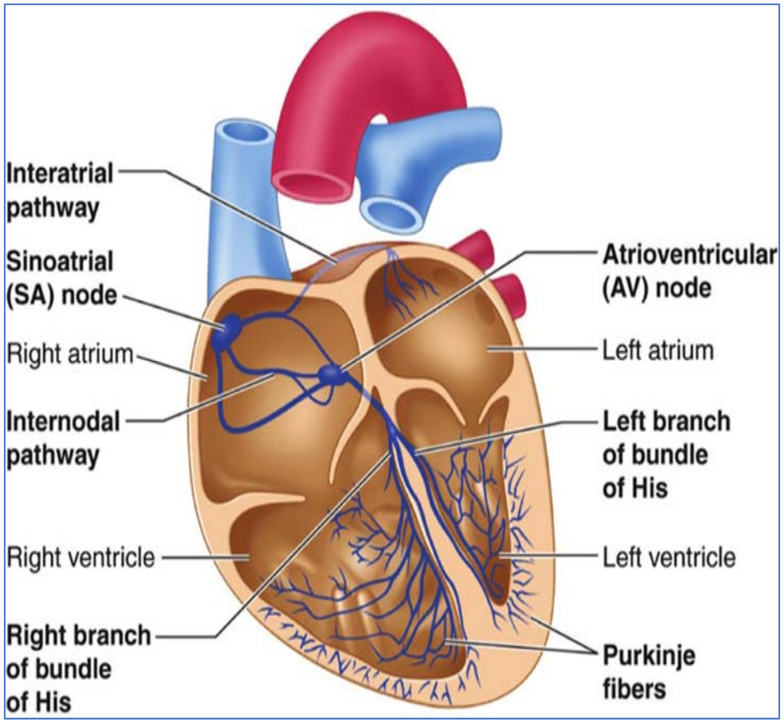

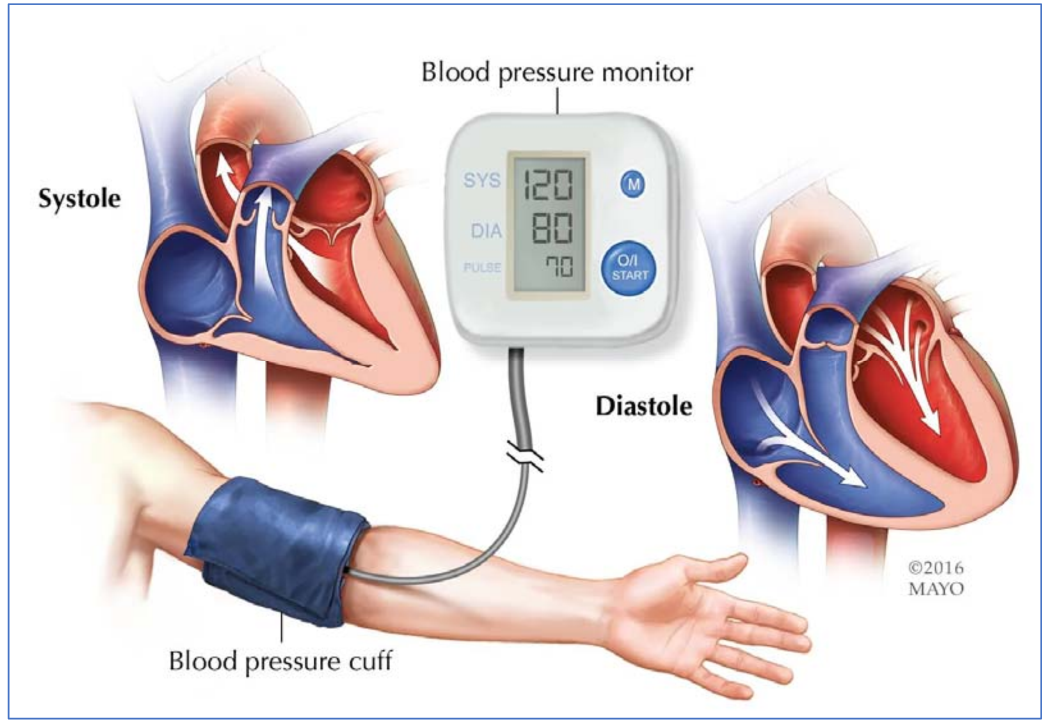

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blood pressure, origin of heart pulse and ECG

Department of occupational Therapy Techniques

Blood pressure: is the force the blood exerts against the walls of the blood vessels.

