Physiology

Gastrointestinal Physiology Questions

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1. Which of the following food substances requires chewing for digestion?
A) Cheese
B) Eggs
C) Vegetables
D) Meat

2. Which of the following is the main digestible carbohydrate normally consumed in the human diet?
A) Amylose
B) Cellulose
C) Maltose
D) Starch

3. Which of the following is not normally found in abundance in the portal blood?
A) Amino acids
B) Glucose
C) Short-chain fatty acids
D) Triglycerides

4. Digestion of which of the following foodstuffs is impaired to the greatest extent in patients with achlorhydria?
A) Carbohydrate
B) Fat
C) Protein

5.The proenzyme pepsinogen is secreted mainly from which of the following structures?
A) Acinar cells of the pancreas
B) Ductal cells of the pancreas
C) Epithelial cells of the duodenum
D) Gastric glands of the stomach

6. Compared to plasma, saliva has the highest relative concentration of which of the following ions under basal conditions?
A) Bicarbonate
B) Chloride
C) Potassium
D) Sodium

7. Which of the following ions has the highest concentration in saliva under basal conditions?
A) Bicarbonate
B) Chloride
C) Potassium
D) Sodium

8. Biopsies are taken from the antral and duodenal mucosa of a 65-year-old woman. Which of the following hormones can be found in tissue homogenates from both locations?
A) Cholecystokinin (CCK)
B) Glucose-dependent insulinotropic peptide (GLIP)
C) Gastrin
D) Motilin
E) Secretin

9. A 10-year-old boy consumes a cheeseburger, fries, and chocolate shake. The meal stimulates the release of several gastrointestinal hormones. The presence of fat, carbohydrate, or protein in the duodenum stimulates the release of which of the following hormones from the duodenal mucosa?
A) Cholecystokinin (CCK)
B) Glucose-dependent insulinotropic peptide (GLIP)
C) Gastrin
D) Motilin
E) Secretin

10. Which of the following hormones is released by the presence of fat and protein in the small intestine and has a major effect to decrease gastric emptying?
A) Cholecystokinin (CCK)
B) Glucose-dependent insulinotropic peptide (GLIP)
C) Gastrin
D) Motilin
E) Secretin

11. A clinical experiment is conducted in which one group of subjects is given 50 g of glucose intravenously and another group is given 50 g of glucose orally. Which of the following factors can explain why the oral glucose load is cleared from the blood at a faster rate compared to the intravenous glucose load? (CCK, cholecystokinin; GLIP, glucose-dependent insulinotropic peptide; VIP, vasoactive intestinal peptide)
A) CCK-induced insulin release
B) CCK-induced VIP release
C) GLIP-induced glucagon release
D) GLIP-induced insulin release
E) VIP-induced GLIP release

12. Which of the following factors can inhibit gastric acid secretion? (GLIP, glucose-dependent insulinotropic peptide)

	Somatostatin	Secretin	GLIP	Enterogastrones	Nervous reflexes
A	No	No	Yes	No	Yes
B	No	Yes	No	No	No
C	No	Yes	No	Yes	No
D	Yes	No	No	Yes	Yes
E	Yes	No	Yes	No	No
F	Yes	Yes	Yes	Yes	Yes

13. The gastrointestinal hormones have physiological effects that can be elicited at normal concentrations as well as pharmacological effects that require higher than normal concentrations. What is the direct physiological effect of the various hormones on gastric acid secretion? (GLIP, glucose-dependent insulinotropic peptide)

	Gastrin	Secretin	Cholecystokinin	GLIP	Motilin
A	No effect	Stimulate	Stimulate	No effect	No effect
B	Stimulate	Inhibit	No effect	Inhibit	No effect
C	Stimulate	Inhibit	No effect	No effect	No effect
D	Stimulate	Inhibit	Inhibit	Stimulate	Stimulate
E	Stimulate	Stimulate	Inhibit	Inhibit	No effect

