



Alterations of Cardiovascular Function in Children

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Congenital Heart Defects

- Major cause of death in the first year of life other than prematurity
- Prenatal, environmental, and genetic risk factors:
 - Maternal rubella or increased age, type 1 diabetes, alcoholism, PKU, drugs, and hypercalcemia
 - Prematurity
 - Chromosome aberrations



Congenital Heart Disease

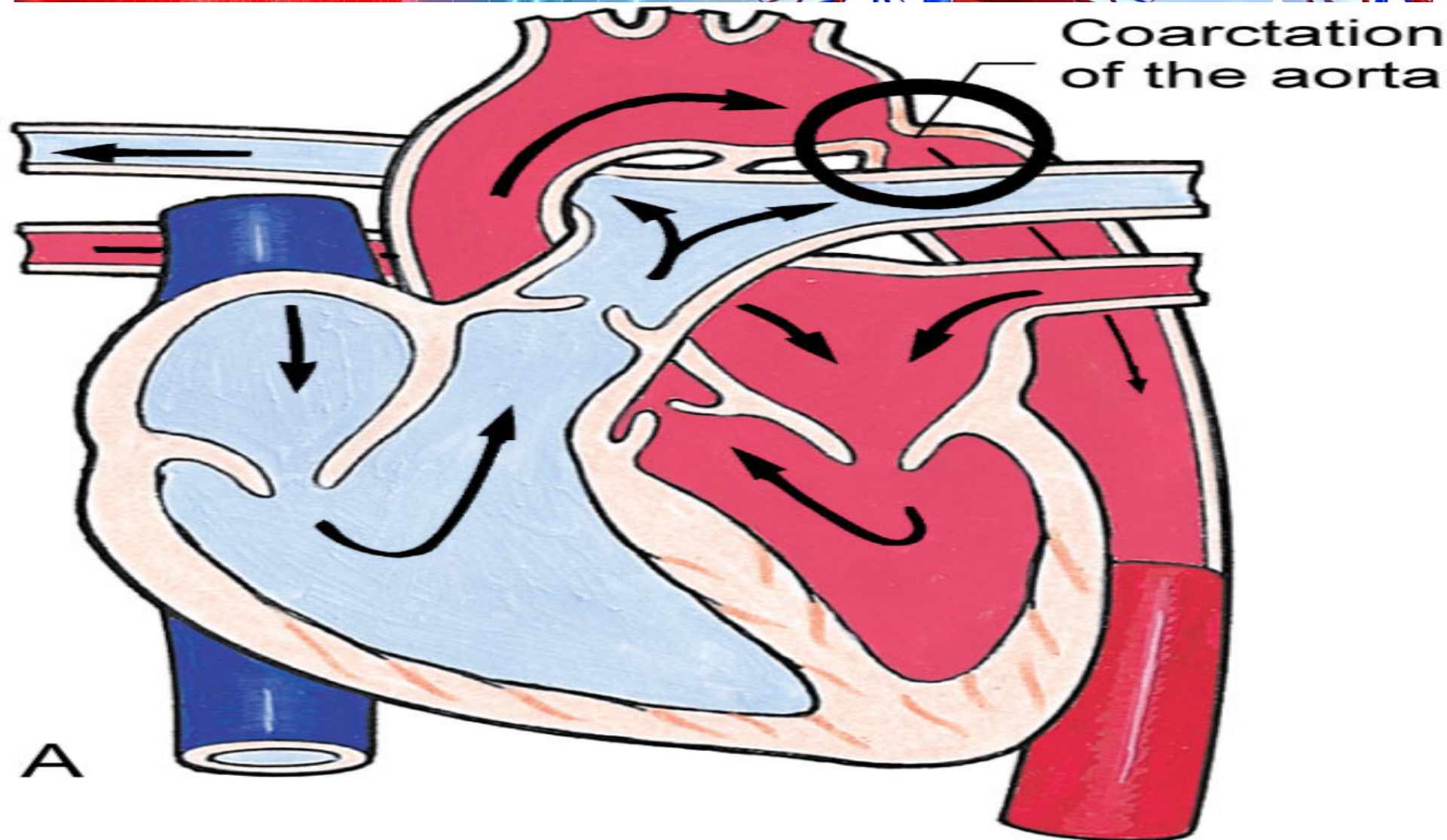
- Heart defects
- Hemodynamic alterations
 - Right-to-left shunt, left-to-right shunt
- Status of tissue oxygenation
 - Cyanotic defects
 - Acyanotic defects



Obstructive Defects

- Coarctation of the aorta
 - Narrowing of the lumen of the aorta that impedes blood flow
 - Almost always in a juxtaductal position
 - Manifestations:
 - If severe decreased CO, acidosis, hypotension at birth
 - If mild, no manifestations until find hypertension in upper extremities at older age

