الفسلجة
مرحلة ثانية

الأستاذ المساعد الدكتور
خالد سعود صالح

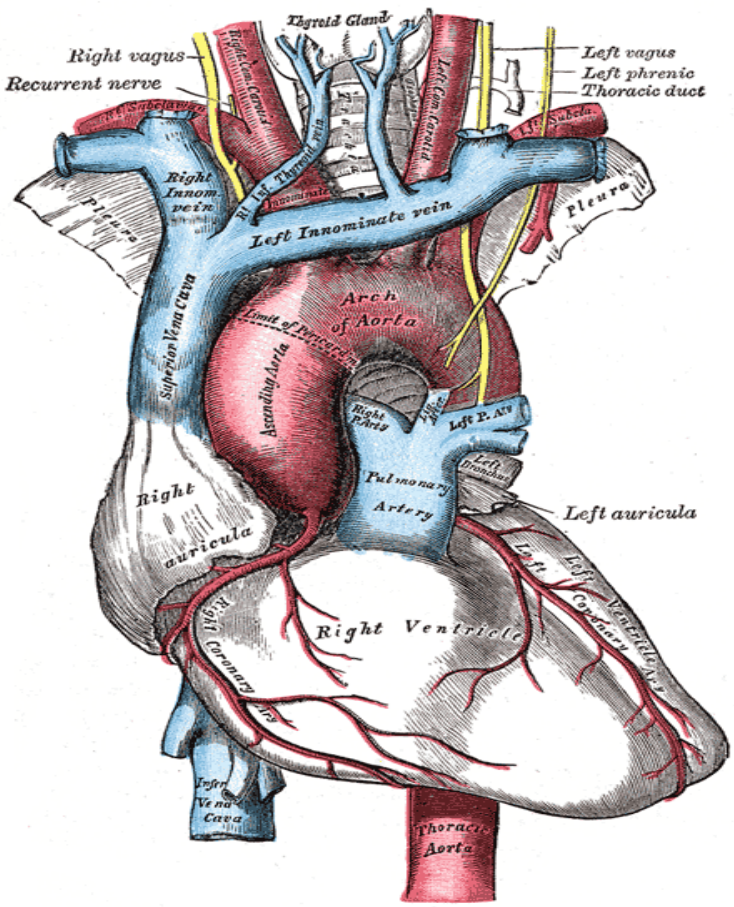
CARDIOVASCULAR SYSTEM

Innervation and Blood Supply:

- **The heart receives a rich supply of sympathetic and parasympathetic nerve fibers:**

- **Sympathetic fibers release norepinephrine which acts on (β1) receptors distributed on cardiac muscle.**

- **Parasympathetic contained in the vagus nerves release (Ach) which acts on the muscarinic receptors.**



- **The circulating epinephrine (adrenaline) hormone from adrenal medulla also acts on (β1) receptors.**
- *Noradrenergic fibers are epicardial, whereas the vagal fibers are endocardial*.
- **However, connections exist for reciprocal inhibitory effects of both innervation of the heart.**

Blood supply of the heart:

The myocardial cells receive their blood supply through coronary arteries.

drain into a single large vein, the coronary sinus, which drain into the right atrium.

