Available online on 15.04.2019 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Research Article

A study on evaluation of risk factors and anti-microbial prophylaxis in the prevention of surgical site infection

Deepthi Shenoy, Keerthana Nalluri, C Manasa, Pradeep Reddy, R Srinivasan*

Department of Pharmacy Practice, PES College of Pharmacy, Bengaluru, Karnataka, India-560 050

ABSTRACT

Background: Surgical site infections are potential complications associated with a type of surgical procedure. Although surgical site infections are among the most preventable healthcare associated infections, they still represent a significant burden in terms of morbidity, mortality and addition costs to healthcare systems and service payers worldwide. Appropriate antibiotic prophylaxis has shown to be effective in reducing the incidence of surgical site infections.
Aim: The aim of the study is to carry out an evaluation of the risk factors and prophylactic antibiotics used to prevent surgical site infection in surgeries performed in an NABH accredited quaternary care hospital in Bengaluru, Karnataka.
Objective: To evaluate patient related risk factors contributing to the incidence of surgical site infection. To evaluate the prophylactic anti-biotic used in the prevention of post-operative surgical site infection and to determine the incidence of surgical site infection.
Methodology: Subjects who meet the study criteria will be enrolled in the study. Collection of patient related data with subsequent identification and evaluation of risk factors and prophylactic anti-biotics, and calculation of incidence of surgical site infection using statistical analysis.
Results: In this study, on observation of 372 surgical cases, it was estimated that 1 in 10 patients acquired Surgical Site Infection within 30 days post-surgery.
Conclusion: Conclusively, it can be said that the incidence of surgical site infection varies by different patient and procedure factors as well as prophylactic anti-biotic properties. They particularly show greater association to age, gender, certain comorbidities (like diabetes mellitus, chronic lung disease, and renal insufficiency), and duration of surgery, administration of prophylactic antibiotic, frequency, timing and dose. Therefore, greater care must be taken for every specific patient and procedure and also choice of antibiotic prophylaxis.

Keywords: Surgical site infection, risk factors, prophylactic anti-biotics.

Article Info: Received 18 Feb 2019; Review Completed 24 March 2019; Accepted 26 March 2019; Available online 15 April 2019

Cite this article as:

Shenoy D, Nalluri K, Manasa C, Reddy P, Srinivasan R, A study on evaluation of risk factors and anti-microbial prophylaxis in the prevention of surgical site infection, Journal of Drug Delivery and Therapeutics. 2019; 9(2-s):159-166
http://dx.doi.org/10.22270/jddt.v9i2-s.2477

***Address for Correspondence:**

Dr. R. Srinivasan, Head of the Department, Department of Pharmacy Practice, P.E.S. College of Pharmacy, Hanumantha nagar, Bengaluru, Karnataka, INDIA - 560 050

INTRODUCTION

Surgical site infections (SSIs) are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site. SSIs are potential complications associated with any type of surgical procedure. SSIs are the third (14-16%) most frequent cause of nosocomial infections among hospitalized patients, and the primary (40%) cause of nosocomial infection in surgical patients. Although SSIs are among the most preventable HAIs[1,2], they still represent a significant burden in terms of patient morbidity and mortality and additional costs to health systems and service payers worldwide (3-11). SSI is both the most frequently studied and the leading HAI reported hospital-wide in LMICs[3,4]. For these reasons, the prevention of SSI has received considerable attention from surgeons and infection control professionals, health care authorities, the media and the public. In particular, there is a perception among the public that SSIs may reflect a poor quality of care.

The surveillance of HAI is one of the core components of an effective healthcare programme[1,2]. Surveillance is defined as "the ongoing, systematic collection, analysis, interpretation and evaluation of health data closely integrated with the timely dissemination of these data to those who need it". However, defining, detecting, reporting and interpreting HAI, including SSI, is challenging and requires expertise, time and resource dedication. The primary aim of surveillance is the collection of data on SSI rates in order to obtain a measure of the magnitude of the problem. These data must then be analysed to identify and investigate trends, including a careful interpretation of results. Finally, surveillance data should guide the

identification of improvement actions and evaluate the effectiveness of these interventions. In this context, the feedback of SSI rates to relevant stakeholders is important.

The importance of post-discharge surveillance it is estimated that a significant proportion of SSIs are detected following patient discharge. This proportion varies across settings and according to different definitions, but it has been estimated to be between 13 to 71% (25). The fact that hospital length of stay has been steadily decreasing over the past decades has probably contributed to shifting the burden from inpatient to outpatient infections.