- The pumping of the ventricles creates blood pressure, which is measured in mmHg (millimeters of mercury).
- When a systemic blood pressure reading is taken, two numbers are obtained: systolic and diastolic.
- Systolic pressure is accrue during the left ventricle is contracting.
- Diastolic pressure is accrue during the left ventricle is relaxed.

- Systemic blood pressure is highest in the aorta, which receives all of the blood pumped by the left ventricle. As blood travels farther away from the heart, blood pressure decreases.
- BP in capillaries is 30 to 35 mmHg at the arterial end. While at the venous end 12 to 15 mmHg —high enough to permit filtration but low enough to prevent rupture of the capillaries.
- Pulmonary BP is always low (the right ventricle pumps with less force): 20 to 25/8 to 10 mmHg. This low BP prevents filtration and accumulation of tissue fluid in the alveoli.

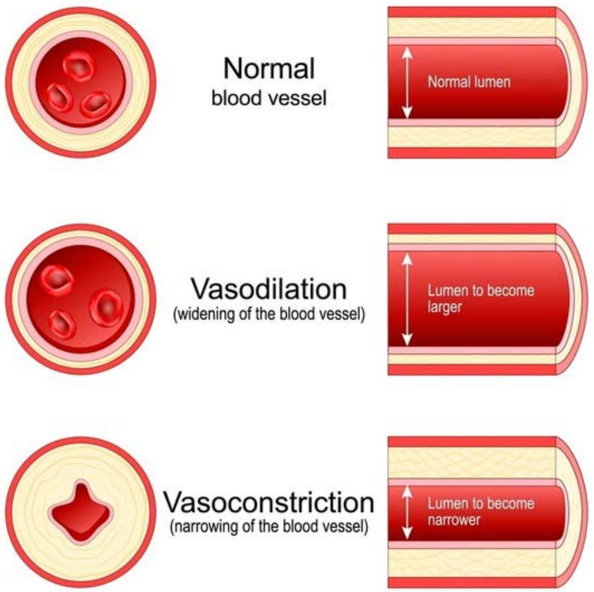
- The upper limit of the normal blood pressure range is 120/80 mmHg.
- The levels of 125 to 139/85 to 89 mmHg, once considered high-normal, are now called **"prehypertension,"** that is, with the potential to become even higher.
- A systemic blood pressure consistently higher than the normal range is called **hypertension.**
- A lower than normal blood pressure is called **hypotension.**

Because blood pressure is so important, many physiological factors and processes interact to keep blood pressure within normal limits:

1. **Venous return:** the amount of blood that returns to the heart. If venous return decreases, the heart contracts less forcefully (Frank-Starling law) and BP decreases.

2. **Heart rate and force:** if heart rate and force increase, BP increases, because it increases cardiac output, forcing more blood through vessels faster.

3. **Peripheral resistance:** the resistance of the arteries and arterioles to the flow of blood. These vessels are usually slightly constricted to maintain normal diastolic BP. Greater vasoconstriction will increase BP; vasodilation will decrease BP. In the body, vasodilation in one area requires vasoconstriction in another area to maintain normal BP.



4. **Elasticity of the large arteries:** when the left ventricle contracts, the blood that enters the large arteries stretches their walls. The arterial walls are elastic and absorb some of the force. When the left ventricle relaxes, the arterial walls recoil, which helps keep diastolic pressure within the normal range.

5. **Viscosity of blood:** depends on RBCs and plasma proteins, especially albumin. Having too many red blood cells is rare but does occur in the disorder called polycythemia vera and in people who are heavy smokers. This will increase blood viscosity and blood pressure. Severe anemia tends to decrease BP, deficiency of albumin as in liver or kidney disease tends to decrease BP. In these cases, compensation such as greater vasoconstriction will keep BP close to normal.