Coarctation of the Aorta



High blood pressure before point of coarctation

Low blood pressure beyond point of coarctation



Coarctation of the aorta

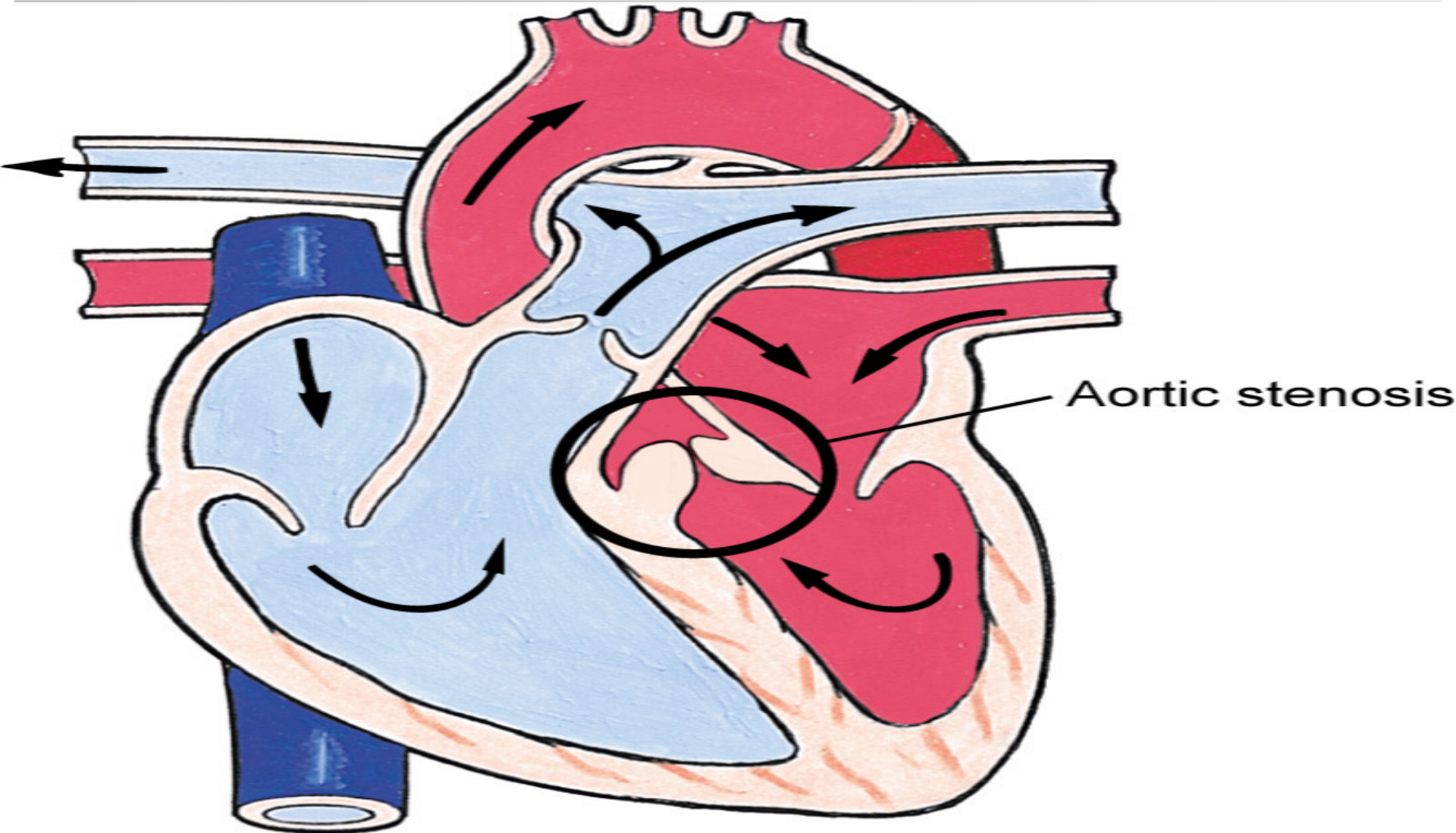


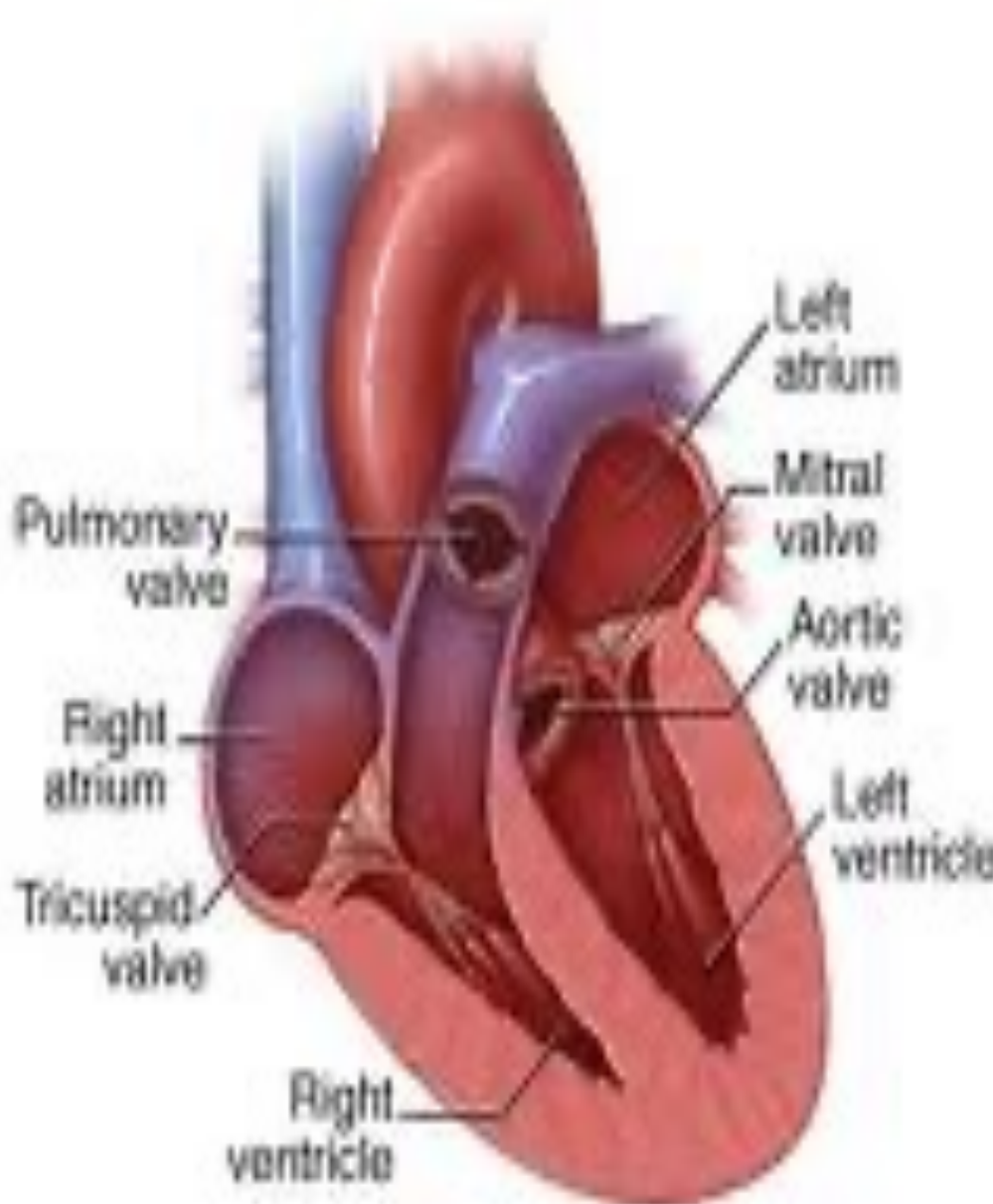


Obstructive Defects

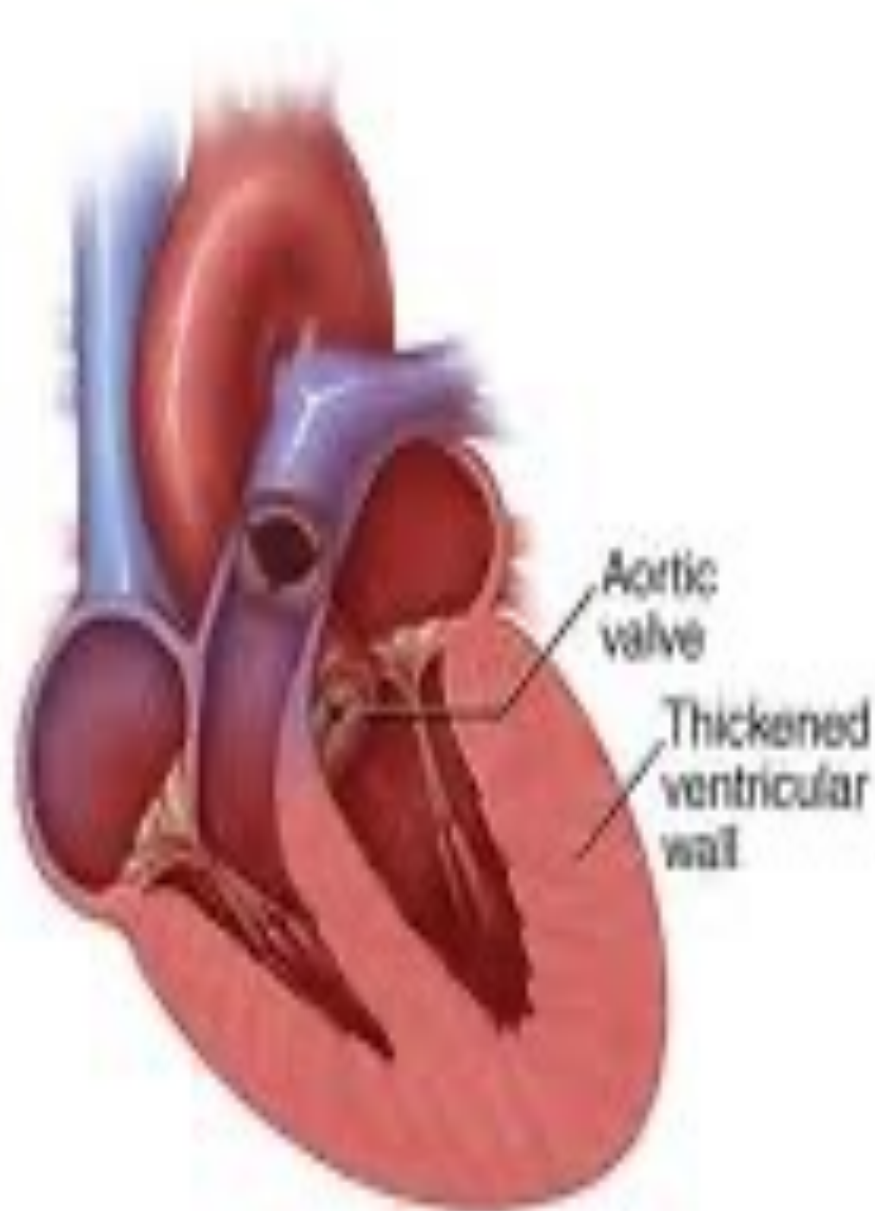
- Aortic stenosis
 - Narrowing of the aortic outflow tract
 - Caused by malformation or fusion of the cusps
 - Causes increased workload on left ventricle and left ventricular hypertrophy
 - Various types
 - Manifestations:
 - Infant: if significant faint pulses, hypotension, tachycardia, and poor feeding
 - Older children: may have complaints of exercise intolerance
 - Risk for bacterial endocarditis

