# In the name of God



**Medical Nutrition Therapy for Acute Myocardial Infarction**

Dr. Hadi Abdollahzad
Associate Professor in KUMS
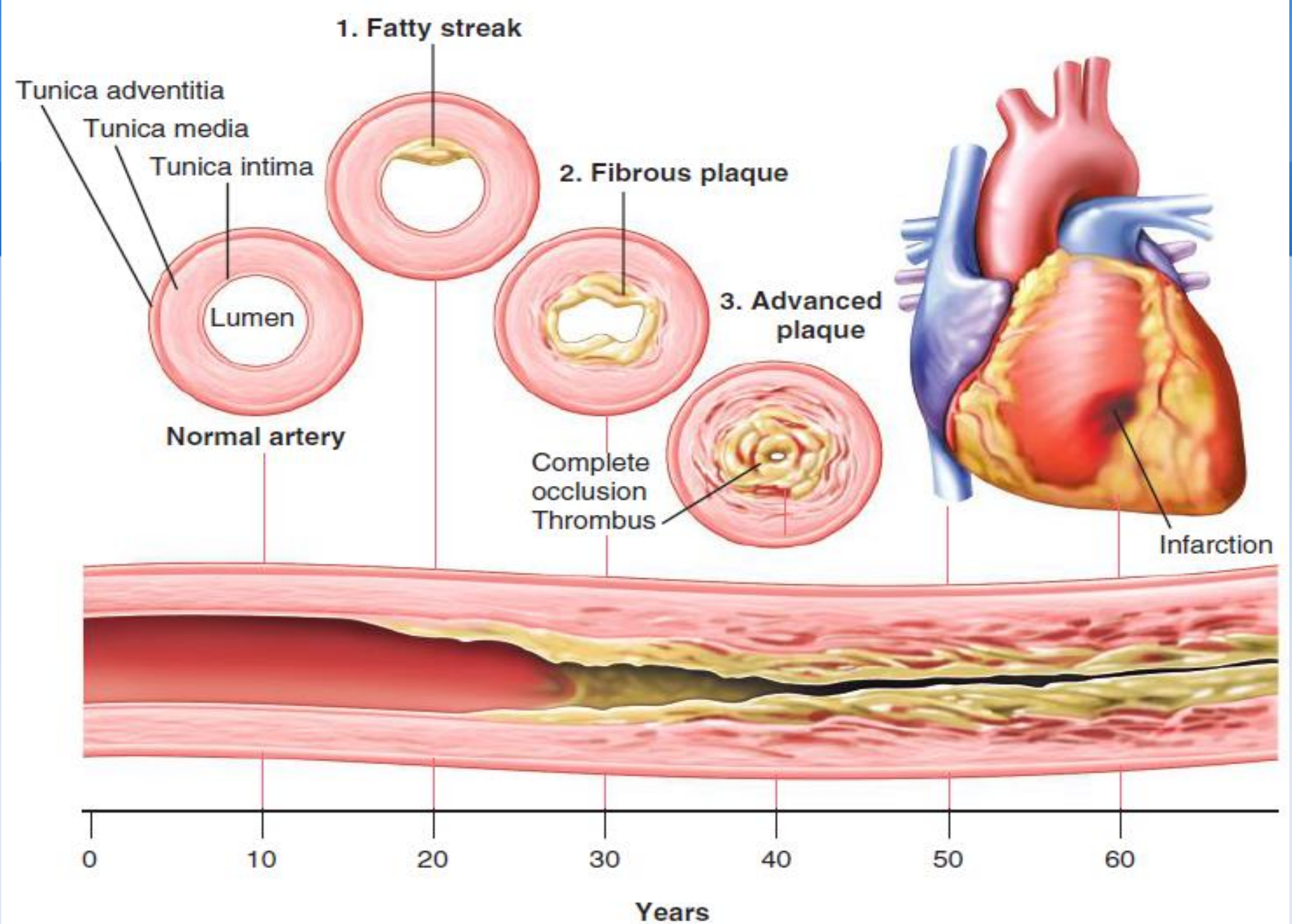Nutrition and Diet Therapy, PhD

