

Evaluation of Administration Prophylactic Antibiotic against Incidence of Surgical Site Infection in Post Appendectomy at Panembahan Senapati Hospital, Indonesia

Esa Adzillina^{1*}, Sri Sundari², Siti Mizabul Ijabah³

* Correspondence Author : eadzillina@gmail.com

¹ Master of Hospital Administration, Universitas Muhammadiyah Yogyakarta, Indonesia

² Faculty of Medicine, Universitas Muhammadiyah Yogyakarta, Indonesia

³ Hubei University of Science and Technology, Wuhan, Hubei Province, China

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ABSTRACT

Appendicitis is a prevalent abdominal surgical emergency in Indonesia, occurring at a rate of 5 per 1,000 people, with around 10 million cases each year. Appendectomy, the surgical removal of the vermiform, is the primary treatment for appendicitis but carries a high risk of surgical site infections. Prophylactic antibiotics are given to minimize the risk of infection resulting from surgery, administered in accordance with established guidelines. This study aims to evaluate the administration of antibiotic prophylactic against SSIs. This study used a mixed-methods approach to evaluate prophylactic antibiotic administration and the incidence of surgical site infection in post-appendectomy patients. The researchers conducted in-depth interviews with surgeons and nurses and an analytical observational study with a cross-sectional design, observing various indicators such as the timing and duration of prophylactic antibiotic administration and the presence of surgical site infections. The study found that the duration of antibiotic administration ≤ 24 hours had a higher number of infection-free patients (62.50%). The researchers analyzed the relationship between the duration of antibiotic administration and surgical site infection in post-appendectomy patients and found a significant relationship ($p < 0.05$) at the hospital. There is a relationship between prophylactic antibiotic administration and surgical site infection. All patients were given prophylactic antibiotics with appropriate timing, duration, and method of administration.

Kata kunci:

Antibiotik Profilaksis;
Infeksi Daerah
Operasi;
Apendisitis;
Apendektomi

Apendisitis ialah kondisi medis yang sering memerlukan tindakan darurat. Di Indonesia, dengan angka kejadian sekitar 5 per 1.000 orang per tahun dan mencapai sekitar 10 juta kasus setiap tahunnya. Apendektomi, atau pengangkatan apendiks vermiformis, merupakan tindakan utama dalam pengobatan apendisitis, namun memiliki risiko yang tinggi terhadap infeksi daerah operasi. Antibiotik profilaksis diberikan untuk mengurangi risiko komplikasi infeksi pasca operasi, dengan pemberian yang sesuai dengan pedoman yang telah ditetapkan. Penelitian ini menggunakan pendekatan campuran (mixed-methods) dalam mengevaluasi pemberian antibiotik profilaksis dan kejadian infeksi daerah operasi pada pasien pasca-apendektomi. Peneliti melakukan wawancara mendalam dengan dokter bedah dan perawat serta melakukan studi observasional analitik dengan desain potong lintang, dengan mengamati berbagai indikator seperti waktu dan durasi pemberian antibiotik profilaksis serta keberadaan infeksi di daerah bekas operasi. Hasil penelitian menunjukkan bahwa durasi pemberian antibiotik profilaksis selama ≤ 24 jam memiliki jumlah pasien yang lebih banyak yang bebas dari infeksi (62,50%). Peneliti menggunakan uji chi-square untuk mengevaluasi hubungan antara durasi pemberian antibiotik profilaksis dan daerah operasi pada pasien pasca-apendektomi dan menemukan bahwa terdapat terdapat hubungan yang signifikan ($p < 0,05$). Ada hubungan antara pemberian antibiotik profilaksis dan infeksi di daerah bekas operasi, dan semua pasien diberikan antibiotik profilaksis dengan waktu, durasi, dan cara pemberian.