Aortic Stenosis





Normal heart



Heart with Aortic Valve Stenosis



Obstructive Defects

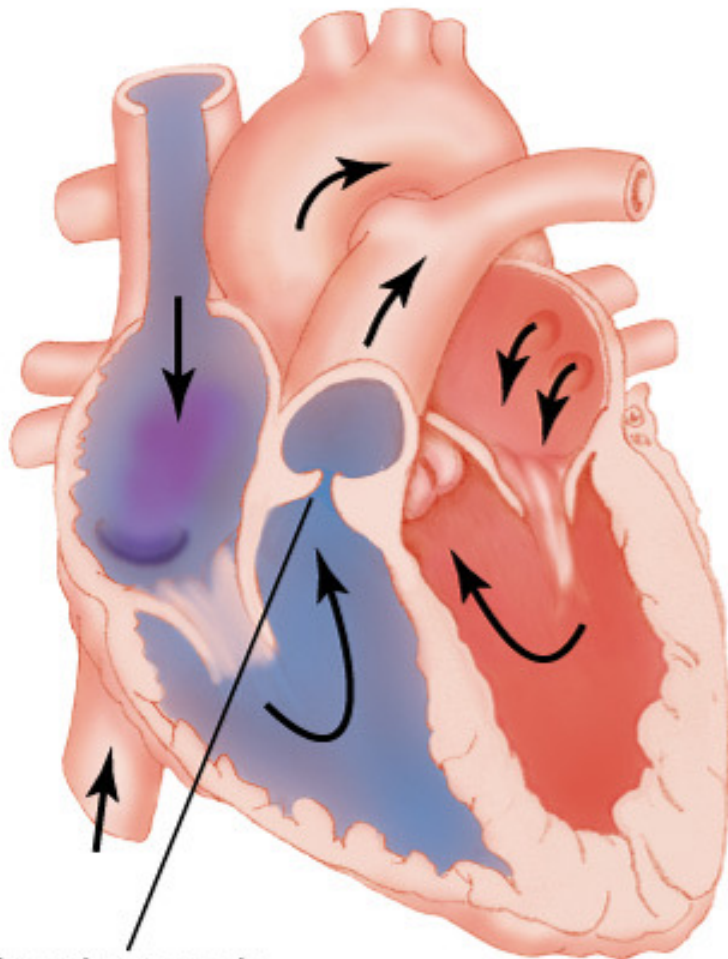
- Valvular aortic stenosis
 - Malformed or fused cusps
 - Progressive obstruction with episodes of ischemia
 - Strenuous activity limited
- Subvalvular aortic stenosis
 - Stricture caused by a fibrous ring below a valve



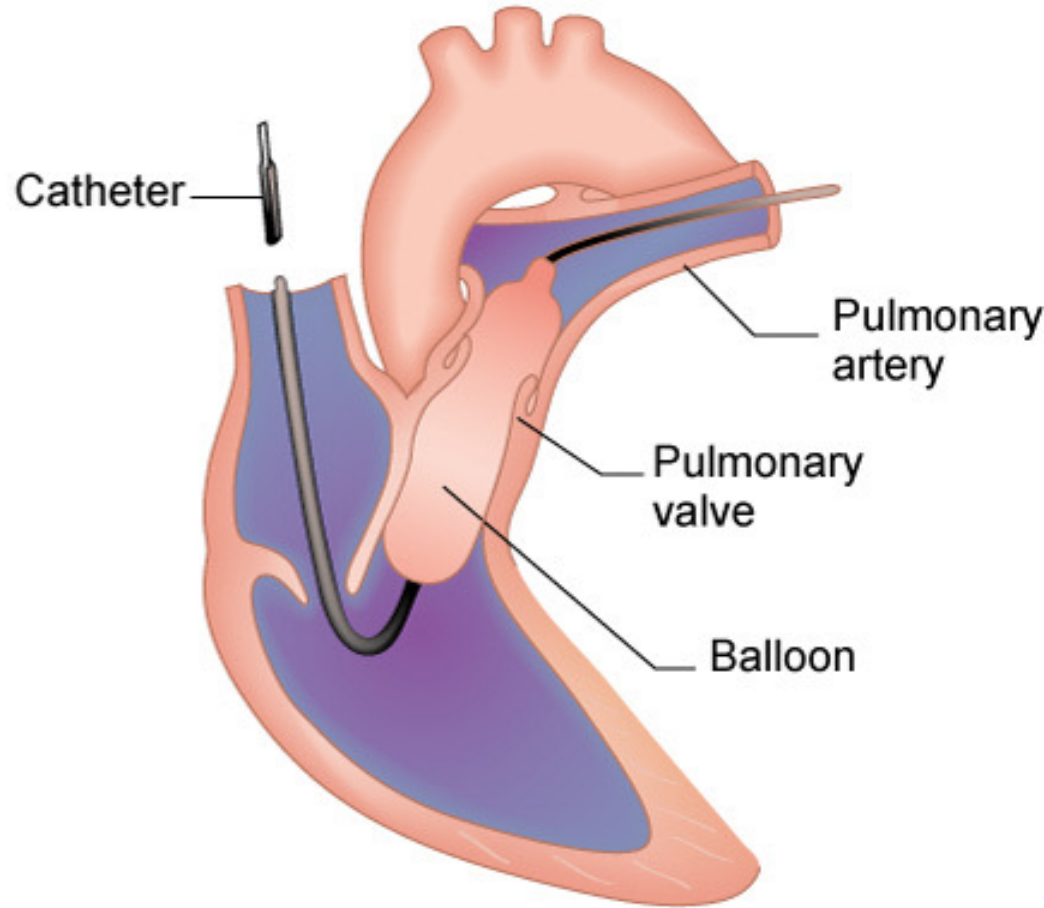
Obstructive Defects

- Pulmonic stenosis
 - Narrowing of the pulmonary outflow tract
 - Abnormal thickening of the valve leaflets
 - Narrowing of the valve with resistance to flow from right ventricle to pulmonary artery
 - Right ventricular hypertrophy
 - Pulmonary semilunar valve atresia
 - Manifestations:
 - If severe: cyanosis from right-to-left shunt through atrial septal defect; decreased CO

