SURGICAL SITE INFECTIONS

Standard definitions of SSIs classify them as superficial incisional, deep incisional (involving fascia or muscle), and organ space depending on the depth of tissue involvement. Most SSIs occur within 30 days of the operation, but some may develop later, especially in the setting of implanted foreign bodies (e.g., arthroplasty). During 2006 to 2008, the overall risk of SSI was 1.9 cases per 100 procedures. Approximately 500,000 SSIs occur annually, costing an estimated $45 billion per year. Patients who develop an SSI have an increased risk of death.

Endogenous seeding from the patient's skin flora is the most common avenue of infection. *S. aureus* and coagulase-negative *Staphylococcus* cause more than 40% of SSIs. In clean-contaminated operations, including open abdominal surgeries, gram-negative bacilli are predominant. An SSI should be suspected when postoperative patients have wound-associated purulent drainage, pain, tenderness, swelling, or redness. Positive culture growth from an aseptically obtained specimen is most convincing.

Many practices are used to prevent SSIs (see Table 99-1). One of the earliest and most effective strategies has been active surveillance and subsequent reporting of infection rates to the surgeons and staff. Much of the reduction in rates was attributed the Hawthorne effect (i.e., active monitoring changes the behaviors of those being monitored). Other important interventions designed to reduce SSIs include antimicrobial prophylaxis (i.e., the right drug at the right dose and right time), appropriate skin antisepsis, and maintenance of glucose control (see Table 99-1).

Management of SSIs often involves opening of the incision, evacuation of infected tissue, and allowing the wound to heal by second intention. The decision for initiating antibiotics is made on an individual basis and depends on the appearance of the wound, systemic signs of infection, depth of the infection, host's immune system, and type of surgery. Culture and Gram stain results help to dictate antibiotic coverage. For SSIs from a clean operation, empirical therapy covering *S. aureus* and *Streptococcus* species is recommended. For procedures involving the perineum, intestinal tract, or urogenital tract, broader coverage is needed to address gram-negative and anaerobic pathogens. When the SSI occurs within 48 hours of the index operation, *Streptococcus pyogenes* and *Clostridium* species are often implicated.

IMPORTANCE OF ANTIMICROBIAL STEWARDSHIP: *CLOSTRIDIUM DIFFICILE* INFECTION

CDI is defined as diarrhea or toxic megacolon with detection of the *C. difficile* organism or toxin A or B, or both, in the stool or evidence of pseudomembranous colitis detected endoscopically, surgically, or histopathologically. This colonic infection is often accompanied by fever and leukocytosis.

The incidence and severity of CDIs have been increasing, and most reports implicate the emerging BI/NAP1/027 strain and the aging population of hospitalized patients, who are disproportionately affected by CDI. The BI/NAP1/027 strain hypersporulates (i.e., produces more of toxins A and B than previous strains) and produces a third binary toxin. Although resistance to the primary antimicrobials used to treat CDI—metronidazole and oral vancomycin—is rare, the BI/NAP1/027 epidemic strains show an increased resistance to fluoroquinolones. There is a concern that the increasing widespread use of fluoroquinolones may be providing a selective advantage for this epidemic strain. However, virtually every antibiotic has been associated with increasing the risk of CDI.

The continued rise of CDI, increasing resistance to antimicrobials by many different pathogens, and lack of antimicrobials with novel mechanisms of action underscore the importance of antimicrobial stewardship. Antimicrobial stewardship is a strategy that emphasizes optimal selection, dose, and duration of antimicrobial therapy, producing the best clinical outcome while decreasing the risk of subsequent complications.

The consequences of poor stewardship include the emergence of resistance, CDI, and excessive drug expenditures. Antimicrobials have different probabilities of invoking resistance or CDI. Strategies implemented by antimicrobial stewardship programs include provider education and guidelines, de-escalation or tailoring of empirical therapy when possible, use of more appropriate empirical treatments, and front-end restriction of certain antibiotics.

For a deeper discussion of these topics, please see Chapter 283, "Approach to the Patient with Suspected Enteric Infection," and Chapter 296, "Clostridial Infections," in Goldman-Cecil Medicine, *25th Edition.*

MULTIDRUG-RESISTANT PATHOGENS

MDROs are organisms that are resistant to more than one class of antimicrobial agents, although the names of some (e.g., MRSA, VRE) imply resistance to only one drug. According to NHSN data reported from the 2009-2010 period, more than one half of reported HAIs were caused by MDROs (Table 99-4).

Infections caused by MDROs lead to increased length of hospitalization, health care costs, and mortality rates for patients compared with those who are infected by antimicrobial-susceptible organisms. Kollef and colleagues found that patients who received inadequate antimicrobial therapy for their HAIs had an infection-related mortality rate 2.37 times that of those in the ICU who received adequate coverage. The principal reason for inadequate coverage was multidrug resistance.

The predominant gram-positive MDRO pathogens are MRSA and VRE. Methicillin resistance in *S. aureus* is caused by the production of an alternate penicillin-binding protein (PBP2A) that has a low affinity for β-lactam antibiotics and forms stable peptidoglycan products in the presence of adequate levels of the β-lactam. MRSA infections tend to have worse outcomes compared with methicillin-susceptible *S. aureus* (MSSA), but the typical health care–acquired strains are not necessarily more virulent. However, community-acquired MRSA, the most prevalent of which is the USA-300 strain, tends to be more virulent, and 87% of these isolates produce the Panton-Valentine leukocidin toxin, which is associated with greater leucocyte destruction and tissue necrosis. The largest reservoirs of MRSA are patients with the greatest contact with the health care system, and most carriers are asymptomatic.

Vancomycin resistance in *S. aureus* is another concern. Vancomycin intermediate-resistant strains, vancomycin heteroresistant strains, and vancomycin-resistant strains are being detected.