Objectives and learning goal
Objectives

• To study all clinically relevant intra-abdominal infections
• To understand the differences and similarities that exist among the diverse intra-abdominal infections
Learning goal

To develop enough clinical skills to properly manage a patient with an intra-abdominal infection
Contents

- Introduction
- Primary or spontaneous peritonitis
- Secondary peritonitis
- Secondary peritonitis associated with peritoneal dialysis
- Hepatic abscess
- Pancreatic abscess
- Cholecystitis and cholangitis
- Helicobacter pylori-associated peptic ulcer disease
- Key messages
- Further reading
Introduction
Relevance and main features

- Incidence of intra-abdominal infections is difficult to ascertain
- Provoke a significant number of hospital admissions
- Often at the interface of internal medicine and surgery
- In many cases, the internist, gastroenterologist, radiologist, and general surgeon need to coordinate themselves to assure the most favorable outcome
Primary or spontaneous peritonitis
Pathogenesis

- Occurs in patients with **ascites** due to **severe cirrhosis**, and less frequently in ascites due to heart failure, malignancy, or lymphedema
- Bacteria may enter the peritoneal space by:
  - Hematogenous spread
  - Lymphatic spread
  - Migration through the bowel wall
- Factors favoring infections in severe cirrhosis:
  - The reticuloendothelial system of the liver is often bypassed secondary to shunting, increasing the risk of prolonged bacteremia
  - Bowel motility is also slowed, resulting in bacterial overgrowth
Cirrhosis of the liver
Microbiology

• The most common pathogens are enteric bowel flora: *E. coli* and *Klebsiella pneumoniae*
• Also common *Streptococcus pneumoniae* and other streptococci and enterococci
• Rarely *S. aureus*, anaerobes and others
Clinical manifestations

- Initial symptoms and signs may be subtle
- Fever the most common manifestation, initially often low grade
- Abdominal pain diffuse and constant, differs from the usual sensation of tightness with tense ascites
- Development of hepatic encephalopathy
- Diarrhea usually precipitated by overgrowth of bowel flora
- Abdominal tenderness is diffuse and without guarding; in the late stages rebound tenderness may be elicited
Diagnosis

- Paracentesis, 4 samples of ascitic fluid for:
  - Culture, 10 mL inoculated into a blood flask
  - Cell counts and cytology analysis, tube containing anticoagulant
  - Total protein, albumin, LDH, glucose, and amylase levels
  - Gram stain
- Leukocyte count > 250 cells/mm³ with predominance of polymorphonuclears
- Urinalysis leukocyte esterase strips, a reading > 20 indicates acute inflammation and probable infection
- Gram stain is positive in 20-40 % of cases
- High total protein, LDH, and amylase, and low glucose, suggest secondary peritonitis, due to bowel perforation
Treatment and outcome

• Empiric cefotaxime or ceftriaxone, as an emergency
• If secondary peritonitis is suspected, anaerobic coverage with metronidazole should be added
• Mortality 60-70%
• Spontaneous peritonitis is a marker of terminal liver disease, and sufferers should strongly be considered for liver transplant
• Antibiotic prophylaxis, initiated after the first episode with trimethoprim-sulfamethoxazole, oral norfloxacin, or oral ciprofloxacin
Secondary peritonitis
Pathogenesis

- Spillage of bowel flora into the peritoneal cavity
- Causes include:
  - Perforation of a gastric ulcer
  - Appendicitis with rupture
  - Diverticulitis
  - Bowel neoplasm
  - Gangrenous bowel resulting from
    - Strangulation
    - Mesenteric artery insufficiency
  - Pancreatitis
Microbiology

- Stomach perforation $\rightarrow$ infection with mouth flora, including *streptococci*, *Candida* spp., lactobacilli, and anaerobes
- Bowel perforation $\rightarrow$ mixed enteric flora, including:
  - **Anaerobes** such as *Bacteroides fragilis*
  - Aerobic gram-negative bacteria such as *E. coli*, *Klebsiella* spp., *Proteus* spp., and *Enterobacter* spp.
  - Gram-positive bacteria such as *S. viridans*, enterococci, and *C. perfringens*
Peritoneal response to infection

- Rapid and exuberant
- Large quantities of **proteinaceous exudate** are released into the peritoneum → wall off infection → abscesses
- Massive influx of **polymorphonuclears** and **macrophages**
- Massive influx of **fluid** that can result in intravascular fluid losses of 300-500 mL hourly
- Lymphatics clear large numbers of bacteria quickly, but finally bacteria invade the bloodstream
- Host defense may be overwhelmed → metabolic acidosis, tissue hypoxia, shock, multiorgan failure, and death
Clinical manifestations: symptoms

- Anterior peritoneum is richly enervated, and the first manifestation is pain, usually sharp, localized to the site of spillage, and aggravated by motion.
- Loss of appetite, nausea, fever, chills, constipation, and abdominal distension.
- Patients usually lie still in bed, breathing with shallow respirations.
- Generalized abdominal pain, tachycardia, and hypotension develop in the later stages.
Clinical manifestations: signs

