidative stress. In normal living systems, even at the homeostatic condition, reactive oxygenated and nitrosative species are always generated as by-product of mitochondrial respiratory and signaling messengers. They include super oxide anions, hydroxyl, peroxyle, hydrogen peroxide, nitric oxide (NO), peroxynitrite, hypobromous, hypochlorous acid and alkoxyl (1). In addition, Reactive species generation are accelerated by the activity of cyclooxygenase, xanthine oxidase, peroxidases, cytochrome p450s, NO synthase, lipoxygenase and, NADH/NADPH oxidases. These reactants are main factors, mediate oxidative stress associated cellular dysfunction. Physiologically, generation and neutralization of reactive species are in a steady state. Oxidative stress is characterized by alleviation or inactivation of reductants (antioxidants), and excessive production of reactive species lead to injurious condition in living systems. Indeed, many evidences have proved oxidative damage has major contribution in various disorders pathogenesis, among endothelial dysfunction (2).

Endothelial cells are an important part of cardiovascular compartment and its health is critical for normal blood circulation. Endothelial dysfunction results from multiple pathological pathways that disturb blood flow and accelerate ischemic condition. In much literature has been conducted oxidative damage of endothelial cell causes abnormal NO bioavailability. In this cell, NO acts as a potential vasodilator, that is generated by endothelial cell NO synthase (eNOS) activity (3). Conversely, in oxidative condition, NO is degraded by reactive oxygenated species and eNOS is converted to enzymes that accelerate production of superoxide anions. In some common diseases, such as diabetes mellitus, insulin resistance exerts signaling pathways alterations that cause suppression of eNOS expression, finally lead to disruption of balance between NO and superoxide radicals. In addition, oxidized low-density lipoprotein (Ox-LDL) results in linoleic hydroperoxy and alkoxy generation that are capable to react with NO (4). Indeed, overproduction of reactive oxygenated species mediated by smoking, heart failure, hypertension, and hypercholesterolemia cause alteration of NO bioavailability, associated abnormal endothelium-dependent vascular relaxation. The several studies have been investigated sources of reactive species production that degrade NO in endothelial cells. It is indicated 3 enzymes are mostly responsible, include NADH oxidase, eNOS and xanthine oxidase. NADH/NADPH oxidase is the main source of superoxide generation in endothelial cells. Its activity is associated hormones and cytokines stimuli regulated signaling pathways such as angiotensin II, TGFα, platelet-derived growth factor (PDGF) and thrombin. In recent investigations, on animal models vascular smooth muscle cells, it examined role of NADH/NADPH oxidase in angiotensin II associated hypertension. They found superoxide generation is dramatically elevated by up-regulating expression of p22phox protein. However, its participant subunits have not been known (5).

Likewise, eNOS uncoupling may be effective in oxidative stress induced endothelial dysfunction through at least 3 mechanism, include 1) the lowering NO generation allows to other radicals that attack to cellular targets, 2) eNOS participates in superoxide

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generating reactions, and 3) this enzyme can produce peroxynitrite that aggravates oxidative damage (6).
In conclusion; oxidative damage may have main contribution in endothelial dysfunction pathogenesis.

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FDS was the single author of the paper.

Conflicts of interest
The author declared no competing interests.

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References
1. Rashid K, Sinha K, Sil PC. An update on oxidative stress-mediated organ pathophysiology. Food Chem Toxicol. 2013;62:584-600.
2. Csonka C, Sárközy M, Pipicz M, Dux L, Csont T. Modulation of hypercholesterolemia-induced oxidative/nitrative stress in the heart. Oxid Med Cell Longev. 2016;2016:3863726.
3. Shu X, Keller TC 4th, Begandt D, Butcher JT, Biwer L, Keller AS. Endothelial nitric oxide synthase in the microcirculation. Cell Mol Life Sci. 2015;72:4561-75.
4. Stark J. Oxidative stress and atherosclerosis. ORV Hetil. 2015;156:1115-9.
5. Kalinowski L, Malinski T. Endothelial NADH/NADPH-dependent enzymatic sources of superoxide production: relationship to endothelial dysfunction. Acta Biochim Pol. 2004;51:459-69.
6. Förstermann U, Münzel T. Endothelial nitric oxide synthase in vascular disease. Circulation. 2006;113:1708-14.