Pathophysiology of the digestive system

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Digestive system overview
Most frequent GI disorders

- Gastritis
- Peptic ulcer disease
- Pancreatitis
- Bowel obstruction

General etiology of GI disorders

Gastroduodenal mucosal integrity is determined by protective ("defensive") and damaging ("aggressive") factors.
Acute Gastritis

Definition

Acute gastritis is a term covering a broad spectrum of entities that induce inflammatory changes in the gastric mucosa.

The different etiologies share the same general clinical presentation. However, they differ in their unique histologic characteristics.

Gastritis: classification

- **Acute Gastritis:**
  - Irritants, drugs, chemicals, alcohol.

- **Chronic Gastritis:**
  - Autoimmune: Pernicious anaemia.
    - Anti-parietal cell & Anti-intrinsic factor AB.
  - Chemical:
    - NSAIDs, Bile reflux, Alcohol.
  - Bacterial:
    - Helicobacter pylori (most common)
Gastritis: Types

- Environmental factors
  - Radiation, smoking
- Diet
  - Alcohol, spicy food
- Pathophysiologic conditions
  - Burns, renal failure, sepsis
- Other factors
  - Psychologic stress, NG tube
Gastritis:
etiology

- Alcohol
- NSAIDs
- Helicobacter
- Stress/ICU associated
- Autoimmune

Acute gastritis:
pathogenesis

<table>
<thead>
<tr>
<th>Exogenous factors</th>
<th>Endogenous factors</th>
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<tbody>
<tr>
<td>Irritants</td>
<td>Uremia</td>
</tr>
<tr>
<td>Drugs</td>
<td>Diabetic coma</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Shock</td>
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<tr>
<td>Aggressive substances</td>
<td>▼ Bloodflow</td>
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Gastritis
Acute Gastritis
Clinical Manifestations

- Anorexia
- Nausea
- Vomiting
- Epigastric tenderness
- Feeling of fullness
- Hemorrhage
  - Common with alcohol abuse
  - May be only symptom

Chronic Gastritis

Chronic gastritis is a histopathologic entity characterized by chronic inflammation of the stomach mucosa.

The epithelial changes may become dysplastic and constitute a background for the development of carcinoma.
Chronic H. Pylori gastritis

- Direct cytopathogenic action (toxins, enzymes)
- Indirect effect pathogenic effect on mucous defense through bacterial lipase and protease
- Urease activity (urea $\rightarrow$ NH$_3$)

Chronic autoimmune gastritis (atrophic)

- Body gastritis
- Atrophy of gastric glands
- Gastric ulcer
- Acid hyposecretion
- Intestinal metaplasia
- Risk of stomach cancer
Evolution of atrophic gastritis

• Pernicious anemia
  ▪ Gastrointestinal
  ▪ Hematologic
  ▪ Neurologic
  syndrome

• Precancerosis
  ▪ Gastric carcinoma appears 3 to 20 times more frequently in patients with atrophic gastritis.

Gastritis: complication

- **Dyspepsia** (particularly alcohol, NSAIDs)
- **Bleeding**
- **Loss of intrinsic factor** (if body involved)
- Decreased gastric acid secretion
- Progression to ulcer
- Progression to cancer/lymphoma
Peptic ulcer disease:
Definition

Defect of gastric or duodenal mucosa which interfere over lamina muscularis mucosae, submucosa or penetrates across whole gastric or duodenal wall
Location and Type of Ulcer:

- Type 1: Primary gastric ulcer. Associated with diffuse antral gastritis.
- Type 2: Gastric ulcers with duodenal ulcers, most likely secondary to duodenal ulcers.
- Type 3: Prepyloric or channel ulcer.
- Type 4: Proximal stomach or gastric cardia.

