CHAPTER 4

The Problem of Cardiovascular Disease

4.1 THE PREVALENCE OF CARDIOVASCULAR DISEASE (CVD)

The obesity epidemic carries serious long term health implications because of the increased morbidity associated with being overweight and obese. There is a tendency towards heightened risk factors and a greater incidence of diabetes mellitus, cardiovascular disease (CVD) endpoints such as coronary heart disease, stroke, and heart failure. In addition, degenerative joint disease, asthma, and cancer are intimately tied to obesity. Cardiovascular disease refers to people suffering from hypertension, heart disease (HD), stroke, peripheral artery disease (PAD), and diseases of the veins. It is the most prevalent medical disorder in the United States with a total of 82.6 million Americans who have one or more types of CVD, representing about 24% of the U.S. population. It is not surprising then that as many as 76.4 million suffer from hypertension. As of 2008 both CVD and stroke alone carried a price tag of $297.7 billion in direct and indirect costs. By contrast cancers and benign neoplasms cost $228 billion in direct and indirect medical expenses (Roger et al., AHA 2012). It is also responsible for the greatest mortality in the United States, representing 810,810 deaths in 2008 or 32.8% of all reported deaths in the United States that year. Although death rates from CVD have declined 30.6% between 1998 and 2008, CVD still remains a significant health burden. This is especially true when specific metrics of good cardiovascular health are measured in the population. It is estimated that 63% of adult whites, and 71% of adult African and Mexican Americans have only three or fewer ideal metrics of good health out of seven (Roger et al., AHA 2012).

4.2 THE CAUSES OF CARDIOVASCULAR DISEASE

4.2.1 Poor Diet and Lifestyle Habits

There four basic behaviors that are considered healthy and conducive to keeping CVD in check in the population. First, moderate to high levels of physical activity need to be included on a daily basis; daily commitments of 60 minutes or 420 minutes per week greatly contribute to managing stable body weights in addition to increasing the HDL cholesterol, known as the good cholesterol. It is concerning that only 61% of teenagers and adults consider themselves as physically active. Second, the decision not to smoke sizably decreases a person's risk of developing heart disease. Approximately 84% of teenagers and 73% of adults are non-smokers in the United States; third, maintaining a BMI<25 has been clearly associated with lower risks of CVD; however, as many as 38% of teenagers and 68% of adults fail to meet that weight standard; fourth, meeting 5 healthy dietary practices can substantially decrease CVD risks.

The American Heart Association Diet & Lifestyle Recommendations (**AHA, 2015; 2006**) affirm the importance of 1) consuming ≥4 to 5 servings /day of fruits and vegetables; 2) a minimum of two 3.5oz-wt servings/week of oily fish such as salmon, mackerel, herring, albacore tuna, lake trout or sardines; 3) maintaining sodium intake to around 1500 mg/day is ideal for lowering BP; 4) keeping added sugar intake to <100g/day for women and <150g/day in men; 5) ensuring the consumption of 6-8oz-equivalent of grain foods/ day of which a least 3oz-wt/day should be whole grains; 6) select fat-free, one percent fat and low-fat dairy products; 7) limiting red meats and specifically processed meats high in saturated fats and sodium; and 8) saturated fat intake should be kept at < 7% of calories, preferably no more than 5-6% of total calories and trans-fats< 1% of calories and cut back on the use of hydrogenated vegetable oils (AHA, 2015; 2006).

The NHANES 2007-2008 survey data measured a number of cardiovascular health risks in the U.S. population, and the findings are setting off alarms at the national level. In the 12–19 year old age group there are a number of dietary and lifestyle practices that heighten this age group's risk of developing CVD early on in their lives (**Figure 4.1**). At a most fundamental level, impoverished eating habits are now forcibly making this crisis alarmingly dangerous. An imposing 92% of teenagers fail to consume more than 4.5 cups of vegetables/day, whereas 88% of those older than 20 years do not meet this basic healthy nutrition goal.

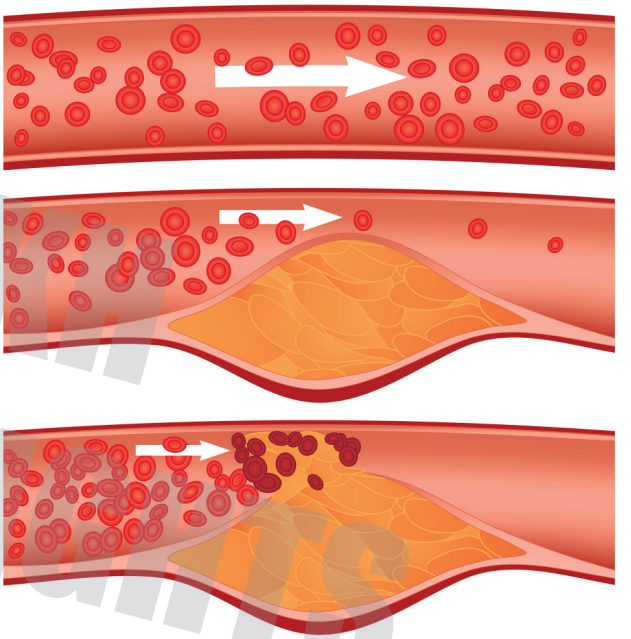

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Figure 4.1 *Atherosclerosis in the arteries.*

