DISORDER OF THE CARDIOVASCULAR SYSTEM

Anatomic and physiologic overview of CVS

Cardiovascular system

- Is the transport system of the body by which food, oxygen, water and all other essentials are carried to the tissue cells and their waste products are carried away
- It consists of three parts:
  - The blood,
  - The heart
  - The blood vessels

Anatomic and physiologic overview cont…

The Blood

- Blood is classified as a connective tissue, since nearly half of it is made up of cells.
- However, it differ from other connective tissues in that its cells are not fixed in position, instead they move freely in the liquid portion of the blood, the ***plasma.***

Anatomic and physiologic overview cont…

Functions of the Blood

- **Transportation**
  - Oxygen
  - foods and other needed substances
  - waste products
  - Hormones
- **Regulation**
  - PH
  - body temperature
- **Protection**
  - against pathogens
  - blood loss

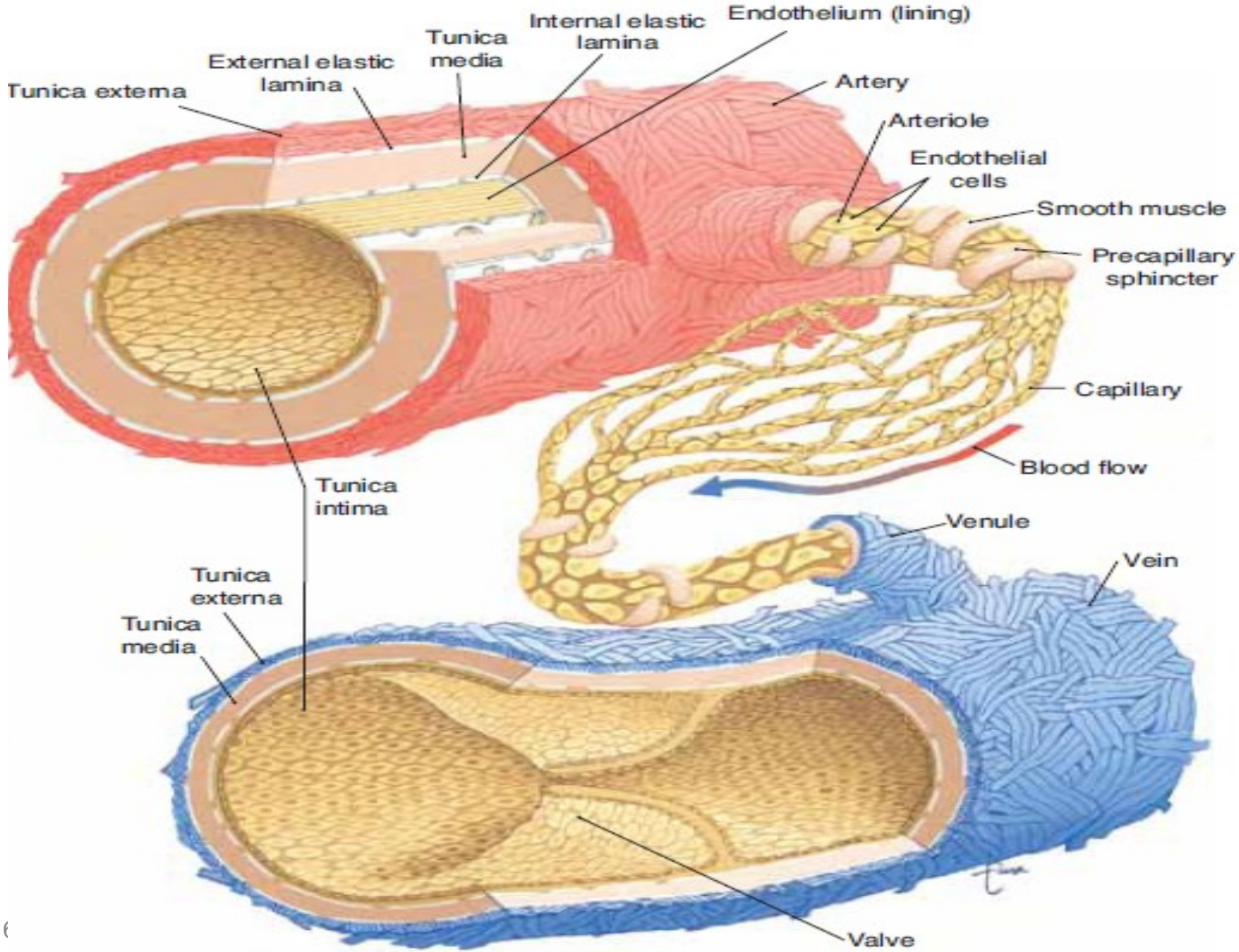
Composition of Blood

- Plasma
  - Liquid portion of the blood
  - The plasma itself is 90% water. Many different substances dissolved or suspended in the water, make up the other 10%
- Formed elements
  - the cells and fragments of cells
    - Erythrocytes, Leukocytes and Platelets

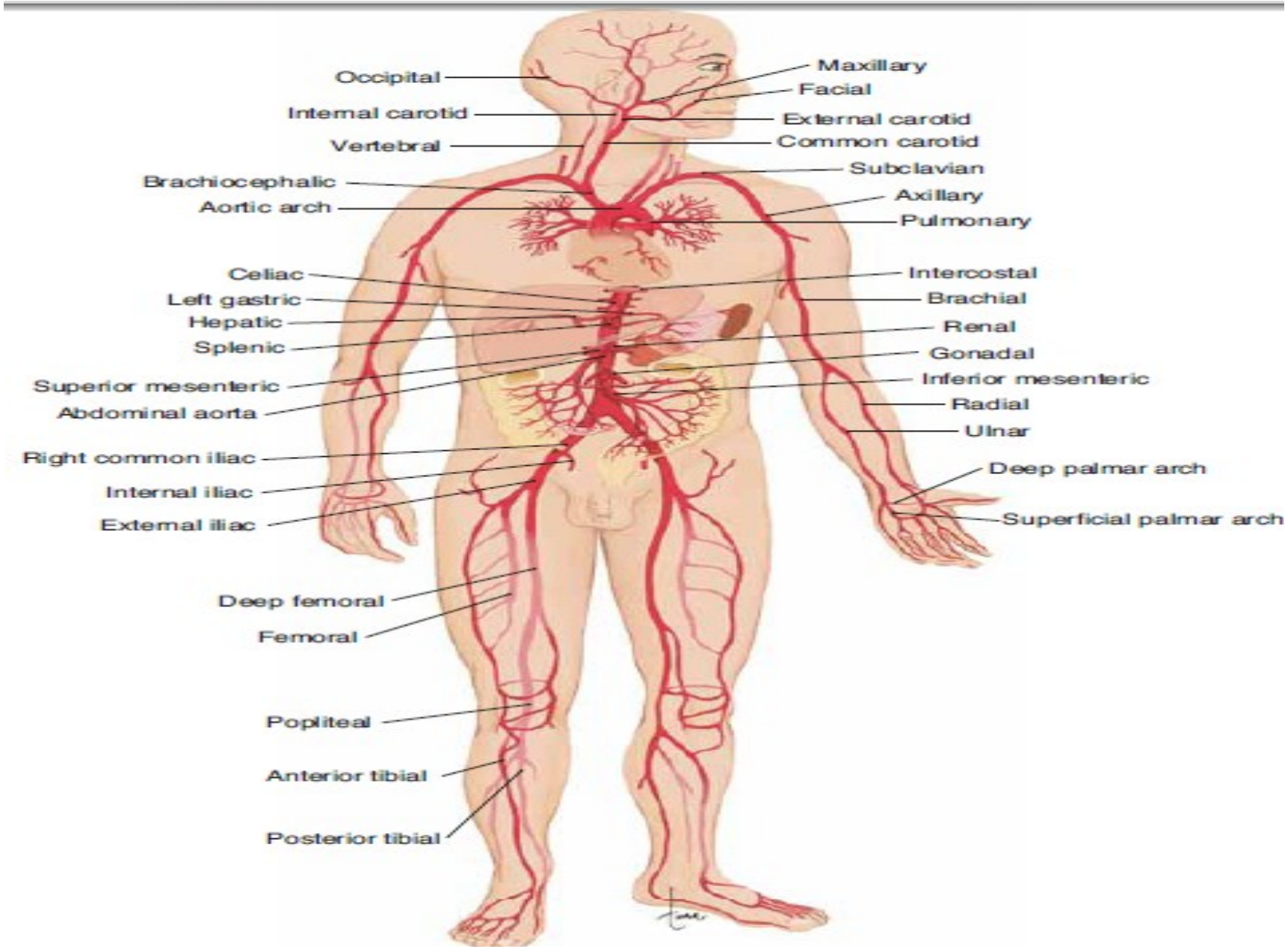
Blood Vessels

- The blood vessels, together with the four chambers of the heart, form a closed system for the flow of blood
- **Functional classification**
  - Arteries
  - arterioles
  - Veins
  - Venules
  - Capillaries