Monitoring the incidence of surgical site infections is hampered by the lack of agreed measuring systems. In particular, to monitor the rates of surgical site infection within an organisation, or to benchmark between organisations, there needs to be a standard approach to diagnosis. Criteria for such a definition have been developed by the Centres for Disease Control and Prevention (CDC). More detailed surgical site infection scoring systems have been developed but these are time consuming to use.

Traditionally, the risk for SSIs has been stratified by surgical procedure in a classification system developed by the National Research Council (NRC; Table 127–1).The NRC classification system proposes that the risk of an SSI depends on the microbiology of the surgical site, presence of a pre-existing infection, likelihood of contaminating previously sterile tissue during surgery, and events during and after surgery[5,6]. A patient's NRC procedure classification is the primary determinant of whether antibiotic prophylaxis is warranted. However, because a patient's NRC wound classification is influenced by surgical findings (e.g., gangrenous gallbladder) and perioperative events (e.g., major technique breaks), categorization generally occurs intraoperatively[7].

According to the Centers for Disease Control and Prevention's (CDC) National Nosocomial Infections Surveillance System (NNIS), 3 SSIs can be categorized as either incisional (e.g., cellulitis of the incision site) or organ/space (e.g., meningitis). Incisional SSIs are subcategorized into superficial (involving only the skin or subcutaneous tissue) and deep (fascial and muscle layers) infections. Organ/space SSIs can involve any anatomic area other than the incision site. For example, a patient who develops bacterial peritonitis after bowel surgery has an organ/space SSI. By definition, SSIs must occur within 30 days of surgery[8,9].

Many surgical site infections, for example, those involving prosthetic joints, often develop late (>28 days post-operation), so post-discharge surveillance schemes are essential. Patients need to be aware how a surgical site infection may present after discharge from hospital. Surveillance of surgical site infections and feedback to the surgical team has been shown to reduce rates of infection[10,11].

Risk factors:

Whether a wound infection occurs after surgery depends on a complex interaction between the following:

Procedure-related factors: Implantation of foreign bodies, degree of trauma to host tissues, duration of the surgery, type of the surgery, type of the surgical wound and experience of surgeon.

Patient-related factors: Host immunity, nutritional status and the presence or absence of diabetes, chronic lung disease, social habits (smoking and alcohol).

Microbial factors: Tissue adherence and invasion.

Peri-operative antimicrobial prophylaxis: Appropriate anti-biotic, dose, frequency of dosing, time the dose was given.

Prosthetic implants: Medical implants have a detrimental effect on host defences such that a lower bacterial count is needed to initiate infection. Hence, there is a greater risk of infection during implant surgery. Bacteria growing on an abiotic surface, such as a prosthetic hip implant or heart valve, together with a protective layer of microbial polymers are known as a biofilm. Anti-microbials are frequently ineffective against micro-organisms growing in biofilms, making treatment of implant infections problematic and their prevention even more important.

Duration of surgery: The longer the operation, the greater is the risk of wound infection. This, in turn, may be influenced by the experience (Fig. 39.2) speed and skill of the surgeon and is additional to the classification of the operation by risk of infection, for example, clean, contaminated, dirty or infected.

Patient related factors: A number of patient related factors are known to influence the likelihood of developing a surgical site infection and include the following:

Wound potential for infection, for example, clean, contaminated, dirty or infected site.

Physical status of patient

Smoking: Smoking increases the risk of developing a wound infection. The mechanism is not known but tobacco use may delay wound healing via the vasoconstricting effects of nicotine and thus increase the risk of infection.

Diabetes mellitus: Long-term diabetes does not appear to have any impact on the risk of developing a surgical site infection. However, perioperative fluctuations in blood glucose for up to 48 h have been shown to double the infection risk in cardiac patients.

Age: Increasing age is associated with an increased risk of surgical site infection. However, there is debate whether age serves simply as a marker for underlying disease or whether the decline in immune function with age is the significant factor. A study of 72,000 patients in the USA, which adjusted for hospital type, procedure, duration, wound class and physical status of the patient, showed a 1.1% increase in surgical site infection per year of age from the age of 18 to 65 years, but a 1.2% decrease in individuals over 65 years. In contrast, the findings of the English surgical site infection surveillance scheme indicated that the chance of getting a surgical site infection were 37% higher for a 65-year-old person compared to a 45-year-old person.

