## The Cardiovascular System

- Circulating fluid (blood)
- The Heart
- Blood vessels

## The Cardiovascular System:The Heart

***Overview***

- ***Heart chambers:Atria,ventricles***
- ***Pulmonary circuit***
- ***Systemic, coronary circuit***
- ***Arteries, veins, capillaries***

## The Heart

***Size, Location, and Orientation***

- ***Weighs between 250-350 grams***
- ***Located in mediastinum(extends obliquely from 2nd rib to 5th intercostal space)***
- ***Base, apex***

## Coverings of the Heart

- ***Fibrous pericardium***-(1) protection;(2) anchors to surroundings (diaphragm,great vessels); (3) prevents blood overfill.
- ***Serous pericardium***-(1) parietal layer lines inner fibrous pericardium;(2)visceral layer (epicardium);(3) Pericardial cavity-in between

## Layers of the Heart Wall

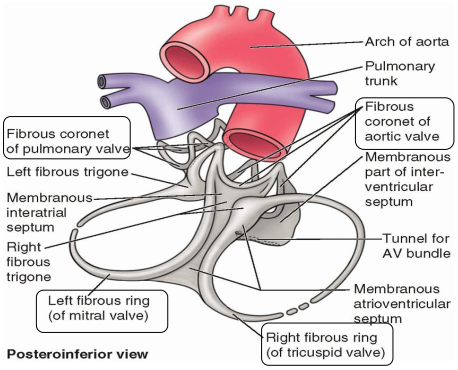
- ***Epicardium***-often infiltrated with adipose
- ***Myocardium***-layered cardiac muscle tissue(contractile), CT, blood vessels, & nerves
- ***Endocardium***-glistening white endothelial layer resting on CT;continuous with endothelium

## Cardiac Muscle Tissue

- ***Cardiocytes***-central nucleus,myofibrils, intercalated discs,aerobic respiration;high myoglobin [ ];glycogen/lipid reserves
- Circulatory supply more extensive vs.red muscle tissue
- Cardiocyte membranes bound together by intercalated discs (desmosomal cell junctions); functional syncytium.

## Fibrous Heart Skeleton

- *Collagen & elastic fibers*
- *Encircle bases of pulmonary trunk/aorta and heart valves*
- ***Functions**:(1) stabilizes cardiocyte/valve positionings; (2) reinforcement of blood vessels & nerves;(3) elasticity*




### Anatomical Orientation and Superficial Heart Anatomy

- ***Borders***: Superior, Right, Inferior, Left
- ***Sternocostal surface***-rt.atrium & ventricle
- ***Diaphragmatic surface***-post./inf.wall of left ventricle
- ***Auricles***
- ***Coronary sulci***
- ***Interventricular sulci*** (ant.,post.)

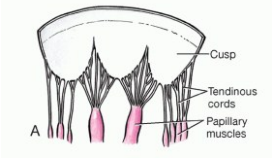
## Internal Anatomy/Organization of the Heart

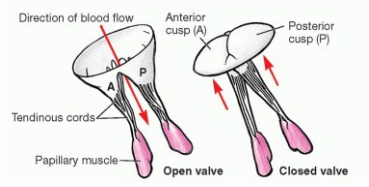
- ***Right atrium***-superior/inferior venae cavae, coronary sinus; pectinate muscles, interatrial septum, fossa ovalis
- ***Tricuspid valve***
- ***Right ventricle***-chordae tendineae, papillary muscles,trabeculae carneae, pulmonary semilunar valve, pulmonary trunk

## Internal Anatomy/Organization of the Heart(cont'd)

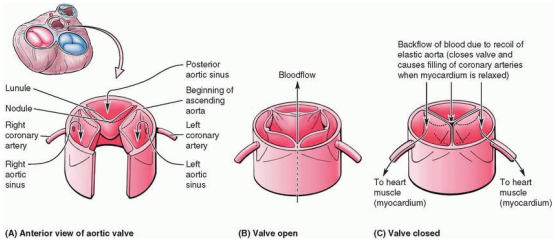
- ***Left Atrium***-Lt./Rt. Pulmonary veins
- ***Bicuspid valve***
- ***Left ventricle***-Aortic semilunar valve,aortic sinuses, ascending aorta
- ***Vestigial structures***:Ligamentum arteriosum (pulm.trunk, aortic arch),fossa ovalis

