Exam 2.0 Cheat Sheet

by jjovann via cheatography.com/67730/cs/18924/

Vessel Structure and Function

•There are 5 main types of blood vessels
–Arteries
–Arterioles
–Capillaries
–Venules
–Veins

Blood Vessel Types

–Veins
– carry blood towardsthe heart

Vessel Structure and Function

Arteries (Tunic Intima)	Both	Vein (Tunic Intima)
• Internal elastic membrane	• Endothelium	
	• Subendothelial layer	
Arteries (Tunic Media)	smooth muscle and elastic fibers	Vein (Tunic Media)
• External elastic membrane		
Arteries (Tunic Externae)	(collagen fibers)	Vein (Tunic Externae)
	• Vasa vasorum	

Vessel Structure and Function

•Arterioles
–Regulate blood flow to the capillaries
–They are the primary "adjustable nozzles" across which the greatest drop in pressure occurs.

Vessel Structure and Function

•Capillaries empty into venules.
•The venules empty into veins
–Because intravenous pressure is so low, veins have valves to keep blood flowing in only 1 direction.

Vessel Structure and Function (cont)

•When exposed to higher than normal pressures, the valves in veins can become incompetent allowing blood to pool (varicose veins).

Capillary Beds: Two Types of Vessels

•True capillaries
–10 to 100 exchange vessels per capillary bed
–Branch off metarteriole or terminal arteriole

Capillary Exchange

•Diffusion
•The movement of a substance from an area of high concentration to an area of low concentration
•In all capillaries, excluding the brain, diffusion is the most important means in net solute exchange between the plasma and interstitial fluid

Fluid Exchange - Starling Forces

–Filtration
•the movement of fluid (plasma) through the walls of the capillary and into the interstitial fluid.
•Two pressures promote filtration:
–Blood hydrostatic pressure (BHP) generated by the pumping action of the heart
–Interstitial fluid osmotic pressure (IFOP) is due to the presence of dissolved solutes in the interstitial fluid

Gas And Nutrient Exchange

–Gases and these other substances simply move into or out of the capillary down their concentration gradient.

Resistance

–Opposition to flow
–Measure of amount of friction blood encounters with vessel walls, generally in peripheral (systemic) circulation
–Three important sources of resistance
•Blood viscosity
•Total blood vessel length
•Blood vessel diameter

Blood Viscosity

•The "stickiness" of blood due to formed elements and plasma proteins
•Increased viscosity = increased resistance

Systemic Vascular Resistance (SVR)

–Also called Total Peripheral Resistance (TPR)
–All the vascular resistances offered by the systemic blood vessels
–Also called Total Peripheral Resistance (TPR)
–A major function of arterioles is the control of SVR
–Pathos is atherosclerosis

Arterial Blood Pressure

•Systolic pressure: highest pressure obtained in arteries during ventricular ejection
•Diastolic pressure: lowest level of pressure obtained in the arteries during ventricular diastole
•Pulse pressure = difference between systolic and diastolic pressure
•Mean arterial pressure (MAP): pressure that propels blood to tissues

Regulation of BP and Flow

•Control is accomplished through several negative feedback systems
–BP controlled by adjusting HR, SV, TPR, and blood volume
–Some systems are rapid for quick adjustment
•Counteract fluctuations in blood pressure by altering peripheral resistance and CO
•E.g. – keeps you from passing out from the drop in blood pressure in the brain when you get out of bed
–Others systems act more slowly
•Counteracts fluctuations in blood pressure by altering blood volume•These provide long-term regulation
–The body may also require adjustments in distribution of flow
•E.g. – when you exercise, a greater percentage of total flow is diverted to skeletal muscle

Neural Reflexes

•Nervous system regulates blood pressure using negative feedback loops that occur as 2 types of reflexes
–Baroreceptor reflex
–Chemoreceptor reflex

Hormonal Regulation of BP

•Regulation of blood pressure and flow is also under the control of several hormones.
–Renin-angiotensin-aldosterone (RAA) system
–Epinephrine and norepinephrine
–Antidiuretic hormone
–Atrial Naturetic Peptide