INTRODUCTION

Appendicitis is characterized as an acute inflammation of the vermiform appendix. There is ample evidence indicating that acute appendicitis is the most prevalent abdominal surgical emergency. In the global incidences of 2019, around 17.7 million cases were reported, indicating an incidence rate of 228 cases per 100,000 individuals. Furthermore, there were over 33,400 fatalities, with a death rate of 0.43 per 100,000 individuals (Wickramasinghe, 2021). Appendicitis is suffered by nearly 100 per 100,000 person-years in Australia, Europe, and North America (van den Boom et al., 2020). In Indonesia, appendicitis is reported at a rate of 5 per 1,000 people, with around 10 million cases each year, making it the highest incidence in the ASEAN region (Saputra et al., 2022). Studies suggest that appendectomy, the surgical removal of the vermiform appendix, serves as the primary treatment for acute appendicitis. However, antibiotic therapy might be effective for a specific group of patients with uncomplicated acute appendicitis. Appendectomy is generally considered a safe surgical procedure, with a case fatality rate of 2.1-2.4 per 1,000 patients, as documented in European research (Danwang et al., 2020).

The appendectomy procedure is an operation with a high risk of developing surgical site infections. The incidence rate of surgical site infection after appendectomy is still high. In a study, it was reported that the incidence rate almost reached 10% for all cases of surgical site infection (Koumu et al., 2021).

Surgical site infections (SSI) are characterized as those that develop in the superficial, deep, or organ space surrounding the surgical area within 30 days following the surgery or 1 year if implants are present (Owens & Stoessel, 2008). SSI is categorized into 3 levels (superficial incision, deep incisional, and organ or space infection), significantly contributing to surgical morbidity and mortality each year (Alamrew et al., 2019). Avoiding surgical wound infections involves meticulous surgical methods, proper and punctual administration of pre-operative antibiotics, and numerous preventative actions targeting the neutralization of bacterial, viral, and fungal contamination risks presented by the surgical team, the operating room atmosphere, and the patient's environment. The role of endogenous skin flora is also significant (Reichman & Greenberg, 2009). The latest research also mentions that hand hygiene compliance affects the occurrence of surgical site infections (Hastuti et al., 2021). A study also states that compliance with hand hygiene among medical personnel can increase the risk of hospital-acquired infections (Arini, 2016). In efforts to categorize the likelihood of developing surgical site infections (SSI), regularly evaluated factors consist of patient age, gender, type, and length of surgery, American Society of Anesthesiologists (ASA) rating, and examination of the wound contamination score (World Health Organization, 2018).

Prophylactic antibiotics are antibiotics given to minimize the risk of infection complications resulting from a surgical procedure that may lead to an infection (Bootsma et al., 2008). The administration of prophylactic antibiotics to patients must be given in accordance with established rules based on prophylactic antibiotic administration guidelines (Prévost et al., 2021). In a study on the administration of prophylactic antibiotics for a surgical procedure, it was shown that prophylactic antibiotics can reduce the incidence rate of surgical site infections (Mulder et al., 2018). A different research indicates that prophylactic antibiotics can lower the occurrence of SSI. Antibiotics were administered to 73.3% of patients, particularly after undergoing surgery (58.3%). The commonly prescribed

antibiotics were cefotaxime (80.7%), metronidazole (63.5%), cefradine (13.6%), and amoxicillin/clavulanate (11.6%) (Mwita et al., 2021). However, another study states that the prevalence of SSI is relatively high despite the fact that most surgical patients are given prophylactic antibiotics. Comorbidities, contaminated and dirty wound class, lack of prophylactic antibiotics, administration of prophylactic antibiotics between 1 and 2 hours before incision, and a 48-hour duration of surgical prophylactic antibiotics are significantly associated with SSI (Kefale et al., 2020).

The likelihood of suffering from appendicitis is high in Panembahan Senopati Hospital, leading to a rise in the number of appendectomy operations. Consequently, these surgeries carry a potential risk of surgical site infection, raising concerns about the appropriate administration of antibiotics in the hospital.

This study aimed to evaluate prophylactic antibiotic administration in appendectomy patients and the correlation between the evaluation of prophylactic antibiotic administration and the incidence of SSI in post-appendectomy patients at Panembahan Senopati Hospital.

RESEARCH METHOD

This study used a mixed methods approach consisting of both quantitative and qualitative methods. We first use a quantitative method to analyze the initial data and then proceed with a qualitative approach to strengthen the argument. In the qualitative approach, the researchers conducted in-depth interviews with surgeons and nurses. The results of these interviews were used to evaluate the administration of prophylactic antibiotics and surgical site infection in post-appendectomy patients. In the quantitative approach, the researchers used an analytical observational study with a cross-sectional design that measured variables simultaneously, and data collection was done retrospectively from 2020 to 2021 at Panembahan Senopati Hospital.

