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Effect of Low Calorie, High Anti-oxidant Diet on Progression of Coronary Artery Disease: A Single Case Experimental Study

Abstract

Introduction: A large amount of scientific evidence supporting the hypothesis that nutritional modification might prevent cardiovascular disease (CVD) deaths, could even reverse the remodelling and risk factors of CVD. However, studies on the interplay between diet and CVD are scarce especially in low- and middle-income countries. The current single patient observational study attempted to evaluate the relationship between controlled diet along with standard medication and coronary artery disease (CAD) outcomes.

Methods and results: A 69-year-old male, with a known history of diabetes and occasional postprandial angina, diagnosed with ischemic heart disease and triple vessel disease with 80-90% narrowing in all three epicardial branches of the coronary artery was enrolled in this study. The patient was put on the interventional phase (reverse diet) for 12 weeks after completion of the baseline phase. The reverse diet contained pre-portion ready to cook food products to fulfil daily requirements of breakfast, lunch, dinner, soup, and early morning diet. He was suggested for daily walk and exercise (less aerobic). At the end of the intervention, the patient's overall calcified and non-calcified plaque volume, lumen volume, atheroma plaque volume was found reduced as confirmed by computed tomography angiography (CTA). Additionally, the patient's standard medications were also reduced after the intervention by approximately 50%.

Conclusion: This single patient evidence suggested that the low calorie and anti-oxidant rich reverse diet intervention is capable to reduce the odds of CAD.

Keywords: Atheroma; Cardiovascular disease; Coronary artery disease; Plaque volume; Reverse diet

Rohit S¹, Rahul M^{2*} and Amin G³

- 1 Madhavbaug Clinics and Hospitals Mumbai, India
- 2 Head of Research and Development, Madhavbaug Clinics and Hospitals Mumbai, India
- 3 M.D in Ayurveda, Head of Medical Department, Madhavbaug Clinics and Hospitals Mumbai, India

*Corresponding author: Rahul M

drrahul@madhavbaug.org

Head of Research and Development, Madhavbaug Clinics and Hospitals Mumbai, India

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Introduction

Coronary artery disease (CAD) is the major cause of cardiovascular disease (CVD) deaths, followed by stroke and heart failure. CVD accounts for approximately 800,000 deaths in the United States, while, CAD is the leading cause of morbidity related to CVD in both men and women. The development of atherosclerotic lesions in coronary arteries is central to the pathogenesis of CAD and its progression depends upon various environmental and genetic risk factors, amongst, obesity, diabetes, hypertension, and dyslipidaemia are the greatest risk factors [1-3].

Unhealthy dietary patterns including excessive intake of sodium and processed foods; added sugars; unhealthy fats; and low intake of fruit and vegetables, whole grains, fibres, legumes, fish, and nuts along with overweight and obesity, stress, alcohol consumption, smoking found increase the prevalence of CVD. The Global Burden of Disease study also considered an unhealthy diet as a major factor behind CVD and its risk factors [4-6]. Hence, the prevention of CVD through lifestyle modifications has become a public health priority [5]. Indeed, a large amount of scientific evidence supporting the hypothesis that nutritional modification might prevent CVD deaths, could even reverse the remodelling and risk factors of CVD such as overweight/obesity, hypertension, diabetes, or dyslipidaemia [2,7,8].

Therefore, the identification and classification of such dietary patterns have become a priority. Indeed, the international development and nutrition community trying to draw attention to the development of such food systems. However, studies on the interplay between diet and CVD/CAD are scarce especially in low and middle-income countries [5]. The current single patient experiment attempted to evaluate the relationship between controlled diets along with standard medication and CAD outcomes [9,10].

Materials and Methods

A 69-year-old male, with a known history of diabetes since 10-12 years had a complaint of occasional postprandial angina when investigated with cardiac stress testing was diagnosed with ischemic heart disease. Angiography on 19 Oct 2019 suggested triple vessel disease (TVD) with 80-90% narrowing in all three epicardial branches of the coronary artery. The patient has a BMI of 22.3 kg/m² (height: 176 cm and weight: 69 Kg). At baseline patient's systolic blood pressure (SBP) was 140 mm/Hg, diastolic blood pressure (DBP) was 90 mm/Hg, heart rate was 63 pulse/ min, and blood sugar level was 115 mg/dl. Informed consent was obtained from the patient before the intervention on 19 Dec 2019.

Research design

The study involves a single patient assessment where the patient acted as his control. The study was performed in two phases: The baseline phase and the intervention phase.

Baseline phase: The duration before the intervention, when all the baseline parameters were noted.