6. **Loss of blood:** a small loss will be rapidly compensated for by faster heart rate and greater vasoconstriction. After severe hemorrhage, these mechanisms may not be sufficient to maintain normal BP.

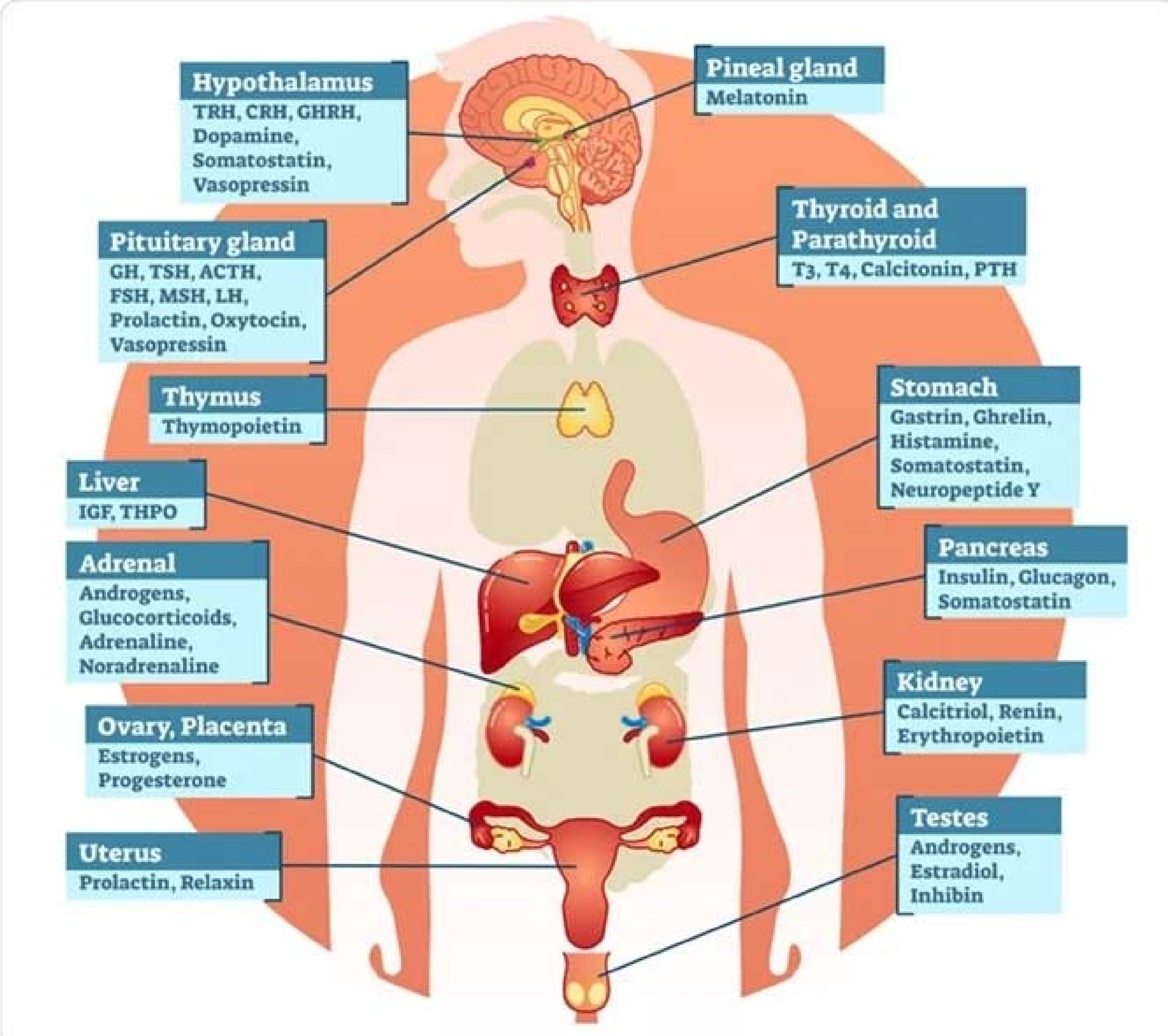
7. Hormones:

- The nervous and endocrine systems act together to coordinate functions of all body systems. The nervous system acts through nerve impulses conducted along axons of neurons. At synapses, nerve impulses trigger the release of mediator (messenger) molecules called neurotransmitters. The endocrine system also controls body activities by releasing mediators, called hormones, but the means of control of the two systems are very different.