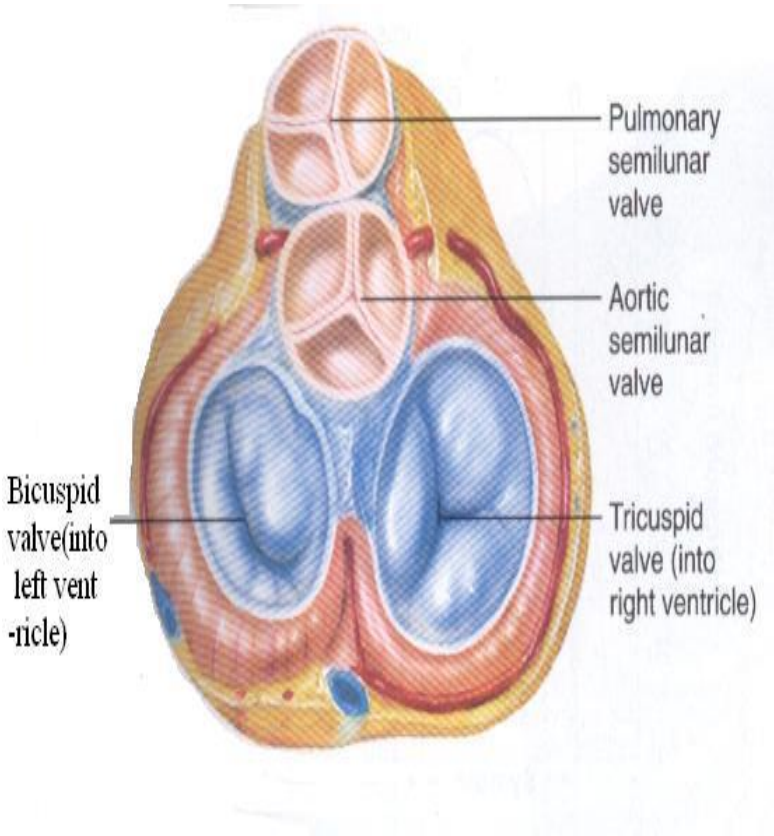
The Heart Valves:

a) **The atrio-ventricular AV valves: are composed of thin membranous cusps, which hang down in the ventricular cavities during diastole.**

The AV valves include:

i. **The left AV valve; *the mitral or bicuspid valve*, which consists of two cusps (anterior and posterior).**

ii. **The right AV valve; *the tricuspid valve*, which consists of three cusps.**



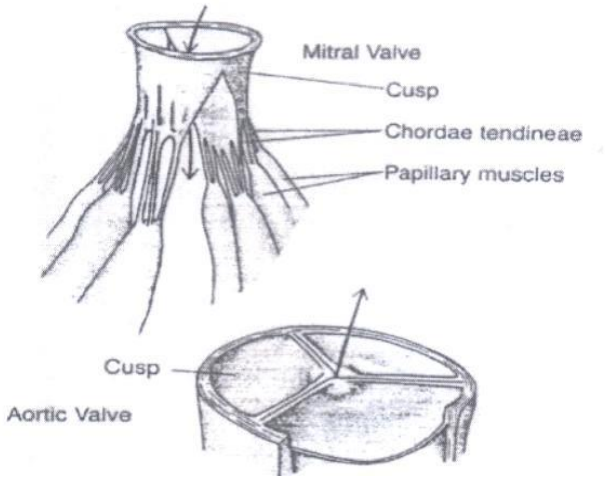
The function of AV valves

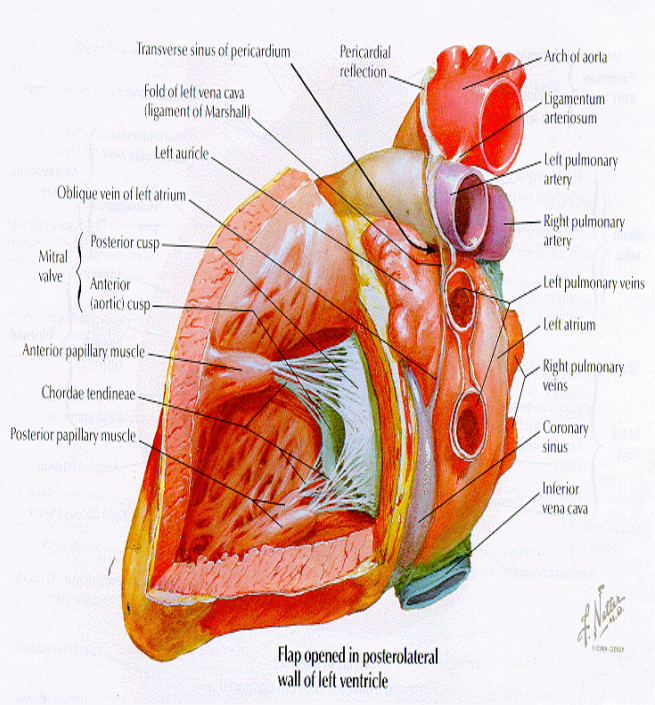
i. **to allow blood to flow from the atrium to the ventricle.**

ii. **to prevent backflow (regurgitation; leakage) of blood into the atria during ventricular contraction.**

