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Determinant Factors of Surgical Site Infection after Laparotomy at Referral Hospital in Central Java Indonesia

Stefani Candra Firmanti [1*], Antonius Suryanto [2]

[1] *Microbiology Department, Faculty of Medicine, Diponegoro University, Jln. Prof Soedarto, Semarang, 1269, Indonesia*
[2] *RSUD dr. Adhyatma, MPH, Jln. Tugurejo Raya, Semarang, 50156, Indonesia*

Abstract:*Surgical Site Infection (SSI) is a major clinical problem and the most common cause of nosocomial infection in patients after laparotomy. Data on SSI in Indonesia is still limited. The aim of this study is to determine the determinant factors of SSI after laparotomy at Referral Hospital in Central Java Indonesia. A cross-sectional study was conducted on medical record data of patients with a history of laparotomy from 1 October 2021 to 30 June 2022. Bivariate Chi-square analysis was performed to identify risk factors with a significant p-value <0.05. A total of 213 patients received laparotomy during the study period. SSI occurred in 9.38% (20) of patients. The mean age is 37.61 (±20.6) years. ASA score <3 (p=0.006, PR=5.11, 95% CI=1.416-18.453) and contaminated and dirty surgical wound (p=0.023, PR=2.860, 95% CI=1.124-7.276) were the determinants of post-laparotomy SSI. The incidence of SSI after laparotomy at Referral Hospital in Central Java Indonesia is quite high. The ASA score and the type of surgical wound are risk factors associated with an increased incidence of SSI. Attention to these factors must be increased in efforts to control and prevent infection so that the incidence of post-laparotomy SSI can be reduced.*

Keywords -*Determinant factors, SSI, laparotomy*

I. INTRODUCTION

Surgical Site Infection (SSI) is a major clinical problem and is the most common cause of nosocomial infections, especially in post-laparotomy patients. The 2020 CDC report revealed that the prevalence of SSI in patients undergoing surgery was 110,800 based on a survey in 2015. Although various infection prevention and control efforts have been made, including improving the quality of operating room ventilation, sterilization methods, barriers, surgical techniques, and the availability of prophylactic antibiotics, SSI remains a substantial problem as a cause of morbidity, prolonged hospitalization, and mortality.[(1)] SSI is reported to be a 20% contributor to nosocomial infections and is associated with a 2-11 times increase in mortality. The cost of treatment due to SSI is the highest burden in nosocomial infections about $ 3.3 billion per year. The length of stay due to SSI was prolonged by 9.7 days with an increase in treatment costs of $20,000 per day.[(2-4)]

In Indonesia, data on the incidence of SSI and its determinants are still limited, even though the prevalence seems high. The incidence of SSI in Indonesia is around 2-15%. The percentage of SSI incidents in several educational center hospitals in Indonesia without differentiating the type of surgery is as follows: RSUP dr. Pringadi Medan in 2006 (12%), RSUP dr. Sardjito in 2007 (5.9%), Adam Malik Hospital in (5.6%), Arifin Achmad Pekan Baru Hospital in 2014 (4.5%).(5)

Several risk factors associated with SSI have been widely reported worldwide. Risk factors can come from patients, operations, or microorganisms that cause SSI. Age, secondary ischemia due to vascular disease, comorbid diseases, diabetes mellitus, radiation exposure, smoking, obesity, and Staphylococcus aureus colonization are important factors for patients to cause SSI. Drain, surgical technique (handling tissues gently, leaving no hematoma, avoiding dead space), type of surgical wound, type of anesthesia, and ASA score affect the incidence of postoperative SSI. Microorganisms that cause SSI can come from endogenous or exogenous microorganisms. (6,7)

Even though there are currently advances in clinical practice and various methods of infection prevention and control have been implemented, including in Indonesia, the incidence of SSI, complications, and burden in terms of patient morbidity, medical costs, and mortality rates are still critical public health issues. Therefore, this study aims to assess the magnitude and identify the factors that contribute to SSI at Refferal Hospital in Central Java Indonesia.

II. METHOD

2.1 Subjects and Research Design

The study used a cross-sectional observational design with research subjects taken from medical records of patients who underwent laparotomy at Tugurejo Hospital Semarang in the period 1 October 2021 -30 June 2022. Incomplete medical record data were excluded from the study.The study was approved by the Medical and Health Research Ethics Committee of Tugurejo Hospital Semarang.

2.2 Sample size

Calculation of the minimum sample size using the binominal proportion formula for cross-sectional studies with the assumption of 95% CI, the proportion of SSI events is 15%, and the limit value of error is 5%. The minimum sample size for this study is 204.