- **A hormone:** is a molecule that is released in one part of the body but regulates the activity of cells in other parts of the body. Most hormones enter interstitial fluid and then the bloodstream. The circulating blood delivers hormones to cells throughout the body. Both neurotransmitters and hormones exert their effects by binding to receptors on or in their "target" cells.

Hormones control many different bodily processes, including

- Metabolism.
- Homeostasis (constant internal balance), such as blood pressure and blood sugar regulation, fluid (water) and electrolyte balance and body temperature.
- Growth and development.
- Sexual function.
- Reproduction.
- Sleep-wake cycle.
- Mood



Hypothalamus
TRH, CRH, GHRH, Dopamine, Somatostatin, Vasopressin
Pineal gland
Melatonin
Pituitary gland
GH, TSH, ACTH, FSH, MSH, LH, Prolactin, Oxytocin, Vasopressin
Thyroid and Parathyroid
T3, T4, Calcitonin, PTH
Thymus
Thymopoietin
Stomach
Gastrin, Ghrelin, Histamine, Somatostatin, Neuropeptide Y
Liver
IGF, THPO
Pancreas
Insulin, Glucagon, Somatostatin
Adrenal
Androgens, Glucocorticoids, Adrenaline, Noradrenaline
Kidney
Calcitriol, Renin, Erythropoietin
Ovary, Placenta
Estrogens, Progesterone
Testes
Androgens, Estradiol, Inhibin
Uterus
Prolactin, Relaxin

(a) Norepinephrine stimulates vasoconstriction, which raises BP.

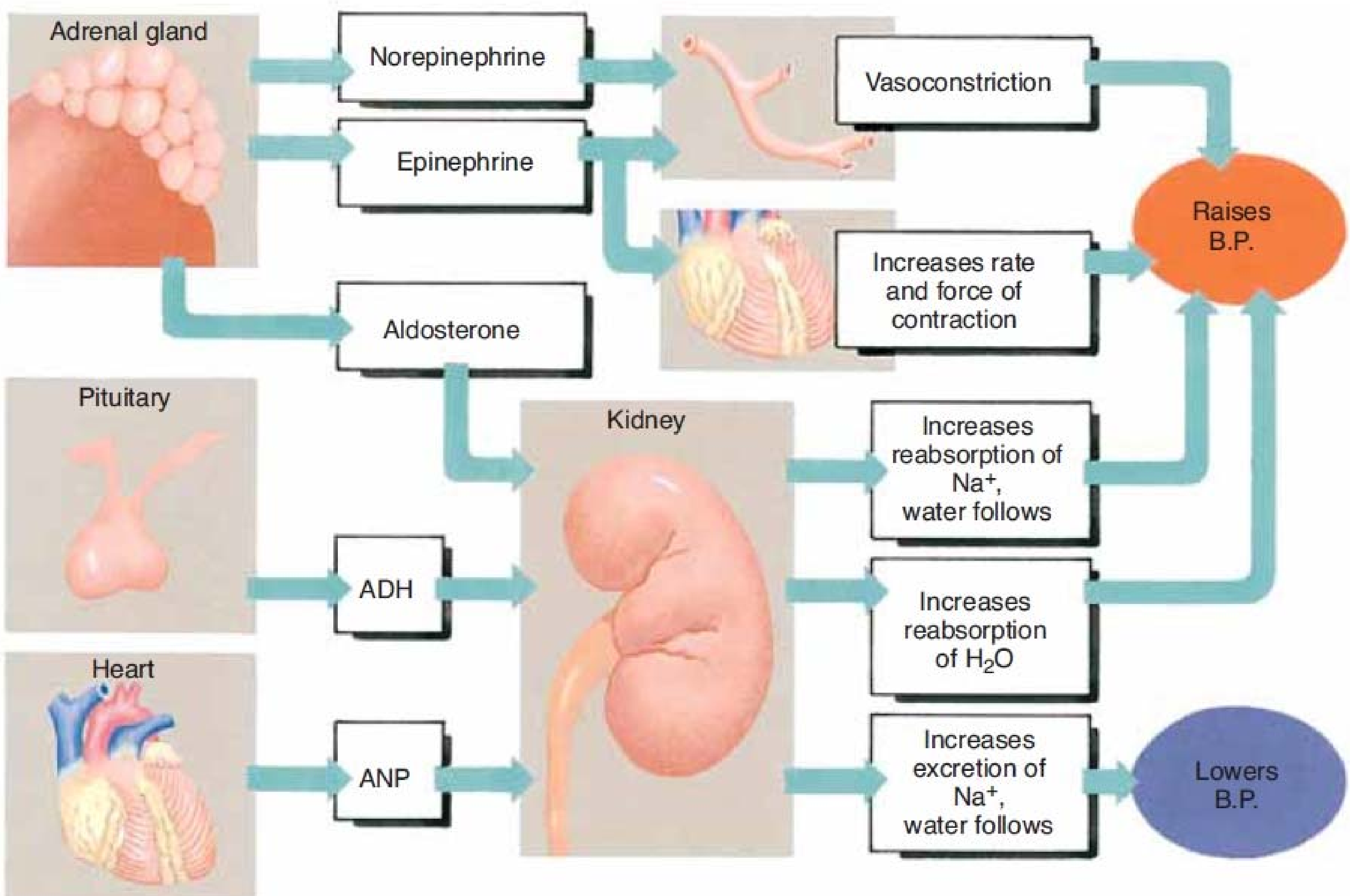
(b) Epinephrine increases cardiac output and raises BP.

