SCRUBS

STUDENT COLLABORATIVE RESOURCES FOR UNDERSTANDING AND BRODY SUCCESS

SCRUBS is a student driven initiative that aims to develop supplemental resources for current and future cohorts that will pass through Brody. Members of **SCRUBS** participate in a variety of sub-committees working to create resources for students, by students. These resources aim to offer unique perspectives from students who have walked in the same shoes and can develop resources that we wish we had been exposed to during our time in the course.

The hope is this organization will become a staple of the Brody student body, exemplifying the unique collaborative community that Brody offers. If this is a mission that aligns with your goals and you have the desire to help those that will come behind you, as well as a goal to leave your mark on Brody as a whole, we invite you to join the team!

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Coursepack Practice Questions

Embryology Chapter 10 - Digestive System

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Quiz Level

1. The main pancreatic duct is derived from which of the following structures?

A) Dorsal pancreatic bud
B) Greater omentum
C) Ventral pancreatic bud
D) Septum transversum
E) Lessor omentum

2. The Kupfer cells of the liver are derived from which of the following?

A) Ventral mesogastric endoderm
B) Ventrall pancreatic bud
C) Ventral mesogastric mesoderm
D) Dorsal mesogastrium
E) Septum Transversum

3. Which of the following correctly pairs the mesenteric derivative with ventral or dorsal mesentery?

A) Dorsal Mesentery : Falciform ligament
B) Dorsal Mesentery : Hepatoduodenal ligament
C) Ventral Mesentery: Coronary ligaments
D) Ventral Mesentery: Splenorenal ligament
E) Ventral Mesentery: Mesoappendix

4. Which of the following correctly identifies the embryonic region supplied by the superior mesenteric artery and a structural derivative?

A) Foregut : Spleen
B) Midgut : Uncinate process
C) Hindgut : Inferior third of the anal canal
D) Midgut : Horizontal portion of the duodenum
E) Forgut : Appendix

5. List the steps of midgut development correctly in chronologic order

1 - Retraction of the midgut into the abdomen with 180-degree rotation
2 - Physiologic herniation into the umbilicus into the intraembryonic coelom
3 - 90 degree rotation of the cranial limb to the right
4 - Physiologic herniation into the umbilicus into the extraembryonic coelom
5 - 90 degree rotation of the cranial limb to the left

A) 4, 5, 1
B) 2, 3, 1
C) 2, 1, 5
D) 2, 5, 1
E) 4, 3, 1

Test Level

6. A 2-day-old male neonate is brought to the hospital due to failure to pass meconium (first stool). The parents report that the baby has had episodes of vomiting, abdominal swelling, and irritability. On physical examination, the infant has a distended abdomen and appears uncomfortable. A rectal exam reveals a tight anal sphincter and, upon withdrawal of the finger, there is an explosive release of gas and stool (positive squirt sign). Abdominal X-ray reveals dilated bowel loops. A contrast enema demonstrates a transition zone with dilation of the proximal colon and narrowing of the distal colon. What is the most likely embryological cause of this condition?

A) Abnormal rotation of the midgut
B) Failure of neural crest cell migration to the distal colon
C) Incomplete recanalization of the rectum
D) Failure of the allantois to regress
E) Abnormal development of the anorectal septum

7. A 4-week-old male infant is brought to the pediatrician due to episodes of projectile, non-bilious vomiting after feeding. The parents note that the vomiting has progressively worsened over the last week, and the infant appears increasingly hungry after each episode. On physical examination, the infant is mildly dehydrated, and an olive-shaped mass is palpated in the upper right quadrant of the abdomen. Laboratory results show hypochloremic metabolic alkalosis. What is the most likely underlying cause of this patient's condition?

A) Failure of neural crest cell migration
B) Malrotation of the midgut
C) Incomplete recanalization of the duodenum
D) Hypertrophy of the pyloric smooth muscle
E) Defective development of the vitelline duct

8. A 2-day-old male neonate is brought to the emergency department due to bilious vomiting and poor feeding. The parents report that the infant has vomited multiple times since birth, especially after feeding. Physical examination reveals abdominal distension. An abdominal X-ray shows a "double bubble" sign, indicative of dilation of the stomach and proximal duodenum. An upper gastrointestinal series reveals a narrowing of the second portion of the duodenum with a small communication region, suggesting partial obstruction but ruling out complete duodenal atresia. What is the most likely embryological cause of this patient's condition?

A) Abnormal migration of the ventral pancreatic bud
B) Incomplete recanalization of the duodenum
C) Malrotation of the midgut
D) Defective formation of the vitelline duct
E) Failure of neural crest cell migration to the gut

9. A 34-year-old woman undergoes a routine prenatal ultrasound at 20 weeks gestation. The ultrasound reveals a central abdominal wall defect with the liver and intestines protruding into the umbilical cord and covered by a thin, membranous sac. Amniocentesis shows a normal karyotype. The mother's pregnancy has otherwise been uncomplicated, and there is no history of drug or alcohol use. Which of the following is the most likely cause of this fetal condition?