Antidiuretic hormone (ADH), Vasopressin

–released from the posterior pituitary gland in response to dehydration or decreased blood volume.
–Increases water reabsorption in the kidneys which increases blood volume
–Potent vasoconstrictor

Metabolic Controls

•Vasodilation of arterioles and relaxation of precapillary sphincters occur in response to local chemical changes
–Declining tissue O2
–Substances from metabolically active tissues (H+, K+, adenosine, and prostaglandins) and inflammatory chemicals

Intrinsic and Extrinsic Mechanisms

Intrinsic	Extrinsic
autoregulation	• Neuronal or hormonal controls
• Metabolic or myogenic controls	• Maintain mean arterial pressure
• Distribute blood flow to individual organs and tissues as needed	• Redistribute blood during exercise and thermoregulation
Myogenic	Neuronal
• Stretch	Sympathetic tone

Intrinsic and Extrinsic Mechanisms (cont)

Metabolic	Hormonal
• Endothelins	• Angiotensin II
	• Antidiuretic hormone
	• Epinephrine
	• Norepinephrine

Hypertension

–defined as elevated systolic blood pressure (SBP), an elevated diastolic blood pressure (DBP), or both.
–Diastolic pressure is greater than 100
–Systolic pressure is greater than 160
–Depending on severity, it is classified as pre-hypertension, Stage 1 HTN, or stage 2 HTN

Shock and Homeostasis

•Heart rate & force increase
•Vasoconstriction or vasodilation depending on the type of shock
•ADH released to conserve water
•Renin releases Angiotensin II
•Aldosterone released to conserve Na+
•ANP inhibited

Respiratory System

•Air passing through the respiratory tract traverses the:
–Nasal cavity
–Pharynx
–Larynx
–Trachea
–Primary (1o) bronchi
–Secondary (2o) bronchi
–Tertiary (3o) bronchi
–Bronchioles
–Alveoli (150 million/lung)

Nasal Conchae

•scroll-shaped bony elements forming the upper chambers of the nasal cavities
–Tucked under each nasal concha is an opening, or meatus
–Receptors in the olfactory epithelium (used for smell)pierce the bone of the cribriform plate.

Pharynx

•The pharynx has 3 anatomical regions:
–Nasopharynx
–Oropharynx
–Laryngopharynx

Laryngopharynx

•The laryngopharynx lies inferiorly and opens into the larynx (voice box) and the esophagus.
–It participates in both respiratory and digestive functions.

Epiglottis

–a flap of elastic cartilage covered with a mucous membrane
–The epiglottis guards the entrance of the glottis, the opening between the vocal folds
•For breathing, it is held anteriorly, then pulled back-ward to close off the glottic opening during swallowing

Trachea Cartilage

•The purpose of the semi-rigid cartilage rings in the respiratory tract is to prevent airway collapse during inhalation
•The tracheal cartilage rings are incomplete posteriorly, facing the esophagus.
–This allows the esophagus to expand as it moves the bolus of swallowed food toward the stomach
–Esophageal masses can press into this soft part of the trachea and make it difficult to breathe, or even totally obstruct the airway.

Bronchi

•The bronchi and bronchioles go through structural changes as they continue to branch and become smaller.
–The mucous membrane changes cell type and then disappears.
–The cartilaginous rings become more sparse, and eventually, disappear altogether.
–As the amount of cartilage rings decrease, smooth muscle content(under the control of the Autonomic Nervous System) increase.