- **This is normally prevented by contraction of the papillary muscles within the ventricles.**

- **These are connected to AV valve flaps by strong tendinous cords (*the chordae tendineae*).**





The Heart Valves:

b) The semi-lunar valves: pulmonic and aortic valves:

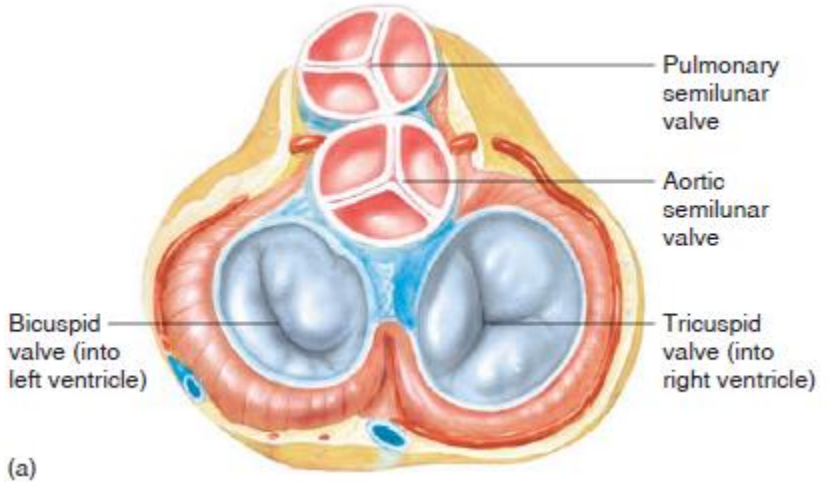
- **Each consist of three semilunar cusps that resemble pockets.**
- **They contain no papillary muscle.**
- **During diastole the cusps become closely approximated to prevent regurgitation of blood.**

c) There are no valves at entrance of venae cavae and pulmonary veins into the atria:

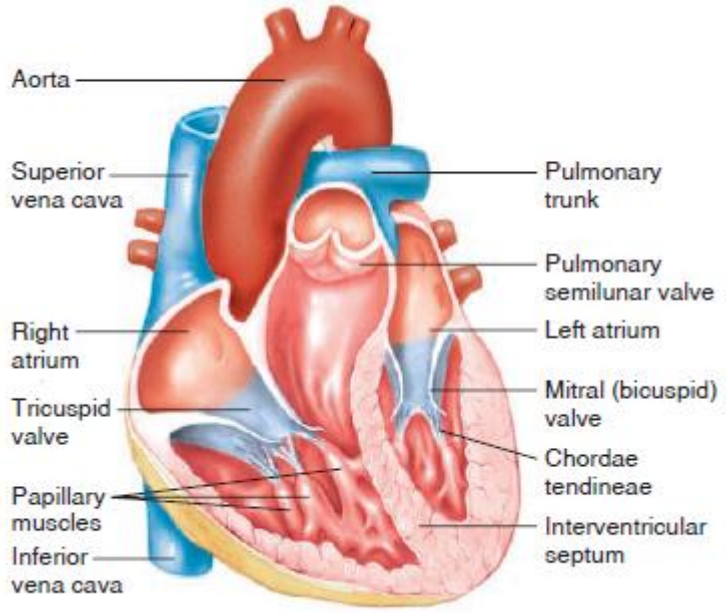
- **Compression of these veins by the atrial contraction prevents the backflow of blood from the atria toward the veins.**

Atrioventricular and Semilunar Valves

Although adjacent myocardial cells are joined together mechanically and electrically by intercalated discs, the atria and ventricles are separated into two functional units by a sheet of connective tissue—the fibrous skeleton previously mentioned. Embedded within this sheet of tissue are one-way **atrioventricular (AV) valves.** The AV valve located between the right atrium and right ventricle has three flaps, and is therefore called the *tricuspid valve.* The AV valve between the left atrium and left ventricle has two flaps and is thus called the bicuspid valve, or, alternatively, the mitral valve.



