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Risk factors for surgical site infection (ssi) in post-appendectomy patients at Massenrempulu Hospital, Enrekang Regency, 2023

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ABSTRACT

Surgical Site Infection (SSI) is a major healthcare-associated infection that significantly increases morbidity, mortality, and healthcare costs. This study aims to analyze the risk factors for SSI in post-appendectomy patients at Massenrempulu Hospital, Enrekang Regency, using a cross-sectional method with secondary data from patient medical records. A total of 41 patients met the inclusion criteria. The results indicate that SSI was more prevalent in females (65.9%) compared to males (34.1%), with the highest incidence occurring in the 17-25 age group (34.1%). In terms of nutritional status, most SSI cases were observed in patients with abnormal BMI, including underweight (22%), overweight (29.3%), and obesity (7.3%). Additionally, 92.7% of patients had no comorbidities, while a small percentage had hypertension (4.9%) or fatty liver disease (2.4%). Surgical duration was also a critical factor, as most SSI cases (92.7%) were associated with moderate-duration surgeries (60-120 minutes), while only 7.3% occurred in short-duration surgeries (<60 minutes). These findings highlight the importance of monitoring SSI risk factors, particularly among younger patients, females, and those with abnormal nutritional status. The study emphasizes the need for improved infection control strategies, proper nutritional management, and enhanced postoperative care to minimize SSI occurrence. Future research should consider primary data collection and additional variables to further explore risk factors. Additionally, healthcare facilities should enhance infrastructure and transition from manual to electronic medical records to improve patient management and reduce infection rates.

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1. Introduction

Surgical Site Infection (SSI) is one of the Healthcare-Associated Infections (HAIs) that threatens the lives of hundreds of millions of patients each year. According to the World Health Organization (WHO) (2017), in the United States, SSI is estimated to contribute to an additional 400,000 hospital care days, with costs amounting to 10 billion USD per year. In Low- and Middle-Income Countries (LMICs), surgical

infections are the most common, occurring at an average rate of 5.9 per 100 surgical procedures and 11.2 per 100 surgical patients.

In the Asia-Pacific Accreditation Cooperation (APAC) region, SSI incidence varies widely, with a cumulative incidence of 2.8% in Australia (2002-2013), 2.0-9.7% in South Korea, 4% in China (2000-2017), and 7.8% in Southeast Asia and Singapore (2000-2012). The prevalence of SSI in Indonesia is estimated to be around 2.3-18.3%, making it the most common nosocomial infection, accounting for 38% of HAIs. Surgical Site Infection (SSI) can manifest both locally and systemically. Local complications include delayed wound healing, leading to chronic wounds and potential damage to local tissues. Additional infections, abscess formation, and osteomyelitis may also occur.

Systemic complications involve bacteremia, which can spread hematogenously and cause sepsis. In severe infections, organ failure may occur, especially in patients with comorbidities, further worsening their condition. The occurrence of SSI is a serious issue as it increases postoperative morbidity and mortality rates, prolongs hospital stays, and raises healthcare costs. SSI remains a major challenge in surgical wound healing, contributing significantly to morbidity and mortality rates. Several risk factors contribute to the occurrence of SSI. Some are non-modifiable, such as gender and age. As individuals age, structural changes in the skin and metabolic alterations occur, making older patients more susceptible to hypothermia during surgery. Hypothermia can lead to coagulation disorders and impaired wound healing.

Modifiable risk factors include nutritional status. Inadequate nutrient intake, especially proteins essential for tissue repair, vitamin C for collagen synthesis, and zinc (Zn) as a cofactor for enzymes involved in wound healing, can increase the risk of SSI. Comorbidities such as diabetes mellitus (DM) can also contribute, as elevated hemoglobin affinity for oxygen in DM patients reduces oxygen release to tissues. Chronic Kidney Disease (CKD) and chronic liver disease can lead to hypoalbuminemia, which hampers wound healing and increases infection risk. Another risk factor is prolonged surgical duration, as prolonged exposure of the surgical site to the operating room environment increases the risk of contamination by exogenous bacterial flora and endogenous bacterial translocation. The operating room environment itself can contribute to SSI risk since it requires strict air quality control to prevent microbial contamination.

Proper ventilation must be maintained to minimize turbulence and airborne contamination. Previous studies have examined various aspects of SSI. Sommeng F (2019) investigated airborne bacteria in operating rooms and bacteria in postoperative infection wounds at Ibnu Sina Hospital by sampling both the operating room and post-surgical patients. Alam N et al. (2017) explored risk factors for SSI in digestive surgery at a private hospital, using variables such as nutritional status, age, type of surgery, duration, and nature of the procedure.