Preoperative immunosuppression: Corticosteroid use may increase infection risk.

Malnutrition: It is a well-described risk factor for postoperative complications, including SSI, impaired wound and colonic anastomosis healing, and prolonged hospital stay. Although enteral feeding during the perioperative period can reduce bacterial translocation by maintaining the integrity of the intestinal mucosa, nutritional supplementation does not decrease the incidence of infection.

Objectives

- ✓ To evaluate patient related risk factors contributing to the incidence of surgical site infection.

- ✓ To compare with antimicrobial prophylactic guidelines of the Hospital, ICMR, and IDSA with the antimicrobials prescribed pre- operatively, peri-operatively and post-operatively.
- ✓ To evaluate the prophylactic antibiotic used in the prevention of post-operative surgical site infection.
- ✓ To determine incidence of surgical site infection.

MATERIALS AND METHODS

Study site:

The study was conducted in an NABH accredited Quaternary Care Hospital, Bengaluru, Karnataka, India.

Study design:

A prospective hospital-based observational study.

Study duration:

The study was conducted for a period of six months.

Study criteria:

Inclusion criteria

- ➢ Subjects of any age undergoing open surgery (clean to dirty contaminated wounds)
- ➢ Subjects of only elective surgeries are considered.
- ➢ Surgeries from departments such as-Gastroenterology, General surgery, Orthopedic, Plastic surgery, Neurology, Obstetrics and Gynecology, Urology, Oncology, Cardiovascular are considered.

Exclusion Criteria

- ✓ Topical antibiotics
- ✓ Antibiotics administered as treatment for known infections are not considered.
- ✓ Transplants, micro-surgeries and laser surgeries.
- ✓ Emergency and trauma cases were not collected.

Source of Data

Patient profile form

The patient profile form was self-designed in accordance with the required information for the study. The form consisted of four broad categories: Patient related information; Pre-operation details; Surgery related details and Post-operative details.

Patient related details

This part of the patient profile form consists of patient details including patient name, gender, age, weight in kg, height in cm, date of admission, date of discharge, unique health identification number (UHID), in-patient number (IP), contact details, patient residential location, current medical diagnosis, medical history and allergies if any, medication history, social history like smoking, alcohol use or others, presence of any risk factors such as age, obesity, anaemia or presence of any co-morbidities such as diabetes mellitus; chronic lung disease; immunosuppressed status; renal insufficiency etc.

Pre-operation details

Preoperative details include laboratory data collected prior to the surgery, blood glucose levels, blood pressure, presence of antimicrobial prophylaxis, if yes- choice of antibiotic, dose of the administered drug, route of administration, time of administration, frequency of administration and comparison of the administered drug to antimicrobial guidelines.

Surgery related details

Surgery details include type and department of surgery, date and time of surgery, history of surgery if any, wound type- clean; clean-contaminated; contaminated; dirty, duration the of surgery, use if implants if any, and any other required information.

Post-operative details

This section includes information regarding use of any antimicrobial therapy post surgery, post-operative medications during the hospital stay and discharge medications.

Questionnaire

The follow-up patient data was collected in a well-designed "Surgical wound healing post- discharge Questionnaire", Public health England (permission taken). Data was obtained over the call after period of 30 days from either the patient or the care taker.

The questionnaire consists of patient details such as-Name of the patient, UHID number, date of the admission, category of surgery and date of the surgery. Followed by the patient details, a series of questions are included in the questionnaire pertaining to presence or absence of various signs and symptoms due to the infection in case of presence of a surgical site infection. The questions are designed to attain information regarding:

- Discharge or leakage of any kind from the site of surgery.
- Presence of any other kind of symptoms such as pain or soreness at the sight, redness or inflammation, erythema, swelling, gaped openings at wound site.
- Consultation post infection to any health care service providers
- Details of any antibiotics prescribed post SSI.

The questionnaire also consists of a SSI surveillance categorizing the symptoms into 4 categories that are:

1) Criteria 1- discharge pus + antibiotics prescribed.

2) Criteria 2-clinical signs*+dehiscence.

3) Criteria 3-clinical signs*+antibiotics prescribed.