And it is the quality of the fats that are consumed specifically that impact the vascular system. Atherosclerosis is defined as a chronic inflammatory disease that generally culminates in athero-thrombotic complications, after several decades of silent development. A gradual thickening of the arterial walls by an atheroma causes a slowed circulation because of a narrowing of the artery leading gradually to obstruction. The end point is acute coronary syndromes, which often occur as a heart attack or stroke. Indeed, arterial obstruction prevents the oxygen-rich blood from reaching specific tissues. A heart attack occurs when a specific region of the heart muscle receives inadequate oxygen; a stroke is when regions of the brain are deprived of blood because of a vascular obstruction (**Figure 4.1**). Cardiovascular risk factors such as hypercholesterolemia,

hypertension, smoking, or diabetes are often at the source of the inflammation. There are other circumstances however, when inflammation precedes atherosclerotic alterations. One of the theories behind atheroma formation begins with an arterial wall injury resulting from elevated BP. Damage to the inner wall of the artery called the endothelium, initiates an inflammatory response which causes a convergence of free and esterified cholesterol, monocytes and macrophage which form a foam-like substances that attempts to heal the injury through fibrosis and calcification. It is precisely at the location of arterial lesions that platelets begin to aggregate and stick to the injury site, leading often times to the formation of blood clots and to an eventual obstruction to blood flow, resulting in a heart attack (Balanescu et al., 2010; Grundy, 2006). The diet can protect against the formation of an atheroma and heart attack most notably through the consumption of omega-3 fatty acids, abundantly found in oily fish. These fish are particularly rich in EPA and DHA, which are known fatty acids that protect against strokes and cardiovascular events. Sadly, only 9.2% of teenagers and 18.3% of adults over 20 years of age consume ≥ 2-3.5oz-wt of oily fish servings/week. Sodium intake in foods tends to be very elevated the more processed the food. The ingestion of sodium needs to be controlled because of its tie to hypertension. Here again there are concerns at the population level as less than 1% of teenagers and adults maintain their sodium intake < 1500mg/day. The NHANES 2005-2006 survey revealed that 90.4% of adult Americans do in fact exceed their maximal daily allowance of 2400 mg.

Sugary beverages are being ingested in larger volumes at an earlier age. In fact, 68% of teenagers fail to drink ≤450 kcal/week, and as many as 48% of adults fail to keep soft drinks and other sugary beverages in check. When a composite of four to five healthy eating behaviors were monitored in the NHANES 2007-2008 survey, none of the teenagers and a mere 0.3% of the adults met four to five out of the eight recommended healthy eating practices. Is there any wonder that CVD risk factors still remain elevated?

4.2.2 Abnormal Lipid Metabolism

The lipid profile of patients with heart disease reveals high LDL cholesterol, low HDL cholesterol, elevated triglycerides (TG) and often times there is hyperglycemia. Understanding how lipoproteins are formed and work within the scheme of lipid metabolism is critical for understand the diagnosis of heart disease risks as well as the treatments. It begins with fat ingestion in our diet and the absorption of that fat from the lumen of the intestine into the blood and then to the various tissues either for deposition or energy production. The ideal model would be that all the fat ingested at a meal would be taken up by the individual cells and oxidized in the Tricarboxilic acid (TCA) cycle to ATP. In this way there would be no surplus fat to deposit in any of the adipocytes. Obesity would not be a problem in this context. Unfortunately, obesity and heart disease are two of the main epidemics currently afflicting American society. The main dietary deviances that are causing these problems are the excess total and saturated fats consumed regularly by the population.

Once fat is ingested, the bile, secreted from the gallbladder, emulsifies the fat into dispersed droplets, called micelles, which are then easily hydrolyzed principally by the "lipase" enzyme secreted by the pancreas. Pancreatic lipase is considered the most important fat digestive enzyme. It cleaves the fatty acids from the glycerol backbone thus resulting in free fatty acids. The latter are absorbed into the enterocytes—the cells lining the small intestine—where they are encapsulated into a large lipoprotein called **chylomicron**. Inside this lipoprotein are found long and some medium chain fatty acids, glycerol, phospholipids, proteins and cholesterol. These chylomicrons are released into the circulation first via the **lymphatic system**, which eventually connects with the subclavian vein (superior vena cava), and onwards to the liver (**Figure 4.2**). As the chylomicron circulates in the blood leading to the liver, it deposits its main cargo of triglycerides into muscle cells, where the fatty acids are eventually oxidized, and into the adipocytes for storage. Afterwards, having lost most of the triglycerides, the chylomicron becomes a **chylomicron remnant**

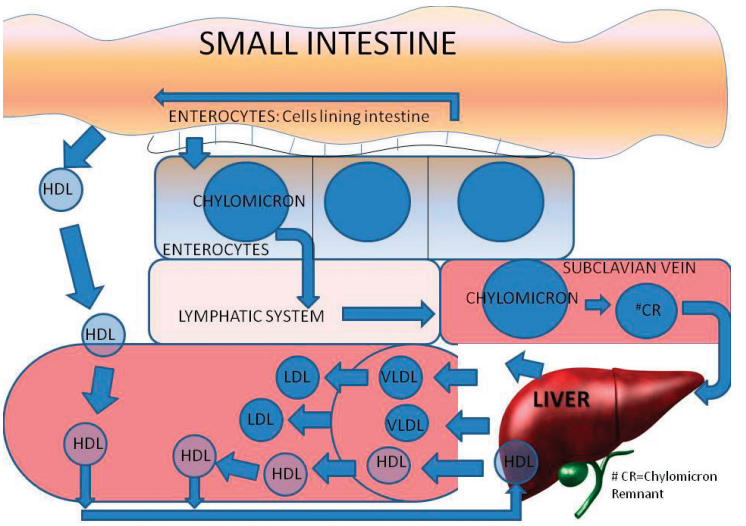

Figure 4.2 *Lipoprotein Metabolism.*

(**CR**), containing significantly less triglycerides and proportionally more cholesterol which it deposits in the liver. From there, very light-density lipoproteins (VLDLs) are released from the liver into circulation with the objective of redistributing the triglycerides into lean tissue and adipose tissue (Hegele, 2009).