Understanding gases

Earths atmosphere is mainly composed of these gases:
–Nitrogen (N2) 78%
–Oxygen (O2) 21%
–Carbon Dioxide (CO2) 0.04%
–Water Vaporvariable, but on average around 1%

Thoracic Cavity Pressure Relationships

–Negative respiratory pressure = less than Patm
–Positive respiratory pressure = greater than Patm
–Zero respiratory pressure = Patm

Pulmonary Ventilation Pressure Changes

–Just before each inhalation, the pressure inside the lungs is equal to the atmospheric pressure.
•760mmHg
–Air flows from high pressure to low pressure
–For air to flow into the lungs, the pressure in the alveoli must be less than atmospheric
–This decrease in alveoli pressure is accomplished by increasing the volume of the lungs through mechanical coupling to a change in thoracic volume

Diaphragm

–Advanced pregnancy, excessive obesity, and confining abdominal clothing can obstruct diaphragm flattening

Exhalation

•The pressure in the lungs is greater than that of the atmosphere

Pneumothorax

- air, or liquid (blood or Interstitial fluid), in the pleural cavity
–From either wound in parietal or rupture of visceral pleura
–Intrapleural pressure goes from -4 to 0 thus eliminating the transpulmonary pressure that keeps a lung open
•lung collapses in on itself

Surface Tension

•The surface tension of alveolar fluid
–Found at all air-water interfaces
•Polar water molecules are more strongly attracted to each other than gas in air
•This means that when air tries to fill the alveoli, the water on the alveoli surface doesn’t want to pull away from itself and produces an inward pull resisting expansion

Infant Respiratory Distress Syndrome (IRDS)

•Deficiency of surfactant in premature infants
•Alveoli collapse due to high surface tension
•Treated by using continuous positive air pressure (CPAP) breathing machines - increases pressure of air going into the lungs - and synthetic surfactant until infant begins producing its own

Airway Resistance

•Just like blood flow through the circulatory system, air flow depends upon pressure difference and resistance
•The diameter of airways is regulated by smooth muscle tone which, as previously discussed, is dependent upon parasympathetic and sympathetic interaction

Airway Resistance

•Obstructive disorders
–Any pathological condition that narrows, or obstructs, airways
•Narrowing of airways greatly increases resistance for inhalation and exhalation
–Increased work of breathing
•Airways can also become blocked via the collapse of bronchioles, alveoli, or build-up of excess mucous
•Types of obstructive lung disease include;
–asthma, bronchitis, chronic obstructive pulmonary disease (COPD), emphysema, cystic fibrosis, etc.

Blood Vessel Types

–Arteries – carry blood away from the heart
•Large elastic arteries (>1 cm);
medium muscular arteries (0.1 – 10 mm);
arterioles (< 0.1 mm)

Blood Vessel Types

Systemic veins and venules have the most percentage of the blood found

Vessel Structure and Function

•The largest arteries are the conducting arteries (elastic arteries)
–Elastic arteries perform the important function of storing mechanical energy during ventricular systole and then transmitting that energy to keep blood moving after the aortic and pulmonary valves close.
–Best exemplified by the garden hose-sized aorta.

Vessel Structure and Function

•Capillaries are the only sites in the entire vasculature where gases, water, nutrients, and wastes are exchanged with the interstitial fluid that bathes tissue.
• They have no tunics

Vessel Structure and Function (cont)

•The minimalist nature of capillaries allows them to be freely permeable to many substances (gases, fluids, and small ionic molecules).

Vessel Structure and Function

•An anastomosis is a union of vessels supplying blood to the same body tissue.
–Should a blood vessel become occluded, a vascular anastomosis provides an alternative route for blood to reach to and return from tissue
–A great example is the genicular anastomosis
•Common at joints, in abdominal organs, brain, and heart
•None in retina, kidneys, spleen

Blood Flow Through Capillary Beds

•Precapillary sphincters are bands of smooth muscle that regulate blood flow into true capillaries
–Blood can go into true capillaries or to shunt depending on contractile state of precap sphincters
•Flow through capillaries regulated by local chemical conditions and vasomotor nerves
•Slow capillary blood flow allows adequate time for exchange between blood and tissues

Capillary Exchange

•Transcytosis
–Movement of a small quantity of material through the endothelial cell using a pinocytic vesicle
•Small membrane enclosed bubble transporting substance within cell
–Used mainly for large lipid-insoluble (water-soluble) molecules that cannot cross capillary walls by other means
•Insulin enters the blood stream this way

