

Intraabdominal infections

Appendicitis Diverticulitis **Cholecystitis** Cholangiitis

Acalculous cholecystitis **Purulent** Liver abscess **Peritonitis**

Perirenal abscess **Abscess** Spontaneous bacterial peritonitis

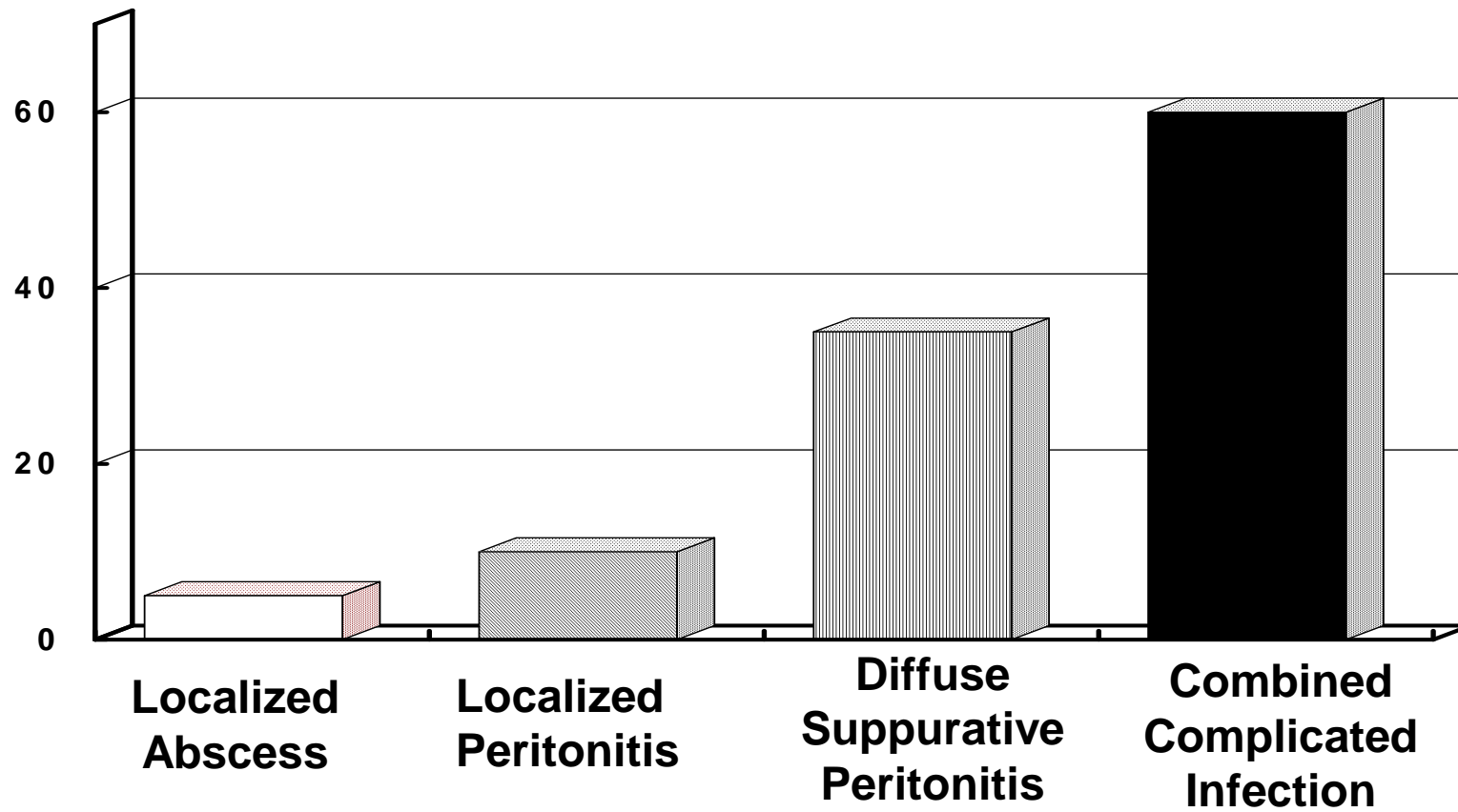
Perforation **Gastroenteritis**

Definition

- An **uncomplicated IAI** does not spread throughout the peritoneum and is limited to a single organ
- A **complicated IAI (cIAI)** is diagnosed when the initial infection has spread into the peritoneal space
 - Complicated IAIs are of major concern because of their high prevalence and their high morbidity and mortality rates.
 - overall mortality rate for IAIs was 10.5 %
 - typically polymicrobial, as the gastrointestinal tract contains a large variety of microorganisms

MORTALITY OF INTRA-ABDOMINAL INFECTIONS

Mortality %



Definition

complicated IAI (cIAI)

- Infections that spread beyond the hollow viscus of origin into the peritoneal space and are associated with:
 - abscess formation or
 - peritonitis
 - primary = spontaneous bacterial peritonitis
 - arises without a breach in the peritoneal cavity or GI tract
 - secondary
 - occurs as a result of spillage of gut organisms through a physical hole in the GI tract or through a necrotic gut wall
 - **may be community acquired or healthcare associated**
 - tertiary
 - peritonitis in a critically ill patient which persists or recurs at least 48 h after apparently adequate management of primary or secondary peritonitis

Microbiology

- Abscesses or secondary peritonitis
 - health care associated intra-abdominal infection usually due to nosocomial organisms particular to the site of the operation and specific hospital and unit
 - community acquired infections
 - *infections derived from stomach, duodenum, biliary system and proximal small bowel:*
 - **Gram positive and Gram negative aerobic and facultative bacteria**
 - *distal small bowel:*
 - **Gram negative facultative and aerobic bacteria**
 - **Anaerobes**
 - *large bowel:*
 - **Facultative and obligate anaerobic bacteria**
