

Antibiotic prophylaxis for surgical procedures at A Tertiary Hospital, Vietnam

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ABSTRACT

Background: Surgical site infections (SSIs) are serious health care problems, increasing treatment costs, prolonging hospital stay, and even leading to permanent disability and death. Fortunately, it can be prevented by appropriate antibiotic prophylaxis for surgical procedures. Hai Phong International Hospital was established in 2015 with more than 500 patient beds and over 450 surgeries each month, serving many patients with high quality. However, up to now, there have not been any specific reports related to the use of antibiotics in surgical patients at the hospital. Therefore, this study aimed to describe the status of prophylactic antibiotic use in surgery patients at Haiphong International Hospital in 2021. **Methods:** A descriptive retrospective study was conducted using medical records of all surgery patients at three surgery departments (General; Urology and Orthopedic Surgery) at Haiphong International Hospital, Vietnam, in 2021. **Results:** The study included 186 surgery patients without preoperative infection. The median age of patients in the study was 46 years old with the range of 34-60. Orthopedic and urologic procedures were the most common surgery with 30.6% and 26.3%, respectively. The most commonly used antibiotics were Ampicillin/Sulbactam (41.9%) Metronidazole (27.4%); Cefazolin (24.7%); Ciprofloxacin (22%); Cefoperazone (14%). The time of administering the antibiotic was mostly within 30 minutes after closing the incision (49.5%). The duration of antibiotic use after surgery ranged from 1 to 28 days, of which 73.1% used from 8 to 14 days. The overall appropriateness of prophylactic antibiotic use was very low with only 1.6%. The main problems were prolonged prophylactic duration (98.4%), inappropriate antibiotic selection (83.3%), inappropriate administration time (66.7%), and inappropriate antibiotic dosage (50.5%). **Conclusion:** The overall appropriateness of prophylactic antibiotic use was very low. The main problems were prolonged prophylactic duration, inappropriate antibiotic selection, inappropriate administration time, and inappropriate antibiotic dosage. Therefore, developing the guidelines for surgical prophylactic antibiotics in the hospital is necessary to prevent surgical site infections and antibiotic resistance.

Keywords: antibiotics, prophylaxis, surgical site infections

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INTRODUCTION

Hospital-acquired infections (HAIs) are very common, directly affecting the healthcare system and significantly increasing treatment costs (1). 2013 in the United States, the estimated cost of HAIs was 9.8 billion USD, of which surgical site infections (SSIs) accounted for the largest proportion of this cost, with 33.7% (2). Moreover, the death rate related to SSIs accounted for up to 3%, of which 75% are deaths caused by SSIs themselves (3). However, SSIs are completely preventable, the rate of preventable SSIs is up to 55%, which means that of the estimated 3.3 billion USD cost of SSIs, 1.8 billion USD can be saved by preventing SSIs (4).

In Vietnam, according to research by Nguyen Viet Hung since 2008, the average surgical wound infection rate in northern province hospitals was 10.5% (5). To limit the rate of surgical wound infection, the most effective measure is to use prophylactic antibiotics (6). In 2019, research at the Military Hospital on the current situation and some risk factors for surgical wound infections showed that the rate of surgical wound infections at the hospital was 12.9%, including the use of prophylactic antibiotics during surgery. Antibiotic prophylaxis for surgical procedures significantly reduced the surgical wound infection rate (9.5%) compared to not using prophylactic antibiotics (26.3%) (7).

Hai Phong International Hospital was established in 2015 with more than 500 patient beds and over 450 surgeries each month, serving many patients with high quality. However, up to now, there have not been any specific reports related to the use of

antibiotics in surgical patients at the hospital. Therefore, this study aimed to describe the status of prophylactic antibiotic use in surgery patients at Haiphong International Hospital in 2021.

METHODS

Research subject

Medical records of all surgery patients at three surgery departments (General; Urology and Orthopedic Surgery) at Haiphong International Hospital in 2021.

