

Surgical Infections

UTCHS
Department of Surgery

Double Edged Sword

- **Appropriate use**
 - prevent infection
 - eradicate infection
- **Inappropriate use**
 - organ injury
 - superinfection
 - resistant organisms

Adverse Events

Harvard Medical Practice Study II

- 30,195 hospital records
- 1,133 patients (3.7% disabling injuries)
- Drug complications most common type

Impact of ADE's

- **Linear regression (LOS & Cost):**
ADE = 1.9 days, \$ 2,262 (p < .001)
- **Logistic regression (mortality)**
= 1.88 (C.I. 1.54 - 2.22; p < .001)

Complication

ADE's in 2.43 Per 100 Admits

	ADE	Controls	p-Value
Mortality (%)	3.5	1.05	< .001
LOS (days)	7.49	4.46	< .001
Cost (\$)	10,010	5355	< .001

Drug-Related Adverse Events

Drug Class	Weighted %
Antibiotic	16.2
Antitumor	15.5
Anticoagulant	11.2
Cardiovascular	8.5
Antiepileptic	8.1
Diabetes	5.5
Antihypertensive	5.0
Analgesic	3.5

Leape, et al., NEJM 1991

Preoperative Antibiotics

- Usually IV, but consider oral antibiotics and "mechanical" cleansing for colon
 - frequently use combination
- Continue antibiotics if already infected
- Consider source of contamination
 - i.e. skin vs. GI tract
- Topical - Ineffective
- Don't use if continued contamination
 - i.e. trach, foley, central line, burns

Types of Infections

- **Cellulitis (skin) well-demarcated**
 - Clostridium
 - Streptococcus
- **Abscess (superficial)**
 - above waist - Staph
 - below waist - mixed flora

Necrotizing Soft Tissue Infection - Clostridial Myonecrosis -

- No erythema
- Mild swelling
- Thin exudate
- Crepitus
- Hyperesthesia
- Gangrene
- Lack of well-demarcated boundaries (vs. cellulitis)

Necrotizing Soft Tissue Infection - Non-Clostridial Myonecrosis -

- Dishwater to purulent drainage
- Mild erythema
- Swelling
- Gangrene
- Bullae
- Crepitus
- SQ ± fascia ± muscle > skin

Treatment

- **Cellulitis**
 - Above waist - cephazolin
 - Below waist - Unasyn, Zosyn, etc.
- **Skin Abscess**
 - I & D then above

Treatment

- **Clostridial myonecrosis**
 - OPERATIVE DEBRIDEMENT
 - PCN G + Clindamycin or 3rd generation cephalosporin + clindamycin
- **Non-clostridial myonecrosis**
 - OPERATIVE DEBRIDEMENT
 - Broad spectrum- Unasyn, Zosyn, etc.

Superficial Wound Infection

- Usually staph/strep
- May include organisms from entered organ
- Routine culture not helpful or indicated
- Treatment is to OPEN WOUND
- No antibiotics unless accompanying cellulitis

Post-Operative Fever Chronology

DAY	CAUSE
1-7	"Wind" (atelectasis)
~ 3	"Water" (UTI)
~ 5	"Wound" (superficial wound infection), "Walk" (DVT)
~ 7	"Wonder Drug" (antibiotics), Intraabdominal abscess

Definitions

- All post op infections in site of surgery are "surgical site infections"
 - Superficial
 - Skin
 - Subcutaneous tissue
 - Deep incisional – fascia and muscle
 - Organ space
 - Intraabdominal
 - Empyema
 - Mediastinitis

Infection Factors

- Virulence and # bacteria
 - Strep, clostridia (exotoxins)
 - need smaller inocula
 - Gram negative (endotoxins)
 - systemic effects
- If inocula $> 10^5$ – usually get infection

Local Wound Risk Factors

- Foreign bodies
- Poor approximation of tissue
- "Strangulation" of tissue with sutures, etc.
- Hematoma
- Seromas

Patient Risk Factors

- Extremes of age
- Low blood flow, i.e. shock, PVD
- ? Hypothermia
- Uremia, steroids
- Cancer
- Trauma
- Malnutrition
- Long preoperative hospital stay
- Diabetes