A) Failure of bowel retraction into the abdominal cavity
B) Incomplete recanalization of the midgut
C) Failure of the vitelline duct to regress
D) Malrotation of the midgut
E) Failure of lateral body wall folds to close

10. A 2-week-old male infant is brought to the emergency department due to sudden onset of bilious vomiting and abdominal pain. The parents report the infant has become increasingly irritable, and they noticed his abdomen is distended. Physical examination reveals a lethargic infant with a distended, tender abdomen. An upper gastrointestinal series shows the duodenum failing to cross to the left side of the abdomen, and a "corkscrew" appearance of the small bowel is observed. Emergency surgery is performed to correct the abnormal positioning of the intestines. What is the most likely underlying embryological cause of this patient's condition?

A) Incomplete recanalization of the duodenum
B) Failure of the midgut to undergo normal rotation during development
C) Failure of neural crest cell migration
D) Incomplete closure of the lateral body folds
E) Persistent vitelline duct

Answers

1. The correct answer is C) Ventral pancreatic bud.
The main pancreatic duct is primarily derived from the ventral pancreatic bud during embryonic development. The pancreas develops from two distinct buds: the dorsal and ventral pancreatic buds. As development progresses, the ventral pancreatic bud rotates and fuses with the dorsal bud. The ventral bud contributes to the formation of the uncinate process, the inferior part of the head of the pancreas, and the main pancreatic duct. This main duct joins with the bile duct to drain into the duodenum at the ampulla of Vater. In contrast, the dorsal pancreatic bud forms most of the pancreas, including the body and tail, and it mainly contributes to the formation of the accessory pancreatic duct. The greater omentum (option B) is a fold of peritoneum attached to the stomach, while the septum transversum (option D) is involved in forming the diaphragm and liver. Similarly, the lesser omentum (option E) connects the stomach and liver but has no role in the pancreas. Therefore, the ventral pancreatic bud is the correct structure from which the main pancreatic duct is derived.

2. The correct answer is E) Septum transversum.

Kupffer cells, the specialized macrophages of the liver, are derived from the septum transversum, which is a mesodermal structure involved in the early development of the liver and diaphragm. During embryogenesis, the septum transversum gives rise to a variety of components of the liver, including Kupffer cells, which are part of the liver's immune system and responsible for filtering blood and destroying pathogens. The other options are incorrect. A) Ventral mesogastric endoderm refers to the endodermal tissue that gives rise to the gastrointestinal tract, but it is not involved in the formation of Kupffer cells. B) Ventral pancreatic bud contributes to the formation of the pancreas, not the liver. C) Ventral mesogastric mesoderm refers to the mesoderm associated with the development of the gastrointestinal structures, but it does not form Kupffer cells. D) Dorsal mesogastrium is involved in the development of the stomach and spleen and is not related to the liver's immune cells.

3. The correct answer is C) Ventral Mesentery: Coronary ligaments.
The ventral mesentery is responsible for forming several important structures in the foregut, including the coronary ligaments, which attach the liver to the diaphragm. The coronary ligaments are part of the ventral mesentery's contribution to the developing liver and diaphragm connection. The other options are incorrect because they either involve structures derived from the dorsal mesentery or incorrectly assign structures to the wrong mesentery. For example, the falciform ligament (option A) and the hepatoduodenal ligament (option B) both arise from the ventral mesentery, not the dorsal mesentery. Additionally, the splenorenal ligament (option D) and the mesoappendix (option E) both derive from the dorsal mesentery, not the ventral mesentery.

4. The correct answer is D) Midgut: Horizontal portion of the duodenum.
The superior mesenteric artery (SMA) supplies blood to the midgut, which includes several portions of the gastrointestinal tract, such as the lower part of the duodenum (starting from the distal portion of the second part), the jejunum, ileum, ascending colon, and the proximal two-thirds of the transverse colon. The horizontal portion of the duodenum, also referred to as the third part of the duodenum, is part of the midgut and is specifically supplied by branches of the superior mesenteric artery. The other options are incorrect for various reasons. Option A (Foregut: Spleen) is not supplied by the SMA. Option B (Midgut: Uncinate process) is also wrong because the uncinate process is a part of the pancreas, which is derived from the foregut, not the midgut. Option C (Hindgut: Inferior third of the anal canal) is incorrect since the inferior third of the anal canal is ectoderm-derived, not part of the hindgut. Finally, option E (Foregut: Appendix) is wrong because the appendix is a structure of the midgut, not the foregut.