Inclusion criteria: Medical records of patients with discharge time from January 1st to December 31st, 2021

Exclusion criteria: Medical records of patients who lacked information on antibiotic usage; Medical records of patients who had preoperative infections.

Research Methodology

Research design: A descriptive retrospective study. All the data was collected from the hospital's electronic medical record software (E-Hospital).

Evaluation standards: The NNIS score was used to evaluate the risk stratification of surgical site infection. The appropriateness of indications, dosage, route of administration, the timing of prophylactic administration of antibiotics, and duration of prophylactic antibiotic treatment were assessed according to the Clinical Practice Guideline on Surgical Antimicrobial Prophylaxis (ASHP) 2013 (8), WHO 2018 global guidelines for preventing surgical site infections (6) and the guidelines for antibiotic use of the Vietnam Ministry of Health in 2015 (9)

Data analysis

Process and analyze data using Excel 2019 and SPSS 2010 software.

RESULTS

Demographic and clinical characteristics of patients

The study analyzed 186 medical records of patients without preoperative infection. The characteristics of patients are described in Table 1. The median age of patients in the study was 46 years old with the range of 34-60. The median of surgery duration was 45 minutes, and the median of hospital stay was 6 days. Orthopedic and urologic procedures were the most common surgery with 30.6% and 26.3%, respectively. The post-operative infection rate was 7%, including superficial incisional SSIs at 6.5% and deep incisional SSIs at 0.5%.

Table 1: Characteristics of patients

Patient characteristics	Total (n=186)
Male: female (n)	121 : 65
Age, years	46 (34-60)
Operation duration, minutes	45 (30-65)
Hospital stays before surgery, days	1 (1-1)
Hospital stays after surgery, days	4 (3-6)
Length of hospital stay, days	6 (4-8)
Surgical wound classification, n (%)	
Clean	98 (52.7)
Clean-Contaminated	88 (47.3)
NNIS score, n (%)	
0	132 (71.0)
1	50 (26.9)
2	4 (2.2)
Type of surgery, n (%)	
Orthopedic	57 (30.6)
Urologic	49 (26.3)
Colorectal	26 (14.0)
Skin and soft tissue	25 (13.4)
Small intestine	15 (8.1)
Head and neck	14 (7.5)
Appendicitis	5 (2.7)
Post-operative infection, n (%)	
Superficial incisional	12 (6.5)
Deep incisional	1 (0.5)
Organ/space	0 (0)

Data are expressed as the median (range). Abbreviations: n: number.

Status of antibiotic use

The rate of prophylactic antibiotic use according to each antibiotic regimen corresponding to each surgical group is presented in Table 2. The most commonly used prophylactic antibiotic regimen for orthopedic procedures was Cefazolin plus Ciprofloxacin with 25 patients

(accounting for 13.4%) and Ampicillin/Sulbactam with 16 patients (accounting for 8.6%). The skin and soft tissue surgery group had 25 patients, the most prophylactic antibiotic regimen used was Cefazolin plus Clindamycin (accounting for 7.5%). Among 26 colorectal surgery patients, 16 patients used the combination antibiotic regimen of Ampicillin/Sulbactam plus Metronidazole (accounting for 8.6%), other antibiotic regimens mainly used also contained Metronidazole. Metronidazole was used in 25 colorectal surgery patients (accounting for 13.4%). Head and neck surgery involved 14 patients, 9 patients (accounting for 4.8%) used Ampicillin/Sulbactam antibiotics to prevent infections, and 11 patients (accounting for 5.9%) used antibiotic regimens containing Ampicillin/Sulbactam. Appendectomy patients were mostly given the regimen of Ampicillin/Sulbactam combined with Metronidazole. The genitourinary surgery group had 49 patients (26.3%), the most commonly used prophylactic antibiotic regimen was Cefoperazone plus Metronidazole (11 patients, accounting for 5.9%); Cefoperazone (9 patients, accounting for 4.8%); Cefotaxim (8 patients, accounting for 4.3%). The most commonly used antibiotic was Cefoperazone in 25 patients (13.4%) and Cefotaxim in 19 patients (10.2%). Antibiotics that were often combined with the above two antibiotics were Ciprofloxacin and Metronidazole.