- Bowel sounds are decreased or absent
- Abdomen is tender to palpation, with **guarding** and **involuntary muscle spasm**: board-like abdomen
- **Rebound tenderness** (slow compression of the abdomen followed by rapid release of pressure causes severe pain), indicates peritoneal irritation
- Tenderness on rectal examination
- Elderly patients often fail to present with the classic findings of peritonitis
Diagnosis I

- Leukocytosis, 17,000-25,000 per mm$^3$, with left shift
- Supine and upright abdominal X-rays:
  - Free air under the diaphragm (bowel or gastric perforation)
  - Assess the bowel gas pattern
  - Search for areas of thickened edematous bowel wall
- Chest X-ray must always be performed to exclude lower lobe pneumonia, which can cause ileus and upper quadrant tenderness mimicking peritonitis
Free air under the diaphragm
Bowel obstruction, air-fluid levels
Diagnosis II

- CT scan of the abdomen and pelvis, after oral and intravenous contrast, test of choice for suspected intra-abdominal infection:
  - Often obviates the need for exploratory laparotomy
  - Accurate diagnosis of appendicitis
  - Localization and needle aspiration of abscesses
  - Identification of areas of bowel obstruction
- Abdominal examination, vital signs, basic blood analyses, and image tests help in deciding whether an exploratory laparotomy is necessary
Acute appendicitis
Treatment

- Antibiotics emergently initiated in suspected secondary peritonitis: **imipenem**, piperacillin-tazobactam, etc.
- A general **surgeon** should be consulted emergently, exploratory laparotomy is often required for diagnosis, drainage, and bowel repair
- Intraoperative cultures may be helpful
- Peritoneal **irrigation** is performed intraoperatively, and **drains** are placed at sites where purulent collections are noted
- Multiple operations are often required for purulent peritonitis
Secondary peritonitis associated with peritoneal dialysis
Pathogenesis and clinical features

- Frequent complication of chronic ambulatory peritoneal dialysis and the most frequent reason for discontinuation of that therapy
- *S. aureus*, including MRSA, or gram-negative bacteria, fungi, mycobacteria, etc.
- Fever and diffuse abdominal pain
- Peritoneal dialysis fluid becomes cloudy
Diagnosis and treatment

- Peritoneal fluid leukocyte counts > 100/mm$^3$, with a predominance of polymorphonuclears; predominance of lymphocytes in fungal or mycobacterial infection
- Peritoneal fluid gram stain and culture
- Blood cultures
- Antibiotic added to the dialysate, cefazolin, or vancomycin + tobramycin.
- If the patient fails to improve within 48 hours, removal of the dialysis catheter should be considered.
Hepatic abscess
Pathogenesis: sources of infection

• **Biliary tract infection**
• Portal vein bacteremia due to intra-abdominal infections:
  • **Appendicitis**
  • Diverticulitis
  • Inflammatory bowel disease
• Extension from a contiguous infection
  • Perforation of the gallbladder or duodenal ulcer
  • Perinephric, pancreatic, or subphrenic abscess
• Penetrating wounds and postoperative complications
• Bacteremia from any source
• In one quarter of cases, a cause cannot be determined
Microbiology

- Reflects the primary site of infection
- Usually polymicrobial:
  - Microaerophilic streptococci, *S. milleri*, etc.
  - Gram-negative rods: *K. pneumoniae* (particularly K1 serotype)
  - *Candida* spp., in patients with leukemia following chemotherapy-induced neutropenia
  - Amoebic liver abscess, rare, complicates 3-9 % cases of amoebic colitis
Clinical manifestations

- **Fever** with or without chills; a common infectious cause of fever of undetermined origin
- Abdominal pain, often in the right upper quadrant, dull and constant
- Weight loss
- Physical examination:
  - Tenderness over the liver
  - Jaundice is rare
  - Abscess in upper regions of liver, decreased lung breath sounds because of atelectasis or pleural effusion
Diagnosis

• Leukocytosis, over 20,000/mm$^3$, with neutrophilia and increased immature forms
• ↑ serum alkaline phosphatase
• Blood cultures positive in up to half of patients
• Abdominal CT scan, the most sensitive test, shows a discrete area of low attenuation at the abscess site
• Ultrasound is somewhat less sensitive
• Found most commonly in the right lobe
• If a single large abscess is noted, amoeba serology should be ordered
Liver abscess
Liver abscess
Treatment and outcome

- Ultrasound and CT can both be used to guide needle aspiration for culture and drainage
- A finding of brownish fluid without a foul odor suggests amoebic abscess
- Antibiotic therapy identical to that for secondary peritonitis
- Open surgical drainage:
  - Persistent fever after 2 weeks of treatment
  - Biliary obstruction
  - Multiloculated abscesses, other than *Echinococcus granulosus*
  - Highly viscous abscesses
- Nearly 100% of patients are now cured
Pancreatic abscess
Characteristics