Resistance

Two factors remain relatively constant:
–Blood viscosity
–Blood vessel length

Fluid Exchange - Starling Forces

–Reabsorption
•the movement of fluid from the interstitial fluid back through the walls of the capillary and into the plasma.
•Two pressures promote reabsorption:
–Blood colloid osmotic (or oncotic) pressure (BCOP)
•due to the presence of plasma proteins too large to cross the capillary wall
–Interstitial fluid hydrostatic pressure (IFHP)
•The fluid pressure of the interstitial fluid

–normally close to zero but can become a significant factor in states of edema.

Blood vessel length

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•Longer vessel = greater
resistance encountered
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Relationship Between BF, BP, and Resistance

•Blood flow (F) is directly proportional to blood pressure gradient
–If one decreases, the other decreases
•Blood flow inversely proportional to resistance (R)
–If one decreases, the other increases and vice versa
• (resistance) more important in influencing local blood flow because easily changed by altering a tissue’s blood vessel diameter

Systemic pressure

•Systemic pressure
–Highest in aorta
–Declines throughout the pathway

Capillary Blood Pressure

•Ranges from 35 (capillary entry)to 16 mmHg (capillary exit)
•Low capillary pressure is desirable
–High BP would rupture fragile, thin-walled capillaries

Pressure, Flow, And Resistance

•In an effort to meet physiological demands, we can increase blood flow by:
–Increasing BP gradient
•Bigger difference between high and low pressure creates greater blood flow
–Decreasing systemic vascular resistance in the blood vessels
•Makes it easier for blood to flow from high to low

Velocity of Blood Flow

•Speed of blood flow
–Usually in cm/sec
–Velocity of blood flow is inversely proportional to total cross-sectional area of vessel lumens

Regulation of BP and Flow

•Regulation of BP can occur by various methods
–Neural control
–Hormonal control
–Autoregulation

Baroreceptor Reflex

–Pressure sensitive sensory receptors
–Found in the aorta, carotid arteries, and other large arteries in the neck and chest
–Changes in pressure cause changes in the rate of impulses (action potentials) sent to the brain
•Decrease in pressure = decrease in impulse rate
•Increase in pressure = increase in impulse rate
–2 most important baroreceptor reflexes
•Carotid sinus reflex
–Helps regulate blood pressure in the brain
•Aortic reflex
–Regulates systemic blood pressure

(RAA) system

•The Renin-angiotensin-aldosterone (RAA) system is an important endocrine component of autoregulation.

(RAA) system (cont)

–Renin is released by kidneys when blood volume falls, Na deficiency is detected, or renal blood flow decreases.
•It causes the conversion of precursors into substances that lead to the production of the active hormone angiotensin II, which raises BP by vasoconstriction and by stimulating secretion of aldosterone from the adrenal glands.

–ACE inhibitors affect the production of angiotensin II

Atrial Natiuretic Peptide (ANP)

–a diuretic polypeptide hormone released by cells of the cardiac atria in response to high blood volume and atrial pressure.
–ANP participates in regulation by:
•Lowering blood pressure (it causes direct vasodilation)
•Reducing blood volume by increasing sodium excretion in the kidneys (promoting loss of salt in urine formation decreases water reabsorption by the kidney

Metabolic Controls

•Effects
–Relaxation of vascular smooth muscle
–Release of Nitric Oxide (powerful vasodilator) by endothelial cells
•Endothelins released from endothelium are potent vasoconstrictors
•NO and endothelins balanced unless blood flow inadequate, then NO wins
•Inflammatory chemicals cause vasodilation, also

Autoregulation

•In an autoregulatory response, important differences exist between the pulmonary and systemic circulations:
–Systemic blood vessel walls dilate in response to hypoxia (low O2) or acidosis to increase blood flow.

Autoregulation (cont)

–The walls of the pulmonary blood vessels constrict to a hypoxic or acidosis stimulus to ensure that most blood flow is diverted to better-ventilated areas of the lung.