Table 2: Rate of antibiotic use by each surgical type

Antibiotics (n=186)	Number (%)
Orthopedic	57 (30.6%)
Amoxicilin/Acid clavulanic	2 (1.1%)
Ampicilin/Sulbactam	16 (8.6%)
Cefazolin	4 (2.2%)
Clindamycin	1 (0.5%)
Ampicilin/Sulbactam + Clindamycin	5 (2.7%)
Cefazolin + Ciprofloxacin	25 (13.4%)
Cefazolin + Ciprofloxacin + Clindamycin	1 (0.5%)
Cefazolin + Clindamycin	3 (1.6%)
Skin and soft tissue	25 (13.4%)
Ampicilin/Sulbactam	14 (7.5%)
Ampicilin/Sulbactam + Clindamycin	6 (3.2%)
Cefazolin	4 (2.2%)
Cefazolin + Clindamycin	1 (0.5%)
Colorectal	26 (14.0%)
Cefotaxim	2 (1.1%)
Cefotaxim + Metronidazol	6 (3.2%)
Amoxicilin/Acid clavulanic + Metronidazol	1 (0.5%)
Ampicilin/Sulbactam + Metronidazol	16 (8.6%)
Head and neck	14 (7.5%)
Amoxicilin/Acid clavulanic	1 (0.5%)
Ampicilin/Sulbactam	9 (4.8%)
Ampicilin/Sulbactam + Cefotaxim	1 (0.5%)

Antibiotics (n=186)	Number (%)
Ampicilin/Sulbactam + Clindamycin	1 (0.5%)
Cefazolin	2 (1.1%)
Small intestine	15 (8.1%)
Cefotaxim	2 (1.1%)
Cefotaxim + Ciprofloxacin	1 (0.5%)
Ampicilin/Sulbactam	3 (1.6%)
Ampicilin/Sulbactam + Metronidazol	2 (1.1%)
Cefazolin	6 (3.2%)
Cefoperazon	1 (0.5%)
Appendicitis	5 (2.7%)
Linezolid + Metronidazol	1 (0.5%)
Ampicilin/Sulbactam	1 (0.5%)
Ampicilin/Sulbactam + Ciprofloxacin + Metronidazol	1 (0.5%)
Ampicilin/Sulbactam + Metronidazol	2 (1.1%)
Urologic	49 (26.3%)
Cefotaxim	8 (4.3%)
Cefotaxim + Ciprofloxacin	5 (2.7%)
Cefotaxim + Ciprofloxacin + Metronidazol	3 (1.6%)
Cefotaxim + Metronidazol	3 (1.6%)
Amoxicilin/Acid clavulanic	1 (0.5%)
Cefoperazon	9 (4.8%)
Cefoperazon + Ciprofloxacin	1 (0.5%)
Cefoperazon + Metronidazol	11 (5.9%)
Cefoperazon + Ciprofloxacin + Metronidazol	4 (2.2%)

The timing of prophylactic administration of antibiotics

The time to give the prophylactic antibiotic dose closest to the time of surgery incision was described in Figure 1. Most of the patients in the study received the closest dose of antibiotics to the incision time within 1 hour after surgery, 92/186 patients had a period of 0-30 minutes after surgery (accounting for 49.5%); 13 patients received antibiotics 30-60 minutes after surgery. The group of patients who received antibiotics for infection prophylaxis before surgery mainly received antibiotics within 2 hours before surgery, with 62 patients receiving antibiotics during this period, accounting for 33.3%. Only 15 patients received the last dose of antibiotics more than 2 hours from the time of skin incision (8%), and 1 patient received a dose of antibiotics at 1 day before surgery.

