Surgical site infections

فاطمه قدیمی استاژر ورودی بهمن 95

خرداد 1400

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INTRODUCTION

- Surgical site infections (SSIs) are a common cause of health care-associated infection .The United States Centers for Disease Control and Prevention has developed criteria that define surgical site infection as infection related to an operative procedure that occurs at or near the surgical incision **within 30 or 90 days** of the procedure , depending on the type of procedure performed.
- SSI are often localized to the incision site but can also extend into deeper adjacent structures.

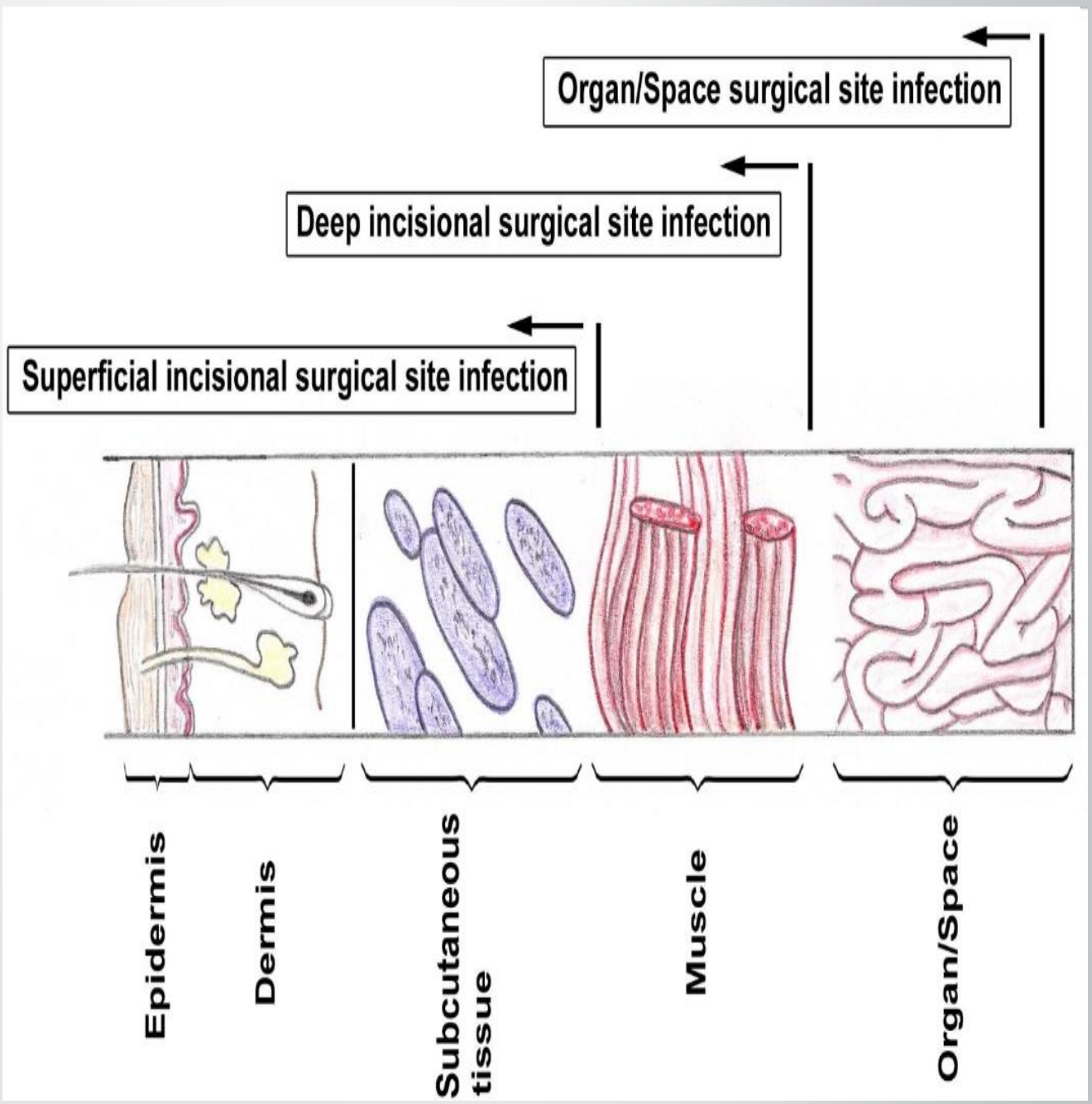
- SSIs are the most common and the costliest health care-associated infections.
- Among surgical patients, SSIs account for **38 percent** of nosocomial infections .
- It is estimated that SSIs develop in 2 to 5 percent of the more than 30 million patients undergoing surgical procedures each year.

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 setting 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.

Classification of SSI:

- SSIs are classified as: **incisional or organ/space**.
- Incisional SSIs are further divided into **superficial** (ie, those involving only the skin or subcutaneous tissue) or **deep** (ie, those involving deep soft tissues of an incision).
- An organ/space SSI may involve any part of the anatomy (other than the incision) that was opened or manipulated during the operative procedure (eg, meningitis following an elective neurologic procedure or mediastinitis following coronary artery bypass surgery).
- Organ/space SSIs account for **one-third** of all SSIs but are associated with more than 90 percent of deaths related to SSIs.