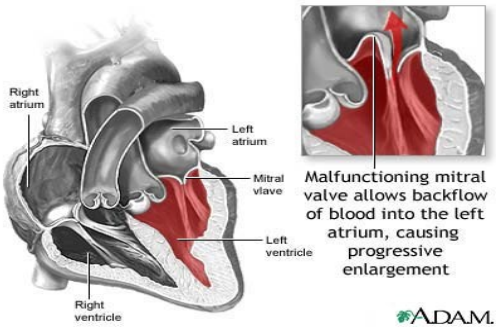
## AV valve functional anatomy

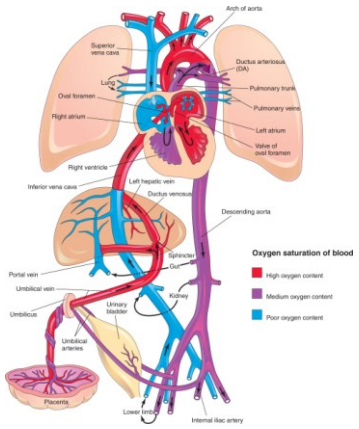


# Semilunar valve functional anatomy



## Coronary Circulation

*Arterial Supply*

- ***Left coronary artery***:anterior interventricular art.(supplies intervent. septum & ant.walls of rt./lt. ventr.) and circumflex art.(lt. atrium & post.walls of lt. vent.)
- ***Right coronary artery***: marginal art. (supplies myocardium of lateral part (rt.side) and post.intervent.art.(post.ventr.walls)
- ***Anastomoses***-fusing collateral routes

## Coronary Circulation

*Venous Supply*

- ***Coronary sinus***-receives blood from great, middle, and small cardiac veins

## Cardiac Cycle

- ***Systole***-chamber contraction (atrial 0.1s, ventricular 0.3s)
- ***Diastole***-chamber relaxation(0.4 s)
- (1)Period of ventricular filling(mid-to-late diastole); (2) Ventricular systole (isovolumetric contraction, ventricular ejection phases);(3)Isovolumetric relaxation (early diastole)

## Cardiac Cycle

*Heart Sounds*

- ***1st ("lubb") sound***- beginning ventricular systole
- ***2nd ("dupp")sound***-beginning ventricular diastole
- ***3rd/4th sounds*** associated with ventricular blood flow & atrial contractions

## Cardiac Cycle

*Coordination of Cardiac Contractions*

- ***Nodal cells***-establish contraction rates(SA, AV nodes)
- ***Conducting fibers***-distribute contractile stimuli to myocardium(AV bundle, Purkinge fibers)
- ***Bradycardia, Tachycardia***

## The Cardiovascular System:

*Blood Vessels*

- ***Blood vessels***-closed delivery system that begins and ends at the heart
- ***Heart>arteries>arterioles>capillary bed> venules>veins>heart***

## Structure of Blood Vessel Walls

- All blood vessels (except capillaries), are composed of three *tunics* surrounding a central blood-containing *lumen*.
- ***Tunica intima (interna)-***endothelium (continuum of endocardium)
- ***Tunica media***-Circular smooth muscle & elastin; regulated by vasomotor nerve fibers of ANS; vasoconstriction/vasodilation;thickest layer

## Structure of Blood Vessel Walls (cont'd)

- ***Tunica externa (adventitia)-***loose collagen fibers that protect/reinforce blood vessel;infiltrated with nerve fibers, lymphatic vessels, elastin fibers; vasa vasorum.

## Arterial System

- ***Elastic (conducting) arteries***; located near heart-aorta & major branches;diameters range from 2.5cm to 1 cm; contain elastin.
- ***Muscular(distributing) arteries***-deliver to target organs and account for *named* arteries in human body; middle tunic has more smooth muscle;active in vasoconstriction.

## Arterial System (cont'd)

- ***Arterioles***-diameter ranges from 0.3mm to 10 μm; larger arterioles/3 tunics
- ***Capillaries***-smallest of blood vessels;single tunic(intima)

## Arterial System (cont'd)

*Types of Capillaries*

- ***Continuous***-abundant in skin and muscles;complete lining with tight junctions
- ***Fenestrated***-have porous walls due to incomplete endothelium
- ***Sinusoids***-highly modified leaky capillaries common in *liver, bone marrow, lymphoid* and *endocrine organs*
- ***Capillary Beds***-microcirculation

## Venous System

- ***Venules***-range from 8 to 10 μm in diameter;porous
- ***Veins***-*65%* of total blood supply; collect blood from all tissues;vein walls less elastic than arteries;sparse tunica media, thick adventitia;valves

## The Pulmonary Circuit

- ***Left/Right Pulmonary Arteries***
- ***Pulmonary Arterioles***
- ***Capillaries, alveoli***
- ***Venules***
- ***Pulmonary veins***

## The Great Vessels

- ***Ascending aorta***
- ***Aortic arch***
- ***Brachiocephalic trunk (rt. common carotid, rt. subclavian)***
- ***Left common carotid***
- ***Left subclavian***