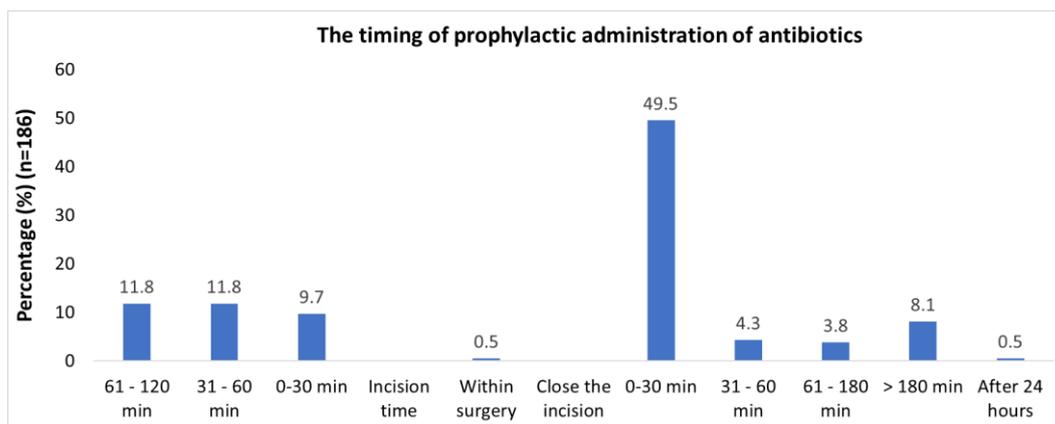


Figure 1. The timing of prophylactic administration of antibiotics

Duration of prophylactic antibiotics

The time to stop antibiotics after surgery is shown in Figure 2. The majority of patients were discharged from the hospital-prescribed antibiotics, and the total duration of postoperative antibiotic use ranged from 8 to 14 days after surgery, accounting for 136 patients in the study (73.1%). There were 31 patients receiving antibiotics 15-21 days after surgery, and 6 patients were prescribed antibiotics more than 3 weeks after surgery. Very few patients received antibiotics less than 7 days from the end of surgery (10 patients) and only 3 patients stopped antibiotics within 24 hours after surgery.

