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INCIDENCE AND RISK FACTORS FOR SURGICAL SITE INFECTIONS: OUR EXPERIENCE AT TERTIARY CARE CENTRE

General Surgery

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ABSTRACT

Background: Surgical Site Infection (SSI) or Wound infection is the third most commonly reported nosocomial infection which has an adverse impact on the hospital as well as on the patient. A continuous surveillance is called for, to keep a check on the occurrence of SSI. **Objective:** The objective of the study was to estimate the incidence of surgical site infections in department of general surgery at GCS Medical College Research centre and Hospital as well as to identify the risk factors associated with it and its prevention strategies. **Materials and methods:** A Non-concurrent cohort study of 524 patients undergoing surgery in general surgery department at GCS Hospital in a duration of 6 months (1st July 2019 to 31st December 2019). Data were analyzed by descriptive, bivariate and multivariate analysis. **Results:** The incidence of surgical site infections (SSIs) was 5.4%. The risk factors associated with surgical site infections were age, length of Preoperative hospital stay, duration of surgery in hours, surgical wound class. **Conclusion:** The identification of the actual incidence and risk factors of surgical site infections in general surgery patients, supports the actions of the health team in order to minimize the complications caused by surgical site infections.

KEYWORDS

Surgical Site Infection, wound infections, SSIs, Nosocomial Infections.

INTRODUCTION

Surgical site infection is defined as "Superficial Incisional Infection less than 30 days after surgery and involves skin and subcutaneous tissue only, plus one of the following: Purulent drainage, diagnosis of superficial SSI by a surgeon, or symptoms of erythema, pain, and local edema" (1).

In our study we considered only those surgeries that are defined under NSHN procedures. NHSN(National Healthcare Safety Network) procedure is defined as that performed in an operating room where the surgeon makes at least one incision, which is closed before leaving the operating room(2).This definition excludes surgeries like Incision and drainage of abscess, debridement, trauma surgeries were wound closure is not done as a part of damage control surgery.

Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs, or implanted material. The surgical wound encompasses the area of the body, internally and externally, that involves the entire operative site. Wounds are generally categorized as follows:

1. Superficial, which includes the skin and subcutaneous tissue.
2. Deep, which includes the fascia and muscle.
3. Organ space, which includes the internal organs of the body if the operation includes that area.

Healthcare-Associated Infection (HAI) is a subject of great concern of the healthcare services. Among the topographies of the HAIs, Surgical Site Infection (SSI) is directly related to surgical procedures, and is currently one of the most important among the HAIs. SSI leads to serious consequences, including increased costs due to its treatment , increased length of hospital stay and increased morbidity. The risk of death in patients with SSI is increased when compared to those who did not develop an infection.

The serious consequences imposed on patients who developed SSI determine the need for efforts to create strategies for the prevention of this infection. One of the strategies used is *the determination of risk factors*, which allows identifying clinical situations or conditions that predispose to the development of SSI. In this sense, the identification of risk factors for SSI contributes to the early adoption of nursing interventions that aim to minimize this type of postoperative complication.

Several risk factors are known in the literature as predisposing to SSI which classifies patients according to their clinical condition; the Wound class, which represents the classification of the surgical wound by the surgical team in terms of the potential presence of microorganisms and the Duration of Surgery. Other risk factors such as Body Mass Index (BMI), smoking, video- assisted procedures, blood transfusion, non-performance of preoperative bath and pre-existing chronic diseases, are also mentioned in the literature and were identified as associated with SSI, in studies on the subject.

Once the diagnosis of SSIs has been established the wound should be cleaned and dressed with betadine and normal saline, if required one or two stitches should be opened to drain the collection, pus should be send for culture and sensitivity and antibiotics should be started based on the sensitivity report. Most of the cases resolve by these modalities. If this fails surgical interventions like resuturing or debridement of infected and dead or necrotic tissues should be considered.

This study was aimed to estimate the incidence of surgical site infections in general surgery department at GCS Hospital while identifying risk factors and prevalent microorganisms and its prevention.

MATERIALS & METHODS

This is a non-concurrent cohort study, performed in GCS Medical college, Research Centre and Hospital in Ahmedabad, from 1st July 2019 to 31st December 2019. Surgical wound showing any of the signs as mentioned in the definition should be considered as SSIs and managed accordingly.