As this lipoprotein makes its deposits, it becomes first an intermediary density lipoprotein (IDL) and finally a light-density lipoprotein (LDL) containing mostly cholesterol. It is this lipoprotein that accumulates in the blood of patients with high cholesterol. The high density lipoproteins (HDLs), by contrast, are considered cholesterol scavengers; they are generated from peripheral tissues like the intestines, and from the liver (Figure 4.1). They scavenge the cholesterol from the vascular epithelium and return it to the liver to be repackaged again as VLDLs and recirculated in the blood or utilized for the synthesis of bile by the liver. The clinician, looking over a patient's lipid profile, wants to see elevated HDLs, low LDLs and triglycerides (TG) (See Table-4.2 for lipid standards). The primary targets of lipid-lowering therapy are the LDLs according to the National Cholesterol Education Program (NCEP).

4.3 ASSESSMENT OF CARDIOVASCULAR DISEASE

An important and valuable tool used in the assessment of CVD is **metabolic syndrome**. The NHANES 2003-2006 survey data confirmed that 34% of adult Americans suffer from metabolic syndrome. A cluster of risk factors for CVD and diabetes are used by the frontline clinicians to screen for patients with metabolic syndrome. These are patients with three or more of five risk factors:

1. Fasting blood glucose > 110 mg/dl
2. HDL cholesterol < 40 mg/dl in men and < 50 mg/dl in women, or who are receiving pharmacotherapy for low HDLs
3. Serum triglycerides ≥ 150mg/dl or receiving medication for hypertriglyceridemia
4. Waist circumference ≥40 inches in men, and ≥50 inches in women
5. BP with a systolic value ≥130 mm Hg and a diastolic ≥85mm Hg or a patient treated with antihypertensive drugs who has a history of hypertension (AHA, 2014; NHLBI, 2001).

While most patients with diabetes have metabolic syndrome, some prefer to stratify these patients into a distinct risk category because of the diabetes. Nevertheless, the criteria used to screen patients with metabolic syndrome is consistently used in the healthcare field and so must be well known by dietitians, nurses and other health care professionals.

4.4 STRATEGIES TO CONTROL CVD

The American Heart Association's (AHA) 2020 goal is to improve cardiovascular health by 20% in the U.S population by the year 2020. The AHA defines "ideal cardiovascular health" as the absence of any of the clinical symptoms of CVD, and of the presence of seven health behaviors such as increased lean body mass—this intimates a low but healthy percentage of body fat,—avoidance of smoking, heightened and regular physical activity [PA], and healthy dietary intake practices that are consistent with the standards of the **Dietary Approaches to Stop Hypertension** [**DASH**] (**Table 4.1**). In addition the AHA recommends reaching and maintaining these blood markers: i-untreated total cholesterol <200 mg/dl; ii-untreated BP <120/<80 mm Hg; and, iii- fasting blood glucose <100 mg/dl. Achieving these health behaviors may prove to be more challenging than most people think (AHA, 2006). The diagnosis of high blood pressure should begin once the BP is equal or greater than 140/90, whereas a person is pre-hypertensive with a BP 120-139/ 80-89 (AHA, 2014b).

Strategies for complying with the DASH Diet—The DASH diet encompasses strict dietary guidelines that are healthy but stringent enough to reduce the risks of heart disease in the population if followed closely. The guidelines overlap with the U.S. Food Guide and the Healthy Eating Guidelines for Americans. In many ways the DASH diet is more stringent and therapeutic in decreasing BP. The DASH diet is generated from extensively studying the dietary factors that are most protective against hypertension. Historically, sodium and salt were thought to be the most influential factors in the etiology of hypertension. The DASH diet still encourages

Table 4.1
Daily Nutrient Goals Achieved by Following the DASH Diet

Total Fat	≤27% of calories
Saturated Fat	≤6% calories
Cholesterol	<150 mg/day
Protein	18% of calories
Carbohydrate	55% of calories
Std. Na DASH Limit	<2300 mg/day
Low Na DASH diet	1500 mg/day
Potassium	4700 mg/day
Magnesium	500 mg/day
Calcium	1,250 mg/day
Fiber	30 g/day
Vegetables	4-5 servings/day
Fruits	4-5 servings/day
Whole grains	6-8 servings/day
Nuts, seeds, legumes	4-5 servings/day
Lean meats, poultry, fish	< 6oz-wt/day

Source: AHA, 2006; NHLBI's Guidelines (2014) retrieved from https://www.nhlbi.nih.gov/health/health-topics/topics/dash/

a target sodium intake of no more than 1500mg per day, but now recognizes the importance of calcium, magnesium, potassium, and fiber in maintaining BP in a healthy zone. The goal is to achieve the nutrient intakes recommended in Table 4.1.

