

## **Why heart attacks occur in many people with normal cholesterol levels**

James Meschino DC, MS, ND

There is no doubt that high cholesterol levels increase risk for heart attack and other cardiovascular diseases. You should strive to achieve a fasting blood cholesterol level that is below 3.9mmol/L if possible, which is the safest level in regards to cardiovascular disease risk. However, there is more to the story than cholesterol alone, when addressing risk for cardiovascular diseases – which remain the number one cause of death in our society. Other factors such as high blood pressure, diabetes, smoking, high blood levels of homocysteine, being overweight and high levels of stress, are all known to contribute to the development of heart attacks and other vascular problems. In addition, a state known as “endothelial dysfunction” has recently emerged as a significant cardiovascular disease risk factor, and its discovery has helped to explain the mechanisms through which smoking, diabetes and stress increase risk for heart attack, stroke, deep vein thrombosis and other vascular diseases

### **Endothelial Dysfunction – Don’t let it suddenly end your life**

The endothelial cells (the endothelium) are the cells that line the inner surface of all blood vessels including arteries and veins (as well as the innermost lining of the heart and lymphatics). In addition to their structural function, endothelial cells participate in number of activities that affect blood coagulation, blood stickiness, and the degree of dilation or constriction of a specific blood vessels from moment to moment, which largely determines how much blood will flow through a particular blood vessel. Under normal circumstances, endothelial cells behave in a way that does not cause excessive blood stickiness and helps to regulate the dilation of blood vessels according to the surrounding tissues requirement for oxygen and other nutrients. If a tissue requires more blood, then endothelial cells secrete nitric oxide (NO), which causes the muscular coat of the blood vessel wall to relax. This enables the local blood vessel to open up (dilate), allowing more blood to circulate to the tissues it serves. A good example of this is the erection of the male penis, which occurs when endothelial cells secrete nitric oxide, allowing the blood vessels supplying the penis to open up and generate an erection. Drugs, such as Viagra, help overcome erectile dysfunction, by increasing levels of nitric oxide in these blood vessels.

When endothelial cells function in an abnormal manner, we call this state, “endothelial dysfunction”. In endothelial dysfunction, the endothelial cells behave abnormally by increasing the stickiness of the blood and producing excessive blood clotting behaviour. In many cases the final event in a heart attack or an ischemic stroke is the clumping together of blood cells, which form a plug in the artery wall, often resulting from endothelial dysfunction. In turn, these plugs can completely block blood flow to a section of heart muscle or brain tissue. This is why doctors try to break down any clots, using powerful anticoagulant drugs, when a heart attack occurs, and why they use anticoagulant drugs like heparin and warfarin (coumadin) to treat deep vein thrombosis. In addition,

endothelial dysfunction also involves an inability for endothelial cells to secrete appropriate amounts of nitric oxide. This results in constriction (tightening) of the involved blood vessel, which severely restricts blood flow to the tissues it supplies. As such, endothelial dysfunction is a significant factor in the development of heart disease, ischemic stroke, and deep vein thrombosis. It is also involved in angina attacks, and erectile dysfunction.

### **So What Causes Endothelial Dysfunction**

In recent years we have learned a great deal about endothelial dysfunction in regards to what causes it and how to prevent it. Not surprisingly, much of the answer lies in our dietary and exercise behaviours. What we know is that high cholesterol levels increase the development of endothelial dysfunction. As such, people with already narrowed arteries from cholesterol build up tend to also have a greater propensity for endothelial dysfunction. So, it's a double whammy for these individuals. Let me state this again, as I have on numerous occasions "Eat a low animal fat diet (with exception of fish) and consume foods that help to lower cholesterol (bean, peas, certain fruits and vegetables, ground flaxseed, psyllium husk fiber, salba grain etc.), stay at your ideal weight and exercise regularly, in order to help keep your cholesterol down".

But even if your cholesterol levels are normal, endothelial dysfunction can still occur from the ingestion of foods containing trans-fats (margarine, shortenings, deep fried foods etc.) and/or high amounts of animal fat (saturated fat), although fish is an exception. The intake of highly refined sugars has also been shown to cause endothelial dysfunction. These factors should not to be considered lightly, as evidenced by the fact that a study of women, published in 2001, showed that endothelial dysfunction was discovered in approximately half of women with chest pain, in the absence of overt blockages in their large coronary arteries. Thus, in the absence of high cholesterol and narrowed arteries (normal angiograms study), many people place themselves at risk for heart attacks and other cardiovascular diseases by regularly eating foods high in animal fat, trans-fats, and refined sugars. We now realize that these foods contribute to vascular disease, even if your body is very good at clearing cholesterol from the blood stream. So, just because your doctor tells you that your cholesterol level is normal does not mean you won't suffer a heart attack, stroke or life-threatening deep vein thrombosis if you eat these foods on a regular basis.

You should also keep in mind that type 1 and type 2 diabetes also encourages endothelial dysfunction, which may further explain why diabetics have a much higher risk of cardiovascular complications. By remaining at your ideal weight and being physically fit, you can dramatically reduce your chances of developing type 2 diabetes. If you have already been diagnosed with diabetes, then the same principles apply to improving the management of your diabetic state. As well, cigarette smoking as also been implicated as a cause of endothelial dysfunction, which further explains the heightened risk for vascular disease that occurs in smokers. Uncontrolled high blood pressure also contributes to endothelial dysfunction.