## Systemic Veins

**SVC formation**

- ***Brachiocephalics***

## The Respiratory System

- ***Pulmonary ventilaton***-movement of air in and out of lungs; ventilation/breathing
- ***External respiration***-gas exchange between blood and alveolar sacs
- ***Transport of respiratory gases***-cardiovascular transport of oxygen/carbon dioxide between lungs and tissue cells
- ***Internal respiration***

## Functional Anatomy of the Respiratory System

- ***Organs***-Nose,nasal cavity,pharynx,larynx, trachea, bronchi,smaller branches, lungs,alveoli
- ***Respiratory zone***-respiratory bronchioles, alveolar ducts, alveoli
- ***Conducting zone***-entrance, nasal cavity,bronchioles

## The Nose and Paranasal Sinuses

- ***Nose provides***: airway, moistens/warms entering air,filters,speech resonating chamber,olfactory receptors
- ***External nose***-nasal bones, maxillary bone, lateral cartilage,greater & lesser alar cartilages,external nares
- ***Nasal cavity***-septum(septal cartilage, perpendicular plate, vomer),conchae,meati, respiratory epithelium
- ***Paranasal sinuses***-frontal,sphenoid, ethmoid,maxillary

## The Pharynx

- Connects nasal cavity and mouth to larynx and esophagus.
- ***Nasopharynx, oropharynx, and laryngopharynx***
- ***Nasopharynx***-posterior to nasal cavity,inferior to sphenoid bone, superior to soft palate level;auditory tubes

## The Pharynx (cont'd)

- ***Oropharynx***-lies posterior to oral cavity;extends from soft palate to esophagus; epithelium transitions from pseudostratified to strat. squamous; palatine, lingual tonsils
- ***Laryngopharynx***-lies directly posterior to epiglottis and extends to larynx

## The Larynx

- Voice box extends 2 inches from C4-C6;attaches to hyoid bone superiorly
- Functions in providing patent airway and to route air and food into proper channels;voice production.
- ***Laryngeal framework***-thyroid cart., laryngeal prominence,cricoid cart., arytenoid, corniculate,cuneiform,vestibular fold,vocal fold,epiglottis
- ***Laryngeal musculature***-extrinsic(stabilization);intrinsic(regulate vocal fold tension).

## The Trachea

- Descends from larynx into mediastinum
- 10-12 cm (4 inches) long,2.5cm diameter(1 inch)
- ***Tracheal walls***-mucosa, submucosa, adventitia
- ***Trachealis muscle***
- ***Carina***

## The Bronchi and Subdivisions: The Bronchial Tree

***The Conducting Zone***

- Right/left primary bronchi(extrapulmonary)
- Secondary(lobar),tertiary(segmental), terminal bronchioles
- Structural changes occur as bronchi diameter diminish:(1)cartilage rings replaced by irregular cartilaginous plates; (2)pseudostratified>columnar>cuboidal; and (3)smooth muscle increases.

## The Bronchial Tree

***The Respiratory Zone***

- Terminal bronchioles feed into into respiratory bronchioles.
- Alveolar ducts
- Alveolar sacs

## Gross Anatomy of the Lungs

- ***Apex, base, root***
- ***Lobes***: Superior, middle, inferior
- ***Fissures***:Horizontal,oblique
- ***Surfaces***: Costal, mediastinal, cardiac notch
- ***Connective tissue, trabeculae, elastic fibers, smooth muscles, and lymphatics.***

## The Pleurae

- ***Parietal***
- ***Visceral***
- ***Pleural cavity***

## Respiratory Muscles

- ***Diaphragm***
- ***External,internal intercostal***
- ***Accessory muscles***: Sternocleidomastoid,serratus anterior, pectoralis minor, scalenes (inspiration)

## Respiratory Muscles (cont'd)

- ***Accessory muscles***:external/internal intercostals, abdominal obliques, and rectus abdominis(expiration)

## Respiratory movements:

- ***Eupnea*** (diaphragmatic breathing/costal breathing)
- ***Hyperpnea***

## Respiratory membrane

- ***Type I cells*** (epitheliocytes)-alveolar walls; angiotensin converting enzyme(ACE)
- ***Type II cells***-secrete surfactant (interferes w/H20 molecule cohesiveness
- ***Alveolar macrophages***
- ***Respiratory membrane-***fused basal laminas of alveolar epithelium & capillary endothelium

## Pathologies

Chronic Obstructive Pulmonary Disease

- Obstructive emphysema-alveolar enlargement,alveolar wall deterioration
- Chronic bronchitis-inhaled irritants
- Asthma
- Tuberculosis
- Lung Cancer