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DEPARTMENT OF BIOMEDICAL ENGINEERING

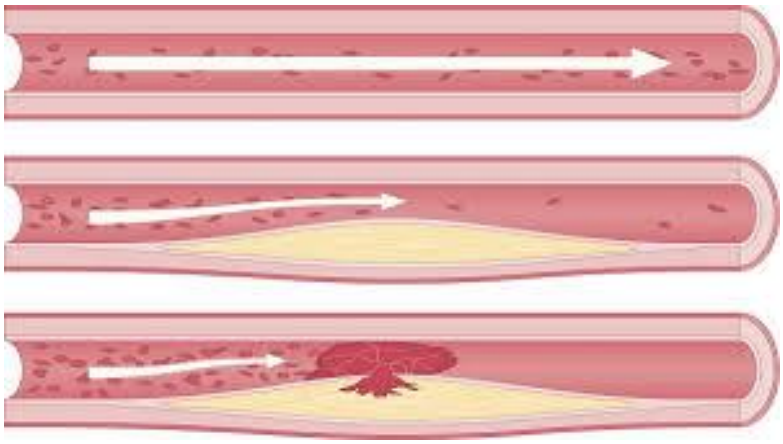
VII Semester

OBT357 BIOTECHNOLOGY IN HEALTH CARE

UNIT- 2 CLINICAL DISEASES

2. 7 Atherosclerosis

Atherosclerosis is a condition where arteries become narrowed and hardened due to plaque buildup (cholesterol, fat, and other substances) on their inner walls, reducing blood flow. It's a major cause of cardiovascular diseases like heart attack and stroke. Below is a comprehensive overview:



2.7.1 Causes of Atherosclerosis:

Atherosclerosis develops over time due to multiple factors:

1. **Primary Causes**:
    - **High Cholesterol**: Excess low-density lipoprotein (LDL, "bad cholesterol") accumulates in artery walls, forming plaques.
    - **Hypertension**: High blood pressure damages artery walls, making them more susceptible to plaque buildup.

- **Smoking**: Tobacco chemicals damage blood vessels and promote plaque formation.

- **Diabetes**: Elevated blood sugar levels injure arteries and increase lipid accumulation.

2. **Contributing Factors**:
   - **Obesity**: Excess body fat, especially abdominal fat, raises LDL and lowers HDL ("good cholesterol").
   - **Sedentary Lifestyle**: Lack of physical activity worsens cholesterol levels and blood pressure.
   - **Unhealthy Diet**: Diets high in saturated fats, trans fats, and refined sugars contribute to plaque buildup.
   - **Genetics**: Family history of cardiovascular disease increases risk.
   - **Inflammation**: Chronic inflammation (e.g., from autoimmune diseases or infections) can trigger or worsen plaque formation.
   - **Age and Sex**: Risk increases with age; men are at higher risk earlier, but women's risk rises post-menopause

2.7.2 Symptoms of Atherosclerosis:

Atherosclerosis often develops silently until arteries are significantly narrowed or blocked. Symptoms depend on the affected arteries:

1. **Coronary Arteries (Heart)**:

   - Chest pain (angina), especially during physical activity or stress.
   - Shortness of breath.
   - Fatigue or weakness.

2. **Cerebral Arteries (Brain)**:

   - Sudden numbness or weakness in arms/legs (especially one side).
   - Slurred speech or difficulty speaking.
   - Vision loss or blurred vision.
   - Dizziness or loss of balance.

3. **Peripheral Arteries (Limbs)**:

    - Leg pain or cramping during activity (claudication).
    - Numbness or coldness in extremities.
    - Slow-healing sores or infections.

4. **Other Areas** (e.g., kidneys, abdomen):

    - High blood pressure (renal artery stenosis).
    - Abdominal pain after eating (mesenteric ischemia).

2.7.3. Diagnosis of Atherosclerosis:

Atherosclerosis is diagnosed through medical history, physical exams, and tests:

1. **Medical History and Physical Exam**:

    - Assessing risk factors (e.g., smoking, diabetes, family history).
    - Checking for weak pulses, abnormal heart sounds, or signs of reduced blood flow.

