



Angina rapidly improved with a plant-based diet and returned after resuming a Western diet

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Atherosclerosis and its related cardiovascular disease is the most common cause of morbidity and mortality in the Western world.^[1] The roots of this disease may lie, in part, in dietary and lifestyle behaviors, indicating that modification of these behaviors may lead to profound improvements.

A 77-year-old woman presented with unstable angina. Her past medical history included hypertension, hyperlipidemia and remote tobacco use for which she had been treated with atenolol 50 mg daily and simvastatin 20 mg daily. At her baseline, she could walk more than half a mile without complaints. Over the two to three months prior to presenting, she developed gradually worsening chest pressure and shortness of breath to the point where she was unable to walk more than half of a city block or up one flight of stairs. Her symptoms resolved with rest. Coronary angiography revealed severe three-vessel disease, and a referral for coronary artery bypass graft surgery (CABG) was made. Her left ventricular size and function were normal on echocardiography. Daily aspirin 81 mg and sublingual nitroglycerin as needed were added to her medication regimen.

The patient chose, however, to not proceed with surgery and rather she chose to adopt a whole-food plant-based diet, which included all vegetables, fruits, whole grains, potatoes, beans, legumes and nuts. She eliminated all animal derived products, such as eggs, cow's milk, yoghurt, chicken and beef, and she presented to our cardiac wellness program. She described her previous diet as a 'healthy' Western one.

Clopidogrel 75 mg daily was added to her medical regimen, simvastatin was replaced by a high-potency statin (atorvastatin 80 mg daily) and atenolol was replaced by carvedilol. Within one month of lifestyle change her symptoms had nearly resolved, and she was able to walk on a treadmill for up to 50 min without chest discomfort or

dyspnea. Her total cholesterol decreased from 5.7 mmol/L to 3.2 mmol/L, and her LDL cholesterol decreased from 3.7 mmol/L to 1.5 mmol/L over three months.

Four to five months after the initial lifestyle change, her adherence to a whole-food plant-based diet ended. She returned to her prior eating habits, which included chicken, fish, low fat dairy and other animal products multiple times per day. Although her medical regimen had not changed, her anginal symptoms returned within four to six weeks. She had chest discomfort with minimal exertion at a gym and she was admitted to an outside hospital. Shortly thereafter, she underwent CABG surgery. She moved out of state and continued her prior eating habits. A coronary stent was placed one year later for another episode of unstable angina.

We present the case of a 77-year-old woman with unstable angina, whose symptoms resolved without mechanical intervention while consuming a whole-food plant-based diet. This case highlights the potential of this lifestyle to help rapidly improve anginal symptoms and to contribute to improving the atherosclerotic disease process. This potential is reinforced by our patient's rapid deterioration despite no change in her medications when she returned to her baseline 'healthy' Western diet.

A growing body of evidence suggests that animal-based foods may be harmful for health, while plant-based diets can halt and even improve both coronary atherosclerotic disease and survival. Large population-based studies found consumption of animal products to be associated with both increased mortality and incidence of atherosclerotic cardiovascular disease.^[2–5] Multiple mechanisms for these observational findings have been proposed, such as saturated fat consumption,^[6] salt intake,^[7] increased inflammation,^[8] obesity,^[9] hyperlipidemia,^[10] hypertension,^[11] diabetes mellitus,^[4] and the role of trimethylamine-N-oxide (TMAO). Intestinal microbiota dependent metabolic pathways involving dietary phosphatidylcholine (derived mainly from

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eggs, beef and pork) and L-carnitine (mainly from beef) have been implicated, in part, in the pathogenesis of atherosclerotic cardiovascular disease via TMAO, which is associated with accelerated atherosclerosis, increased risk of death, myocardial infarction and stroke.^[12] Furthermore, endothelial dysfunction has been invoked as an effect of a lipid-laden meal. Vogel, *et al.*^[13] described that a single high-fat meal (mainly from animal sources) rapidly induced endothelial dysfunction as measured by brachial artery flow-mediated dilation independently of serum lipid levels.

In contrast, consuming plant-based foods may be more optimal for health. Studies evaluating a plant-based diet have found a beneficial effect in regards to cardiovascular disease outcomes. Investigators in the Adventist Health Study 2 reported vegetarian and vegan diets to be associated with decreased rates of all-cause and cardiovascular mortality compared to nonvegetarians.^[14] Authors of the EPIC-Elderly study (European Prospective Investigation into Cancer and Nutrition) reported that increased adherence to a plant-based diet was associated with substantially reduced all-cause mortality.^[15] In a recent analysis of the PRED-MIED trial (a randomized controlled trial of a Mediterranean diet vs. a low-fat control diet), Martínez-González, *et al.*^[16] reported that the risk of all-cause mortality was lower among study participants consuming a mainly plant-based diet compared to omnivores.

The benefits of a whole-food plant-based diet, which our patient followed for a limited time, are manifold. A review by Ferdowsian and Barnard describes the beneficial effects of plant-based diets on plasma lipids, reporting an up to 35% decrease in plasma low-density lipoprotein (LDL) cholesterol with a whole-food plant-based diet combined with nuts, soy and fiber.^[17] The beneficial effect of plant-based diets on weight, plasma lipids and glycemic control has been investigated in a randomized controlled trial by Mishra, *et al.*^[18] with favorable results. In addition to published case reports,^[19,20] several larger studies are applicable to the case we present. The Lifestyle Heart Study randomized patients with coronary atherosclerotic heart disease to a low-fat vegetarian diet (among other interventions, such as exercise, smoking cessation and stress reduction) vs. a standard diet, and followed them for one year. Patients in the experimental group were found to have regression of angiographically detected coronary atherosclerosis and a 91% reduction of frequency of angina, while patients on the standard diet were found to have a 186% increase in the frequency of angina.^[21,22] Esselstyn, *et al.*^[23] reported a similar regression of coronary atherosclerotic heart disease by angiography in patients who adhered to a whole-food plant-based diet. In a study by Dod, *et al.*,^[24] endothelial

function was measured by flow-mediated dilation in patients undergoing an intensive lifestyle modification program including a whole-food plant-based diet, and was improved in the experimental group. Lin, *et al.*^[25] found decreased endothelial function in omnivores compared to vegetarians. Future interventions should focus on ways to help patients successfully adopt and maintain a whole-food plant-based diet, as increased adherence to a healthy lifestyle is associated with greater health benefits.^[26]

In summary, a whole-food plant-based diet was associated with reversing angina symptoms in our patient with severe coronary atherosclerotic disease. Her angina returned when she resumed consuming a 'healthy' Western diet.

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