



Review Article

Implementation of Peri-Operative Strategies for Prevention of Surgical Site Infection

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ABSTRACT

Surgical site infection (SSI) is also known as nosocomial or health acquired infection which is increasing day by day and augmenting morbidity and mortality rate. The presence of the SSI shows the signs and symptoms including redness, pain, heat, presence of pus, and many more. Despite improvements in operational practice and contamination control strategies, SSI plays a major role in high morbidity and mortality and places a heavy burden on the resources of medical services. The purpose of this review article is collection of data that already exists about the pre-operative, intra-operative and post-operative strategies for prevention of the SSIs. The data about the SSI has been collected from the different review articles and research papers. Different keywords like prevention of SSI, cure from SSI, epidemiology of SSI, causes of SSI, and peri-operative strategies for prevention of SSI were used for data collection. Implementation of the pre-operative, intra operative and post-operative strategies can reduce or completely eliminate the surgical site infection. The morbidity and mortality rates that are directly linked with the SSI can be decreased by the alteration of different factors including operation theatre environment, treatment related factors and patient related factors. A proven and thorough strategy to lower the incidence of SSIs is SSI surveillance. Maintaining operation theatre quality is also essential for SSI reduction. But more research is still needed to improve the standards for regular infection control and surveillance in hospitals.

INTRODUCTION

Surgical site infections (SSIs) are described as infections happening in the span of 30 days after a surgical operation and influencing either the cut or deep tissue at the surgical site. This infection causes deep organ contaminations. Despite improvements in operational practice and contamination control strategies, SSI plays a major role in high morbidity and mortality and places a heavy burden on the resources of medical services. The frequency of the contamination can be decreased by implementing proper

techniques during surgical procedure. This requires a precise methodology with reference to risk factors connected with the patient, the strategy, and the medical environment [1]. In some cases, SSI infection can be superficial with only the involvement of the skin. The presence of the surgical site infection shows the signs and symptoms including redness, pain, heat, presence of pus, and many more. SSI is the third most commonly reported nosocomial infection in the patients. SSIs increase the

mortality rate and it is a hospital-acquired infection. In the mid of 19th century, fever developed in the patient, followed by the drainage of the pus from the incision. Postoperative infection ratio was decreased by implementing techniques of antiseptics properly. This thoroughly changes surgery by decreasing the surgical site infection and death rate [2]. Prior to the surgical incision, the skin of the patient at the site of operation is cleaned with an antiseptic solution in the operating theater. The purpose of disinfecting the skin is to reduce the amount of microorganisms present on the skin and, therefore to reducing the risk of surgical wound infection [3]. Surgical wounds have following different classifications. Clean wounds, clean-contaminated, and fully contaminated wounds are included in this classification. It depends on the area of the incision, the level of infection and the area of inflammation. Infection is less likely to occur after a surgical operation if it is classified as clean. The report of different studies shows that external and internal factors can also cause surgical site infections. Internal factors are patient-related i.e., older age, dehydration, co-existing disease and diabetes, and external factors are surgical procedure-related i.e., procedure's length, working ethics of the surgeon, stability of pre-operative skin preparation, and availability of antibiotic prophylaxis [4]. Different studies show that microorganisms play a vital role for causing surgical site infections. The microorganisms *Staphylococcus aureus* and *Methicillin-Resistant Staphylococcus aureus* (MRSA) are main causative microbes for causing SSI. *S. aureus* and MRSA cause medical complications, which result in increased postoperative hospital stay and ultimately increasing hospital expenses [5]. According to the Centers for Disease Control (CDC), there are four main types of wounds. A clean wound is one that is not infected, is not inflamed, and has not yet been reached by the alimentary, respiratory, genital, or uninfected urinary tracts. Blunt trauma surgical incisional wounds; clean-contaminated wounds, the surgical wounds that are entered by sterile techniques such as the gastrointestinal, respiratory, vaginal, or urinary systems; and contaminated wounds include open or accidental wounds that are highly contaminated. For instance, acute inflammation is prevalent after procedures with significant blockage brought on by leaks from the gastrointestinal tract and incisions that do not contain pus. These procedures primarily involve filthy, infected wounds, traumatic wounds, and lacerated wounds as mentioned in Figure 1 [6].