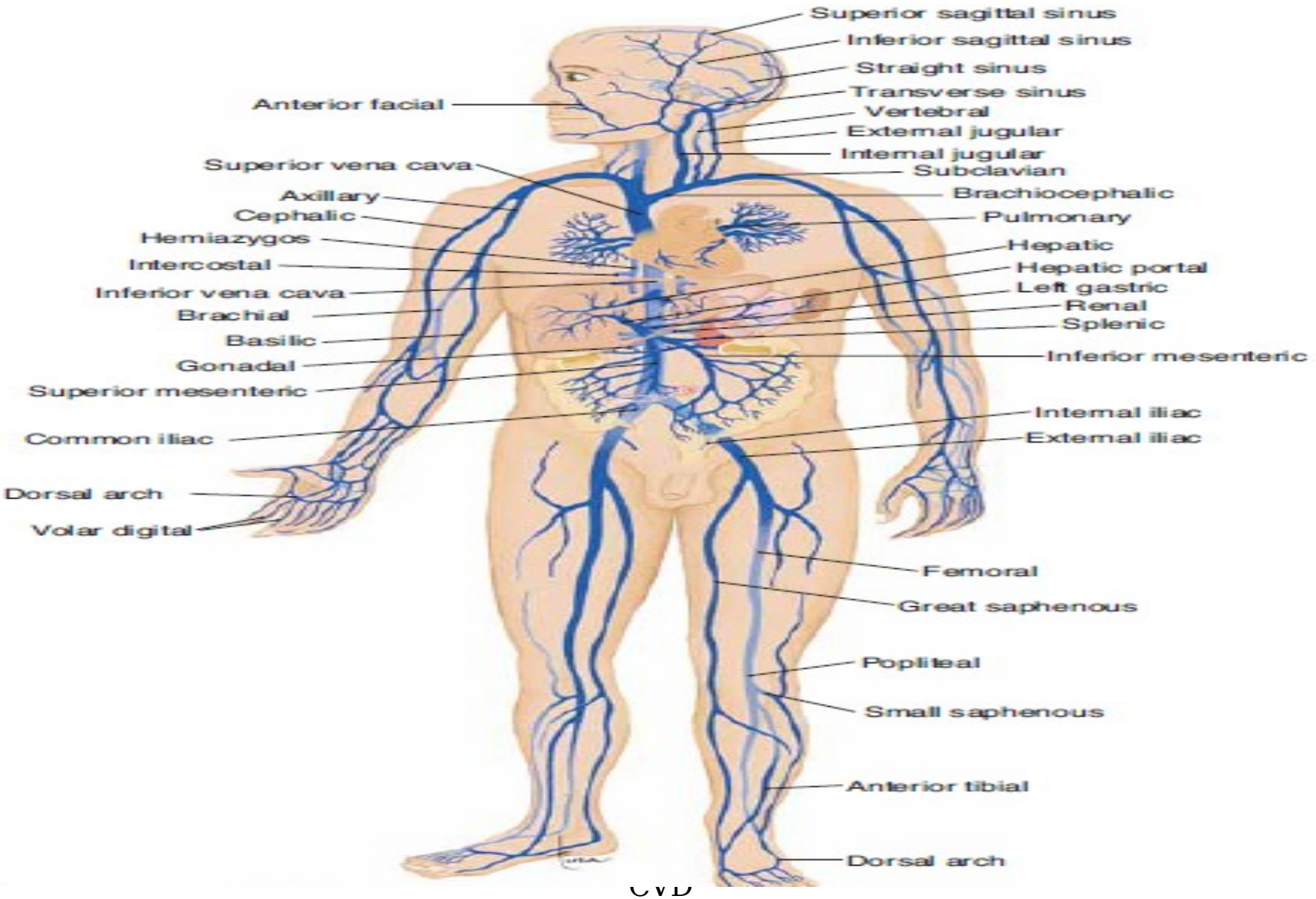
- **Structure of blood vessels**
  - Three coats or layers are found in both arteries and veins except the capillaries
    - Tunica externa.
    - Tunica media of arteries and veins.
    - Tunica interna in arteries and veins


Endothelium (lining)
Internal elastic lamina
Tunica media
External elastic lamina
Tunica externa
Artery
Arteriole
Endothelial cells
Smooth muscle
Precapillary sphincter
Capillary
Blood flow
Tunica intima
Venule
Vein
Tunica externa
Tunica media
Valve

Location and Names of arteries



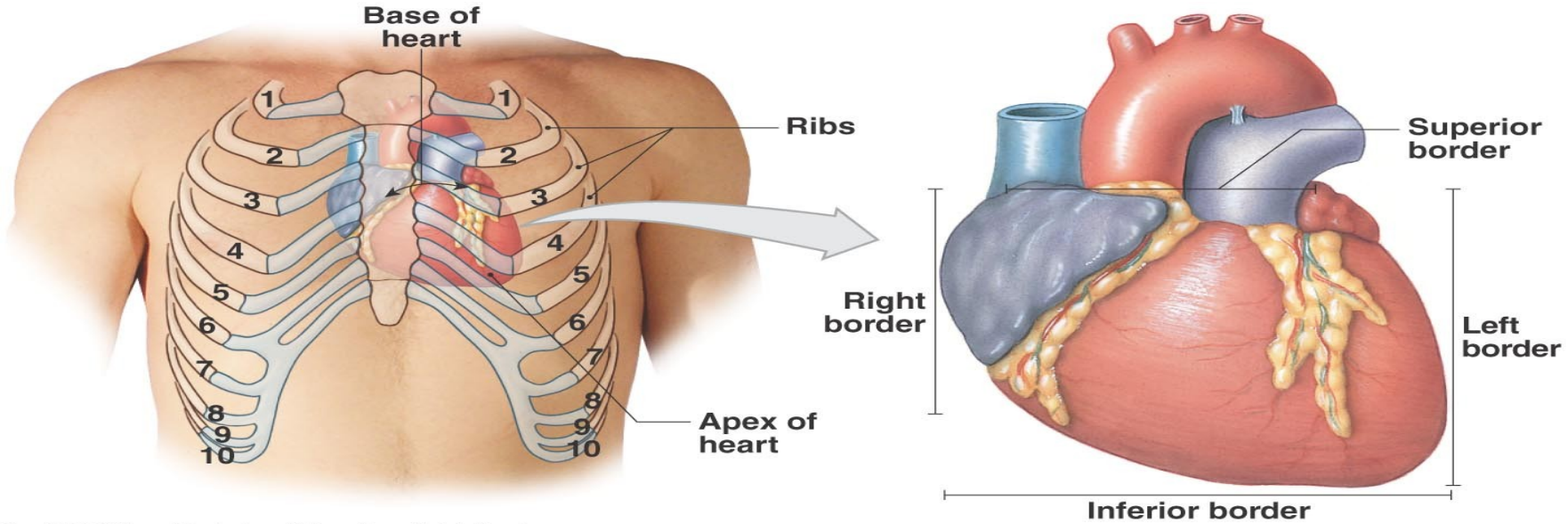
Location and Names of veins



ANATOMIC AND PHY SIOLOGIC OVERVIEW

Location of the heart

- The heart is located in the thoracic cavity between the lungs(**mediastinum)**
- The base is uppermost of the heart
- The apex (tip) of the heart points downward



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The Heart

- Is a muscular pump
- It weighs 250-350 gm (about 1 pound)
- Drives the blood through the blood vessels
- Slightly bigger than a fist
- Begins to beat at 4th weeks of gestation.
- Primery purpose is to pump blood

