Practice Points:
Nosocomial Surgical Site Infection

Surgical site infections (SSIs) are the second most common healthcare-associated infection and are associated with substantial morbidity and mortality rates. SSIs can lead to 7-10 additional postoperative hospital days, practically double the rate of re-hospitalization, and increase hospital charges by $2,000 to $4,500 per patient.[1] According to the Centers for Disease Control and Prevention, out of the 4 million orthopaedic surgeries that are performed each year, typically less than 1% result in an SSI.[9] Although this percentage may seem small, infections of prosthetic joints are very difficult to treat.[3] Most surgical site infections are acquired at the time of surgery.[1] A multifaceted team approach by the patient, healthcare workers, and all hospital staff is critical to prevention of nosocomial surgical site infections.

SSI Definition

The Centers for Disease Control and Prevention have outlined criteria for what is classified as a surgical site infection. SSI is an infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the surgery or within one year if an implant is left in place and if the infection appears to be related to the operative procedure.[4] In a patient with more than one surgical incision from a single procedure, the main incision is referred to as the primary incision and the others are known as secondary incisions.[4] Examples of secondary incisions include donor sites or drain insertion sites.[4]

According to the CDC, an infected surgical site also must include one or more of the following: purulent drainage (with or without laboratory confirmation), a positive fluid or tissue culture, diagnosis of infection by a physician, or show at least one sign of infection that requires reopening of the surgical site.[4] Signs and symptoms of infection include localized swelling, pain, tenderness, and heat.[4] SSIs are further categorized by location as incisional or organ/space.[4] Incisional SSIs can be superficial or deep.[4] Organ/space SSIs may involve other structures that may have been manipulated during surgery.[4]

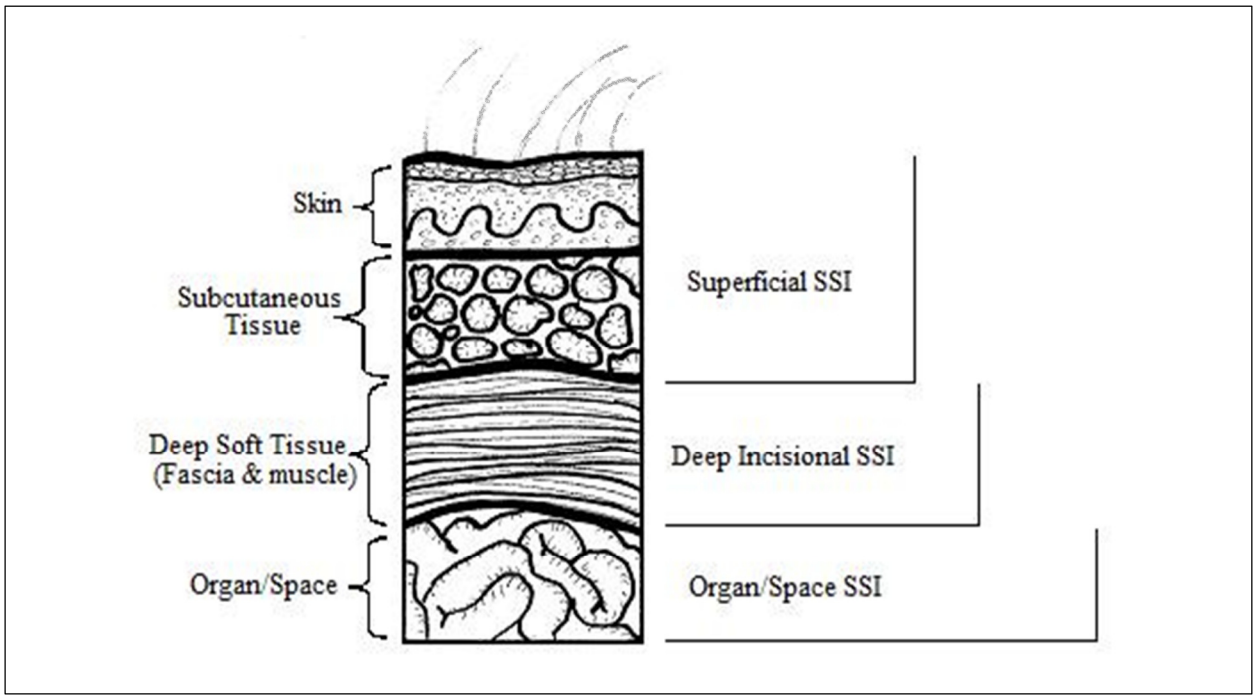

Figure. Cross-section of abdominal wall with surgical site infection classifications. Drawing adapted from Reference 10.[10]

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Predicting SSI Risk

The National Nosocomial Infections Surveillance System (NNIS) Risk Index was created in 1990. The NNIS Risk Index is a combination of the CDC's traditional wound classifications (clean, clean-contaminated, contaminated, or dirty), the American Society of Anesthesiologists Physical Status Classification Score, and a cut point for the average length of hospital stay for a specific type of surgery.[8] This Risk Index is considered the most accurate predictor of risk and allows for valid comparisons of SSI rates across time, surgeons, and hospitals.[1]

Patient Risk Factors[1,3,10,11]	Risk Factors related to Surgery[1,3,10,11]
Poor nutritional status	Incision site skin preparation
Uncontrolled diabetes	Skin antisepsis
Smoking	Shaving surgical site
Obesity	Length of operation
Coexistent infection in remote body site	Operating room ventilation
Colonization of microorganisms (+Staff, MRSA)	Surgical instrument sterilization
Altered immune System (HIV, chronic steroid use)	Foreign material in surgical site (sutures, prostheses, indwelling device, or implant)
Perioperative anemia	Drain placement
Increased length of hospital stay	Surgical technique (poor homeostasis, failure to obliterate dead space, tissue trauma)

What is best practice in assessing and managing surgical site infections?