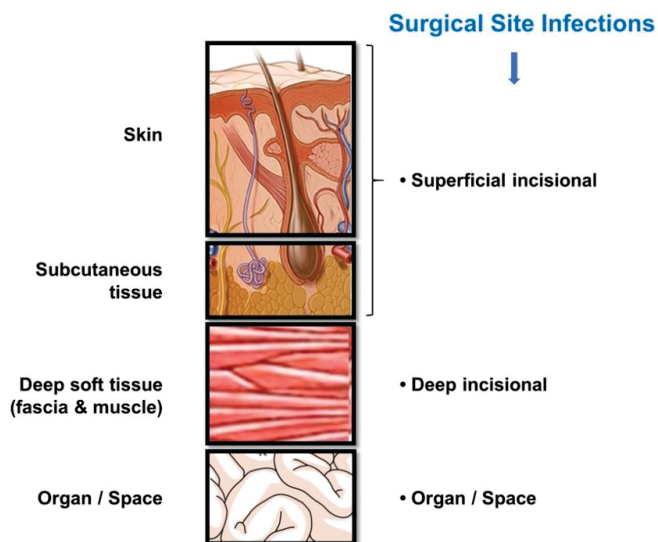


Figure 1: Proliferation steps for causing SSI [6]

METHODS

The information about the SSI has been collected from the different review articles and research articles. Analyses of the many articles, review articles, and deep study of the databases have been used to get information about peri-operative strategies of SSI. Different keywords like prevention of SSI, prevention of SSI, Epidemiology of SSI, causes of SSI, peri-operative strategies for prevention of SSI were used for information collection.

Risk Factors for Surgical Site Infection

Patient-Related Factors

In the favor of patient-related risk factors, the top risk factors are serum albumin concentrations and advanced age. The serum albumin concentration is a nutritional status indicator. The serum albumin is important as an index of surgical risk [7]. Old age is another component, given the probability that old patients have organ dysfunction and comorbidities and get treatment indicating anticoagulation and corticosteroids that augment further the risk of disease. In a worldwide populace described by expanding age and by elevated standards of life prolongation, numerous surgeries are presently done on older patients highlighting different risk factors and related multi-morbidities [8]. For instance, older patients with the malignant growth of the upper gastrointestinal tract regularly have disabled physiologic capability, unhealthiness, and a depressed immune response and logically will go through a clean-contaminated procedure, seriously endangering them for SSI. Physiologic changes and organ malfunction describe increasing age, including all body systems that influence adversely the patient's response to operation. Increasing age, usually more than 65 years, predicts a higher chance of

SSI multi-morbidity [9].

Treatment-Related Factors

Lack of implementation of proper surgical techniques and insufficient concentration on the procedure's technical flaws can cause infection after the procedure [10]. Following are the strategies for the prevention of SSIs as mentioned in Figure 2 [4].

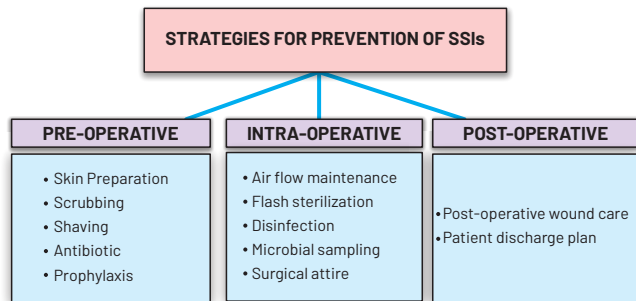


Figure 2: Strategies for the prevention of SSIs [4]

Pre-Operative Strategies

Pre-operative strategies include skin preparation to decrease risk of infection. For this purpose, mostly used anti-septic agents contain alcohol products, chlorhexidine gluconate and iodophors. Alcohol including ethyl alcohol or isopropyl alcohol is considered most viable for the preparation of the skin. The volume of ethyl alcohol used is 60-90%, and isopropyl 50-90% [11]. Alcohol has bacterial, fungicidal and virucidal properties, but few spores show resistance to alcohol [12]. According to the CDC instructions, "hand hygiene" can help to decrease the transfer of microorganisms that cause surgical site infection. Trimming of the nails and the proper use of an antiseptic agent for cleaning and its drying are the guidelines that are provided by the CDC for control of SSIs. Shaving of the procedure site causes an increase in SSIs (5.6%) as compared to the removal of hair by other method (0.6%), traumas caused by shaving in the skin provide favorable condition to bacteria for growth and provide a medium for replication [13]. Proper educational programs and policies should be created among health departments to decrease the infection linked with microorganisms associated with movement of patients, which in turn limit hospital-acquired infections among after surgery patients. Before the surgical procedure, the delivery of antibiotic prophylaxis has been shown to seriously decrease the risk of infections related to surgical procedures. The use of antibiotic drugs prophylactically permits the availability of proper concentrations in tissue so, decrease microbial load and inhabitation at the incision area [14]. The SSI can be reduced by the administration of the antibiotics, known as the antibiotic prophylaxis and thus, it is effective or beneficial for most of the situations. Improper administration of the antibiotic can be harmful instead of

positive response. Antibiotic prophylaxis is not the exact cure, its administration before the procedure may prove beneficial or harmful for patients [15]. The patient should be evaluated for factors that can be treated in the preoperative period. The skin lesions should be permitted to heal if possible, and the patient should be liberated from bacterial diseases of any sort before the elective medical procedure. The patient should stop smoking, if possible, ideally before the medical procedure. The patient should not be shaved the prior night, as the chances of SSI are plainly expanded by microscopic organisms that colonize the little cuts and scraped spots. Specific consideration should be paid to the nutritional status as well. Just 5 days of nutritional carefulness can reduce the risk of SSI effectively [16].