14. The cephalic phase of gastric secretion accounts for about 30% of the acid response to a meal. Which of the following can totally eliminate the cephalic phase of gastric secretion?
A) Antacids (e.g., Rolaids)
B) Anti-gastrin antibody
C) Atropine
D) Histamine H2 blocker
E) Vagotomy
F) Sympathectomy

15. A newborn boy does not pass meconium in the first 24 hr. His abdomen is distended and he begins vomiting. Various tests lead to a diagnosis of Hirschsprung disease. An obstruction is most likely found in which portion of the gut?
A) Ascending colon
B) Ileocecal sphincter
C) Lower esophageal sphincter
D) Pylorus
E) Sigmoid colon

16. Migrating motility complexes (MMC) occur about every 90 min between meals and are thought to be stimulated by the gastrointestinal hormone, motilin. An absence of MMCs causes an increase in which of the following?
A) Duodenal motility
B) Gastric emptying
C) Intestinal bacteria
D) Mass movements
E) Swallowing

17. Gastric emptying is tightly regulated to ensure that chyme enters the duodenum at an appropriate rate. Which of the following events promotes gastric emptying under normal physiological conditions in a healthy person?

	Tone of orad stomach	Segmentation contractions in small intestine	Tone of pyloric sphincter
A	Decrease	Decrease	Decrease
B	Decrease	Increase	Decrease
C	Increase	Decrease	Decrease
D	Increase	Decrease	Increase
E	Increase	Increase	Increase

18. Parasympathetic stimulation increases gastrointestinal motility and sympathetic stimulation decreases motility. The autonomic nervous system controls gut motility by changing which of the following?
A) Gastrin secretion
B) Pacemaker discharge frequency
C) Secretin secretion
D) Slow wave frequency
E) Spike potential frequency

19. Swallowing is a complex process that involves signalling between the pharynx and swallowing center in the brainstem. Which of the following structures is critical for determining whether a bolus of food is small enough to be swallowed?
A) Epiglottis
B) Larynx
C) Palatopharyngeal folds
D) Soft palate
E) Upper esophageal sphincter

20. A 54-year-old woman eats a healthy meal. Approximately 20 min later the woman feels the urge to defecate. Which of the following reflexes results in the urge to defecate when the stomach is stretched?
A) Duodenocolic reflex
B) Enterogastric reflex
C) Gastrocolic reflex

D) Intestino-intestinal reflex
E) Rectosphincteric

21. A 60-year-old woman severs her spinal cord at T6 in an automobile accident. She devises a method to distend the rectum to initiate the rectosphincteric reflex. Rectal distension causes which of the following in this woman?

	Relaxation of internal anal sphincter	Contraction of external anal sphincter	Contraction of rectum
A	No	No	No
B	No	No	Yes
C	No	Yes	Yes
D	Yes	No	Yes
E	Yes	Yes	No
F	Yes	Yes	Yes

22. The gastrointestinal hormones have physiological effects that can be elicited at normal concentrations as well as pharmacological effects that require higher than normal concentrations. What is the physiological effect of the various hormones on gastric emptying?

	Gastrin	Secretin	Cholecystokinin	GLIP	Motilin
A	Decrease	Decrease	Decrease	Decrease	Increase
B	Increase	Decrease	None	Decrease	Increase
C	Increase	None	None	Increase	Increase
D	None	None	Decrease	Increase	Increase
E	None	None	Decrease	None	None
F	None	None	Increase	None	None

23. Cholecystokinin (CCK) and gastrin share multiple effects at pharmacological concentrations. Which of the following effects do CCK and gastrin share (or not share) at physiological concentrations?