Acid hyper secretion common among type 2 and 3 ulcers. Type 1 and 4 pathophysiologically the same.
Peptic ulcer disease: Frequencies

- 10% of the world population (6-11% in different sources)
- Men: Women – 7:1
- Duodenal : Gastric – 4:1
- Duodenal ulcer is prevalent in the age group 30-50 (men > women)
- Gastric ulcer is predominant after the age of 40 (morbidity in men and women is equal)

Peptic ulcer disease: Classification:

Acute ulcer (ulcus acutum)
- smooth non-elevated borders and smooth base
- major bleeding into upper GIT

Chronic ulcer (ulcus chronicum)
- rushed and elevated borders, inflammation with hypertrophic and fibrotic proliferation is present
- the most frequent form of ulcer disease
**Etiology of PUD**

**Normal**

**Increased Attack**
Hyperacidity, Zollinger Ellison syndrome.

**Weak defense**
Stress, drugs, smoking
Helicobacter pylori*

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**Peptic ulcer disease:**

**Etiology**

- *Helicobacter pylori* infection*
- Hyperacidity
- Drugs - anti-inflammatory (NSAIDs) & Corticostroids.
- Cigarette smoking, Alcohol,
- Rapid gastric emptying
- Duodenal reflux.
- Personality and stress
- Genetic

*Hurry, Worry, Curry….*!
Pathogenesis of ulcer disease

Gastric Ulcer
- Less common - 1
- Increase with age
- High in high class
- A group common
- Lower acid levels.
- H.pylori – 70%

Duodenal Ulcer
- More common - 3
- Increase upto 35y
- Equal
- O group common.
- Higher acid levels
- H.pylori – 95-100%
Gastric ulcer

- Ulcer of the corpus of the stomach
- Prepyloric ulcer
- Gastric, preceded by duodenal ulcer

The main pathogenetic unit is decreased mucosal resistance of the stomach, and the main pathogenetic factor – hypersecretion of gastric juice.

Symptoms of gastric ulcer disease:

- Epigastric pain after meal or during meal
- Upper dyspeptic syndrome – loss of appetite, nauzea, vomiting, flatulence
- Vomiting brings relief
- Reduced nutrition
- Loss of weight
Duodenal ulcer

- Elevated peptic activity of gastric juice
  - Stress
  - Humoral-hormonal stimuli
  - Increasing the number and sensitivity of gastric parietal cells
- Altered secretory and evacuational capacity of the stomach
- Decreased resistance of duodenal mucosa

Symptoms of duodenal ulcer disease:

- Epigastric pain 2 hours after meal or on an empty stomach or during night
- Pyrosis
- Good nutrition
- Obstipation
- Seasonal dependence (spring, autumn)
A – penetration  
B – perforation  
C – bleeding  
D – stenosis  

Penetrating and perforating ulcers
Lifestyle Changes

- Discontinue NSAIDs.
- Acid suppression—Antacids
- Smoking cessation
- No dietary restrictions unless certain foods are associated with problems.
- Alcohol in moderation
  - Men under 65: 2 drinks/day
  - Men over 65 and all women: 1 drink/day
- Stress reduction

Surgery

People who do not respond to medication, or who develop complications:

- **Vagotomy** - cutting the vagus nerve to interrupt messages sent from the brain to the stomach to reducing acid secretion.

- **Antrectomy** - remove the lower part of the stomach (antrum), which produces a hormone that stimulates the stomach to secrete digestive juices. A vagotomy is usually done in conjunction with an antrectomy.

- **Pyloroplasty** - the opening into the duodenum and small intestine (pylorus) are enlarged, enabling contents to pass more freely from the stomach. May be performed along with a vagotomy.
Pancreatitis is an inflammatory process in which pancreatic enzymes autodigest the gland.