Patient Preparation

Where possible, recognize and treat already present disease, and try to defer a medical procedure through conservative method of giving medicine. Try not to shave hair on all sides of the incision site, except if it will disrupt the procedure. Presuming hair to be removed, this should be done beforehand, preferably with trimmers. Avoid higher blood sugar levels in diabetic patients, this will help to avoid perioperative hyperglycemia. Recommend the patient to avoid tobacco and ask patients to shower with a sterile solution essentially the night prior to the procedure. Wash the area around the incision site to eliminate contamination prior to implementing germ-free skin preparation. Use highly effective antiseptic solution for the preparation of skin like povidone-iodine [4]

Hand Scrubbing of Surgical Team

The person or individual who has to be in direct contact with sterile field or operating area or supplies that are used in OT should wash their hands up to forearms with appropriate asepsis techniques just before doing or wearing gown and gloves. The antiseptic should have a broad-spectrum activity [17]. The most common antiseptics nowadays are Povidone-iodine and chlorhexidine gluconate. There are some factors that increase the effectiveness of scrub and these are techniques of the scrubbing, duration of scrubbing, drying and gloving techniques. At least, two minutes of proper scrubbing is effective than traditional scrubbing. Keep nails trimmed and avoid wearing artificial nails prior to procedure. Perform scrub for 2 to 5 minutes utilizing a suitable germ-free solution preoperatively. After carrying out the hand scrub, stay your hands up and away from the body surface. Dry your hands with a sterile cloth and wear a clean surgical gown and hand gloves [18].

Management of Infected Surgical Staff

Contagious disease symptoms and side effects should be made known to surgical employees so they can alert their

managers and the occupational health administration right away. Develop distinct approaches regarding patient consideration obligations when personnel have possibly contagious situations. It is necessary that hospitals implement policies that are effective against the transmission of the microorganisms from personnel to patients. The policies should maintain the hospital acquired disease, hospital related exposure and exclusion of ill person from hospital or from contact of patient. Policies should be powerful that can eliminate ill personnel and should encourage the ill personnel to provide information when they are ill [19].

Antimicrobial Prophylaxis

Manage antibacterial prophylaxis just when necessary and choose the agent as per viability against most normal microbes related to a particular operation. Give the IV-coordinated initial dosage so that tissues and antibiotics have bactericidal concentrations when the surgical cut is made. Prepare the colon physically by using enemas and cathartic agents prior to any elective colon-related procedures. Make sure the administration of oral antibiotics before procedure [4].

Intra Operative Strategies

Surgical site infection may be the result of microbes that are present on the surgical incision [20]. Ventilation and humidity of the OR are significant factors in diminishing the chance of surgical site infection. To try not to get possibly contaminated air arriving at the careful suite, in the surgical operation room (OR), pressure should be positive as compared to outside the room. For best results, there must be no less than fifteen air changes per hour. To stop the growth of molds and organisms, humidity must be preserved at a distinct level [21]. Natural surfaces are not spreading infections. The surfaces that look clean but not actually, they spread the infection. The disinfection of the OR with a disinfectant before the next case can reduce the surgical site infection. The disinfectant should be approved by the environmental protection agency (EPA). As per Occupational Safety and Health Administration (OSHA) prerequisite, surfaces of the hospital ought to be cleaned after exposure to blood or other body fluid. At the end of night or day, a disinfectant authorized by the EPA, should be used on a routine basis for cleaning the floor and walls of the operation theatre [22]. The mats have no role in the reduction of microorganisms that are present on wheels of stretchers or shoes. So, there is no need for mats in the hospital [23]. Infections at the surgical site can be managed if the anesthetic team and those in scrubs follow aseptic procedures. Different studies connected with theatre visits uncovered that anesthesia staff were involved in the spreading of microbes while putting intravascular devices like ETT (endotracheal tubes) and IV

(intravenous) medicines. The wrong accomplishment of aseptic techniques during surgical procedures can cause infection after the surgery. But the proper implementation of surgical and aseptic principles can decrease the SSIs rate. There are some factors that increase the surgical site infection rate, including sutures, implants, drains, etc. Some studies show that the surgical site infection rate can be decreased by using suction drains in place of open drains [24].