4) Criteria 4- Not applicable (includes only single symptom)

**Clinical signs-at least 2 of pain, heat, redness, or swelling.*

Procedure

- Data was collected prospectively from those surgical cases that met the study inclusion criteria.
- Required data was collected into the patient profile form and the case was followed up until patient was discharged.
- The data obtained is thoroughly reviewed and the antimicrobial drug administered is compared to antimicrobial guidelines such as the hospital antimicrobial guidelines, IDSA guidelines, ICMR guidelines and the WHO antimicrobial prophylaxis guidelines.
- The post-operative medication and the discharge medication are reviewed for drug interactions that may interfere with the action of the prescribed anti-biotic.

After a period of 30 days, the patient was contacted on their provided contact details for collection of the follow up data.

- The follow up data was collected on a questionnaire that was collected from the "Surgical wound healing post-discharge questionnaire" Health agency, London.
- The patients who were infected at the surgical site were questioned regarding the signs and symptoms that they were experiencing and information regarding post infective medical care was also collected.
- After the data collection was complete, the total number of infected cases was estimated.
- Every patient that experienced an SSI was reviewed thoroughly to study the risks that may have contributed to the occurrence of the infection at the surgical site.
- Following the review of risk factors, the incident rate of the infection was calculated.

The patients that reported an SSI were categorized into criteria based on Public Health England (PHE) scoring. The criteria were:

1) Criteria 1- discharge pus + antibiotics prescribed

2) Criteria 2-clinical signs*+dehiscence

3) Criteria 3-clinical signs*+antibiotics prescribed

4) Criteria 4- Not applicable (includes only single symptom)

**Clinical signs-at least 2 of pain, heat, redness, or swelling.*

The data collected, and the incident rate was graphically represented.

RESULTS

Total of 372 subjects were collected out of which 36 (10%) acquired surgical site infection. 372 surgical cases were collected from various surgical departments.

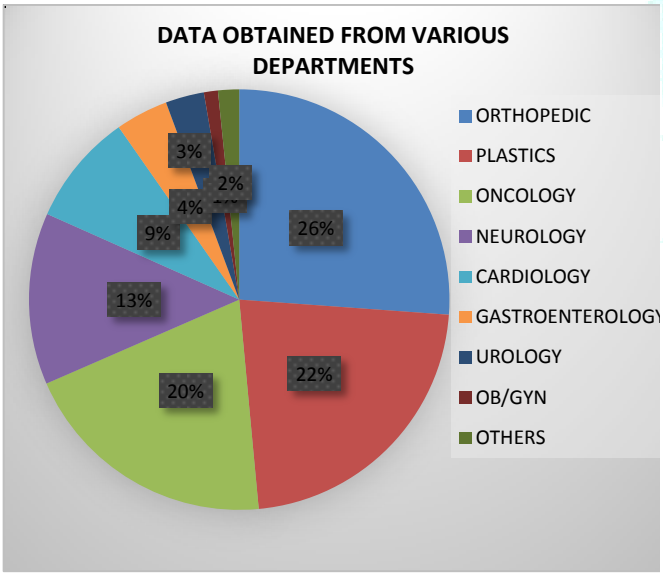

Figure 1: Distribution of surgical cases in various departments

Figure 1 shows distribution of surgical cases in various departments. The 36 infected surgical cases were categorized based on various risk factors.

The risk factors are divided into as follows:

Patient related factors

The various patient related factors include sex, age, co-morbidities, and social habits.

Sex

Out of 36 infected surgical cases, 20 belonged to male category while 16 belonged to the female category.

Age

Age was categorized into two categories. First category was age below 10 years (pediatric population) and 2 patients out of 36 infected cases belonged to this category while 11 patients belonged to category of age above 60 years (geriatric population).

Social habits

Social habits were categorized into alcohol and smoking.1 out of 36 infected patients was found to be a smoker, while, 2 were found to be alcoholic.

Graph 2 shows population distribution based on various patient related risk factor.

Diabetes mellitus

Diabetes mellitus was found to be a major risk factor. Out of 36 infected surgical cases, 18 of them were found to be diabetic prior to the surgery.

Chronic lung disease

Chronic lung disease is also considered to be a risk factor associated with surgical site infection. Out of the total infected cases, 1 of the surgical cases was found to be suffering from chronic lung disease.

Renal insufficiency

Renal insufficiency is a contributing risk factor for surgical site infection. Out of the total infected cases, 1 of the surgical cases was found to be suffering from renal insufficiency.