**1. Fatty streak**

**2. Fibrous plaque**

**3. Advanced plaque**

Tunica adventitia

Tunica media

Tunica intima

Lumen

Normal artery

Complete occlusion Thrombus

Infarction

Years

0  10  20  30  40  50  60

**FIGURE 33-2** Natural progression of atherosclerosis. (From Harkreader H: *Fundamentals of n*

# Dyslipidemia



- a blood lipid profile that increases the risk of atherosclerosis:
  - LDL ↑
  - HDL ↓

- 3 important biochemical measurements in CVD:
  - lipoproteins
  - total cholesterol
  - triglycerides

**3**

# Total Cholesterol

- 60% - 70% is carried on LDL

- 20% - 30% on HDL

- 10% - 15% on VLDL

- a high serum cholesterol level (specifically high LDL) is one of the key causes of ASCVD, stroke, and mortality.

**4**

# Triglycerides

- The TG-rich lipoproteins:
    - chylomicrons
    - VLDLs
    - any remnants
- Fasting TG levels:
    - normal (<150 mg/dl)
    - borderline high (150 to 199 mg/dl)
    - high (200 to 499 mg/dl)
    - very high (≥500 mg/dl)

**5**

## BOX 33-2 Cardiovascular Disease Risk Factors



### Major Risk Factors

Hypertension

Age (older than 45 years for men, 55 years for women)

Diabetes mellitus

Estimated glomerular filtration rate <60 ml/min

Microalbuminuria

Family history of premature cardiovascular disease (men <55 years of age, or women <65 years of age)

### Modifiable Cardiovascular Risk Factors

Lipoprotein profile

Low-density lipoprotein cholesterol, elevated

Total triglycerides, elevated

Elevated TMAO (Trimethylamine N-oxide)

High-density lipoprotein (HDL) cholesterol, low

Inflammatory markers

Fibrinogen

C-reactive protein

### Lifestyle Risk Factors

Tobacco use, particularly cigarettes

Physical inactivity

Poor diet

Stress

Insufficient sleep

Excessive alcohol consumption

### Related Conditions

Hypertension

Obesity (body mass index >30)

Metabolic syndrome (including reduced HDL, elevated triglycerides, abdominal obesity)

# Inflammatory Markers

- 50% of heart attacks occur in individuals with normal serum cholesterol

- Inflammatory markers indicate:

  - the presence of atherosclerosis in asymptomatic individuals

  - the extent of atherosclerosis in patients with symptoms.

- Plasma levels of ω-3 fatty acids were inversely associated with the inflammatory markers:

  - CRP

  - IL-6

  - Fibrinogen

  - homocysteine

**7**

# Lp-PLA2

- An inflammatory marker specific to **vascular inflammation** has recently become available.

- Lp-PLA2 levels indicate ASCVD risk independent from other markers and provides information on the relationship between inflammation and atherosclerosis.

- The PLAC test measures Lp-PLA2.

Lp-PLA2 = Lipoprotein-associated phospholipase A2

# *Fibrinogen*

- Most MIs are the result of an intracoronary thrombosis.

- **Fibrinogen:** an independent predictor of ASCVD

- elevated fibrinogen is due to:

  - Smoking
  - Diabetes
  - Hypertension
  - Obesity
  - sedentary lifestyle
  - ↑TG
  - Genetic factors

# *C-Reactive Protein*

- synthesized in the liver as the acute-phase response to inflammation.

- In a individual without inflammation or infection, CRP levels are very low <0.6 mg/L.

- CRP elevated (>3 mg/L) in people with angina, MI, stroke, peripheral vascular disease.

- CRP levels:

  - low (<1 mg/L)

  - average (2-3 mg/L)

  - high (>3 mg/L)

- after the average of two measurements are taken at least 2 weeks apart.

- CRP is a general measure of inflammation.

- it is not specific to the heart or vascular.

- therefore an increased level requires further investigation to determine the source of the inflammation.