Hypotension

–defined as any blood pressure too low to allow sufficient blood flow (hypo-perfusion) to meet the body's metabolic demands (to maintain homeostasis)
–Hypotension leading to hypo-perfusion (pressure and flow are related) of critical organs results in shock

Shock and Homeostasis

•Most cases of severe shock call for the administration of extra fluids and emergency medications like epinephrine to help restore perfusion (blood flow)to the tissues.
• If a balance is not restored organs will fail (kidney failure, liver failure, coma) and damage may become permanent.

Respiratory System

•Structurally, The respiratory system is divided into upper and lower divisions,or tracts.
–Upper respiratory tract
•consists of the nose, pharynx and associated structures.
–Lower respiratory tract
•consists of the larynx, trachea, bronchi and lungs.

Respiratory System

•Much, not all, of the respiratory tract is covered with pseudostratified ciliated columnar epithelium with interspersed goblet cells (secrete mucous)
•Cilia in the upper respiratory tract move secreted mucous with trapped particles down toward the pharynx.

Respiratory System (cont)

•Cilia in the lower respiratory tract move secreted mucous up toward the larynx.

Nasal Mucosa and Conchae Functions

•During inhalation, conchae and nasal mucosa
–Filter, heat, and moisten air
•During exhalation these structures
–Reclaim heat and moisture

Nasopharynx

•The nasopharynx lies behind the internal nares.
–It contains the openings of the Eustachian tubes (auditory tubes), which come off of it and travels to the middle ear cavity.

Laryngopharynx

•As air passes from the laryngopharynx into the larynx, it leaves the upper respiratory tract and enters the lower respiratory tract.

Rima Glottis

•formed by a pair of mucous membrane vocal folds
–The vocal folds are situated high in the larynx just below where the larynx and the esophagus split off from the pharynx

Respiratory System

•The carina is an internal ridge located at the junction of the two mainstem bronchi
– a very sensitive area for triggering the cough reflex.

Respiratory System

•Sympathetic stimulation causes airway dilation –> bigger airway = less airflow resistance
•Parasympathetic stimulation causes airway constriction –> smaller airway = more airflow resistance.

Respiration

–3 basic steps
•Pulmonary ventilation
•External (pulmonary) respiration
•Internal (tissue) respiration

Understanding Gases

–The pressure we feel on the surface of the earth is, in essence, the weight of the gasses in our atmosphere
•At high altitudes, the atmospheric pressure is less; descending to sea level, atmospheric pressure is greater.

Understanding Gases

At sea level, the air pressure is:–760 mmHg = 1 atmosphere

Intra-alveolar Pressure

–Pressure in alveoli
–Changes when breathing
–Always eventually equalizes with Patm

Diaphragm

–Most important muscle for inspiration
–Dome-shaped skeletal muscle innervated by the phrenic nerve
–Contraction of the diaphragm causes it to flatten
•Lowers (flattens) the dome
•This increases the vertical volume of the thoracic cavity
•The change in volume is transferred to the lungs via the intrapleural cavity and the pressure within it

External Intercoastals

–Second most important muscles of inhalation
–During contraction, these muscles elevate the ribs increasing the anteroposterior and lateral diameters of the chest cavity
•During inhalation, the ribs move upward and outward like the handle on a bucket

Passive Exhalation

•Normal exhalation during quiet breathing
•Called passive because no muscular contractions are involved
•Instead, it results from inward forces;
–The elastic recoil of the chest wall and lungs
–the inward pull of the surface tension of the alveolar fluid

Pneumothorax

–At the same time, the chest wall moves outward because its elastic recoil is no longer opposed by coupling to the inward pulling forces of the lungs
–Treated by removing excess intrapleural air/fluid with chest tubes; restores negative pressure lung re-inflates
–Because the lungs are in separate pleural cavities, one may collapse without interfering with the function of the other