Recommended For Practice

Antibiotic Prophylaxis

Antibiotic prophylaxis may be used to prevent SSI by reducing microorganisms at the surgical site.[2] It is not considered prophylactic to administer antibiotics to a patient with an already contaminated or potentially infected wound.[2] In this case, the patient would require a therapeutic course of antibiotics.[2] Antibiotic prophylaxis is recommended for orthopaedic procedures such as total joint replacements, surgical repair of fractures, and internal fixation with foreign hardware such as nails or plates.[2]

Cefazolin (1 to 2g IV) or cefuroxime (1.5g IV) are the antibiotics typically recommended for surgical prophylaxis.[2] Cefazolin is a first generation cephalosporin that is active against streptococci and methicillin susceptible staphylococci.[2] Cefuroxime is a second generation cephalosporin with broader activity against gram negative organisms.[2] Depending on the type of surgery and common pathogens in that area of the body, other antibiotics may be added to the regimen.[2]

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Recommended for Practice (continued)

Patients with a history of an uncomplicated Penicillin allergy such as a minor skin rash may still be treated with cephalosporins because allergic cross-reactions are infrequent.[2] If the patient has had a severe allergic reaction to penicillin in the past such as anaphylaxis, cephalosporins should not be used and a safer antibiotic should be chosen for that patient.[2]

Cephalasporins are not active against the increasingly common pathogen, methacillin-resistant staphylococcus aureus (MRSA).[2] Use of prophylactic vancomycin (1g [10-15mg/kg]) may be appropriate for patients with risk factors for postoperative MRSA infection.[2] Risk factors for MRSA include local resistance patterns, recent hospitalization, renal disease, or diabetes.[2] Prophylactic vancomycin is also an appropriate choice for patients undergoing implantation of a prosthetic device or with allergy to penicillin.[6] Depending on the type and location of surgery, additional antibiotics may be added to cover common pathogens. If not contraindicated, a beta-lactam such as cefazolin may be added to this regimen cover against gram-negative organisms.[2]

The antibiotics should be administered within 60 minutes prior to the incision (or within 120 minutes if using vancomycin or a fluroquniolone) to ensure adequate drug levels in the tissues.[2] In the case of an open fracture, the patient should receive antibiotics as soon as possible, and continue for twenty-four hours postoperatively.[6]

For procedures lasting less than four hours, one repeat dose of the antibiotic is appropriate.[2] For surgeries more than four hours, or if there is major blood loss, repeat dosing may be indicated.[2] Antibiotics should be discontinued no longer than twenty-four hours after surgery.[2,6]

Due to the low infection rate, antibiotic prophylaxis is not necessary for patients undergoing minimally invasive diagnostic and operative arthroscopic surgeries.[2]

Preoperative

Patient education should be initiated early in the preoperative phase, preferably before the day of surgery. Patients should be educated on the risks of surgical site infection, how their surgical team is working to prevent them, and what they themselves can do to help prevent infection.[11] Depending on hospital protocols, patients should be given instructions about what to do the day of surgery including preoperative showering and not shaving.[5] Discharge instructions regarding wound care and importance of follow up appointments may be introduced here as well. Guidelines recommend using an integrated care pathway for healthcare-associated infections to help communicate teaching to patients and caregivers.[11] Preoperative patient education classes, multimedia, and pamphlets are creative ways to educate patients about SSIs. The following links are helpful teaching aids for patients undergoing surgery.

http://www.ncmedsoc.org/non_members/prc/ihi_infectionspostsurgery.pdf
http://www.shea-online.org/Assets/files/patient%20guides/SSI.pdf
http://jama.ama-assn.org/cgi/reprint/294/16/2122.pdf
http://www.orthonurse.org/ResearchandPractice/PatientEducation/tabid/490/Default.aspx

A preoperative physical assessment is necessary to identify risk factors and plan individual patient care. Prior to surgery, all infections should be treated.[2] Surgeries involving an implant should be postponed if there is even a minor infection present such a boil, upper respiratory infection, or infected toenail.[2]

To limit possible exposure to pathogens, keep the preoperative hospital stay as short as possible while allowing time for proper preparation of the patient.[7]

Routine nasal decontamination is not recommended, but may be appropriate for patients who are immunocompromised, or undergoing implantation of a foreign device.[2,11] Nasopharyngeal decontamination may be performed with an agent such as mupirocin nasal ointment.[2]