Anatomy of heart

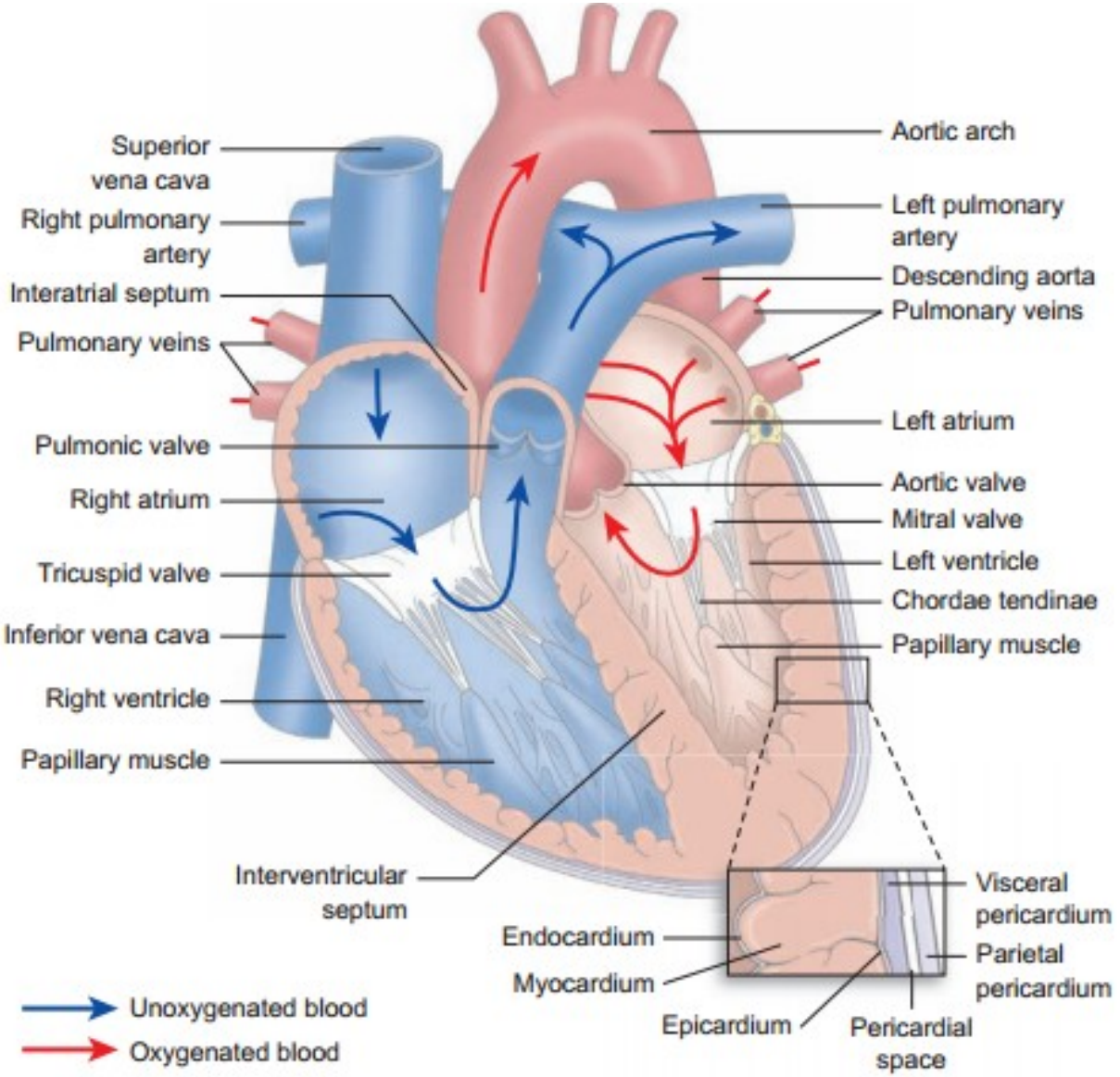


Figure 26-1 Structure of the heart. Arrows show course of blood flow through the heart chambers.

Function of the Heart

- The function of the cardiovascular system is to supply body cells and tissues with oxygen-rich blood and eliminate carbon dioxide (CO2) and cellular wastes
- Cardiac Electrophysiology

ASSESSMENT OF THE CVS

- History
- Physical Examination
- Diagnostic Tests
  - Laboratory tests
  - Radiography and Radionuclide Studies
  - Magnetic resonance imaging(MRI)
  - Echocardiography
  - Electrocardiography

HEART FAILURE

HEART FAILURE

- Is the inability of the heart to pump sufficient blood to meet the needs of the tissues for oxygen and nutrients
- Congestive heart failure = clinical syndrome which is developed due to accumulation of the blood in front of the left or right parts of the heart

TYPES OF HEART FAILURE

SYSTOLIC FAILURE is the inability of the ventricle to contract normally and expel sufficient blood

DIASTOLIC FAILURE is the inability of the ventricle to relax and fill normally

- Its manifestations relate principally to the elevation of filling pressures in the left and/or right ventricles.
- Diastolic HF is usually defined as HF in patients with an ejection fraction 50%.

- **Acute HF** is sudden reduction in cardiac output often results in systemic hypotension without peripheral edema.

- **Chronic HF** is typically observed in patients with dilated cardiomyopathy or multivalvular heart disease and develops or progresses slowly. Vascular congestion is common in chronic HF, but arterial pressure is ordinarily well maintained until very late.

LEFT-SIDED HEART FAILURE :

- occurs when the output of the left ventricle is less than the total volume of blood received from the right side of the heart through the pulmonary circulation.
- As a result, the pulmonary circuit becomes congested with blood that cannot be moved forward and the systemic blood pressure falls

RIGHT-SIDED HEART FAILURE:

- occurs when the output of the right ventricle is less than the input from systemic venous circulation.
- As the result, the systemic venous circuit is congested and the out put to the lungs decreased

BACKWARD HEART FAILURE:

- The concept of backward HF contends that in HF one or the other ventricle fails to discharge its contents or fails to fill normally.
- As a consequence, the pressures in the atrium and venous system behind the failing ventricle rise, and
- Retention of sodium and water occurs as a consequence of the elevation of systemic venous and capillary pressures and the resultant transudation of fluid into the pulmonary or systemic interstitial space

FORWARD HEART FAILURE

- The concept of foreward HF is , The clinical manifestations of HF result directly from an inadequate discharge of blood into the arterial system.
- According to this concept, salt and water retention is a consequence of diminished renal perfusion and excessive proximal and distal tubular reabsorption of sodium, the latter through activation of the renin-angiotensin-aldosterone system (RAAS)

CAUSES OF CHF

The causes of CHF are classified into two major classes as

Underlying causes

- It is the main pathological lesion that is responsible for the heart not to pump adequately.

UNDERLYING CAUSES

- **Myocardial lesions**
  - Cardiomyopathy
  - Myocarditis
  - Myocardial infarction
- **Valvular & Endocardial lesions**
  - Endocarditis
  - Congenital valvular- heart disease
  - RHD (Rheumatic Heart Disease)
- **Pericardial – lesions**
  - Pericarditis
  - Cardiac-tamponade

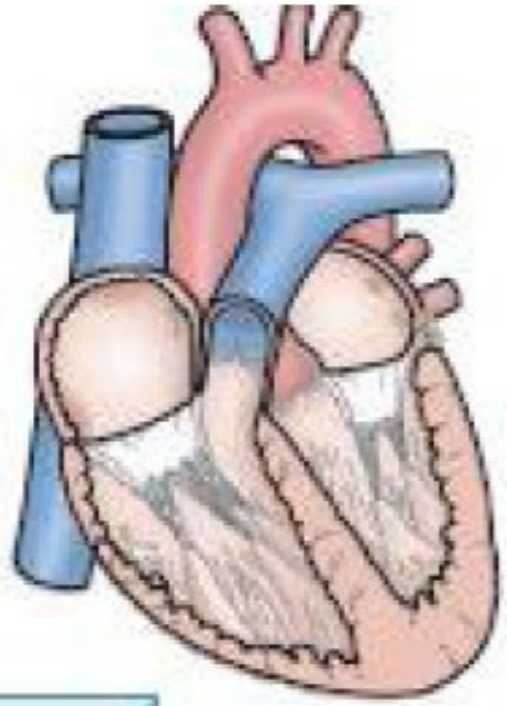
Precipitating (secondary) causes.

- Normally in the absence of precipitating factors or causes, an individual heart with those underlying lesions tries to compensate by making multiple pathophysiologic changes.
- The precipitating causes are abbreviated by a phrase “heart-fails”.

PRECIPITATING (SECONDARY) CAUSES

- **H** = Hypertension
- **E** = Infective Endocarditis
- **A** = Anemia
- **R** = Rheumatic –fever (Recurrence)
- **T** = Thyrotoxicosis
- **F** = Fetus (pregnancy)
- **A** = Arrhythmias
- **I** = Infections
- **L** =Lung problems (pathologies)
- **S**= stress ,salt