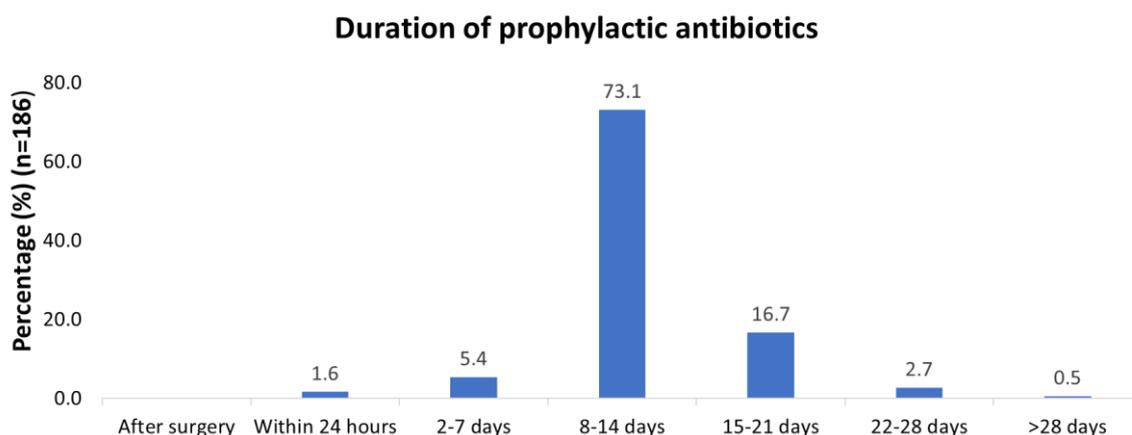


Figure 2. Duration of prophylactic antibiotics

Characteristics of dosage and route of administration

Characteristics of antibiotic dosage and route of administration are described in Table 3. In the study, 182 of 186 patients used antibiotics intravenous injection (accounting for 97.8%), the number of patients using antibiotics intravenous infusion also accounted for over half of the patients in the study (103 patients, accounting for 53.2%), and 17 patients used oral antibiotics (8.6%). Most patients use antibiotics at normal doses. With some antibiotics, patients were given antibiotics at a dose higher than the recommended dose for prophylactic antibiotics, such as Ampicillin/Sulbactam in 24 patients at a dose of 2g/1g; Cefazolin in 34 patients at a dose of 2g, Metronidazole in 50 patients at a dose of 1000mg. The proportion of antibiotics used at the correct recommended dose was relatively high, however, some patients were also given some

antibiotics which were not included in ASHP 2013 recommendations for prophylactic antibiotics such as Cefoperazone, Amoxicillin/Clavulanic and Ciprofloxacin.

Table 3. Characteristics of dosage and route of antibiotic administration

Antibiotics	Actual dose	Recommended dose	Number (%) (n=186)
Intravenous injection			182 (97.8%)
Ampicilin/Sulbactam	1000mg+ 500mg	2000mg+ 1000mg	54 (18.2%)
	2000mg+1000 mg		24 (8.1%)
Cefazolin	1g	2g	13 (4.4%)
	2g		34 (11.4%)
Cefoperazon	1g	Not recommended	25 (8.4%)
	2g		1 (0.3%)
Cefotaxim	1g	1g	31 (10.4%)
Intravenous infusion			99 (33.3%)
Ciprofloxacin	400mg/200ml	400mg	40 (13.5%)
Clindamycin	600mg	900mg	8 (2.7%)
Metronidazol	500mg/100ml	500mg	1 (0.3%)
	1000mg/200ml		50 (16.8%)
Oral route			16 (5.4%)
Amoxicilin/Acid clavulanic	1000 mg	Not recommended	5 (1.7%)
Ciprofloxacin	500mg	Not recommended	1 (0.3%)
Clindamycin	300mg	Not recommended	10 (3.4%)

Evaluate the appropriateness of using prophylactic antibiotics

Figure 3 showed the appropriateness of using prophylactic antibiotics according to indications, dosage, route of administration, the timing of prophylactic administration of antibiotics, and duration of prophylactic antibiotic criteria. Of the 186 patients in the study, the highest rate of appropriateness in antibiotic administration was assessed at 90.9%. The appropriate rate in prescribing prophylactic antibiotics was up to 78.5%, but the rate of patients assessed for appropriate antibiotic selection was only 16.7%. The appropriate rate of antibiotic administration time was relatively high, accounting for 49.5%, however, this was the time of antibiotic administration closest to the time of skin incision, and the time of first antibiotic administration had not been evaluated. In addition, 30.6% of patients were evaluated for appropriateness of antibiotic dosage, and only 3 patients were evaluated for appropriateness of

antibiotic stopping time in the study. The overall appropriateness of prophylactic antibiotic use is shown in Figure 4. Of the 186 patients in the study, 78.49% of patients were assessed as appropriate for prophylactic antibiotics; 16.67% of patients have assessed appropriately for indications and antibiotic selection; 4.3% of patients were assessed as suitable for all 3 criteria for indication, selection, and timing of antibiotic use. 6 patients were evaluated for suitability in terms of 5 criteria: indication, selection, time of use, dose, and route of administration. Only 3 patients were assessed for the overall appropriateness of prophylactic antibiotic use.

