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Gastric Disorders II
Small Intestine Disorders I
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• What are examples of injuries likely to occur to the oropharynx, esophagus, stomach, or duodenum from ingesting acidic or alkaline chemicals?
  – Strong alkaline; liquefactive necrosis, destruction of cells and membranes
  • Most damage generally occurs in the oropharynx and esophagus and to a lesser degree the stomach, full thickness burns likely
  – Strong acids; eschar, coagulation necrosis
  • Most damage generally occurs in the antrum, possible small bowel exposure and damage
• What are other examples of findings which may be associated with ingestion of strongly acidic chemicals?
  – Metabolic acidosis
  – Hemolysis
  – Acute renal failure
  – Death
What are examples of other potential complications from ingesting acidic or alkaline chemicals?

- Gastritis
- Tissue edema
- Hemorrhagic ulceration
- Tissue necrosis
- Strictures:
  - May cause development of gastric outlet obstruction with sequela
- Perforation leading to:
  - Peritonitis, mediastinitis, shock, septicemia
What are examples of signs and symptoms from the ingestion of acidic or alkaline chemicals?

- Dysphagia, drooling
- Dyspnea
- Abdominal pain, guarding
- Chest pain, stridor
- Hoarseness, dysphonia, aphonia
- Respiratory distress
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• What diagnostics tests should be done with suspected caustic ingestions?
  – pH testing; <2.0 or >12.5 potential serious damage
  – Electrolytes, bun, creatinine, ABG, CBC, urinalysis
  – Consider toxicology screen
  – CXR, abdominal x-rays
  – Esophagoscopy unless contraindicated
What are bezoars?

- Concreted masses of foreign material in the stomach that fail to pass to the small intestine
  - Milk curd; lactobezoar
    - Infants; possibly due to insufficient dilution of powdered milk
  - Hair; trichobezoar
    - Women > men (under age of thirty most common)
  - Plant/vegetable material; phytobezoar or food-ball
    - Men > women (over age thirty most common)
- Potential causes; incomplete mastication, hypochlorhydria, decreased antral motility, gastric surgeries, diabetics with gastroparesis, psychiatric causes
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• What are examples of signs and symptoms of a bezoar?
  – Anorexia, vomiting, diarrhea
  – Abdominal or epigastric pain
  – Feelings of fullness
  – Weight loss
  – Halitosis
  – Obstruction, ulceration, perforation, bleeding
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• How are bezoars diagnosed?
  – Physical exam; a mass may be palpable
  – Abdominal x-rays
  – EGD
  – Upper GI series
  – Abdominal CT scans
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• How are bezoars treated?
  – Lactobezoar; hydration, withholding feedings for 48 hours, saline gastric lavage
  – Trichobezoar; surgery-gastrotomy, enterotomy, laparoscopy, mini-laparotomy, laparotomy
  – Phytobezoar; enzymatic use (acetylcysteine, papain, cellulase), endoscopy disruption, surgery
• What are causes of infectious gastritis?
  – Viral, bacterial, fungal, parasitic
• Who is at risk for infectious gastritis?
  – Immunocompromised patients
    • Examples; HIV, chemotherapy, organ transplant patients
• How is infectious gastritis diagnosed?
  – Endoscopy with biopsy, culture, cytology
  – Labs; serology such as for H Pylori, CMV
  – Stool samples; culture, ova and parasites
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• What is the anatomy of the small intestine (SI)?
  - About 7 meters of convoluted tube decreasing in size before ending in the large intestine
  - Extends from the pyloris to colic valve
  - Located in the central and lower parts of the abdominal cavity
  - The mesentery is a supporting structure and contains blood vessels, insulating fat and lymphatics
  - Functions include; digestive, barrier, absorptive, immunological, and secretory
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- Other pertinent facts concerning the small intestine include;
  - Attached to the vertebral column by folds of peritoneum (mesentery)
  - Is divided into three portions;
    - Duodenum; c-shaped and muscular, begins at the pyloric sphincter and ends at the ligament of Treitz
      - The Ampulla of Vater is where the common bile duct empties into duodenum
    - Jejunum; thicker and more vascular than ileum
    - Ileum; extends from the jejunum to the iliocecal valve
What is the anatomy of the SI walls?

