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SURGICAL SITE INFECTION: A COMPREHENSIVE NARRATIVE REVIEW

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ABSTRACT Surgical Site Infection (SSI) is an infection occurring within 30 days of surgery near the surgical site. It can be categorized as superficial or deep incisional or involve organ/space infections. The incidence of SSI varies widely (5-30%), affecting 2-5% of inpatient surgical cases annually in the US. Risk factors include patient health, surgical technique, and contamination level. Objective tools like ASEPSIS and patient-centered wound questionnaires aid SSI assessment. Diagnosis involves direct wound examination, imaging, and culture analysis. Treatment includes wound exploration, debridement, and drainage of infected fluid. Wound management with serial dressing changes or negative pressure wound therapy helps facilitate healing.

KEYWORDS : Surgical Site Infection, Postoperative Infection, Wound Infection, Surgical Wound Complication.

INTRODUCTION

Surgical site infection (SSI) is a prevalent and concerning health care–associated complication that occurs following surgical procedures. With its substantial impact on patient outcomes and the health care system, SSI poses a significant challenge to surgical teams and patients alike. Studies show that 2 to 4 percent of individuals undergoing surgeries in the United States will develop an SSI annually, leading to prolonged hospital stays, transfer to intensive care units, and increased hospital readmission rates. Apart from the physical consequences, SSI also affects patient-reported outcomes, causing postoperative anxiety, especially when patients are responsible for wound care and SSI management after discharge. Addressing SSI is crucial for improving surgical outcomes and enhancing patient experiences (1).

Methods

The search strategy for this narrative review on surgical site infection will employ a comprehensive and systematic approach to identify relevant literature. Electronic databases such as PubMed, Scopus, and Web of Science will be searched using a combination of controlled vocabulary (MeSH terms) and keywords. The main search terms will include "surgical site infection," "postoperative infection," "healthcare-associated infection," "SSI risk factors," and "SSI prevention." Filters will be applied to limit the search to human studies published in the last five years. In addition to database searches, manual screening of reference lists and citation tracking will be conducted to identify additional relevant studies. The inclusion criteria will focus on original research articles, clinical trials, and meta-analyses. By adopting this rigorous search strategy, we aim to gather a comprehensive and up-to-date pool of evidence to inform our narrative review on the topic of surgical site infection.

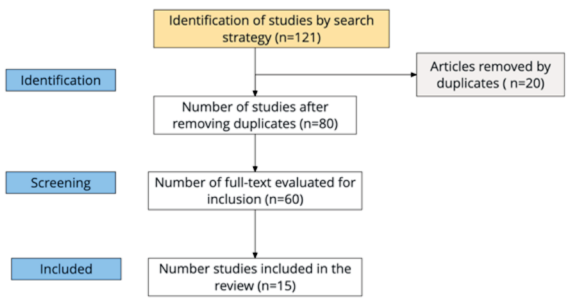

Figure 1. PRISMA.

Definition

Surgical Site Infection (SSI) is defined by the CDC as an infection occurring within 30 days of surgery (or up to 90 days with an implant) near the surgical site. Incisional SSIs are categorized as superficial or deep, while organ/space infections involve abscesses or implant-related infections. Objective tools like ASEPSIS and patient-centered wound questionnaires aid SSI assessment. ASEPSIS showed better agreement between surgeons than CDC definitions for colorectal surgery. However, these tools can be impractical outside research settings due to their complexity. Improving SSI detection remains crucial for better patient outcomes, especially in postoperative wound care beyond hospital settings (2).

Incidence And Risk Factors

Unplanned readmission after surgery is most frequently caused by Surgical Site Infection (SSI). The incidence of SSI varies widely (5-30%), depending on operative site and wound classification. In the US, SSI affects 2-5% of inpatient surgical cases annually. SSIs are linked to increased morbidity and mortality. While prevention efforts have reduced the incidence over time, an aging population and more complex surgeries may contribute to rising SSI rates (3).

Low- to middle-income countries may experience higher SSI rates due to cumulative risk factors and resource limitations. For instance, the FALCON study reported an SSI incidence of 22% for clean-contaminated and 30% for contaminated/dirty cases in such settings. Risk factors included lack of antimicrobial prophylaxis, a high proportion of emergency cases, and current smoking. SSIs in ambulatory surgical settings are relatively low (3.1-4.8 per 1000 procedures). Surgical volume may impact SSI risk, with smaller hospitals having higher rates than medium and large hospitals. SSI rates also vary significantly among specific procedures, with abdominal surgery, particularly colon surgery, presenting a 10% SSI rate. Procedures involving implants, while less common, carry profound consequences (4).

Numerous factors influence SSI development, including patient health, surgical technique, and contamination level. Objective tools and wound classification systems help assess and manage risks. Prophylactic measures like timely antibiotic administration and good surgical technique can mitigate SSI risk. Various topical and local antibiotic delivery methods have shown promise in certain cases. Other practices, such as surgical drain use and prophylactic

negative pressure wound therapy, remain under investigation. Optimizing wound closure and using wound protectors may further reduce SSI rates (5).

