SURGICAL SITE INFECTIONS AND ANTIBIOTIC SURGICAL PROPHYLAXIS

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*Lecture is based on Up To Date (*www.uptodate.com)

1. INTRODUCTION

- Among surgical patients, SSIs account for 38 percent of nosocomial infections.
- CDC has developed criteria that define SSI as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 90 days if prosthetic material is implanted at surgery

2. CLINICAL CRITERIA FOR DEFINING SSI

include one or more of the following :

- A purulent exudate draining from a surgical site
- A positive fluid culture obtained from a surgical site that was closed primarily
- A surgical site that is reopened in the presence of at least one clinical sign of infection (pain, swelling, erythema, warmth) and is culture positive or not cultured
- The surgeon makes the diagnosis of infection

3. WOUND CLASSIFICATION:

- Clean wounds are uninfected operative wounds in which no inflammation is encountered and the wound is closed primarily. By definition, a viscus is not entered during procedure. (1.3 to 2.9%)
- Clean-contaminated wounds are operative wounds in which a viscus is entered under controlled conditions and without unusual contamination. (2.4 to 7.7%)
- Contaminated wounds are open, fresh accidental wounds, operations with major breaks in sterile technique, or gross spillage from a viscus. Wounds in which acute, nonpurulent inflammation was encountered also were included in this category. (6.4 to 15.2%)
- Dirty wounds are old traumatic wounds with retained devitalized tissue, foreign bodies, or fecal contamination or wounds that involve existing clinical infection or perforated viscus. (7.1 to 40.0%)

4.1 MICROBIOLOGY - ENDOGENOUS SOURCE

- SSIs after clean procedures (skin flora): streptococcal species, Staphylococcus aureus, and coagulase-negative staphylococci.
- In clean-contaminated procedures, the predominant organisms include gram-negative rods, enterococci in addition to skin flora.
- When the surgical procedure involves a viscus, the pathogens reflect the endogenous flora of the viscus or nearby mucosal surface; such infections are typically polymicrobial.

4.2 MICROBIOLOGY – EXOGENOUS SOURCE

- Contamination of the surgical site by organisms from the OR environment or personnel.
- Nasopharyngeal, anal or vaginal carriage of group A streptococci by OR personnel / a cause of SSI outbreak
- Carriage of gram-negative organisms on the hands has been shown to be greater among surgical personnel with artificial nails

5. INDICATIONS

Antimicrobial prophylaxis is justified for most clean-contaminated procedures and in certain clean procedures where there are severe consequences of infection, even if infection is unlikely (prosthetic implants).

The use of antimicrobial agents for dirty procedures or established infection is classified as treatment of presumed infection, not prophylaxis.

6. GOALS

Antimicrobial prophylaxis should:

- prevent SSI,
- prevent related morbidity and mortality,
- reduce duration and costs of healthcare,
- cause minimal adverse drug effects,
- have minimal adverse effects for the microbial flora of the patient or the hospital.

7. ANTIMICROBIAL AGENT SHOULD BE

- active against the pathogens most likely to contaminate the surgical site,
- be administered in an appropriate dose and at an appropriate time to ensure adequate serum and tissue concentrations during the period of potential contamination,
- and be administered for the shortest effective period to minimize adverse effects, emergence of resistance, and cost.

8. ANTIBIOTIC SELECTION

- Antibiotic selection for SSI prophylaxis is based on cost, safety, pharmacokinetic profile, and antimicrobial activity.
- Cefazolin (drug of choice for many procedures) has a desirable duration of action, reasonable safety, and low cost. It is active against streptococci, methicillin-susceptible staphylococci, and some gram-negative organisms.
- Second-generation cephalosporins (such as cefuroxime) have broader coverage against gram-negative organisms than cefazolin

- Patients with history of penicillin intolerance (manifesting as an uncomplicated skin rash) may be treated with a cephalosporin; allergic cross-reactions between penicillin and cephalosporins are infrequent.

