Intra-abdominal Infections

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- Peritonitis
- Intra-abdominal Abscess
- Diverticulitis
- Appendicitis
- Antibiotic-Associated Diarrhea
  - *Clostridium difficile*
- Food Poisoning/Traveler’s Diarrhea
- *Helicobacter pylori*
- Pelvic Inflammatory Disease
- Viral
- Parasitic

I.D. 101

Site of Infection?

Organisms at the Site??

ChemoTX with activity against Organisms???

Patient and Disease Specific Factors????

Intra-abdominal Infections

Infections contained within the peritoneum or retroperitoneal space:

- Peritoneal cavity contains:
  - Stomach
  - Jejunum, Ileum
  - Appendix
  - Large intestine (colon)
  - Liver, gallbladder and spleen
- Retroperitoneal space:
  - Duodenum
  - Pancreas
  - Kidneys

Anatomy of the GI Tract

GI microflora depends on the anatomic site!

**Upper Intestine:**
- Staphylococci
- Enterococci
- *E. coli*
- *Klebsiella*
- *Enterobacter*

**Colon:**
- Bacteroides
- *Prevotella*
- *Bifidobacteria*
- *Clostridium*
- *Escherichia coli*
- *Klebsiella*
- *Enterobacter*
- *Staphylococci*
- *Enterococci*

**Stomach:**
- *H. Pylori*
- Lactobacilli

**Jejunum:**
- Streptococci
- Enterococci
- *Staphylococci*
- *Escherichia coli*
- *Klebsiella*
- *Enterobacter*

**Ileum:**
- Streptococci
- Enterococci
- *Staphylococci*
- *Clostridium*
- *Bifidobacteria*
Normal GI Microflora

- **Stomach:**
  - Total bacterial count $10^{10}$ log organisms/g
  - Helicobacter pylori
  - Streptococci
  - Lactobacilli

- **Upper Small Intestine:**
  - Total bacterial count $10^{10}$ log organisms/g
  - Aerobes
    - Streptococci (Enterococci)
    - Staphylococci
    - E. coli, Klebsiella
  - Anaerobes
    - Bacteroides

- **Ileum:**
  - Total bacterial count $10^{10}$ log organisms/g
  - Aerobes
    - Streptococci
    - Staphylococci
    - Escherichia coli, Klebsiella
    - Enterobacter
  - Anaerobes
    - Bacteroides

- **Large Intestine (Colon):**
  - Total bacterial count $10^{10}$ log organisms/g
  - Aerobes
    - E. coli, Klebsiella
    - Enterobacter
    - Streptococci (Enterococci)
    - Staphylococci
  - Anaerobes
    - Bacteroides
    - Clostridium

Peritonitis

**Inflammation of the serous lining of the peritoneal cavity due to:**
- Microorganisms
- Chemicals
- Irradiation
- Foreign body injury

Clinical Symptoms

- Abdominal pain
- Anorexia (N/V)
- Fever (100 to 102 F)
- Abdominal distention and tenderness
- Hypoactive or faint bowel sounds
- Leukocytosis

Peritonitis

- **Normally:** 20 to 50 mL transudate
  - Peritoneal membrane measures approx. 1.7 m²
  - WBC < 300 cells/mm³
  - Protein: <3 g/dL

- **Bacterial peritonitis:** 300 to 500 mL inflow/hr resulting in hypovolemia.
  - WBC > 300 cells/mm³
  - Gram stain + for bacteria

Peritonitis

- **Primary**
  - No focus of disease is evident
  - Bacteria transported from blood stream to peritoneal cavity (Cirrhosis, CAPD)

- **Secondary**
  - Acute perforation of the GI tract (Gastric, Diverticular, Appendix, Gallbladder, Tumor perforations) [66%]
  - Post-operative peritonitis [24%]
  - Post-traumatic peritonitis [10%]

Primary Peritonitis

- Relatively infrequent
- 25% of patients with alcoholic cirrhosis
- 60% of all patients on chronic ambulatory peritoneal dialysis (CAPD) will have at least one episode in 1st year.
- Average incidence in CAPD patients is 1.3 to 1.4 episodes/yr.
- Catheter connecting abdominal cavity to exterior body is a major risk factor.

Peritonitis

- **Common Bacteria:**
  - Escherichia coli
  - Streptococci
  - Enterococci
  - Klebsiella
  - Staphylococci (CAPD patients)
  - Pseudomonas aeruginosa
  - Bacteroides sp.

Intra-abdominal Abscess

- Result from chronic inflammation and often occur without generalized peritonitis.
- Located within peritoneal cavity or visceral organs.
- May range from a few milliliters to a liter in volume.
- Often have a fibrinous capsule and take days to yrs to form.
- Appendicitis is the most common cause.
- Ultrasound or CT scan may be used for evaluation

Clinical Manifestations:

- Symptoms less dramatic than peritonitis
- +/- pain
- +/- fever
- +/- abdominal distention
- **Common Bacteria:**
  - E. coli
  - Klebsiella
  - Enterococci
  - B. fragilis
  - Clostridium

Management of Intra-Abdominal Infections

**Combination of modalities:**

- **Surgical**
  - Prompt drainage of abscess (secondary peritonitis) and/or debridement
  - Resection of perforated colon, small intestine, ulcers
  - Repair of trauma