Clinical Features

The clinical presentation of Surgical Site Infections (SSI) varies based on the depth and extent of infection. When SSI is suspected, direct examination of the wound is crucial to assess symptoms and signs. In less severe cases, patients may be evaluated while still hospitalized, while discharged patients are requested to return to the clinic or emergency room. Superficial SSI symptoms include localized swelling, warmth, drainage with or without odor, wound breakdown (dehiscence), peri-incisional erythema, and pain. Palpation may reveal induration or tenderness. Systemic evidence may include fever or leukocytosis. Purulent drainage or wound separation often indicates an infection (6).

For deep incisional SSI, fascia and/or muscle involvement are observed. Symptoms are similar to superficial SSI but more severe. Imaging (ultrasound, CT) helps estimate infection depth. Wound exploration and debridement may be performed in the operating room. Organ/space SSI presents with malaise, fever, and localized pain/tenderness, often without skin changes (7).

Organ/space SSI diagnosis is made with imaging confirmation of abscess and culture analysis. Necrotizing infections, a surgical emergency, manifest rapidly with severe pain, skin discoloration, blistering, and devitalization. Obtaining imaging should not delay operative wound exploration and debridement due to rapid infection dissemination (8).

Diagnosis

The diagnosis of Surgical Site Infections (SSI) involves various approaches to assess the extent and causative agents of infection. Superficial SSI can often be diagnosed through direct wound observation, and telemedicine with patient-generated wound images and symptom reports can be useful for monitoring infection emergence. In cases where deeper tissues or organ spaces may be affected, cross-sectional imaging plays a vital role in diagnosis (9).

Cultures are essential for confirming the causative organisms in suspected SSI cases. Gram stain and culture are obtained from the wound opening, and swabs are taken directly from the infection site to differentiate colonization from true infection. During surgical debridement, samples of synthetic materials or necrotic tissue can be sent for culture. Empiric therapy is initiated based on Gram stain results, while specific treatment relies on subsequent culture findings. Negative cultures in an infected wound may indicate atypical or fungal infections, especially in immunocompromised patients. Systemic signs of infection warrant blood cultures, which aid in refining empiric antibiotic therapy. Treatment should be tailored based on culture-specific sensitivities. The diagnosis of SSI involves a combination of clinical observation, imaging, and culture results to ensure prompt and appropriate management (10).

Management

General management of suspected or confirmed superficial and deep incisional surgical site infections (SSIs) involves a comprehensive approach to ensure proper healing and prevention of complications. The primary steps in managing SSIs include wound exploration, debridement, and drainage of infected fluid, which should be cultured to identify the causative organisms. When there is a concern for deep tissue involvement or organ space infection, clinicians should have a low threshold for obtaining cross-sectional imaging to evaluate for undrained abscesses requiring source control (11).

In cases of superficial SSI, direct observation of the wound allows for a thorough evaluation. Serial wound images and symptom reports transmitted via telemedicine can help monitor the progression of infection. Superficial SSI may present with localized symptoms such as swelling, warmth, drainage with or without odor, wound breakdown, peri-incisional erythema, and pain. Palpation of the wound area may reveal induration or tenderness. Systemic signs of infection, like fever and leukocytosis, may also be present. Purulent wound drainage or separation of wound edges typically indicates an infection. However, superficial incisional dehiscence can occur without infection, necessitating careful assessment (12).

Treatment of superficial/deep incisional SSI involves opening the wound, draining infected fluid, and debriding necrotic tissue. This process is crucial for adequate treatment and to prevent the spread of infection. If deeper tissue involvement is suspected, the tissue should be sent for culture to guide specific antimicrobial therapy. Depending on the presence of underlying materials like bone or implants, the surgical wound may need to be cautiously opened. The choice of antibiotics is based on clinical presentation, wound class, site, prior antibiotic exposure, colonization with antibiotic-resistant organisms, and local antimicrobial resistance patterns (13).

Wound exploration and debridement can often be performed in clinics, emergency rooms, or at the bedside to minimize patient discomfort. Mechanical debridement with forceps and scalpel or scissors is followed by serial debridement until no necrotic tissue remains and granulation tissue is present. In cases of deep SSI in abdominal wounds, prompt exploration in the operating room may be necessary to safely debride deeper tissue and facilitate abdominal exploration. Organ/space SSI poses greater risks and higher morbidity/mortality. Imaging is used to guide percutaneous drain placement into abscesses, while distinguishing an abscess from anastomotic leak can be challenging (14).

Wound management for opened wounds due to SSI involves healing by secondary intention with serial dressing changes. Dressings maintaining moisture and warmth facilitate healing and granulation tissue development. Negative pressure wound therapy (NPWT) provides an alternative to wound packing, promoting healing and protecting the patient's skin. However, the timing of NPWT application must be considered carefully. Delayed primary closure may be considered for some wounds to expedite healing, although risk of recurrent infection should be weighed (15).

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