The Treatment of Coronary Artery Disease with a Plant-Based Diet

Introduction

For over 45 years, evidence from interventional studies has strongly indicated that a low-fat plant-based diet is both safe and efficacious in the treatment of coronary artery disease (CAD). Interventional studies have shown that a low-fat (<10% of calories) plant-based diet is a viable and highly advantageous alternative to other interventional strategies. This treatment can be used in combination with standard treatment regimens, including medication, stenting and CABG.

A low-fat vegetarian diet can reverse or prevent further progression of coronary atheroma, improve endothelial dysfunction and is effective even in cases of severe stenosis. Studies show that in addition to regression, there is a remolding of the geometry of the stenosis with consequent improvement in coronary flow reserve.

Reductions of risk factors and comorbidities such as angina, apolipoprotein B, hypercholesterolemia, hypertension, diabetes, metabolic syndrome and obesity have been noted, while this treatment is practically devoid of side effects and contraindications.

Follow up studies at one and five years confirm continued benefit to the patient. Patient compliance has been very high even at 5 years.

Insurance studies on treating coronary artery disease have documented substantial financial savings and one program based on this therapeutic diet of treatment has been approved for Medicare.

Research

General Intervention

It has long been known that vegetarians and vegans had lower incidences of several common chronic diseases including ischemic heart disease. Much lower total and LDL serum cholesterol levels among vegetarians have also been observed. Our previous posting on hypercholesterolemia addresses this research.

Proceeding from these two observations, researchers have investigated using a very low-fat vegan or nearly vegan diet to treat CAD of varying severity, and have achieved very positive results.

A moderately low-fat vegetarian diet was studied as an intervention for CAD as early as 1960. Morrison placed 50 patients with confirmed CAD on a moderately low-fat (25 g/day) vegetarian diet and followed them, and the 50 patients with CAD in the control group, for 12 years. While none of the patients in the control group survived for that length of time, 38% of the patients in the treatment group did. (1) It should be noted that since in 1960 neither stent, nor CABG surgery, nor cholesterol-reducing drugs, were available this was a very notable finding.

More recently in 1990, a prospective, randomized, controlled trial was done to determine whether comprehensive lifestyle changes affect coronary atherosclerosis after one year. 28 patients were assigned to an experimental group (very-low-fat vegetarian diet, healthy lifestyle and stress management) and 20 to a standard care control group. 195 coronary artery lesions were analyzed by

quantitative coronary angiography. The average percentage diameter stenosis regressed from an average 40.0 % to 37.8 in the experimental group, yet progressed from an average of 42.7% to 46.1% in the control group. When only lesions greater than 50% stenosed were analyzed, the average percentage diameter stenosis regressed from an average of 61.1% to 55.8% in the experimental group, and progressed from an average of 61.7% to 64.4% in the control group. Overall, 82% of experimental-group patients had an average change towards regression. (2) In evaluating the regression, it is very important to keep in mind that blood flow increases by the radius raised to the 4^{th} power according to Poiseuille's Law.

This landmark study provided compelling evidence that a low-fat vegetarian diet can not only halt the progression of CAD, but even result in modest regressions in arterial stenosis. Given that CAD culminating in myocardial infarction is the leading cause of death in the developed world, and a tremendous burden on the health care system as well as on the patients themselves, the importance of this finding can hardly be overstated.

Following up on these results, researchers then looked to see if the treatment effects were sustained for longer periods of time, and if even further improvements could be obtained. The answer to both questions seems to be yes.

In a group of patients who participated in a 5-year follow up, the average percent diameter stenosis at baseline decreased 1.75 absolute percentage points after 1 year (a 4.5% relative improvement) and by 3.1 absolute percentage points after 5 years (a 7.9% relative improvement). In contrast, the average percent diameter stenosis in the control group increased by 2.3 percentage points after 1 year (a 5.4% relative worsening) and by 11.8 percentage points after 5 years (a 27.7% relative worsening).