(c) Aldosterone is a hormone from the adrenal cortex. When blood pressure decreases increases reabsorption of Na ions by the kidneys; water follows Na and increases blood volume and BP.

(d) Antidiuretic Hormone (ADH) is secreted by the posterior pituitary gland when the water content of the body decreases, which increases water reabsorption by the kidneys, which increases blood volume and BP.

(e) Atrial natriuretic peptide (ANP)

Another function of the atria is the production of a hormone involved in blood pressure maintenance. When the walls of the atria are stretched by increased blood volume or blood pressure, the cells produce atrial natriuretic peptide (ANP), also called atrial natriuretic hormone (ANH). ANP decreases the reabsorption of sodium ions by the kidneys, so that more sodium ions are excreted in urine, which in turn increases the elimination of water. The loss of water lowers blood volume and blood pressure.



Adrenal gland
Norepinephrine
Epinephrine
Vasoconstriction
Raises B.P.
Increases rate and force of contraction
Aldosterone
Pituitary
Kidney
Increases reabsorption of Na^+, water follows
ADH
Increases reabsorption of H_2O
Heart
ANP
Increases excretion of Na^+, water follows
Lowers B.P.

Regulation of Blood Pressure:

The mechanisms that regulate systemic blood pressure may be divided into two types: intrinsic mechanisms and nervous mechanisms.

❑ Intrinsic mechanisms:

1. **The heart:** responds to increased venous return by pumping more forcefully (Frank-Starling law), which increases cardiac output and BP.

2. **The kidneys**: decreased blood flow decreases filtration, which decreases urinary output to preserve blood volume. Decreased BP stimulates the kidneys to secrete **renin**, which initiates the **renin-angiotensin mechanism** (Renin-Angiotensin-Aldosterone System, or RAAS) that results in the formation of angiotensin II, which causes vasoconstriction and stimulates secretion of aldosterone.

