Clinical Research

Surgical site infection after digestive surgery in a single tertiary hospital in Indonesia: six years of data

Ridho Ardhi Syaiful, Yarman Mazni, Muhamad Luthfi Prasetyo, Toar Jean Maurice Lalisang

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pISSN: 0853-1773 • eISSN: 2252-8083
https://doi.org/10.13181/mji.oa.192698
Med J Indones. 2020;29:310–5

Received: August 17, 2018
Accepted: November 20, 2019

Authors' affiliations:
Department of Surgery, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia

Corresponding author:
Muhamad Luthfi Prasetyo
Department of Surgery, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jalan Pangeran Diponegoro No. 71, Kenari, Senen, Central Jakarta 10430, DKI Jakarta, Indonesia
Tel/Fax: +62-21-3148991
E-mail: luthfi_prasetyo@yahoo.com

ABSTRACT

BACKGROUND Surgical site infection (SSI) is responsible for increasing cost, morbidity, and mortality related to surgical operations, and has continued to be a significant problem even in hospitals with advanced facilities. This study aimed to describe the SSI among patients after digestive surgery.

METHODS From 2012 to 2017, all abdominal surgeries with SSI in Cipto Mangunkusumo Hospital, except obstetrics and gynecology cases, were included in the study. Demographic characteristics, nutritional status, preoperative and intraoperative conditions, wound contamination/SSI type, and mortality data were reported.

RESULTS From 4,893 abdominal surgeries during the period, 135 subjects (2.8%) developed SSI with 42.2% of cases were the clean-contaminated type. Most of the cases were males (66.7%), aged between 25–65 years old (80.0%), subjective goal assessment B (46.7%), had normal weight (57.8%), had longer duration of surgery (70.4%), and had preoperative stay between 2–15 days (65.2%). Most of the SSI patients survived (77.8%).

CONCLUSIONS Even though the SSI in Cipto Mangunkusumo Hospital was low, it still needs improvement in preoperative care, intraoperative care, and SSI awareness. Therefore, further studies are required to understand how to reduce the incidence, risk, and SSI-related mortality.

KEYWORDS digestive surgery, incidence, risk factors, surgical site infection

In Indonesia, the incidence of surgical site infections (SSIs) from studies conducted in some hospitals ranged from 5.32–13.9% in the case of clean and clean-contaminated operations.[1–4] In Cipto Mangunkusumo Hospital, the prevalence of postoperative SSIs in the abdomens of children reached 7.2% between the years 2009–2011.

According to the Centers for Disease Control and Prevention (CDC) guideline, SSI is categorized into superficial incisional SSI, internal deep incisional SSI, and organ SSI.[5] Local factors, such as the degree of contamination and surgical techniques, have been previously identified as strong predictors of SSI occurrence. Recent studies showed that host factors, such as age, gender, nutritional status, lifestyle, obesity, comorbidities, and preoperative assessment played pivotal roles in the pathogenesis of SSI complications.[6,7]

In addition to the risk factors for SSI, it is necessary to obtain the results of the microbial examination of the infection site to prevent and manage SSI. This type of examination includes the types of microbes and microbial antibiotic resistance to determine appropriate antibiotics. Risk factors, such as length of stay and previous antibiotic use, may also affect the microbes of SSIs. Previous studies showed that the most common microbes of SSI are aerobic Gram-positive cocci, especially *Staphylococcus*.[7–9] Meanwhile, in digestive surgery, Gram-negative bacterial infections, such as *Escherichia coli, Pseudomonas aeruginosa*, and anaerobic bacteria, such as *Bacteroides fragilis*, are also common etiologies of SSIs.[7–9] With the increase of antibiotic-resistant bacteria, the prophylactic antibiotics, and certain empirical antibiotics need to be re-evaluated. They may be inconsistent with the results of cultures for some cases of SSIs.[9] In this study, we describe data about SSIs from 2012 to 2017 at Cipto Mangunkusumo Hospital, Jakarta, Indonesia.

METHODS

We conducted a cross-sectional and descriptive study using the data registration of patients who had SSI at Cipto Mangunkusumo Hospital, Jakarta, Indonesia, from January 2012 to November 2017. All patients aged ≥18 years old who underwent emergency or elective abdominal surgery were included. Patients with incomplete medical records or who had undergone obstetric and gynecological surgery were excluded. The data were collected from medical records. This study protocol was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia (No: 844/UN2.F1/ETIK/2015).