The AV valves allow blood to flow from the atria to the ventricles, but they normally prevent the backflow of blood into the atria. Opening and closing of these valves occur as a result of pressure differences between the atria and ventricles. When the ventricles are relaxed, the venous return of blood to the atria causes the pressure in the atria to exceed that in the ventricles. The AV valves therefore open, allowing blood to enter the ventricles. As the ventricles contract, the intraventricular pressure rises above the pressure in the atria and pushes the AV valves closed.



There is a danger, however, that the high pressure produced by contraction of the ventricles could push the valve flaps too much and evert them. This is normally prevented by contraction of the *papillary muscles* within the ventricles, which are connected to the AV valve flaps by strong tendinous cords called the *chordae tendineae* .

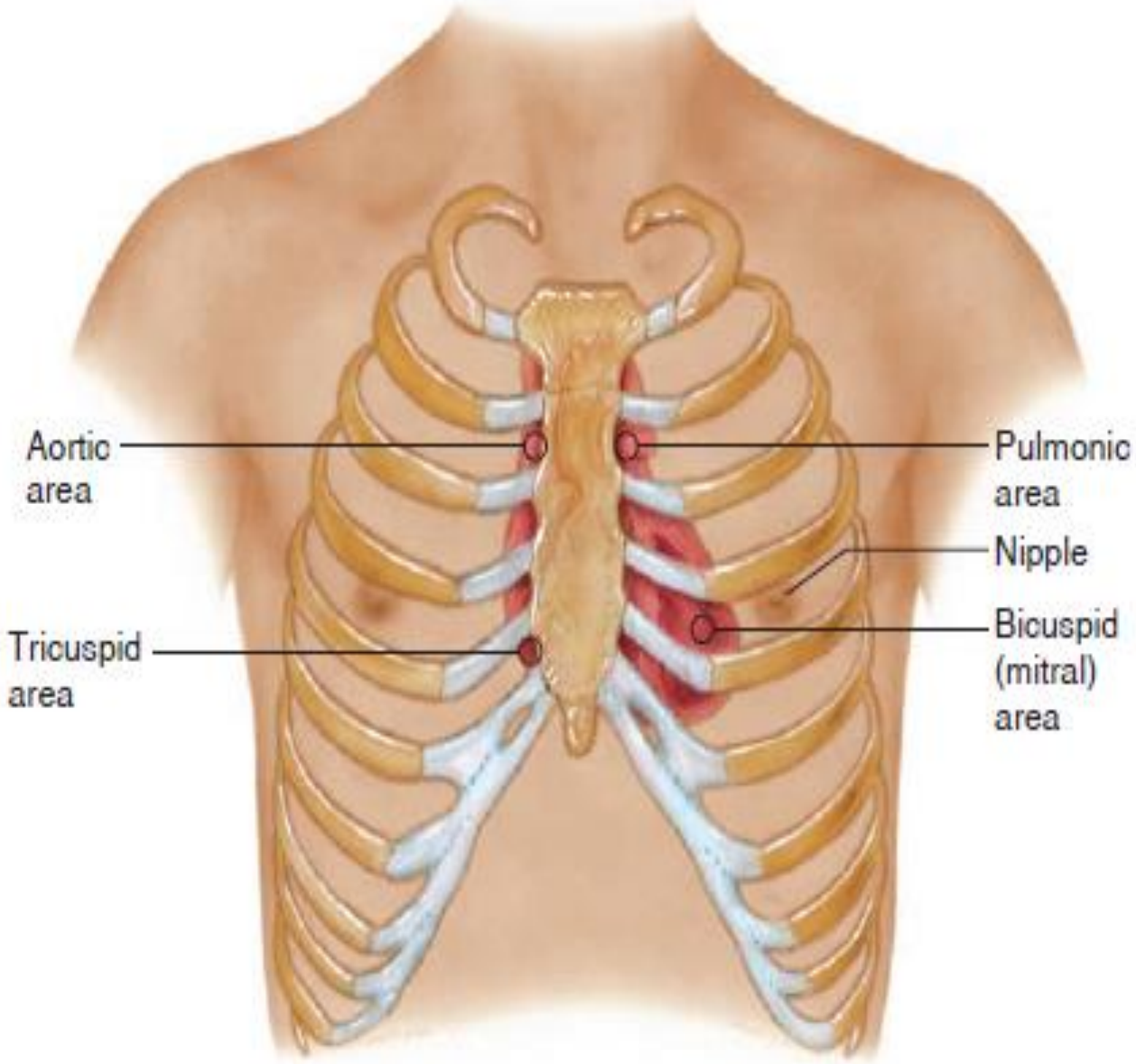
Contraction of the papillary muscles occurs at the same time as contraction of the muscular walls of the ventricles and serves to keep the valve flaps tightly closed.