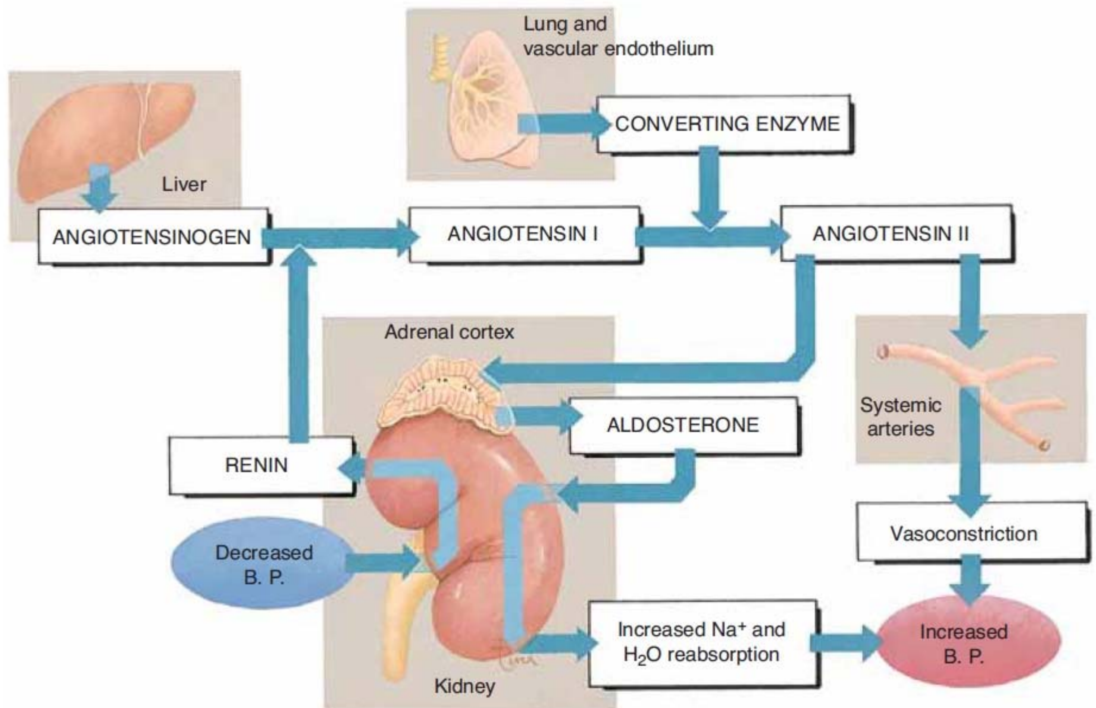
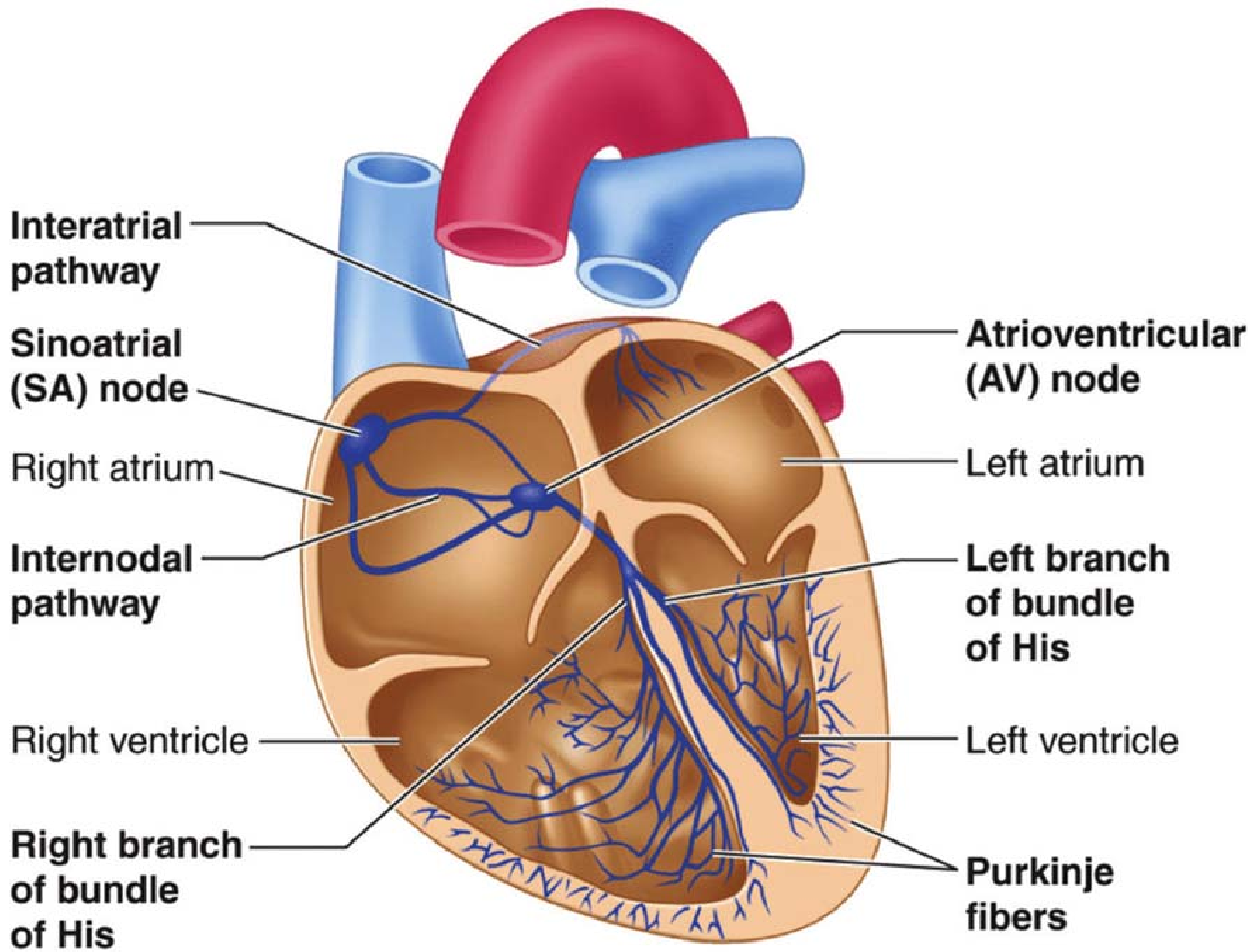