- Cephalosporins should be avoided in patients with a history of IgE-mediated reaction to penicilin. (allergic immediate reaction - Type I)

8.1 ALTERNATIVES TO CEPHALOSPORINS ARE

- intravenous vancomycin (15 to 20 mg/kg) or clindamycin (600 to 900 mg). In some cases, an agent with activity against gram-negative bacteria must be added.
- There is no role for routine use of vancomycin prophylaxis for any procedure. Nasal colonization with methicillin-resistant or methicillin-susceptible S. aureus and preoperative prophylaxis with vancomycin was associated with an increased risk of postoperative SSI.
- S. aureus - There is no consensus regarding the benefit of routine preoperative screening for S. aureus colonization.

8.2 VANCOMYCIN MAY BE ACCEPTABLE

when:

- A cluster of SSIs due to MRSA or methicillin-resistant coagulase-negative staphylococci has been detected at an institution.
- A patient is known to be colonized with MRSA.
- A patient is at high risk for MRSA colonization in the absence of surveillance data (patients with recent hospitalization, nursing home residents, patients on hemodialysis, patients on immunosuppressive medications).

We favor use of vancomycin in combination with cefazolin for prevention of SSI due to MRSA and coagulase-negative staphylococci in the above scenarios.

9. RESISTANT ORGANISMS

Surgical prophylaxis for patients known to be colonized/infected with drug-resistant pathogens must be individualized.

Whether prophylaxis should include coverage for such pathogens depends on many factors:

- the pathogen,
- its antimicrobial susceptibility profile,
- the host,
- the planned procedure,
- the proximity of the likely reservoir of the pathogen to the incision sites.

Specific prophylaxis for a resistant gram-negative pathogen in a patient with past infection or colonization may not be necessary for a cutaneous procedure.

10. ANTIBIOTIC ADMINISTRATION

10.1 Route of administration

- antibiotic should be administred intravenously for the SSI prevention

10.2 Choice of dose

- Antibiotic prophylaxis should be administred in doses sufficient to achieve adequate serum and tissue drug levels for the interval during which the surgical site is open.
- For most adults, it is acceptable to dose antimicrobials based on standardized doses for safety, efficacy, and convenience.
- the serum and tissue concentrations of some drugs administered to obese patients may differ from those in nonobese (lipophilicity)

10.3 Timing

- Antimicrobial therapy should be initiated within the 60 minutes prior to surgical incision to optimize adequate drug tissue levels at the time of initial incision.
- The half-life of the antibiotic should be considered
- administration of vancomycin should begin 120 minutes before surgical incision because of the prolonged infusion times required for these drug.

10.4 Repeat dosing

- Repeat intraoperative dosing is warranted for procedures that exceed two half-lives of the drug and for procedures in which there is excessive blood loss (>1500 mL).
- Redosing when antimicrobial half-life is shortened (extensive burns).
- Redosing not warranted for patients in whom the antimicrobial half-life is prolonged (renal insufficiency).

10.5 Duration of prophylaxis

- repeat antimicrobial dosing following wound closure is not necessary and may increase the risk for development of antimicrobial resistance and C. difficile infection. There is no difference in the rate of SSI with single dose compared with multiple-dose regimens.
- For cases in which prophylaxis beyond the time of surgery is warranted, in general, the duration should be less than 24 hours .

TRAUMATOLOGY ET ORTHOPEDIC SURGERY

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Clean operation involving hand, knee, or foot with no implantation of foreign material		none		
Spinal procedures Hip fracture Internal fixation Total joint replacement Removal of orthopedic hardware used for treatment of lower extremity fractures	Staphylococcus aureus, Staphylococcus epidermidis	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours

CARDIAC SURGERY

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Cardiac procedures: coronary artery bypass, cardiac device insertion procedures (eg, pacemaker implantation), placement of ventricular assist devices	Staphylococcus aureus, S. epidermidis	Cefazolin OR	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
		Cefuroxime	1.5 g IV	