2. **Diagnostic Tests**:

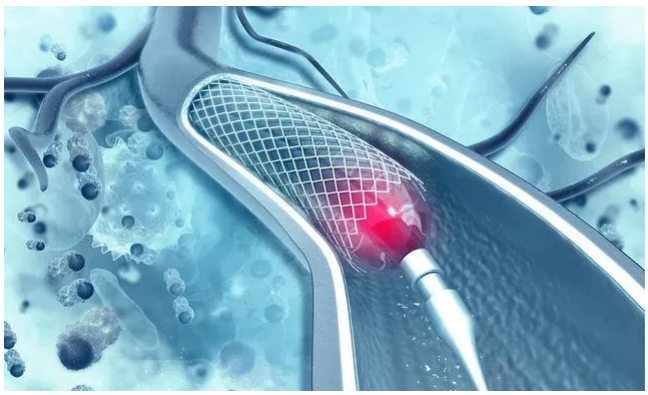
    - **Blood Tests**: Measure cholesterol levels (LDL, HDL, triglycerides), blood sugar, and inflammation markers (e.g., C-reactive protein).
    - **Electrocardiogram (ECG/EKG)**: Detects heart rhythm abnormalities or signs of reduced blood flow.
    - **Stress Testing**: Monitors heart function during exercise to identify blockages.
    - **Echocardiogram**: Uses ultrasound to visualize heart and blood vessel function.
    - **Coronary Angiography**: Injects dye into arteries to visualize blockages via X-ray.
    - **CT Calcium Scoring**: Detects calcium deposits in coronary arteries.
    - **Ankle-Brachial Index (ABI)**: Compares blood pressure in arms and legs to diagnose peripheral artery disease.

- **Carotid Ultrasound**: Evaluates plaque in neck arteries supplying the brain.

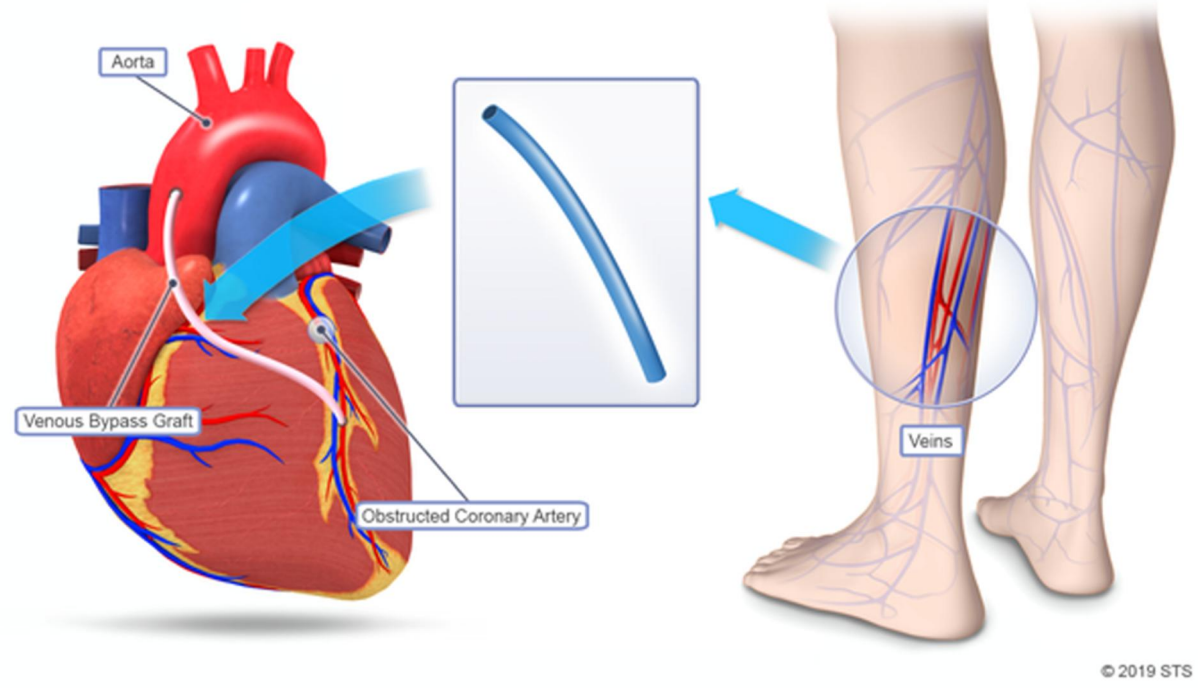
2.7.4 Treatment of Atherosclerosis:

Treatment focuses on relieving symptoms, slowing progression, and preventing complications:

1. **Lifestyle Changes**:
   - **Diet**: Adopt a heart-healthy diet (e.g., Mediterranean diet) rich in fruits, vegetables, whole grains, lean proteins, and healthy fats (e.g., olive oil, fish). Limit saturated fats, trans fats, and sodium.
   - **Exercise**: Aim for 150 minutes of moderate aerobic activity (e.g., brisk walking) weekly, plus strength training.
   - **Quit Smoking**: Smoking cessation programs, nicotine replacement, or medications to reduce vascular damage.
   - **Weight Management**: Achieve and maintain a healthy BMI (18.5–24.9) through diet and exercise.
   - **Stress Management**: Practice yoga, meditation, or counseling to reduce stress-related inflammation.
2. **Medications**:
   - **Statins** (e.g., atorvastatin): Lower LDL cholesterol and stabilize plaques.
   - **Antiplatelets** (e.g., aspirin, clopidogrel): Prevent blood clots.
   - **Antihypertensives** (e.g., ACE inhibitors, beta-blockers): Control blood pressure.
   - **Antidiabetic Drugs**: Manage blood sugar in diabetic patients.
   - **Anticoagulants**: Reduce clotting risk in some cases.
   - **PCSK9 Inhibitors**: For patients with resistant high cholesterol.
3. **Medical Procedures**:
   - **Angioplasty and Stenting**: Opens blocked arteries with a balloon and inserts a stent to keep them open.



- **Coronary Artery Bypass Grafting (CABG)**: Creates new routes for blood flow around blocked arteries.



- **Carotid Endarterectomy**: Removes plaque from carotid arteries to prevent stroke.
- **Peripheral Artery Interventions**: Similar procedures for leg arteries.

4. **Management of Underlying Conditions**:
    - Control diabetes, hypertension, and other conditions through medication and lifestyle.

2.7.5 Prevention of Atherosclerosis:

Preventing atherosclerosis involves reducing risk factors:

1. **Healthy Diet**:
   - ❖ Focus on low-saturated-fat, high-fiber foods (e.g., oats, beans, nuts).
   - ❖ Limit processed foods, red meat, and sugary beverages.
2. **Regular Exercise**:
   - ❖ Engage in 30 minutes of moderate activity most days (e.g., walking, cycling).
   - ❖ Include strength training to improve metabolism and heart health.
3. **Maintain Healthy Weight**:
   - ❖ Aim for a BMI below 25; waist circumference <35 inches (women) or <40 inches (men).
4. **Avoid Smoking**:
   - ❖ Quit smoking and avoid second-hand smoke exposure.
5. **Control Risk Factors**:
   - ❖ Monitor and manage cholesterol, blood pressure, and blood sugar regularly.
   - ❖ Regular check-ups to detect early signs of atherosclerosis.
6. **Limit Alcohol**:
   - ❖ Stick to moderate drinking (up to 1 drink/day for women, 2 for men).
7. **Mental Health**:
   - ❖ Address stress, anxiety, or depression through therapy or relaxation techniques.
8. **Community and Policy Support**:
   - ❖ Support initiatives for smoke-free zones, healthier food options, and safe spaces for physical activity.

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