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

Gastrointestinal Mucosal Integrity is Determined by Protective ("defensive") and Damaging ("aggressive") Factors

- Protective Factors:
  - Mucus
  - Blood flow
  - Growth factors
  - Cell renewal
  - PGs

- Damaging Factors:
  - H. pylori
  - Helicobacter
  - Ethanol
  - Acids
  - Ischemia
  - NSAIDs

- Protective:

- Damaging:

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.

**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**

**Exogenous factors**
- Irritants
- Drugs
- Alcohol
- Aggressive substances

**Endogenous factors**
- Uremia
- Diabetic coma
- Shock

↓ Bloodflow   ↓ HCO₃⁻

Gastritis
**Acute Gastritis**

*Clinical Manifestations*

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

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**Chronic Gastritis**

*Definition*

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 → NH₃)

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 syndrome
  - Hematologic
  - Neurologic
- 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
Defect of gastric or duodenal mucosa which interfere over lamina muscularis mucosae, submucosa or penetrates across whole gastric or duodenal wall.

Ulcer disease

Peptic Ulcer Disease
Localisation of ulcers

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)

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**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 boders, 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*
13.4.2016 г.

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
13.4.2016

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

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.
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.
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.

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 0-6 months</th>
<th>Child 6 months – 15 years</th>
<th>Young adult 18-40 years</th>
<th>Middle age 40-60 years</th>
<th>Elderly 60 years and over</th>
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</thead>
<tbody>
<tr>
<td>Congenital absence</td>
<td>Intussusception</td>
<td>Appendicitis</td>
<td>Crohn’s disease</td>
<td>Mesenteric vascular occlusion</td>
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<tr>
<td>Volvulus rectum</td>
<td></td>
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<td>Small bowel tumour</td>
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<tr>
<td>Meckel’s diverticulum</td>
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<td>Gastroenteric tumour</td>
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<td>Imperforate anus</td>
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<td>Hirschsprung’s disease</td>
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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
- Residual colonic gas above peritoneal reflection /p 6-12h
- Adhesions
- 60-80% resolve with non-operative Mx
- Must show objective improvement, if none by 48h consider OR

- Complete obstipation
- No residual colonic gas on AXR
- Early complete from high-grade partial
- Almost all should be operated on within 24h
Thank You