Organ/Space surgical site infection
Deep incisional surgical site infection
Superficial incisional surgical site infection
Epidermis
Dermis
Subcutaneous tissue
Muscle
Organ/Space

Wound classifications:

- Clean wounds are uninfected operative wounds in which no inflammation is encountered and the wound is closed primarily. By definition, a viscus (respiratory, alimentary, genital, or urinary tract) is not entered during a clean procedure.
- Clean-contaminated wounds are operative wounds in which a viscus is entered under controlled conditions and without unusual contamination.
- 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.
- 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

Classification	Description
Clean (class 1)	Uninfected operative wound No acute inflammation Closed primarily Respiratory , GI , biliary and urinary tracts not entered No break in aseptic technique Closed drainage used if necessary
Clean- contaminated (class2)	Elective entry into respiratory , biliary , GI , urinary tracts and with minimall spillage No evidence of infection or major break in aseptic technique Example : appendectomy
Contaminated (class3)	Nonpurulant inflammation present Gross spillage from GI tract Penetrating traumatic wounds < 4 hours
Dirty-infected (class4)	Purulant inflammation present Preoperative perforation of viscera Penetrating traumatic wounds > 4 hours

Wound class, representative procedures, and expecte infection rates

WOUND CLASS	EXAMPLES OF CASES	EXPECTED INFECTION RATES
Clean (class I)	Hernia repair, breast biopsy	1–2%
Clean/ contaminated (class II)	Cholecystectomy, elective GI surgery (not colon)	2.1–9.5%
Clean/ contaminated (class II)	Colorectal surgery	4–14%
Contaminated (class III)	Penetrating abdominal trauma, large tissue injury, enterotomy during bowel obstruction	3.4–13.2%
Dirty (class IV)	Perforated diverticulitis, necrotizing soft tissue infections	3.1–12.8%

- While widely used, this classification scheme is a poor predictor of overall risk of SSI. Other factors, such as the **operative technique**, **length of surgery**, and **health of the surgical patient**, may be as important as wound classification in predicting infectious risks for SSI.
- Antimicrobial prophylaxis is justified for most clean-contaminated procedures. The use of antimicrobial agents for dirty procedures or established infection is **not classified as prophylaxis**; rather, it represents treatment for presumed infection.
- Antimicrobial therapy administered in the setting of contaminated wounds is not considered prophylactic. in such cases, a therapeutic course of antimicrobial therapy is warranted.

ANTIMICROBIAL PROPHYLAXIS:

- The goal of antimicrobial prophylaxis is to prevent surgical site infection (SSI) by reducing the burden of microorganisms at the surgical site during the operative procedure.
- The efficacy of antibiotic prophylaxis for reducing SSI has been clearly established. Preoperative antibiotics are warranted if there is **high risk of infection** or if there is high risk of **deleterious outcomes** should infection develop at the surgical site (such as in the setting of immune compromise, cardiac surgery, and/or implantation of a foreign device).
- Patients who receive prophylactic antibiotics within **one to two hours before** the initial incision have lower rates of SSI than patients who receive antibiotics sooner or later than this window

- Patients receiving antimicrobial prophylaxis are at relatively low risk for adverse drug events such as development of Clostridioides (formerly Clostridium) difficile and postoperative infection due to drug-resistant organisms .

- Ideally, antimicrobial prophylaxis should prevent SSI, prevent **morbidity and mortality**, **reduce duration and cost of health care**, **cause minimal adverse drug effects**, and **have minimal adverse effects for the microbial flora** of the patient or the hospital .
- To achieve these goals, an 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.

Table 6-7

Risk factors for development of surgical site infections

Patient factors
- Older age
- Immunosuppression
- Obesity
- Diabetes mellitus
- Chronic inflammatory process
- Malnutrition
- Smoking
- Renal failure
- Peripheral vascular disease
- Anemia
- Radiation
- Chronic skin disease
- Carrier state (e.g., chronic *Staphylococcus* carriage)
- Recent operation

Local factors
- Open compared to laparoscopic surgery
- Poor skin preparation
- Contamination of instruments
- Inadequate antibiotic prophylaxis
- Prolonged procedure
- Local tissue necrosis
- Blood transfusion
- Hypoxia, hypothermia

Microbial factors
- Prolonged hospitalization (leading to nosocomial organisms)
- Toxin secretion
- Resistance to clearance (e.g., capsule formation)

Microbiology

- The predominant organisms causing SSIs after clean procedures are skin flora, including streptococcal species, S. aureus, and coagulase-negative staphylococci. In clean-contaminated procedures, the predominant organisms include gram-negative rods and 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.