Acute pancreatitis occurs suddenly and lasts for a short period of time and usually resolves.
Acute Pancreatitis: Etiology

- Alcohol abuse
- Gallstones
  - Hyperlipidemia, Hypercalcemia
  - Genetic/Idiopathic
  - Hyperparathyroidism
- Shock, hypothermia.
- Infections - mumps
- Abdominal / surgical trauma
- Drugs: steroids & thiazide
- Peptic ulcer, Carcinoma,
- Snake/insect bite, poisoning.
- Tropical calcific Pancreatitis

Biliary pancreatitis: About 40~60% of cases of pancreatitis are associated with gallstone disease, which, if untreated, usually gives rise to additional acute attacks.

- Bile reflux → pancreatic duct → activate enzymes.
- Obstruction → increased duct pressure → damage pancreatic acinus → destroy gland.
Etiology

Alcoholic Pancreatitis:
Alcohol stimulates gastric acid secretion which increases CCK-PZ (cholecystokinin and pancreozymin) excretion in duodenum and then increases pancreatic secretion.

- Make the sphincter spasm and edema
- Increase duct pressure.
- Direct toxic to pancreas

Hypercalcemia:
Hyperparathyroidism and other disorders accompanied by hypercalcemia are occasionally complicated by acute pancreatitis, it is thought that the *increased calcium concentrations* in pancreatic juice that result from hypercalcemia may *prematurely activate proteases*, they may also facilitate precipitation of calculi in the duct.
Etiology

Hyperlipidemia:
- Pancreatitis seems to be a direct consequence of the metabolic abnormality. During an acute attack usually associated with normal serum amylase levels, because the lipid interferes with the chemical determination for amylase; urinary output of amylase may still be high.

Etiology

Drug-induced pancreatitis:
- Corticosteroids, estrogen-containing contraceptives, azathioprine, thiazide diuretics, and tetracyclines. Pancreatitis associated with use of estrogens is usually the result of drug-induced hypertriglyceridemia.
Acute Pancreatitis - Pathogenesis

**SUMMARY:**
- Lipase → Fat necrosis – Inflammation.
- Protease → Blood Vessel injury – Bleeding.
- Trypsin → Kallikrein → Thrombosis - Necrosis

**Acute pancreatitis clinical manifestations**

- Abdominal distention
- Abdominal guarding
- Abdominal tympany
- Hypoactive bowel sounds
- Severe disease: peritoneal signs, ascites, jaundice, palpable abdominal mass, Grey Turner’s sign, Cullen’s sign, and signs of hypovolemic shock
Grey Turner Sign - Cullen’s Sign

Severe

Mild

Acute Pancreatitis: Common Complications

- Pulmonary
  - Atelactasis
  - Pleural effusions
  - ARDS
- Cardiovascular
  - Cardiogenic shock
- Neurologic
  - Pancreatic encephalopathy
- Metabolic
  - Metabolic acidosis
  - Hypocalcemia
  - Altered glucose metabolism
- Hematologic
  - DIC
  - GI bleeding
- Renal
  - Prerenal failure
Chronic Pancreatitis:

- Painful, relapsing, inflammation, fibrosis & exocrine atrophy.
- Malabsorption, hypoalbuminemia, weight loss,
- Type I DM (if sufficient loss of islets).
- Recurrent Jaundice - gall stone.
- Types:
  - Toxic metabolic- 70%: Alcohol, Hyperlipidaemia, toxins, drugs, hypercalcaemia.
  - Idiopathic-20%: Early/Late.
  - Others: Genetic, autoimmune, Post necrotic.
- Destruction of exocrine pancreas, Fibrosis, cystic ducts remain. (both true & pseudocyst).
- Calcification, lithiasis & Malignant transformation.