Immunosuppression

Immunosuppression is one of a major risk factor associated with surgical site infection. Out of the total infected cases, 13 patients were found to be suffering from immune-suppression.

Anemia

Anemia is an important risk factor associated with surgical site infections. Out of the total infected cases, 12 patients were found to anemic prior to the surgery.

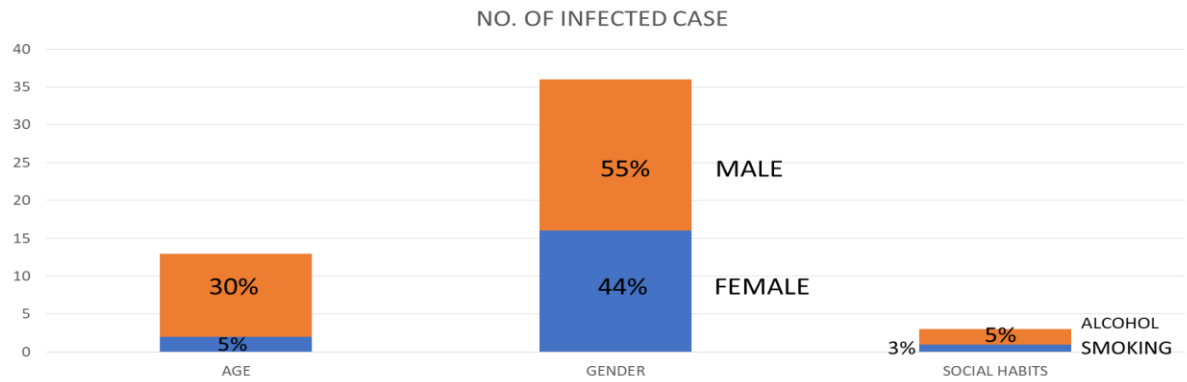

Figure 2: Population distribution based on various patient related risks

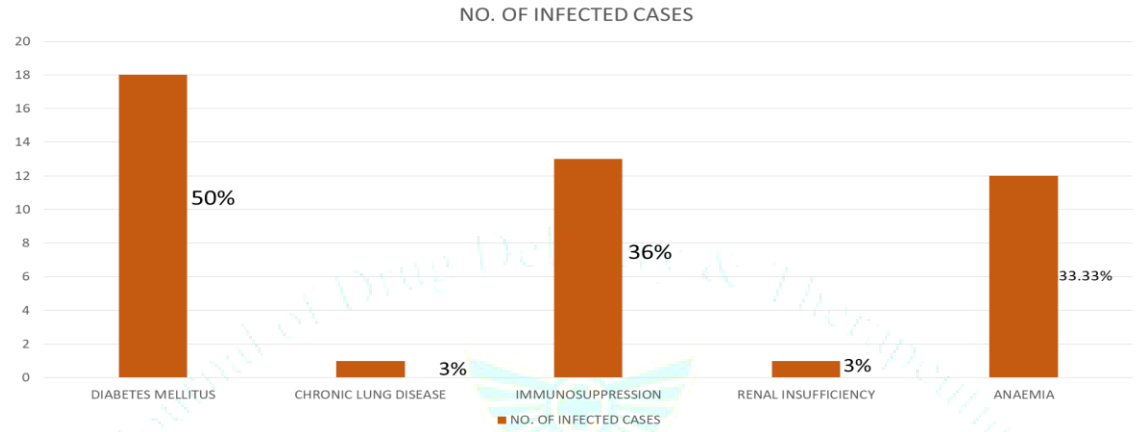

Figure 3: Distribution of infected population based on various risk factors

Graph 3 shows distribution of infected population based on various risk factors such as diabetes mellitus, chronic lung disease, immunosuppression, renal insufficiency, and anemia

Surgery related risk factors

The surgery related risk factors include the wound type, duration of surgery and use of implants.

Wound type:

The type of wound is considered to be an important risk factor that may be associated with the incidence of SSI. Out of 36 infected surgical cases, 34 of the patients had a clean type of wound while 2 patients had clean-contaminated type of wound.

Duration of the surgery:

Duration of surgery is a risk factor for the incidence of an SSI with respect to frequency of antimicrobial prophylaxis administered and its half-life. The duration of surgery was categorized into 0-3 hours and more than 3 hours. Out of the total infected cases 15 surgical procedures were completed with 3 hours of time while 21 surgical procedures took more than 3 hours for completion.