For the data collection for the quantitative approach, we only used 73 medical record data of patients who underwent appendectomy procedures and met the inclusion and exclusion criteria. For the qualitative approach, we conducted in-depth interviews with surgeons, ward nurses, and surgical assistants. The selection of respondents was based on specific criteria, namely medical personnel who provided care and direct contact with patients.

RESULTS AND DISCUSSION

The results of this study are derived from the study subjects, appendectomy patients, surgeons, ward nurses, and surgical assistants in Panembahan Senopati Hospital. This study used medical record data from 73 patients who met the inclusion criteria, as well as interviews with surgeons, inpatient nurses, and surgical assistants. The indicators observed by the researchers were pre-operative diagnosis, post-operative diagnosis, length of surgery, type of antibiotic, use of single or combination antibiotic therapy, timing of prophylactic antibiotic administration, duration of prophylactic antibiotic administration, length of hospital stay, and the presence of surgical site infection.

This study used a mixed methods approach. In the quantitative analysis, univariate and bivariate analyses were performed. The univariate analysis aimed to determine the characteristics of the respondents, including pre-operative diagnosis, post-operative diagnosis,

length of surgery, type of antibiotic, use of single or combination antibiotic therapy, timing of prophylactic antibiotic administration, duration of prophylactic antibiotic administration, length of hospital stay, surgical site infection, while the bivariate analysis was used to determine the relationship between the evaluation of prophylactic antibiotic administration and the incidence of surgical site infection in post-appendectomy patients using the Chi-square statistical test with IBM SPSS Ver.13 . The qualitative analysis involved conducting in-depth interviews with respondents identified. Initials were given as S, SY, and H. We do transcripts of interviews verbatim and analyze up to several codes, themes, and categories.

Distribution of Respondent's Characteristics Based on Diagnosis

Table 1. Frequency Distribution of Respondents' Characteristics Based on Pre-operative Diagnosis

Pre-operative Diagnosis	Frequency (N)	Percentage (%)
Infiltrat appendicitis	9	12.3
Chronic appendicitis	18	24.7
Acute appendicitis	42	57.5
Acute exacerbation appendicitis	4	5.5
Total	73	100

The analysis presented in Table 1 shows that the pre-operative diagnosis of respondents includes 9 individuals with infiltrate appendicitis (12.3%), 18 individuals with chronic appendicitis (24.7%), 42 individuals with acute appendicitis (57.5%), and 4 individuals with acute exacerbation of appendicitis (5.5%).

Table 2. Frequency Distribution of Respondents' Characteristics Based on Post-operative Diagnosis

Pre-operative Diagnosis	Frequency (N)	Percentage (%)
Infiltrat appendicitis	13	17.8
Chronic appendicitis	17	23.3
Acute appendicitis	38	52.1
Acute exacerbation appendicitis	4	5.5
Periappendicular abscess	1	1.4
Total	73	100

The results of the analysis presented in Table 2 show that the post-operative diagnosis of respondents includes 13 individuals with infiltrate appendicitis (17.8%), 17 individuals with chronic appendicitis (23.3%), 38 individuals with acute appendicitis (52.1%), 4 individuals with acute exacerbation of appendicitis (5.5%), and 1 individual with periappendicular abscess (1.4%).

Distribution of Surgery Duration

Table 3. Distribution of Surgery Duration

Duration	Frequency (N)	Percentage (%)
25-30 minute	5	6.8
31-40 minute	5	6.8
>40 minute	63	86.3
Total	73	100



Table 3 reveals that the surgery duration of the respondents includes 5 individuals with a surgery duration of 25-30 minutes (6.8%), 5 individuals with a surgery of 31-40 minutes (6.8%), and 63 individuals with a surgery duration >40 minutes (86.3%).