- vegetable-based diet →↓ CRP levels

# *Homocysteine*

- A metabolite of methionine, is a risk factor for CVD.

- children who were deficient in cystathionine B synthase, had premature atherosclerosis.

- Elevated total homocysteine (tHcy) independently increases the odds of stroke, especially in younger individuals.

- supplementation with vitamins B6, B12.

# *Trimethylamine-N-oxide (TMAO)*

- a gut biota-dependent metabolite that contributes to heart disease.

- Is produced by the liver after intestinal bacteria have digested animal protein.

- TMAO has been shown to predict cardiac risk in individuals not identified by traditional risk factors and blood tests.

# Management of Risk Factors

1- adoption of a <span style="color:green">healthy lifestyle</span>:

- eating a heart-healthy diet
- exercising regularly
- managing weight
- not using tobacco

2- adherence to lipid and hypertension <span style="color:green">drug therapy</span>.

# Lifestyle Guidelines

- Lifestyle modification remains the backbone of MI management.

- lifestyle factors:
  - a heart-healthy diet
  - regular exercising
  - avoidance of tobacco
  - maintenance of a healthy weight

**15**

## BOX 33-4 Summary of ACC/AHA Recommendations for Lifestyle Management

### DIET

*LDL-C*

**Advise adults who would benefit from LDL-C lowering to**

1. Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy products, poultry, fish, legumes, nontropical vegetable oils and nuts; and limits intake of sweets, sugar-sweetened beverages and red meats.
   a. Adapt this dietary pattern to appropriate calorie requirements, personal and cultural food preferences, and nutrition therapy for other medical conditions (including diabetes mellitus).
   b. Achieve this pattern by following plans such as the DASH dietary pattern, the USDA Food Pattern, or the AHA Diet.
2. Aim for a dietary pattern that achieves 5% to 6% of calories from saturated fat.
3. Reduce percent of calories from saturated fat.
4. Reduce percent of calories from trans fat.

## Blood Pressure (BP)

**Advise adults who would benefit from BP lowering to**

1. Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy products, poultry, fish, legumes, nontropical vegetable oils and nuts; and limits intake of sweets, sugar-sweetened beverages, and red meats.
   a. Adapt this dietary pattern to appropriate calorie requirements, personal and cultural food preferences, and nutrition therapy for other medical conditions (including diabetes mellitus).
   b. Achieve this pattern by following plans such as the DASH dietary pattern, the USDA Food Pattern, or the AHA Diet.
2. Lower sodium intake.
3. a. Consume no more than 2400 mg of sodium/day.
   b. Further reduction of sodium intake to 1500 mg/day is desirable because it is associated with even greater reduction in BP.
   c. Reduce intake by at least 1000 mg/day because that will lower BP, even if the desired daily sodium.
4. Combine the DASH dietary pattern with lower sodium intake.

# Mediterranean Diet (MeD)



- Greater number of servings of fruits and vegetables

- Emphasis on root vegetables and greens, whole grains, fatty fish ($\omega$3)

- Lower amounts of red meat (lean meats)

- Lower fat dairy products

- Nuts and legumes, olive oil, canola oil, nut oil, or margarine blended with rapeseed oil or flaxseed oil.

- Total fat (32-35%), relatively low in SFA (9-10%), high in PUFA ($\omega$3), and high in fiber (27-37g/d).

# DASH diet



- high in fruits and vegetables

- low-fat dairy products

- whole grains, fish, and nuts

- low in animal protein and sugar

- Two DASH variations were studied in the OmniHeart:

- one replaced 10% of total daily energy from CHO with Pro

- the other replaced the same amount of CHO with unsaturated fat

- The former had showed better results in lowering CVD risk

# Vegan Diet



- A strict vegetarian diet

- includes no dietary sources from animal origins.

- There is ongoing research to suggest only this type of very restricted diet can actually reverse ASCVD.