Patients in the experimental group lost 10.9 kg (23.9 lbs) at 1 year, and sustained a weight loss of 5.8 kg (12.8 lbs) at 5 years, whereas weight in the control group changed little from baseline. In the experimental group, LDL cholesterol levels decreased by 40% at 1 year and remained 20% below baseline at 5 years. Experimental group patients also had a 91% reduction in reported frequency of angina after 1 year, and a 72% reduction after 5 years. (3) It is important to note that for the results obtained above were dose dependent. The more closely patients adhered to the dietary regimen the better their results.

A smaller study also showed good results. 17 patients with CAD treated with a low-fat vegan diet, were followed for 5 years. Lesion analysis by percent stenosis showed that of 25 lesions, 11 regressed and 14 remained stable. Mean arterial stenosis decreased from an average of 53.4% to 46.2%. (4)

A larger study, though with only a 3.7 year follow up, also showed positive results. 198 patients were placed on a low fat vegan, or total vegetarian diet. 93% of patients experienced improvement or resolution of angina symptoms during the follow up period. Radiographic or stress testing results documented disease reversal in 22% of patients. 99.4% of adherent patients avoided major cardiac events. 89% patients were adherent to the treatment regimen. However, this was not a controlled study and the self-selected patients were very motivated. (5)

Foreign General Intervention Studies

A low-fat vegetarian diet as a treatment for CAD has also been studied in other countries. For instance, an Indian study examined 360 coronary lesions in 123 such patients. Results were dose dependent. In

CAD patients with the greatest adherence to a low-fat vegetarian diet, percent diameter stenosis regressed by an average of 18.23 absolute percentage points. 91% of all patients showed a trend towards regression, and 51.4% lesions regressed by more than 10 absolute percentage points. (6)

A Dutch interventional study took patients who had at least one 50% obstruction and placed them on a vegetarian diet, although not as low in fat and cholesterol as other studies. After 2 years, 46% of patients showed no progression of the stenosis. Dietary changes were associated with a significant increase in linoleic acid content of cholesteryl esters, and a significant lowering of body weight, systolic blood pressure, serum total cholesterol, and the ratio of total to high-density lipoprotein (total/HDL) cholesterol. (7)

Coronary Perfusion Study

As might be expected, patients on a low-fat vegetarian diet experience improvements in coronary perfusion as well. In one study after 5 years, the size and severity of perfusion abnormalities on dipyridamole PET images decreased after risk factor modification in the experimental group, compared with an increase of size and severity in controls. The percentage of left ventricle perfusion abnormalities outside 2.5 SDs of those of normal persons, on the dipyridamole PET image of normalized counts, worsened in controls by an average of 10.3% and improved in the experimental group by an average of 5.1%. The percentage of left ventricle with activity less than 60% of the maximum activity worsened in controls by an average 13.5% and improved in the experimental group 4.2%. The myocardial quadrant on the PET image with the lowest average activity, expressed as a percentage of maximum activity, worsened in controls by an average of 8.8% and improved in the experimental group by an average of 4.9%. The size and severity of perfusion abnormalities on resting PET images were also significantly improved in the experimental group as compared with controls. The relative magnitude of changes in size and severity of PET perfusion abnormalities was comparable to, or greater than, the magnitude of changes in percent diameter stenosis, absolute stenosis lumen area, or stenosis flow reserve documented by quantitative coronary arteriography. (8)

Stenotic Morphology Study

In 1992, an interesting study looked at the change of the geometric shape of the stenosis, in addition to the degree of stenosis, and their combined effect on flow reserve. Percent stenosis is an incomplete measure of stenosis because length, absolute lumen area and shape effects are not accounted for, and correlate poorly with the functional measure of coronary stenosis, coronary reserve flow. (9) Patients treated with a low-fat vegetarian diet show complex stenosis shape change, with profound effects on fluid dynamic severity, not accounted for by simple percent narrowing in a dose dependent manner. This effect is most pronounced with patients with severe pretreatment stenosis, with stenosis flow reserve <3. In this study, the minimal diameter increased by 18%. Patients with a pretreatment average of 67% stenosis showed a 14% improvement in diameter. (10) As mentioned earlier, coronary blood flow effects are a function of arterial radius raised to the 4^{th} power, so small changes in the radius have proportionately much larger effects on flow capacity and functional severity of stenosis, thus contributing to the greater significance of stenosis flow reserve as a measure of change in severity.