Patient characteristics were presented in frequency (n) and percentage (%). Preoperative factors (prophylactic antibiotic use, albumin serum, gender, length of preoperative hospitalization, body mass index [BMI], and subjective global assessment [SGA]), intraoperative factors (operation type, intraoperative complications, relaparotomy status, bleeding volume, and duration of surgery), and postoperative condition (wound contamination degree/SSI type) were retrieved. Prophylactic antibiotic use was defined as intravenous antibiotics use <2 hours before the operation. Albumin serum was classified as <3 g/dl and ≥3 g/dl. The length of preoperative hospitalization was divided into 1 day, 2–15 days, and >15 days to analyze the possibility of nosocomial infection. BMI was classified into underweight (<18.5 kg/m^2), normal weight (18.5–23 kg/m^2), and overweight–obese (>23 kg/m^2) according to World Health Organization (WHO) Asian standard.[10] SGA was divided according to international standards, which are SGA A, B, and C.[11] Relaparotomy status during hospitalization was also described with a "yes" or "no".

SSIs type was divided into superficial incisional, deep incisional, and organ, according to the WHO/CDC classification as diagnosed by the surgeon postoperatively.[7] The operation type was also classified, as clean, clean-contaminated, contaminated, and dirty according to the WHO classification.[7] Patient's response to prophylaxis antibiotic is defined as adequate and inadequate based on post-operative clinical assessment by the surgeon. In this hospital, the standard specimens collections from intra-abdominal infection used a culture medium from the base of the wounds and were sent to the Department of Clinical Pathology, Cipto Mangunkusumo Hospital. However, this method might sustain potential contamination with normal skin flora. For data analysis, the data were entered, cleaned, and analyzed using SPSS software version 21 (IBM Corp., USA).

RESULTS

From 4,893 abdominal surgery cases, there were 135 (2.8%) of the surgeries developed SSI, and 42.2% of the SSI cases were of the clean-contaminated type. Most of SSI cases were males, aged between 25–65 years old, SGA B, had normal weight, and had longer duration of surgery. This study also found that most of the SSI cases had a preoperative stay between 2–15 days (65.2%). The majority of patients with SSI in the study survived. The complete descriptions of the patients are described in Table 1.

The microbial data is presented in Figure 1. Most infections were caused by *E. coli* and *Klebsiella pneumoniae*. The antibiotics sensitivities are described in Figure 2.

DISCUSSION

SSIs are a significant problem in hospitalized patients who undergo surgery. They are the most common postoperative complication in about 3% of all patients undergoing surgery. The Department of Surgery, Cipto Mangunkusumo Hospital, Jakarta, Indonesia reported postoperative abdominal surgery SSIs in pediatric patients reaching 7.2% from January

Table 1. Descriptions of patients

Descriptions of patients	n (%) (N = 135)
Prophylactic antibiotics (≥2 hours before surgery)	95 (70.4)
Albumin (<3 g/dl)	49 (36.3)
Male sex	90 (66.7)
Age	
<25 years	16 (11.9)
25–65 years	108 (80.0)
>65 years	11 (8.1)
Length of preoperative hospitalization	
1 day	18 (13.3)
2–15 days	88 (65.2)
>15 days	29 (21.5)
BMI	
Underweight	22 (16.3)
Normal weight	78 (57.8)
Overweight–obese	35 (25.9)
SGA	
A	51 (37.8)
B	63 (46.7)
C	21 (15.5)
Intraoperative complication	5 (3.7)
Relaparotomy	30 (22.2)
Intraoperative bleeding (<1,500 ml)	132 (97.8)
Duration of surgery (<3 hours)	40 (29.6)
Operation type	
Clean	3 (2.2)
Clean-contaminated	57 (42.2)
Contaminated	54 (40.0)
Dirty	21 (15.6)
Total death	30 (22.2)
SSI type	
Organ	26 (19.3)
Deep	77 (57.0)
Superficial	32 (23.7)
Prophylaxis antibiotic response	
Adequate	42 (31.1)
Inadequate	93 (68.9)

BMI=body mass index; SGA=subjective global assessment; SSI=surgical site infection

1 to February 28, 2007.[4] This study showed 135 cases of SSIs from 2012 to 2017. Castro et al[3] reported that the SSI incidence was 23.8% in Brazil. Ishikawa et al[8] have also reported that the SSI incidence ranged from 5–26% in Japan. However, Ouedraogo et al[12] reported that the incidence of SSIs was 11.8% in Africa after digestive surgery.