Use of implants:

Use of implants in surgical procedures is also considered to be a risk factor in patients especially those that are inherently at a higher risk. Out of the total infected cases, 8 patients were found to have undergone implant surgery.

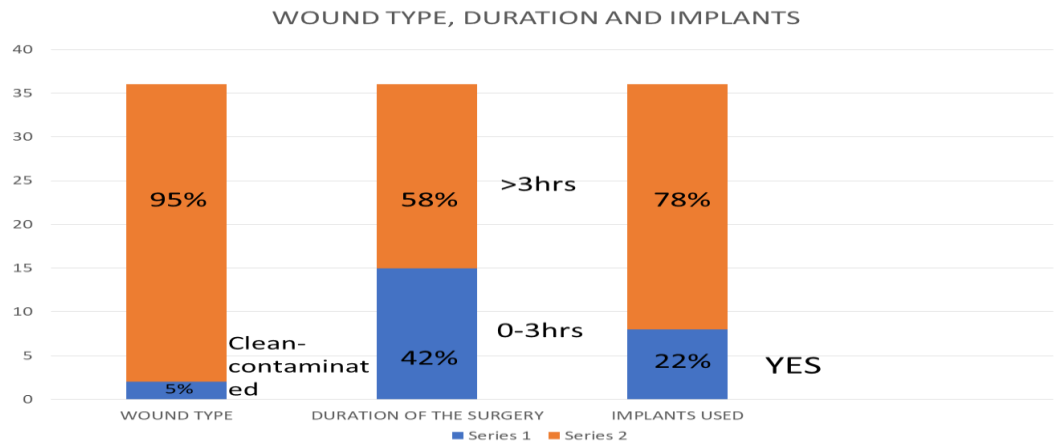

Figure 4: distribution of infected population based on surgery related risk factors

Graph 4 shows distribution of infected population based on surgery related risk factors such as wound type, duration of surgery, and use of implants.

Drug related risk factors

Anti-microbial guidelines are designed in a way to prevent surgical site infection. It is necessary to comply with these guidelines before and after the surgical procedures. Out of the total infected cases, 19 cases did not comply with the guidelines.

Frequency of administered antimicrobial agent plays a vital role in the prevention of surgical site infection. It is necessary to monitor the dose with respect to duration of surgery and half-life of the drug. Out of the total infected cases, only in 3 patients the antimicrobial prophylaxis was given more than once.

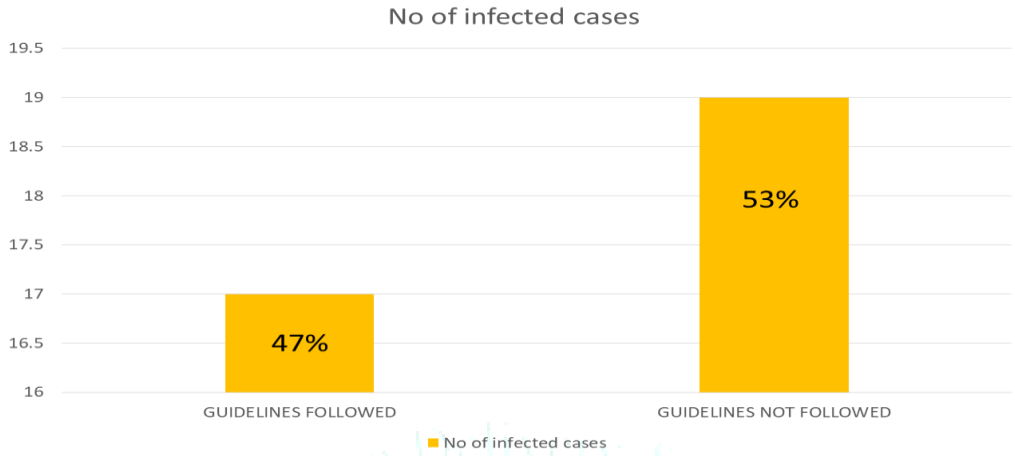

Figure 5: Number of infected cases

PHE criteria score

The patients that reported an SSI were categorized into criteria based on Public Health England (PHE) scoring. The criteria were:

1) Criteria 1- discharge pus + antibiotics prescribed.