PATHOPHYSIOLOGY OF HEART FAILURE



Myocardial dysfunction

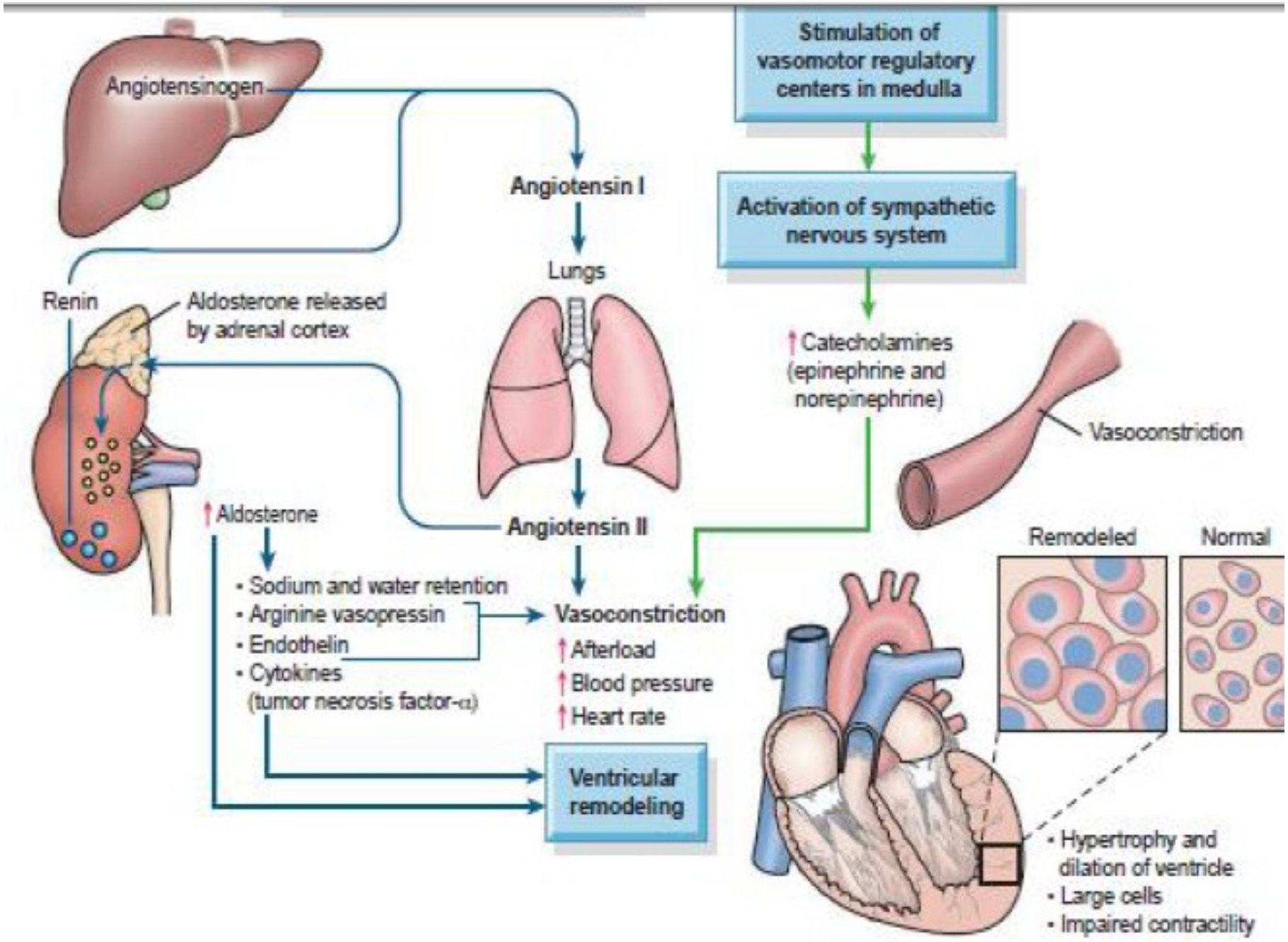
- Ischemic heart disease
- Hyperthyroidism
- Myocardial infarction
- Valve disease
- Alcohol, cocaine abuse
- Hypertension

↓ Cardiac output
↓ Systemic blood pressure
↓ Perfusion to kidneys

Activation of baroreceptors

- Left ventricle
- Aortic arch
- Carotid sinus

Activation of renin–angiotensin–aldosterone system


Angiotensinogen
Angiotensin I
Lungs
Renin
Aldosterone released by adrenal cortex
Aldosterone
Angiotensin II
• Sodium and water retention
• Arginine vasopressin
• Endothelin
• Cytokines (tumor necrosis factor-α)
Vasoconstriction
Afterload
Blood pressure
Heart rate
Ventricular remodeling
Stimulation of vasomotor regulatory centers in medulla
Activation of sympathetic nervous system
Catecholamines (epinephrine and norepinephrine)
Vasoconstriction
Remodeled
Normal
• Hypertrophy and dilation of ventricle
• Large cells
• Impaired contractility

CLASSIFICATION OF HEART FAILURE (NYHA)

New York Heart Association Functional Classification

- **NYHA I** No symptoms and no limitation in ordinary physical activity, e.g. shortness of breath when walking, climbing stairs etc.

- **NYHA II** Mild symptoms (mild shortness of breath and/or angina) and slight limitation during ordinary activity.

- **NYHA III** Marked limitation in activity due to symptoms, even during less-than-ordinary activity, e.g. walking short distances (20-100 m). Comfortable only at rest.

- **NYHA IV** Severe limitations. Experiences symptoms even while at rest. Mostly bed bound patients. ACC/

THE AMERICAN HEART ASSOCIATION AND THE AMERICAN COLLEGE OF CARDIOLOGY HF STAGES

Stage A
At high risk for HF but without structural heart disease or symptoms of HF.

Stage B
Structural heart disease but without symptoms of HF.

Stage C
Structural heart disease with prior or current symptoms of HF

Stage D
Refractory HF requiring specialized interventions.

Signs and Symptoms of heart failure

1. Forward failure:

- **Symptoms** result from inability of the heart to pump enough blood to the periphery (from left heart), or to the lungs (from the right heart)

- **A . Forward failure of left heart**:- muscle weakness, fatigue, dyspepsia, oliguria..
    - Due to tissue hypoperfusion

- **B. Forward failure of right heart**: - hypoperfusion of the lungs → disorders of gas exchange decreased blood supply to the left heart

2. backward failure:

– symptoms result from inability of the heart to accept the blood coming from periphery and from lungs

a. backward failure of left heart:

- – increased pulmonary capillary pressure → dyspnoea and tachypnoea, pulmonary edema (cardiac asthma → arterial hypoxemia and hypercapnia....)

b. backward failure of right heart:

– increased pressure in systemic venous system → peripheral edemas, hepatomegaly, ascites →↑nocturnal diuresis....

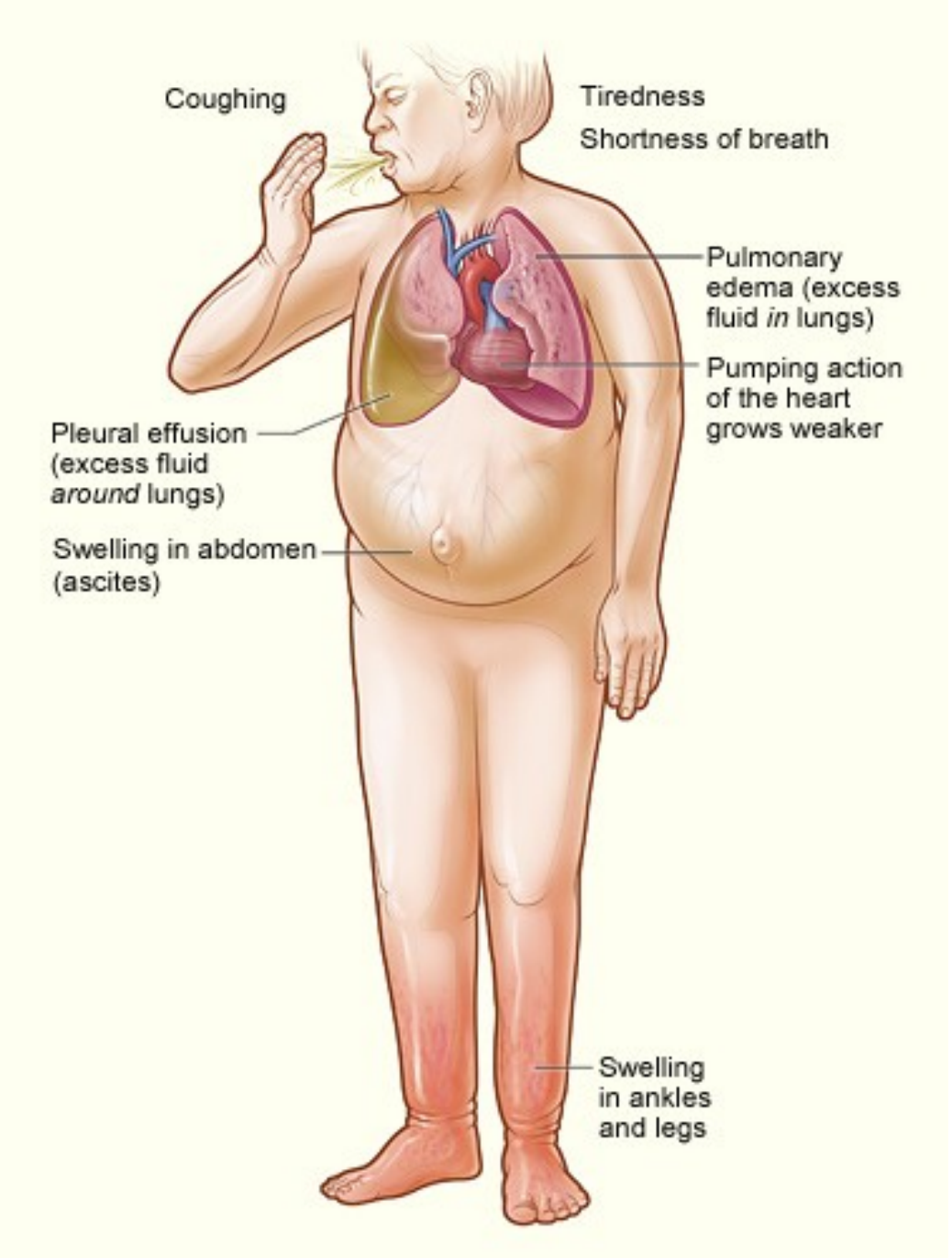
CLINICAL MANIFESTATIONS OF HEART FAILURE

- **Dyspnea :** rapid, shallow breathing characteristic of cardiac dyspnea
- In early HF, dyspnea is observed only during exertion, when it may simply represent an aggravation of the breathlessness that occurs normally. As HF advances, dyspnea occurs with progressively less strenuous activity and ultimately it is present even at rest
- It is observed most frequently in patients with elevations of pulmonary venous and capillary pressures who have engorged pulmonary vessels and interstitial accumulation of interstitial fluid.