 - **Streptococi and enterococci commonly present**
- Tertiary peritonitis
 - coagulase negative staphylococci
 - *Pseudomonas*
 - *Candida*
 - Enterococci

- **Empiric** antimicrobial coverage needs to be adequate for Gram-positive, Gram-negative, aerobic, and anaerobic bacteria.
- Coverage for **anaerobic** bacteria is especially important for infections that originate from the **distal small bowel, appendix, or colon**



Complicated IAI

- The 2010 Surgical Infection Society (SIS)/Infectious Diseases Society of America (IDSA) guidelines for the management of cIAIs identify three distinct treatment categories:
 - low-risk community-acquired (CA),
 - high-risk CA, and
 - healthcare-associated cIAIs.
- **Factors that identify a CA infection as high risk** include
 - Acute Physiology and Chronic Health Evaluation (APACHE) II score greater than 15,
 - extensive cardiovascular disease,
 - poor nutritional status,
 - failure to achieve sufficient source control,
 - immunosuppression,
 - extended length of hospital stay before the operation (≥ 5 days), and
 - extended use of preoperative antimicrobial treatment (≥ 2 days)

The APACHE II Score

Physiologic Variable	High Abnormal Range					Low Abnormal Range			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Rectal Temp (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean Arterial Pressure (mmHg)	≥160	130-159	110-129		70-109		50-69		≤49
Heart Rate	≥100	140-179	110-139		70-109		50-69	40-54	≤39
Respiratory Rate	≥50	35-49		25-34	12-24	10-11	6-9		≤5
Oxygenation a) FIO ₂ ≥0.5 record A-aDO ₂ b) FIO ₂ <0.5 record PaO ₂	≥500	350-499	200-349		<200 PO ₂ >70	PO ₂ 61-70		PO ₂ 55-60	PO ₂ <55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
HCO₃ (mEq/l)	≥52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
K (mEq/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Na (mEq/l)	≥100	160-179	155-159	150-154	130-149		120-129	111-119	≤110
S. Creat (mgm/dl)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	≥50		50-59.9	46-49.9	30-45.9		20-29.9		<20
TLC (10³/cc)	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
GCS									