2) Criteria 2-clinical signs*+dehiscence

3) Criteria 3-clinical signs*+antibiotics prescribed

4) Criteria 4- Not applicable (includes only single symptom)

**Clinical signs-at least 2 of pain, heat, redness, or swelling.*

DISCUSSION

Surgical Site infection is a well-known surgical complication. Strict asepsis, meticulous surgical techniques, less tissue handling, reducing the use cautery and use of prophylactic antibiotic have drastically reduced the incidence of SSI. In this study, on observation of 372 surgical cases, it was estimated that 1 in 10 patients acquired Surgical Site Infection within 30 days post-surgery. The possible causes of SSI in spite of administration of anti-microbial prophylaxis include:

Gender:

In this study, men were at higher risk for surgical site infection in comparison to the women population. This could be due to the differences in propensity for skin colonization or other anatomical differences. Although, gender differences in SSI exist and are procedure specific, the underlying mechanisms need to be further elucidated so that the targeted measures for the prevention of SSI can be developed.

Age:

Surgical site infections affect all the age groups and its incidence increases with the age. Older age group is considered a risk factor for development of SSI due to probable presence of comorbid conditions, impaired basic activities of daily living, cognitive impairment, frailty, use of multiple medications, nutritional status, reduced immune functionality and type of residence (nursing home).

Weight:

Obesity

Excessive subcutaneous fat tissue predisposes obese patients to impaired healing due to low regional perfusion and oxygen tension. Secondly, there is increase in surgery time and a longer surgery time has been a significant predictor for postoperative wound infections. Furthermore impaired immunity, elevated blood glucose and too much tension on surgical incision are contributory factors to impaired healing.

Malnutrition

Nutrition depletion leads to malnutrition and impairs body resistance to infection. The various arms of defence system against infection require adequate nutrition for optimal function. In nutrition depletion this protection is impaired. Therefore, enhanced nutrition is required for improved immunological status.

Comorbidites:

Diabetes mellitus

Patients with diabetes mellitus have a 50% higher chance of developing SSI than patients without diabetes. This is due to the altered cellular immune function. Pre and post-operative hyperglycaemia, elevated HbA1c level and history of diabetes mellitus adds on to the list of risk factor associated with SSI.

Renal insufficiency

It is observed that patients with chronic renal failure have an increased risk of SSI. This may be due to impaired host defences and wound healing. CKD and ESRD often occur in

older people who have limited physical mobility and predisposition for developing pressure related wounds. The common risk factor for impaired wound healing in CKD and ESRD patients includes poorly controlled DM, neuropathy, peripheral vascular disease, chronic venous insufficiency and aging.

Chronic lung disease:

Oxygen encourages the formation of collateral circulation (angiogenesis) and promotes wound contraction. Since in chronic lung disease both the quality and quantity of wound healing is limited.

Immunosuppression:

The body's natural defence mechanism is the immune system. However in some conditions such as diabetes, chronic lung disease and carcinoma have a negative impact on the body's ability to fight infection. For example, high blood sugar levels can cause the immune cells to function ineffectively, thereby raising the risk of infection. Dysfunction and apoptosis of anti-tumor effector cells in the tumor bearing host, creates and immune imbalance.

Anaemia:

The wound healing process relies completely on oxygenation. Therefore, low oxygen levels caused by anaemia can halt or slow down the wound healing stages, which leave patients more susceptible to wound infection.

Social habits:

Smoking

Smoking is an important risk factor for SSI. It is known that smoking can lead to wound healing deficiencies. Tobacco use inhibits fibroblast proliferation by direct action of nicotine, as well as decreases collagen production and angiogenesis delaying the healing time.

Alcohol use (more than 4 drinks per day)

The routine use of alcohol is another important risk factor for SSI. The exact mechanism by which this factor increases the risk is unknown, but it is known that alcohol affects numerous physiological functions including, hemostasis, body immunity, cardio vascular and central nervous system.

Wound type

The degree of risk of an SSI is linked to the type of surgical wound present. Clean wounds are wounds that are not inflamed or contaminated and do not involve operating an internal organ while clean contaminated wounds have no evidence of infection at the time of surgery but do involve operating on an internal organ, so therefore, increasing the risk of causing a surgical site infection.

Duration of surgery

Duration of surgery is an independent risk factor for the development of SSI. Procedures requiring more time usually relate to complex cases and may involve extensile exposures and considerable tissue damage. Another factor contributing to the infection related to the surgical sites is the half-life of the drug.