Pulmonic Stenosis

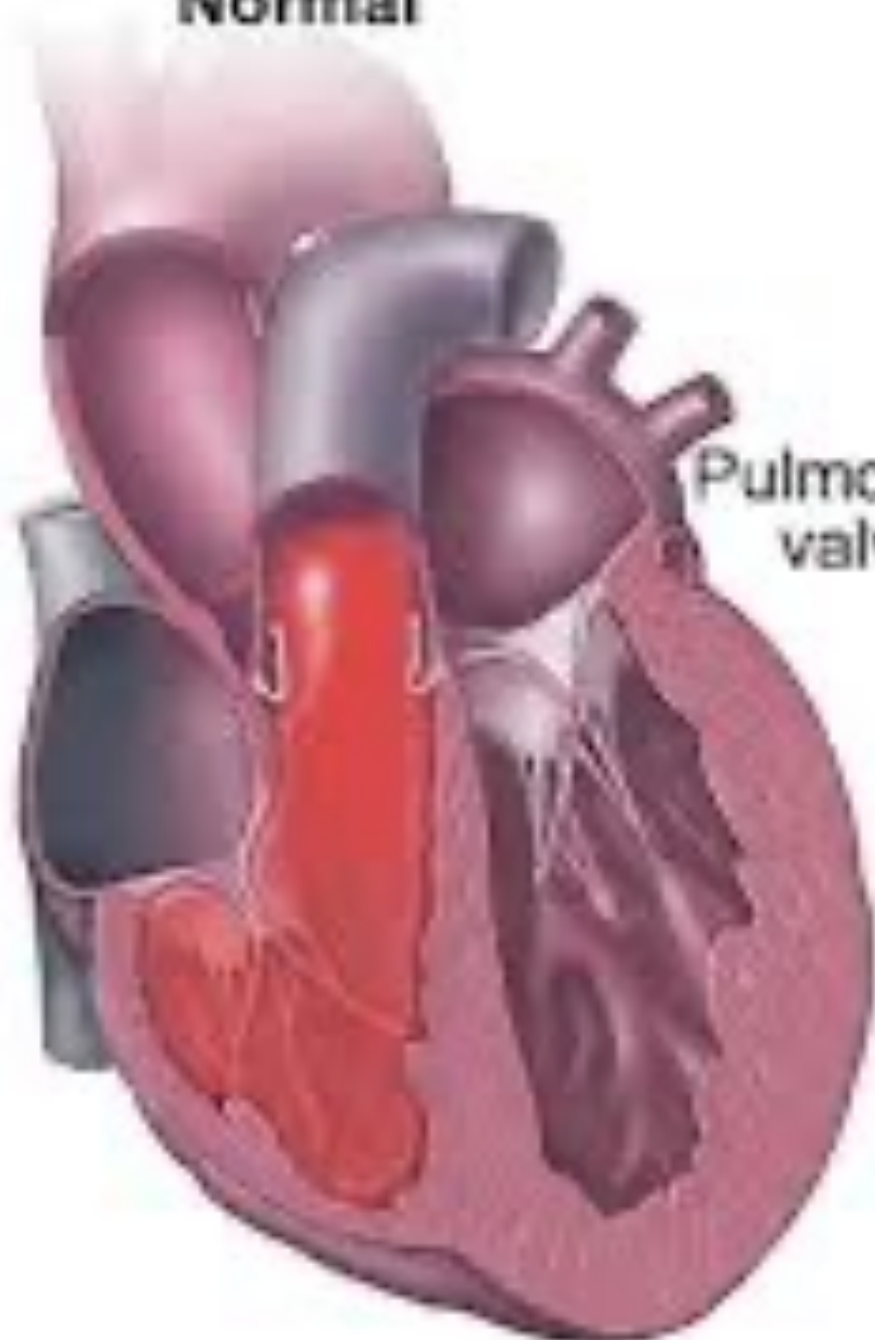


Pulmonic stenosis



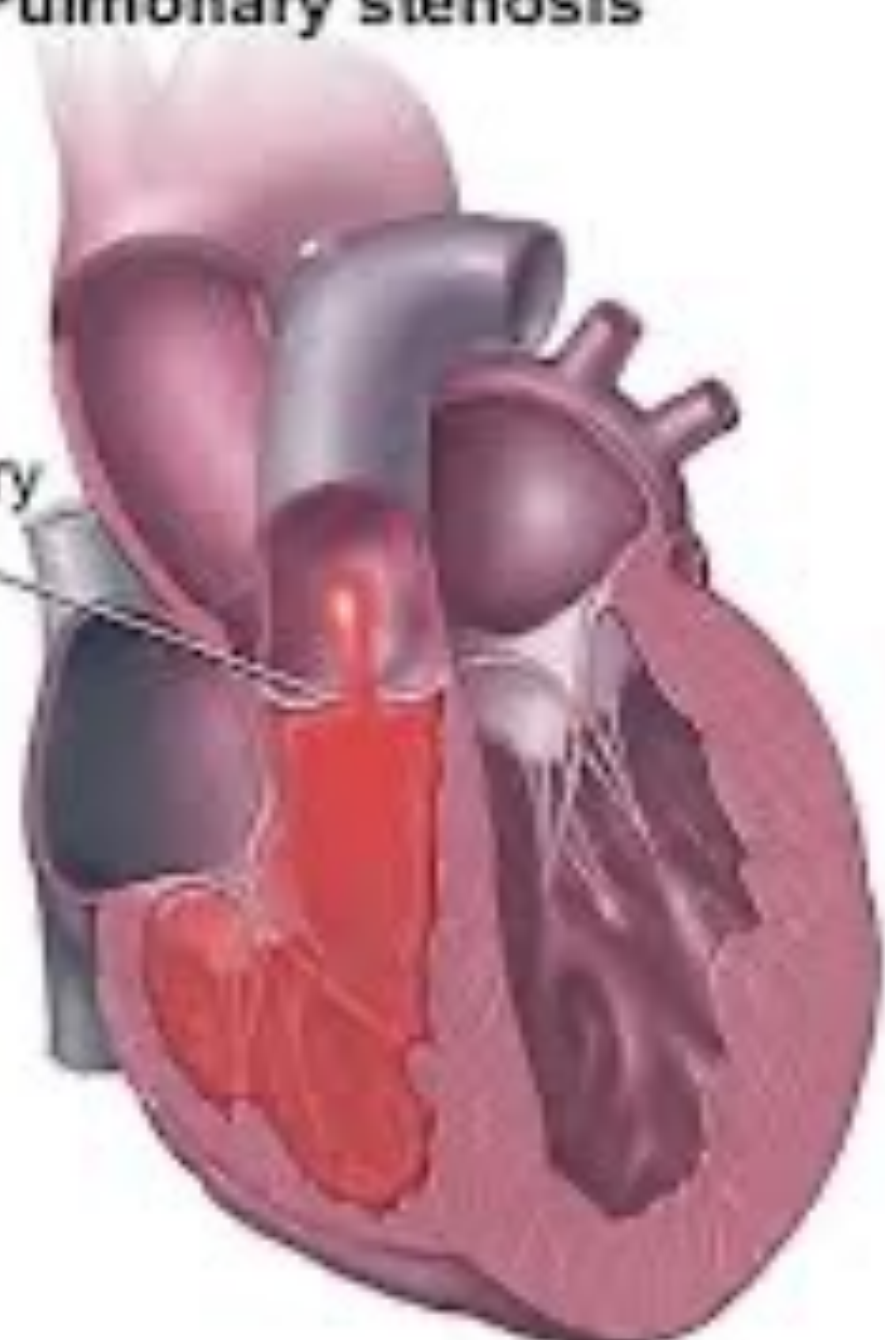
B

Normal



Pulmonary stenosis

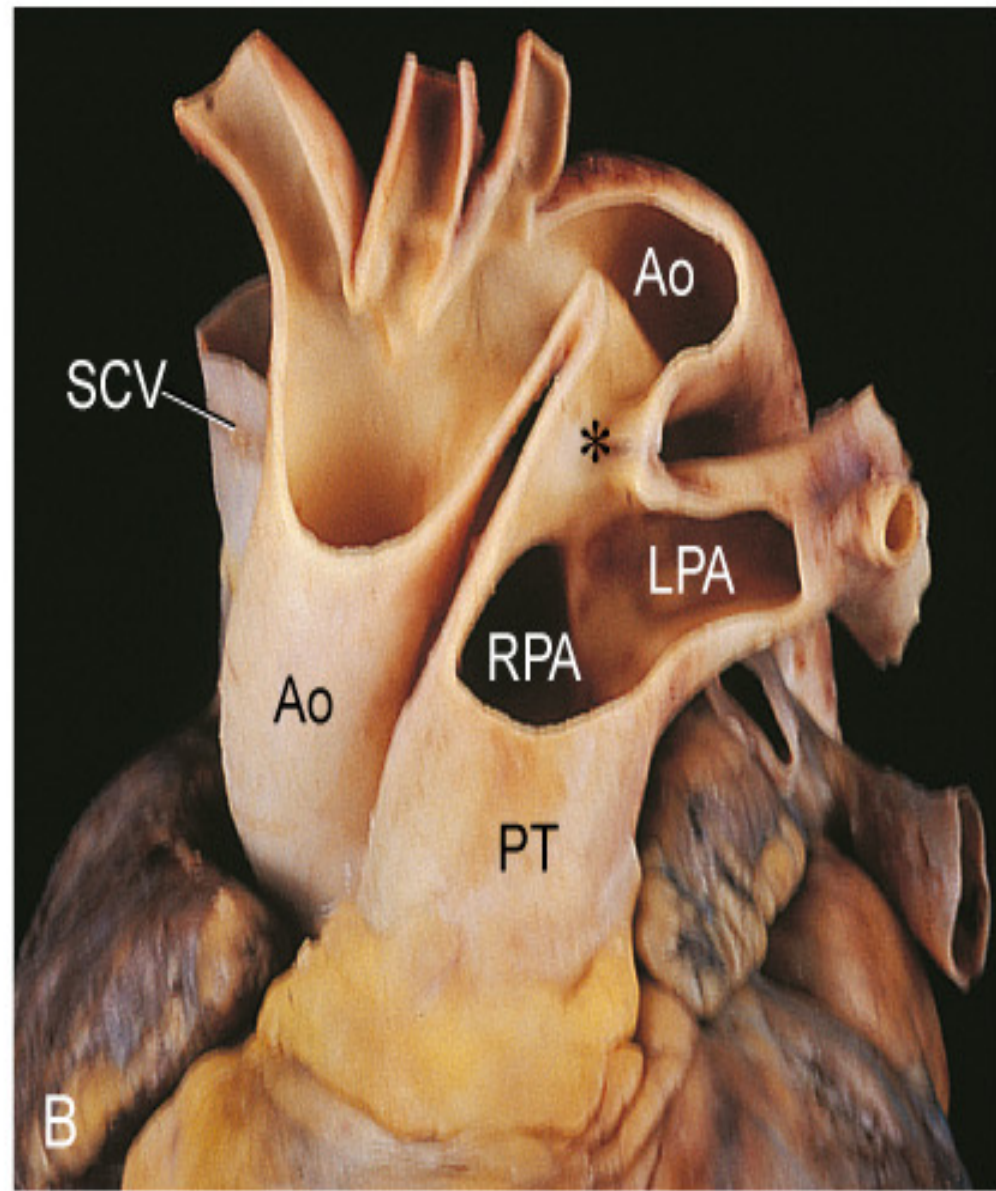
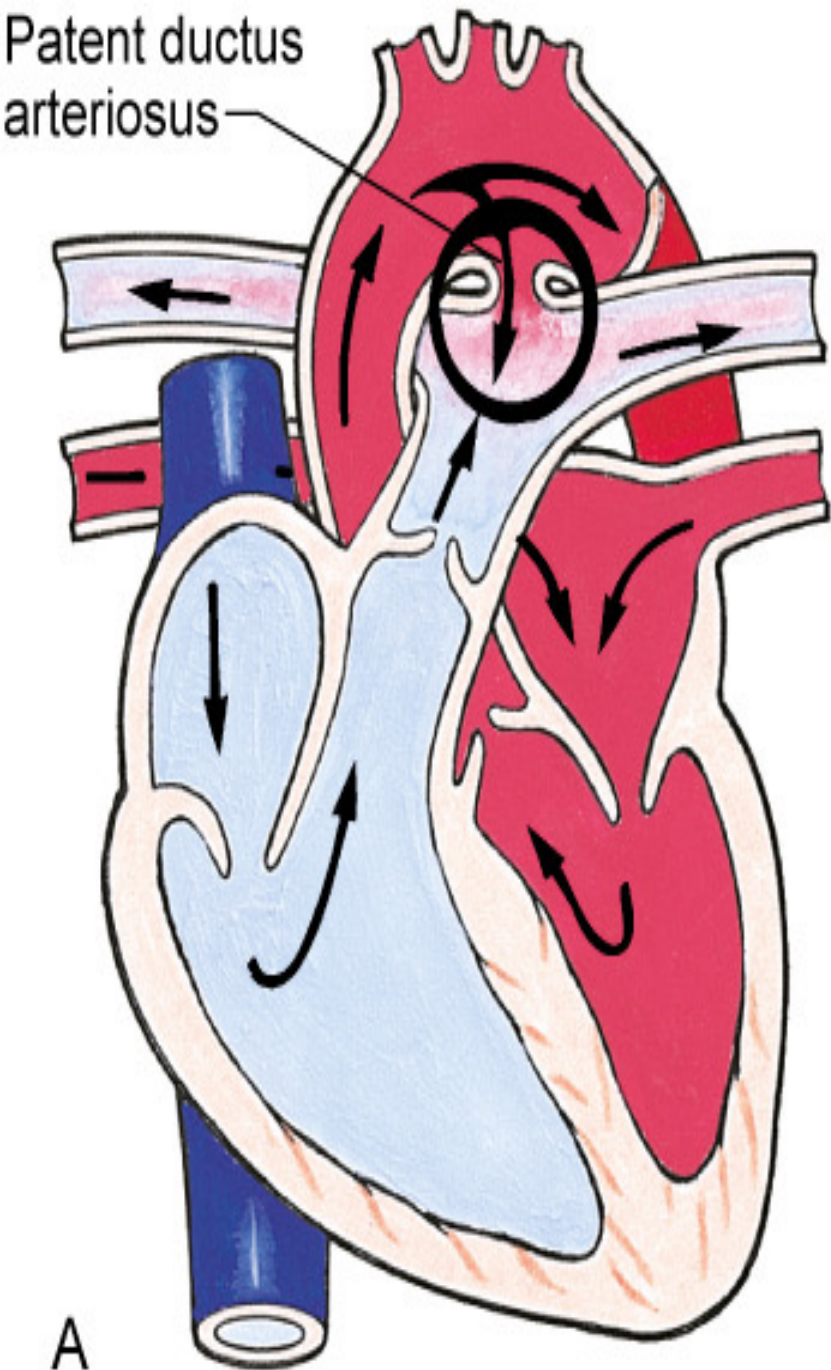
Pulmonary valve





Defects Increasing Pulmonary Blood Flow

- Patent ductus arteriosus (PDA)
 - Failure of the ductus arteriosus to close
 - PDA allows blood to shunt from the aorta to pulmonary artery causing left-to-right shunt
 - Manifestations:
 - Asymptomatic or pulmonary overcirculation (dyspnea fatigue, poor feeding)
 - Complications:
 - Risk for bacterial endocarditis