- Composed of four coats:
  - Serous (tunica serosa)- composed of connective tissue and derived from the peritoneum
  - Muscular (tunica muscularis)- has 2 coats of unstriped fibers consisting of an internal circular and external longitudinal layers separated by myenteric plexus (neurological network)
  - Areolar (tela submucosa)- connects mucous and muscular coats, composed of filamentous areolar tissue which contains lymphatics, blood vessels, nerves
  - Mucous (tunica mucosa)- connective tissue (lamina propria) of columnar epithelium separating mucosa from submucosa
Other pertinent facts pertaining to the submucosa and mucosa layers include:

- Submucosa and mucosa layers are arranged in circular folds (plicae circulares) which are valvular flaps in the lumen of the bowel and act to increase surface area for secretion and absorption.
- The mucosa has many (millions) of protrusive, small, columnar epithelial lined structures (villus) with each structure covered by microvilli (brush border).
What are the intestinal glands “crypts of Lieberkuhn”?

- Very small tubular depressions in the mucous membrane, perpendicular to the surface with small circular apertures
- The structures are lined with columnar epithelium covered by exterior capillaries
- Contain mitotic undifferentiated cells that replace the epithelium approximately every 36 hours
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• What are the duodenal glands “Brunner’s glands”?  
  – Small compound acinotubular glands with multiple alveoli lined with short columnar epithelium which open by a single duct into the crypts of Lieberkuhn, found in the submucosa areolar tissue and contain mucous and serous secretory cells  
  – Are in greatest numbers at the pyloris, and proximal duodenum
What are Peyer’s patches?

- They are largest and most numerous in the ileum
- Approximately 25% of the small intestine is lymphoid tissue
- Aggregated lymphatic nodules; 20-30 nodules make up circular/oval patches found in the submucosa and mucosa with the cells being instrumental in immunity and antibody synthesis
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• What is the role of the lymphocytes and plasma cells in the lamina propria and intraepithelial lymphocytes?
  – Lamina propria; majority produce immunoglobulin IgA for activity against pathological organisms and immune modulation of antigenic activity
  – Intraepithelial lymphocytes; located between the intestinal epithelial cells, mostly T cells
What is the anatomy of the vasculature and innervation to the SI?
- The duodenum is supplied by the hepatic artery with the superior mesenteric artery supplying the jejunum and ileum
- Innervation:
  - Sympathetic plexus around the superior mesenteric artery to myenteric plexus (Auerbach’s plexus) with the submucosa plexus (Meisner’s plexus) innervating circular muscular fibers and ganglia to the muscularis mucosae and mucus membrane
  - Parasympathetic; (autonomic function) from vagus nerve controlling tone, motility and secretory activity
What are examples of the primary function of the SI?

- Absorption of the nutrients in chyme by columnar cells of the villous epithelium
- Duodenum; primary area of calcium and iron absorption
- Jejunum; primary area for processing proteins, fats and carbohydrates
- Ileum; primary area for processing bile acids and vitamin B$_{12}$
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- What are the mechanisms of absorption by the SI?
  - Nonionic movement
  - Passive diffusion
  - Hydrolysis
  - Active transport
  - Facilitated diffusion
  - Digestion in the small intestine normally takes three to six hours
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• What are examples of substances absorbed by the SI?
  – Bile salts and vitamin $B_{12}$ absorbed in the terminal ileum, $B_{12}$ after combining with intrinsic factor for active transport (other water soluble vitamins absorbed by diffusion)
  – Iron is absorbed in the duodenum and proximal jejunum
  – Sodium is absorbed by active transport with amino acids, chloride and glucose being co-transported
  – Carbohydrates are reduced to fructose, glucose, galactose and then absorbed by active transport or facilitated diffusion
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• What are other examples of substances absorbed by the SI?
  – Phosphate, magnesium and potassium absorbed throughout the SI
  – Amino acids (hydrolyzed proteins) absorbed by active transport
  – Calcium is absorbed mainly in duodenum and proximal jejunum by a transcellular route and throughout the SI based on a concentration dependant process
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• What are examples of problems that can arise as a result of SI dysfunction?
  – Ileal disorders can result in bile acid malabsorption and $B_{12}$ deficiency
  – Duodenal disorders can result in iron and calcium deficiency
  – Disorders of the jejunum can cause malabsorption of fats, carbohydrates, and proteins
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• What are the three types of SI movement which result in the mixing of chyme?
  – Peristaltic waves consisting of short propulsive contraction more pronounced in the upper portions of the duodenum and jejunum
  – Segmental concentric contractions occurring in the jejunum
  – The villi change lengths resulting in the mixing of chyme
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- How are fats (lipids) digested by the SI?
  - Bile and the pancreatic enzyme lipase emulsifies lipids into fatty acids, glycerides and glycerol
  - Bile acids and the formation of micelles makes fatty acids and monoglycerides water soluble
  - Vitamins that are fat soluble combine with bile salts forming water soluble micelles
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• What are examples of secretions that are needed to aid in the digestive process?
  – Secretions by the pancreas and liver
  – Secretions by ten different endocrine cells in the crypts that produce hormones and peptides;
    • Serotonin, gastrin inhibitory peptide, peptidases, disaccharides, vasoactive intestinal peptide, gastrin, somatostatin, neurotensin, enteroglucagon, cholecystokinin, motilin and secretin
What substances help form mucosal protectants and carriers for absorption of chyme?