5. The correct answer is E) 4, 3, 1.
The steps of midgut development occur in a specific sequence during embryogenesis. First, the midgut undergoes physiologic herniation into the extraembryonic coelom through the umbilicus (step 4) because the abdominal cavity is too small to accommodate the rapidly growing midgut. Following this, the midgut experiences a 90-degree rotation to the right around the axis of the superior mesenteric artery (step 3). This rotation helps position the cranial and caudal limbs of the midgut properly. Finally, as the abdominal cavity enlarges, the midgut retracts back into the abdominal cavity, during which it undergoes an additional 180-degree rotation, completing a total of 270 degrees of rotation (step 1). This orderly process ensures the correct positioning of the intestines within the abdominal cavity. The other answer choices are incorrect as they misplace or incorrectly describe steps such as the direction of rotation or the type of herniation.

6. The Correct answer is B) Failure of neural crest cell migration to the distal colon

The neonate's failure to pass meconium, abdominal distension, and the explosive release of stool upon rectal examination (positive squirt sign) are classic features of congenital megacolon (Hirschsprung's disease). This condition is caused by a failure of neural crest cell migration to the distal colon, leading to an absence of ganglion cells and impaired peristalsis in that segment. Abnormal rotation of the midgut (answer A) would present with volvulus or malrotation. Incomplete recanalization of the rectum (answer C) could lead to atresia, but it would not cause the described findings. Failure of the allantois to regress (answer D) results in abnormalities related to the urinary system, such as a patent urachus. Abnormal development of the anorectal septum (answer E) would result in anorectal malformations.

7. The correct answer is D) Hypertrophy of the pyloric smooth muscle

This infant's presentation of projectile, non-bilious vomiting, a palpable olive-shaped mass, and hypochloremic metabolic alkalosis is characteristic of pyloric stenosis. The condition results from hypertrophy of the pyloric smooth muscle, leading to gastric outlet obstruction. Failure of neural crest cell migration (answer A) is associated with conditions such as Hirschsprung's disease. Incomplete recanalization of the duodenum (answer C) typically causes duodenal atresia, which presents with bilious vomiting in most cases. Malrotation of the midgut (answer B) could lead to volvulus, but this would typically present with bilious vomiting. Defective development of the

vitelline duct (answer E) is associated with Meckel’s diverticulum, which is unrelated to pyloric stenosis.

8. The correct answer is A) Abnormal migration of the ventral pancreatic bud

This patient's presentation, including bilious vomiting, abdominal distension, the "double bubble" sign, and a small region of communication in the second portion of the duodenum, suggests an incomplete duodenal obstruction, characteristic of an annular pancreas. Annular pancreas results from abnormal migration of the ventral pancreatic bud, which partially encircles and compresses the second portion of the duodenum, leading to obstruction. Incomplete recanalization of the duodenum (answer B) could result in complete duodenal atresia, which would lack any region of communication, although this presentation is often associated with the “double-bubble sign”. Malrotation of the midgut (answer C) would typically present with signs of volvulus or obstruction lower in the gastrointestinal tract. Defective formation of the vitelline duct (answer D) leads to Meckel's diverticulum, and failure of neural crest cell migration (answer E) is related to conditions like Hirschsprung’s disease, which involves the colon.

9. The correct answer is A) Failure of bowel retraction into the abdominal cavity

Omphalocele results from the failure of the midgut to retract into the abdominal cavity during the normal process of intestinal development, which typically occurs around the 10th week of gestation. The presence of a membranous sac and the involvement of the umbilical cord are characteristic features of omphalocele. Incomplete recanalization of the midgut (answer B) would cause duodenal atresia. Failure of the vitelline duct to regress (answer C) results in Meckel’s diverticulum. Malrotation of the midgut (answer D) can lead to volvulus but does not result in an abdominal wall defect. Failure of the lateral body wall folds to close (answer E) leads to gastroschisis, which differs from omphalocele as it does not involve a membranous sac and the defect is typically to the right of the umbilicus.

10. The correct answer is B) Failure of the midgut to undergo normal rotation during development

This infant’s sudden onset of bilious vomiting, abdominal distension, and findings on imaging suggest intestinal malrotation with volvulus. This condition occurs due to the failure of the midgut to undergo its normal 270-degree rotation around the superior mesenteric artery during development, resulting in improper positioning of the intestines and an increased risk of volvulus (twisting of the bowel), which can compromise blood flow. Incomplete recanalization of the duodenum (answer A) would cause duodenal atresia or stenosis, typically presenting with a "double bubble" sign. Failure of neural crest cell migration (answer C) is associated with conditions like Hirschsprung’s disease. Incomplete closure of the lateral body folds (answer D) is associated with gastroschisis. Persistent vitelline duct (answer E) can result in Meckel’s diverticulum, not malrotation.