Implants

Surgical implants constitute an essential component of modern medicine. Escalating use of surgical implants, particularly in patients inherently at high risk of infections, has magnified the importance of infectious complications. Infections associated with surgical implants are generally more cumbersome to manage, have a greater adverse impact on quality of life, result in excessive prolongation of hospital stay and incur excessive costs.

Drug related

Anti-microbial guidelines are carefully designed to meet the needs of major infection prophylaxis. It is of utmost importance to follow these guidelines and deviation from these guidelines may result in post-operative infections. Frequency and dose of the prophylactic antibiotics must be similar to the guidelines and in some cases must be tailored to the specific needs of the patients. Such special cases when the frequency and dose of the drug is patient specific are: if the duration of the surgery is longer than the usual or if the half-life of the drug is shorter, etc.

CONCLUSION

The study was conducted in an NABH accredited Quaternary Care Hospital in Bengaluru, Karnataka revealed that the SSIs are caused due to various risk factors and improper selection and re-dosing of antimicrobial prophylaxis. This can be prevented by considering the risk factors and appropriate selection of antimicrobial prophylaxis prior to surgery.

Conclusively, it can be said that the incidence of surgical site infection varies from different patient and procedure factors as well as prophylactic antibiotic properties. They particularly show greater association to age, gender, certain comorbidities (like Diabetes mellitus, chronic lung disease, and renal insufficiency), and duration of surgery, administration of prophylactic antibiotics, frequency, timing and dose. Therefore, greater care must be taken for every specific patient and procedure and also choice of antibiotic prophylaxis. Thus, the study is aimed at identification of people at risk for SSIs and implementation of preventive strategies. Also, measures must be taken to improve health related quality of life and reduce the personal and economic burden of the patient with SSIs. Future prospective studies are therefore necessary to gather more accurate information in this regard.

The study results helped in creating awareness amongst healthcare professionals regarding high incidence of SSI in spite of well-structured antimicrobial prophylactic guidelines. Therefore, evidence based, patient specific antimicrobial prophylaxis has to be customised in order to prevent the occurrence of surgical site infection.

ACKNOWLEDGEMENT

The authors wish to thank the management of PES College of Pharmacy, Bengaluru, Karnataka, India for providing necessary equipment for research, constant encouragement, facilities and support.

CONFLICTS OF INTEREST

The author declares that there is no conflict of interest to disclose.

REFERENCES

1. Joseph T. Dipiro. Pharmacotherapy. A Physiologic Approach. 7th Edition: 2027-40.
2. Horan TC, Gaynes RP, Martone WJ. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. Infect Control Hosp Epidemiol. 1992; 13(10):606-8.
3. Mangram AJ, Horan TC, Pearson ML. Guideline for prevention of surgical site infection. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol 1999; 20(4):250-278.
4. Whitehouse JD, Friedman ND, Kirkland KB. The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: adverse quality

of life, excess length of stay, and extra cost. Infect Control Hosp Epidemiol 2002; 23(4):183-9.
5. Martone WJ, Nichols RL. Recognition, prevention, surveillance, and management of surgical site infections: introduction to the problem and symposium overview. Clin Infect Dis 2001; 33(suppl 2):S67-8.
6. Bratzler DW, Houck PM, Richards C, Steele L, Dellinger EP. Use of antimicrobial prophylaxis for major surgery: baseline results from the National Surgical Infection Prevention Project. Arch Surg 2005; 140:174-82.
7. Bratzler DW, Houck PM. Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project. Am J Surg 2005; 189:395-404.
8. Eskicioglu C, Gagliardi AR, Fenech DS, Shawn FS, Marg MRN. Surgical site infection prevention: a survey to identify the gap between evidence and practice in University of Toronto teaching hospitals. Can J Surg 2012; 55:233-238.
9. Dellinger EP, Gross PA, Barrett TL, Krause PJ, Martone WJ. Quality standard for antimicrobial prophylaxis in surgical procedures. Infectious Diseases Society of America. Clin Infect Dis 1994; 18:422-7.
10. Adetayo OA, Salcedo SE, Biskup NI, Gupta SC. The battle of words and the reality of never events in breast reconstruction: incidence, risk factors predictive of occurrence, and economic cost analysis. Plast Reconstr Surg 2012; 130:23-9.
11. Anguzu JR, Olila D. Drug sensitivity patterns of bacterial isolates from septic post-operative wounds in a regional referral hospital in Uganda. Afr Health Sc 2007; 7:148-54.