Table 13–3 THE RENIN-ANGIOTENSIN MECHANISM

1. Decreased blood pressure stimulates the kidneys to secrete renin.
2. Renin splits the plasma protein angiotensinogen (synthesized by the liver) to angiotensin I.
3. Angiotensin I is converted to angiotensin II by an enzyme (called converting enzyme) secreted by lung tissue and vascular endothelium.
4. Angiotensin II:
   - causes vasoconstriction
   - stimulates the adrenal cortex to secrete aldosterone

Origin of the heart pulse:

- Cardiac muscle cells have the ability to contract spontaneously. The heart generates its own beat, and the electrical impulses follow a very specific route throughout the myocardium
- The natural pacemaker of the heart is the **sinoatrial (SA) node**, a specialized group of cardiac muscle cells located in the wall of the right atrium just below the opening of the superior vena cava.
- The cells of the SA node are more permeable to Na ions than are other cardiac muscle cells. Therefore, they depolarize more rapidly, then contract and initiate each heartbeat.
- From the SA node, impulses for contraction travel to the **atrioventricular (AV) node**, located in the lower interatrial septum. The transmission of impulses from the SA node to the AV node and to the rest of the atrial myocardium brings about atrial systole.
- **The atrioventricular bundle (AV bundle), also called the bundle of His** within the upper interventricular septum; it receives impulses from the AV node and transmits them to the right and left bundle branches.
- From the bundle branches, impulses travel along **Purkinje fibers** to the rest of the ventricular myocardium and bring about ventricular systole.


Interatrial pathway
Sinoatrial (SA) node
Right atrium
Internodal pathway
Right ventricle
Right branch of bundle of His
Atrioventricular (AV) node
Left atrium
Left branch of bundle of His
Left ventricle
Purkinje fibers

The electrical activity of the atria and ventricles is depicted by an electrocardiogram (ECG):

Electrocardiogram (ECG):

- A heartbeat is a series of electrical events, and the electrical changes generated by the myocardium can be recorded by placing electrodes on the body surface.

