Preventing Surgical Infections

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June 3, 2002 13:30-15:00
Medicine Residents' Half-Day

How to Reach Me

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Objectives

- To help you understand the art and science behind choosing preoperative antibiotics
- To identify the differences between routine surgical prophylaxis and unique surgical prophylaxis

Clinical Scenario

- 36 year-old man
- progressive MS
- referred by orthopaedics service for ?
- preoperative antibiotics (O.R. scheduled tomorrow) seems the best question to answer

Clinical Scenario
History

- diagnosed with MS 5 years ago
- has had several acute flairs, including 2 episodes of optic neuritis treated with pulse corticosteroids
- long-standing urinary retention, left arm tremor
- intermittent self-catheterization
- has had recurrent urinary tract infections

Clinical Scenario
History

- no other medical problems
- NKDA
- has been taking cephalexin x 21 days for an infected heel ulcer with mild leg cellulitis
- scheduled to undergo elective lumbar surgery (discectomy)

Clinical Scenario
Physical Examination

- looks generally well and medically stable
- H&N, resp, cardiac and abdominal exams normal
- left CN VI palsy
- lower limb spasticity; power 3/5 on left and 4/5 on right
- diminshed vibration and joint position sensation on left
- cerebellar left arm tremor
- mild coccygeal skin erythema from decubitus pressure, but no overt skin breakdown
- no evidence of active cellulitis (i.e. clinically healed)

Clinical Scenario
Investigations

- CBC, electrolytes, renal function normal
- Urinalysis: 2+ WBCs and 1+ RBCs

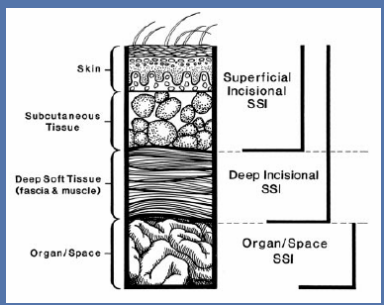
Clinical Scenario

What are your recommendations?

Q: What is a surgical site infection (SSI)?

- Superficial SSI:
  - within 30 days post-op
  - involves only skin and/or subcutaneous tissue
- Deep SSI:
  - within 30 days post-op (if no implanted device) or within 1 year post-op (if implanted device)
  - involves deep soft tissues (e.g. muscle, fascia) +/- (skin and/or subcutaneous tissue)
- Organ/Space SSI:
  - within 30 days post-op (if no implanted device) or within 1 year post-op (if implanted device)
  - involves any part of the anatomy (other than the incision) manipulated during the surgery

Q: What is a surgical site infection (SSI)?



Pathogenesis of SSIs

1. presence of (potentially) pathogenic flora on skin, mucous membranes, or hollow viscus*
2. incision
3. introduction of microbes to usually sterile site

* surgical personnel and the operative environment (including instruments) can also serve as a source of pathogens

Co-factors of SSIs

SSI risk

= patient factors x surgical factors

= (microbial load x virulence) x (surgical technique x surgical time)
host resistance

Co-factors of SSIs
Patient factors

- microbial load
- microbial virulence
- host resistance

Co-factors of SSIs
Patient factors - Microbial load

- risk of infection has been shown to increase with bacterial load
- pre-op shaving increases surface bacterial load
- bacterial load is progressively higher in higher surgical wound classes

Co-factors of SSIs
Patient factors - Microbial load

I Clean (<2%)
- uninfected, uninflamed
- resp/GI/genital/uninfected GU tract not breached

II Clean-contaminated (2-4%)
- resp/GI/genital/uninfected GU tract entered under controlled conditions
- includes biliary tract, vagina, appendix, oropharynx

III Contaminated (7-10%)
- open, fresh, accidental wounds OR
- major break in technique OR
- GI tract spillage

IV Dirty (10-40%)
- old wounds with infected tissue OR clinically infection OR
- perforated viscus