	Stimulation of acid secretion	Inhibition of gastric emptying	Stimulation of gastric mucosal growth	Stimulation of pancreatic growth
A	Not shared	Not shared	Not shared	Not shared
B	Not shared	Not shared	Shared	Not shared
C	Not shared	Shared	Not shared	Not shared
D	Shared	Shared	Not shared	Not shared
E	Shared	Shared	Shared	Shared

24. Vomiting is a complex process that requires coordination of numerous components by the vomiting center located in the medulla. Which of the following occurs during the vomiting act?

	Lower esophageal sphincter	Upper esophageal sphincter	Abdominal muscles	Diaphragm
A	Contract	Contract	Contract	Contract
B	Contract	Contract	Relax	Relax
C	Relax	Contract	Contract	Relax
D	Relax	Relax	Contract	Contract
E	Relax	Relax	Relax	Relax

25. Various proteolytic enzymes are secreted in an inactive form into the lumen of the gastrointestinal tract. Which of the following substances is/are important for activating one or more proteolytic enzymes, converting them to an active form?

	Trypsin	Enterokinase	Pepsin
A	No	No	No
B	No	No	Yes
C	No	Yes	No
D	Yes	Yes	No
E	Yes	Yes	Yes

26. Mass movements constitute an important intestinal event that lead to bowel movements. Mass movements cause which of the following?
A) Contraction of internal anal sphincter
B) Duodenal peristalsis
C) Gastric retropulsion
D) Hunger sensations
E) Rectal distension

27. An 82-year-old woman with upper abdominal pain and blood in the stool has been taking NSAIDS for arthritis. Endoscopy revealed patchy gastritis throughout the stomach. Biopsies were negative for *Helicobacter pylori*. Pentagastrin administered intravenously would lead to a less than expected (i.e., less than normal) increase in which of the following?
A) Duodenal mucosal growth
B) Gastric acid secretion
C) Gastrin secretion
D) Pancreatic enzyme secretion
E) Pancreatic growth

28. Which of the following is a likely consequence of ileal resection?
A) Achalasia
B) Atrophic gastritis
C) Constipation
D) Peptic ulcer
E) Vitamin B12 deficiency

29. Which of the following factors have a physiologic role to stimulate the release of hormones or stimulate nervous reflexes, which in turn can inhibit gastric acid secretion?

	Acid	Fatty acids	Hyperosmotic solutions	Isotonic solutions
A	No	No	Yes	No
B	No	No	Yes	Yes
C	Yes	Yes	No	Yes
D	Yes	Yes	Yes	Yes
E	Yes	Yes	Yes	No

30. A 23-year-old medical student consumes a cheeseburger, fries, and chocolate shake. Which of the following hormones produce physiological effects at some point over the next several hours?

	Gastrin	Secretin	Cholecystokinin	GLIP
A	No	Yes	Yes	Yes
B	Yes	No	Yes	Yes
C	Yes	Yes	No	Yes
D	Yes	Yes	Yes	Yes
E	Yes	Yes	Yes	Yes

31. A 68-year-old woman with hematemesis has heartburn and stomach pain. Endoscopy shows inflammation involving the gastric body and antrum as well as a small gastric ulcer. Biopsies were positive for *Helicobacter pylori*. *H. pylori* damages the gastric mucosa primarily by increasing mucosal levels of which substance?
A) Ammonium
B) Bile salts
C) Gastrin
D) NSAIDS
E) Pepsin

32. A 71-year-old man with hematemesis and melena has a cresenteric ulcer in the duodenum. Lavage dislodged the clot, revealing an underlying raised blood vessel, which was successfully eradicated via cautery with a bipolar gold probe. Which of the following factors are diagnostic for duodenal ulcer?

	Endoscopy	Plasma gastrin level	Rate of acid secretion
A	No	No	No
B	Yes	No	No
C	Yes	No	Yes
D	Yes	Yes	No
E	Yes	Yes	Yes

33. A clinical study is conducted in which gastric acid secretion is stimulated using pentagastrin before and after treatment with a histamine H2 blocker. Which of the following rates of gastric acid secretion (in mEq/hr) is most likely to have occurred in this experiment?