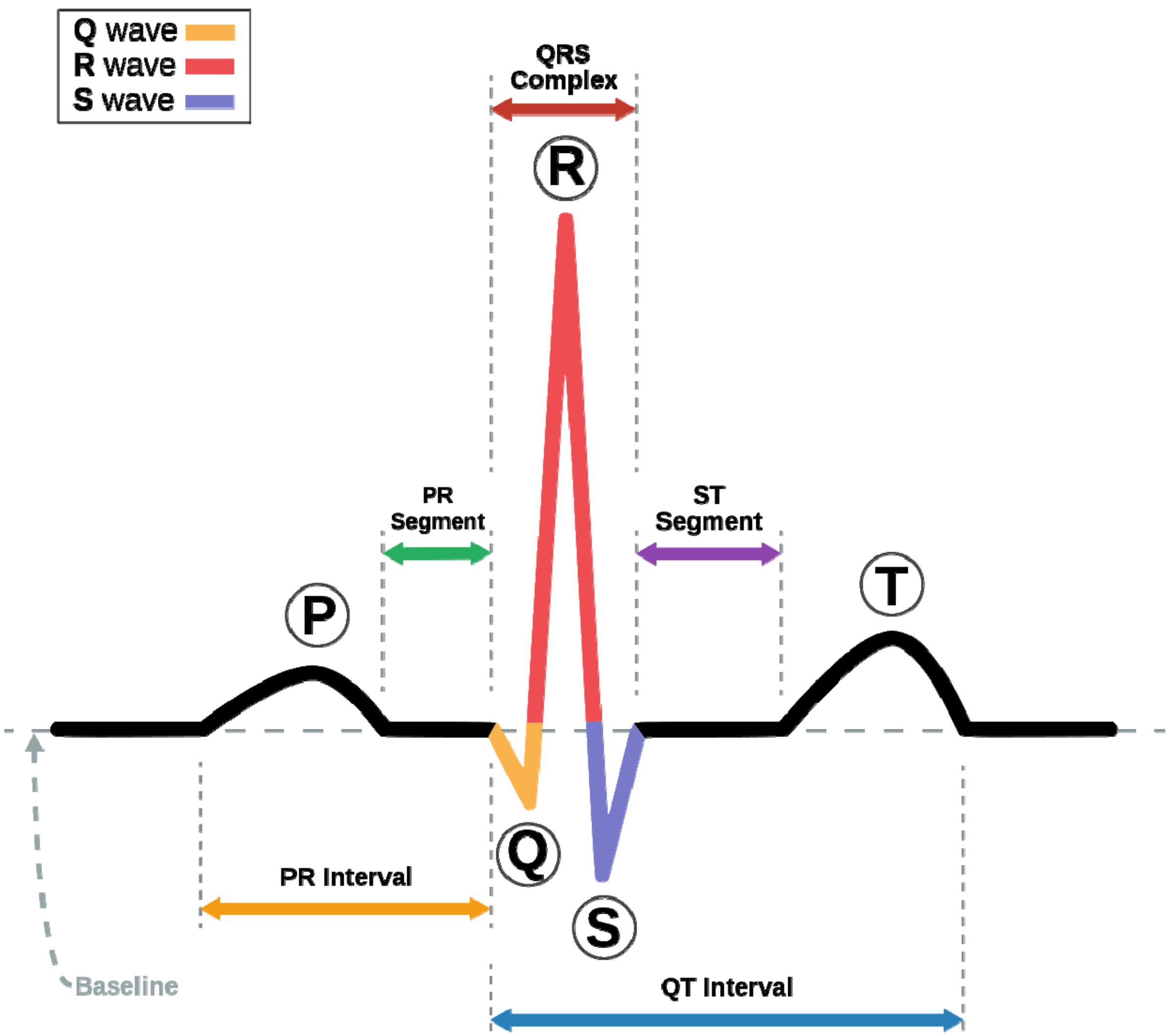
- A typical ECG consists of three distinguishable waves or deflections: the P wave, the QRS complex, and the T wave. Each represents a specific electrical event.

- The P wave represents depolarization of the atria, that is, the transmission of electrical impulses from the SA node throughout the atrial myocardium.

- The QRS complex represents depolarization of the ventricles as the electrical impulses spread throughout the ventricular myocardium.

- The T wave represents repolarization of the ventricles (atrial repolarization does not appear as a separate wave because it is masked by the QRS complex . The length of each wave and the time intervals between waves are noted.

- An ECG may be helpful in the diagnosis of coronary atherosclerosis, which deprives the myocardium of oxygen or other valve disorders that result in enlargement of a chamber of the heart and prolong a specific wave of an ECG.



Q wave
R wave
S wave
QRS
Complex
R
PR
Segment
ST
Segment
P
T
Q
S
PR Interval
Baseline
QT Interval