Antibiotic Types

Table 4. Types of Antibiotic

Monotherapy or Combination	Antibiotic	Frequency (N)	Percentage (%)
Monotherapy	Amoxicillin	2	3.0
	Cefotaxime	1	1.5
	Ceftriaxone	63	95.5
Combination	Ceftazidime+ Metronidazole	1	14.3
	Ceftriaxone+Cefixime	1	14.3
	Ceftriaxon+Metronidazole	5	71.4

Table 4 shows that the type of prophylactic antibiotics given to the respondents were single therapy given to 66 individuals (90.4%) and combination therapy given to 7 individuals (9.6%). The single therapy antibiotics were mostly ceftriaxone, given to 63 individuals (95.5%), followed by Amoxicillin, given to 2 individuals (3.0%), and cefotaxime, given to 1 individual (1.5%). The majority of the combination therapy antibiotics were Ceftriaxone+Metronidazole, given to 5 individuals (71.4%), followed by Ceftazidime+Metronidazole and Ceftriaxone+Cefixime, each given to 1 individual (14.3%).

Timing of Antibiotic Administration

Table 5. Timing of Antibiotic Administration

Time	Frequency (N)	Percentage (%)
<60 minute	3	4.1
>60 minute	70	95.9
Total	73	100

Table 5 shows that the timing of antibiotic administration to the respondents includes 3 individuals with antibiotic administration time <60 minutes (4.1%) and 7 individuals with antibiotic administration time ≥60 minutes (95.9%).

Duration of Antibiotic Administration

Table. 6 Duration of Antibiotic Administration

Time	Frequency (N)	Percentage (%)
≤24 Hours	72	98.6
>24 Hours	1	1.4
Total	73	100

The analysis presented in Table 6 shows that the duration of antibiotic administration in patients who received antibiotics for ≤24 hours was 72 individuals (98.6%). In comparison, for patients who received antibiotics for >24 hours, it was only 1 person (1.4%).

Incidence of Surgical Site Infection**Table 7. Distribution of Incidence Surgical Site Infection**

SSI'S	Frequency (N)	Percentage (%)
Present	27	37
Absent	46	63
Total	73	100

Table 7 shows 27 individuals (37.0%) with surgical site infections and 46 individuals (63.0%) who did not have surgical site infections among the respondents.

The relationship between prophylactic antibiotics and surgical site infection in post-appendectomy patients

Based on the bivariate analysis between prophylactic antibiotic and surgical site infection, the results are presented:

Table 8. Relationship between the type of prophylactic antibiotic and surgical site infection in post-appendectomy patients

Infection in post appendectomy patients						
Type of Antibiotic	SSI'S				Total	*P-value
	Present		Absent			
	N	%	N	%		
Monotherapy	21	31.82	45	68.18	66	0.005
Combination	6	85.71	1	14.29	7	
Total	27	36.99	46	63.01	73	

The research results showed that a single type of antibiotic was more commonly used in patients and did not result in surgical site infections, with 45 out of 66 respondents (68.18%) being infection-free. The study examined the relationship between prophylactic antibiotic type and surgical site infection in post-appendectomy patients using a chi-square test, resulting in a p-value of 0.005 ($p < 0.05$), indicating a significant relationship between prophylactic antibiotic type and surgical site infection in post-appendectomy patients at the hospital.

Table 9. Relationship Between Timing of Antibiotic Administration and Surgical Site Infection in Post-Appendectomy Patients

Timing	SSI'S				Total	*P-value
	Present		Absent			
	N	%	N	%		
<60 minute	0	0.00	3	100.00	3	0.175
≥60 minute	27	38.57	43	61.43	70	
Total	27	36.99	46	63.01	73	

The results show that antibiotic administration time of ≥60 minutes was more commonly used in patients and did not result in surgical site infections, with 43 out of 70 respondents (61.43%) being infection-free. The study examined the relationship between timing of antibiotic administration and surgical site infection in post-appendectomy patients using a chi-square test, resulting in a p-value of 0.175 ($p > 0.05$), indicating no significant

relationship between timing of antibiotic administration and surgical site infection in post-appendectomy patients at the hospital.

Table 10. Relationship Between Duration of Antibiotic Administration and Surgical Site Infection in Post-Appendectomy Patients

Infection in Post Appendectomy Patients						
Duration	SSI'S				Total	*P-value
	Present		Absent			
	N	%	N	%		
≤24 hour	27	37.50	45	62.50	72	0.44
>24 hour	0	0.00	1	100.00	1	
Total	27	36.99	46	63.01	73	

The research shows that the duration of antibiotic administration of ≤24 hours had a higher number of patients who did not experience surgical site infection, with 45 out of 72 respondents (62.50%) being infection-free. The study examined the relationship between duration of antibiotic administration and surgical site infection in post-appendectomy patients using a chi-square test, resulting in a p-value of 0.44 ($p > 0.05$), indicating no significant relationship between duration of antibiotic administration and surgical site infection in post-appendectomy patients at hospital.