Bowel obstruction (Ileus)

- Definitions:
  - Ileus: Mechanical or functional intest. Obstruction (Adynamic or paralytic).
  - Mechanical obstruction: complete or partial blockage of the intestinal lumen.
  - Simple obstruction: one obstructing point.
COMMON CAUSES OF INTESTINAL OBSTRUCTION ACCORDING TO AGE

<table>
<thead>
<tr>
<th>Neonate (0-4 months)</th>
<th>Child (6 months – 15 years)</th>
<th>Young adult (15–40 years)</th>
<th>Middle age (40–60 years)</th>
<th>Elderly (65 years and over)</th>
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<tr>
<td>Congenital aberrations</td>
<td>Intussusception</td>
<td>Meckel’s diverticulum</td>
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<tr>
<td>Vascular necrosis</td>
<td></td>
<td>Bile</td>
<td></td>
<td>Bile</td>
</tr>
<tr>
<td>Meconium ileus</td>
<td></td>
<td>Adhesive</td>
<td></td>
<td>Adhesive</td>
</tr>
<tr>
<td>Imperforate anus</td>
<td></td>
<td>Gas</td>
<td></td>
<td>Gas</td>
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**Intussusception**

- **Normal bowel**
- **Intussusception**

80% of intussusception occur in children under 2 years
Etiology?

- Outside the wall
- Inside the wall
- Inside the lumen

Lesions Extrinsic to Intestinal Wall

- Adhesions (usually postoperative)
- Hernia
  - External (e.g., inguinal, femoral, umbilical, or ventral hernias)
  - Internal (e.g., congenital defects such as paraduodenal, foramen of Winslow, and diaphragmatic hernias or postoperative secondary to mesenteric defects)
- Neoplastic
  - Carcinomatosis, extraintestinal neoplasm
- Intra-abdominal abscess/diverticulitis
- Volvulus (sigmoid, cecal)
Lesions Intrinsic to Intestinal Wall

- Congenital
  - Malrotation
  - Duplications/cysts
- Traumatic
  - Hematoma
  - Ischemic stricture
- Infections
  - Tuberculosis
  - Actinomycosis
  - Diverticulitis
- Neoplastic
  - Primary neoplasms
  - Metastatic neoplasms
- Inflammatory
  - Crohn's disease
- Miscellaneous
  - Intussusception
  - Endometriosis
  - Radiation enteropathy/stricture

Intraluminal/ Obturator Lesions

- Gallstone
- Enterolith
- Bezoar
- Foreign body
Where?

- May occur at any point in length of small bowel

CLASSIFICATION

1. Mechanical obstruction obturation
   obstructoin intestine compression lesions in the intestinal wall

2. Nonmechanical obstruction
   dynamic ileus------>including paralytic ileus
Dynamic vs Mechanical Ileus Obstruction

- Gas diffusely through intestine, incl. colon
- May have large diffuse A/F levels
- Quiet abdomen
- No obvious transition point on contrast study
- Peritoneal exudate if peritonitis
- Large small intestinal loops, less in colon
- Definite laddered A/F levels
- "Tinkling", quiet= late
- Obvious transition point on contrast study
- No peritoneal exudate

Pathophysiology

- Hypercontractility – hypocontractility
- Massive third space losses
  - oliguria, hypotension, hemoconcentration
- Electrolyte depletion
- Bowel distension--increased intraluminal pressure--impedement in venous return-- arterial insufficiency
Local Effects of Obstruction

1. Hyperperistalsis -> abnormal peristalsis
2. Secretion increase and absorption decrease
3. Accumulation of fluids and electrolytes
4. Distension of intestinal lumen
5. Edema of the bowel wall -> anoxemia -> necrosis

Systemic Effects of Obstruction

1. Water and electrolyte losses
2. Toxic materials and toxemia
3. Cardiopulmonary dysfunction
4. Shock
Clinical features

- 1. Abdominal pain
- 2. Vomiting
- 3. Obstipation
- 4. Distention

Partial vs Complete

- Flatus
- Complete obstipation
- Residual colonic gas above peritoneal reflection /p 6-12h
- No residual colonic gas on AXR
- Adhesions
- Early complete from high-grade partial
- 60-80% resolve with non-operative Mx
- Almost all should be operated on within 24h
- Must show objective improvement, if none by 48h consider OR
Thank You