Research suggests that hair removal is not necessary to decrease surgical site infection.[2] If hair at the site must be removed, it should be clipped just prior to the surgical incision, as shaving is a risk for SSI.[2,6,11]

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Recommended for Practice (continued)

Intraoperative

Most surgeons, anesthesiologists, and hospital epidemiologists acknowledge the benefit of maintaining perioperative normothermia throughout all the operative stages to reduce the risk of SSI.[2]

Environmental surfaces in United States operating rooms are rarely sources of pathogens that cause SSIs, but still must be routinely cleaned between operations.[10] Equipment or furniture that are soiled or may be touched by surgical personnel, must be cleaned with an Environmental Protection Agency Positive registered hospital-grade germicidal agent after every procedure.[10]

The operating team should remove all hand jewelry, nail polish, and artificial nails prior to surgery.[12] Prior to the first surgical scrub of the day, it is recommended that the operating team clean beneath each fingernail with a single use brush or pick.[12]

The surgical team should cleanse hands and forearms with an antimicrobial soap or an alcohol-based hand rub with persistent activity.[2] After hand washing, arms should be held up and away from the body with elbows flexed so that water drips down and away from the hands.[10] Dry hands with a sterile towel and don sterile gloves and gowns.[10] Consider wearing two pairs of sterile gloves if there is a high risk for glove perforation or serious risks of contamination.[12]

Barrier devices such as masks, caps, gowns, drapes and shoe covers are worn by operating personnel for protection against body fluids.[2] Their role in preventing surgical site infection is not supported by research, but should be worn according to hospital protocol.[2]

During surgery, positive pressure ventilation should be maintained inside the operating room.[10] Keep operating room doors closed and limit the number of personnel entering the room to the minimum necessary[10,12] Prepare sterile equipment and solutions immediately before use.[10] Operating room asepsis must be maintained throughout surgery.[10]

Skin at the operative site should be cleaned immediately before incision with a Chlorhexidine alcohol antiseptic to reduce bacteria on the skin. This type of antiseptic is superior to the other forms because it is not inactivated by blood or serum.[2]

Proper surgical technique includes handling tissues gently, maintaining homeostasis, minimizing dead tissue and foreign bodies such as sutures.[1,2,6]

If drainage is necessary, a closed suction drain is recommended.[10] Insert drains through a separate incision distant from the primary operative incision.[10] Remove drains as soon as possible to lower risk of infection.[2] Drains left in more than twenty-four hours are at an increased risk for contamination.[6]

Postoperative

The initial postoperative dressing change may be performed as early as twenty-four hours after surgery.[6] Multiple studies have shown that the use of occlusive dressings can increase the rate of wound healing and decrease surgical site infection.[6] Perform hand hygiene before and after all dressing changes and any contact with surgical site.[12] Use an aseptic non-touch technique when performing dressing changes.[12]

Discontinue prophylactic antibiotics after twenty-four hours post surgery.[2]

Patient education is an extremely important part of the post-operative phase. The patient, family, and caregivers must be educated regarding proper incision care, the signs and symptoms of infection (redness, pain, swelling, drainage, odor, fever) and how and when to contact their health care provider if they start to experience any of these symptoms.[8] Reinforce strict hand washing techniques.[11]

Prompt discharge as soon as the discharge criteria is met will limit exposure to potential hospital pathogens and therefore may decrease surgical site infections.[7]

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Likely to be Effective

- Laminar flow (ultra-clean air) ventilation systems in operating rooms for surgeries with insertions of orthopaedic devices.[3]
- High oxygen supplementation perioperatively has led to decreased SSI rates, although some small studies did not show a benefit. Further research is needed for this intervention.[3]
- Patients identified with potential wound healing problems or inability to perform proper wound care independently should be considered for specialist wound care services or home care services.[12]

Benefits Balanced with Harm

It is recommended that all remote infections be treated prior to surgery, but for circumstances where urgent surgery is warranted, the risk of infection must be weighed with the timing of surgical intervention.[2]

Perioperative anemia is a significant risk factor for SSIs. However, studies suggest that treating patients with transfusions prior to surgery may lead to decrease immunity as a result of the increased leukocytes after receiving a transfusion.[3]

Although they continue to be used in current practice, research recommends that the use of drains is not necessary in elective joint replacement.[6] Studies have associated the use of perioperative drains with increased infection rates and increased relative risk of transfusions.[6]

Effectiveness Not Established

- Leukocyte-depleted red blood cell transfusions for patients with perioperative anemia.[3]
- Preoperative showering with an antiseptic solution.[2]
- Effectiveness of subcuticular suturing vs. skin stapling techniques.[3]
- Insufficient evidence to recommend how soon after surgery the surgical site can become wet during a shower.[11]
- Thus far, the literature does not support the routine prophylactic use of vancomycin over cefazolin, cefuroxime, or ceftizoxime for prevention of SSI.[2]

Not Recommended for Practice

- Routine preoperative application of mupirocin to the nares.[11]
- Preoperative surgical site shaving.[2]
- Hydrogen peroxide for post operative wound cleaning.[6]
- Routine delaying of surgery to provide parenteral nutrition.[12]

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