Apolipoprotein B Reduction

Studies have shown that vegetarians and vegans have lower apolipoprotein B than meat eaters. (11) Several studies show that a low-fat vegetarian diet reduces apolipoprotein B concentrations. (12, 2)

Also, when a low-fat vegetarian diet is introduced, apolipoprotein B levels are reduced more than by other diets such the Atkins and South Beach diets. (13)

Post Op Cardiac Rehabilitation Studies

Researchers have also studied the effects of a low-fat vegetarian diet on patients who had already had standard treatments and were ready for post op cardiac rehabilitation.

One study compared patients in cardiac rehabilitation programs using either the standard treatment or a low-fat vegetarian diet (combined with stress reduction). Low-fat vegetarian program participants had significantly greater reductions in anginal frequency, body weight, body mass index, systolic blood pressure, total cholesterol, low-density lipoprotein cholesterol, glucose and dietary fat. (14)

Another study looked at psychosocial risk factors and quality of life variables for patients in cardiac rehabilitation programs, using either the standard treatment or a low-fat vegetarian program. At 3 and 6 months, vegetarian participants demonstrated significant improvements in all 12 outcome measures, while the standard rehabilitation group improved in only 7 of the 12. (15)

Clinical Considerations

The beneficial effects of a low fat vegetarian diet are indicated for patients at risk of heart failure and who also have CAD. Lifestyle changes are recommended for coronary heart disease patients at risk for heart failure [ACC/AHA stage B; left ventricular ejection fraction (LVEF)<or=40%]. One study showed significant improvements in such patients with documented CHD, regardless of ejection fraction, in lifestyle behaviors, body weight, body fat, blood pressure, resting heart rate, total and LDL-cholesterol, exercise capacity, and quality of life by 3 months. Most improvements were maintained over 12 months. (16)

A low-fat vegetarian treatment regimen has also been shown suitable for diabetics with CAD. In a one year study, diabetic patients with comorbid CAD showed good adherence to the treatment, and improvements in both cardiovascular and diabetic parameters, as demonstrated by significant improvements in weight, body fat, low density lipoprotein cholesterol, exercise capacity. About 20% of these patients were able to reduce or discontinue diabetic medications such as insulin or oral anti-hyperglycemics. (17)

An all-too-common comorbidity, angina, can also be treated with a low-fat plant-based diet. One study examined over 100 patients with CAD at 22 different clinics throughout the U.S. After 12 weeks, 74% of these patients were angina free and an additional 9% moved from limiting to mild angina. (18) Another study found that 91% of patients had a reduction in the frequency of angina episodes. (3) Using a purely vegan diet, one small study found complete remission of symptoms in all patients by the 6th month. (19)

The problem of depression is a common concomitant of heart disease. A study using a low-fat plant-based diet in cardiac rehab patients, found that 80% saw very significant reductions in depression by 12 weeks, and the improvement was maintained for at least one year. (20) Another study of patients at high risk also showed an improvement in depressive symptoms. (21)

There has been an unfortunate tendency amongst some physicians to recommend fish oils to their patients. However, this has not been borne out by the evidence. One review of studies (metastudy) conducted on the supposed benefits of fish oil reported, "*All of the studies included were the gold-standard kind of clinical trial -- with people assigned at random to either take fish oil or a placebo. The studies ranged in length from one to nearly five years. The authors detected no reduction in any cardiovascular events, such as heart attacks, sudden death, angina, heart failures, strokes or death, no matter what dose of fish oil used.*" (22)