(A from Hockenberry MJ et al: *Wong's essentials of pediatric nursing*, ed 8, St Louis, 2009, Mosby; B from Damjanov I, Linder J, editors: *Anderson's pathology*, ed 10, St Louis, 1996, Mosby.)



Defects Increasing Pulmonary Blood Flow

- Atrial septal defect
 - Abnormal opening between the atria; blood flows from left atria to right atria
 - Manifestations:
 - Asymptomatic at early age
 - Pulmonary symptoms on exertion at later age



Defects Increasing Pulmonary Blood Flow

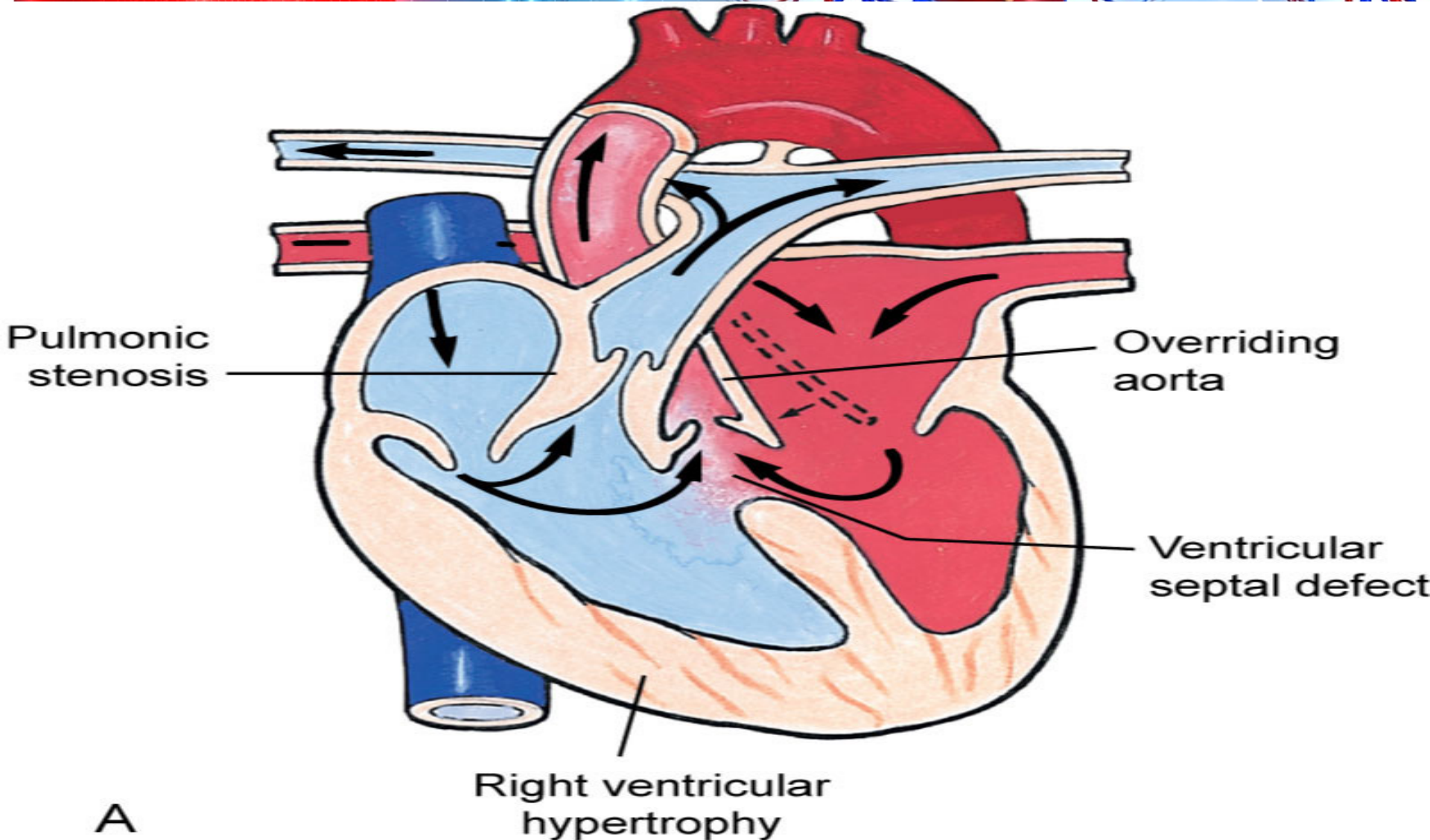
- Ventricular septal defect (VSD)
 - Abnormal communication between the ventricles
 - Most common type of congenital heart lesion
 - Two types
 - Manifestations:
 - May be asymptomatic
 - If severe: increased pulmonary blood flow from left-to-right shunt; pulmonary hypertension