	Pentagastrin alone	Pentagastrin + H2 blocker
A	15	15
B	25	25
C	25	15
D	26	28
E	40	45

34. A tsunami tidal wave hits the east coast of South America and the people living there are forced to drink unclean water. Within the next several days, a large number of people develop severe diarrhea and about half of these people expire. Samples of drinking water are positive for *Vibrio cholerae*. Which of the following types of ion channels is most likely to be irreversibly opened in the epithelial cells of the crypts of Lieberkühn in these people with severe diarrhea?
A) Calcium channels
B) Chloride channels
C) Magnesium channels
D) Potassium channels
E) Sodium channels

35. One of the following hormones can stimulate growth of the intestinal mucosa and two other hormones can stimulate pancreatic growth. Which three hormones are these?

	Gastrin	Secretin	CCK	GLIP	Motilin
A	No	Yes	Yes	Yes	No
B	Yes	No	Yes	No	Yes
C	Yes	No	Yes	Yes	No
D	Yes	No	Yes	Yes	No
E	Yes	Yes	Yes	No	No

36. Which of the following structures undergoes receptive relaxation when a bolus of food is swallowed?
A) Orad stomach
B) Palatopharyngeal folds
C) Pharynx
D) Thoracic esophagus
E) Upper esophageal sphincter

37. A 65-year-old man eats a healthy meal. Approximately 40 min later the ileocecal sphincter relaxes and chime moves into the cecum. Gastric distention leads to relaxation of the ileocecal sphincter by way of which reflex?
A) Enterogastric reflex
B) Gastroileal reflex
C) Gastrocolic reflex
D) Intestino-intestinal reflex
E) Rectosphincteric reflex

38. A healthy, 21-year-old woman eats a big meal and then takes a 3-hr ride on a bus that does not have a bathroom. Twenty minutes after eating, the woman feels a strong urge to defecate, but manages to hold it. Which of the following have occurred in this woman

	Relaxation of internal anal sphincter	Contraction of external anal sphincter	Contraction of rectum
A	No	No	No
B	No	Yes	Yes
C	Yes	No	Yes
D	Yes	No	No
E	Yes	Yes	Yes

39. The gastric mucosal barrier has a physiological and an anatomical basis to prevent back-leak of hydrogen ions into the mucosa. Some factors are known to strengthen the integrity of the gastric mucosal barrier, whereas other factors can weaken the barrier. Which of the following factors strengthen or weaken the barrier?

	Bile salts	Mucous	Aspirin	NSAIDS	Gastrin	Ethanol
A	Strengthen	Strengthen	Weaken	Weaken	Strengthen	Strengthen
B	Strengthen	Strengthen	Weaken	Weaken	Weaken	Strengthen
C	Weaken	Strengthen	Strengthen	Weaken	Strengthen	Weaken
D	Weaken	Strengthen	Weaken	Weaken	Strengthen	Weaken
E	Weaken	Weaken	Weaken	Strengthen	Strengthen	Weaken

40. A 45-year-old man presents with abdominal pain and hematemesis. An abdominal exam was relatively benign, and abdominal x-rays were suggestive of a perforated viscus. Endoscopy revealed a chronically perforated gastric ulcer, through which the liver was visible. Which of the following is a forerunner to gastric ulcer formation?
A) Back-leak of hydrogen ions
B) Mucus secretion
C) Proton pump inhibition
D) Tight junctions between cells
E) Vagotomy

41. A 19-year-old man is fed intravenously for several weeks following a severe automobile accident. The intravenous feeding leads to atrophy of the gastrointestinal mucosa most likely because the blood level of which of the following hormones is reduced?
A) Cholecystokinin only
B) Gastrin only
C) Secretin only
D) Gastrin and cholecystokinin
E) Gastrin and secretin
F) Secretin and cholecystokinin

42. A 62-year-old man with dyspepsia and a history of chronic gastric ulcer has abdominal pain. Endoscopy shows a large ulcer in the proximal gastric body. Biopsies were positive for *Helicobacter pylori*. Which of the following are used clinically for treatment of gastric ulcers of various etiologies?