Dietary Recommendations of the DASH Diet—Respecting the DASH diet guidelines means eating four to five servings of vegetables per day, an amount most of the American public is not likely to consume. Nevertheless, the standard DASH diet recommends vegetables that are rich in magnesium and potassium such as tomatoes, carrots, broccoli, sweet potatoes, and include greens of various types like spinach, kale, and cabbage, all good sources of fiber. One serving of leafy greens is 1 cup and so is ½ cup of cooked or raw vegetables. The idea is to creatively decrease meat portions by increasing the proportion of vegetables in a dish, for instance.

Fruits servings need to increase to four to five servings/day. One serving is understood to be 1 medium size fruit, ½ cup of fresh, frozen or canned (with no syrup or added sugar), or ½ cup of juice. Fruits need very little preparation, and so can be eaten on the run, as a dessert or as a flavorful snack any time of the day. The snacking industry in the United States is controlled by large multinational corporations that flood the grocery stores with cheap non-nutritious snack foods; their goal is not to feed the population but to make a lot of money. Hence massive snacking publicity campaigns flood the media and the market place, whether on billboards, TV, Internet commercials, or magazines. The ads encouraging the consumption of soft drinks, candies, cakes, pastries, and chips are everywhere. The catastrophic consequences of these expensive campaigns, is that the desire to eat fruit instead has gone down considerably since the 1980s.

Dairy intake needs to represent two to three servings a day as this is a major source of calcium, vitamin D, and protein. Indeed, three servings of milk contain 24g of high quality protein, 900 to 1100 mg of calcium, and 120 to 300 IU of vitamin D. Milk is fortified in the United States following the standard of 40-100 IU/100 Kcals. One serving of dairy equates to 1 cup of milk (skim or 1%) and 1.5oz-wt of cheese. Plain yogurt can be incorporated in the diet with much greater ease than sweetened yogurts. For desserts, it is a good idea to mix frozen unsweetened berry blend fruit mixes into plain yogurt; this strategy maximizes dairy and fruit consumption without including any added sugar (**Figure 4.5**).

Grains need to be included to the tune of six to eight servings/day. One serving consists of ½ cup of cooked cereal, pasta or rice; it will also include 1oz-wt of dry cereal, or 1oz-wt of bread. The goal is to select whole grain products that are elevated in fiber. For instance, brown rice, whole grain pasta, and a high fiber cereal containing at least 5g/serving are excellent choices for reaching the fiber intake goal of 30g/day.

Lean meats, poultry, and oily fish are encouraged. The goal is to consume six or less servings / day. One serving has been defined as 1oz-wt of meat or 1 egg. Eating enough protein in the diet has not been a problem for the American public in recent years because of the abundant meat consumed in the United States. However, the quality of that protein needs to be scrutinized more closely. As a rule the United States is not a great consumer of fish and seafood, but yet, history and research informs us that the omega-3 fats found in salmon, herring, and tuna, are highly protective against heart disease. Otherwise, leaner cuts of poultry and red meats need to be purchased more frequently. The goal here is to decrease saturated fat to ≤6% of calories (DASH diet standard).

Nuts, seeds, and legumes should be consumed more frequently and in greater abundance. The goal is to reach four to five servings /week. One serving is characteristically 1/3 cup of nuts, 2 tablespoons of seeds, or ½ cup of cooked legumes like lentils, Romano beans, kidney beans, navy beans, or soy beans. These are excellent sources of vegetable protein which, when complemented with grains in the diet, form complete proteins. These foods are rich in healthy oils that contain omega-3 and monounsaturated fatty acids. Legumes are also rich in magnesium and potassium, not to mention soluble fibers that help regulate serum cholesterol and decrease the risk of some cancers (Mayo Clinic, 2014).

Fats and oils are valuable in regulating cardiovascular risks. The vilification of fats in recent years has led to the adoption of low fat weight loss diets by many individuals, and to a significant decline in healthy fat intakes. The DASH diet encourages consuming

no more than 27% of calories as fat, and giving preference to monounsaturated fats. In order to maintain saturated fats to <6% of calories, it is imperative that individuals limit their intakes of meat, butter, cheese, whole milk, cream, and eggs, in addition to lard, solid shortenings, palm and coconut oils. There is also intent to restrict the trans fats by avoiding baked goods, crackers, and fried foods made from shortenings and hard margarines.

To help the patient maintain a healthy weight, the recommendation is to consume five or fewer servings of sweets/week. This includes limiting the ingestion of regular soft drinks, candies, and pastries of various types.

Therapeutic Lifestyle Change (TLC)—The Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in adults (Adult Treatment Panel III or ATPIII) has updated a set of guidelines for interpreting blood cholesterol values (Table 4.2). These parameters have been adopted by the National Cholesterol Education Program's (NCEP) clinical guidelines that can help clinicians understand the severity of the hypercholesterolemia and better interpret the dietary and lifestyle guidelines the patients might have to follow in order to significantly alter the clinical risks.

