The Role of Antibiotic Prophylaxis in Preventing Surgical Site Infections – A Systematic Review

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ABSTRACT

Surgical site infections (SSIs) are a significant concern in healthcare, arising at or near surgical incision sites. They can develop within 30 days post-surgery or within 90 days if a prosthetic material is implanted. Clinical manifestations of SSIs include local signs of inflammation (redness, warmth, swelling, and pus) and systemic signs (fever and leucocytosis). Risk factors such as age, chronic diseases (e.g., diabetes), smoking, and obesity contribute to the increased likelihood of SSIs. SSIs are classified into three categories: superficial, deep, and organ/space infections, each with varying severity and treatment requirements. Superficial SSIs are confined to the skin and subcutaneous tissue, while deep SSIs involve muscles and fascia. Organ/space SSIs affect internal organs and require more complex treatments. Effective antibiotic selection plays a crucial role in preventing and treating SSIs, with cefazolin being a first-line option due to its broad spectrum. Surgical antibiotic prophylaxis (SAP) aims to reduce microbial load and prevent infections through preemptive antibiotic administration, ideally minimizing resistance and adverse effects. Proper antibiotic use is vital to decrease the risk of SSIs and promote better patient outcomes. However, improper use can lead to antibiotic resistance and increased healthcare costs.

Keywords

Surgical site infection (SSI), antibiotic prophylaxis, superficial infection, deep infection, organ/space infection, cefazolin, antibiotic resistance, surgical complications, infection prevention, healthcare costs.

INTRODUCTION:

Definition: A surgical site infection (SSI) is an infection that occurs at or near a surgical incision or operation site. It can develop within 30 days after surgery, or within 90 days if a prosthetic material was implanted during the procedure.

Clinical Manifestations: Symptoms of an SSI include localized signs of inflammation, such as redness, warmth, swelling, and pus discharge. Systemic signs like fever and an increased white blood cell count (leucocytosis) are also common.

Risk Factors: Various factors can increase the risk of developing an SSI, including age, chronic health conditions (like diabetes), smoking, obesity, malnutrition, and immune system issues. The risk is also higher depending on the type of surgery and how clean or contaminated the wound is during the procedure [1,2,3&4].

Classification:

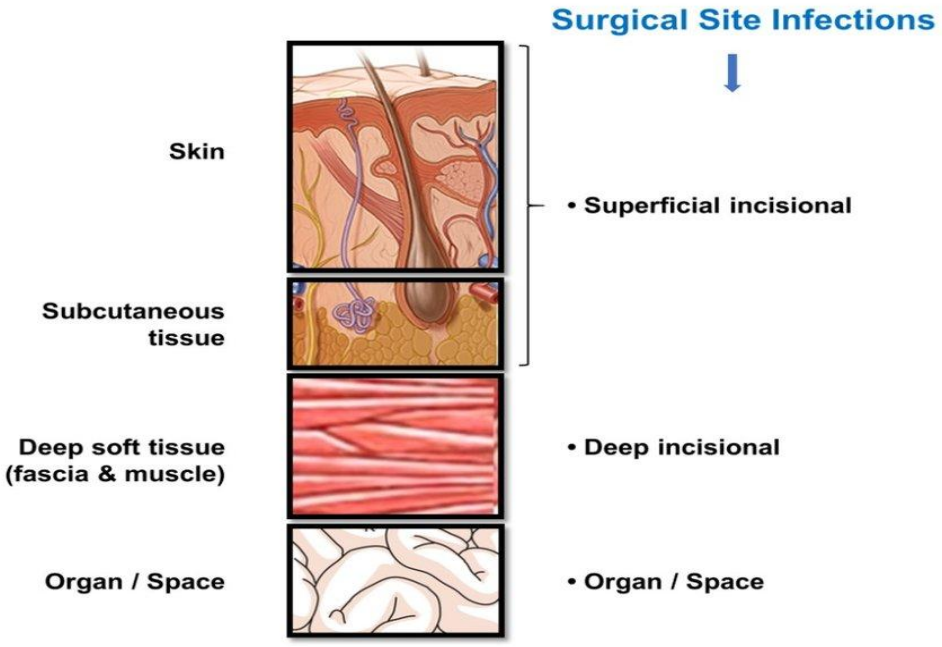
Surgical site infections (SSIs) are classified into three categories: superficial, deep, and organ/space infections. Each of these types can lead to significant surgical complications.

i. **Superficial SSIs**: These infections are confined to the skin and subcutaneous tissue, the outermost layers of the surgical site. Symptoms include redness, warmth, swelling, and pus discharge. Although they are usually less severe than deeper infections, superficial SSIs can worsen if not treated, potentially developing into more serious deep or organ/space infections.

ii. **Deep SSIs**: These infections affect the deeper layers beneath the skin, including muscle and fascia. They are more invasive and can lead to serious complications such as abscess formation, tissue death (necrosis), or damage to nearby structures. Deep SSIs often result in longer hospital stays, additional surgeries, and require intense medical care to treat the infection and prevent further complications.

iii. **Organ/Space SSIs**: These infections affect areas of the body other than the surgical incision site, including internal organs or body cavities. Organ/space SSIs are complex and difficult to diagnose, as they may involve vital organs. Treatment typically requires extended antibiotic therapy, and may also involve surgery such as reoperation or drainage. These infections need careful monitoring and a multidisciplinary treatment approach due to their potential for serious, long-term effects [5].