	Antibiotics	NSAIDS	H2 blockers	Proton pump inhibitors
A	No	No	Yes	Yes
B	Yes	No	No	Yes
C	Yes	No	Yes	Yes
D	Yes	Yes	Yes	Yes
E	No	Yes	Yes	Yes

43. Eating a meal leads to a large increase in gastric acid secretion that peaks within about 5 min and returns to normal about 4 hr after a meal is taken. How long after a meal does the pH of the gastric contents reach its lowest level (in hours)?
A) 1.0
B) 1.5
C) 2.0
D) 2.5
E) 3.0
F) 4.0

44. Cystic fibrosis (CF) is an inherited disorder of the exocrine glands, affecting children and young people. Mucus in the exocrine glands becomes thick and sticky and eventually blocks the ducts of these glands (especially in the pancreas, lungs, and liver), forming cysts. A primary disruption in the transfer of which ion across cell membranes occurs in CF leading to decreased secretion of fluid?
A) Calcium
B) Chloride
C) Phosphate
D) Potassium
E) Sodium

45. Which of the following stimulus-mediator pairs normally inhibit gastrin release? (CCK, cholecystokinin; GLIP, glucose-dependent insulinotropic peptide)

	Stimulus	Mediator
A	Acid	CCK
B	Acid	GLIP
C	Acid	Somatostatin
D	Fatty acid	Motilin
E	Fatty acid	Somatostatin

46. A newborn boy has a distended abdomen, fails to pass meconium within the first 48 hr of life, and vomits repeatedly. Analysis of a rectal biopsy provides a definitive diagnosis of Hirschsprung disease. The absence of which type of cell is diagnostic for Hirschsprung disease?
A) Lymphatic endothelial cells
B) Capillary endothelial cells
C) Parasympathetic ganglion cells
D) Red blood cells
E) Smooth muscle cells

47. Mass movements are often stimulated after a meal by distention of the stomach (gastrocolic reflex) and distention of the duodenum (duodenocolic reflex). Mass movements often lead to which of the following?
A) Bowel movements
B) Gastric movements
C) Haustrations
D) Esophageal contractions
E) Pharyngeal peristalsis

48. A 45-year-old man adds lots of high-fiber wheat and bran foods to his diet to reduce his cholesterol. He loses 30 lb on the new diet, but has undesirable side effects such as stomach cramps, flatulence, and diarrhea. His gastroenterologist diagnoses a syndrome called gluten-enteropathy or celiac sprue. Which of the following is decreased in this man?
A) Absorption of nutrients
B) Digestion of fat
C) Stool carbohydrates
D) Stool fat
E) Stool nitrogen

49. A 57-year-old man is admitted as an emergency for upper GI bleeding. Endoscopy reveals multiple ulcers in the duodenum. Serum gastrin levels are eight-fold higher compared to normal. Zollinger-Ellison syndrome (ZES, gastrinoma) is suspected. Administration of which of the following substances is useful in confirming the diagnosis?
A) Cholecystokinin (CCK)
B) Glucose-dependent insulinotropic peptide (GLIP)
C) Motilin
D) Pentagastrin
E) Secretin

50. A 71-year-old man with upper abdominal pain and blood in the stool takes NSAIDS for the pain and washes it down with whiskey. Pentagastrin administration produced lower than predicted levels of gastric acid secretion. Secretion of which of the following substances is most likely to be diminished in this patient with gastritis?
A) Intrinsic factor
B) Ptyalin
C) Rennin
D) Saliva
E) Trypsin

51. Gastric acid is secreted when a meal is consumed. Which of the following factors have a direct action on the parietal cell to stimulate acid secretion?