The TLC has specific dietary therapeutic recommendations that can assist the patient in significantly reducing blood lipid values without medications. A minimal 10% weight reduction in combination with regular physical activity will benefit a patient if minimal dietary adjustments are made: saturated fat should be kept <7% of total kcals, total dietary cholesterol <200 mg/day, 2g/day of plant stanols/

Table 4.2

ATP III Classification of Blood Cholesterol and Triglycerides

Bio measures	Goals mg/dl	Food Items
LDL Cholesterol (mg/dl)	<100	Optimal
	100-129	Near optimal
	130-159	Borderline High
	160-189	High
	≥190	Very high
TTL Cholesterol (mg/dl)	<200	Desirable
	200-239	Borderline High
	≥240	High
HDL Cholesterol (mg/dl)	>40	desired for men
	>50	desired for women
	≥60	Ideal / protective against heart disease
Triglycerides (TG) (mg/dl)	<150	Desirable
	150-199	Borderline High
	200-499	High
	≥500	Very high

Source: Shils, M.E, 2006, p: 1896; AHA, 2006; NHLBI, 2005, 2001

sterols can be taken in combination with viscous soluble fibers (10-25g/day). The recommendations in Table 4.3 are the complete TLC dietary guidelines.

4.5 CVD CASE STUDY-4.1: A 54-YEAR-OLD MALE WITH HYPERLIPIDEMIA

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Figure 4.3 *A 54-Year-Old Male Being Treated for Hyperlipidemia.*

4.5.1 Presentation

John B. is a 54-year-old male business executive who came for his yearly checkup. He presented with no specific complaints and has maintained a clean bill of health for all of his life. The yearly review documented early hypertension, and hypercholesterolemia. His current weight: 183 lbs; his height: 5 feet 9 inches. Patient admits gaining 20 lbs over the last year because of excessive work-related travel. Consequently he has not been able to maintain his normal YMCA exercise commitment of 3 times a week for 1 hour and 30 minutes.

4.5.2 Diet Assessment

His dietary habits changed slightly in that he has been eating out more because of traveling and business meetings. He is also drinking more beer and wine at meals compared to previous years. Otherwise his meals are balanced according to the MyPlate food guide.

Table 4.3
Nutrient Composition of the TLC Diet

NUTRIENTS	RECOMMENDED INTAKE
Saturated Fat	<7% calories
Polyunsatured fat	Up to 10% calories
Monounsaturated fat	Up to 20% calories
Total fat	25-35% calories
Carbohydrates	50-60 % calories
Fiber	20-30g/day
Protein	~15% calories
Cholesterol	<200mg/day
Grains	7 servings/day
Vegetables	5 servings/day
Fruits	4 servings/day
Lean meats, poultry, fish	≤ 5oz-wt/day

Shils, M.E. et. al. (2006) p: 1898; AHA, 2006

4.5.3 Body Composition Assessment

Patient's BMI of 24 has been maintained stable for many years, which is within the healthy range of 18.5 to 25. His current 20 lb weight gain in the last year now results in a BMI=27 which places him in the overweight category as he is situated within the range of 25 to 29.9. His weight circumference equals 41 inches. Because the circumference measure is >40 inches, he is at risk.

4.5.4 Medical Assessment

His blood biochemistry and general medical exam results are displayed in Table 4.4 below.

The profile indicates that John B. has hypertension, that blood sugars are normal, but that LDL cholesterol is borderline elevated in addition to total cholesterol; HDL is too low, and triglycerides are borderline elevated and he is pre-hypertensive. This is an ideal candidate for diet therapy and lifestyle modification to help bring risk factors down.

4.5.5 Recommendations—Exercise Prescription

First, weight loss is the primary goal; losing 20 lbs over the next 40 weeks should bring his BP down. Aiming for slow but regular weight loss is possibly the ideal way to lose weight as it decreases the chances of weight regain after dieting. In addition, including an exercise schedule could possibly accomplish two things: first, accelerate the weight loss from heightened energy expenditure; second, exercise is known to increase HDL cholesterol in the blood. According to the *2008 Physical Activity Guidelines for Americans*, adults should complete 150 minutes/week of moderate intensity aerobic exercise (2 hours 30 minutes). Spread over five days that works out to be 30 minutes/day. The patient should additionally dedicate two days or more of muscle strengthening exercises at a rate of at least 30 minutes per day. This would help the patient lose the weight or at the very least prevent further weight gain (Health & Human Services, 2008). Physical activity can be increased to 300 minutes/week and split between vigorous and moderate aerobic activity in addition to two days of muscle strengthening exercise.

Diet Prescription: A restrictive diet would not be recommended as the patient only recently gained weight because of excess alcohol intake and more meals eaten in restaurants while traveling. Patient should simply be advised to drink only one alcoholic beverage with meals, and to consistently eat only 50-75% of the plate served at a restaurant; this will decrease total fat, saturated and sodium in amounts sufficient to bring down LDLs and TGs. The rationale here is simply that larger portions are generally served in restaurants, and often the entrées are cooked in oil and salt to enhance the taste. It is a successful approach used to increase sales and repeat food acquisition behaviors. Otherwise, recommend that the patient continue to eat normally.

Table 4.4
Results of Medical Tests

TESTS	ACTUAL	GOAL
Glucose (mg/dl)	85	≤100
LDL Cholesterol (mg/dl)	135	<100
HDL Cholesterol (mg/dl)	38	≥60
BP mmHg	138/87	<120/80
Triglycerides (TG) (mg/dl)	179	<150
Total Cholesterol (mg/dl)	223	<200

Source: NCEP 2001 report JAMA 16 (285): 2486- 97

4.6 CVD CASE STUDY-4.2: A 38-YEAR-OLD MALE WHO SUFFERED A HEART ATTACK

Credit © Luis Louro /Shutterstock.com

Figure 4.4 *A 38-Year-Old Heart Attack Victim.*

4.6.1 Presentation

Ryan V. is a 38-year-old pharmaceutical sales representative with a family history of heart disease. He suffered a heart attack about five weekends ago while doing home repairs. He underwent bypass surgery two weeks ago and is now stable.