Defects Decreasing Pulmonary Blood Flow

- Tetralogy of Fallot
 - Syndrome represented by four defects:
 - Ventricular septal defect (VSD)
 - Overriding aorta
 - Pulmonary valve stenosis
 - Right ventricle hypertrophy
 - Manifestations:
 - Acute cyanosis at birth or gradual cyanosis
 - Gradual clubbing, poor growth; Tet spells
 - If untreated, emboli, stroke, brain abscess, seizures

Tetralogy of Fallot

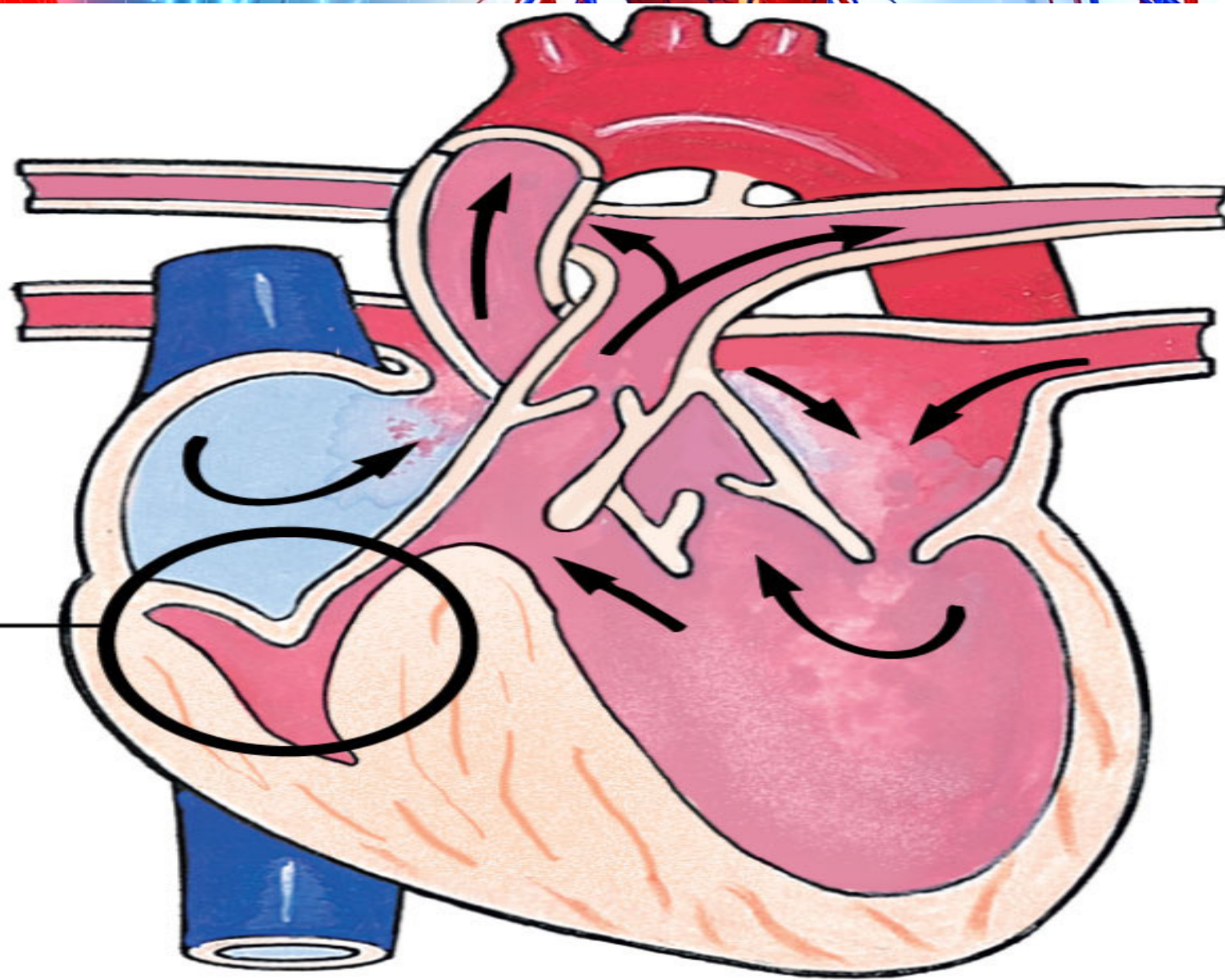




Defects Decreasing Pulmonary Blood Flow

- Tricuspid atresia
 - Imperforate tricuspid valve
 - Lack of communication between the right atrium and right ventricle
 - Additional defects:
 - Atrial septal defect
 - Hypoplastic or absent right ventricle
 - Enlarged mitral valve and left ventricle
 - Pulmonic stenosis
 - Manifestations:
 - In newborn, cyanosis, tachycardia, dyspnea, poor feeding
 - In older child, signs of chronic hypoxemia

Tricuspid Atresia



Tricuspid atresia

A

(A from Hockenberry MJ et al: *Wong's essentials of pediatric nursing*, ed 8, St Louis, 2009, Mosby.)



