

Endothelial Function Improvement: You're Patients' Daily Prescription

John P. Higgins

McGovern Medical School, University of Texas Health Science Center at Houston, USA

Abstract

The vascular endothelium is an important barometer of health and wellness, yet is often not discussed because it is out of sight. Abnormal endothelial function often accompanies aging and is associated with arteries that are pro-thrombotic, pro-adhesive, pro-inflammatory, and more prone to vasoconstriction. Importantly such endothelial dysfunction is associated with detrimental medical conditions including diabetes, hypertension, cardiovascular disease and some cancers. This paper summarizes things that are associated with improved endothelial function and suggests daily habits that will help patients desiring for improved endothelial function. Giving patients this new way of thinking about their health may provide another means to achieve health promotion.

Keywords: Endothelial cells; Exercise; Resveratrol; Diet; Mediterranean

Corresponding author:

John P. Higgins

✉ John.P.Higgins@uth.tmc.edu

McGovern Medical School at The University of Texas Health Science Center at Houston (UTHealth), Houston, TX 77026-1967, USA.

Tel: +17135006836

Fax: +17135005912

Received: July 22, 2016; **Accepted:** October 13, 2016; **Published:** October 18, 2016

Citation: Higgins JP. Endothelial Function Improvement: You're Patients Daily Prescription. *Insights Pediatr Cardiol* 2016, 1:1.

Introduction

At the close of my outpatient encounters, I spend a few minutes describing the vascular endothelium, its functions, things that affect vascular endothelium and then challenge my patients to do one thing every day to improve their endothelial function. What follows is the medical description for the health care provider that I use to help educate my patients.

The vascular endothelium forms the inner lining of the arteries, veins and capillaries. It comprises of approximately 60 trillion endothelial cells that weighs about 2.2 lbs (1 kilogram) and covers a total surface area of 43000-86000 square feet (4000-7000 square meters) [1]. Vascular endothelial function is a barometer of health and wellness; however, it is frequently ignored because it is unseen and there are no reliable circulating markers to measure its activity. Now, it can be measured non-invasively.

The endothelium is a highly metabolically active organ that is adaptive, flexible, and critical to many physiological processes such as vasomotor tone, leukocyte adhesion, cell migration, inflammation, hemostasis, and also serves as a barrier. [1]. Endothelium cell function have an important implications in regard to regulation of hemostasis and thrombosis, local vascular tone, redox balance and the orchestration of acute and chronic inflammatory reactions within the arterial wall [2]. Furthermore, the endothelium is in a constant state of flux with variation in cell shape, volume, contractility, intercellular contacts, and expression of biomolecules that effect cell function [1].

Nitric oxide (NO) is synthesized in endothelial cells from L-arginine by the action of endothelial nitric oxide synthase enzyme (eNOS) in the presence of oxygen, NADP(H) and the NOS co-factor, tetrahydrobiopterin (BH4) [3]. The synthesized nitric oxide diffuses rapidly into the smooth muscle cell layers and platelets where it promotes vascular relaxation and inhibits platelet aggregation, maintaining the equilibrium between pro-thrombotic and anti-thrombotic factors in the blood and arterial wall.

However reduced endothelial function termed endothelial dysfunction is associated with breakdown of this equilibrium and is characterized by reduced NO availability and increased production of oxidants, per-oxynitrites, superoxides and substances that promote disease states [3].

Such endothelial dysfunction can occur in inflamed blood vessels with high hemodynamic shear stress and result in endothelial cells losing their anti-thrombotic abilities and switching their phenotype to promote a pro-thrombotic, pro-adhesion and pro-inflammatory state.

Endothelial dysfunction is associated with the development of diabetes, hypertension, atherosclerosis (coronary artery, cerebrovascular and peripheral arterial disease), erectile dysfunction, sleep apnea and some malignancies [1,2]. Importantly endothelial dysfunction is the harbinger of atherosclerosis and also promotes atherogenesis thereafter [3].

Endothelial function is being measured in clinical settings with the help of non-invasive methods such as flow mediated dilation after temporary upper arm blood pressure cuff occlusion. The reactive hyperemia is a result of the response to shear-stress caused by turbulent blood flow, and causes nitric oxide to be released and promotes endothelium dependent vasodilation, which can be measured using high-resolution ultrasound images of the brachial artery.

Moreover, in clinical studies, endothelial function improves more in men than women, and changes are often greater when some degree of endothelial dysfunction (e.g. with aging) is present to begin with [4,5].

What advice can a health care provider give to patients on how they can improve their endothelial function, and thus reduce morbidity and mortality?

A healthy lifestyle including exercise training and regular intake of correct antioxidant-rich diet such as fresh fruits, vegetables, olive oil, red wine and tea have beneficial effects on endothelial function and can reduce risk. Avoiding exposure to and treating triggers of endothelial dysfunction are also important. Factors associated with alterations in endothelial function are detailed (Table 1). It is important to understand that these factors are associated with one another and therefore causation versus linkage via common disease pathways has not been completely determined at this time.