Co-factors of SSIs
Patient factors - Microbial virulence

- all organisms have the potential to produce SSI
- not all organisms have the same potential to produce SSI
  - the presence of S. aureus in nares is associated with increased risk of SSI
  - eradication of S. aureus in nares reduces the risk of SSI in cardiac surgery
- relatively non-pathogenic organisms (e.g. CNSt, diphtheroids) are especially pathogenic to prosthetic devices

Co-factors of SSIs
Patient factors - Host resistance

- poor **glycæmic control** (both pre-operative and post-operative) has been associated with risk of SSI
- poor **vascular supply** to the surgical site increases risk of SSI
  - this has been best shown in sternotomy infections following bilateral internal mammary artery grafting of coronary arteries
- there is no good data confirming **steroid use** as a risk factor for SSI
- **malnutrition** has been shown to be an independent risk factor for SSI
  - trial evidence has repeatedly failed to show a benefit of TPN in preventing SSI

Co-factors of SSIs
Surgical factors

- risk of infection varies with surgeon and institution
- reasons for some surgeons having a lower operative infection risk are largely speculative
- controlling for patient factors and surgery type, O.R. time is the most important determinant of infection risk

Principles of pre-operative antimicrobial prophylaxis

- contaminated and dirty wounds require "therapy" not "prophylaxis"
- high-risk surgeries can be identified
- the potential source and organisms of wound infection can be identified
- antibiotics can sterilize the source of wound infection (i.e. must be bactericidal)
- the benefit of pre-operative antimicrobial prophylaxis outweighs the risk of institutional drug resistance

Principles of pre-operative antimicrobial prophylaxis

- contaminated and dirty wounds require "therapy" not "prophylaxis"
- however, if all infected tissue is removed, further therapy is usually unnecessary

Principles of pre-operative antimicrobial prophylaxis
"High risk"

- at a certain (usually unknown) point, the risk of infection becomes less than the combined risk of
  - individual adverse event (e.g. allergic reaction)
  - institutional risk of drug resistance
- all "clean-contaminated" surgeries are considered high risk
- some "clean" procedures are also high risk
  - vascular prosthetic material insertion
  - prosthetic joint insertion
  - cardiac surgery
  - pacemaker infection
  - arterial graft surgery
  - neurosurgery

Institutional risk of drug resistance
The case of vancomycin

- this has long been an argument against vancomycin as surgical prophylaxis
- vancomycin was also much more expensive than cefazolin prior to coming off-patent in the late 1990s
- a recent decision analysis looking at CABG gave the following results:
  - vancomycin = base case
  - cefazolin → 7% more SSIs, 1% more deaths, US $117/procedure
  - placebo → 42% more SSIs, 3.6% more deaths, US $888/procedure
- there has been no sufficient decision model accounting for the risk of developing drug resistance

*Emerging Inf Dis 2001;***7**:820-7

Principles of pre-operative antimicrobial prophylaxis
"Low risk"

Low Risk

- varicose vein surgery
- cardiac catheterization
- most dermatologic and plastic surgery
- arterial puncture
- thoracentesis
- paracentesis
- lumbar puncture

Controversial

- breast surgery
- herniorraphy
- other clean surgery

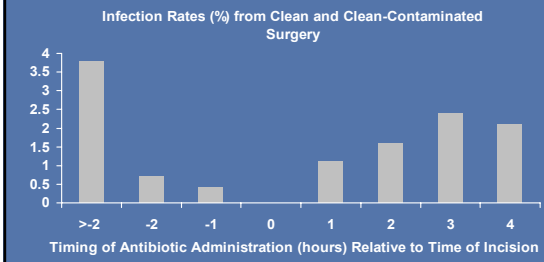
Principles of pre-operative antimicrobial prophylaxis
Pathogens

S. aureus, CNSt
- all grafts, implants, prostheses
- neurosurgery
- breast surgery
- vascular surgery

S. aureus, CNSt, GN bacilli
- orthopædic surgery
- cardiac surgery
- thoracic surgery

GN bacilli, anaerobes
- appendectomy
- biliary tract
- gastroduodenal (also has streptococci)
- colorectal
- OB/GYN (also has Group B strep, enterococci)