# Physical Inactivity

- A risk factor for CHD

- Physical activity lessens CHD risk by:

  - retarding atherogenesis

  - ↑ vascularity of the myocardium

  - ↑ fibrinolysis

  - ↑ HDL

  - improving glucose tolerance and insulin sensitivity

  - aiding in weight management

  - ↓blood pressure

- The 2013 ACC/AHA recommendations : 3-4 sessions of aerobic exercise/week for an average of 40 minutes

# Stress

- Stress activates a neurohormonal response results in:

    - ↑ HR

    - ↑ BP

- The stress hormone, angiotensin II, is released following stimulation of the SNS.

- exogenous infusion of angiotensin II accelerates the formation of plaque.

- effect of stress is comparable to that of hypertension.

# Tobacco Use

- 35% of deaths from tobacco use, are from CVD.

- Women who smoke and use OCPs have 10 times the risk of developing CHD than women who do not smoke and who do not use OCPs.

- Risk increases with the number of cigarettes

- any exposure increases the risk.

# Obesity

- BMI and CHD are positively related:

  - ↑BMI → ↑risk of CHD

- excess adipose tissue affects the heart through:

  - hypertension, glucose intolerance, inflammatory markers, sleep apnea, endothelial dysfunction, and dyslipidemia.

    - Many inflammatory proteins come from the adipocyte.

- Weight distribution (abdominal versus gynoid) is also predictive of CHD risk, glucose tolerance, and serum lipid levels.

- Central adiposity has also been strongly related to markers of inflammation, especially CRP.

- Recommended waist circumference:

  - <35 inches for women
  - <40 inches for men

- Small weight losses (10-20lb) can improve LDL, HDL, TG, high BP, glucose tolerance, and CRP levels, even if an ideal BMI is not achieved.

# Medical Nutrition Therapy

- Discussion of physical activity, is the primary intervention for patients with elevated LDL.

- With diet, exercise, and weight reduction, patients can often reach serum lipid goals and reduce body inflammation.

- An initial visit of 45-90 minutes followed by 2-6 visits of 30-60 minutes each with the RDN is recommended.

- These interventions continue during pharmacologic treatment to enhance effectiveness of the medication.

# Lifestyle recommendations

- The ACC/AHA recommends diet and lifestyle changes to reduce CVD risk.

# *Saturated Fatty Acids*

- sources of SFAs in the diet are animal foods (meat and dairy).

- SFAs raise serum LDL by:

    – ↓LDL receptor synthesis and activity.

- recommendation of SFA for decreasing LDL is 5-6%.

# *Trans-fatty Acids (stereoisomers)*



- produced in the <span style="color:red">hydrogenation process</span> used in the food industry to:

  – increase shelf life of foods

  – make margarines, from oil

- Trans fatty acids:

  - ↑LDL

  - ↓HDL

- FDA (2013) removed Partially hydrogenated oils (PHOs) from the safe list.

# *Monounsaturated Fatty Acids (MUFA)*

- Substituting oleic acid for carbohydrate has almost no appreciable effect on blood lipids.

- replacing SFAs with MUFAs (substituting olive oil for butter) lowers serum cholesterol, LDL, and TG levels.

- Oleic acid as part of the Mediterranean diet has antiinflammatory effects.