- Pancreatitis → release of pancreatic enzymes → tissue necrosis that becomes infected by:
  - Reflux of contaminated bile
  - Hematogenous spread
- Usually polymicrobial
- Ultrasound and CT scan for diagnosis, culture and drainage
- The same antibiotic used for secondary peritonitis
- Open drainage and debridement are usually required
Pancreatic abscess after acute necrotizing pancreatitis
Cholecystitis and cholangitis
Pathogenesis

- Gallstones $\rightarrow$ biliary obstruction $\rightarrow$ ↑ pressure and distension of the gallbladder $\rightarrow$ blood flow compromise and interfere with lymphatic drainage $\rightarrow$ tissue necrosis and inflammation $\rightarrow$ cholecystitis $\rightarrow$ cholangitis

- Infection is not the primary cause of acute cholecystitis and cholangitis, obstruction prevents flushing of bacteria from the gallbladder $\rightarrow$ infection in more than half of all cases
Microbiology

- Organisms of the bowel flora, similar to those in secondary peritonitis
- The most frequently cultured:
  - *E. coli*
  - *Klebsiella* spp.
  - Enterococci
  - Anaerobes
Clinical manifestations

• Charcot triad (fever, right upper quadrant pain, and jaundice)
• Marked tenderness over the liver
• Hypotension suggests gram-negative etiology
• Elderly patients may not complain of pain
• Marked leukocytosis with left shift
• ↑ alkaline phosphatase, gamma-glutamyl transpeptidase, bilirubin, aminotransferases
• Blood cultures frequently positive
Diagnosis and treatment

- Ultrasonography, preferred diagnostic study for:
  - Gallstones
  - Dilatation of the gallbladder
  - Dilatation of the biliary ducts
- CT scan and magnetic resonance imaging
- Endoscopic retrograde cholangiopancreatography (ERCP)
  - Diagnosis
  - Dilatation of sphincter of Oddi, removal of stones, placement of stents, etc.
  - Under antibiotic coverage
  - Avoided in cases of cholangitis → high-level bacteremia
Treatment

- Imipenem, ampicillin + gentamicin, immediately
- Prompt surgical intervention for
  - Gangrenous gallbladder
  - Gallbladder perforation
- Acute cholecystitis: \textit{decompression} of the gallbladder and stone removal with:
  - ERCP
  - Percutaneous drainage
  - Urgent if hypotension, mental confusion, etc.
- Outcome favorable in uncomplicated cases
Gangrenous cholecystitis: markedly distended gallbladder with presence of air fluid level
Helicobacter pylori-associated peptic ulcer disease
Microbiology

- *Helicobacter pylori*
  - Small, curved
  - Microaerophilic gram-negative rod
  - Corkscrew-like motility
  - Closely related to *Campylobacter* spp.
- Survive and multiply within the gastric mucosa
Pathogenesis

- Adheres to gastric mucosa, with pedestals similar to those of enteropathogenic E. coli
- Have urease $\rightarrow$ ammonium ions that buffer the gastric acid
- $H. pylori \rightarrow \uparrow$ inflammatory cells in the lamina propria of gastric wall $\rightarrow$ cytokines $\rightarrow$ ↓ somatostatin levels $\rightarrow$ ↑ gastrin levels $\rightarrow$ peptic ulcers
- $H. pylori \rightarrow$ chronic inflammation $\rightarrow$ aplastic changes in the gastric mucosa $\rightarrow$ gastric carcinomas
Clinical manifestations and diagnosis

- *H. pylori* peptic ulcer:
  - Burning pain several hours after meals, relieved by food
  - Belching, indigestion, and heartburn
- Testing for *H. pylori*, only in symptomatic patients:
  - Urease breath test, patient ingests $^{13}$C- or $^{14}$C-labeled urea, and their breath is analyzed for $^{13}$C or $^{14}$C
  - Stool antigen test
  - Measurement of IgG antibody levels by ELISA
- Endoscopic biopsy:
  - Tested for urease (CLO test)
  - Cultured in selective media, antibiotic sensitivities in refractory cases
  - Silver, gram, or Giemsa stain, and immunofluorescence test
Treatment

- Lansoprazole or omeprazole + amoxicillin + clarithromycin
- Penicillin-allergic, metronidazole can be substituted for amoxicillin
- Sequential therapy: rabeprazole + amoxicillin → rabeprazole + clarithromycin + tinidazole
- Quadruple therapy, one “-prazol” + bismuth + two oral antibiotics (amoxicillin, clarithromycin, metronidazole, tetracycline, etc.)
Key messages
To remember...

Most intra-abdominal infections are produced by bacteria of the intestinal flora, have a similar pathogenesis and must be treated with antibiotics that cover the three main groups of bacteria: gram-positive cocci, gram-negative rods and anaerobes. Drainage is also frequently needed.
Further reading


Preparing the exam

- These slides