Update on Treatment of Surgical Infections

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Balance of Factors Normally Prevents Infection

- Bacterial Factors
- Environmental Factors
- Host Defenses

Virulence Factors: Polysaccharide Capsule of *B. fragilis*

Encapsulated = Abscess
Unencapsulated
Microbial Synergy

1 + 1 = 3

Microbial Synergy in “Mixed Infections”

Mortality (%)

Days

Oxidative Killing Mechanisms for Destruction of Microbes

Note: System REQUIRES molecular Oxygen
Diagnosis of Sepsis / Infection

Antibiotic Therapy
Intravenous ABX should be started within 1 hr of recognition of severe sepsis, after cultures obtained.

GRADE 1B/C
Initial empiric ABX should include ≥ 1 drug with activity against likely pathogens.
GRADE 1B

Reassess anti-microbial regimen daily to optimize efficacy
GRADE 1C
Duration of Rx should typically be limited to 7-10 days
GRADE 1D

**Source Control**

Pts with sepsis should be evaluated for focus amenable to source control (e.g., drain abscess, debride necrotic tissue, etc.) as rapidly as possible

GRADE 1C

Once a focus is identified (e.g., abscess, GI perforation, cholangitis, etc.) source controls measures should be instituted ASAP after resuscitation with least insulting intervention

GRADE 1D


# Intra-abdominal Surgical Infections

## Classification of Peritonitis

<table>
<thead>
<tr>
<th>Types of Patients</th>
<th>Primary</th>
<th>Secondary</th>
<th>“Tertiary”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immuno-compromised Pts with Cirrhosis</td>
<td>Relatively “Normal” Patients</td>
<td>Compromised ICU Patients</td>
</tr>
<tr>
<td></td>
<td>Children</td>
<td></td>
<td>MODS / MSOF</td>
</tr>
<tr>
<td>Source of Bacteria</td>
<td>Exogenous</td>
<td>Endogenous</td>
<td>Endogenous</td>
</tr>
<tr>
<td># Bacterial Species</td>
<td>Single</td>
<td>Multiple</td>
<td>Multiple</td>
</tr>
<tr>
<td>“Surgery” Required</td>
<td>Seldom</td>
<td>Usually</td>
<td>Varies</td>
</tr>
</tbody>
</table>

## Defect in GI Tract

<table>
<thead>
<tr>
<th>Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serosa</td>
</tr>
<tr>
<td>Muscular</td>
</tr>
<tr>
<td>Serosa</td>
</tr>
<tr>
<td>Muscular</td>
</tr>
<tr>
<td>Serosa</td>
</tr>
<tr>
<td>Muscular</td>
</tr>
</tbody>
</table>
Role of Aerobes and Anaerobes in a Rat Model of Intra-abdominal Sepsis

- **% Abscess**
- **% Mortality**

### Inoculum into Peritoneal Cavity
- E. coli
- B. fragilis
- E. coli + B. fragilis

Pathogens in Intra-abdominal Infections

<table>
<thead>
<tr>
<th>Aerobes</th>
<th>Anaerobes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>%</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td><em>Bacteroides fragilis</em></td>
</tr>
<tr>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td><em>Enterococcus faecalis</em></td>
<td>Other Bacteroides spp.</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Proteus spp.</td>
<td>Cladosporium</td>
</tr>
<tr>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>Peptostreptococci</td>
</tr>
<tr>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>Peptococcus</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Other streptococci</td>
<td>Propionibacteria</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Other aerobes</td>
<td>Other streptococci</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>Other streptococci</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><em>Peptostreptococcus anaerobius</em></td>
<td>Other streptococci</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>


Surgical Infection Society (SIS) 2002 Guidelines: Antimicrobial Therapy for Intra-Abdominal Infections

1. **Single Agents**
   - AM / SBT
   - CTT
   - CEX
   - ERT
   - IMI / CIL
   - MER
   - PIP / TAZ
   - TIC / AMC

2. **Combination regimens**
   - AMGs (AKN, GENT, NET, TOB) + an antianaerobe
   - AZT + CLIN
   - CXM + MTD
   - CFL + MTD
   - Third/ fourth-generation CEPHs (CPM, CFX, CEF, CTZ, CXD) + an antianaerobe


Note: All bacterial species and antimicrobial agents are listed in the original document. For a comprehensive understanding, refer to the original sources.
Source Control in the Proximal GI Tract: Influence of Anatomic Location

Intra-abdominal Sepsis: Treatment
Correct the primary pathology!!!
- exploratory surgery
  - resect, patch, repair, debride, or drain underlying cause

Aggressive resuscitation and monitoring
  - enormous "third space" fluid losses
Important role for appropriate antibiotics
  - knowledge of pathogens based on origin of bacterial inoculation

"Damage Control" Laparotomy
Focus treatment on immediately life-threatening injuries.
Non-life-threatening injuries can be treated at planned reoperation.
Avoids hypothermia.

