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

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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!

Stomach:
- H. Pylori

Upper Intestine:
- Streptococci
- Enterococci
- Staphylococci
- E. coli
- Klebsiella
- Bacteroides

Intestine:
- Bacteroides
- Peptostreptococci
- Clostridium
- Bifidobacteria
- Escherichia coli
- Klebsiella
- Enterobacter
- Streptococci
- Enterococci
- Staphylococci
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- Clostridium
- Bifidobacteria
- Escherichia coli
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Normal GI Microflora

**Stomach:**
- Total bacterial count 0-10⁸ log organisms/g
  - *Helicobacter pylori*
  - Streptococci
  - Lactobacilli

**Upper Small Intestine:**
- Total bacterial count 0-10⁸ log organisms/g
  - Aerobes
    - Streptococci (Enterococci)
    - Staphylococci
    - Lactobacilli
    - *E. coli, Klebsiella*
  - Anaerobes
    - *Bacteroides*

Ileum
- Total bacterial count 10⁹-10¹⁰ log organisms/g
  - Aerobes
    - Streptococci
    - Staphylococci
    - *Escherichia coli, Klebsiella*
    - Enterobacter
  - Anaerobes
    - *Bacteroides*
    - *Clostridium*

Large Intestine (Colon)
- Total bacterial count 10¹⁰-10¹² log organisms/g
  - Anaerobes
    - *Bacteroides*
    - *Peptostreptococcus*
    - *Clostridium*
    - *Bifidobacteria*
  - Aerobes
    - *Escherichia coli, Klebsiella*
    - Enterobacter
    - Streptococci (Enterococci)
    - *Staphylococcus*

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 bowl 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 500mL 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
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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Anatomy of the GI Tract

- GI microflora depends on the anatomic site!

  - Stomach: H. Pylori
  - Upper Intestine: Streptococci, Enterococci, Staphylococci, E. coli, Klebsiella, Bacteroides
  - Ileum: Streptococci, Staphylococci, E. coli, Klebsiella, Enterobacter, Bacteroides, Clostridium
  - Colon: Bacteroides, Peptostreptococci, Clostridium, Bifidobacteria, Escherichia coli, Klebsiella, Enterobacter, Streptococci, Enterococci, Staphylococci

Antibiotic Therapy

*Empiric Therapy must include aerobic/anaerobic coverage!*

- **Aerobic and Anaerobic activity**
  - Ampicillin/sulbactam (Unasyn) *(enterococci)*
  - Piperacillin/tazobactam (Zosyn) *(enterococci)*
  - Cefotetan (Cefotetan)
  - Cefoxitin (Mefoxin)
  - Imipenem/cilastin (Primaxin)
  - Meropenem (Merrem)
  - 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 (Cliform)
    - Ceftriaxone (Rocephin)
    - Aztreonam (Azactam) (Gram negative only)
  - Quinolones:
    - Ciprofloxacin (Cipro) (Mostly Gram negative)
    - Levofloxacin (Levaquin) (Gram +/- and some anaerobic coverage)

Antibiotic Therapy

- **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
  - Depends on presentation of appendix:
    - Normal, inflamed, gangrenous or perforated
  - Begin antibiotics before appendectomy is performed
    - Anti-anaerobic cephalosporin (e.g. Cefotetan, Cefoxitin, Piperacillin/tazobactam, Ampicillin/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.
“Recommend dosing for intraperitoneal administration of an antibiotic for a CAPD patient with a Staphylococcus peritonitis?”

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

“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/subbactam (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.