- **Paroxysmal(Nocturnal) Dyspnea :**refers to attacks of severe shortness of breath and coughing that generally occur at night, usually awaken the patient from sleep
- Paroxysmal nocturnal dyspnea may be caused in part by the depression of the respiratory center during sleep, which may reduce ventilation sufficiently to lower arterial oxygen tension, particularly in patients with interstitial lung edema and reduced pulmonary compliance
- Cardiac asthma is closely related to paroxysmal nocturnal dyspnea and nocturnal cough and is characterized by wheezing secondary to bronchospasm— most prominent at night

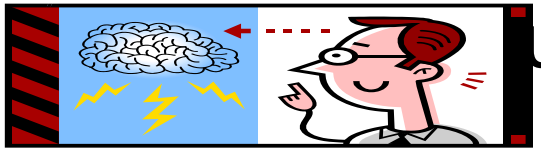
- **Fatigue and Weakness**
  - These nonspecific but common symptoms of HF are related to the reduction of skeletal muscle perfusion.
- **Abdominal Symptoms :**
  - Anorexia and nausea associated with abdominal pain and fullness are frequent complaints and may be related to the congested liver and portal venous system

Major symptoms & signs of heart failure

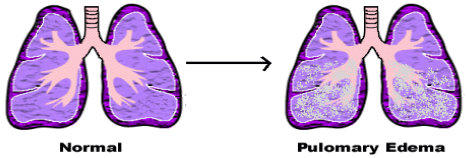


When the EF is Abnormal
What Happens in the Body?

- Less blood goes to the brain that u feel confused or dizzy



- Your lungs may fill up with fluid mal short of breath



- Your kidneys may not be able to get the fluid



- Your belly, ankles and feet may swell up



Other Signs and Symptoms of CHF

- Extreme Fatigue
- Frequent Coughing



- Sudden Weight Gain
- Chest Pain or Pressure
- Nausea, Loss of Appetite or Bloating
- Decreased Urination



TREATMENT OPTIONS

The more common forms of heart failure cannot be cured, but can be treated

- Lifestyle changes
- Medications
- Surgery

LIFESTYLE CHANGES CONT…

- Stop smoking
- Loose weight
- Avoid alcohol
- Avoid or limit caffeine
- Eat a low-fat, low-sodium diet
- Exercise





LIFESTYLE CHANGES CONT…

- Reduce stress
- Keep track of symptoms and weight and report any changes or concern to the doctor
- Limit fluid intake
- See the doctor more frequently

What Can I Do To Prevent Progression of the Disease?

- **Become Conscious of Lifestyle Choices!**
- **Make Better Choices**
  - **Quit Smoking**
  - **Reduce Weight**
  - **Avoid Excess Alcohol and Dr**
  - **Exercise**
  - **Take Medication**









Self Care Strategies

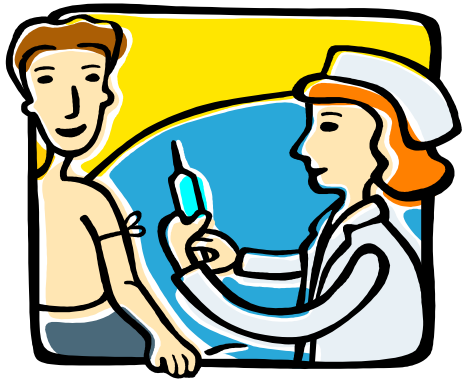
- ♥ Take an active part in your care
- ♥ Communicate with your healthcare team (Healthwise for Life)
- ♥ Be knowledgeable about your health
- ♥ Take your medication as prescribed
  - * Never run out of medications
- ♥ Treat high cholesterol, diabetes and irregular heart beat

Self Care Strategies

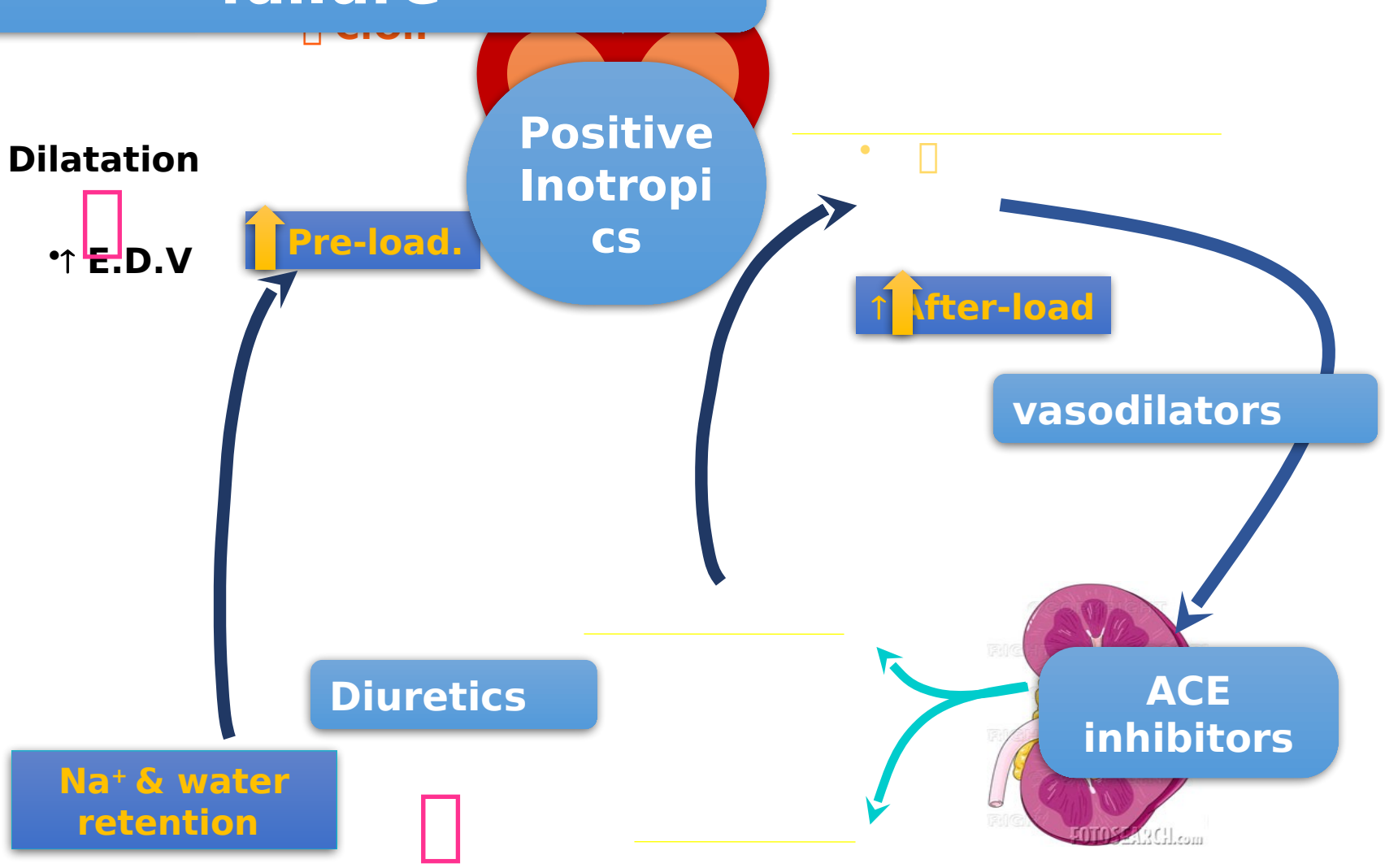
- ♥ Keep high blood pressure under control
- ♥ Salt restrictions
- ♥ Daily weights and records
- ♥ Look for swelling
- ♥ Manage stress