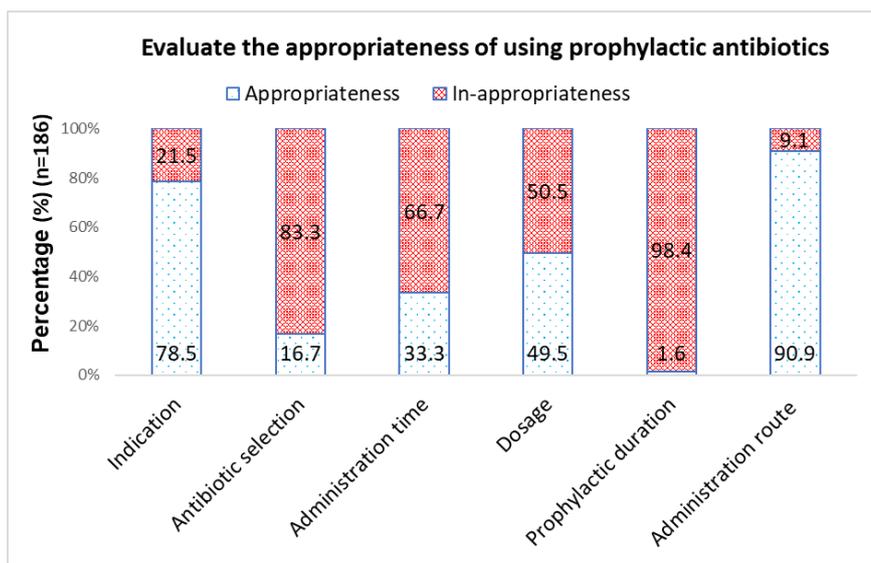


Figure 3. Evaluate the appropriateness of using prophylactic antibiotics

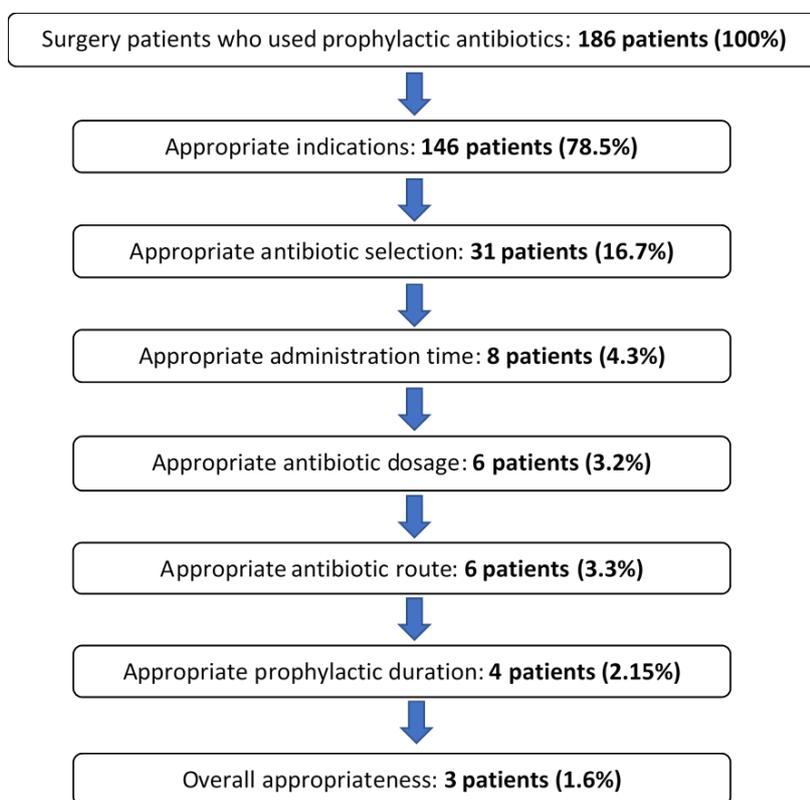


Figure 4. The overall appropriateness of prophylactic antibiotic use

DISCUSSIONS

In the study, 100% of patients were prescribed antibiotics for surgical prophylaxis, in which prophylactic antibiotics were assessed for appropriateness based on information from the medical records of patients in the study sample according to recommendations. ASHP 2013 (8). Prophylactic antibiotics were indicated for all surgical interventions in clean-contaminated surgery (9). Accordingly, the rate of patients assessed as having appropriate indications is 78.5%. Antibiotic prescriptions are considered inappropriate, including antibiotic prescriptions in cases of laparoscopic surgery in low-risk patients; The surgery belongs to the group of clean head and neck surgery and clean surgery on the feet, hands, and knees (8).