There has also been a mistaken notion that the Eskimo had a lower incidence of coronary heart disease, by virtue of their high fish oil consumption. This also turns out to not be the case. One report states, "*Greenland Eskimos and the Canadian and Alaskan Inuit have CAD as often as the non-Eskimo populations*." (23) Another study states, "*Eskimos have CHD despite high consumption of omega-3 fatty acids*." (24)

While the interventional studies stressed a low fat dietary regimen, there is good evidence that the inclusion of tree nuts, despite their fat content, reduces cardiac risk. (25, 26)

One of the key advantages of the treatment of coronary heart disease with a low fat vegetarian diet is the very low restenosis rate. One study reports the following average restenosis rates: balloon angioplasty 30-60%, bare metal stents, 16-44%, drug eluting stents 16%. (27) Compare this with the low-fat vegan diet, which resulted in 0% restenosis rate in a study by Dean Ornish. (28)

Dietary intervention is an extremely cost effective treatment, and may be the only viable treatment for those patients struggling with the affordability of other options.

Some patients are either unwilling, fearful of or not good candidates for surgery. This treatment also offers them a nonsurgical option of proven efficacy.

Discussion

Treatment Advantages

The low-fat vegetarian diet also has no surgical risk of mortality, morbidity, no post op complications, very low cost, and also both treats and lowers the risk of common comorbidities such as hypertension, diabetes and certain forms of cancer. It can serve as a monotherapy or as an adjunct to standard treatments.

Cost-Effective Treatment

The treatment of CAD with a plant-based diet has been shown to be very cost effective. Highmark's Blue Cross estimated cost savings per participant in the Ornish low-fat vegetarian cardiac program is $16,186 measured in 1999 dollars. (29) Estimated savings would likely be much higher today. A Mutual of Omaha Insurance study, also conducted in the 1990s, determined that for every dollar spent on the Ornish program there was a savings of $5.55 in health care costs that would have otherwise accrued. (30)

According to a Kaiser Family Foundation/New York Times survey, among people with health insurance, one in five (20%) working age Americans report having had problems paying medical bills in the past year, often causing serious financial challenges and changes in employment. The situation is even worse

among people who are uninsured: half (53%) face problems with medical bills, bringing the overall total to 26 percent. (31) Many people struggle with copayments, have high deductibles or are still uninsured.

Coronary artery disease takes a tremendous toll in both lives and money. Heart disease remains the leading cause of death for both men and women. (32) CAD costs the United States $108.9 billion each year. (33, 34)

Clearly, a more cost-effective treatment to Percutaneous Coronary Intervention and CABG is needed. As we have seen, treatment of CAD with a low-fat vegetarian diet would save a very considerable amount of money.

A Needed Treatment Option

As most physicians know, many patients these days attempt to gain health-related information and to treat themselves based upon what they read on the internet. Such information is often highly unreliable. (35) In our experience, most patients would rather get their health information and advice from their physicians, but turn to the internet when they can't. Therefore, to serve the best interests and needs of their patients, physicians should familiarize themselves with this treatment.

Research has documented the high rate of compliance with this treatment, especially when physicians explain the rationale behind the treatment and specifically prescribes it to their patients.

We live in an age of advanced medical technology. These advances have alleviated much suffering and saved countless lives. They have an unquestioned place in modern medicine. However, this can sometimes lead towards a kind of technological fundamentalism. Little notice is taken of treatments that, while lacking in technological sophistication, are nevertheless quite efficacious. This indeed seems to be the case with treating CAD with a low-fat vegetarian diet.

Fortunately, many doctors have already started to practice vegetarian nutritional medicine and integrate it into their patients' treatment of CAD. Even the new president of the American College of Cardiology, Dr. Ken Williams, uses this modality of treatment for his patients. (36)

References

1. Morrison LM. Diet in Coronary Atherosclerosis. *JAMA*. Jun 1960;173(8):884-888.

2. Ornish D, Brown S, Scherwitz L, et.al. Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial. *Lancet*. Jul 1990;336(8708):129-33.