2.3 Operational definition

SSI is defined as a surgical procedure-associated infection occurring at/near a surgical incision within 30 days of the procedure. The U.S. The Centers for Disease Control and Prevention (CDC) and the National Nosocomial Infection System (NNIS) define SSI using the following clinical criteria: 1. Purulent exudate draining from the operating area; 2. Positive cultures obtained from areas of operation that were initially closed; 3. Diagnosis of infection by a surgeon; 4. The surgical site requires reopening because of at least one of the following signs or symptoms: pain, swelling, redness, or heat. (1)

Surgical wounds are divided into: 1. Clean wounds, namely surgical wounds that are not infected, without an inflammatory process; 2. Clean-contaminated wounds, which are surgical wounds where the respiratory, digestive, genital, or urinary tracts are under controlled conditions, contamination does not always occur; 3. Contaminated wounds, including open, fresh, accidental, and surgical wounds with major damage by aseptic technique or contamination of the gastrointestinal tract, this category includes acute incisions, and non-purulent inflammation; 4. A dirty wound or infection (Dirty wound), is a type of wound that occurs in an environment that has been contaminated by bacteria, including wounds resulting from operations in non-sterile places, for example, emergency operations in the field. (1)

The American Society of Anesthesiologists (ASA) classifies pre-anesthesia physical status into 5 (five) classes, namely: 1) ASA 1: surgical disease patients without systemic disease. 2) ASA 2: surgical disease patients accompanied by mild systemic disease. Examples are coughs and colds in children or controlled hypertension and DM in adults. 3) ASA 3: surgical disease patient accompanied by severe systemic disease due to various causes but not life-threatening. Examples are uncontrolled DM and hypertension, active hepatitis, and obesity (BMI > 40). 4) ASA 4: surgical disease patient accompanied by severe systemic disease due to various causes but not life-threatening. Examples are ongoing cardiac ischemia or severe heart valve dysfunction. 5) ASA 5: surgical patients who are accompanied by severe systemic diseases that can no longer be helped, operated on, or not within 24 hours the patient will die. Examples are multiorgan failure and sepsis with hemodynamic instability. [1]

2.4 Statistic analysis

The chi-square test was used to determine a significant relationship between risk factors and the incidence of SSI. Odds ratios were calculated using Fisher's exact test to test the strength of the association between risk factors. P<0.05 was considered statistically significant.

III. Results

A total of 213 patients received laparotomy during the study period. SSI occurred in 9.38% (20) of patients. The mean age is 37.61 years (±20.6). The average weight is 53.55 kg (± 19.45) and the average height is 156.89 cm (± 19.47). There were no significant differences in the mean age (p=0.957), body weight (p=0.108), and height (p=0.818) between groups of study subjects with and without SSI.

The most indication for laparotomy surgery in research subjects was appendicitis at 34.1% (73). The other indications for laparotomy were caused by perforation, tumor, and malignancy at 21.1% (45), 11.7% (25), and 6.1%, respectively (13). In more detail, indications for laparotomy in study subjects are shown in Fig.1.

