Infections of the Surgical Site: An Overview

Mohammed Wasif

Intern, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar-751003, Odisha, India

Abstract

Surgical site infection is a type of nosocomial infection that not only increases the medical expenses of the patient but also the risk of fatality. It is of major concern as the patient has come for treatment of diseases and getting a new infection due to negligence in following sterilization and asepsis protocols during surgery. Therefore the article enlists the method on how to manage SSI.

Keywords: *Surgical site infections, risk factors, intra-operative, and post-operative management protocols.*

Introduction

Surgical site infections or SSIs are among the principal hospital-acquired infections. As per the latest studies its occurrence is around two to eleven percent of the total surgical operations. SSIs cause an increase in health care expenditures, an increase in hospital stay, and increased death rates.[1]

Categorization of SSI:

1. **SSIs are categorized into:**

Superficial–start in less than thirty days post-surgery, affect the skin as well as subcutaneous tissue;

Deep–start post thirty days or in less than one year (on condition that a foreign particle got into the fascial spaces and muscle;

Infection of the organ or body spaces found near the incision area – occurs in less than thirty days to one year (if a foreign particle got into it).

2. Wounds of the surgical site are categorized into 4 categories based on how hygienic or dirty the wounds are:

Corresponding Author:
Dr. Mohammed Wasif
Intern, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar 751003, Odisha, India
e-mail: mwasifcool7@gmail.com

Type 1 type of wounds: clean wound where the occurrence of infection is less than two percent;

Type 2 types of wounds: clean or dirtied wound where the occurrence of infection is less than ten percent;

Type 3 type of wounds: dirtied wound where the occurrence of infection is nearly twenty percent;

Type 4: dirty or infected wound where the occurrence of infection is less than forty percent.[2]

Microorganisms responsible for SSI:

- *Staphylococcus epidermidis* (Commonly seen but only causes disease sometimes)
- *Staphylococcus aureus* (Rarely occurs, disease-causing in nature)
- *Staphylococcus warneri* (Rarely occurs, sometimes disease-causing in nature)
- *Streptococcus pyogenes* (Rarely occurs, disease-causing in nature)
- *Streptococcus mitis* (Commonly occurring, causes disease sometimes)
- *Propionibacterium acnes* (Commonly occurring, sometimes causes diseases)
- *Corynebacterium* spp. (Commonly occurring, sometimes causes diseases)
- *Acinetobacter johnsonii* (Commonly occurring, sometimes causes diseases)

- *Pseudomonas aeruginosa* (Rarely occurring, sometimes causes diseases)[3]

Components affecting SSI:

Factors depending on the patient: Age of the patient, nutrition of the patient, uncontrolled diabetic patients, regular Smokers,obese patients, parasitic infestations, colonization with drug-resistant disease-causing microbes, Immuno-compromised individuals,Time period of hospital stays prior surgery and post-surgery.

Factors depending on Surgery: Sanitization of the skin, removal of hair from the skin, peri-operative antibiotic dosage, time period of surgery, improper instrument sterilization, air ventilation or conditioning, foreign particle inside the wound, drainage of the surgical site, insufficient hemostasis, significant surgical trauma.[4]

Prevention of SSI:

Preoperative phase:

Surgical site shaving:

It has been seen that the use of bladed razors makesmicro-injuries on the epithelium. Therefore it increases the chances of SSI. Hence hair removal is usually done with the help of an electrical razor which has a one-time use tip which is used just before the patient is sent to the operating room.[5]

Nutritional status of the patient: Nutrition deficiency or improper nutrition hurts the patient's condition and surgical results. Two method could be used for assessment of the person's nutritional status:

- Nutritional-Risk Screening
- Nutritional-Risk Index[6]

An assessment of the association involving malnutrition

And SSI usually includes the mode and degree of surgical interference.