Based on the qualitative approach, several essential codes were found. These essential codes were identified and then grouped into three themes: 1) Prophylactic antibiotics given to appendectomy patients, 2) Administration of prophylactic antibiotics, and 3) Length of hospitalization/treatment.

Prophylactic antibiotics given to appendectomy patients

Giving prophylactic antibiotic administration in patients undergoing appendectomy, the following are quotes from the informants:

"Yes, it's already a procedure, so when the patient arrives here, they will be given antibiotic automatically. The administration of prophylactic antibiotics is to prevent infection after surgery..." (Surgeon)

"...About 90% of patients receive prophylactic antibiotics. If they have not been scheduled, while about 10% of patients have not scheduled antibiotics." (Surgical Assistant)

"The antibiotic administration for cases of appendicitis is given from the beginning. For example, patients who come from the ER or outpatient department will continue to receive the antibiotics in the ward" (Ward Nurse)

The type of antibiotics given to patients undergoing appendectomy is usually ceftriaxone. The following is an excerpt from the informants' statements:

"...Automatically, they will be given ceftriaxone there." (Surgeon)

"Ceftriaxone, sometimes if the infection spreads or reaches peritonitis, metronidazole is used" (Ward Nurse)

Given that ceftriaxone, because it is a broad-spectrum antibiotic, the following is an excerpt from the informants' statements:

"Antibiotics, yes, because they are broad spectrum." (Surgeon)

There are no exceptions in the administration of antibiotics. The following is an excerpt from the informants' statements:

"There is no exception; it must be given because he is already in an infected condition." (Surgeon)
"Nothing, because it's already from the room, huh. So we just have to give it." (Ward Nurse)

Administration of prophylactic antibiotics

The antibiotics are given as soon as possible, at least 30-60 minutes before the procedure. The following is an excerpt from the informants' statements:

"Just give it right away, as soon as possible, to prevent the spread of the infection." (Surgeon)
"For the time of administration, for example, 30 minutes before surgery, prophylactic antibiotics are given." (Ward Nurse)
"Yes, that's the range before 60 minutes. So what is clear is that we agree on no more than 1 hour." (Surgical Assistant)

In the hospital, there is a standard operating procedure for providing prophylactic antibiotics. The following is an excerpt from the informants' statements:

"In the operating room itself, there is a standard operating procedure for administering prophylactic antibiotics." (Surgical Assistant)
"There is a standard operating procedure for administering prophylactic antibiotics." (Ward Nurse)

The duration of prophylactic antibiotics is less than 24 hours. The following is an excerpt from the informants' statements:

"yes, usually it takes less than 24 hours.." (Ward Nurse)

The length of hospitalization/treatment

Length of stay of post-appendectomy patients: 3 days. The following is an excerpt from the informants' statements:

"...3 days, after 3 days he can go home." (Surgeon)
"cases like this should be around 3 days. Sometimes there is a delay of more than 3 days, depending on the patient's recovery." (Ward Nurse)

The researcher analyzed the relationship between variables obtained from qualitative results and compared them with quantitative results. The data analysis at this stage was combined with the hypothesis testing results from quantitative data analysis, resulting in a good and comprehensive data analysis that can be used as a reference.