Surface Tension

•Causes the alveoli to assume the smallest possible diameter
•Accounts for 2/3 of lung elastic recoil.
–If unopposed, this force would cause the alveoli would close with each expiration and make our “Work of Breathing” insupportable

Compliance of the Lungs

–How easily something stretches
•High pulmonary compliance means the lungs and chest wall are easily expanded – easier for inflation
•Low pulmonary compliance means they resist expansion – harder for inflation
–Lung compliance dependent upon 2 factors
•Elasticity
•Surface tension

Airway Resistance

–The same as in blood vessel diameter, the larger the diameter of an airway, the less the airway resistance and the greater the flow
–If the bronchioles dilate even a little, the resistance drops by a power of 4

Blood Vessel Types

Capillaries – site of nutrient and gas exchange

Vessel Structure and Function

•The wall of a blood vessel consists of basic layers or “tunics”:
•Tunica interna (intima)
•Tunica media
•Tunica externa

Vessel Structure and Function

•Medium sized muscular (distributing) arteries
–Muscular arteries help maintain the proper vascular tone to ensure efficient blood flow to the distal tissue beds by constricting and dilating.
–Some examples include the brachial artery in the arm and radial artery in the forearm.

Vessel Structure and Function

•The body contains three types of capillaries:
–Continuous capillaries
•The most common•Endothelial cells form a continuous tube, interrupted only by small intercellular clefts.
–Fenestrated capillaries (fenestra = windows)
•Found in the kidneys, villi of small intestines, and endocrine glands
•These are much more porous.
–Sinusoids
•Form very porous channels through which blood can percolate, e.g., in the liver and spleen.

Capillary Beds: Two Types of Vessels

•Vascular shunt (metarteriole—thoroughfare channel)
–Directly connects terminal arteriole and postcapillary venule

Capillary Exchange

•Capillary exchange
–The movement of substances between the blood and interstitial fluid
–Substances may pass using;
•Diffusion
•Transcytosis
•Bulk Flow (Filtration and Reabsorption)

Capillary Exchange

•Bulk flow
–Passive process in which large numbers of ions, molecules, or particles in a fluid move together in the same direction with the fluid
–Movement is from an area of high pressure to one of low pressure
–Important for regulation of relative volumes of blood and interstitial fluid
–hydrostatic and osmotic forces determine bulk flow direction
–These are called Starling Forces

Fluid Exchange - Starling Forces

•Blood colloid osmotic pressure
–These create an osmotic pressure that pulls water into the capillary
•Interstitial fluid hydrostatic pressure (IFHP)
–This is the water pressure of the interstitial fluid that pushes fluid into the capillary
•Blood hydrostatic pressure
-Basically, the water pressure of the blood pushing fluid out
•Interstitial fluid osmotic pressure
-These solutes create an osmotic pressure that pulls water out of the capillary

Physiology of Circulation

•Blood flow
–Volume (amount) of blood flowing through vessel, organ, or entire circulation in a given period
•Measured as ml/min
•As a whole, relatively constant when at rest•Amount varies widely through individual organs, based on needs
–Factors that affect blood flow
•Blood pressure
•Vascular resistance
•Venous return
•Velocity of blood flow

Blood pressure

–Force per unit area exerted on the wall of the blood vessel by blood
•Expressed in mmHg
–Pressure gradient provides driving force that keeps blood moving from higher to lower pressure areas
–Determined by CO, blood volume, and vascular resistance

Blood vessel diameter

–Constantly monitored and easily/quickly adjusted
–Greatest influence on resistance
•Vasoconstriction
–Decrease vessel lumen diameter by contraction of smooth muscle
•Vasodilatation
–Increase vessel lumen diameter by relaxation of smooth muscle
–Varies inversely with fourth power of vessel radius

Systemic Blood Pressure

•Pumping action of heart generates blood flow
•Resistance generates blood pressure

Arterial Blood Pressure

•Reflects two factors of arteries close to heart
–Elasticity (compliance or distensibility)
–Volume of blood forced into them at any time
–Arterial pressure changes as they accommodate more or less blood from the upstream vessel

Venous Return

•The volume of blood returning through the veins to the right atrium must be the same amount of blood pumped into the arteries from the left ventricle
–Besides pressure, venous return is aided by the presence of venous valves, a skeletal muscle pump, and the respiratory pump.
•The skeletal muscle pump –uses the action of muscles to squeeze blood in 1 direction (due to valves).
•The respiratory pump
–uses the negative pressures in the thoracic and abdominal cavities generated during inspiration to pull venous blood towards the heart.