Obesity (BMI greater than thirty) influences the healing of the by various means. The subcutaneous tissue blood supply in overweight patients may not be enough and it may not supply proper O2 whereas tissue healing has an increased metabolic requirement and insufficient O2 supply reduces the speed of the entire process. Cells that provide immunity have an increased O2 demand, which is used for the production of anti-microbial oxygen compounds.[7]

Immuno-suppressive treatment: An examination conducted by Berthold et al shows that the immuno-suppressive treatment damages healing of the wound and raises the chances of occurrence of infection. Stoppage of immune-suppression may cause aggravation of the disease which was already present. The guidelines given by The Society for Healthcare Epidemiology (America), recommended the stoppage of immunosuppressive therapy before and after surgery as long as it is possible.[8]

Use of antibiotics for prevention of SSI: Prophylactic therapy of antibiotics is usually given for clean or dirtied wounds and clean wounds with foreign particles. Usually, for a clean wound, we use cephazolin or cefuroxime or vancomycin. For contaminated wounds, the person must not be usually given a prophylactic treatment but a full antibiotic course.[9]

Intraoperative phase:

Operating room: When a patient who has undergone surgery goes through the process of healing, for it to happen without complications of infection, the patient should be placed in hygienic surroundings. The correct planned operating room must have regions that constantly increase in sterility. The hospital staff must walk amidst areas where scrubbing takes place to reduce contamination of the OR environment with disease-causing microbes. The essential step when considering planning of OR is the differentiation of the clean and the dirty areas of the room from each other.

Sanitization of the surgical area: The objective is to decrease the pathogens which naturally occur inside the superficial layer of skin, and restrict the growth tendency of disease-causing organisms pre-surgery and post-surgery. Frequently substances used for skin decontamination before surgery consists of an alcohol solution of chlorhexidine gluconate as well as povidone-iodine. Chlorhexidine gets absorbed by proteins that contain phosphorous inside the cell wall of the bacteria. At bacterio-static quantity, the solution gets into and destroys the membrane of the cell which causes seepage of structures of the cytoplasm. When it reaches bactericidal quantity, it gets into the cell of the bacteria and permanently attaches itself with Adenosine-triphosphate of the cell as well as nucleic acids. Chlorhexidine has fungi-static and fungicidal properties and usually kills

viruses of some types. The least amount required to stop bacterial virulence is usually lesser for Gram-positivebacteria compared to Gram-negativebacteria because chlorhexidine shows more likeness to the Gram-positivebacterial wall of the cell. Povidone-iodine comprises a normal solution containing one percent iodine which is free. Iodine seeps inside the cell wall causing oxygenation of cysteine as well as iodination of the other amino-acid compounds as well as fatty acids which are not saturated which results in a decrease in protein production a well as the injury of the cell wall. Iodine, which is useful for treating infections due to Gram-positivebacteria and Gram-negativebacteria and a couple of bacteria that form spores, Mycobacteria, virus, and also fungi. Dissolving chlorhexidine along with povidone-iodine/ethanol/isopropylethanol increases bactericidal action. The alcohol damages proteins as well as increases the killing of the bacterial cell. It's effectiveness in opposition to *Staphylococcus aureus* which is methicillin-resistant, Enterococci which is vancomycin-resistant, and *Mycobacterium-tuberculosis*.

Studies have been conducted which compare chlorhexidine and povidone-iodine confirmed that both the materials demonstrate comparable anti-bacterial action. Chlorhexidine operates for an increased duration of time by combining with the skin as well as the proteins of the mucous membrane. As opposed to povidone-iodine, its function is unchanged when in contact with blood/any other type of body fluid. There are statements regarding the effectiveness of chlorhexidine as well as povidone-iodine which are contradictory. Considering the meta-analysis which was done by Lee et al (which also includes the nine randomized controlled trials), the better usefulness provided by chlorhexidine can be concluded but the significance of the examination has been argued upon since multiple studies have compared alcohol chlorhexidine solution and povidone-iodine solitarily. During meta-analysis which was done by Priviter et al which was for comparisons between alcohol solution of chlorhexidine as well as povidone-iodine, it was established that usage of chlorhexidine results in the decreased occurrence of SSI.[10]

