Study Questions for Chapter 5

1. The most common interventricular septal defect (VSD) seen clinically is

(A) persistent truncus arteriosus
(B) membranous VSD
(C) common ventricle
(D) foramen secundum defect
(E) premature closure of foramen ovale

2. Which of the following clinical signs would be most obvious on examination of a patient with either tetralogy of Fallot or transposition of the great vessels?

(A) Sweaty palms
(B) Lack of femoral artery pulse
(C) Pulmonary hypertension
(D) Cyanosis
(E) Diffuse red rash

3. Which of the following congenital cardiovascular malformations is most commonly associated with maternal rubella infection?

(A) Isolated dextrocardia
(B) Patent ductus arteriosus
(C) Persistent truncus arteriosus
(D) Coarctation of the aorta
(E) Double aortic arch

4. The most common atrial septal defect (ASD) seen clinically is

(A) common atrium
(B) foramen secundum defect
(C) premature closure of the foramen ovale
(D) persistent truncus arteriosus
(E) probe patency of the foramen ovale

5. The ventral surface of the adult heart as seen on gross examination or radiography is comprised primarily of the

(A) left atrium
(B) left ventricle
(C) inferior vena cava
(D) bulbus cordis
(E) right ventricle

6. The left recurrent laryngeal nerve recurs around the

(A) left primary bronchus
(B) left subclavian artery
(C) left subclavian vein
(D) ductus arteriosus
(E) left common carotid artery

7. Which of the three primary germ layers forms the histologically definitive endocardium of the adult heart?

(A) Ectoderm
(B) Endoderm
(C) Mesoderm
(D) Epiblast
(E) Hypoblast

8. Which of the following is responsible for the proper alignment of the atrioventricular canal and the conoventricular canal?

(A) Lateral folding of the embryo
(B) Craniocaudal folding of the embryo
(C) Programmed cell migration
(D) Formation of the aorticopulmonary septum
(E) Dextral looping

9. The hepatic sinusoids that can be observed histologically in an adult liver are derived from the

(A) supracardinal veins
(B) anterior cardinal veins
(C) posterior cardinal veins
(D) vitelline veins
(E) subcardinal veins

10. Which of the following arterial malformations is very common in premature infants?

(A) Patent ductus arteriosus
(B) Coarctation of the aorta
(C) Right aortic arch
(D) Double aortic arch
(E) Abnormal origin of the right subclavian artery

11. A physician monitoring a newborn infant's heart sounds using a stethoscope hears the characteristic murmur of a patent ductus arteriosus. How soon after birth should this murmur normally disappear?

(A) 1–2 months
(B) 1–2 weeks

(C) 1–2 days
(D) 1–2 hours
(E) Immediately

12. How soon after birth does the foramen ovale close?

(A) 1–2 months
(B) 1–2 weeks
(C) 1–2 days
(D) 1–2 hours
(E) Immediately

13. A 9-year-old boy presents with complaints of numbness and tingling in both feet. Examination reveals no pulse in the femoral artery, increased blood pressure in the arteries of the upper extremity, and enlarged intercostal veins. Which of the following abnormalities would be suspected?

(A) Double aortic arch
(B) Tetralogy of Fallot
(C) Postductal coarctation of the aorta
(D) Right aortic arch
(E) Abnormal origin of the right subclavian artery

14. The coronary sinus is derived from which of the following?

(A) Truncus arteriosus
(B) Bulbus cordis
(C) Primitive ventricle
(D) Primitive atrium
(E) Sinus venosus

15. The conus arteriosus is derived from which of the following?

(A) Truncus arteriosus
(B) Bulbus cordis
(C) Primitive ventricle
(D) Primitive atrium
(E) Sinus venosus

16. The proximal part of the aorta is derived from which of the following?

(A) Truncus arteriosus
(B) Bulbus cordis
(C) Primitive ventricle
(D) Primitive atrium
(E) Sinus venosus

17. The trabeculated part of the right ventricle is derived from which of the following?

(A) Truncus arteriosus
(B) Bulbus cordis
(C) Primitive ventricle
(D) Primitive atrium
(E) Sinus venosus

18. Tricuspid atresia is a cardiac malformation that involves which of the following septa?

(A) Aorticopulmonary septum
(B) Atrial septum
(C) Atrioventricular septum
(D) Interventricular septum

19. A muscular VSD is a cardiac malformation that involves which of the following septa?

(A) Aorticopulmonary septum
(B) Atrial septum
(C) Atrioventricular septum
(D) Interventricular septum

20. Tetralogy of Fallot is a cardiac malformation that involves which of the following septa?

(A) Aorticopulmonary septum
(B) Atrial septum
(C) Atrioventricular septum
(D) Interventricular septum

