Surgical Site Infections in Orthopaedic Surgery: Risk Factors and Preventive Measures

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Introduction

The surgical site infections (SSIs) are devesting complications in orthopaedics. They are major burden to patients in terms of additional pain, long duration of hospital stay, escalation of hospital expenditure, poor outcome, high rate of morbidity and mortality [1]. Studies show that SSI patients have five times more chance to get readmission and two times more likely to die as compared to patients without SSI [2]. In recent years, increased number of complex orthopaedic surgeries and implant usage significantly contribute to SSI. Staphylococcus group of organisms are the leading cause of orthopaedic SSI [3]. Risk of recurrent infections were more with multi-resistant pathogens such as methicillin-resistant Staphylococcus aureus (MRSA) (10-20%) [4]. Even after several studies, there are controversies regarding risk factors and effectiveness of preventive measures.

Risk Factors

SSIs are multifactorial and preventable complications, influenced by several factors like patients’ characteristics, intraoperative and postoperative procedures. It may occur due to endogenous and exogenous exposure. The exogenous exposures being main cause, includes patients, hospital staff, IV drugs, blood products, air particles, instruments and fomites [5]. Meta-analysis done by Zhu et al [6] and Kunutsor et al [7] conformed patient-related factors.
Preoperative Measures

a. Patient education: Patient’s co-operation is essential in prevention of SSIs for better assessment of patient related factors and to maintain their personal and wound hygiene. It is also important for management of modifiable risk factors.

b. Management of modifiable risk factors: Smoking cessation before and even after surgery, glycaemic control, management of malnutrition and high-dose corticosteroid therapy tapering before elective orthopaedic surgery is beneficial in prevention of SSI [13,14]. World health organisation (WHO) [15] and centres for disease control and prevention (CDC) [16] both recommend the implementation of intensive perioperative glycaemic control in all the patients in order to decrease the risk of SSI. CDC recommends fasting blood sugar level less than 200mg/DL in all surgical patients and studies also recommend preprandial level of 90-130mg/dl, postprandial levels of 180mg/dl and hba1c levels less than 7% in elective surgeries[16-18]. However optimal timing, duration and delivery method of the control are yet be cleared.

c. Preoperative antibiotic prophylaxis: antibiotic prophylaxis is crucial for SSI control. Studies show that antimicrobial prophylaxis for orthopaedic implant surgery helps to reduce SSI rates to 1-3% as compared to 4-8% without antibiotic cover [13]. However, choice of antibiotic agents, their dosage and duration differs individually. Inappropriate administration of antibiotics has no role in prevention of SSI, instead it results in systemic toxicity, antibiotic resistance, raise of hospital expenditure and C. difficile infections. The selection of antibiotic is based on patient’s history of any allergic reaction and their sensitivity to organisms colonised in hospital. The half-life of the selected antimicrobial agent should cover the crucial time interval of SSIs. Most of the studies recommend first and second-generation cephalosporins as they are wide spectrum antibiotics, acting against both aerobic gram-positive and gram-negative bacteria, with excellent bactericidal activity, good distribution in bony, synovial and muscle tissues with very low systemic toxicity and reasonable cost [19-21]. However, with rise of MRSA infection in orthopaedic SSI, shifting of betalactum antibiotics to glycopeptide prophylaxis in all patients is still debatable due to lower efficacy of glycopeptides on MRSA and their inefficacy against gram-negative bacteria [19]. Studies show, combination of vancomycin and cephalosporins increases the risk of acute kidney injury and Clostridium difficile infection [22]. The modification of standard prophylaxis is required when local surveillance programmes show a high incidence of resistant microbial agents to the protocols in use. The dose must be adjusted according to the patient’s weight for every antibiotic to be
administered. The ideal time to administer the prophylactic antibiotic is prior to 30 minutes to 1 hour before the incision. It helps to achieve adequate tissue concentration from the time of incision to wound closure for effective prophylaxis against SSI [19,23]. However, timing also depends on specific antibiotic and its half-life. Usage of single antibiotic dose is recommended by some studies and is still debatable [14,19]. However, the antibiotic prophylaxis beyond 24 hours not recommended. It not only increases hospital expenditure and antibiotic resistance but also adversely affects the patient’s health [19].

d. Surgical site skin hair removal: This is practiced traditionally since long time. It helps in skin marking, suturing and application of adhesive bandage. But there is no evidence showing decrease in the chance of SSI [24]. However, the decision totally depends on operating surgeon. If hair removal is performed, it should be done with electric clippers instead of razors, immediately before surgery [14,19].

e. Preoperative bathing: Skin acts like reservoir for bacteria. Maintaining the personal hygiene of the operative staff and the patient is standard practice before any invasive intervention. WHO and CDC recommend patient’s bathing or showering prior to surgery on the day or the night before [15,16]. However, use and type of antiseptic agent is not clear yet.

f. Screening of MRSA and Bacteriuria: Studies recommend screening and nasal decolonization of MRSA. It helps in reduction of SSIs hence, decreasing the hospital cost. Only symptomatic bacteruia needs the treatment [14,19,25].

**Operative Room Measures**

a. Surgical site skin preparation: it helps to decrease the local bacterial load at surgical site. However, choice of antiseptic is debatable. Most commonly used antiseptics are chlorhexidine, isopropyl alcohol and 10% povidone-iodine. After many studies, WHO recommends to use CHG alcohol-based antiseptic solutions for surgical site skin preparation [15].

b. Surgical hand preparation: It is the most important step in prevention of SSIs as in most of the cases; strains from the surgeon’s fingers and postoperative infections are matching. However, effective antiseptic and ideal duration remains unknown. Some studies recommend alcohol based antiseptics and minimum 2-3 minutes for hand preparation [26].

c. Laminar flow ventilation system: Laminar flow (LF) is unidirectional flow to drive air, aerosols, and particles out of the room to reduce risk of SSIs. However, studies show laminar flow do not reduce the SSI significantly [27,28]. WHO suggests that LF should not be used to reduce the risk of SSI for patients undergoing TJA [15].

d. Traffic in operating room: It is one of the major source for environmental contamination in operating room. Studies recommend operating room traffic should be kept minimal [19].

e. Wound irrigation: The role of wound irrigation in prevention of SSI is not clear yet. Most of studies recommend irrigation with an aqueous povidone iodine solution of clean and clean-contaminated wounds decrease the risk of SSI compared to saline solution [15,16,29].

f. Adhesive drapes: WHO and CDC confirmed that the use of plastic adhesive drapes is not necessary for the prevention of SSI [15,16].

**Postoperative Measures**

The Proportion of SSI in postoperative ward care is still unknown. Studies fail to determine any superiority of one protocol or one topical agent over another in for prevention of SSI. Some studies proposed necessity for a prolonged, post-discharge
surveillance with a minimal follow-up of one year for implant-related surgery [14].

**Conclusion**

SSI in orthopaedic surgery is divesting complication. Aim should be targeted towards prevention of these complications. SSI can be prevented with multifocal interventions like better understanding of risk factors, causative organisms, proper preoperative patient management and strict hospital ward and operative room protocols.

**Bibliography**