Table 6-3

Common pathogens in surgical patients

- Gram-positive aerobic cocci
  - *Staphylococcus aureus*
  - *Staphylococcus epidermidis*
  - *Streptococcus pyogenes*
  - *Streptococcus pneumoniae*
  - *Enterococcus faecium, E faecalis*
- Gram-negative aerobic bacilli
  - *Escherichia coli*
  - *Haemophilus influenzae*
  - *Klebsiella pneumoniae*
  - *Proteus mirabilis*
  - *Enterobacter cloacae, E aerogenes*
  - *Serratia marcescens*
  - *Acinetobacter calcoaceticus*
  - *Citrobacter freundii*
  - *Pseudomonas aeruginosa*
  - *Stenotrophomonas maltophilia*
- Anaerobes
  - Gram-positive
    - *Clostridium difficile*
    - *Clostridium perfringens, C tetani, C septicum*
    - *Peptostreptococcus* spp.
  - Gram-negative
    - *Bacteroides fragilis*
    - *Fusobacterium* spp.
- Other bacteria
  - *Mycobacterium avium-intracellulare*
  - *Mycobacterium tuberculosis*
  - *Nocardia asteroids*
  - *Legionella pneumophila*
  - *Listeria monocytogenes*
- Fungi
  - *Aspergillus fumigatus, A niger, A terreus, A flavus*
  - *Blastomyces dermatitidis*
  - *Candida albicans*
  - *Candida glabrata, C paropsilosis, C krusei*
  - *Coccidiodes immitis*
  - *Cryptococcus neoformans*
  - *Histoplasma capsulatum*
  - *Mucor/Rhizopus*
- Viruses
  - Cytomegalovirus
  - Epstein-Barr virus
  - Hepatitis A, B, C viruses
  - Herpes simplex virus
  - Human immunodeficiency virus
  - Varicella zoster virus

- In general, antimicrobial selection for SSI prophylaxis is based on **cost**, **safety**, **pharmacokinetic profile**, and **antimicrobial activity**.

- Cefazolin is a drug of choice for many procedures; it has a desirable duration of action, spectrum of activity against organisms commonly encountered in surgery, reasonable safety, and low cost. It is active against streptococci, methicillin-susceptible staphylococci, and many gram-negative organisms.
- we favor administration of cefazolin 2 g for patients <120 kg and cefazolin 3 g for patients ≥120 kg (Grade 2B)
- Second-generation cephalosporins (such as cefuroxime) theoretically have broader coverage against gram-negative organisms than cefazolin, but **resistance** to these antimicrobials is increasing. Cefoxitin and cefotetan also have some anaerobic activity.

- 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 except in patients with severe IgE-mediated reactions to penicillin. Cephalosporins should be avoided in patients with a history of IgE-mediated reaction to penicillin.
- Alternatives to cephalosporins include intravenous vancomycin (15 to 20 mg/kg) or clindamycin (600 to 900 mg

- Antimicrobial therapy should be administered **within 60 minutes** before surgical incision to ensure adequate drug tissue levels at the time of initial incision. If the preferred agent is **vancomycin or a fluoroquinolone**, administration should begin **120 minutes** before surgical incision because of the prolonged infusion times required for these drugs.
- To ensure adequate antimicrobial serum and tissue concentrations, repeat intraoperative dosing is warranted for procedures that **exceed two half-lives of the drug** or for procedures in which there is **excessive blood loss (>1500** mL).
- In general, repeat antimicrobial dosing following wound closure is not necessary and may increase antimicrobial resistance. For cases in which prophylaxis beyond the period of surgery is warranted, in general, the duration should **be less than 24 hours**

Table 6-6

Prophylactic use of antibiotics

SITE	ANTIBIOTIC	ALTERNATIVE (E.G., PENICILLIN ALLERGIC)
Cardiovascular surgery	Cefazolin, cefuroxime	Vancomycin, clindamycin
Gastroduodenal area Small intestine, nonobstructed	Cefazolin	Clindamycin or vancomycin + aminoglycoside or aztreonem or fluoroquinolone
Biliary tract: open procedure, laparoscopic high risk	Cefazolin, cefoxitin, cefotetan, ceftriaxone, ampicillin-sulbactam	Clindamycin or vancomycin + aminoglycoside or aztreonem or fluoroquinolone Metronidazole + aminoglycoside or fluoroquinolone
Biliary tract: laparoscopic low risk	None	None
Appendectomy, uncomplicated	Cefoxitin, cefotetan, cefazolin + metronidazole	Clindamycin + aminoglycoside or aztreonem or fluoroquinolone Metronidazole + aminoglycoside or fluoroquinolone
Colorectal surgery, obstructed small intestine	Cefazolin or ceftriaxone plus metronidazole, ertapenem, cefoxitin, cefotetan, ampicillin-sulbactam	Clindamycin + aminoglycoside or aztreonem or fluoroquinolone, metronidazole + aminoglycoside or fluoroquinolone
Head and neck; clean contaminated	Cefazolin or cefuroxime + metronidazole, ampicillin-sulbactam	Clindamycin
Neurosurgical procedures	Cefazolin	Clindamycin, vancomycin
Orthopedic surgery	Cefazolin, ceftriaxone	Clindamycin, vancomycin
Breast, hernia	Cefazolin	Clindamycin, vancomycin

Data from Pieracci FM, Barie PS. Management of severe sepsis of abdominal origin, *Scand J Surg*. 2007;96(3):184-196.

Thanks for your Attention