- Crypts of Lieberkuhn; secrete succus entericus which is a carrier vehicle in absorption of chyme when in contact with the villi
- Brunner’s glands in the proximal duodenum produce a clear fluid with a pH 8.2-9.3 (alkaline) which protects duodenal mucosa
- Goblet cells secrete a protective mucus from on and between the villi
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• What are examples of SI pathological abnormalities?
  – Malabsorption syndromes; Whipple’s disease, celiac disease, lactose intolerance, short bowel syndrome
  – Parasite, bacterial, viral infections
  – Meckel’s diverticulum
  – Crohn’s disease
What are examples of SI pathological abnormalities that affect children?

- Constipation
- Acute infectious diarrhea
- Shwachman-diamond syndrome
- Short bowel syndrome
- Celiac Sprue disease
- Cystic fibrosis
- Hirschsprung’s disease
- Intussusception
- Cow and soy milk allergic enteropathy
- Meckel’s diverticulum
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• What are examples of potential SI infectious agents?
  – Bacteria
    • Invasive
    • Enterotoxin producing
  – Viral
  – Parasites
  – Fungus
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• What are examples of bacteria which cause the most invasive damage to the SI and colon mucosa?
  – E. coli
  – Vibrio parahaemolyticus
  – Shigella
  – Salmonella
  – Clostridium difficile
  – Staphylococcus aureus

• What are examples of bacteria which cause penetration of the SI mucosa causing illness?
  – Salmonella typhi
  – Yersinia enterocolitica
  – Helicobacter Pylori (H Pylori)
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- What are examples of bacteria which produce enterotoxins?
  - Vibrio cholerae
  - Escherichia coli
  - Clostridium perfringens
  - Bacillus cereus
  - Staphylococcus aureus
  - Clostridium Botulinum

- What are examples of viruses which cause SI disease?
  - Cytomegalovirus
  - Norwalk virus
  - Coronavirus
  - Rotavirus
  - Adenovirus
What are examples of symptoms associated with SI infections?

- Invasive bacteria can cause bloody stools, mucus in the stools, fecal leukocytes, fever
- Bacteria which affect the gastric mucosa can cause:
  - Fever, and sepsis due to extra-intestinal involvement
  - Fecal leukocytes
- Enterotoxin producing bacteria can produce copious diarrhea, fever (rare)
- Viruses can cause diarrhea and malabsorption
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• How can infections of the SI be diagnosed?
  – Determine etiology of infection
    • History and physical
    • Labs; CBC (evaluate for anemia), kidney and liver function chemistries, amylase, lipase, H pylori serology, stool hemacult, stool for O&P, stool for C&S, stool leukocyte exam, blood cultures if febrile
    • Abdominal x-rays, abdominal CT, double-contrast barium radiography
    • Endoscopy with biopsy and culture
• How are infections of the SI treated?
  – Oral re-hydration with clear liquids with sodium and glucose containing fluids (one teaspoon of salt to four teaspoons of sugar in one liter of water)
  – IV fluids for dehydration and electrolyte disturbances (normal saline or a lactated Ringer solution)
  – Antiemetics; IV, PO, or rectally
  – Antibiotics, antiviral, antifungal medications where indicated
  – Antidiarrheal medications are generally contraindicated
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- What intracytoplasmic protozoa cause mucosal damage of the SI?
  - Coccidiosis by Isopora (hominis, belli, natelenis)
  - Rare in the USA
  - Symptoms
    - Steatorrhea
    - Chronic diarrhea (intermittent or continuous)
    - Acute fulminate diarrhea
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• How are SI infections by coccidiosis diagnosed and treated?
  – May be self limiting
  – Evaluate for dehydration and electrolyte imbalance and treat where needed
  – Total parenteral nutrition (TPN) in case of children with malabsorption, severe diarrhea
  – Furoxone (furazolidone) for severely ill patients
What is the most commonly identified intestinal parasite in the USA and how do they produce disease?