Table 11. Conclusion

Indicator	Quantitative data	Qualitative data	Note
Prophylactic antibiotic administration in patients undergoing surgery	In Panembahan Senopati Hospital, patients who undergo appendectomy have been given prophylactic antibiotics both before and after surgery. The antibiotics given include Ceftriaxone, Cefixime, Metronidazole, and Amoxicillin.	Prophylactic antibiotics have been given to patients with appendicitis from the beginning of their admission and to those who undergo surgery. Antibiotic administration has followed the standard procedure, usually based on the patient's admission.	Strengthening, expanding, and deepening
The type and selection of prophylactic antibiotics administered	The type of single-therapy antibiotic given is mostly ceftriaxone, followed by Cefixime and Metronidazole.	The prophylactic antibiotic given to patients undergoing appendectomy at Panembahan Senopati Hospital is Ceftriaxone. However, if the infection spreads, metronidazole is used for peritonitis treatment.	Strengthening, expanding, and deepening
The timing of antibiotic administration.	The administration of antibiotics in patients undergoing appendectomy at Panembahan Senopati Hospital is mostly done at ≥ 60 minutes.	For the timing of administration, for example, prophylactic antibiotics are given 30 minutes before the surgery. However, in reality, some patients may receive the antibiotics 3 hours or 4 hours before the surgery.	Strengthening, expanding, and deepening
The duration of antibiotic administration.	The analysis results showed that almost all respondents stated the duration of antibiotic administration of ≤ 24 hours.	The patient is given antibiotics after being admitted to the ward to prevent the spread of infection. The duration of administration is within 60 minutes. So, it is agreed that the administration should not exceed one hour.	Strengthening, expanding, and deepening
The length of hospitalization/treatment	The analysis results showed that the length of hospitalization/treatment is mostly >3 days (91.8%), while only 8.2% had a length of hospitalization/treatment ≤ 3 days.	"The length of patient hospitalization/treatment takes into consideration the wound recovery process. The length of hospitalization/treatment can be around 3 days or more, depending on the patient's condition. Some patients may even stay in the hospital for more than 3 days.	Strengthening, expanding, and deepening

Table 11. Conclusion (cont')

Indicator	Quantitative data	Qualitative data	Note
The complaints conveyed by patients regarding prophylactic antibiotics	The majority of patients stated that there was no surgical site infection (63%).	So far, there have been no issues with the administration of prophylactic antibiotics in patients with appendicitis. If there are side effects, we sometimes use cefuroxime or cefotaxime. As for complaints, there are only a few cases where the administration was not appropriate. Usually, for patients with widespread infection, we conduct an antibiotic sensitivity culture test to see which antibiotics are still effective.	Strengthening, expanding, and deepening
Relationship between the type of prophylactic antibiotics and surgical site infection in patients after appendectomy	There is a relationship between the type of prophylactic antibiotics and surgical site infection in patients after an appendectomy at Panembahan Senopati Hospital in 2020-2021.	There is a relationship between the type of antibiotics and surgical site infection because, at Panembahan Senopati Hospital, we follow standard operating procedures and administer the correct dosage of antibiotics. Suppose additional antibiotics are needed for special conditions, such as metronidazole or meropenem. In that case, we evaluate the patient's condition, check for signs of peritonitis from an abdominal X-ray, and look for significant increases in body temperature during physical examination, which indicate a widespread infection.	Strengthening, expanding, and deepening

Based on the above data analysis, there is a relationship between quantitative and qualitative research. The quantitative research results show the decision of accepted hypotheses, and the qualitative research results provide the same information. Moreover, the qualitative research provides in-depth and complete information related to the evaluation variable of prophylactic antibiotic administration. Therefore, these results strengthen the evidence that surgical site infections are influenced by the type of prophylactic antibiotics administered.

The pattern of antibiotic use from 73 patients was divided into single and combination antibiotic use. One patient could receive 2 types of antibiotics, namely single and combination antibiotics, and other patients could receive only single or combination antibiotics. The results showed that almost all patients received single antibiotics, which was 90.4%, and only 9.6% received combination antibiotics. Based on Table 4, the most commonly given single antibiotic was ceftriaxone (95.58%), and the most commonly given combination was ceftriaxone-metronidazole (71.4%). That is consistent with the study conducted (Sheikh et al., 2020), which revealed that ceftriaxone as monotherapy has good efficacy for antibiotic prophylaxis. The most commonly used antibiotic for prophylaxis in digestive surgery is ceftriaxone, the cephalosporin 3rd generation (Narulita et al., 2021). That is strengthened by research conducted (Sonda et al., 2019) that ceftriaxone is currently still used as a prophylaxis, and its effectiveness is high in reducing surgical site infection.