Age -s score

<44 → 0
45-54 → 2
55-64 → 3
65-74 → 5
≥75 → 6

GCS:

15 → 0	14 → 1	13 → 2
12 → 3	11 → 4	10 → 5
9 → 6	8 → 7	7 → 8
6 → 9	5 → 10	4 → 11
3 → 12		

JAMA 1993;270(24):2957-2963

Clinical features

- difficult to diagnose in the critically ill patient because history is usually unobtainable and physical signs usually masked by decreased conscious level
- consider diagnosis in the appropriate clinical setting in patients with otherwise unexplained signs of sepsis or organ dysfunction:
 - recent abdominal surgery
 - source of arterial emboli
 - peripheral vascular disease
 - thrombotic disorder
 - recent arteriography
 - history of reduced splanchnic blood flow (eg use of vasopressors or prolonged shock)
- unexpected shortness of breath or supraventricular tachycardia occurring 3-4 days after an abdominal operation, new onset renal dysfunction or elevated bilirubin or transaminases should all raise suspicion of intra-abdominal infection

Investigations

- Microbiological
 - Blood cultures
 - often negative
 - polymicrobial or anaerobic bacteraemia should raise possibility of anaerobic infection
 - Community acquired infections: Gram stain of no value
 - Healthcare associated infections: Gram stain may be valuable in defining need for specific therapy *S.aureus* or *Enterococcus* spp.
- Radiological ...

Diagnostic approach to intra-abdominal infection

– AXR

- look for free gas, bowel obstruction, or subtle signs of intestinal ischaemia
- water-soluble contrast studies can show leaks
- injection of contrast into drains, fistulae or sinus tracts may help demonstrate anatomy of complex infections and help monitor adequacy of abscess drainage

– Ultrasound

- advantage of being portable and almost risk-free
- useful for:
 - identifying abscesses and fluid collections
 - guidance of percutaneous drainage procedures
 - detection of free fluid
 - evaluation of biliary tree
- disadvantages:
 - operator dependent
 - difficult to perform in patients who have abdominal dressings or paralytic ileus

– CT abdomen ...

Diagnostic approach to intra-abdominal infection

Abdominal CT

- with use of IV and oral or rectal contrast most causes of secondary peritonitis can be readily diagnosed
- requires movement of potentially unstable patient out of ICU
- relative contraindications:
 - renal dysfunction: contrast may aggravate renal dysfunction
 - paralytic ileus
- a negative CT generally indicates a very low probability of a process that can be reversed by surgical intervention, however bowel ischaemia cannot be excluded, particularly in the early stages

Invasive investigations in ICU

- judicious probing of surgical wounds with sterile culture swab or gloved finger can often identify collections of infected material immediately adjacent to incision
- diagnostic peritoneal lavage
 - may reveal bacteria, white cells, bile or intestinal contents
 - bloody lavage return suggests acute intestinal ischaemia
- bedside laparoscopy ☹
 - difficult
 - experience in critically ill patients largely anecdotal

Management

1. physiological resuscitation
2. systemic antibiotics
3. source control

Antibacterials

- Should be administered as soon as infection is suspected and preferably before surgical intervention (to minimize the risk of surgical wound infection).

Choice of antibacterials for *community acquired* infection

- should be active *against enteric Gram negative aerobic and facultative bacilli and β -lactam susceptible Gram positive cocci*
- for *distal* small bowel and colon-derived infections antibacterials *should cover anaerobes*.
 - Same recommendation also applies to more proximal GI perforations when obstruction is present
- avoid agents used to treat nosocomial infection in the ICU, except for high risk patients
- inclusion of antibacterials that *cover enterococcal infections provides no benefit* in terms of outcome for patients with community acquired infections
- suitable regimes include:
 - **cefazolin or cefuroxime plus metronidazole**
 - **metronidazole plus quinolone (eg moxifloxacin or gatifloxacin)**
- high risk patients should be given antibacterials with a wider spectrum of activity
suitable regimes include:
 - **Piperacillin/tazobactam**
 - **Imipenem, meropenem**
 - **3rd or 4th gen cephalosporin plus metronidazole**
 - **ciprofloxacin plus metronidazole**
 - **aztreonam plus metronidazole**

risk factors:

higher APACHE II
poor nutritional status
significant cardiovascular disease
inability to obtain adequate source control
immunosuppression