Intervention phase: The intervention phase was of 12 weeks, where, the patient was put on the reverse diet. Patients were suggested for daily walk and exercise (less aerobic). During this phase patient's daily diet, weight, SBP, and DBP before and after the walk were monitored. Characterization and quantification of atherosclerotic plaque as calcified fibrotic and lipid core was done with help of 128 slice CCTA (cardiac CT angiography) keeping resting HR below 70/min and breath hold for 15 sec [11]. Non-ionic contrast was given during procedure. These measurements were carried out before intervention on 2 Nov 2019 and after intervention on 8 Feb 2020. During the entire study, along with the diet intervention, the patient was also prescribed with standard medications including Ecosprin (Aspirin), Clopilet (Clopidogrel), Met XL (Metoprolol), Tonact TG (Atorvastatin+Fenofibrate), TenglynM (Metformin+Teneligliptin), Metride (Glimepride+Metformin), and Ismo (Isosorbide-5mononitrate).

Computed tomography angiography (CTA)

CTA was done after IV injection of non-ionic contrast using electrocardiogram (ECG) gating. Post-procedure the data was collected with dedicated software and images and interpreted as maximum intensity projections (MIP), multiplanar reformation or reconstruction (MPR), curved MPR, and volume-rendering technique (VRT) reformations.

Study intervention

The patient received a reverse diet kit, which is a scientifically designed diet box contained pre-portion ready to cook food products to fulfil daily requirements of breakfast, lunch, dinner, soup, and early morning diet. The diet is proposed to have anti-inflammatory and anti-oxidant properties that help reverse CAD progression, improve vessel health, reduce plaque, and improve blood flow. The nutrition content of the daily reverse diet is given in **Table 1**. The monthly reverse diet kit contained the following products:

- 1. Madhavprash: 5 g twice/ day (Early morning and evening)
- 2. Breakfast options:
- a) Cardiac tea- 2 tea bags (56 tea bags/month)
- b) Muthiya mix- 40 gm per packet (8 packets/month)
- c) Soy dhokla mix- 40 gm per packet (12 packets/month)
- d) Rajma flour dosa- 40 gm per packet (8 packets/month)
- 3. Main meal options: (For Lunch and Dinner):
 - a) Atta mix- 30 gm per packet (56 packets/month)
 - b) Lentil daal mix- 15 gm per packet (56 packets/month)
 - c) Herbs masala mix- 10 gm per packet (28 packets/month)
 - d) Chutney mix- 10 gm per packet (28 packets/month)
 - 4. Evening snacks option:
 - a) Nuts mix chiwda- 30 gm per packet (28 packets/month)
 - b) Tamarind soup mix- 15 gm per packet (28 packets/month)

The monthly diet plan of the patient is shown in **Table 2**. The reverse diet kit contained day to day food ingredients that are easily available in the Indian climate hence no adverse events are expected. However, vomiting, loose motions, hyperacidity may encounter in case of allergy to any of the food ingredients.

Outcome measurement

Following the outcome, parameters were recorded: Weight, SBP, DBP, heart rate, and blood sugar level measured at baseline, and the end of every week during the 12 weeks of the intervention period. Calcium score, calcium volume, % change in calcium volume, calcified plaque volume and % change in calcified plaque volume, non-calcified plaque volume and % change in non-calcified plaque volume, lumen volume and % change in lumen volume, a plaque to the lumen ratio, change and % change in total atheroma volume in the left anterior descending artery (LAD), right coronary artery (RCA), left circumflex artery (LCX), and overall in the body measured at baseline and end of the intervention phase. Standard medications used during the

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Table 1: Nutrition content of the daily reverse diet.

Nutrition Factor	Content		
Calories	1000 Kcal		
Carbohydrates (Low insulin provoking and low glycaemic index carbohydrates)	40% of total calories		
Proteins (Moderate protein)	20 % of total calories		
Fats	40% of total calories		
Vitamin C	1 g per day		
Vitamin E	Fortified		
Potassium	4700 mg		
Omega 3 Fatty Acid	Quantity sufficient		
Low sodium	Quantity sufficient		
Garlic	Quantity sufficient		
Ginger	Quantity sufficient		

Table 2: Monthly diet plan of the patient.

Time/ Menu	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	
Early morning	1 tsp of Madhavprash							
	Boiled egg whites							
Breakfast (8 am)	1 Cup cardiac tea							
	Muthiya mix	Sou dhakla mix ((3-4 2 small Raima Soy dhoki	Sov dhokla mix	Muthiya mix	Soy dhokla mix (3-4 Medium pcs)	2 small Rajma Flour Dosa	
	(5-6 small Steam Balls)	Medium pcs) Flour Dosa	(3-4 Medium pcs)	(5-6 small Steam Balls)			
	2 tsp green chutney							
Mid-morning (11 am)	1 medium fruit							
	With lunch and dinner 1 tsp of chutney							
Lunch (1 pm)	1 bowl salad + pc of lemon							
	2 small fulka							
	1 bowl vegetable							
	1 bowl lentil daal							
	Grilled or steam 3-4 small pc chicken/fish							
Mid-evening (4.30 pm)	1 cup cardiac tea							
	1 cup nut mix chiwda+ 1tsp Madhavprash							
Evening (6.30 pm)	1 bowl tamarind soup							
Dinner (8 pm)	1 bowl salad + pc of lemon							
	2 small fulka							
	1 bowl vegetable							
	1 bowl lentil daal							

intervention and after the end of the intervention were also recorded.