Ceftriaxone is much more common than cefotaxime because ceftriaxone has a longer half-life than cefotaxime. The half-life of ceftriaxone is about 8 hours, while the plasma half-life of cefotaxime is around 1 hour and is given every 6 to 12 hours. The dose of ceftriaxone for adults given as a single prophylaxis for surgery is 1g, and for colorectal surgery prophylaxis, it is 2g. It is administered through intramuscular injection, intravenous bolus, or infusion. Meanwhile, the plasma half-life of cefotaxime is around 1 hour and is given every 6 to 12 hours (Khan et al., 2017). Ceftriaxone is a third-generation cephalosporin antibiotic that is commonly used in patients with a diagnosis of appendicitis because it has a broad spectrum of activity and is active against *S. aureus* and *E. coli*, which can cause surgical site infections. It has a longer half-life than all other cephalosporin antibiotics, which is 5-11 hours, so if the surgery takes longer than expected, there is no need to repeat the dose. It also has good tissue penetration, low toxicity, no coagulase problems, and a good therapeutic index. The weakness of ceftriaxone is that it is a broad-spectrum antibiotic that can disrupt normal flora and increase the risk of antibiotic resistance (Farizal et al., 2016).

Ceftriaxone can be combined with metronidazole for surgical prophylaxis in cases of mixed infections, such as intra-abdominal and genitourinary infections (Ayele & Taye, 2018). Metronidazole is a nitroimidazole antibiotic with a limited spectrum of activity that includes various protozoa, gram-positive bacteria, and anaerobic gram-negative bacteria. Metronidazole has activity against protozoa such as *E. histolytica*, *G. lamblia*, and *Trichomonas vaginalis*, which can be used for intra-abdominal infections due to its ability to fight anaerobic bacteria such as *B. fragilis*, which are encountered during some surgical procedures. Its half-life is 7.5 hours, and it is protein-bound to 10-20%. Metabolism occurs in the liver, and it can accumulate in patients with liver impairment (Ceruelos et al., 2019). Another consideration for the use of ceftriaxone is that the most commonly found microorganisms causing appendicitis are *Streptococci* spp, *E. coli*, and some anaerobic bacteria. Ceftriaxone's broad spectrum of activity covers these microorganisms and is effective against them (Richardson et al., 2015). The next point is regarding the duration of administration. Research shows that the administration of antibiotics in patients undergoing appendectomy at Panembahan Senopati Hospital is almost entirely done within ≥ 60 minutes, which is 95.9%. This result is reinforced by the opinions of the respondents who were interviewed.

CONCLUSION

The results showed that patients undergoing appendectomy at Panembahan Senopati Hospital have already been given prophylactic antibiotics before surgery. The type of antibiotic given to patients undergoing appendectomy is almost entirely ceftriaxone. The administration of antibiotics in patients undergoing appendectomy is almost entirely ≥ 60 minutes. The duration of antibiotic administration in patients undergoing appendectomy is almost entirely ≤ 24 hours. The length of stay for patients undergoing appendectomy at Panembahan Senopati is almost entirely > 3 days. The majority of patients undergoing appendectomy reported no surgical site infections. There is a relationship between the type of prophylactic antibiotic and surgical site infections in patients undergoing post-appendectomy at Panembahan Senopati in 2020-2021.

Based on the results of qualitative research, these findings reinforce the hypothesis of the quantitative research on the evaluation of prophylactic antibiotic administration on the incidence of surgical site infections in post-appendectomy patients. The qualitative data analysis results showed that patients undergoing appendectomy at Panembahan Senopati have been given prophylactic antibiotics from the beginning of admission and before surgery, antibiotic administration has been performed according to the standard operating procedure and appropriate dosages, and the type of prophylactic antibiotic given is ceftriaxone. However, if the infection spreads or peritonitis occurs, metronidazole is used in addition to antibiotics, and the administration time varies from 3-4 hours before surgery. The duration of administration is less than 60 minutes, and the length of patient care considers the patient's wound condition. Some patients are hospitalized for more than 3 days.

So far, there have been no problems with the administration of prophylactic antibiotics in patients with appendicitis. Based on the results of the above data analysis, there is a correlation between quantitative and qualitative research. The results of the quantitative research show the accepted hypothesis and the qualitative research provides in-depth and comprehensive information regarding the relationship between antibiotics and surgical site infections because Panembahan Senopati Hospital has provided prophylactic antibiotics according to standard operating procedures and appropriate dosages. In special conditions such as peritonitis, additional antibiotics such as metronidazole or meropenem may be used.

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