Choice of antibacterials for **healthcare associated** infection

- More resistant flora routinely encountered
- Organisms seen are similar to those seen in other nosocomial infections
- Treatment *should be based on knowledge of local nosocomial flora and their resistance patterns*
- Agents which cover enterococci should be used when enterococci are isolated from patients with healthcare associated infections
- Role of antibiotics in tertiary peritonitis is poorly defined
 - little evidence that they significantly alter outcome
 - some recommend the use of narrow spectrum agents based on results of culture and sensitivity and avoidance of agents with anti-anaerobic activity
 - there are some data which suggest that use of antibiotics with anti-anaerobic activity increases gut colonization with *Candida* and vancomycin resistant *Enterococci*.

Duration of therapy

- No more than 24 h for:
 - bowel injuries due to penetrating, blunt or iatrogenic trauma that are repaired within 12 h
 - intraoperative contamination of operative field by enteric contents
 - acute perforations of stomach, duodenum and proximal jejunum in absence of antacid therapy or malignancy
- For patients with established infections:
 - until resolution of signs of infection occurs. This assessment should be based on signs of sepsis and return of GI function
 - if source control is adequate the role of antibiotics is largely adjuvant and the course can usually be restricted to 5-7 days
 - further investigation is indicated or patients with persistent or recurrent clinical evidence of intra-abdominal infection after 5-7 days of therapy

Source control

- Physical measures to eradicate focus of infection, prevent on-going contamination and ultimately to restore optimal anatomy and function
 1. drainage
 2. debridement
 3. definitive management
- Successful source control and antibiotic management is associated with resolution of clinical features of systemic inflammation and reversal of organ dysfunction. Progression or failure of resolution of organ dysfunction suggests persistence of the disease and the need for further intervention

1. Drainage

- formation of an abscess isolates infection from surrounding sterile tissues but has disadvantage of preventing influx of host immune cells and antibiotics
- drainage converts to a controlled sinus or fistula
- percutaneous ultrasound or CT guided drainage is initial intervention of choice for management of localized, radiologically defined infectious foci
- can also be used as a temporizing measure eg. to decompress infected retroperitoneal collections in patients with necrotizing pancreatitis so operative intervention can be delayed until it is safer
- indications for surgical drainage:
 - failure of percutaneous drainage
 - collections with a significant solid tissue component requiring debridement
 - simultaneous management of a source of ongoing contamination
 - when local peritoneal defences have not contained the infectious focus, resulting in generalized peritonitis



2. Debridement

- in contrast to drainage which removes the liquid component of an infection, debridement is the physical removal of infected or necrotic solid removal
- debridement less frequently required in patients with intra-abdominal infection
- main indications in this setting:
 - intestinal infarction
 - infected peripancreatic necrosis
- decision of when to operate relates to relative risks and benefits.
 - Thus the benefit of early excision of necrotic bowel vastly outweighs the risks.
 - In contrast, the bacterial burden in infected retroperitoneal necrosis is lower and the organisms sequestered in the necrotic tissue are less able to gain access to the circulation.
 - In addition early exploration is difficult because of poor demarcation between viable and non viable tissue.
 - As a result there is a trend to delayed rather than immediate intervention

Diverticulosis

- Diverticulosis is extremely common, affecting 50-80% of people older than 80 years
- Complications
 - Acute diverticulitis
 - Bleeding
 - Perforation