NEUROSURGERY

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Elective craniotomy Cerebrospinal fluid shunting procedures Implantation of intrathecal pumps	Staphylococcus aureus, S. epidermidis	Cefazolin	<120 kg: 2 g ≥120 kg: 3 g	4 hours

ABDOMINAL SURGERY

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Gastroduodenal surgery, viscus entrance	Gram + cocci Gram - bacilli	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
Billiary and pancreatic surgery	Enteric gram-negative bacilli, enterococci, clostridia	Cefazolin or Second generation cephalosporin	≥120 kg: 3g IV <120 kg: 2g IV	4 hours
Laparoscopic procedure – biliary surgery	Enteric gram-negative bacilli, enterococci, clostridia	none	none	
Appendectomy	Enteric gram-negative bacilli, anaerobes, enterococci	Cefazolin or Second generation cephalosporin	≥120 kg: 3 g IV <120 kg: 2 g IV	4 hours
		+ Metronidazole	500 mg IV	once

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Small intestine surgery, nonobstructed	Enteric gram-negative bacilli, gram-positive cocci	Cefazolin	≥120 kg: 3 g IV <120 kg: 2 g IV	4 hours
Small intestine surgery, obstructed	Enteric gram-negative bacilli, anaerobes, enterococci	Cefazolin or cephalosporin 2nd generation	≥120 kg: 3 g IV <120 kg: 2 g IV	4 hours
		+ Metronidazole	500 mg	once
Hernia repair	Aerobic gram-positive organisms	Cefazolin	≥120 kg: 3 g IV <120 kg: 2 g IV	4 hours
Colorectal surgery	Enteric gram-negative bacilli, anaerobes, enterococci	Cefazolin or cephalosporin 2nd generation	≥120 kg: 3 g IV <120 kg: 2 g IV	4 hours
		+ Metronidazole	500 mg	once
	Oral (used in conjunction with mechanical bowel preparation)	Neomycin + metronidazole	#	#

In addition to mechanical bowel preparation, the following oral antibiotic regimen is administered: neomycin (1 g) plus metronidazole (1 g). The oral regimen should be given as three doses over approximately 10 hours the afternoon and evening before the operation. Issues related to mechanical bowel preparation are discussed further separately; refer to the UpToDate topic on overview of colon resection

HEAD AND NECK SURGERY

PROCEDURE	PATHOGENS	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Clean	/	/	/	/
Clean with placement of prosthesis (excludes tympanostomy tube placement)	Staphylococcus aureus, S. epidermidis, streptococci	Cefazolin or	<120 kg: 2 g ≥120 kg: 3 g	4 hours
		Cefuroxime	1,5g	4 hours
Clean - contaminated		Cefazolin +	<120 kg: 2 g ≥120 kg: 3 g	4 hours
		Metronidazole	500 mg	
		Or Cefuroxime +	1,5 g	4 hours
		Metronidazole	500 mg	

GYNECOLOGIC AND OBSTETRIC SURGERY

PROCEDURE	RECOMENDED ANTIBIOTIC	DOSAGE	REDOSE INTERVAL
Hysterectomy (abdominal, including supracervical, vaginal, laparoscopic, or robotic)	Cefazolin or	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
	Second generation cephalosporin		
Pelvic reconstruction procedures, including colporrhaphy or those involving mesh or vaginal sling placement	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
	Second generation cephalosporin		
Cesarean section	Cefazolin	<120 kg: 2 g IV ≥120 kg: 3 g IV	4 hours
Uterine evacuation (including surgical abortion, suction)	Doxycycline	200 mg orally	
Hysterosalpingogram, including chromotubation or saline infusion sonography	Not recomended		
Laparoscopy (diagnostic, tubal sterilization, operative except for hysterectomy) Other transcervical procedures: Cystoscopy† Hysteroscopy (diagnostic or operative) Intrauterine device insertion Endometrial biopsy Oocyte retrieval D&C for non-pregnancy indication Cervical tissue biopsy, including LEEP or endocervical curettage	Not recomended		