3. Ornish D, Scherwitz L, Billings J, et.al. Intensive Lifestyle Changes for Reversal of Coronary Heart Disease. *JAMA*. 1998;280(23):2001-7.

4. Esselstyn CJ, Ellis S, Medendorp S, Crowe T. A strategy to arrest and reverse coronary artery disease: a 5-year longitudinal study of a single physician's practice. *Journal of Family Practice*. Dec 1995;41(6):560-8.

5. Esselstyn CJ, Gendy G, Doyle J, et.al. A way to reverse CAD? *Journal of Family Practice*. Jul 2014;63(7):356-364b.

6. Gupta S, Sawhney R, Rai L, et.al. Regression of coronary atherosclerosis through healthy lifestyle in coronary artery disease patients--Mount Abu Open Heart Trial.. *Indian Heart Journal*. Sept-Oct 2011;63(5):461-9.

7. Arntzenius A, Kromhout D, Barth J, et.al. Diet, Lipoproteins, and the Progression of Coronary Atherosclerosis — The Leiden Intervention Trial. *New England Journal of Medicine*. Mar 1985;312(13):805-11.

8. Gould K, Ornish D, Scherwitz L, et.al. Changes in myocardial perfusion abnormalities by positron emission tomography after long-term, intense risk factor modification. *JAMA*. Sep 1995;274(11):894-901.

9. Gould K. *Coronary arterial stenosis: a textbook of Coronary Pathophysiology, Quantitative Arteriography, Cardiac PET and reversal of Coronary Artery Disease*: Elsevier; 1990.

10. Gould K, Ornish D, Kirkeeide R, et.al. Improved stenosis geometry by quantitative coronary arteriography after vigorous risk factor modification. *American Journal of Cardiology*. Apr 1992;69(9):845-53.

11. Bradbury K, Crowe F, Appleby P, et.al. Serum concentrations of cholesterol, apolipoprotein A-I, and apolipoprotein B in a total of 1694 meat-eaters, fish-eaters, vegetarians, and vegans. *European Journal of Clinical Nutrition*. Feb 2014;68(2):178-183.

12. Cooper R, Goldberg R, Trevisan M, et.al. The selective lipid-lowering effect of vegetarianism on low density lipoproteins in a cross-over experiment. *Atherosclerosis*. Sep 1982;44(3):293-305.

13. Miller M, Beach V, Sorkin J, et.al. Comparative effects of three popular diets on lipids, endothelial function, and C-reactive protein during weight maintenance. *Journal of American Dietetic Assoc*. Apr 2009;109(4):713-7.

14. Aldana S, Whitmer W, Greenlaw R, et.al. Cardiovascular risk reductions associated with aggressive lifestyle modification and cardiac rehabilitation. *Heart and Lung*. Nov-Dec 2003;32(6):374-82.

15. Aldana S, Whitmer W, Greenlaw R, et.al. Effect of intense lifestyle modification and cardiac rehabilitation on psychosocial cardiovascular disease risk factors and quality of life.. *Behavior Modification*. Jul 2006;30(4):507-25.

16. Pischke C, Weidner G, Elliott-Eller M, Ornish D. Lifestyle changes and clinical profile in coronary heart disease patients with an ejection fraction of 40% in the Multicenter Lifestyle Demonstration Project.. *European Journal of Heart Failure*. Sep 2007;9(9):928-34.

17. Pischke C, Weidner G, Elliott-Eller M, et.al. Comparison of coronary risk factors and quality of life in coronary artery disease patients with versus without diabetes mellitus.. *American Journal of Cardiology*. May 2006;97(9):1267-73.

18. Frattaroli J, Weidner G, Merritt-Worden T, et.al. Angina pectoris and atherosclerotic risk factors in the multisite cardiac lifestyle intervention program. *American Journal of Cardiology*. Apr 2008;101(7):911-8.