## **Vitamins and Essential Fatty Acids Can Help Prevent And Combat Endothelial Dysfunction**

From a dietary standpoint, in addition to reducing your intake of saturated fat, trans-fats and refined sugars, more recently we have learned that certain vitamins, minerals and other natural agents can help to reduce the development of, or reverse, endothelial dysfunction. For instance, the B-vitamin folic acid has been shown to improve endothelial dysfunction. Other studies indicate that omega-3-fats improve endothelial function as well as certain antioxidants, such as Vitamin E and Vitamin C.

Supplementation with these nutrients, as well as the amino acid L-arginine, has shown beneficial effects on reversing endothelial dysfunction problems in human subjects.

Folic acid has been shown to increase the synthesis and release of nitric oxide from endothelial cells, thereby relaxing blood vessels and improving blood flow through the large, medium and small arteries of the body. Vitamin E and Vitamin C decrease free radicals in the artery wall, which promotes the release of endothelial agents that also relax blood vessels and improve blood flow. Omega-3 fats encourage the production of endothelial agents known as prostacyclins, which also relax the blood vessel wall, improve blood flow, and reduce blood stickiness, which prevents abnormal clotting.

Vitamin E supplementation also reduces the stickiness of the blood.

Supporting endothelial function is one of the reasons that I recommend that adults supplement a healthy diet with a High Potency Multiple Vitamin and Mineral supplement that contains 1,000 mg of Vitamin C, 400 IU of Vitamin E, a B-50 complex (including 400 mcg of folic acid), as well as an Essential Fatty Acid Supplement containing 400 mg each of fish oil, flaxseed oil, and borage seed oil. There is also evidence that coenzyme Q10 and the herb hawthorn improve endothelial dysfunction. I recommend that adults over the age of 45-50 also include a supplement including CoQ10 and hawthorn, to prevent congestive heart failure, high blood pressure and endothelial dysfunction as they age.

### **Conclusion**

Cardiovascular disease accounts for approximately 40% of all deaths in North America, many of which occur in people long before they have lived a full life. Although genetic factors play a role, studies confirm that in more than 90% of cases premature heart attacks, stroke, deep vein thrombosis and other vascular diseases result from faulty dietary and lifestyle patterns. In light of the importance of endothelial function to premature death from vascular disease, having a low cholesterol level and being thin are no longer acceptable reasons to permit yourself to regularly consume foods that are high in saturated fat, trans-fats, and refined sugars. In addition to following more prudent dietary patterns, maintaining normal blood pressure, exercising regularly, remaining at your ideal weight and not smoking, I strongly suggest that you take a High Potency Multiple Vitamin and Mineral Supplement and an Essential Fatty Acid Supplement each day, as described above. Individuals over the age of 45-50 should also include a supplement containing 30-60mg of coenzyme Q10 and 37.5-75mg of Hawthorn (standardized to 3-5% flavonoid content), as an additional means to guard against endothelial dysfunction and cardiovascular disease.

## References

- Brown A, Hu FB. Dietary modulation of endothelial function: implications for cardiovascular disease. *Am J Clin Nutr*, 73;4:673-686. 2001
- De Bree A, Van Mierlo LA, Draijer R. Folic acid improves vascular reactivity in humans: a meta-analysis of randomized controlled trials. *Am J Clin Nutr*. 86;3:610-7. 2007
- Stroes ESG, van Faassen E, Yo M, et al. Folic acid reverts dysfunction of endothelial nitric oxide synthase. *Circulation Research*. 86:11129. 2000
- Granato H. Circulatory function and vascular integrity. (Virgo Publishing 2008) <http://www.naturalproductsinsider.com/>. (posted 03/28/2008).
- Koukkou E, Ghosh P, Lowy C, Poston L. Offspring of normal and diabetic rats fed saturated fat in pregnancy demonstrate vascular dysfunction. *Circulation*. 98:2899-2904. 1998
- Gerber RT, Holemans K, O'Brien-Coker I et al. Cholesterol-independent endothelial dysfunction in virgin and pregnant rats fed a diet high in saturated fat. *J Phys*. 517;2:607-616. 1999.
- Roberts CK, Barnard RJ, Sindhu RK et al. A high-fat, refined-carbohydrate diet induces endothelial dysfunction and oxidant/antioxidant imbalance and depresses NOS protein expression. *J Appl Physiol*. 98:203-210. 2004.
- Zhang HY, Reddy S, and Kotchen TA. A high sucrose, high linoleic acid diet potentiates hypertension in the Dahl salt sensitive rat. *Am J Hypertens* 12: 183-187, 1999
- Lopez-Garcia E, Schulze MB, Meigs JB, Manson JE, Rifai N, Stampfer MJ, Willett WC, Hu FB. Consumption of trans fatty acids is related to plasma biomarkers of inflammation and endothelial dysfunction. *Journal of Nutrition*, 135(3):562-6. 2005
- Reis SE, Holubkov R, Smith AJC, Kelsey SF, Sharaf BL, Reichek N, Rogers WJ, Merz NB, Sopko G, Pepine CJ. Coronary microvascular dysfunction is highly prevalent in women with chest pain in the absence of coronary artery disease: Results from the NHLBI WISE Study. *Am Heart J*, 141;5:735-741. 2001
- Esper RJ, Nordaby RA, Vilarino JO et al. Endothelial dysfunction: a comprehensive appraisal. *Cardiovascular Diabetology*. 5;4:1475-2840. 2006

- Heitzer T, Yla-Herttuala S, Luomo J. Cigarette smoking potentiates endothelial dysfunction of forearm resistance vessels in patients with hypercholesteolemia. *Circulation*.93:1346-1353.1996.