## Causes
- **Typical:** *Helicobacter pylori*, NSAIDs, critical illness (SRMD)
- **Atypical:** hypersecretion, viral infections, vascular insufficiency, radiation/chemo, genetic, idiopathic
- **Etiology:** disruption of normal mucosal defense mechanisms, hypersecretion of acid
- **Risk factors:** smoking, psychological stress, diet, chronic diseases

## Complications
- Upper GI bleed, perforation, obstruction (scarring, edema)
- Mortality: gastric ulcers > duodenal ulcers

## Clinical presentation
- **Pain:** epigastric abdominal pain, nocturnal pain, severity in clusters → food helps with pain
- **GI complaints:** heartburn, belching, bloating, nausea, vomiting, anorexia

## Treatment
- **Proton Pump Inhibitors**
  - Omeprazole, esomeprazole, lansoprazole, rabeprazole, pantoprazole, dexlansoprazole
    - **MOA:** bind to H+/K+ ATPase pumps → inhibit active secretion of gastric acid
    - **Admin:** take 30-60 mins before meals; need to take continuously because effects ↑ over 3-4 days; enteric coated or buffered for pH sensitivity
    - **Dosage forms**
    - **SE:** fairly well tolerated overall, headache, nausea, abdominal pain
    - **Contraindications:** sodium bicarb formulations
    - **Interactions:** pH dependent drugs (e.g. calcium, ketoconazole), clopidogrel
- **Histamine, Receptor Antagonists**
  - Cimetidine, famotidine, nizatidine, ranitidine
    - **MOA:** blocks histamine at H2 receptors on gastric parietal cells → inhibits gastric acid secretion
    - **May develop tolerance over time, not recommended for maintenance**
    - **SE:** thrombocytopenia (reversible)
    - **Contraindications:** moderate to severe renal failure may require dose reductions
    - **Interactions:** cigarette smokers may require higher doses, CYP450 (cimetidine), pH dependent drugs
- **Sucralfate** (Carafate)
  - **MOA:** forms protective coating on gastric lining
  - **Admin:** take on empty stomach, many doses per day needed (↓ compliance), taken before meals
  - **SE:** constipation, seizures (especially with Al antacids)
  - **Interactions:** oral fluoroquinolones
- **Misoprostol** (Cytotec)
  - **Prostaglandin E1 analog**
  - **MOA:** replaces protective prostaglandins
  - **Efficacy:** comparable to H2RA or sucralfate
  - **SE:** diarrhea
  - **Contraindications:** pregnancy (also avoid in women who could potentially get pregnant)
- **Bismuth subsalicylate**
  - **MOA:** antibacterial effect, local gastroprotective effect, stimulates prostaglandins
  - **SE:** black stool, black hairy tongue
  - **Contraindications:** elderly, renal failure, salicylate sensitivity
  - **Interactions:** salicylates
- **Antacids**
  - **MOA:** neutralize gastric acid, inactivate pepsin, bind bile salts
  - **Interactions:** interferes with absorption of pH dependent drugs (e.g. enteric coating), need to separate by 2 hours
  - **Aluminum antacids:** interferes with phos absorption (e.g. sucralfate), may cause constipation
  - **Magnesium antacids:** avoid use in CrCl <30mL/min, may cause diarrhea
  - **Calcium antacids:** may cause hypercalcemia and milk-alkali syndrome
**H. pylori induced ulcers**

- **H. pylori**: pH sensitive, gram negative, microaerophilic, spiral shaped, lives between mucus layer & surface epithelial cells
- **Consequences** of H. pylori infection: chronic gastritis, PUD, gastric cancer, MALT lymphoma
  - H. pylori causes mucosal injury through direct mucosal damage, inflammatory response, hypergastrinemia
  - H. pylori enhances carcinogenic conversion of gastric epithelial cells
- **Transmission**: fecal-oral, oral-oral, or gastro-oral
- **Testing**: stool antigen, serologic tests, urea breath test, mucosal biopsy, empiric treatment
- **Treatment regimens**
  - **3 drug regimen**
    - PPI + clarithromycin 500mg bid + amoxicillin 1g bid
    - PPI + clarithromycin 500mg bid + metronidazole 500mg bid
  - **4 drug regimen**
    - PPI + bismuth subsalicylate 525mg qid + metronidazole 250-500mg qid + tetracycline 500mg qid
    - PPI + bismuth subsalicylate 525mg qid + metronidazole 250-500mg qid + clarithromycin 250-500mg qid
  - **Sequential therapy**
    - PPI days 1-10, amoxicillin 1g bid days 1-5, metronidazole 250-500mg bid days 6-10, clarithromycin 250-500mg bid days 6-10

  - **PPIs can be qd or bid**
  - **1st line**: PPI-based 3 drug regimen for 10-14 days (PrevPac easy to use)
    - Do not substitute antibiotics
  - **2nd line**: PPI-based 3 drug regimen with different antibiotic –or– 4 drug regimen
  - **SE**: taste disturbances, N/V/D, abdominal pain, colitis, candidiasis

**NSAID-induced ulcers**

- **Risk factors**
  - **Established**: >60 y/o, previous ulcers or complications, corticosteroid, NSAID, ASA, anticoagulant or coagulopathy, antiplatelet drug, bisphosphonates, SSRIs, chronic illness
  - **Possible**: NSAID dyspepsia, H. pylori, rheumatoid arthritis, alcohol
  - **Questionable**: smoking
- **Nonselective NSAIDs**: indomethacin, piroxicam, ibuprofen, naproxen, sulindac, ketoprofen, ketorolac, flurbiprofen
- **Partially selective NSAIDs**: etodolac, nabumetone, meloxicam, celecoxib, diclofenac
- **Selective COX-2 inhibitors**: rofecoxib, valdecoxib
- **Salicylates**: aspirin, salsalate, trisalicylate
- **Treatment**: R/O H. pylori infection, stop NSAID, start PPI, H$_2$RA, or sucralfate
  - If cannot stop NSAID: start PPI, misoprostol, switch to selective COX2 inhibitor

**Zollinger-Ellison’s Syndrome**

- **Acid hypersecretion** with recurrent peptic ulcers due to gastrin-producing tumor
  - 65% of gastrin-producing tumors are malignant
- **Clinical presentation**: multiple ulcers, recurrent/refractory PUD, esophagitis & ulcer complications, diarrhea, steatorrhea, Vit B$_{12}$ malabsorption
  - PPIs can mask clinical presentation
- **Diagnosis**: serum gastrin >1000 pg/mL, BAO > 15 mEq/hr if intact stomach (>5 mEq/hr if previous gastric surgery), pH<2
- **Treatment**
  - Need to identify and remove tumor
  - Goal: BAO 1-10mEq/hr an hour before PPI dose
  - **PPIs = DOC**
  - **Octreotide**: (-)gastric acid secretion, (-)gastrin release, long-acting repeatable octreotide stabilizes tumor growth
  - Metastatic gastrinoma: surgical resection, chemo