Examples:
- Pack liver injuries.
- Delay bowel anastomoses, stoma
- Delay vascular reconstruction IF feasible.
Patients Who May Benefit from Damage Control Approach

Hemodynamically unstable
Coagulopathy
Hypothermia (< 35°C)
Complex and major visceral injuries
Inability to control bleeding
Severe acidosis (<7.30)
Operative time > 90 minutes
Transfusion ≥ 10 U PRBC

Temporary Abdominal Closure

Temporary Abdominal Closure (plastic drape, JP drains, sponge)

Bogota Bag (sterile plastic sheet sewn to skin)

Topical Negative Pressure Therapy (VAC)

Admission Intra-abdominal Pressure in ICU Patients

**Predisposing Factors for IAH after Damage Control Surgery**

Severe abdominal injuries  
Spillage of intestinal contents (massive contamination)  
Intra-abdominal packing for coagulation  
Massive transfusions with bowel edema and/or congestion  
Failure to control bleeding with resultant worsening acidosis and coagulopathy


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**Percutaneous Drainage for Abdominal Compartment Syndrome**


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**ACS Treatment**

**Initial Treatment**  
Treatment of underlying cause  
Supportive care with monitoring  
Optimized fluid resuscitation  
Evacuation of intraluminal contents  
- mechanical or pharmacologic  
Mechanical ventilation  
+/- Vasopressors

**If no response to initial treatment**  
Surgical abdominal decompression  
Neuromuscular blockade + mechanical ventilation  
Dialysis

**Decompressive Laparotomy**

Operating Room  
Bedside in ICU

The “downside” of late STSG closure of open abdomen

Courtesy of CC Cothren, MD, Denver Health Medical Center
Complicated (Severe) Skin and Soft Tissue Infections

Classification of SSTIs

Uncomplicated
- Cellulitis
- Impetiginous lesions
- Furuncles
- Simple abscesses
- Can be treated by surgical incision and drainage alone

Complicated
- Deep soft tissue infections
- May require surgical intervention
  - Infected ulcers
  - Infected burns
  - Major abscesses
- Significant underlying disease state, which complicates response to treatment


Severe* Soft Tissue Infections
(* severe = requires "surgical intervention" to treat)

- Extensive tissue destruction
- High mortality rate
- Mixed aerobic and anaerobic
  - gram-negative and gram-positive bacteria
- Recognize early and treat promptly
  - Surgical Rx: debride all necrotic tissue
  - May require amputation
  - Worry about reconstruction later
Soft Tissue Gas on Radiographs: “Fournier” Gangrene

External Appearances Can Be Deceiving!

Aggressive (appropriate) Debridement is Cornerstone of Soft Tissue Surgical Treatment
Necrotizing Infection of Extremity

Completed Debridement
- often large open wounds

Vacuum-Assisted Wound Closure (VAWC)

Microbiology of Necrotizing Soft Tissue Infections

Polymicrobial most common
- *Staphylococcus aureus*
- Anaerobic streptococci
- Aerobic gram-negative bacilli
- *Bacteroides fragilis*--unusual

Monomicrobial
- *Streptococcus pyogenes*
- *Streptococcus viridans*
- *Clostridium sp.*

Rare monomicrobial
- *Aspergillus*
- *Vibrio vulnificans*

Summary: Management of Surgical Infection

- Surgical infection/ sepsis recognition.
- Initiate antibiotics, resuscitation, and source control early!
- Surgical infections usually polymicrobial.
- Debridement, repair, resection are most important principles of surgical intervention.
- Damage control is not just for trauma.
- High index of suspicion for IAH / ACS.
- Broad applications for negative pressure therapy.

Thank You