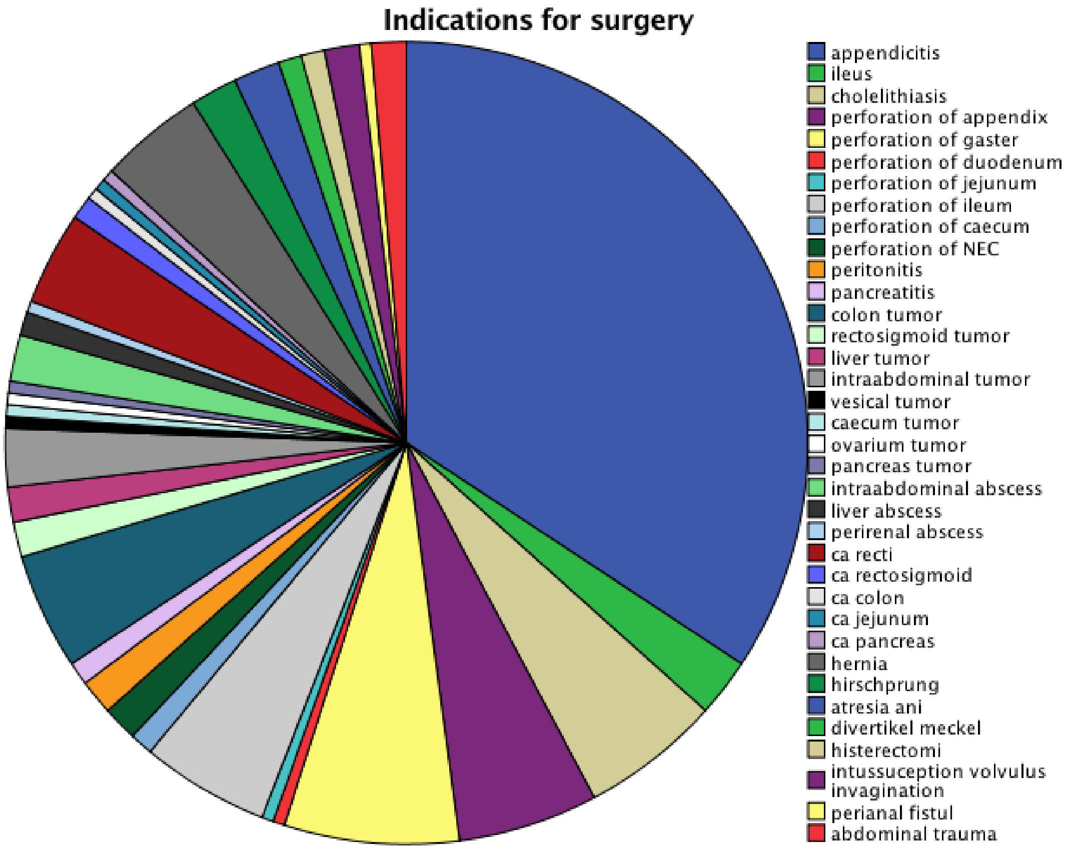

Figure 1. Indications of laparotomy in study subjects

The results of the bivariate analysis of the factors that were considered to influence the incidence of SSI are shown in Table 1. The results of the analysis showed that the ASA score and the type of surgical wound were the determinants of post-laparotomy SSI in the study subjects. ASA score ≥ 3 increases the risk of SSI by 5 times. The type of contaminated and dirty surgical wound increases the risk of SSI by 2.9 times.

Table 1. Analysis of determinants factor of SSI

	Without SSI	SSI	p value	PR	CI 95%
Sex					
Male	109	15			
Female	84	5	0.110	0.433	0.151-1.238
BMI					
Overweight	87	13	0.222	0.515	0.175-1.516
Normal	65	5			
ASA Score					
<3	184	16			
3	9	4	0.006*	5.111	1.416-18.453
Diabetes mellitus					
DM	9	0			
without DM	184	20	0.324	0.902	0.862-0.944
Type of wound surgery					
Clean and Clean- contaminated	143	10	0.023*	2.860	1.124-7.276
Contaminated and Dirty	50	10			
Technic of surgery					
Median incision	129	14	0.775	0.864	0.317-2.353
Non-median incision	64	6			
Length of surgery					
< 120 minutes	164	12	0.085	2.424	0.861-6.820
≥ 120 minutes	29	6			

*p< 0.05, p= Chi square, SSI= Surgical Site Infection, BMI= Body Mass Index, ASA = The American Society of Anesthesiologists, DM= Diabetes Mellitus

IV. DISSCUSSION

The incidence rate of post-laparotomy SSI was high (9.38%) at Tugurejo Hospital Semarang. This number is within the range of SSI incidence rates in Indonesia that have been reported by several previous studies of 2-15%.(5) Recent studies in Ethiopia, Bangladesh, and Nepal showed higher SSI incidence rates of 11.1%,12 .9%, and 38%. (7-9) The prevalence and incidence of SSI after digestive surgery in Europe tend to be lower by 4.4 and 5.4%. (10) In the United States, the incidence of SSI in surgical patients is 2-5%. (2) These studies revealed that the incidence of SSI in developing countries is high, but the available data regarding the incidence and prevalence of SSI is still limited. Surveillance and studies on the determinants of the incidence of SSI, especially post-laparotomy, need to be intensified.

The results of this study indicate that ASA values >3 increase the risk of SSI events five times higher in patients with a history of laparotomy. These results are in line with the results of a systematic review of risk factors for SSI which states that increasingly severe ASA values increase the risk of SSI 12 times greater in surgical patients. (11)

In line with the results of a meta-analysis of observational studies regarding the determinants of SSI in surgical patients, the type of surgical wound is a risk factor for SSI in this study. The results of the seven studies of the meta-analysis showed that the type of surgical wound that was contaminated and dirty increased the risk of SSI (RR = 2.65, 95% CI: 1.52–4.61, I = 86%). [12] In this study, patients with this type of surgical wound were contaminated and gross have the risk of experiencing an SSI of 2.8 times. This type of dirty surgical wound causes more microorganisms to grow that causing infection.

This research will be useful in future studies on SSI. This study aims to provide data to strengthen information about several risk factors but there are still some weaknesses. An important factor in preventing SSI is the competency and skill of the surgeon, which is a variable factor that is difficult to measure. Surgeon experience could not be measured in this study. The cross-sectional observational method and the use of medical record data as a source of information have the potential to cause data bias. Randomized Controlled Trial research is needed for further research. Heterogeneous types of laparotomy surgery in this study led to limitations in comparing the results with other studies so the conclusions drawn cannot be immediately generalized. This is also related to differences in clinical factors and parameters used. Future research can take one type of operation to increase sample homogeneity. There is no information about the bacteria that cause SSI and the pattern of sensitivity of bacteria to antibiotics in the study location hospital so it cannot provide suggestions for empirical management of post-laparotomy SSI in that hospital.

V. Conclusion

The ASA score > 3 and the type of contaminated and dirty surgical wound are the determinants of the incidence of post-laparotomy SSI at Refferal Hospital in Central Java Indonesia. Better data and understanding of SSI and its risk factors can guide clinicians and policymakers in making more appropriate interventions to prevent and control SSI events.

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