One-way **semilunar valves** are located at the origin of the pulmonary artery and aorta. These valves open during ventricular contraction, allowing blood to enter the pulmonary and systemic circulations. During ventricular relaxation, when the pressure in the arteries is greater than the pressure in the ventricles, the semilunar valves snap shut, thus preventing the backflow of blood into the ventricles.

Heart Sounds

Closing of the AV and semilunar valves produces sounds that can be heard by listening through a stethoscope placed on the chest. These sounds are often verbalized as “lub dub.”
The “lub,” or first sound, is produced by closing of the AV valves during isovolumetric contraction of the ventricles

The “dub,” or second sound, is produced by closing of the semilunar valves when the pressure in the ventricles falls below the pressure in the arteries.
The first sound is thus heard when the ventricles contract at systole, and the second sound is heard when the ventricles relax at the beginning of diastole.


Aortic area
Pulmonic area
Nipple
Tricuspid area
Bicuspid (mitral) area

Heart Murmurs

Murmurs are abnormal heart sounds produced by abnormal patterns of blood flow in the heart. Many murmurs are caused by defective heart valves. Defective heart valves may be congenital, or they may occur as a result of rheumatic endocarditis, associated with rheumatic fever.

Many people have small defectsthat produce detectable murmurs but do not seriously compromise the pumping ability of the heart. Larger defects, however, may have dangerous consequences and thus may require surgical correction.

In mitral stenosis, for example, the mitral valve becomes thickened and calcified. This can impair the blood flow from the left atrium to the left ventricle. An accumulation of blood in the left atrium may cause a rise in left atrial and pulmonary vein pressure, resulting in pulmonary hypertension.

To compensate for the increased pulmonary pressure, the right ventricle grows thicker and stronger.

Valves are said to be ***incompetent*** when they do not close properly, and murmurs may be produced as blood regurgitates through the valve flaps. One important cause of incompetent AV valves is damage to the papillary muscles. When this occurs, the tension in the chordae tendineae may not be sufficient to prevent the valve from everting as pressure in the ventricle rises during systole.

Murmurs also can be produced by the flow of blood through ***septal defects*** —holes in the septum between the right and left sides of the heart. These are usually congenital and may occur either in the interatrial or interventricular septum.

When a septal defect is not accompanied by other abnormalities, blood will usually pass through the defect from the left to the right side, due to the higher pressure on the left side. The buildup of blood and pressure on the right side of the heart that results may lead to pulmonary hypertension and edema (fluid in the lungs).