Total Number of Patients included in the study : 524
Surgical Site Infections Seen in : 28

- **INCLUSION CRITERIA :**
- Age above 18 years.
- Patient undergoing surgery defined under NHSN procedure.
- Patients giving consent for the participation in the study.

- **EXCLUSION CRITERIA :**
- Patients below 18 years age
- Patients NOT giving consent for the participation in the study.

The following ***variables*** were analyzed: ***gender*** (male and female); ***age*** (under and above 54 years old); ***preoperative hospital stay*** (greater and less than 24 hours before the surgical procedure, as recommended by the National Health Surveillance Agency); ***duration of surgery*** (in hours); ***wound Class*** (clean, clean-contaminated, contaminated or dirty/infected); ***emergency surgery*** (yes and no); and ***implant use*** (yes

and no). The variables age and length of preoperative hospital stay were collected as continuous variables and subsequently dichotomized. The variable duration of surgery was collected and analyzed as a continuous variable.

The overall incidence of SSIs was calculated for the given study period. The variables gender, age and preoperative hospital stay were studied in details and the data obtained on this basis was analyzed, Chi Square test applied, p value observed and the Significance of the Data was determined on the basis of above mentioned three variables.

RESULTS

Out of the 524 surgical procedures, 370 (70.5%) were male patients and 154 (29.5%) were female patients. The mean age was 54.2 years ± 16.4 (18-99), with a median of 55 years. The mean duration of surgeries was 1.6 hours ± 1.0 (0.2-20.9), with a median of 1.2 hours. During the study period, 28 SSIs were diagnosed making an incidence of 5.4% [95% CI is 5.2 to 5.6].

Table 1 Bivariate analysis of the given variables in relation to Surgical Site Infection.

Variables		SSIs		chi Square	p value	Inference
		YES	NO			
GENDER	Male	18	352	0.581	0.4459	Data is Not Significant
	Female	10	144			
AGE	< 54 years	8	280	8.323	0.0039	Data is **Significant**
	> 54 years	20	216			
Preoperative hospital Stay	< 24 hrs	5	196	5.258	0.0218	Data is **Significant**
	> 24 hrs	23	300			

In our study, total 18 out of 370 males had developed SSIs which constituted 4.86 % while 10 out of 144 females having SSIs contribute 18.51%. Though the variable ***gender*** had been selected in the study to analyze whether it was a risk factor for SSIs or not, on applying chi square test, it was found to that data was not statistically significant($p<0.20$). For more accurate results larger sample size is advisable.

To study the impact of age of patient on SSI and for the convenience of the study patients were divided into two groups, one group consisted patients below age of 54 years and another group was age above 54 years. 8 out of 288 patients below 54 years age showed SSIs making an incident of 2.86 %, while 20 out of 236 patients with age greater than 54 years had SSIs making an incidence of 8.47 %. On application of chi- square test it showed that the data was significant, which indicates that the risk of developing SSI increases with the increasing age.

Based on the Preoperative hospital stay, patients were divided into two groups. One consisted of patients admitted only 24 hours prior to the surgery and another group consisted the patients admitted for more than 24 hours prior to the surgery.SSI was found in 5 out of 201 patients(2.49%) with preoperative hospital stay less than 24 hours and 23 out of 323 patients (7.12 %) with preoperative hospital stay more than 24 hours. On applying chi square test it was observed that the data was statistically significant which indicates that as the length of the Preoperative hospital stay of the patient increases, incidence of SSI increases. Optimum preoperative hospital stay is 24 hrs prior to the surgery in case of all elective surgeries.

During the study it was also observed that as the duration of surgery increases, risk of development of SSIs also increases. Surgical wound Class also has impact on the SSIs. Contaminated and dirty wounds are more prone to develop SSIs.

Of the 28 infections identified, cultures showed that the principle causative organisms were *Staphylococcus aureus* (36.4%) and Escherichia *coli* (18.18%).

DISCUSSION

The overall SSI incidence found in our study was 5.4%.

The risk factors identified for SSI were:

- Age of patient
- Length of preoperative hospital stay
- Duration of surgery
- Wound Class
- Pre-existing medical co-morbidities

The variable ***gender*** showed that the percentage of SSI was higher in males but after calculating chi square test and calculating the p value it was observed that the results are not significant.. In the study Langelotz C et al (3) the relation between SSI and gender, females showed less incidence of SSI. This could be because their study group consisted of equal number of males and females.