- Giardiasis by Giardia lamblia
- Exact mechanism of pathology is unclear but they are thought to cause damage to the endothelial brush boarder, produce enterotoxins, cause alteration of GI motility, and initiate an immune response
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• How is Giardia lamblia contracted and what are the signs and symptoms?
  – Infection by:
    • Fecal oral transmission
    • Contaminated water
    • Contaminated food (not as common)
  – Signs and symptoms;
    • Malodorous stools, abdominal cramps, explosive diarrhea, fever, vomiting, malaise, weight loss, anorexia, malabsorption
How is giardiasis diagnosed and treated?
- Diagnosis; multiple stool samples for ova and parasite evaluation (three stools taken two days apart), stool antigen detection testing, duodenal sampling with biopsy done by endoscopy
- Treatment; treat for dehydration, electrolyte imbalance and malabsorption as indicated
- Pharmacology; Flagyl, Furoxone, Alinia, Tizoxanide, Humatin (can be used in pregnant females), Tindamax
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- Strongyloidiasis is caused by the parasitic nematode *Strogyloides stercoralis*. How is it contracted and what is the life cycle of this parasite?
  - Filariform larvae penetrate the skin when in contact with contaminated soil, also fecal-oral route
  - Once penetration or ingestion has occurred they are carried to the lungs (alveoli) by the venous system then ascend the tracheobronchial tree and larynx and are then swallowed reaching the SI becoming adults (only female parasites), and produce rhabditiform (non-infective larvae) which are passed in feces
  - Autoinfection can occur producing virulent infection
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• What populations are affected by strongyloidiasis?
  – Rare in the USA
  – Most prevalent in the Caribbean, West Africa, and Southeast Asia, tropical, and subtropical areas
  – Has a high mortality rate because of delay in diagnosis
  – Initial infection during childhood more common
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• What are examples of signs and symptoms of acute strongyloidiasis?
  – Itching of the lower extremities with erythematous maculopapules where filariform penetrate the skin
  – Dyspnea, wheeze, cough
  – Diarrhea, epigastric symptoms (pain, discomfort, tenderness), possible nausea and vomiting, low grade fever
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• **What are the signs and symptoms of chronic strongyloidosis?**
  – Repeated rashes, chronic urticaria
    • Larva currens- rapidly and irregularly formed wheels often beginning around the anus extending to the buttocks, thighs, and abdomen
  – Intermittent nausea, vomiting and diarrhea
  – Most have only minimal abdominal discomfort which can be worse after eating
  – Possible epigastric tenderness
  – Possible weight loss
• What are examples of signs and symptoms of a severe infestation of the strongylodes nematode?
  – Hemoptysis, wheezing, crackles, shortness of breath (dyspnea), and cough varying in severity
  – Significant abdominal pain, nausea and vomiting, hematochezia, hematemesis, abnormal bowels sounds (hyperactive or hypoactive)
  – Fever, chills
  – Rash consisting of purpura, and/or petechiae
  – Central nervous system involvement such as mental status changes, neck pain and stiffness, headaches, menigismus
How is strongyloidosis diagnosed?