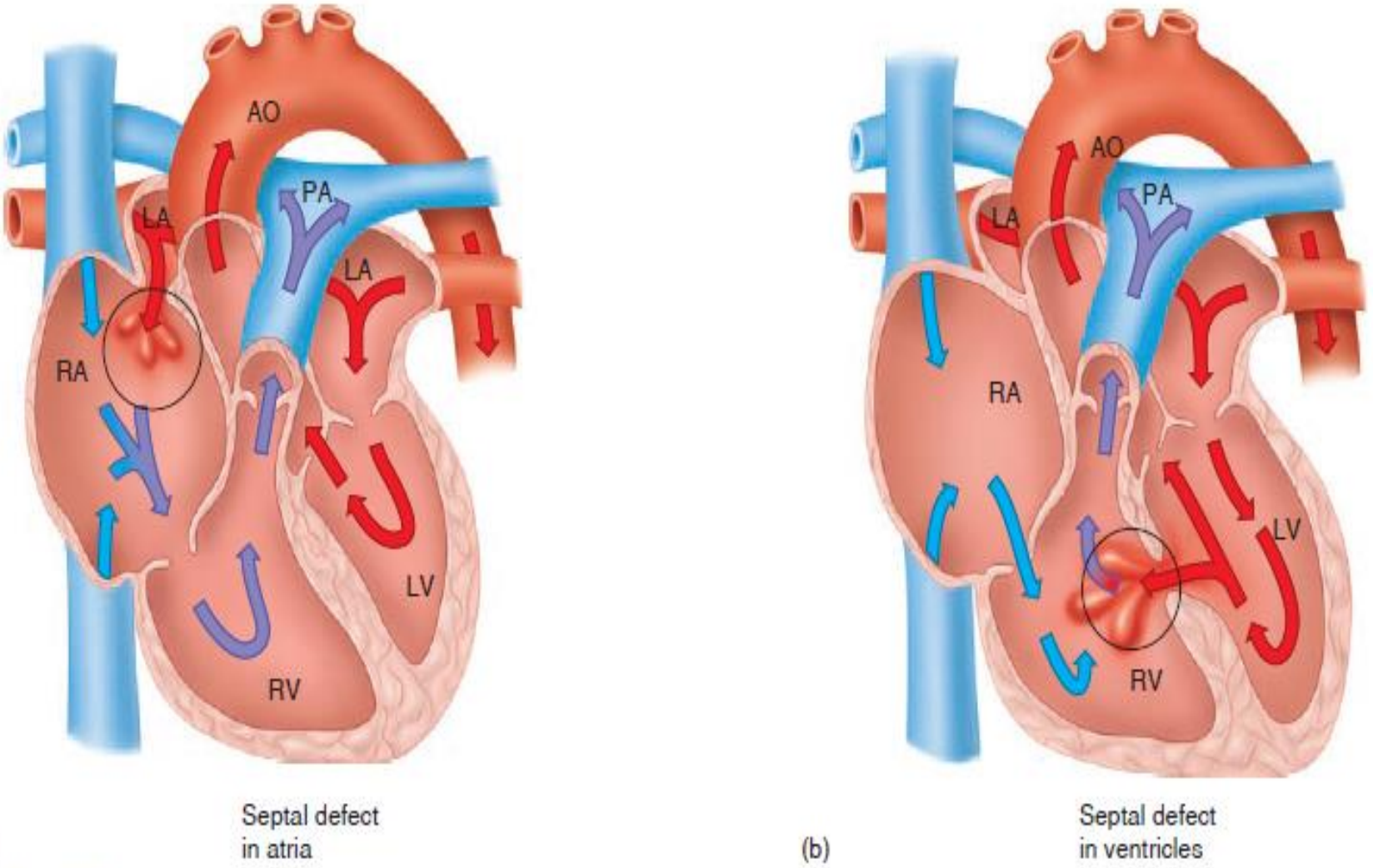


Figure 13.14 **Abnormal blood flow due to septal defects.** Left-to-right shunting of blood is shown (circled areas) because the left pump is at a higher pressure than the right pump in the adult heart. (*a*) Leakage of blood through a defect in the atria (a patent foramen ovale). (*b*) Leakage of blood through a defect in the interventricular septum. (RA = right atrium; RV = right ventricle; LA = left atrium; RA = right atrium; AO = aorta; PA = pulmonary artery.)

Properties of Cardiac Muscle

Autorhythmicity

Excitability

Conductivity

Contractility