Stages of diverticulitis	
Stage I	Small, confined pericolic abscess
Stage II	Distant abscess (retroperitoneal or pelvic)
Stage III	Generalized supportive peritonitis from rupture of abscess (noncommunicating with bowel lumen)
Stage IV	Fecal peritonitis caused by free communicating perforation

Diverticulitis - Treatment

- Outpatient vs. Hospital admission
 - Need for narcotics to control pain
 - Presence of peritoneal signs
 - Comorbidities, signs of sepsis
 - Inability to tolerate oral liquids
 - Complications that may potentially require surgical intervention
 - Abscess
 - peritonitis
- Outpatient
 - Broad-spectrum AB that *covers Gr- rods and anaerobes*, eg.:
 - **Trimethoprim/sulfamethoxazole**
 - **Cipro+metronidazole**
 - **Clindamycin+gentamycin**
 - Clear liquid diet
 - Close FU
- In hospital ...

Diverticulitis

In-hospital Treatment

- Iv hydration
- Electrolyte correction
- Bowel rest (nothing per mouth)
- Iv broad spectrum AB
 - **Ampicillin+/-aminoglycoside+/-metronidazole**
 - **Carbapenems for more severe cases**
- Pain, fever, WBC are to diminish in few days
- Dietary intake can be advanced gradually
- *If fever or pain persists look for complications*
 - Abscess
 - Stricture
 - obstruction

Acute diarrhea

- 90% of acute diarrhea is infectious
- Presence of blood would suggest an invasive bacterial infection
 - Enteroinvasive or haemorrhagic E.coli
 - Campylobacter
 - Shigella
 - Salmonella
- If leukocytes are present in stool it is suspicious for
 - Salmonella
 - Shigella
 - Yersinia
 - Enteroinvasive or haemorrhagic E.coli
 - Clostridium diff
 - Campylobacter
 - Entamoeba histolytica
- The majority of diarrheas are viral and self-limited

Traveller's diarrhea

Bacteria	Viruses	Parasites
E.Coli (all types)	Rotavirus	Giardia lamblia
Salmonella	Norovirus	E. histolytica
Shigella		Cryptosporidium parvum
Vibrio non-cholera		
Campylobacter		

Symptom occurrence after eating a salad containing mayonnaise

Within 6 hours	S. aureus
8-12 hours	Clostridium perfringens
12-14 hours	E. coli



Treatment

Prevention

Ciprofloxacin 2x500 mg 1-2 days

Azithromycin single 1000 mg (10 mg/kg in children) - pregnant

Postoperative fever

- Most common postop complication
- 50% after major surgeries
- Typically resolves spontaneously
- If occurs within 36 hours post laparotomy
 - Bowel injury with leakage of GI content into the peritoneum
 - Invasive soft-tissue wound infection
 - B-haemolytic Streptococci – HD instability, shock
 - Clostridium
 - Toxic shock syndrome – Staph.aureus

Postoperative fever

Wind (pneumonia)

Water (UTI)

Wound (SSI)

Walk (DVT)

Wonder drugs (drug fever)



Onset	Infectious	Noninfectious
Intraop up to 24h postop	Preexisting Urinary catheter Intraop leakage Invasive soft-tissue Toxic shock sy	Surgical trauma Medications Blood products (during transfusion) Malignant hyperthermia
1 day to 1 week	UTI Pneumonia SSI Catheter related Cellulitis	AMI Alcohol/drug withdrawal Pancreatitis PE Thrombophlebitis Benign postop fever
1-4 weeks after	SSI Thrombophlebitis Pseudomembr colitis Device related Abscess	Medication toxicity DVT/PE
> 1 month	Transfusion hepatitis IE SSI Device related Vascular graft inf	Postpericardiotomy syndrome

Type of surgery ~ fever

- Laparoscopy – less fever
- Cardiothoracic – pleural effusion → pneumonia
- Abdominal – deep abdominal abscess, pancreatitis
- Gynecological – deep pelvic abscess, pelvic thrombophlebitis
- Genitourinary – UTI
- Neurosurgery – meningitis, DVT