This study will focus on Surgical Site Infection (SSI) in a previously unstudied area, namely Massenrempulu Hospital, Enrekang Regency. It will examine different variables from previous studies, including gender, age, nutritional status, comorbidities, and surgical duration.

2. Methods

This study is a qualitative descriptive study using a cross-sectional method aimed at explaining the risk factors for the occurrence of Surgical Site Infection (SSI) in post-appendectomy patients. The risk factors examined include age, nutritional status, comorbidities, and duration of surgery, obtained from secondary data in the form of patient medical records at Massenrempulu Regional General Hospital, Enrekang Regency. The sample was collected using a total sampling technique, which includes all patients who meet the inclusion and exclusion criteria.

The inclusion criteria consist of patients who underwent an appendectomy and experienced surgical site infection, aged 0-65 years, and had specific comorbidities such as Diabetes Mellitus, Hypertension, Chronic Kidney Disease, and Chronic Liver Disease. Meanwhile, patients with incomplete medical records, comorbid HIV/AIDS or autoimmune diseases, those who did not attend the follow-up visit on the third day post-appendectomy, or those who died within three days after surgery were excluded from this study. The independent variables in this study include gender, age, nutritional status,

comorbidities, and duration of surgery, while the dependent variable is the occurrence of Surgical Site Infection (SSI). The collected data will be processed using Microsoft Excel Office 365 and the Statistical Program for Social Science (SPSS) software to analyze the relationship between these variables.

3. Results and Discussion

3.1. Results

Based on the collected data, there were 41 patients who met the diagnostic criteria for Surgical Site Infection (SSI), where the patients exhibited one or more signs of inflammation, including rubor (redness), calor (heat), tumor (swelling), dolor (pain), and functio laesa (loss of function). This study utilized a total sampling method for data collection, in which all subjects meeting the criteria were included in the study within the specified time frame.

Characteristics of Patients

Table 1.
Characteristics of Patients with Surgical Site Infection (SSI)

Variables	Frequency	Percentage(%)
Age		
0-5 years	0	0
5-11 years	2	4,9
12-16 years	6	14,6
17-25 years	14	34,1
26-35 years	8	19,5
36-45 years	4	9,8
46-55 years	6	14,6
56-65 years	1	2,4
>65 years	0	0
Gender		
Male	14	34,1
Female	27	65,9
Body Mass Index		
Normal	17	41,5
Underweight	9	22
Overwight	12	29,3
Obesity	3	7,3
Comorbidity		
Negatif	38	92,7
Hypertension stage 1	2	4,9
Fatty Liver	1	2,4
Duration of Surgery		
<60 minutes	3	7,3
60-120 minutes	38	92,7
Total	41	100

Based on the table 1. presents the characteristics of 41 patients with Surgical Site Infection (SSI), covering age, gender, body mass index (BMI), comorbidities, and duration of surgery. The highest prevalence of SSI was in the 17-25 years age group (34.1%), followed by 26-35 years (19.5%), while no cases were reported in the 0-5 and >65 years groups. Female patients had a higher incidence (65.9%) compared to males (34.1%). In terms of BMI, most patients had a normal BMI (41.5%), followed by overweight (29.3%), underweight (22%), and obesity (7.3%). Most patients (92.7%) had no comorbidities, while 4.9% had Stage 1 Hypertension and 2.4% had Fatty Liver Disease. Regarding the duration of surgery, 92.7% of cases occurred in surgeries lasting 60-120 minutes, whereas only 7.3% had surgeries lasting less than 60 minutes. These findings indicate that SSI was more common in younger patients, females, those with normal or overweight BMI, and those undergoing surgeries lasting between 60-120 minutes.

3.2. Discussion

Surgical Site Infection (SSI) is an infection that occurs at the incision site after surgery, developing within 30 days or even up to one year. According to the Indonesian Ministry of Health, SSI is classified into three categories: superficial, deep, and organ/space infections. A superficial infection affects the skin, subcutaneous tissue, or other tissues above the fascia. A deep infection involves soft tissues such as fascia and muscle, while an organ/space infection can occur in any part of the body. SSI frequently occurs in hospitalized patients after surgery, characterized by signs such as inflammation, wound discharge, pus formation, positive culture results, or a physician's confirmation of SSI. Risk factors that can increase the incidence of infection include age, gender, nutritional status, history of diabetes, and duration of surgery. It was found that the majority of respondents were female, with 27 individuals (65.9%), while male respondents accounted for only 14 individuals (34.1%). Theoretically, males are at higher risk of developing SSI than females due to differences in skin anatomy and physiology. However, this study found a higher incidence of SSI in females. A study by Sandyawan et al. (2023) stated that females have a higher percentage of body fat than males due to hormonal factors influencing fat distribution after puberty. This fat is distributed in the breast, lower abdomen, thighs, and near the genital area. This finding is supported by a study by Kuan-Yong Yu et al. (2023), which found that thickened subcutaneous fat layers can increase pressure at the suture site, reducing blood flow to the incision area. Consequently, this can lead to wound dehiscence (suture rupture) and delay the healing process.