Antibiotic prophylaxis is most effective when given shortly before incision



N Engl J Med 1992;**326**:281-6

Don't bother giving post-operative antibiotics

- because infection is usually introduced from peri-incisional flora, there is little theoretical benefit from post-operative antibiotics
- most published studies included 1-2 post-op doses of antibiotic
- a meta-analysis looking at appendectomies showed no additional benefit from multi-dose antibiotics over single-dose pre-op prophylaxis

Cochrane Database Systematic Reviews 2001; **2**

Don't bother arguing with surgeons about post-operative antibiotics (e.g. cardiac surgery)

Postoperative antimicrobial prophylaxis regimens

	Overall results	British Columbia	Alberta	Sask	Manitoba	Ontario	Quebec	NB	Nova Scotia	Nfld
Postoperative prophylaxis	97% (32/33)	100% (4/4)	100% (2/2)	100% (2/2)	100% (2/2)	100% (9/9)	100% (11/11)	100% (1/1)	100% (1/1)	0% (0/1)
Regimen (n)*										
Ampicillin 1 g every 6 h	1	–	–	–	–	–	1	–	–	–
Cefazolin										
Total	33	4	2	2	3	10	9	2	1	–
0.5 g every 6 h	1	–	–	–	–	1	–	–	–	–
1.0 g every 6 h	1	–	–	–	–	–	1	–	–	–
1.0 g every 8 h	23	2	1	2†	2	8‡	6	1§	1	–
2.0 g every 8 h	6	–	1	–	1	1‡	2	1§	–	–
2.0 g every 12 h	1	1	–	–	–	–	–	–	–	–
3.0 g every 6 h	1	1	–	–	–	–	–	–	–	–
Cloxacillin										
Total	2	–	–	–	–	–	2	–	–	–
1.0 g every 4 h	1	–	–	–	–	–	1	–	–	–
1.0 g every 6 h	1	–	–	–	–	–	1	–	–	–
Vancomycin										
Total	2	–	–	–	–	–	2	–	–	–
0.5 g every 8 h	1	–	–	–	–	–	–	–	–	–
1.0 g every 12 h	1	–	–	–	–	–	1¶	–	–	–

*Some institutions reported more than one postoperative prophylaxis regimen; †Cefazolin 2 g administered once patient was off cardiopulmonary bypass; ‡Cefazolin 1 g for body mass index less than 30, cefazolin 2 g for body mass index 30 or greater; §Cefazolin 1 g every 8 h for patients weighing less than 100 kg, cefazolin 2 g every 8 h for patients weighing 100 kg or greater; ¶Patients with valve replacements

*mean duration of prophylaxis is 36h *Can J Infect Dis* 2002; **13**:21-27

Generally recommended antimicrobials for preoperative prophylaxis

- all grafts, implants, prostheses
- neurosurgery
- breast surgery
- vascular surgery
  - cefazolin
  - vancomycin

- orthopædic surgery
- cardiac surgery
- thoracic surgery
  - cefazolin
  - cefuroxime
  - vancomycin

- appendectomy
- biliary tract
- gastroduodenal (also has streptococci)
- colorectal
- OB/GYN (also has Group B strep, enterococci)
  - cefotetan
  - cefazolin + metronidazole

Procedures/Surgeries and Prosthetic Joints

- prosthetic joints are almost always infected at the time of surgery
- rarely, systemic bacteræmia can result in seeding a prosthetic joint
- oral organisms rarely cause prosthetic joint infection
- despite lack of evidence, the ADA and American Academy of Orthopaedic Surgeons recommend giving antibiotics for
  - long procedures
  - surgery in an infected area
  - other procedures with a high risk of bacteræmia
- there is generally no need to worry about infected prosthetic joints during dental, GI or GU procedures