The variable ***age*** when compared between age groups greater than 54 years and less than 54 years, the p value obtained showed that the results were significant indicating that the greater age itself is a risk factor for the development of SSI. In the study conducted by Keith S et al (4)**,** the age and the risk of SSI similar results were obtained. The reason behind this could be that with growing age body's immune system becomes weaker and also the medical co morbidities affect the natural defense mechanisms of the body.

The variable ***length of preoperative hospital stay*** greater than 24 hours was associated with increased risk of developing SSI, when compared to a length of hospital stay less than 24 hours ($p<0.001$). Hence for the process and structure for SSI prevention, recommended preoperative hospital stay is less than 24 hours. In the study conducted by Edin Mujagic et al (5) it was observed that the risk of SSI is more in the patients whose Preoperative hospital stay increases more than 24 hours. A preoperative hospital stay greater than 24 hours is related to a greater incidence of SSIs probably due to contamination of the patient during the hospitalization period, facilitating the development of infectious processes.

Another variable that showed a statistically significant association with SSI was the ***duration of surgery***. In this study, for each hour of duration of surgery, there was a 34% increase in the chance of SSI development ($p<0.001$). In the study Surg Infect (Larchmt) by Hang Cheng et al it was observed that more the intraoperative time more is the risk of SSIs. The increased duration of surgery is associated with higher SSIs rate. It is inferred that this may be related to a greater exposure of the incision site to pathogens and/or a greater chance of breach of the aseptic technique in the procedure. In addition, increased duration of surgery is associated not only with increased SSI rates, but also with other clinical and post-surgical complications such as wound dehiscence, development of Urinary Tract Infection and even septic shock. The search for a shorter duration of surgery can significantly decrease the risk of SSIs. Selection of proper surgical techniques, skillful surgeons, well trained surgical team and optimum post op care, all these strategies can help to reduce the preoperative timings and hence reducing the incidence of the SSI.

Surgical Wound Class also has impact on SSI. Those surgeries as clean-contaminated, contaminated and dirty/infected showed an increase in the chance of developing SSI when compared to surgeries involving clean wounds. The wound class is also reported in several other nationals and internationals literatures as a risk factor associated with SSI. When Surgical wound classes were compared with one another it was observed that the chances of development of SSI increases as the class of surgical wound increases. This proves that the wounds which are more contaminated preoperatively are more prone to develop SSIs.

The identification of risk factors contributes to the creation of SSI prevention strategies, thus allowing health professionals to take actions that reduce complications resulting from infections and to minimize SSI rates.

Other specific activities can also be carried out to prevent the occurrence of SSIs. These activities include: *preoperative bath performance*; *better glucose control of the patient diagnosed with Diabetes Mellitus and control of environmental factors in the operating room and preoperative antibiotic injection*.

This study used information from databases collected during the defined study period, a fact that may limit the accuracy of the results obtained due to the occurrence of information and follow-up biases. The verification of the consistency of the information in each variable of the database and the analysis of the differential loss of the missing data were some strategies used to guarantee the accuracy of the presented results. It should be noted that this study used a limited number of variables. In order to overcome the limitations of this study due to limited sample size and to know the actual Incidence, risk factors and prevention strategies a study involving larger individuals is advisable.

CONCLUSION

The overall incidence of SSI was 5.4%. The risk factors associated with SSI were: increasing age; length of preoperative hospital stay greater than 24 hours; a longer duration of surgery; and present Surgical Wound Class. Among the SSIs cultures analyzed, the most prevalent microorganism was *S. aureus* followed by *E. coli*.

It is important to recognize the risk factors for developing SSI in patients undergoing surgeries early, so that the preventive measures can be adopted earlier with the aim of reducing infection rates. In this context, new studies using different methodologies, involving a large number of patients should be conducted so that the study results can be generalized universally and carried out in order to add knowledge about SSIs in general surgeries.

As the increasing age has been identified as a risk factor, patients with increasing age should be given more attention while selecting the mode of surgery, preoperative hospital stay and management of other existing medical co-morbidities.

Duration of preoperative hospital stay more than 24 hours increases the chances of SSIs, hence protocols and strategies should be directed towards decreasing the preoperative hospital stay by promoting required preoperative investigations and fitness to be done on outdoor basis in elective surgeries. Once the operative timings are decided patient can be called for admission 24 hours prior to the surgery. This strategy can help to reduce the SSI in our setup.

Intraoperative time can be reduced by selecting appropriate mode of surgeries, well trained and experienced staff.

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