21. D-Transposition of the great arteries is a cardiac malformation that involves which of the following septa?

(A) Aorticopulmonary septum
(B) Atrial septum
(C) Atrioventricular septum
(D) Interventricular septum

22. An insufficient amount of AV cushion material will result in which of the following?

(A) Persistent truncus arteriosus (PTA)
(B) Ebstein anomaly
(C) Transposition of the great arteries
(D) Common ventricle
(E) Tricuspid atresia

23. A partial development of the aorticopulmonary septum will result in which of the following?

(A) Persistent truncus arteriosus (PTA)
(B) Ebstein anomaly
(C) Transposition of the great arteries
(D) Common ventricle
(E) Tricuspid atresia

24. A failure of the tricuspid leaflets to attach to the annulus fibrosus will result in which of the following?

(A) Persistent truncus arteriosus (PTA)
(B) Ebstein anomaly

(C) Transposition of the great arteries
(D) Common ventricle
(E) Tricuspid atresia

25. A faulty fusion of the right and left bulbar ridges and AV cushion will result in which of the following?

(A) Persistent truncus arteriosus (PTA)
(B) Ebstein anomaly
(C) Transposition of the great arteries
(D) Common ventricle
(E) Membranous VSD

26. The superior mesenteric artery is derived from which of the following?

(A) Posterolateral arteries
(B) Lateral arteries
(C) Ventral arteries

27. The arteries to the upper extremity are derived from which of the following?

(A) Posterolateral arteries
(B) Lateral arteries
(C) Ventral arteries

28. The gonadal arteries are derived from which of the following?

(A) Posterolateral arteries
(B) Lateral arteries
(C) Ventral arteries

29. The proximal part of the internal carotid artery is derived from which of the following?

(A) Aortic arch 1
(B) Aortic arch 2
(C) Aortic arch 3
(D) Aortic arch 4
(E) Aortic arch 6

30. A portion of the arch of the aorta is derived from which of the following?

(A) Aortic arch 1
(B) Aortic arch 2
(C) Aortic arch 3
(D) Aortic arch 4
(E) Aortic arch 6

31. The proximal part of the right subclavian artery is derived from which of the following?

(A) Aortic arch 1
(B) Aortic arch 2
(C) Aortic arch 3
(D) Aortic arch 4
(E) Aortic arch 6

32. The portal vein is derived from which of the following?

(A) Vitelline veins
(B) Umbilical veins
(C) Anterior cardinal veins
(D) Posterior cardinal veins
(E) Subcardinal veins

33. The renal veins are derived from which of the following?

(A) Vitelline veins
(B) Umbilical veins
(C) Anterior cardinal veins
(D) Posterior cardinal veins
(E) Subcardinal veins

34. The superior mesenteric vein is derived from which of the following?

(A) Vitelline veins
(B) Umbilical veins
(C) Anterior cardinal veins
(D) Posterior cardinal veins
(E) Subcardinal veins

35. Closure of the foramen primum results from fusion of which of the following structures?

(A) Septum secundum and the fused atrioventricular cushions
(B) Septum secundum and the septum primum
(C) Septum primum and the fused atrioventricular cushions
(D) Septum primum and the septum spurium
(E) Septum primum and the sinoatrial valves

36. A 3-day-old boy delivered at 32 weeks of gestation is experiencing respiratory distress syndrome. The physician detects a heart murmur characteristic of a patent ductus arteriosus, a diagnosis that is confirmed with an echocardiogram. Which embryonic structure is involved in this diagnosis?

(A) Left third aortic arch
(B) Right third aortic arch
(C) Left sixth aortic arch
(D) Umbilical arteries
(E) Vitelline arteries

Answers and Explanations

1. **B.** The most common of all cardiac congenital malformations seen clinically are membranous VSDs. The membranous interventricular septum forms by the proliferation and fusion of tissue from three different sources: the right and left bulbar ridges and the atrioventricular (AV) cushions. Because of this complex formation, the probability of defects is very high.

2. **D.** Marked cyanosis is a distinct clinical sign in both tetralogy of Fallot and transposition of the great vessels. Any congenital cardiac malformation that allows right-to-left shunting of blood is sometimes called cyanotic heart disease. Right-to-left shunting allows poorly oxygenated blood from the right side of the heart to mix with highly oxygenated blood on the left side of the heart. This causes decreased oxygen tension to peripheral tissues, leading to a characteristic blue tinge (cyanosis) and bulbous thickening of the fingers and toes (clubbing).

3. **B.** Patent ductus arteriosus (PDA) is the most common congenital cardiac malformation associated with rubella infection of the mother. It is unclear how the rubella virus acts to cause PDA.

4. **B.** The most common ASD is foramen secundum defect, which is caused by excessive resorption of the septum primum or the septum secundum. This results in an opening between the atria (patent foramen ovale). Some of these defects may remain undiagnosed and may be tolerated for a long time (up to age 30 years before the person presents clinically).