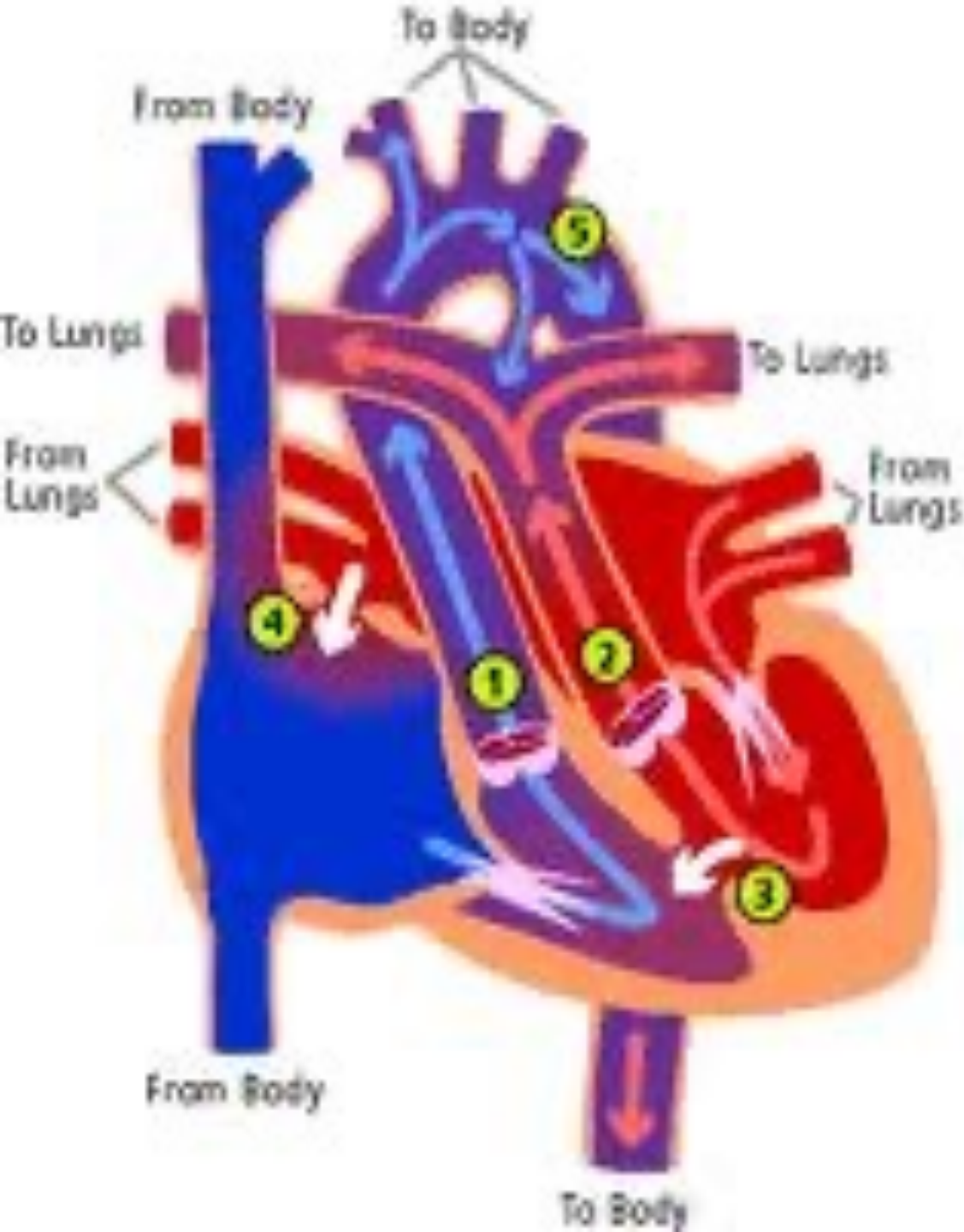
Mixed Defects

- Transposition of the great arteries
 - Aorta arises from the right ventricle and the pulmonary artery arises from the left ventricle
 - Results in two separate, parallel circuits
 - Unoxygenated blood circulates continuously through the systemic circulation
 - Oxygenated blood circulates continuously through the pulmonary circulation



Mixed Defects

- Transposition of the great arteries
 - Extrauterine survival requires communication between the two circuits
- Manifestation:
 - Depends on size and associated defects



①

Aorta emerges from right ventricle

②

Pulmonary artery emerges from left ventricle

③

Hole or defect in ventricular septum

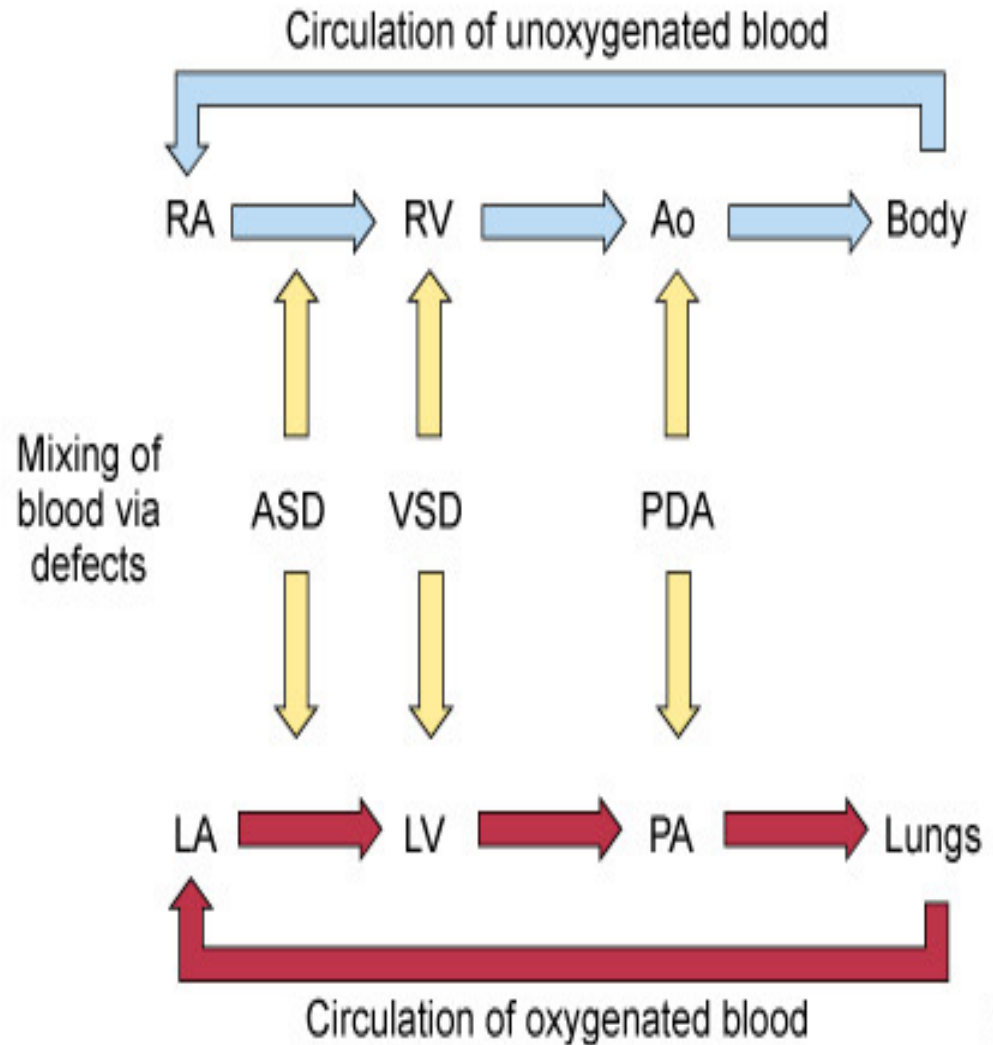
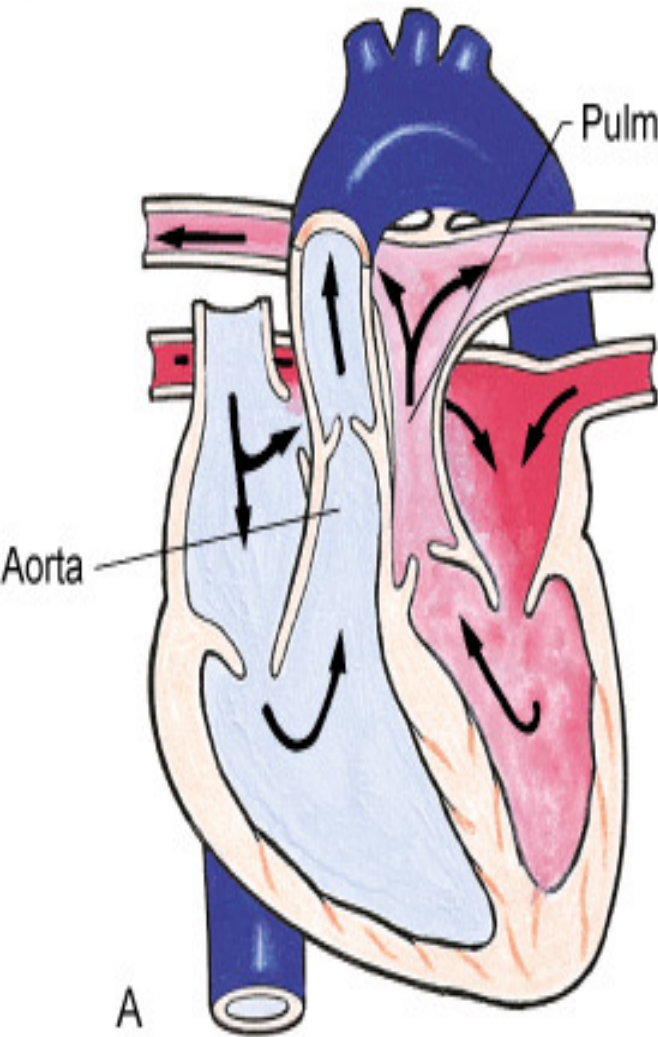
④