Neural Regulation

•CV center also has a role in regulation of blood vessel diameter
–Vasomotor center
•Vasoconstrictor center
•Vasodilator center
•Sympathetic neurons that innervate blood vessels in the viscera and peripheral areas
–Vasomotor tone
–This sets the resting level for systemic vascular resistance

Chemoreceptor Reflex

–Sensory receptors that monitor chemical changes in the blood
–Located close to the baroreceptors of the carotid sinus and aortic bodies
–Detect changes in blood CO_2, pH, and many detect O_2 , also
•Hypoxia = low O_2 availability

Chemoreceptor Reflex (cont)

•Acidosis = increase in H+ concentration above normal
•Hypercapnia = excess CO2

Epinephrine and Norepinephrine

–Released from the adrenal medulla as an endocrine response to sympathetic stimulation.
–They increase cardiac output by increasing heart rate and force of contractions.
–Also have effects on blood vessels
•Vasoconstrictory (harder for to blood flow) in some places, vasodilatory (easier for blood to flow) in others

Autoregulation of BP

–The ability of a tissue to automatically adjust its blood flow to match its metabolic demand
•Very important in heart, brain, and skeletal muscle
•Blood distribution to various parts of the brain changes
–Controlled intrinsically by modifying the diameter of local arterioles feeding capillaries
–2 general types of stimuli cause autoregulatory changes in blood flow•Metabolic controls
•Myogenic controls
•Both determine the final autoregulatory response

Myogenic Controls

•Myogenic responses keep local tissue perfusion constant despite most fluctuations in systemic pressure
•Vascular smooth muscle responds to stretch
–Passive stretch (increased intravascular pressure) promotes increased tone and vasoconstriction

Long-term Autoregulation

•Occurs when short-term autoregulation cannot meet tissue nutrient requirements
•Angiogenesis
–Growth of new blood vessels

Long-term Autoregulation (cont)

–Number of vessels to nutrient deficient region increases and existing vessels enlarge to supply more blood flow in an effort to restore normal chemical environment
–Common in heart when coronary vessel occluded, or throughout body in people in high-altitude areas

Shock

–Failure of the cardiovascular system to deliver enough oxygen and nutrients to meet cellular metabolic demands
•The 4 basic types of shock are:
–Hypovolemic shock
•due to decreased blood volume
–Cardiogenic shock
•due to poor heart function
–Obstructive shock
•due to obstruction of blood flow - embolism
–Vascular shock
•due to excess vasodilation - as seen in cases of a massive allergy

Respiratory System

•Functionally, the respiratory system is divided into the conducting zone and the respiratory zone.
–Conducting zone
•Involved with bringing air to the site of external respiration and consists of the nose, pharynx, larynx, trachea, bronchi, bronchioles and terminal bronchioles.
–Respiratory zone
•The main site of gas exchange and consists of the respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli.

Respiratory System

•The external nose is visible on the face.
•The internal nose is a large cavity beyond the nasal vestibule.
–The internal nasal cavity is divided by nasal septum into right and left nares.

Pharynx

–A hollow tube that starts posterior to the internal nares and descends to the opening of the larynx in the neck.
–It is formed by a complex arrangement of skeletal muscles that assist in swallowing
–It functions as:
•a passageway for air and food
•a resonating chamber for sound
•a housing for the tonsils (lymphatic organs)

Oropharynx

•The oropharynx lies behind the mouth and participates in both respiratory and digestive functions.