5. **E.** During embryological formation of the heart, the arterial and venous ends of the heart tube are fixed in place. As further growth continues, the heart tube folds to the right. This greatly contributes to the ventral surface of the adult heart being comprised primarily of the right ventricle. The definitive anatomical orientation of the adult heart within the thorax is not at all similar to the strong image we have in our minds of the classic Valentine's Day heart.

6. **D.** The left recurrent laryngeal nerve recurs around the ductus arteriosus (ligamentum arteriosus in the adult). Early in embryological development, both the right and left recurrent laryngeal nerves hook (recur) around aortic arch 6. The left aortic arch 6 persists as the ductus arteriosus.

7. **C.** The entire cardiovascular system is of mesodermal origin.

8. **E.** Dextral looping aligns these two canals through early looping, convergence, wedging, and repositioning. This is especially important in correcting the unusual blood flow pattern in the primitive heart tube where venous blood flows into the left ventricle prior to the right ventricle.

9. **D.** Because of the location of the vitelline veins and the tremendous growth of the developing liver (hepatic diverticulum), the vitelline veins are surrounded by the liver and give rise to the hepatic sinusoids. The umbilical veins also contribute to the hepatic sinusoidal network.

10. **A.** Patent ductus arteriosus (PDA) is very common in premature infants. Infants with birth weight less than 1750 grams typically have a PDA during the first 24 hours postnatally. PDA is more common in female infants than in male infants.

11. **D.** The ductus arteriosus functionally closes within 1–2 hours after birth via smooth muscle contraction of the tunica media. Before birth, the patency of the ductus arteriosus is controlled by the low oxygen content of the blood flowing through it, which in turn stimulates production of prostaglandins, which cause smooth muscle to relax. After birth, the high oxygen content of the blood due to lung ventilation inhibits production of prostaglandins, causing smooth muscle contraction. Premature infants can be treated with prostaglandin synthesis inhibitors (such as indomethacin) to promote closure of the ductus arteriosus.

12. **E.** The foramen ovale functionally closes almost immediately after birth as pressure in the right atrium decreases and pressure in the left atrium increases, thereby pushing the septum primum

against the septum secundum. Anatomical fusion occurs much later in life; more than 25% of the population has probe patency of the foramen ovale, in which anatomical fusion does not occur.

13. C. No pulse in the femoral artery, increased blood pressure in the arteries of the upper extremity, enlarged intercostal veins, and numbness and tingling in both feet are clinical symptoms indicative of postductal coarctation of the aorta. Because of the constriction of the aorta, the blood supply to the lower extremity is compromised.

14. E. The coronary sinus is derived from the sinus venosus.

15. B. The smooth part of the right ventricle, known as the conus arteriosus, is derived from the bulbus cordis.

16. A. The proximal part of the aorta is derived from the truncus arteriosus.

17. C. The trabeculated part of the right ventricle is derived from the primitive ventricle.

18. C. Tricuspid atresia involves the atrioventricular septum.

19. D. Muscular VSD is caused by perforations in the muscular interventricular septum.

20. A. Tetralogy of Fallot involves the aorticopulmonary septum.

21. A. D-Transposition involves the aorticopulmonary septum.

22. E. Insufficient amount of AV cushion material will cause tricuspid atresia.

23. A. Partial development of the aorticopulmonary septum will cause persistent truncus arteriosus.

24. B. Failure of fusion of the tricuspid leaflets with the annulus fibrosus results in Ebstein anomaly.

25. E. Faulty fusion of the right and left bulbar ridges and AV cushions will cause membranous VSD.

26. C. The superior mesenteric artery is derived from ventral branches of the dorsal aorta, specifically the vitelline arteries.

27. A. Arteries to the upper extremity are derived from posterolateral branches of the dorsal aorta.

28. B. The gonadal arteries are derived from lateral branches of the dorsal aorta.

29. C. The proximal part of the internal carotid artery is derived from aortic arch 3.

30. D. Part of the arch of the aorta is derived from aortic arch 4.

31. D. The proximal part of the right subclavian artery is derived from aortic arch 4.

32. A. The portal vein is derived from the right vitelline vein.

33. E. The renal veins are derived from the subcardinal veins.

34. A. The superior mesenteric vein is derived from the vitelline veins.

35. C. The foramen primum forms between the free edge of the septum primum and the atrioventricular (AV) cushions. It is closed when the septum primum fuses with the AV cushions.

36. C. Patent ductus arteriosus (PDA) is a condition in which the ductus arteriosus, a blood vessel that allows blood to bypass the baby's lungs before birth, fails to normally close after birth. The ductus arteriosus is derived from the distal portion of the left sixth aortic arch.