19. Ellis F, Sanders T. Angina and the Vegan Diet. *American Heart Journal*. Jun 1977;93(6):803–805.

20. Silberman A, Banthia R, Estay I, et.al. The effectiveness and efficacy of an intensive cardiac rehabilitation program in 24 sites. *American Journal of Health Promotion*. Mar-Apr 2010;24(4):260-2.

21. Pischke C, Frenda S, Ornish D, et.al.. Lifestyle changes are related to reductions in depression in persons with elevated coronary risk factors. *Psychology and Health*. Nov 2010;25(9):1077-100.

22. Kwak S, Myung S, Lee Y, et.al. Efficacy of Omega-3 Fatty Acid Supplements in the Secondary Prevention of Cardiovascular Disease. *Archives of Internal Medicine*. May 2012;172(9):686-94.

23. Fodor J, Helis E, Yazdekhasti N, et.al. "Fishing" for the origins of the "Eskimos and heart disease" story: facts or wishful thinking?. *Canadian Journal of Cardiology*. Aug 2014;30(8):864-8.

24. Ebbesson S, Risica P, Ebbesson L, Kennish J. Eskimos have CHD despite high consumption of omega-3 fatty acids: the Alaska Siberia project. *Internat Journal of Circumpolar Health*. Sep 2005;64(4):387-95.

25. Gopinath B, Flood V, Burlutksya G, Mitchell P. Consumption of nuts and risk of total and cause-specific mortality over 15 years.. *Nutrition, Metabolism, and Cardiovascular Diseases*. Dec 2015;25(12):1125–1131.

26. Kris-Etherton P. Walnuts decrease risk of cardiovascular disease: a summary of efficacy and biologic mechanisms. *Journal of Nutrition*. Apr 2014;144(4 Suppl):547S-554S.

27. Farooq V, Gogas B, Serruys P. Restenosis: delineating the numerous causes of drug-eluting stent restenosis. *Circulation, Cardiovascular Interventions*. Apr 2011;4(2):195-205.

28. Ornish D. Avoiding revascularization with lifestyle changes: The Multicenter Lifestyle Demonstration Project. *American Journal of Cardiology*. Nov 1998;82(10B):72T-76T.

29. Highmark Blue Cross Blue Shield. *Two-Year Results of Highmark Blue Cross Blue Shield's Dr. Dean Ornish Program For Reversing Heart Disease Demonstrates Outstanding Lifestyle Improvements By The Men and Women Who Took Bold Step in Quest For Longer, Better, Happier Lives*. Pittsburgh: PR Newswire; 1999.

30. Ornish D. *Dr Dean Ornish's Program for Reversing Heart Disease.*: Random House; 2010.

31. Kaiser Family Foundation. *New Kaiser/New York Times Survey Finds One in Five Working-Age Americans With Health Insurance Report Problems Paying Medical Bills*: kff.org; 2016.

32. Hasty R, Garbalosa R, Barbato V, et.al. Wikipedia vs peer-reviewed medical literature for information about the 10 most costly medical conditions. *Journal of American Osteopath Assoc*. May 2014;114(5):368-73.

33. Centers for Disease Control and Prevention, National Center for Health Statistics. *Underlying Cause of Death 1999-2013*: Wonder.CDC.gov/ucd-icd10.html; Accessed Feb 3, 2015.

34. Heidenreich P, Trogdon J, Khavjou O, et.al. Forecasting the future of cardiovascular disease in the United States: a policy statement from the American Heart Association.. *Circulation*. Mar 2011;123(8):933-44.

35. Schwartz K, Roe T, Northrup J, et.al. Family Medicine Patients' Use of the Internet for Health Information: A MetroNet Study. *Journal of American Board of Family Medicine*. Jan-Feb 2006;19(1):39-45.

36. Tuso P. Nutritional Update for Physicians: Plant-Based Diets. *The Permanente Journal*. Spring 2013;17(2):61-66.