	Gastrin	Somatostatin	Acetylcholine	Histamie
A	No	No	Yes	Yes
B	Yes	No	No	Yes
C	Yes	No	Yes	Yes
D	Yes	Yes	Yes	Yes
E	Yes	Yes	No	Yes

52. An 84-year-old man with hematemesis and melena is diagnosed with a duodenal ulcer. A patient diagnosed with a duodenal ulcer is likely to exhibit which of the following?

	Parietal cell density	Acid secretion	Plasma gastrin
A	Decreased	Decreased	Decreased
B	Decreased	Increased	Decreased
C	Increased	Decreased	Increased
D	Increased	Increased	Increased
E	Increased	Increased	Increased

53. The gastric phase of gastric secretion accounts for about 60% of the acid response to a meal. Which of the following can virtually eliminate the secretion of acid during the gastric phase?
A) Antiacids (e.g., Rolaids)
B) Antigastrin antibodies
C) Atropine
D) Histamine H2 blocker
E) Proton pump inhibitor

54. A 53-year-old man with a recurrent history of ulcer disease associated with diarrhea and a strong family history of duodenal ulcer disease is suspected of having Zollinger-Ellison syndrome (gastrinoma). Secretin (2 units/kg) was given as a rapid intravenous injection to test for gastrinoma. Which of the following results would support the existence of gastrinoma following secretin administration?
A) Decreased serum gastrin
B) Increased serum gastrin
C) Inhibition of gastric acid secretion
D) Inhibition of gastric emptying
E) Stimulation of pancreatic HCO32 secretion

55. Damage to the gastric mucosal barrier is a forerunner of gastric ulcer. Which of the following can both damage the gastric mucosal barrier and stimulate gastric acid secretion?
A) Bile salts
B) Epidermal growth factor
C) Gastrin
D) *Helicobacter pylori*
E) Mucous

56. Gastric emptying is regulated to ensure the chime enters the duodenum at an appropriate rate. Which of the following factors promotes gastric emptying?
A) Anorexia nervosa
B) Antral peristalsis
C) Bulimia nervosa
D) Obesity
E) Scleroderma
F) Type I diabetes

57. Cystic fibrosis is the most common cause of pancreatitis in children. Which of the following best explains the mechanism of cystic fibrosis–induced pancreatitis?
A) Activation of enterokinase
B) Activation of trypsin inhibitor
C) Autodigestion of pancreas
D) Excessive secretion of CCK
E) Gallstone obstruction

58. Vagal stimulation plays an essential role during the cephalic and gastric phases of gastric secretion. Vagal stimulation tends to cause which of the following changes in the release of gastric releasing peptide (GRP) and somatostatin

	GRP	Somatostatin
A	↑	↑
B	↓	↓
C	↑	↓
D	↓	↑
E	↔	↓

59. The control of gastric acid secretion in response to a meal involves several events that take place over a 4- or 5-hr period following the meal. These events include (1) a decrease in the pH of the gastric contents, (2) an increase in the rate of acid secretion, (3) a decrease in the rate of acid secretion, and (4) an increase in the pH of the gastric contents. Which of the following best describes the correct temporal order of events over a 4- or 5-hr period following a meal?
A) 4, 3, 2, 1
B) 3, 1, 4, 2
C) 3, 4, 1, 2
D) 2, 1, 4, 3
E) 4, 2, 1, 3
F) 1, 2, 3, 4
G) 2, 3, 1, 4
H) 1, 3, 2, 4

60. A 43-year-old obese woman with a history of gallstones is admitted to the emergency department because of excruciating pain in the upper right quadrant. The woman is jaundiced and x-ray suggests obstruction of the common bile duct. Which of the following values of direct and indirect bilirubin are most likely to be present in the plasma of this woman (in milligrams per deciliter)?

	Direct	Indirect
A	1.0	1.3
B	2.3	2.4
C	5.0	1.7
D	1.8	6.4
E	6.8	7.5