**Mediterranean Diet Pyramid**
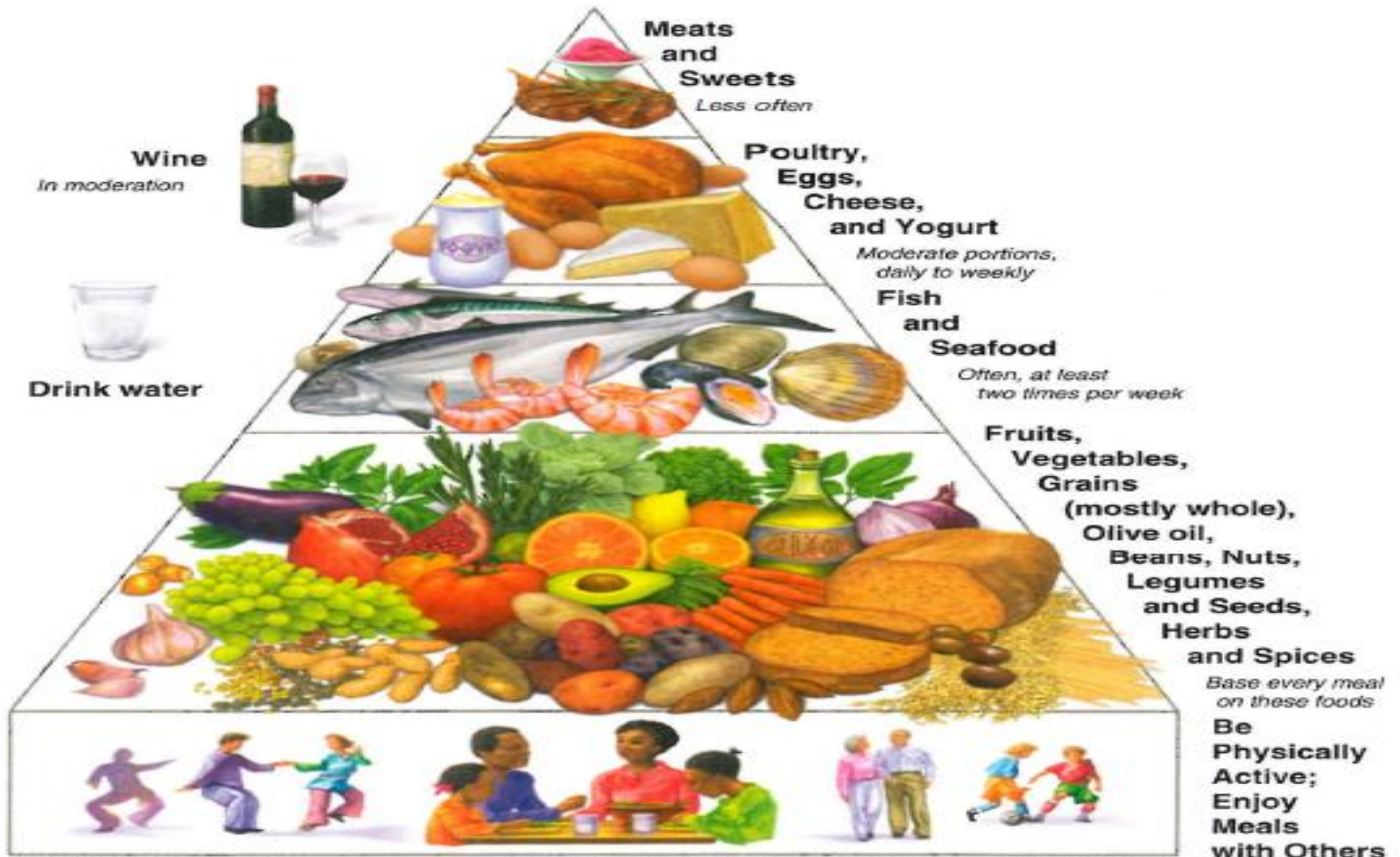A contemporary approach to delicious, healthy eating

Meats and Sweets
Less often

Wine
In moderation

Poultry, Eggs, Cheese, and Yogurt
Moderate portions, daily to weekly

Drink water

Fish and Seafood
Often, at least two times per week

Fruits, Vegetables, Grains (mostly whole), Olive oil, Beans, Nuts, Legumes and Seeds, Herbs and Spices
Base every meal on these foods

Be Physically Active; Enjoy Meals with Others

Illustration by George Middleton

© 2009 Oldways Preservation and Exchange Trust    www.oldwayspt.org

**31**

# *Polyunsaturated Fatty Acids (PUFA)*



- linoleic acid (LA) is the predominant PUFA in the diet.

- High intakes of ω6 (LA):

    - ↓ HDL levels

    - adverse effects on the function of vascular endothelium

    - stimulate production of proinflammatory cytokines

- Replacing PUFAs for CHO →↓ serum LDL.