Figure: 1 Explains Classification of SSI



Appropriate Antibiotic Selection for Surgical Site Infections (SSI)

The protocols for selecting antibiotics for prophylaxis are well-established, prioritizing antibiotics with the most effective spectrum of activity against likely pathogens encountered during specific surgical procedures. These guidelines also take into account regional patterns of antibiotic resistance, ensuring that the chosen antibiotics remain effective in the face of local resistance trends. This strategic selection not only ensures the success of prophylaxis but also promotes antibiotic stewardship by reducing the unnecessary use of broad-spectrum antibiotics.

First-line antibiotics like cefazolin are typically preferred due to their broad spectrum of activity against common surgical pathogens and their well-established safety profile. These antibiotics are commonly used across many surgical procedures. Studies have shown that the use of prophylactic antibiotics significantly reduces the incidence of surgical site infections (SSIs). Among patients who received antibiotics post-surgery, the most commonly prescribed were cefotaxime (80.7%), metronidazole (63.5%), cefradine (13.6%), and amoxicillin/clavulanate (11.6%).

Improper use of antibiotics increases the likelihood of antibiotic resistance, which can also lead to higher medical costs. On the other hand, SSIs can result in increased hospital expenses, prolonged hospital stays, and, in rare cases, even death, even in otherwise healthy patients [6,7].

Surgical antibiotic prophylaxis (SAP) is a critical measure in preventing surgical site infections (SSIs). SAP involves administering an antibiotic to patients without active infections before surgery. These antibiotics are purely preventive, aiming to reduce the microbial load in the surgical field and prevent the body's defences from being overwhelmed. The ideal antibiotic for SAP should meet the following criteria:

- Prevent SSIs
- Reduce SSI-related morbidity and mortality
- Decrease the duration and cost of healthcare
- Be free of adverse effects
- Have no long-term impact on the patient's intestinal microbiota or the healthcare facility

To achieve these objectives, an antibiotic used for SAP should:

- Be effective against the most likely bacteria that could contaminate the surgical area
- Be administered in the correct dosage and at the right time to maintain adequate serum and tissue concentrations throughout the surgery
- Be safe for the patient
- Be used for the shortest possible duration to minimize adverse effects, prevent opportunistic infections, avoid the development of antimicrobial resistance (AMR), and reduce costs[8,9].

DISCUSSION

Surgical site infections (SSIs) are a common and significant complication following surgery, potentially leading to prolonged hospital stays, higher healthcare costs, and even death in severe cases. SSIs are classified into three types: superficial, deep, and organ/space infections, each with varying severity and treatment needs. Superficial SSIs are limited to the skin and subcutaneous tissues, presenting with symptoms like redness, warmth, swelling, and pus discharge. While generally less serious, untreated superficial infections can progress into more severe forms.

Deep SSIs affect the deeper layers of tissue, including muscle and fascia, often leading to complications such as abscess formation, tissue necrosis, and damage to surrounding structures. Organ/space infections, the most severe type, involve deeper internal organs and body cavities, and may be life-threatening if not promptly treated. These infections typically require extended antibiotic therapy and may require additional surgical interventions.

Effective antibiotic selection is crucial in preventing and treating SSIs. Prophylactic antibiotics administered before surgery help reduce microbial contamination and prevent infection. Cefazolin is commonly used as a first-line antibiotic due to its broad-spectrum effectiveness against common surgical pathogens. Appropriate use of antibiotics significantly reduces the risk of SSIs. However, the rise of antibiotic resistance, often due to misuse or overuse of antibiotics, is a growing concern that complicates treatment, increases healthcare costs, and leads to longer treatment durations.

Surgical antibiotic prophylaxis (SAP) is a preventive strategy where antibiotics are administered before surgery to decrease microbial load at the surgical site. The ideal antibiotic for SAP should be effective against the likely pathogens, safe for the patient, and given in the correct dose at the appropriate time. Limiting the duration of antibiotic use is crucial to prevent the development of antimicrobial resistance (AMR) and other adverse effects, such as disruptions to the patient's microbiota. Proper antibiotic stewardship is essential to ensure antibiotics are used effectively while minimizing the risks of overuse and resistance.

CONCLUSION:

Surgical site infections (SSIs) are a major concern in healthcare, leading to significant complications, increased healthcare costs, and extended hospital stays. The classification of SSIs into superficial, deep, and organ/space infections highlights the varying levels of severity and treatment needs. Effective antibiotic selection and surgical antibiotic prophylaxis (SAP) are crucial in preventing these infections. By choosing appropriate antibiotics, ensuring proper administration, and limiting their duration, the risk of SSIs can be minimized, promoting better patient outcomes and reducing the potential for antibiotic resistance. Proper management and stewardship are essential to combat the growing challenge of SSIs.

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