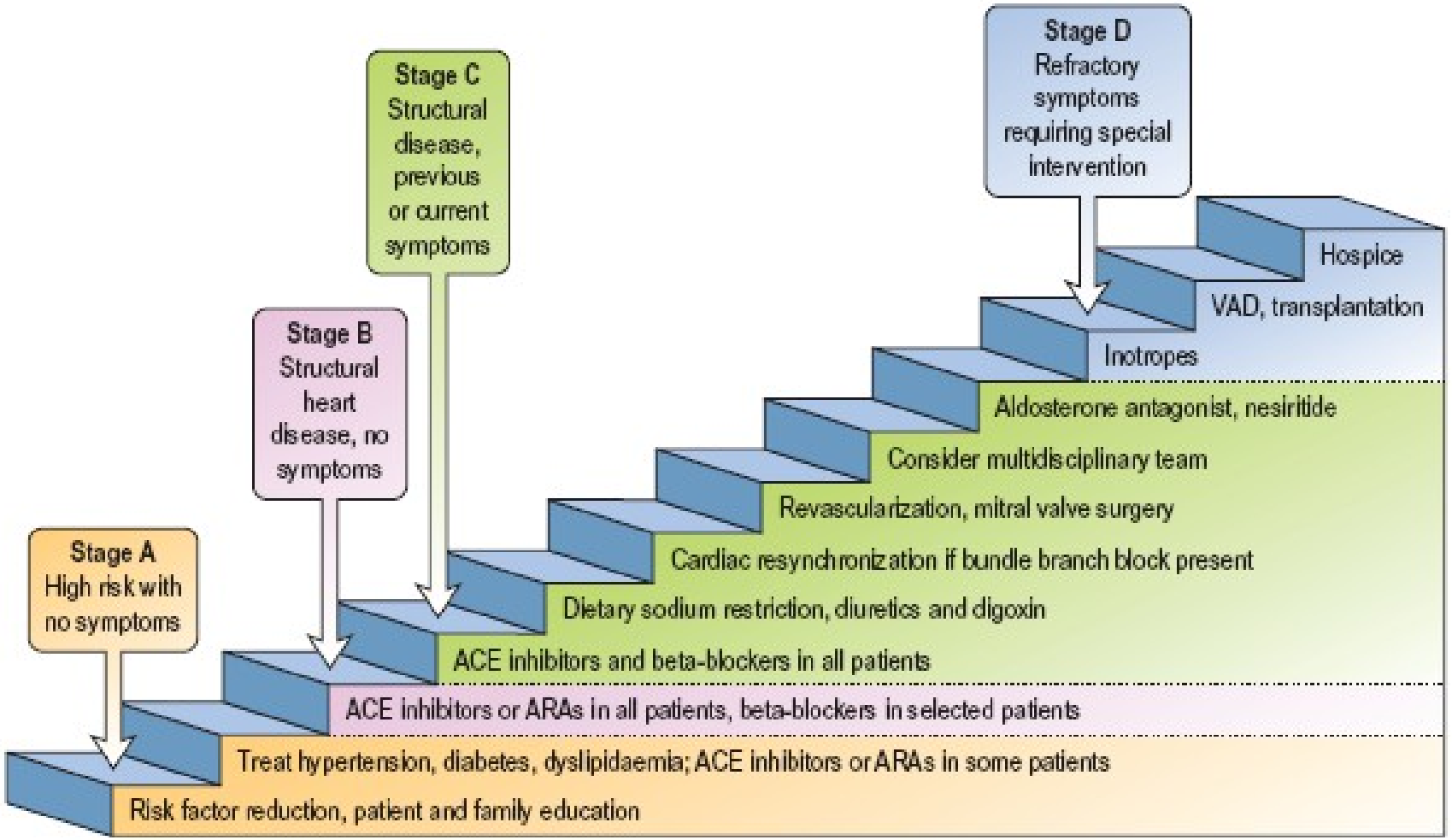






Treatment of heart failure




Stage A
High risk with no symptoms
Stage B
Structural heart disease, no symptoms
Stage C
Structural disease, previous or current symptoms
Stage D
Refractory symptoms requiring special intervention
Risk factor reduction, patient and family education
Treat hypertension, diabetes, dyslipidaemia; ACE inhibitors or ARAs in some patients
ACE inhibitors or ARAs in all patients, beta-blockers in selected patients
ACE inhibitors and beta-blockers in all patients
Dietary sodium restriction, diuretics and digoxin
Cardiac resynchronization if bundle branch block present
Revascularization, mitral valve surgery
Consider multidisciplinary team
Aldosterone antagonist, nesiritide
Inotropes
VAD, transplantation
Hospice

Hypertension

HYPERTENSION

- **Definition:** A systolic blood pressure greater than 140 mm Hg and a diastolic pressure greater than 90 mm Hg over a sustained period.
- 26.4% of the world adult population in 2000
- 29.2% predicted in 2025

HTN PREDISPOSING FACTORS

- Age >60 years
- Sex /men and postmenopausal women
- Smoking
- High cholesterol diet
- Coexisting disorders such as DM

PREDISPOSING FACTORS CONT…

- Family history of hypertension
- Overweight
- Excess Consumption of Sodium Chloride
- Alcohol consumption
- physical inactivity
- Oral contraceptive drugs

CLASSIFICATION OF HYPERTENSION

JNC - VII

Normal	**<120/<80**
Prehypertension	**120-139/80-89**
Stage 1	**140-159/90-99**
Stage 2	**>160/>100**

Chobnian JAMA 2003;289:2560

TYPES OF HYPERTENSION

Essential hypertension,

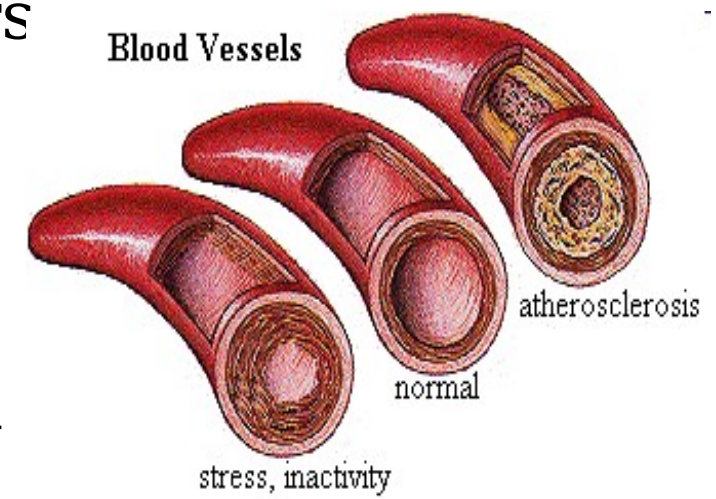
- The chronic elevation in blood pressure occurs without evidence of other disease
- Accounts for 90% to 95% of all hypertension

Secondary hypertension

- The elevation of blood pressure results from some other disorder

CAUSES OF SECONDARY HYPERTENSION

- Kidney disease
- Pheochromocytoma
- Coarctation of the aorta
- Adrenal cortical disorders
- Stress
- Renal artery stenosis
- Hypo or hyperthyroidism
- Cocaine-like substances.