4.6.2 Medical Assessment

The BMI reveals that Ryan is obese. There is a family history of heart disease and obesity; both his father and mother are obese. Prior to the heart attack his weight was 305 lbs; since the surgery he has lost 49 lbs resulting from a loss of appetite. Since the heart attack he stopped eating snacks, drinking beer and barely eats his regular meals. He admits experiencing a fear of eating as he perceived most of his dietary selections as being responsible for his heart attack. His chart information is described in Table 4.5.

Table 4.5
Patient Chart Information

Ryan V... CHART INFORMATION		
Age: 38		
Current Weight: 256 lbs		
Usual Weight: 305 lbs		
Height: 5 feet 11 inches		
Patient lost 49 lbs since suffering a heart attack and going through bypass surgery		
TESTS	**ACTUAL**	**GOAL**
*Glucose (mg/dl)	178	≤100
LDL Cholesterol (mg/dl)	165	<100
HDL Cholesterol (mg/dl)	36	≥60
BP mmHg	162/92	<120/80
Triglycerides (mg/dl)	221	<150
Total Cholesterol (mg/dl)	309	<200

Source: NCEP 2001 report JAMA 16 (285), 2486- 97; American Diabetes Association (2011) Standards of Medical Care in Diabetes—2012 Diabetes Care. *Suppl. 1, S11-63. * Fasting plasma glucose*

This patient has serious hypertension that will require medication. His LDL cholesterol is high and will need to be managed by diet and statins (Stone et al., 2013). His total cholesterol is also high. The low levels of HDLs represent a second risk factor that can be related to smoking, elevated trans-fatty acid intake, low exercise, excessive weight, or consuming a lot of refined foods. The patient should be questioned about these possibilities (Harvard Publications, 2010). Mildly elevated triglycerides usually indicate abundant sugar consumption in the form of sucrose or fructose. Being overweight, smoking and alcohol consumption can also contribute to rising serum triglycerides (Malloy, 2007). Very elevated triglycerides tend to be the result of diabetes. The patient's TG levels are in the high risk range of 200 to 499mg/dl. Considering his elevated fasting glucose (178gm/dl) it would be reasonable to suspect type-2 diabetes mellitus. Weight loss will still be recommended in order to avoid having to prescribe oral hypoglycemic agents to control the blood sugars.

4.6.3 Body Composition Assessment

The dietitian used skinfold calipers to determine the percent body fat using a four site approach: Biceps, triceps, subscapular and supra-iliac. Using specific tables a total fat of 47% was established

Waist circumference = 56 inches

His weight: 256 lbs; height 5 feet 11 inches;
BMI= (256lbsX 0.454lbs/Kg)/
(71 inches X 0.0254 meters/inch)^2

The BMI= 116.22 Kg/ (1.803 meters)^2 = 35.75 He is therefore classified as "obese Class-2."

This assessment indicates that the patient is over fat, and has an overabundance of highly atherogenic visceral fat, as indicated by the waist circumference greater than 40 inches.

4.6.4 Lifestyle Assessment

A review of the patient's chart reveals that the patient works long hours and is often traveling nationally. He covers a large territory and so admits to being in motels and hotels most of the time. He refers to his lifestyle as stressful as he is unable to partake in leisurely exercise except on weekends when he is home with his wife and two children. He reports going out to eat in the restaurant to give his wife a break when he is home on weekends. He rates his activity level as low.

Dietary Assessment—The dietitian sat down with the patient and questioned him about his regular eating habits prior to the heart attack. She used a Usual Food Intake assessment in order to evaluate his usual caloric consumption (Table-4.6), and a Food Frequency Questionnaire (FFQ) to ascertain the quality of his diet. The dietitian also assessed the patient's caloric requirements based on his initial reported weight prior to the heart attack (305 lbs). She used the following equation for total energy expenditure:

For men:

$$TEE = [864 - (9.72 \times \text{Age-years})] + [PA \times ((14.2 \times \text{wt.kg}) + (503 \times \text{ht. meters}))]$$

$$TEE = [864-(9.72 \times 38)] + [1.12 \times (14.2 \times 138.47\ \text{Kg}) + (503 \times 1.803\ \text{meters})].$$

$$TEE = [864-369.36] + [1.12 \times (1966.27 + 906.91)]$$

$$TEE = [494.64] + 1.12\ (2873.18)$$

$$TEE = 3712.60 \sim 3713\ \text{kcals}$$

The usual food intake record (Table 4.6) reveals that prior to the heart attack the patient usually consumed 6700 Kcal/day, an amount that could justifiably cause significant weight gain for it was 80.4% in excess of his caloric needs.