Wound Classification

- **Clean**
 - non trauma
 - no GI, GU, or respiratory tract involvement
 - 1.5 - 2.9% Infection incidence
- **Clean – contaminated**
 - GI or respiratory tract cut without significant spillage
 - Oropharynx, vaginal, biliary, or GU (non infected)
 - Minor technical break
 - 2.8 - 7.7% infection incidence

Wound Classification

- **Contaminated**
 - Major technical break
 - 6.4 - 15.2% Infection incidence
- **Dirty**
 - Trauma
 - GI with gross spillage
 - GU/biliary with Infection
 - 7.1 - 40% Infection incidence

Operative Management

- **Debride dead tissue**
- **Don't close infected wounds**
 - must cover vessels, bone
- **Monofilament suture better than braided**
 - 1,000,000 staph needed for Infection if Injected
 - 10 staph needed if silk suture present

Operative Management

- **If large space (hematoma or seroma potential) use a CLOSED suction drain**
- **Solution to pollution is dilution**
- **Consider delayed primary closure**

CDC Criteria

- **Superficial incisional SSI**
 - Within 30 days
 - Pus, organisms
- **Deep incisional SSI**
 - Within 30 days
 - Pus, dehiscence, x-ray
- **Organ / Space SSI**
 - Within 30 days
 - Pus, organisms from organ space, x-ray

www.cdc.gov

Guideline Resources

- www.east.org
- www.guidelines.gov
- www.cdc.gov
- www.surgicalinfection.org
- www.sccm.org

Evidence Rating Scheme

Level I	large RCT or meta-analysis
Level II	small RCT
Level III	cohort studies
Level IV	case control studies
Level V	uncontrolled studies
Level VI	conflicting evidence favoring recommendation
Level VII	expert opinion

Evidence Rating Scheme

- **Category A**
 - Levels I - III
- **Category B**
 - Levels IV - VI
- **Category C**
 - Level VII

Gastroduodenal Surgery

- Prophylaxis for patients at high risk (↑ pH, obstruction, bleeding, cancer).
When lumen entered → single dose cefazolin at induction
- Strength of evidence = A

Biliary Tract Surgery

- Single dose cefazolin at induction for open procedures
- Strength of evidence = A
- Prophylaxis not recommended for laparoscopic cholecystectomy
- Strength of evidence = B

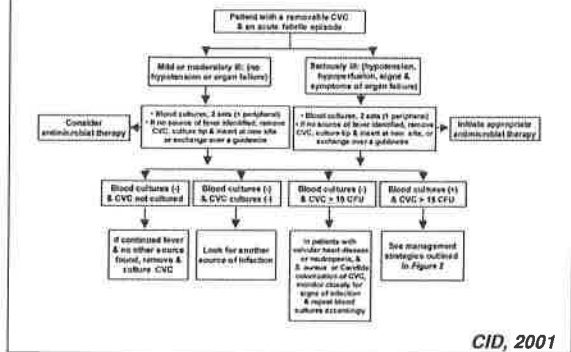
Appendectomy

- For uncomplicated appendicitis, single dose cephalosporin (aerobic plus anaerobic: cefotetan, cefoxitin) at induction
- Alternative is metronidazole plus gentamicin
- Strength of evidence = A

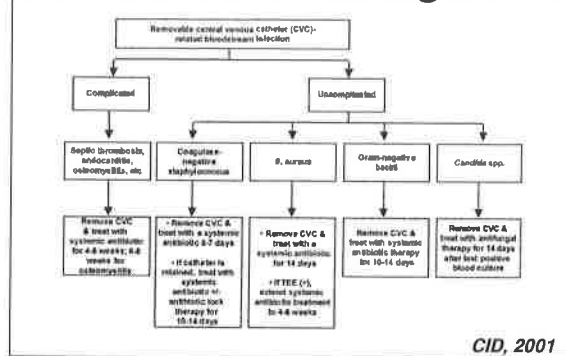
Colorectal Surgery

- Mechanical bowel preparation
- Oral neomycin sulfate (1g) and erythromycin base (1g) following bowel prep at 19, 18, and 9 hours before surgery
- Single 2g dose of cephalosporin (cefotetan, cefoxitin) at induction
- Strength of evidence = A