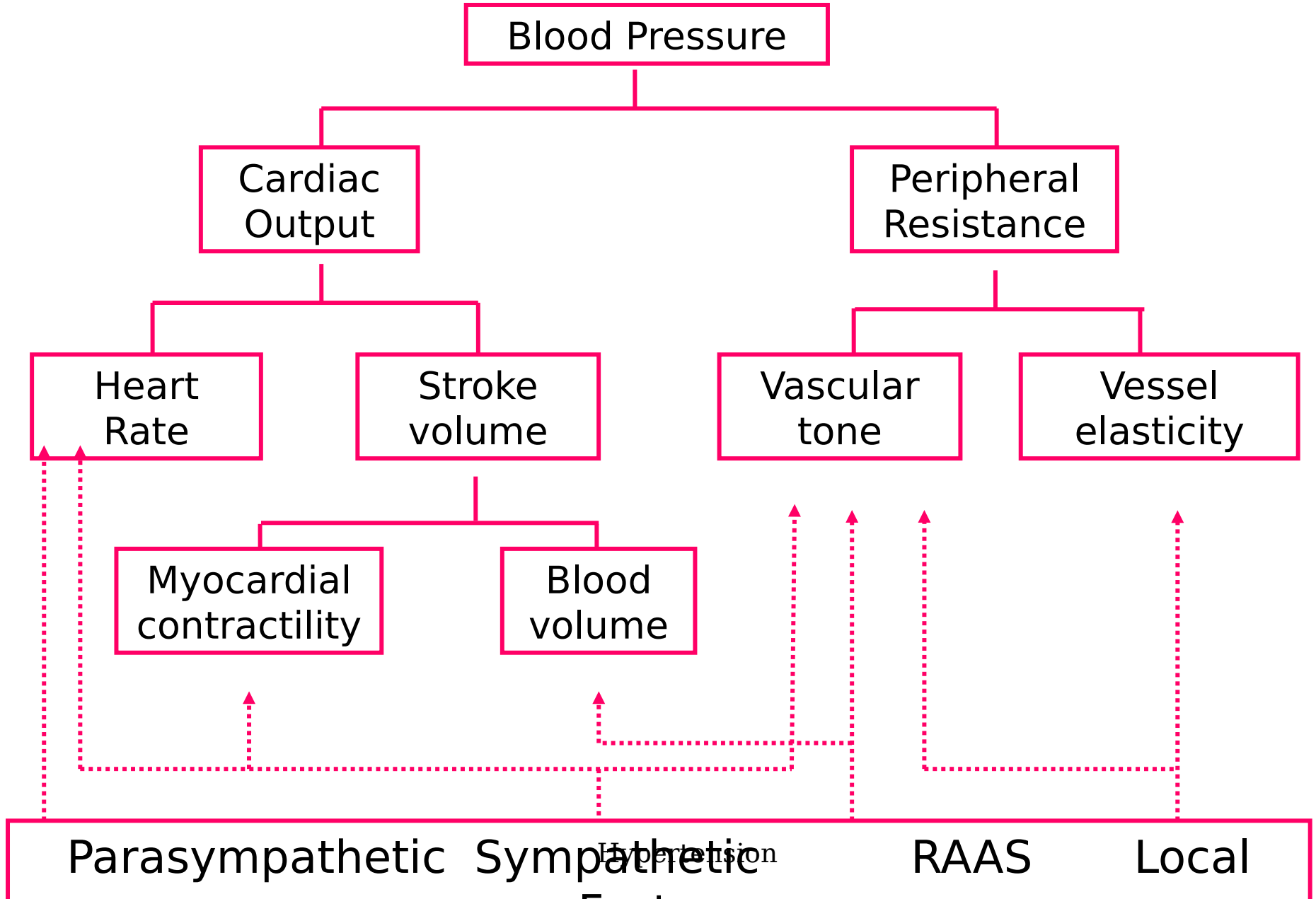


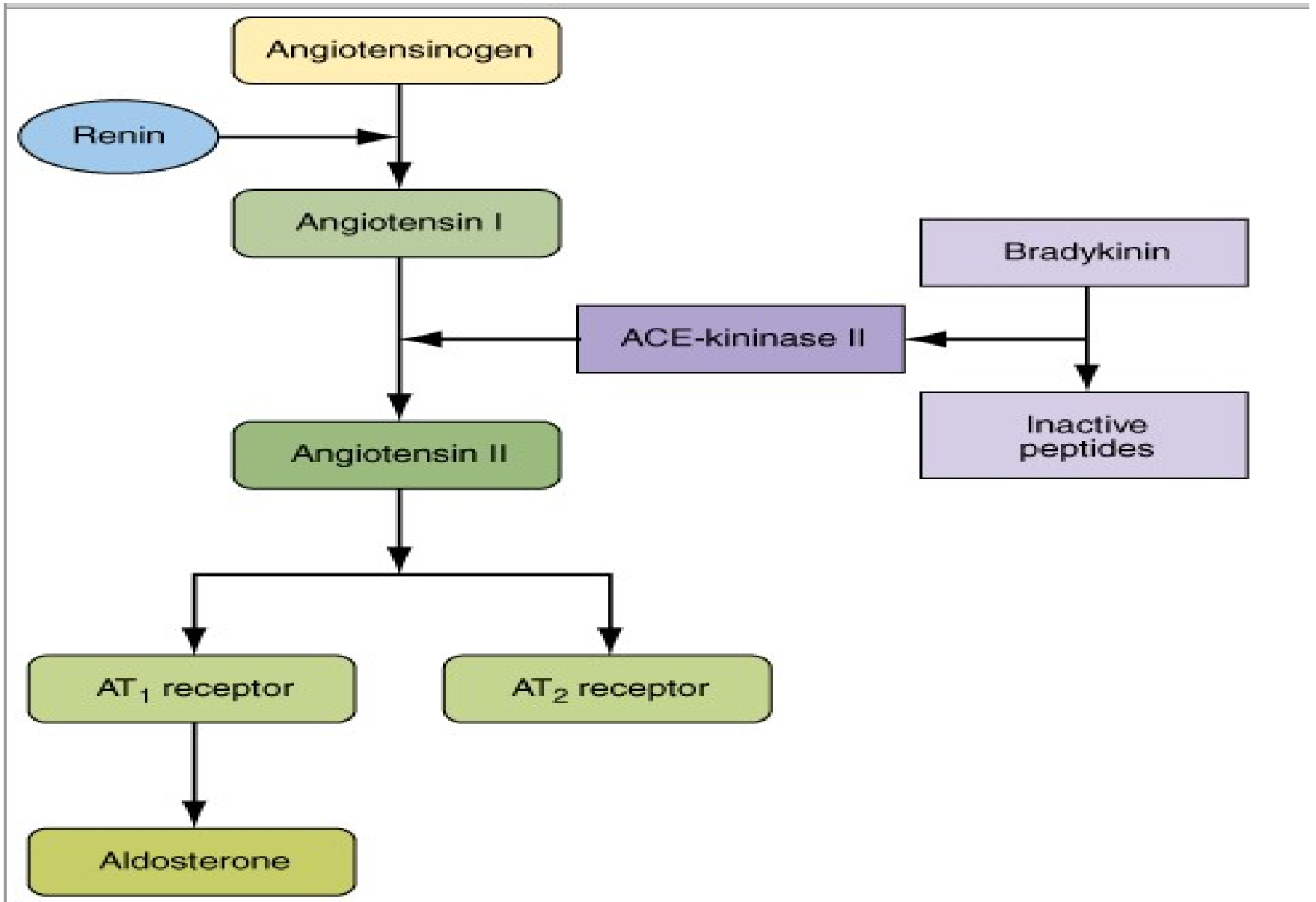
Pathophysiology OF HPT

May be caused by one or more of the following:

- Increased sympathetic nervous system activity
- Increased renal reabsorption of sodium, chloride, and water
- Increased activity of the RAAS
- Decreased vasodilation of the arterioles
- Resistance to insulin action

Mechanisms of Blood Pressure Regulation





Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

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CLINICAL MANIFESTATIONS AND TARGET ORGAN COMPLICATIONS:

- Myocardium – angina / left ventricular hypertrophy
- Brain – CVA
- Peripheral vascular – Peripheral pulse change
- Kidney – renal failure Creatinine / Proteinuria
- Eyes – Hemorrhages with or without papilledema

Follow-up based on initial BP measurements for adults*

Initial Blood Pressure (mmHg)*	Followup Recommended†
Normal	Recheck in 2 years
Prehypertension	Recheck in 1 year‡
Stage 1 Hypertension	Confirm within 2 months‡
Stage 2 Hypertension	Evaluate or refer to source of care within 1 month. For those with higher pressures (e.g., >180/110 mmHg), evaluate and treat immediately or within 1 week depending on clinical situation and complications.