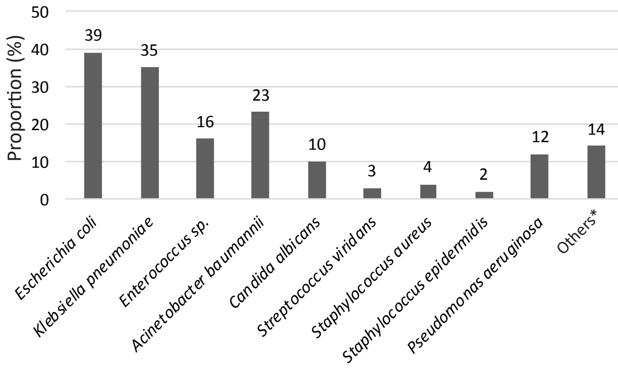

Figure 1. Cultured pathogens of surgical site infection (SSI) in abdominal surgery (N = 158). *Others included: *Bacillus* sp., *Proteus mirabilis*, *Proteus vulgaris*, *Serratia marcescens*, *Citrobacter* sp., *Enterobacter aerogenes*, *Citrobacter diversus*, *Serratia ribidae*

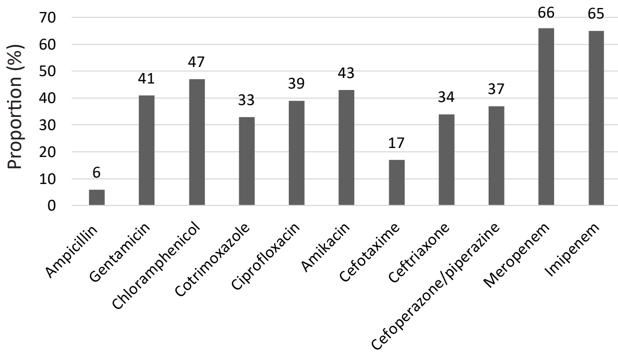

Figure 2. Antibiotic sensitivity of cultured pathogens (antibiotics used were based on cultured pathogen) (N = 428)

Most of the cases were men in our study. Cohen et al[7] stated that this was caused by the biological differences between men and women. This difference is because bacterial colonization on the skin surrounding the central vein catheter at the insertion site is higher in men than in women. Hair growth and pattern could also lead to a higher risk of infection among men.

Nutritional status is a predisposing factor for the occurrence of SSI. There are several indicators available. In this study, most of SSIs cases had normal BMI, SGA category B, and albumin level ≥3 g/dl. Patients who had albumin ≥3 g/dl and did not undergo relaparotomy were more exposed to SSIs. Satyanarayana et al[1] found that the SSI number occurred in 48% of patients with an overweight or obese BMI, and 45% in patients with a normal BMI. Also, only 7% of patients with malnutrition suffered from an SSI. SGA figures as indicators of nutritional status are often used in children and adults. In children with SGA malnutrition category B or C, the frequency of infection complications occurs more often than in children with SGA malnutrition category A with good nutrition. Albumin levels have a direct positive correlation with immune function compared with other nutritional status measurements.[13,14] Shinkawa et al[15] reported that malnutrition could increase the risk of infectious or non-infectious complications by 2.3 to 4.2 times after abdominal surgery. Several studies in children or adults suggest that both thinness and obesity are associated with an increased risk of infection.[13–18]

In surgical patients, malnutrition adversely affected outcomes. Albumin level is the most commonly used and reliable indicator of a patient's nutritional status and a negative acute-phase protein. During hypoalbuminemia, an interruption of cytokine metabolism occurs primarily in interleukin-1 and defects in the complement system. A study of four institutions in Ireland showed that patients who developed an SSI had lower median preoperative serum albumin than those who did not develop an infection, with 3.0 g/dl and 3.6 g/dl, respectively. Low preoperative albumin levels (<3.0 g/dl) were associated with an increased risk of developing severe surgical infections.[13] Therefore, hypoalbuminemia is an important risk factor for colorectal surgery infections.[8] However, our study showed that more than half of our patients had an albumin level of ≥3 g/dl.