- **Support of Vital functions:**
  - Blood pressure/ fluid replacement
  - Monitor Heart rate
  - Monitor urine output (0.5 ml/kg/hr)

- **Appropriate antimicrobial therapy**
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| Organisms at the Site? | ChemoTX with activity against Organisms???
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Antibiotic Therapy

Empiric Therapy must include aerobic/anaerobic coverage:

Aerobic and Anaerobic activity:
- Ampicillin/sulbactam (Unasyn)
- Piperacillin/tazobactam (Zosyn)
- Cefotetan (Cefotetan)
- Cefoxitin (Mefoxin)
- Imipenem/cilastin (Primaxin)
- Meropenem (Merrum)
- Moxifloxacin (Avelox)

Antibiotic Therapy

Empiric Therapy must include aerobic/anaerobic coverage:

Anaerobic activity:
- Chloramphenicol (also includes aerobic Gram +/-)
- Clindamycin (also includes aerobic Gram +)
- Metronidazole (anaerobic coverage only)

Aerobic activity:
- Aminoglycosides:
  - Gentamicin, tobramycin (Gram negatives only)
- Beta-lactams:
  - Cefotaxime (Claforan)
  - Ceftriaxone (Rocephin)
  - Aztreonam (Azactam) (Gram negative only)
- Quinolones:
  - Ciprofloxacin (Cipro) (Mostly Gram negative)
  - Levofloxacin (Levaquin) (Gram +/and some anaerobic coverage)

Factors involved in selection:
- Severity of infection, suspected infecting organism(s) and resistance patterns, efficacy, toxicity (renal dysfunction), allergies.

Evaluating response:
- Improvement in 2 to 3 days
- Switch for oral antibiotic therapy

Failure to improve:
- Resistant organisms
- Recurrent surgical infections
- Other infections: (urinary tract infections, pneumonia)

Appendicitis

One of the most common causes of intra-abdominal infections.

Treatment: Both Surgical and Antibiotics
- Normal, inflamed, gangrenous or perforated
- Begin antibiotics before appendectomy is performed
  - Anti-anaerobic cephalosporin (e.g. Cefotetan, Cefoxitin, Piperacillin/tazobactam, Amoxicillin/sulbactam, Imipenem
  - Combination therapy: Aminoglycoside +/- Clindamycin or Metronidazole
- Continue antibiotics for 7 to 10 days if appendix is perforated or gangrenous (Switch to oral equivalents)
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**Antibiotics and GI flora**

- **Broad spectrum antibiotics can change the normal GI flora.**
- Increases in *Candida* or Gram-negative bacteria
- Proliferation of antibiotic-resistant organisms
- Pseudomembranous colitis from over proliferation of toxin-producing anaerobe, *Clostridium difficile*

**Pseudomembranous Colitis**

- *Clostridium difficile* toxin mediated disease
  - Toxin A (major) and B (minor): cause inflammation, necrosis, loss of fluid electrolytes
  - Associated with broad spectrum antibiotics
  - Patients may develop diarrhea after 3 or more days of hospitalization or within 2 months of antibiotic therapy.
  - 3 to 5% of adults are carriers of *C. difficile*
  - Metronidazole (oral) treatment of choice with vancomycin (oral only) +/- rifampin for recurrences.
  - Recurrence in 7 to 20% of patients.

**Peritonitis in CAPD**

- Antibiotics may be given intraperitoneal via the dialysate (exchanges every 4 to 6 hrs)
  - Gentamicin and tobramycin: 8mg/L
  - Clindamycin: 1 to 3 mg/L
  - Penicillin G: 50,000 units/L
  - Cephalosporins: 125 mg/L
  - Ampicillin: 50 mg/L
  - Vancomycin: 30 mg/L
  - Amphotericin B: 3 mg/L
- Duration: 2 to 3 weeks

**Clinical Questions**

- "Recommend dosing for intraperitoneal administration of an antibiotic for a CAPD patient with a Staphylococcus peritonitis?"
- "Recommend an empiric antibiotic treatment for a ruptured appendix?"
Ruptured Appendix

- Immediately begin empiric antibiotic with aerobic and anaerobic coverage and continue following appendectomy.
  - Ampicillin/sulbactam (Unasyn) +/ Aminoglycoside
  - Piperacillin/tazobactam (Zosyn) +/- Aminoglycoside
  - Clindamycin + Ampicillin + Aminoglycoside
  - Ampicillin + Metronidazole
  - Levofloxacin + Metronidazole
  - And many other combinations

Clinical Questions

“What are the antibiotic treatment options for Pseudomembranous colitis?”

Pseudomembranous colitis

FIRST LINE:

- Oral Metronidazole Treatment of Choice:
  - 250 to 500mg PO 4 times per day X 10 days

ALTERNATIVE: (when not responding to Metronidazole or recurrences)

- Vancomycin oral (not absorbed) 125 to 500mg PO 4 times per day X 10 days +/- rifampin 600mg PO BID.
  - Not recommended as 1st line due to concern of vancomycin-resistant enterococci (VRE) spread.

Conclusions

- Intra-abdominal infections demand immediate evaluation based on patient history and presentation.
- Management includes three components:
  - Surgical evaluation
  - Vital Support
  - Appropriate antimicrobial selection
- Antibiotic selection is based on likely source of infection and should always include aerobic and anaerobic bacterial coverage.