*Without acute end-organ

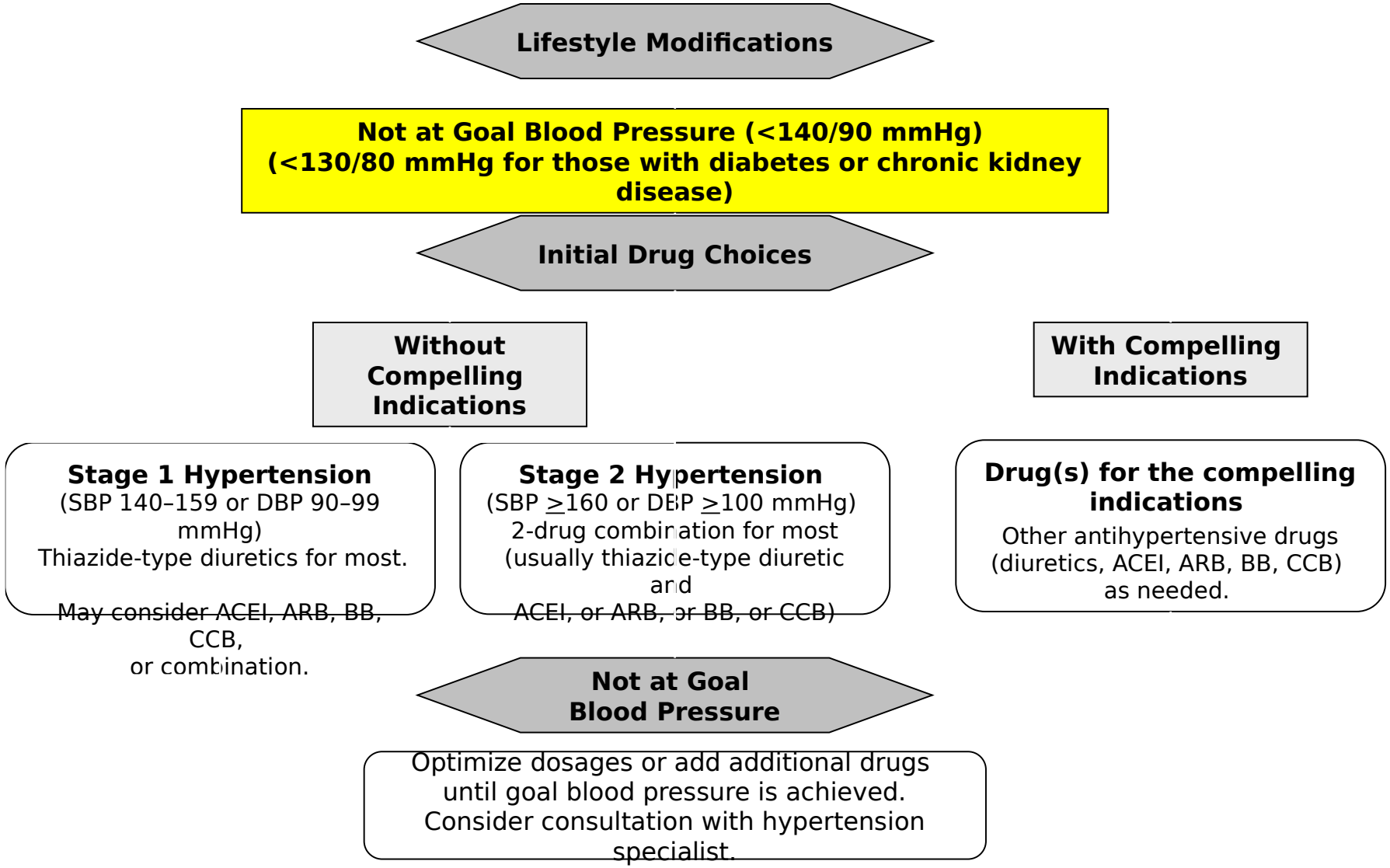
Classification

Table 1. Classification and management of blood pressure for adults*

BP Classification	SBP* mmHg	DBP* mmHg	Lifestyle Modification	Initial drug therapy	
				Without Compelling Indication	With Compelling Indications (See Table 8)
Normal	<120	and <80	Encourage		
Prehypertension	120–139	or 80–89	Yes	No antihypertensive drug indicated.	Drug(s) for compelling indications.‡
Stage 1 Hypertension	140–159	or 90–99	Yes	Thiazide-type diuretics for most. May consider ACEI, ARB, BB, CCB, or combination.	Drug(s) for the compelling indications.‡ Other antihypertensive drugs (diuretics, ACEI, ARB, BB, CCB) as needed.
Stage 2 Hypertension	≥160	or ≥100	Yes	Two-drug combination for most† (usually thiazide-type diuretic and ACEI or ARB or BB or CCB).	

www.nhlbi.nih.gov

Algorithm for Treatment of Hypertension



How to Prevent HTN

- Lifestyle modifications prevent HTN and include:
- -Maintaining a Healthy Weight
- -Reduce Salt/Sodium Intake
- -Increase Physical Exercise
- Smoking Cessation
- Limit Alcohol Consumption
- Limit Fat Intake
- Control Diabetes
- Stress Relieving Techniques
- Take BP Meds as Ordered
- Home Monitoring of BP



➢ANEMIA

WHAT WENT WRONG?

- A low hemoglobin or red blood cell (RBC) count results in decreased oxygen carrying capability of the blood.
- This may be due to *blood loss*, damage to the red blood cells due to altered hemoglobin or destruction (hemolysis), nutritional deficiency (iron, vitamin B12, folic acid), lack of RBC production, or bone marrow failure.

ANEMIA

- Erythrocytes are mature red blood cells (RBCs) to which hemoglobin is attached.
- Their function is to carry oxygen to cells and transport carbondioxide (CO2) to the lungs.
- Anemia is a term that refers to a deficiency of either erythrocytes or hemoglobin.

ANEMIA

- Most anemias result from
  - Blood loss
  - Inadequate or abnormal erythrocyte production
  - Destruction of normally formed RBCs.
- The most common types include
  - Hypovolemic anemia,
  - Iron deficiency anemia,
  - Pernicious anemia,
  - Folic acid deficiency anemia,
  - Sickle cell anemia, and
  - Hemolytic anemias.

TABLE 31-1 Terms Used to Describe Erythrocytes and Erythrocyte Pathology

DESCRIPTOR	MEANING
Normocytic	Normal cell size
Microcytic	Small cell size
Macrocytic	Large cell size
Megaloblastic	Large immature cell
Normochromic	Normal hemoglobin concentration
Hypochromic	Low hemoglobin concentration
Hyperchromic	High hemoglobin concentration
Aplastic	Decreased cell production
Hemolytic	Premature destruction
Pernicious	Potentially injurious

HYPOVOLEMIC ANEMIA

- Caused by a loss of blood volume, which results in fewer blood cells.
- Because erythrocytes are the most abundant type of blood cell, one consequence of blood loss is hypovolemic anemia

Pathophysiology and Etiology

- A sudden loss of a large volume of blood or a gradual, chronic loss of small amounts of blood causes hypovolemic anemia.
- An example of the former is trauma, such as a gun-shot wound; an example of the latter is gastric bleeding from a peptic ulcer.
- When blood is lost, the bone marrow responds by increasing production of erythrocytes.

Pathophysiology and Etiology…

- As a result, the cells are smaller and contain less heme, the pigmented, iron-containing portion of hemoglobin.
- Consequently, the RBCs are microcytic and hypochromic
- If the formation of new RBCs cannot compensate for the loss, cellular function is compromised from an inadequate oxygen supply and accumulated CO2

HALLMARK SIGNS AND SYMPTOMS

- Fatigue due to hypoxia from less oxygen being available to the tissues of the body
- Weakness due to hypoxia
- Pallor due to less oxygen being available to the surface tissues
- Tachycardia as the body attempts to compensate for less available oxygen by beating more rapidly to increase blood supply
- Systolic murmur due to increased turbulence of blood flow
- Dyspnea or shortness of breath due to hypoxia as body attempts to get more oxygen
- Angina as the myocardium is not getting enough oxygen

HALLMARK SIGNS AND SYMPTOMS

- Headache due to hypoxia
- Lightheadedness due to hypoxia
- Bone pain due to increased erythropoiesis as body attempts to correct anemia
- Jaundice in hemolytic anemia due to increased levels of bilirubin as red blood cells break down

Assessment Findings

- Acute hypovolemic anemia from severe blood loss is evidenced by signs and symptoms of hypovolemic shock:
- extreme pallor, tachycardia, hypotension, reduced urine out-put, and altered consciousness
- Symptoms of chronic hypovolemic anemia include pallor, fatigue, chills, postural hypotension, and rapid heart and respiratory rates.

Assessment Findings…

- Laboratory confirmation of acute or chronic hypovolemic anemia is detected through a complete blood count (CBC), which demonstrates
  - Decreased erythrocytes,
  - Increased reticulocytes(erythrocytes in the process of maturation), and
  - Low hemoglobin and hematocrit levels
- Mean cell volume is lower than normal as a result of the smaller size of the erythrocytes.
- The mean cell hemoglobin concentration is below normal, reflecting the reduced hemoglobin level.

TABLE 31-2 Normal CBC Values

COMPONENT	ADULT MALES	ADULT FEMALES
Red blood cells (erythrocytes)	4.6–6.2 million/mm^3	4.2–5.4 million/mm^3
Hematocrit	40%–54%	38%–47%
Hemoglobin	13.5–18 g/dL	12–16 g/dL
Mean cell volume (MCV)	80–94 $\mu g/m^3$	81–99 $\mu g/m^3$
Mean cell hemoglobin (MCH)	27–31 picograms/cell	27–31 picograms/cell
Mean cell hemoglobin concentration (MCHC)	32–36 g/dL	32–36 g/dL
Reticulocytes	0.5%–2.0% of RBCs	Slightly higher in females
White blood cells (leukocytes)	5000–13,000/mm^3	5000–10,000/mm^3
Neutrophils	3000–7500/mm^3	3000–7500/mm^3
Eosinophils	50–400/mm^3	50–400/mm^3
Basophils	25–100/mm^3	25–100/mm^3
Monocytes	100–500/mm^3	100–500/mm^3
Lymphocytes	1500–4500/mm^3	1500–4500/mm^3
T lymphocytes	60%–80% of lymphocytes	60%–80% of lymphocytes
B lymphocytes	10%–20% of lymphocytes	10%–20% of lymphocytes
Platelets	150,000–450,000/mm^3	150,000–450,000/mm^3

INTERPRETING TEST RESULTS

- Hemoglobin level low.
- Hematocrit level low.
- RBC count low.
- MCV (mean corpuscular volume) shows size of cell—normal (normocytic), microcytic (low), or macrocytic (high).
- MCH (mean corpuscular hemoglobin) shows color of cell—normal (normochromic), hypochromic (low).
- RDW (red cell distribution width) elevated—shows the variation of the cell sizes; there is greater variation in cell size when body is attempting to compensate for anemia.
- Reticulocyte count elevated when RBC cell production is increased to compensate for the anemia

TREATMENT

- Correction of the underlying cause is necessary.
- Treatment may include dietary modifications and supplementations. See specific anemias below

Medical Management

- Treatment of sudden severe bleeding requires replacement of blood by transfusions.
- If blood loss is chronic (e.g., from bleeding uterine tumors, peptic ulcer disease, hemorrhoids), the underlying condition is treated.
- Depending on how much blood is lost, treatment includes blood transfusion or administration of oral, intravenous (IV), or intramuscular (IM) iron to help restore the body’s hemoglobin.
- Oxygen therapy sometimes is necessary if the anemia is severe


THANK YOU