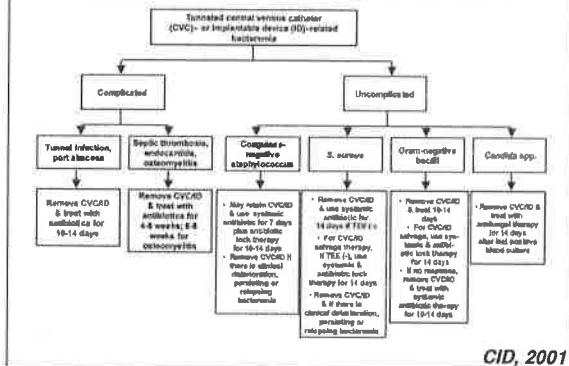
Nontunneled CVC Infection



CVC Infection Management



Tunneled CVC Infection



Penetrating Abdominal Trauma

- Single pre-op dose (aerobic & anaerobic)
 - absence of hollow organ injury requires no further administration
 - continuation for only 24 hours with hollow organ injury
- Strength of evidence = A

Infectious Complications

Risk Factors

- Organ injury
- Hemorrhage and shock
- Degree of injury

Antibiotic Choice

- Cover colon flora
 - 20% have colon injury
- No specific agent / combination superior
- 2nd & 3rd generation cephalosporins
- Aminoglycoside / anaerobe specific
- Advanced spectrum penicillins

Rates of Infection After Antibiotic Regimen

Regimen	# Pts.	# (%) inf.
Aminoglycoside, cephalothin	97	25 (26)
Cefamandole	229	45 (20)
Doxycycline, penicillin	81	16 (20)
Aminoglycoside, clindamycin	878	122 (14)
Cefoxitin	578	80 (14)
Aminoglycoside, metronidazole	80	10 (13)
Carbencillin	90	11 (12)
Cefotaxime	368	35 (10)
Moxalactam	278	20 (7)

Dellinger, RID 1991

Antibiotic Utilization

Duration of Administration

- Prolonged → toxicity, resistance, costs
- Short → higher infections?
- Prolonged for high risk?

Infection Rate & Duration of Antibiotic Administration

Duration	# Patients	# (%) Infected
≤ 24 hours	572	71 (12)
2 days	652	61 (9)
3 days	431	70 (16)
5 days	568	77 (14)
7 days	174	16 (9)

Dellinger, RID 1991

Major Infection Rates

Group	1 Day (118)	5 Day (117)
Total (%)	14	15
Colon (%)	5	1
ATI ≤ 25 (%)	17	30
ATI > 25 (%)	8	10

Fabian, et al., Surgery 1992

Duration of Therapy - abdominal infection -

- Should be set at initial intervention based on operative findings
- Limited to 5 (Level 2) to 7 (Level 3) unless impossible to achieve source control
- Clinical signs of infection after 5 days should prompt diagnostic intervention, not continuation of antibiotics

Antibiotics - abdominal infection -

Single Agents	Combo Agents
cefoxitin	amino + antianaerobe
cefotetan	cefuroxime + metro
amp/sulbactam	3rd gen cef + antianaerobe
ticarcillin/clav	ztreonam + clinda
plp/tazo	clproflox + metro
Imipenem	
meropenem	

None is superior (Level 1)

High Risk Patient - abdominal infection -

Age
Nutrition
Comorbidities
APACHE II

All associated with Tx failure & death (Level 1)

Routine addition of amino no indicated (Level 2)

Empiric antifungal Tx reasonable (Level 2)

Risks for Fungal Infections

	N	%
Broad spectrum atb.	201	26
Cancer	168	21
AIDS	108	14
Leukemia/Lymphoma	103	13
Diabetes	81	10

Ann Pharmacother, 1994

Summary

- More is not better
- Prophylaxis never more than 24 hours
- CVC infection = line removal
- ATB > 24 hours not indicated for PAT
- Empiric Tx based on most likely organisms