A moderate session of exercise can acutely improve endothelial function for up to 17 hours and longer term daily exercise is also associated with improved endothelial function. All exercise modalities (aerobic, resistance or combined) with an average exercise intervention of ≥ 4 weeks in the patients those are ≥ 18 years old have been associated with improved endothelial function [6]. In addition, a dose-response relationship between aerobic exercise intensity and improvement in endothelial function occurs, whereas greater frequency rather than intensity of resistance exercise training improves endothelial function [7,8].

Dietary choices that improve endothelial function are

- Antioxidants (Vitamin C, Flavonoids, Polyphenols),
- Potassium,
- Omega-3 fatty acids,
- The Mediterranean diet.

Finally avoiding the causes of endothelial dysfunction is important which includes appropriate management of exposures and medical conditions that are known to be associated with endothelial dysfunction such as: (1) Control hypertension by reducing salt intake and taking medication if needed (2) Control cholesterol by diet and statins if necessary (3) Control blood sugar levels, reduce refined sugar intake and take medication if needed (4) Stop smoking and avoid second hand smoking (5) Lose weight if overweight (6) Reduce stress by relaxation and/or yoga (7) Get enough quality sleep (8) If you are inactive, become active and use an activity tracker/app to monitor and manage (9) Avoid trans/saturated fats.

Conclusion

I challenge health care providers to ask their patients to do one thing every day to boost their vascular endothelial function. This could include walking 10000 steps, drinking a strawberry-banana-walnut-yogurt smoothie, eating a healthy salad, snacking on 40 grams of 70% cocoa dark chocolate or enjoying a glass of cabernet-merlot. By thinking about their endothelial function more and trying to improve it, patients are more likely to improve their overall health and wellness.

Conflict of Interest

The paper is not under consideration elsewhere, none of the paper's contents have been previously published, the author has read and approved the manuscript, and there is no conflict of interest of the author. I, the author, have no financial or other interest in the products or distributor of the products in the manuscript. In addition, I have no other kinds of associations, such as consultancies, stock ownership, or other equity interests or patent-licensing arrangements in any of the products in the manuscript. No sources of outside support for research were used in the preparation of this manuscript.

Table1 Factors Associated with Changes in Endothelial Function.

Improved Endothelial Function	Reduced Endothelial Function
Exercise	Hypertension
Vitamin C	Hyperlipidemia
Flavonoids	Hyperglycemia
Polyphenols	Smoking
Potassium	Morbid obesity
Omega-3 fatty acids	Stress
Mediterranean diet	Sleep deprivation
Nut consumption	Inactivity
	Trans/saturated fats
	Severe obstructive sleep apnea
	HIV-infection
	High sodium consumption
	Insulin resistance/diabetes

References

- 1 Aird WC (2005) Spatial and temporal dynamics of the endothelium. *J Thromb Haemost* 3: 1392-1406.
- 2 Gimbrone MA Jr, García-Cardena G (2016) Endothelial cell dysfunction and the pathobiology of atherosclerosis. *Circ Res* 118: 620-636.
- 3 Bertoluci MC, Cé GV, da Silva AM, Wainstein MV, Boff W, et al. (2015) Endothelial dysfunction as a predictor of cardiovascular disease in type 1 diabetes. *World J Diabetes* 6:679-692.
- 4 Swift DL, Weltman JY, Patrie JT, Saliba SA, Gaesser GA, et al. (2014) Predictors of improvement in endothelial function after exercise training in a diverse sample of postmenopausal women. *J Womens Health (Larchmt)* 23: 260-266.
- 5 Green DJ, Eijssvogels T, Bouts YM, Maiorana AJ, Naylor LH, et al. (2014) Exercise training and artery function in humans: Nonresponse and its relationship to cardiovascular risk factors. *J Appl Physiol* 117: 345-352.
- 6 Ashor AW, Lara J, Siervo M, Celis-Morales C, Oggioni C, et al. (2015) Exercise modalities and endothelial function: A systematic review and dose-response meta-analysis of randomized controlled trials. *Sports Med* 45: 279-296.
- 7 Ashor AW, Siervo M, Lara J, Oggioni C, Afshar S, et al. (2015) Effect of vitamin c and vitamin e supplementation on endothelial function: A systematic review and meta-analysis of randomized controlled trials. *Br J Nutr* 113: 1182-1194.
- 8 Blanch N, Clifton PM, Keogh JB (2015) A systematic review of vascular and endothelial function: Effects of fruit, vegetable and potassium intake. *Nutrition, metabolism, and cardiovascular diseases: Nutr Metab Cardiovasc Dis* 25: 253-266.