Of particular interest was the alarming amount of fat regularly consumed, representing 44.3% of his caloric intake, and amount that far exceeded the recommended macronutrient range of 20 to 35%, proposed by the DASH and TLC diets. Also carbohydrate intake far exceeded his recommended

Table 4.6

Usual Food Intake Record

PATIENT NAME: Ryan V USUAL FOOD INTAKE		
FOODS CONSUMED	**QUANTITY CONSUMED**	**PLACE**
BREAKFAST: TIME		
Never consumes breakfast		Kitchen & car
Coffee (Starbucks Grande + cream)	3 cups (900 ml) or 30fl-oz	
AM SNACKS TIME:		
Chocolate bar (snickers) Reg. size	105.4g (3.76 oz-wt)	Office/car
Pepsi Cola(Reg.)	12fl-oz (355 ml can)	
Donut (Dunkin donut jelly-filled)	3	
LUNCH TIME:		
Pepsi Cola (Reg.)	12fl-oz (355 ml can)	restaurants
French Fries (McDonald's)	Large	
Lay's plain Potato Chips (bag)	5oz bag	
PM SNACK TIME:		
Pepsi Cola (Reg.)	12fl-oz (355 ml can)	McDonald's
Big Mac	1(7.6oz-wt)	
DINNER TIME:		
Sirloin Steak (Logan's Roadhouse)	16oz-wt (448g)	restaurant
Beer--Indian Pale Ale (IPA)	20fl-oz	
Baked Potato (Logan's Roadhouse)	1 whole	
Butter (salted)	4 pats	
Pasta salad	2 cups	
ENEVING SNACK TIME:		
Orville Reddenbacher…butter popcorn	9 cups popped	
Pepsi Cola (Reg)	20fl-oz (591 ml)	

NUTRIENT BREAKDOWN OF USUAL FOOD INTAKE	
Kcals recommended: 3713 kcal/day (3342-4084 Kcals/day)	Kcals eaten: **6700 kcals**
Carbohydrates recommended: 557g/day (60% DRI Kcals) (418-603g)	Carbohydrates eaten: **770g**
Protein recommended: 139g/day (15% DRI Kcals) (93g-325g)	Protein eaten: **185g**
Fat recommended: 103g (25% DRI Kcals) (83-144g)	Fat eaten: **320g**
Total Maximal Sugar: <232g (25% DRI Kcals)	Total Sugar eaten: **272g**
Total Maximal Sodium: <2400 mg/day	Sodium eaten: **5505 mg**

Calories measured using the www.myfitnesspal.com website.

healthy range of 418-603g. His protein intake was acceptable, but his total sugar intake—most of which was added sugar—exceeded his maximal allowance of 232g/day. Since maximal added sugar is <10% of calories, or 93g, his actual intake can therefore be considered alarmingly elevated. This elevated sucrose intake can, in part, explain the elevated triglycerides (Mallow, 2007). Fiber intake was 45g/day which on the surface appears to meet the daily requirement of 30g. However, when broken down per 1000 kcals to be consistent with ADA guidelines, the patient is actually consuming 6.92g/1000 Kcals, which is far less than the recommended 14g/1000 Kcals. It can be concluded therefore, that the patient's diet is poor in fiber content.

4.6.5 Diet Prescription

He has been referred to a dietitian who is a member of cardiac rehabilitation services; she will be reviewing his usual diet and teaching him the DASH diet. The first step consists of prescribing a weight maintenance diet that will first stabilize his weight at his current weight of 256 lbs, while taking into account his low activity factor. Since the heart attack the patient has lost a lot of weight through a fear of eating and poor appetite. It is important at this point to introduce him to healthy eating, reassuring him that it is safe to eat. Once his weight has stabilized, then a more thoughtful plan for slow and gradual weight reduction in combination with increased physical activity may be introduced. Again, the dietitian used the previous TEE equation to assess his daily caloric needs at his current weight of 256 lbs:

For men:

$$TEE = [864 - (9.72 \times \text{Age-years})] + [PA \times ((14.2 \times \text{wt.kg}) + (503 \times \text{ht. meters}))]$$

$$TEE = [864-(9.72 \times 38)] + [1.12 \times (14.2 \times 116.22\ \text{Kg}) + (503 \times 1.803\ \text{meters})].$$

$$TEE = [864-369.36] + [1.12 \times (1650.32 + 906.91)]$$

$$TEE = [494.64] + 1.12\ (2557.23)$$

$$TEE = 3358.74 \sim 3359\ \text{kcals}$$

So then, the total daily calories necessary to maintain this patient's weight at 256 lbs for a short transition period and assuming a low activity factor is: 3359 Kcals/day. The goal is to prescribe a low fat and a high carbohydrate intake rich in complex starches that are high in fiber and consistent with DASH dietary standards.

Using the recommended macronutrient ranges of the Healthy Eating Guidelines for Americans as a guidepost, the dietitian prescribed 55% of calories as carbohydrates, 18% as protein, and 27% as fat. Her intent was to maintain saturated fat < 6% of calories and dietary cholesterol <150 mg/day. Taking into account the elevated BP, the dietitian recommended keeping sodium intake to < 1500 mg/day. Consistent with the full rationale governing the DASH diet, the dietitian also recommends a diet rich in foods abundant in fiber, magnesium (Mg), potassium (K), and calcium (Ca) as they are helpful in controlling BP.

The dietitian's diet prescription for weight maintenance is found in Table 4.7.