Hole or defect in atrial septum

⑤

Patent (open) ductus arteriosus

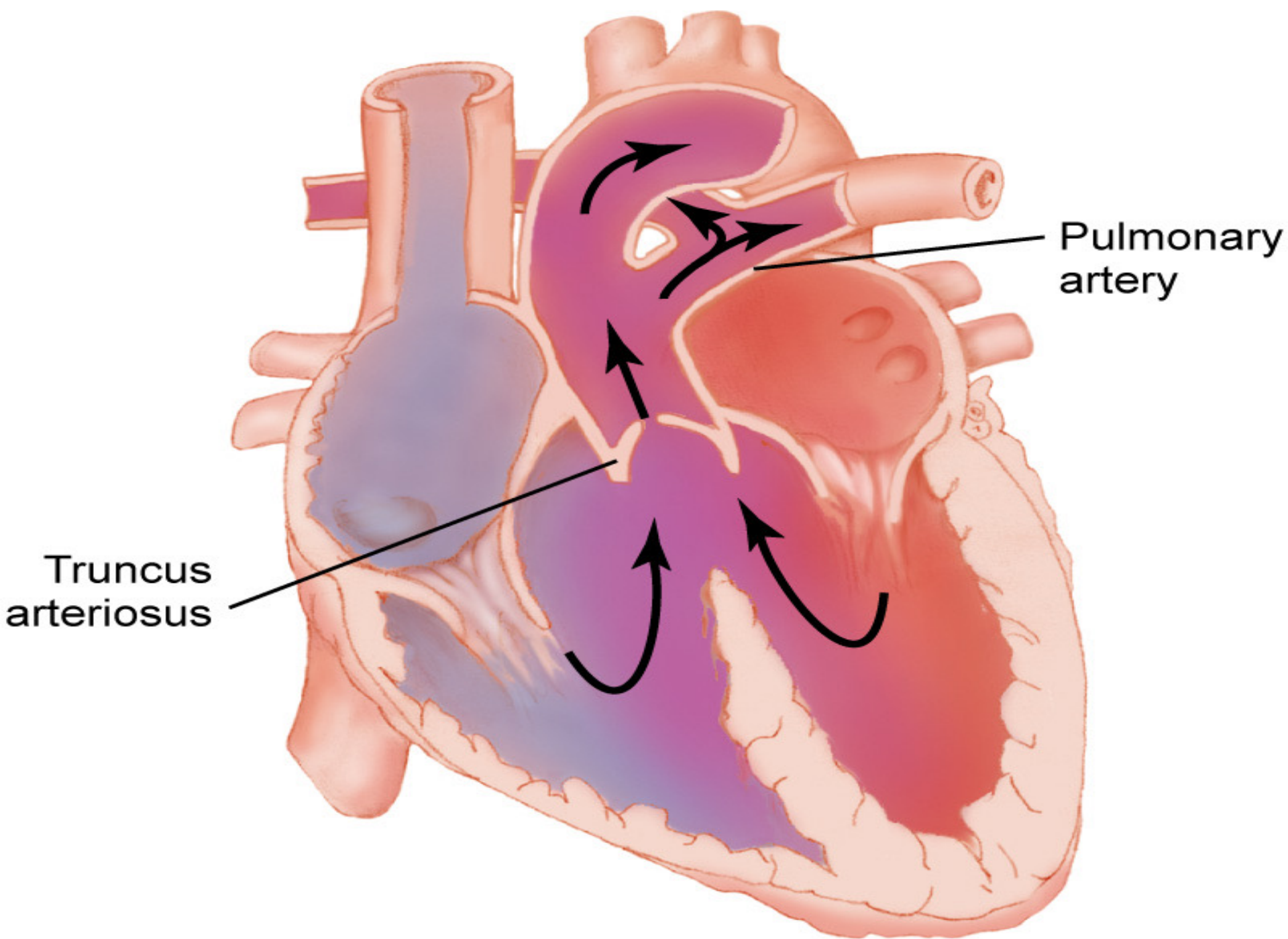
Transposition of the Great Arteries





Mixed Defects

- Truncus arteriosus
 - Failure of the embryonic artery and the truncus arteriosus to divide into the pulmonary artery and the aorta
 - The trunk straddles an always present VSD

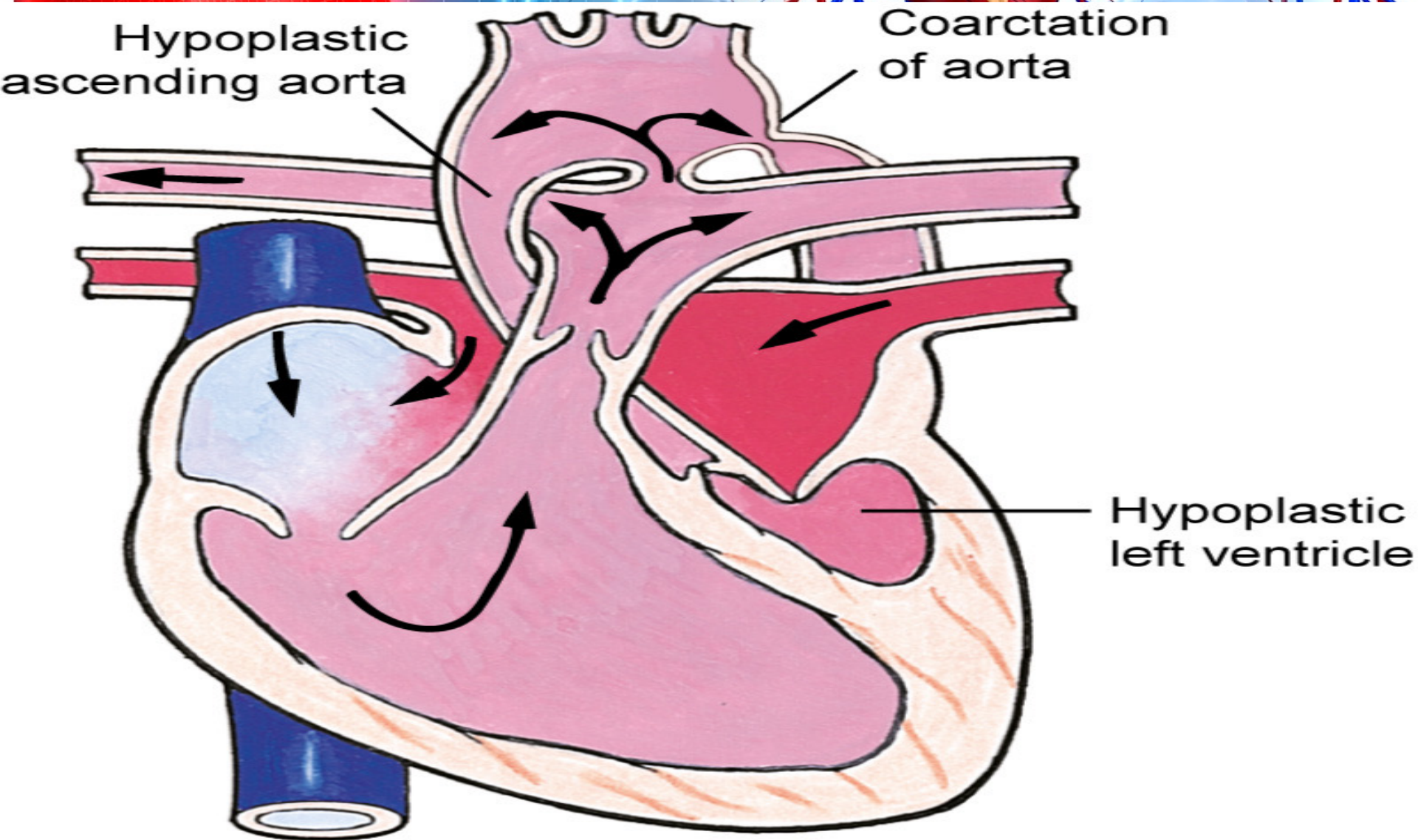




Obstructive Defects

- Hypoplastic left heart syndrome
 - Abnormal development of the left-sided cardiac structures
 - Obstruction to blood flow from the left ventricular outflow tract
 - Underdevelopment of the left ventricle, aorta and aortic arch; mitral atresia or stenosis; coarctation of the aorta
 - Manifestations occur early in newborn (cyanosis, tachypnea, decreased CO)
 - Fatal in early life if untreated

Hypoplastic Left Heart Syndrome





Heart Failure

- Heart is not able to maintain cardiac output at level that meets demands of body
- Result from poor ventricular function
- Complication of many congenital heart defects



Acquired Cardiovascular Disorders

- Systemic hypertension
 - In children defined as systolic and diastolic pressure that is over the 95th percentile for age and gender on at least three occasions
 - Hypertension in children differs from adults:
 - Often has an underlying disease
 - Renal disease or coarctation of aorta
 - A cause of the hypertension in children is almost always found
 - Children commonly asymptomatic
 - Seeing increased incidence of primary hypertension in older children related to obesity



Acquired Cardiovascular Disorders

- Childhood obesity
 - Multivariable and multidimensional
 - Risks:
 - Insulin resistance, diabetes, cardiovascular disease
 - Childhood nutrition, level of physical activity, and engagement of sedentary activities (TV, computer use, etc.)
 - Association with parental obesity
 - Epidemic in the USA