- Labs; CBC with differential to evaluate white blood cell count and the presence of eosinophilia
- Lumbar puncture if CNS involvement suspected
- Stool samples for ova and parasites
- Serology
- CXR, abdominal X-ray
- CT abdomen and pelvis
- Barium enema and barium swallow
- Duodenal aspirate to detect larvae
- Sputum; cultures and examination
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• How is strongyloidosis treated?
  – Treat for dehydration, hypovolemia and anemia as indicated
  – Anthelmintic pharmacotherapy;
    • Albendazole
    • Thiabendazole
    • Ivermectin
  – Antibiotics where indicated (bacteremia, meningitis)
What is the route of transmission?

- Cryptosporidiosis can produce severe illness in malnourished children and in the immunocompromised population but is often self-limiting in the general population.
- The causative organism is the coccidial sporozoa Cryptosporidium.
- It can affect the respiratory system and the entire GI system (colon and SI are the most commonly infected sites).
- Fecal to oral transmission.
- Waterborne transmission.
- Animal to person transmission.
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- What are examples of signs and symptoms of Cryptosporidiosis?
  - Low grade fever, abdominal pain and cramping, malaise, watery diarrhea, steatorrhea
  - Possible rectal bleeding, proctitis
  - In the malnourished and immunocompromised patient:
    - Hypovolemia, dehydration, malabsorption
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• How is Cryptosporidiosis diagnosed and treated?
  – Diagnosis; stool microscopy with a special modified acid fast staining procedure
  – Intestinal biopsies
  – Treatment; supportive measures for fluid and electrolyte disturbances, pharmacology
What pharmacological agents are used to treat patients who are severely ill due to cryptosporidiosis?

- Pharmacological treatment:
  - Thiabendazole
  - Metronidazole
  - Paromomycin
  - Nitazoxanide
  - Antidiarrheal agents
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- Ascariasis is caused by the nematode (roundworm) Ascaris Lumbricoides and is the most common cause of helminth infections. What is the route of transmission and what portion of the digestive system does it infect?
  - Route of transmission is by contact with soil contaminated by human feces, or soil fertilized with feces which contaminate ingested foods
  - It is the largest of roundworms affecting humans and infects the jejunum and middle ileum
  - After infection the larvae go through the intestinal wall vasculature migrating by the portal system to the liver and then to the respiratory system
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• What are examples of signs and symptoms of Ascariasis?
  – Dyspnea
  – Cough
  – Hemoptysis
  – Chest pain
  – Wheezing
  – Abdominal pain
  – Cramping
  – Abdominal tenderness
  – Nausea
  – Vomiting
  – Diarrhea
  – Anorexia
  – Jaundice
How is Ascariasis diagnosed and treated?

- Diagnosis; labs-
  - CBC evaluate for eosinophelia
  - Stool sample evaluation for ova and parasites
- CXR, abdominal x-rays, ultrasound, CT
- Treatment; supportive measures where indicated
- Pharmacological;
  - Albendazole, mebendazole, pyrantel pamoate
- Surgical; where indicated for obstruction
What are the signs and symptoms associated with Diphyllobothrium latum infection?

- Often asymptomatic
- May result in vitamin $B_{12}$ deficiency, anemia, abdominal pain, nausea, vomiting, diarrhea, parasthesia of the extremities, ataxia, weight loss, fatigue, anal itching (pruritis ani), tachycardia, dyspnea, glossitis
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• How is Diphyllobothriasis diagnosed and treated?
  – Diagnosis; labs include:
    • CBC- evaluation for anemia and eosinophelia, B_{12} and folate levels, stool samples for ova and parasite evaluation
  – Supportive treatment where indicated
  – Pharmacological therapy; niclosamide, praziquantel
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• What are the names of other tapeworms (cestodes) which cause infection in man?
  – Taenia solium
  – Taenia saginata
  – Hymenolepis
  – Dipyldium caninum
  – Spirometra
• Peptic ulcer disease (PUD) can affect the lower esophagus, stomach, pyloris, duodenum, and jejunum. H Pylori is the most common cause of duodenal ulcers. Why do duodenal ulcers occur?
  – Damage occurs to the gastric mucosa which allow corrosive changes to occur from exposure to hydrochloric acid (HCL)
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- Who is most susceptible to duodenal ulcers?
  - Men and women equally though the incidence of PUD is increasing in women and decreasing in men
  - Greater percentage affects those with type O blood
  - More prevalent with age coupled with NSAID use
  - Those with H Pylori infection
  - Gastrinoma (Zollinger-Ellison syndrome), CMV, chemotherapy, radiation, HSV-I and possibly users of crack cocaine
What symptoms are usually associated with duodenal ulcer disease?