Larynx

–composed of 9 pieces of cartilage, forms a short passageway connecting the laryngopharynx with the trachea (the “windpipe”).
–The thyroid cartilage (the large “Adam’s apple”) and the one below it (cricoid cartilage) are landmarks for making a temporary emergency airway (called a cricothyrotomy).

Trachea

–a semi-rigid pipe made of semi-circular cartilaginous rings (hyaline cartilage), and located anterior to the esophagus.
–It is about 12 cm long and extends from the inferior portion of the larynx into the mediastinum where it divides into right and left primary (1o, “mainstem”) bronchi.

Bronchi

•The 1st bronchi divide to form 2nd (secondary) and 3rd (tertiary) bronchi which respectively supply the lobes and segments of each lung.
–3rd bronchi divide into bronchioles which in turn branch through about 22 more divisions.
•The smallest are the terminal bronchioles.

Conducting Airways

•All the branches from the trachea to the terminal bronchioles are conducting airways

Pulmonary Ventilation

–the movement of air between the atmosphere and the alveoli of the lungs
–It consists of inhalation and exhalation.

Understanding gases

•A barometer is an instrument that measures atmospheric pressure.
–Baro = pressure or weight
–Meter = measure
–Air pressure varies greatly depending on the altitude and the temperature.

Understanding Gases

•Boyle's law states that volume and pressure are inversely related.

Intrapleural pressure

–Pressure in the pleural cavity
•Pleural cavity is sealed space between the surface of the lungs and internal chest wall
–Changes when breathing
–This should always be a negative pressure (<Patm and <Ppul) in order to prevent lung collapse
–Plural fluid helps limit friction between lungs and thoracic wall, but the fluid amount must be kept to a minimum
•Excess is pumped out by lymphatics•If accumulates   positive Pip pressure   lung collapse

Diaphragm

•This causes the lungs to expand thus increasing their volume and decreasing the pressure at the alveoli below that of atmospheric
•Air rushes in from the higher external atmospheric pressure to the lower internal alveoli pressure causing the lungs to fill in an effort to equalize the two pressures
•This is responsible for about 75% of air that enters the lungs during resting (quiet) breathing

Inhalation

Accessory muscles of inhalation
–Involved in active inhalation
•These assist in increasing thoracic volume during exercise or deep, forceful inhalations
–Sternocleidomastoid
•Elevates the sternum
–Scaline
•Elevates the first two ribs
–Pectoralis minor
•Elevates ribs 3-5

Active Exhalation

–Forceful exhalation
•Yelling, exercise, or playing a wind instrument
–Requires muscles of exhalation
•Abdominals
–Moves the inferior ribs downward and compresses the abdominal viscera» Forces the diaphragm superiorly
•Internal intercostals
–Pulls the ribs inferiorly (downward)

Airflow and Work of Breathing

3 other factors also affect the ease with which we ventilate:
–The surface tension of alveolar fluid
–Compliance of the lungs
–Airway resistance

Surfactant

–A mixture of phospholipids and lipoproteins present in the alveolar fluid
–Reduces the alveolar fluid surface tension below the surface tension of pure water by blocking some water-to-water interactions
•Allows for easier inflation of the alveoli and helps prevent alveolar collapse during exhalation

Compliance of Lungs

–Restrictive disorders restrict lung expansion
•Pulmonary fibrosis
–Scar tissue not very elastic
•Deficiency in surfactant•Pulmonary edema (excess fluid in the lungs)
–Decreases lung compliance
•Impedance to expansion
–E.g. Ventilatory muscle paralysis, broken ribs, obesity

Airway Resistance

•Pressure's role in airway resistance
–As the lungs expand during inhalation, the bronchioles enlarge because they are expanding outward in all directions
•This decreases resistance to flow in to the lungs
–As the lungs expand during inhalation, the bronchioles enlarge because they are expanding outward in all directions
•This increases resistance to flow out of the lungs
•Any condition that narrows, or obstructs, the airways increases resistance