There are a number of foods that will need to disappear from his usual menu while he is on the maintenance diet. This means that the food items are non-negotiable; he needs to eliminate them from his normal fare in order to break away from the addictive nature of these foods: soft drinks (regular and diet), fast food, and unhealthy snack foods (chips, donuts, chocolate bars). These foods are important contributors of total and saturated fats, and therefore need to be removed from the menu, and replaced by a broad variety of fruits. Here, innovative approaches will need to be taken into to get these fruits consumed. This will be rather difficult in the beginning because of the patient's taste preference for foods high in sugar, salt, and fat. Innovative strategies involve the use of plain yogurt, high fiber breakfast cereals, and food carvings. Here are some suggestions:

1. Plain yogurt added to frozen berry blend fruits which have no added sugar. Spoon out 1/3 cup of berry blend fruit into a small plastic container, top with ½ cup of plain yogurt, sprinkle 1 tablespoon of granola, and then seal the lid and store in the refrigerator. These are quick snacks that can be easily accessed. This will increase the patient's calcium and antioxidant intake (**Figure 4.5**).
2. For breakfast, 1 cup of high fiber cereal consisting of 1/3 cup of Kellogg's bran buds, 1/3 cup of old fashioned whole oats, 1/3 cup of dried fruits (raisins, dates, cranberries, and apricots). Serve with skim milk or yogurt
3. A smoothie can also be a creative method of consuming vitamin and mineral-rich foods. Mix together in a blender, ½ cup of yogurt (low fat), 1 medium banana, and ½ cup of thawed frozen berry fruits (blackberry, strawberry and cherry mix). Blenderize until smooth, pour in a container that can be sealed and refrigerated.

Table 4.7
Diet Prescription for Weight Maintenance

Macronutrients	Diet prescribed	Goal
Carbohydrates	462g (1847 Kcals)	55%
Protein	151g (605 Kcals)	18%
Fat	101g (907 Kcals)	27%
Total Calories	3359 Kcals	3359 Kcals
Saturated fat	<22g	<20g
cholesterol	<150mg	<150mg
Sodium	<2300 mg	<2300 mg

Credit © Africa Studio /Shutterstock.com

Figure 4.5 *Fresh & frozen fruits mixed with yogurt.*

Figure 4.6 *Carved Melon Swan with Fresh Fruit.*

4 Carve out the center of a watermelon, and fill with pineapple chunks, apples, grapefruit pieces, orange quarters, cantaloupe, strawberries, and blueberries. Mix in about ½ cup of pure orange juice. Serve at meal time so that the whole family can learn to love fruits. This is especially attractive to children (**Figure 4.6**).

After it becomes clear that the patient's appetite is good and his weight stabilized, a slow weight loss diet can be introduced. Rapid weight loss should be discouraged as the evidence appears to indicate that weight regain is almost inevitable (Mann et al., 2007). The only non-surgical approaches that seem to work so far are mild calorie restrictions in combination with regular exercise. The dietitian aimed for about ½ lbs weight loss/week from diet restriction alone. Given that a 3500 kcal deficit in a week equates to a 1 lb weight loss, and that this can be achieved with a 500 kcal deficit/day, it is therefore correct to advance that a 250 kcal restriction would result in a 1/2 lb weight loss per week. Hence the diet prescription for slow weight loss, would amount to a 3109 Kcal/day diet.

The exercise prescription should not involve rigorous high-intensity workouts, but should be of long duration but mild in intensity. The patient does not have an extensive history of exercise.

5 Walking 3 mi/hr at moderate pace for 2 hours/day for a total of 3 days/week will cause an expenditure of 0.025Kcal/ lb/min. This 256 pound man will therefore be able to expend 768 Kcals/2 hours of walking. In combination with his dietary restriction of 250kcals/ day, this patient will be able to afford 1.16 lbs of weight loss/week. Below, the calculations are outlined.

A caloric restriction of 250 Kcals/day equates to 1750 Kcals/week (250 kcal x 7 days). Energy expenditure from walking = 768 Kcals/2 hours of waking. If patient walks 3 times per week the total energy expenditure from walking = 2304 Kcals/week (3 days x 768 Kcals). The total energy deficit arising from both caloric restriction and exercise equates to 4054 Kcals (1750 Kcals + 2304 Kcals). Since a 3500 kcals deficit equals 1 lb of weight loss, then a 4054 kcal deficit/week will equal a loss of 1.16 lbs/week (4054/3500 Kcals).

As the patient loses weight the risk indicators of heart disease such as waist circumference, hyperglycemia, hyperlipidemia, and BP should greatly diminish. In addition, regular exercise should allow HDLs to rise.

PRACTICE QUESTIONS

1. A 45-year-old female patient presents with a BP: 141/93 and LDL: 165mg/dl, a waist circumference=38 inches, TG=184mg /dl, and an HDL=43 mg/dl. What would you conclude about this patient? [ANSWER: hypertensive, hyperlipidemic, metabolic syndrome]
2. A 55-year-old male patient presents with BP=138/88; TG=167mg/dl; HDL=32 mg/dl; waist circumference: 56 inches, BMI=42 [ANSWER: pre-hypertensive, borderline high TGs, metabolic syndrome, extreme obesity class-3]
3. A 67-year-old male presents with a weight=295 lbs, a height=5 feet 11 inches and a sedentary activity level; BP=156/92. Biochemistry indicates LDL= 178 mg/dl; HDL=31 mg/dl; TG=487 mg/dl; waist circumference 58 inches; BIA analysis reveals 49% body fat. Assess this patient and prescribe a diet that best fits his condition
[ANSWER: Discuss in the classroom]

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