The research shows that the largest proportion of respondents were in late adolescence (17-25 years) with 14 individuals (34.1%), followed by early adulthood (26-35 years) with 8 individuals (19.5%), early adolescence (12-16 years) with 6 individuals (14.6%), late elderly (50-65 years) with 6 individuals (14.6%), late adulthood (36-45 years) with 4 individuals (9.8%), childhood (5-11 years) with 2 individuals (4.9%), and late elderly (56-65 years) with 1 individual (2.4%). This study found that SSI was most common in the 17-25 years age group. This result aligns with the study by Danny et al. (2020), which found that post-appendectomy patients under 30 years old experienced SSI more frequently than those over 30. This is likely due to the high number of appendectomy procedures performed in this age group, increasing the likelihood of SSI. Additionally, factors such as higher physical activity levels and adherence to wound care may also contribute to the incidence of SSI in this group.

Most respondents had an abnormal nutritional status, with 9 individuals (22%) being underweight, 12 individuals (29.3%) being overweight, and 3 individuals (7.3%) being obese. Meanwhile, 17 individuals (41.5%) had a normal nutritional status. This study highlights that abnormal nutritional status affects the wound healing process, as proper nutrition enhances wound strength, reduces wound dehiscence, lowers infection susceptibility, and minimizes scarring. This finding is supported by a study by Andi Siswandi et al. (2020), which states that insufficient body fat can delay wound healing, whereas excessive fat increases infection risk due to inadequate blood supply to adipose tissue. Malnutrition or undernutrition can impair tissue regeneration after surgery, as protein deficiency reduces collagen and leukocyte synthesis, increasing SSI risk. Excessive nutritional status (overweight and obesity) results in a higher fat mass, making surgical procedures more challenging. Increased visceral abdominal fat forces surgeons to consider incision techniques, surgery duration, and higher average blood loss, thereby increasing the risk of SSI. A study by Ita Puspita et al. (2024) found that 82.6% of obese patients developed SSI compared to only 17.4% of non-obese patients. Additionally, a study by Eva A. et al. (2017) reported that 65% of malnourished patients developed SSI, compared to 35% of those with normal nutritional status.

The majority of respondents had no comorbidities (38 individuals, 92.7%), while 2 individuals (4.9%) had Stage 1 Hypertension, and 1 individual (2.4%) had Fatty Liver. This finding aligns with a study by Jiuneshwar (2023), where only 1 out of 40 SSI patients (2.6%) had comorbidities, while 38 individuals (97.4%) had none. This study found the highest SSI prevalence in the 17-25 years age group, which typically has good organ function and metabolism, resulting in a lower risk of comorbidities such as diabetes, hypertension, or cardiovascular diseases compared to older individuals. Although comorbidities increase the risk of SSI, the impact is relatively low in this study. Among the three

respondents with comorbidities, two had Stage 1 Hypertension, and one had Fatty Liver. Hypertension and chronic kidney disease can lead to hypoalbuminemia, prolonging the inflammatory phase, fibroplasia, proliferation, proteoglycan production, and collagen synthesis. Hypoalbuminemia alters metabolism, particularly interleukin-1 (IL-1), leading to complement system failure. It was found that the majority of respondents underwent moderate-duration surgery (60-120 minutes) with 38 individuals (92.7%), while only 3 individuals (7.3%) had short-duration surgery (≤60 minutes). This finding is consistent with a study by Danny (2020), which reported that 82.3% of SSI patients had surgery lasting ≥90 minutes, whereas only 17.7% had surgery lasting <90 minutes. Additionally, a study by Cheng H et al. (2017) identified a linear relationship between surgery duration and SSI incidence, with the likelihood of SSI increasing by 5% for every 10-minute increase in surgery time, 13% for every 15-minute increase, 17% for every 30-minute increase, and.

4. Conclusion

The conclusions of this study indicate that the distribution of Surgical Site Infection (SSI) cases is higher among female patients compared to males, more prevalent in the 17-25 years age group, and more common in individuals with abnormal nutritional status (underweight, overweight, and obesity) than those with normal nutritional status. Additionally, SSI cases are more frequent among patients without comorbidities compared to those with comorbidities, and they occur more often in patients undergoing moderate-duration surgery (60-120 minutes) than in those undergoing short-duration surgery (<60 minutes). Based on these findings, recommendations for future research include conducting studies using primary data on post-appendectomy patients and incorporating additional variables to increase sample size. Furthermore, healthcare facilities are advised to enhance infrastructure and resources to facilitate the transition from manual to electronic medical records.

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