Results

At the end of week 12, the patient's weight was reduced by 1.3 kg, SBP and DBP were reduced by 24 and 23 mm/Hg respectively,

and blood sugar was reduced by 12 mg/dl. The overall calcified and non-calcified plaque volume, lumen volume, and atheroma plaque volume was found reduced at the end of 12 weeks of intervention (**Figures 1, 2 and Table 3**). The CTA results are depicted in **Figure 3**. Additionally, after the intervention, the requirement of the standard medications of the patient Interventional Cardiology Journal ISSN 2471-8157

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LCX: Left circumflex

RCA: Right coronary artery

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Table 3: Change in total atheroma volume from baseline to week 12.

Artery	Before (mm³)	After (mm³)	Change (mm ³)
Left anterior descending	146.4	84.9	61.5
Left circumflex	38.2	56.9	-18.7
Right coronary artery	241.9	159.7	82.2
Overall atheroma plaque volume	426.5	301.5	125



was reduced considerably and prescribed. Only with Tenglyn (Metformin+Teneligliptin), and Metride (Glimepride+Metformin).

Discussion

A recent study in Jordanians evaluating the effect of dietary patterns on the risk of cardiovascular heart diseases (CHD) found that a healthy and high fibre diet lowers the odds of CHD by

40%. The healthy and high fibre Jordanian diet contains fruits, vegetables, fish, and olive oil which is found similar to other healthy dietary patterns. Various studies from the USA and Europe also found that a healthy diet lowers the risk of CHD by 20% to 30% [12-15] in the interventional study with the Mediterranean diet showed a 38% reduction in CVD compared to control. The Mediterranean diet which contains olive oil, fruits,

vegetables, nuts, legumes, and fish is found healthy in reducing the risk of CVD in various other studies [16]. This experimental evidence served as a scientific basis for the preventive activity of a healthy diet in CVD [17,18].

The trans-fats and saturated fats found an increased risk of CHD, while polyunsaturated fats are found protective. Dietary sodium is associated with elevated blood pressure, while dietary potassium lowers the risk of hypertension and stroke. Various fruits and vegetables have a protective action against hypertension, CHD and stroke. Hence, the composite diets (such as dietary approaches to stop hypertension (DASH) diets, Mediterranean diet, and 'prudent' diet) found reduced the risk of hypertension and CHD and also secondarily prevent CVD [19,20].

The reverse diet intervention in the current study is composed of low carbohydrates, a rich source of omega 3 fatty acids, vitamins, and minerals. Carbohydrates help reduce weight, inflammation, triglycerides, and high-density lipoproteins and thereby improve vessel health. The daily intake of omega 3 fatty acids reduces the formation of inflammatory products, and vitamins and minerals have antioxidant property which neutralizes pro-inflammatory products and free radicals thereby holds inflammation. Vitamin C raises immunity; it also increases collagen synthesis and protects blood vessels. Pomegranate and garlic are a rich source of nitric oxide and have proven antioxidant property which helps dilate the blood vessels, lowers blood pressure, clotting, and plaque formation. The anti-oxidant capacity of the reverse diet is 64,000 oxidative radical absorption capacity (ORAC) units per day which is far higher than any conventional food serves (3000-4000 ORAC units per day). Adhering to such diets will help to reduce endothelial dysfunction and cessation of atherosclerotic plaque progression and ultimately primary and secondary prevention of CVD. Similarly, in the current study of CAD patients, at end of the intervention atheroma formation, blood pressure, weight, overall calcified and noncalcified plaque volume, and overall the odds of CAD, found reduced. Additionally, with the help of the study therapy the dependence on standard medications to manage CAD was reduced by 50% approximately.

Conclusion

CAD is an outcome of metabolic syndrome. Qualitative and quantitative dietary correction plays an essential role avoid inflammation and further progression of metabolic diseases such as atherosclerosis. Medicines like statin can positively help in atherosclerotic plaque regression but simultaneous dietary correction may augment plaque progression. Therefore reverse diet kit as stand-alone as well as add-on may be helpful in patients with CAD. It is also known to impart maximum compliance as it is available in pre-portioned and pre-packed form. This single patient evidence suggests beneficial effect of the reverse diet intervention that may reduce the risk CAD.

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