Patients with a preoperative length of stay from 2 to 15 days, duration of surgery of ≥3 hours, and bleeding of <1,500 ml were found to have high SSI numbers from 2012 to 2017. The duration of surgery was investigated in association with SSI events. Longer interventions increased the risk of SSIs because of increased exposure to tissues, and complex surgical techniques and prolonged surgery due to complications (hypotension, hemorrhage, and others). The above conditions provide more opportunities for microbial invasion of the tissues and progress to become infections. The high rates of infection in emergency surgery are thought to be because of inadequate preoperative preparation, more predisposing baseline diseases than elective surgery, and more cases of contaminated or dirty wounds. A study in a teaching hospital in Saudi Arabia also stated that emergency operations are significantly related to a higher rate of infection than elective operations.[19] However, we had three cases of SSI in a clean operation. The distribution of patients with the highest SSIs was in surgery with bleeding volume <1,500 ml (97.8%) in the study by Ishikawa et al.[8] If a patient is suspected of having SSI that starts after surgery or because of treatment failure, antibiotics should be given according to the sensitivity profiles of bacteria. These profiles have been mapped by Cipto Mangunkusumo Hospital and should be applied without waiting for the culture results.

The total death of our data was 30 (22.2%). The mortality rate of various hospitals in Southeast Asia ranged from 7–46%.[9,12,13] SSIs are associated with not only increased morbidity but also substantial mortality. In Figure 1, most SSIs were caused by *E. coli, K. pneumoniae, and Acinetobacter baumannii.* Based on the bacterial and antibiotic susceptibility profile in the surgical inpatient unit at Cipto Mangunkusumo Hospital, even though *E. coli* are susceptible to gentamicin, they were still found in SSIs.[20] *E. coli and K. pneumoniae* were community-acquired infections, and *A. baumannii* were nosocomial infections because of multiple hospital factors that caused SSI. Both *E. coli* and *K. pneumoniae* were also reported in Northwestern Tanzania due to the incidence of SSI.[21] Figure 2 described the antibiotics used in this study.

We started antibiotics with meropenem because most patients were referred from primary and secondary hospitals, and had already been given multiple antibiotics and medications. In our clinical guidelines in abdominal surgery at Cipto Mangunkusumo Hospital, we combined amikacin and metronidazole as first-line antibiotics and decided to use meropenem when abdominal sepsis was diagnosed. In line with Satyanarayana et al,[1] the administration of prophylactic antibiotics should be longer than 2 hours before surgery (ideally within 30 min within two hours of the time of incision). For longer surgical procedures, redosing of the drug is indicated at intervals of one or two times the half-life of the antibiotics (using the same dose).[1,21–23] Castro et al[3] also stated that surgical antibiotic prophylaxis was prescribed in 99.5% of the surgeries, and its use was adequate in 74.5% of them. In contrast, our data showed only 31.1% of patients had adequate response to antibiotic prophylaxis, and the rest of them had inadequate response, prompting the need to change the antibiotic based on sensitivity profile of cultured pathogen. We conclude that this problem is caused by the misuse of antibiotics in primary and secondary hospitals. A study in eight hospitals in developing countries showed that prophylactic antibiotics that were given appropriately improved outcomes significantly in the postintervention period.[21–25]

The limitations of this study include the difficulty in evaluating all patients and comparing all patients in our hospital because of several conditions, such as our hospital is the National Referral Hospital, people came from far away, and patients were given multiple antibiotics and other medications before admission to our hospital. The failure to follow-up patients in 30 days also became a limitation. We were also limited by the cultured anaerobic bacteria that we could analyze because the media were unavailable at our hospital. Also, when the operator swabbed the wrong wound or contamination with normal skin flora occurred. According to American College of Surgeon and Surgical Infection Society 2016 update, some factors that affect SSI were not included in our study, such as modified internal factors (diabetes, alcoholism, smoking status, total bilirubin, and immunosuppression), extrinsic factors (procedure-related and facility), and some operative factors (poor glycemic control, inadequate gloving, inadequate skin preparation, and pre-existing infection).[26] Despite these limitations, to our knowledge, this is the first study that evaluated more than five years of experience of SSI on digestive surgery in Indonesia.

In conclusion, the incidence of SSI in Cipto Mangunkusumo Hospital was low (2.8%). Therefore, improvements are needed not only in the quality of preoperative and intraoperative care, but also in SSI diagnosis and awareness. Furthermore, more studies are needed to increase a better understanding of how to reduce incidence, risk, and SSI-related mortality.

Conflict of Interest

The authors affirm no conflict of interest in this study.

Acknowledgment

None.

Funding Sources

None.

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