Sanitization of hands: The bacteria which are found on the naked hand of the medical personnel may be leading to the causation of infections that are acquired at the hospital. The Gram-negativebacilli as well as Staphylococcus-aureus are the primary components of skin bacteria. Chlorhexidine-solution usually provides surgical sterility through a decreasing number of bacteria. Chlorhexidine has been depicted as a wide spectrum and increased duration of antibacterial action, while alcohol quickly begins taking action. Substances that contain chlorhexidine as well as alcohol mix the property of quick initiation of alcohol along with the increased duration of the consequence of chlorhexidine. Hence are considered most successful.[11]

Phase after surgery: Post-operation wound cleanliness is important. The best method is considered to be the 'no-touch' method which is to avoid touching the wound as well as dressings with non-sterilized hands. Sterile saline must be utilized for sponging or washing the wound. After 48 hours post-surgery, the patient should wash or herself with mild detergent (soap) preferably having antimicrobial properties. It's usually not advised to utilize local antimicrobials or topical antimicrobials to decrease the chances of occurrence of infection. Clinically, the infection presents itself as: Localized reddishness of skin,tenderness,increase in temperature of the site,fluid-filled spaces, pus containing discharge.

In treating SSI, importance is given to opening the area of infection as well as draining the purulent areas. Infections of deeper tissues require draining the area but infection of superficial tissues requires only limited draining of the area which is affected. Fibrins/suture as well as the staple is gotten rid of/tissue debriding must be done to remove the dead cell of the wound. SSI is usually treated with different types of antimicrobials which depend on open the surgeon's choice (for example, solution of povidone-iodine H2O/octenidine-dihydrochloride). The concentrations antiseptics which are commonly in use are almost a hundred times more when compared with the minimal inhibitory concentration of the same compound. Hence these substances kill the bacteria which have developed slight resistance against these antiseptics. The 2014 guidelines of Infectious Diseases Society of America, the usage of antibiotics is not necessary if there is a minimum infiltrate results from inflammation which is lesser than five centimeters near the surgical site with none of the signs of general infection established as fever which is less than thirty-nine degrees Celsius as well as the rate of the heartbeat which is less than hundred and ten per minute. Although, it is mandatory to recommend the initiation and anti-biotics if inflammation near the surgical site becomes greater than five centimeters as well as the sign of general inflammations occur. While making a choice of the 1st-line of therapy, localized epidemiological

situations, and the Gram-staining process of smears of the wound must also be taken into consideration.

Indications for microbiological studies for SSI patients include: Intense screening, the requirement of an anti-biotic therapy,the inclusion of evaluation of drug-resistant disease-causing bacteria,allergic reactions of any kind to the first-line of therapy. In case of there are suspects regarding infections which are caused by staphylococci, cefazoline, cefuroxime/cloxacillin may be useful. For the infections which are caused by MRSA, it is correct to use linezolid or glycopeptide. When there are suspects regarding infection caused by Gram-negativebacteria, the first-line of antibiotics are usually 2nd or 3rd generation cephalosporins or fluoroquinolone. When dealing with the complications of deep as well as non-healing wound, negative pressure treatment is usually taken into consideration. The negative pressure allows the proper supply of blood to the site of wound by increasing the formation of new blood capillaries and thus increases the rate of formation of tissue which is granulomatous. Treatment by negatively applying pressure in case of the wound which is infected is considered safe but it usually precedes debridement and initiation of target antibiotic treatment.[12]

Conclusion

Surgical site infection is a type of nosocomial infection that not only increases the medical expenses of the patient but also the risk of fatality. It is of major concern as the patient has come for treatment of diseases and getting a new infection due to negligence in following sterilization and asepsis protocols during surgery. Therefore the article enlists the method on how to manage SSI.

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