Ventilation

The aim of the laminar airflow is to clean air in aseptic operating field with recommended air changes per hour. Laminar airflow can be vertical or horizontal, air passes through HEPA filters repeatedly. The pressure should be positive in the operating room through doors and related areas. Make sure minimum 15 air changes per hour, including 3 fresh air vents. Filter all air through proper channels. Introduce all air at the roof, and exhaust close to the floor. Avoid use of UV radiation in the operating room to prevent SSI. Keep the operating room doors closed throughout the process, with the exception of when moving personnel, equipment, and patients [23].

Sterilization of Instruments

Sterilize all surgical instruments according to recommended guidelines. Flash sterilization is only for the emergency situation. Strategies and techniques should guarantee that the sterilization and disinfection processes follow the principles of disease avoidance as set out by CDC and World Health Organization. Strategies and methodologies should be assessed and endorsed by the Disease Prevention and Control Committee. They should be promptly available to staff doing the reprocessing. Review of reprocessing strategies and techniques should occur at least every year [25].

Attire and Drapes for Surgical Procedure

Use the mask that fully covers the mouth and nose area while entering the operating room. Use face mask during the whole procedure. Use a cap to cover fully the hair while entering the OT room. Wear shoe covers to prevent SSI. Surgical team members are advised to wear sterile gloves. Wear gloves after surgical gown. Use drapes and gown which are good barriers when wet [4].

Surgical Techniques and Asepsis

Follow rules of asepsis while inserting IV devices or when giving drugs. Hold tissue softly, sustain hemostasis and eliminate dead tissues from the incision site. Always use a closed suction drain. Remove the drain as soon as possible [4].

Post-Operative Strategies

Depending on the type of wound the patient has, aftercare of the incision or wound is required. Closed skin incisions and open incisions are the two most typical kinds of

incisions. In a close incision, the doctor will cleanly bandage the wound; in an open incision, the incision will stay visible while it heals. In the open incision, it should be loaded with a sterile dressing to reduce the risk of infection. The open wound or incision is filled with sterile gauze pieces that contain an antiseptic solution and left the incision for healing. ACS (American College of Surgeons) gives some protocols to change the dressing of incision, including clean gloves and sterile instruments [26]. The risk of SSI can continue for as long as one month after a procedure or for up to one year after the procedure in which the patient is given implants. Currently, patients are discharged timely even before surgical incisions have been healed. The doctor will provide guidance about healing and how to deal it. After a few days of the procedure, most of the wounds start healing. For this type of wound, there is no need for filling of gauze, but covering the area of the wound and changing of the bandage on regular basis with appropriate hygiene may increase the wound healing and protect the wound from further infections. The aim of the discharge planning is to maintain the reliability of therapeutic incision, give awareness about the symptoms of infection, and completely guide the patient about the disease that patient have [27].

Incision Care

Cover the wound with the clean bandage up to 48 hours after surgery. Wash your hands before and after changing dressings. The purpose of dressing after the procedure is to provide a barrier between wound and the microorganisms, this ultimately reduce the surgical site infections. Use the dressing which absorb the exudate of the wound and provide physical protection [28].

Surveillance

The Observation of SSIs, and revealing proper information back to doctors, has been proved to be viable parts of strategies to minimize the risk of SSI. The CDC rules suggest that both direct and indirect strategies ought to be used to record the occurrence of SSIs related with special strategies and that this information should be reported back to the surgical team. For the purpose of identifying SSI in cautious inpatients and short-term patients, follow the CDC control methods for SSI without modification. Use a strategy that complies with readily available resources and information requirements for case finding in the near duration. "Record" the variables that have been shown to be associated with an increased risk of SSI for each patient participating in an activity that has been selected for observation [4, 28].

CONCLUSIONS

To summarize, the implementation of pre-operative, intra operative and post-operative strategies can help in

reducing or completely eliminating the risk of surgical site infection. The morbidity and mortality ratios that are directly linked with the SSI can be decreased by the alteration of different factors including OT environment, treatment related factors and patient related factors. Complete contribution of all individuals including operation theatre staff, manager, surgeons, nurses, and all staff can reduce the SSI ratio. The CDC recommendations for prevention of SSIs emphasize the importance of good patient preparation, aseptic conditions, and adherence to sterile surgical procedure. Antimicrobial prophylaxis is also advised in specific situations. All in all, SSIs prevention calls for a comprehensive strategy and the involvement of everyone concerned, including those in charge of operating room layout, design, and management. To further decrease infection, additional study into prevention strategies and strict adherence to the application of recognized evidence-based techniques to mitigate SSIs are still needed.

Conflicts of Interest

The authors declare no conflict of interest.

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