- When SFAs are replaced with PUFAs in a low-fat diet, LDL and HDL cholesterol levels are lowered.

- eliminating SFAs is twice as effective in lowering serum cholesterol levels as increasing PUFAs.

# *Omega-3 Fatty Acids*

- ω3 (EPA and DHA) are high in fish oils, fish oil capsules, and ocean fish.

- eating fish → ↓CVD risk.

  – general population should eat fish high in ω3 (salmon, tuna, mackerel, sardines) at least twice a week.

- Patients with hypertriglyceridemia need 2-4 g of EPA and DHA per day.

- ω3 lower TG levels by:

  - inhibiting VLDL and apo B-100 synthesis.

- ω3 of vegetables, ALA, has antiinflammatory effects.

- consuming 8 g of ALA daily→↓ CRP

- ω-3 is cardioprotective because:

  - interfere with blood clotting

  - alter PG synthesis.

  - stimulates production of nitric oxide.

- high intakes (Eskimos with low CHD) ↑ bleeding time. **34**

# *Dietary Cholesterol*

- Previous recommendations have been to decrease dietary cholesterol to decrease LDL cholesterol and reduce CVD risk.

- The ACC/AHA 2013 guidelines no longer make this recommendation, and they specifically state that **dietary cholesterol does not raise LDLs**.

- The 2015 US Dietary Guidelines also **eliminate the recommendation to restrict cholesterol**.

- However it is important to remember that most high cholesterol foods are also high in **SFAs** that do raise LDL cholesterol.

# *Fiber*

- ↑intake of fiber→ ↓ CHD and stroke.

- soluble fibers (pectins, gums, mucilages, algal polysaccharides, some hemicelluloses) → ↓LDL.

- Proposed mechanisms:

  - the fiber binds bile acids

  - bacteria in the colon ferment the fiber to produce acetate, propionate, and butyrate, which inhibit cholesterol synthesis.

- Minerals, vitamins, and antioxidants that are components of a high-fiber diet enrich the diet.

- Insoluble fibers such as cellulose and lignin have no effect on serum cholesterol.

  - total recommended fiber intake (25-30 g/d)

  - The most should be from soluble fiber

- This level is easy to achieve with

    - 5 or more servings of fruits or vegetables

    - 6 or more servings of grains per day

# *Antioxidants*

- 2 dietary components (LA and antioxidants) affect the oxidation potential of LDL.

- Vitamins C, E, and β-carotene at physiologic levels have antioxidant roles.

- Vitamin E is the most concentrated antioxidant on LDLs, 20-300 times> other antioxidants. vitamin E prevent oxidation of PUFAs in the cell membrane.

- catechins improve vascular reactivity.

- Red grapes, tea (green tea), berries, beans and olive oil should be in an preventive eating plan.

# *Stanols and Sterols*

- isolated from soybean oils or pine tree oil

- lower blood cholesterol by inhibiting absorption of dietary cholesterol.