- Epigastric; pain or burning sensation, dull, sharp or penetrating pain, episodic or chronic
- Pain may radiate to the back
- Worse 2-3 hours after a meal
- Can awaken at night
- Belching or a bloating sensation
- Duodenal ulcer pain may be relieved by food, may have feelings of hunger
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• What are examples of signs usually associated with duodenal ulcer disease?
  – Hematemesis, melena, coffee ground emesis
  – Tenderness over the epigastrium and possibly the right and left upper quadrants of the abdomen or supraumbilical area
  – Symptoms of peritonitis with perforation

• How are duodenal ulcers diagnosed?
  – Single or double contrast barium x-ray studies
  – EGD
  – H Pylori testing
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• How are duodenal ulcers treated?
  – Treat for H. Pylori if present
  – Proton pump inhibitors, histamine 2 blockers, mucosal protectants
  – Discontinue NSAIDs
  – Surgical procedures;
    • Distal gastrectomy with Billroth I (gastroduodenostomy)
    • or Billroth II (gastrojejunostomy), pyloroplasty, truncal or selective vagotomy
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• What is Crohn’s disease?
  – A transmural inflammatory process that can affect any part of the intestinal tract from the oral-pharyngeal tract to the rectum, most commonly occurring in the iliocecal, colon, and SI and rarely in the esophagus, stomach, and mouth
  – Lesions are in an asymmetric patchy distribution and can go into remission
  – Cause is unknown but it is suspected there is an imbalance between pro-inflammatory and anti-inflammatory mediators
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• What are other important facts concerning Crohn’s disease?
  – Potential causative factors could be genetic, immunologic, dietary, psychological, microbial, environmental or vascular
  – Edema of the GI mucosa could result in obstruction
  – Highest incidence in people of Jewish, Caucasian > non-whites, urban > rural settings, most common onset in ages 15-30 years old
What are examples of changes which occur in the GI tract as a result of Crohn’s disease?

- Onset with focal inflammation around crypts progressing to ulceration of the superficial mucosa followed by the deeper layers becoming inflamed and the development of noncaseating granulomas which extend through the layers of the intestinal walls into the mesentery and regional lymph nodes.
- Inflammation between ulcers can cause the bowel to take on a “cobblestone” appearance.
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• What are examples of other SI changes that can occur as a result of Crohn's disease?
  – Fistulas, obstruction, abscess formation, malabsorption, micro-perforation, diseased bowel loops may adhere to healthy or other diseased bowel loops
  – Luminal narrowing, scarring and stricture formation can occur
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• What are examples of signs and symptoms of Crohn's’ disease?
  – Acute episodes; abdominal pain, cramping and tenderness (possibly more pronounced in the lower right quadrant), increased bowel sounds (borborygmi), nausea, fever, diarrhea (possibly bloody), flatulence, failure to thrive, weight loss and malnutrition
  – Chronic episodes; abdominal pain, steatorrhea, diarrhea, weight loss, anorexia, nutritional deficits
  – Renal and liver disease, arthritis, clubbing, spondylitis, iritis, and skin involvement may result from chronic disease
How is Crohn’s disease diagnosed?

- History and physical
- Labs; CBC, ESR, serology, CRP, chemistries, $B_{12}$, folate, iron studies
- Upper GI series
- Small bowel x-rays
- Upper and lower GI endoscopy with biopsy
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• How is Crohn’s disease treated?
  – Supportive measures where indicated
  – Dietary modifications; low fiber, high calorie, high protein, vitamin and mineral supplementation, TPN if necessary
  – Small frequent meals
  – Pharmacological therapy; 5-aminosalicylate agents, immune modulators, corticosteroids, antibiotics
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• What are other treatments for Crohn’s disease?
  – Surgery; likely in half of all patients with chronic disease often due to obstruction, perforation, significant hemorrhage, fistulas, abscesses
  – Lifestyle changes;
    • reduce stress, utilize support organizations and groups, treat depression if present
Bibliography

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