- these esters can also affect the absorption of β-carotene, α-tocopherol, and lycopene levels.
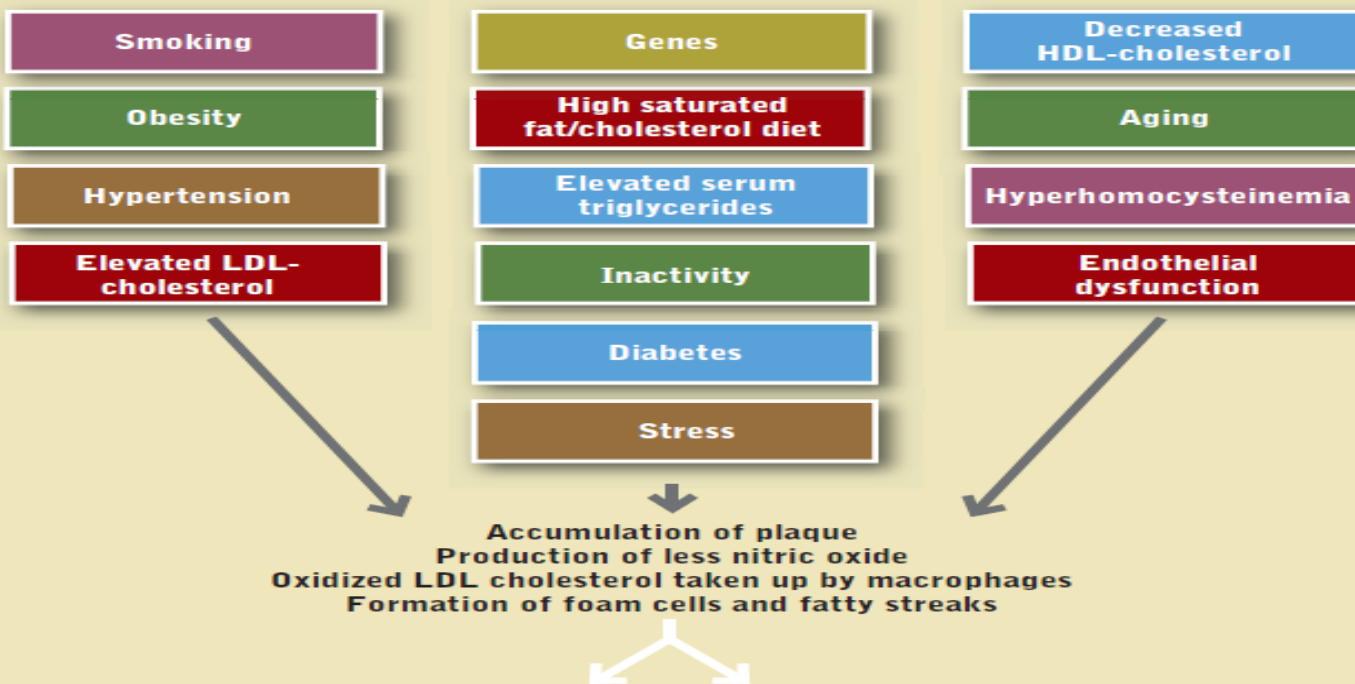
# *Weight Loss*

- obesity raises the risk of hypertension, dyslipidemia, type 2 diabetes, ASCVD, and stroke.

- Obesity is associated with increased risk in all-cause and cardiovascular disease mortality.

## Atherosclerosis

**ETIOLOGY**

| Smoking | Genes | Decreased HDL-cholesterol |
|---|---|---|
| Obesity | High saturated fat/cholesterol diet | Aging |
| Hypertension | Elevated serum triglycerides | Hyperhomocysteinemia |
| Elevated LDL-cholesterol | Inactivity | Endothelial dysfunction |
| | Diabetes | |
| | Stress | |

**Accumulation of plaque**
**Production of less nitric oxide**
**Oxidized LDL cholesterol taken up by macrophages**
**Formation of foam cells and fatty streaks**

**PATHOPHYSIOLOGY**

### Clinical Findings

- Elevated LDL cholesterol
- Elevated serum triglycerides
- Elevated C-reactive protein
- Low HDL-cholesterol

### Nutrition Assessment

- BMI evaluation
- Waist circumference; waist to hip ratio (WHR)
- Dietary assessment for:
  SFA, *trans*-fatty acids, $\omega$-3 fatty acids, fiber, sodium, alcohol, sugar and phytonutrients

**MANAGEMENT**

### Medical Management

- Lifestyle change
- HMG CoA reductase inhibitors (statins)
- Triglyceride-lowering medication
- Blood pressure—lowering medication
- Medication for glucose management
- Percutaneous coronary intervention (PCI)
  - Balloon
  - Stent
- Coronary artery bypass graft (CABG)
- Antiplatelet Therapy

### Nutrition Management

- DASH dietary pattern
- Mediterranean diet pattern
- Weight reduction if needed
- Increase dietary fiber to 25–30 g/day or more
- Add $\omega$-3 fats from food sources
- Add fruits and vegetables
- $CoQ_{10}$ for those on statin drugs

*Thank you*