Single antibiotic regimens and combination of two antibiotics in the study were 46.2% and 51.6%, respectively. The combination regimens with 3 antibiotics accounted for a small proportion (4.8%). According to ASHP recommendations, combination regimens of 2 or 3 antibiotics in surgical prophylaxis are unreasonable. Some antibiotics are also not included in ASHP recommendations such as Amoxicillin and Cefoperazone. The use of some antibiotics is not within ASHP recommendations and the high rate of using antibiotic combination regimens is considered an inappropriate antibiotic choice. In the study, only 16.7% of patients were assessed for appropriate antibiotic selection while the rate of appropriate antibiotic prescription was 78.5%, which shows that the choice of prophylactic antibiotics for patients is mostly not reasonable.

Ampicillin/Sulbactam was the most used antibiotic in the study sample. In ASHP 2013 recommendations, Ampicillin/Sulbactam is recommended in thoracic, biliary, endoscopic, colorectal, head and neck, uterus, and gynecology surgery (8). In this study, Ampicillin/Sulbactam was used in

most surgical groups except genitourinary surgery, which is not suitable in some surgical groups such as trauma-orthopedics, skin and soft tissue surgery, and appendectomy surgical. Therefore, it is necessary to reconsider the use of Ampicillin/Sulbactam alone or in combination with antibiotic prophylaxis as currently used.

Another antibiotic widely used in this study is Metronidazole in colorectal surgery, abdominal surgery, appendix surgery, and genitourinary surgery. Metronidazole was often used in combination with other antibiotics such as ampicillin/sulbactam, Cefotaxim, and Cefoperazone. Using Metronidazole in combination with a 1st and 2nd generation Cephalosporin antibiotic is recommended by ASHP 2013 (8), however, Metronidazole is not recommended by the Ministry of Health in all types of surgeries and procedures (9). Therefore, the use of Metronidazole in combination with a 3rd generation Cephalosporin antibiotic as in the study is not appropriate and should be reconsidered by replacing it with a 1st or 2nd generation Cephalosporin.

Assessment of appropriateness in choosing prophylactic antibiotics was performed according to ASHP 2013 recommendations (8), the results showed that 16.7% of evaluated patients chose appropriate prophylactic antibiotics. Also evaluated according to ASHP recommendations, research by Nguyen Van Manh 2019 shows that the appropriate antibiotics selection rate was 0% (10), this is explained by Pho Noi General Hospital There are no antibiotics such as Cefazolin, Cefotetan, and no more Ampicillin/Sulbactam antibiotics, leading to no suitable antibiotic options (10). However, the rate of choosing appropriate prophylactic antibiotics was low, possibly due to the complex characteristics of infections in hospitals and the increasing situation of drug resistance. Doctors often combine additional antibiotics to prevent infection prevention

and that is not following the recommendations.

The timing of prophylactic antibiotic use affects the effectiveness of SSI prophylaxis in surgical patients. Most recommendations recommend using prophylactic antibiotic doses before skin incision. Studies also show that the use of prophylactic antibiotics is recommended. Using prophylactic antibiotics before skin incision from 0 to 120 minutes before surgery does not significantly change the risk of SSI (11),(6). In this study, the time of giving prophylactic antibiotics was considered reasonable if given within 120 minutes before skin incision as recommended by WHO (2018) (12). In the study, 33.3% of patients were assessed as appropriate, and 66.7% of patients were assessed as inappropriate. Notably, 49.5% of patients received 1 dose of antibiotics 0-30 minutes after closing the incision, accounting for the majority of the study. This is completely inconsistent with the recommendations of ASHP 2013 because prophylactic antibiotic is used before skin incision to create a sufficient concentration to inhibit bacteria at the surgical site during surgery (8).

The majority of prophylactic antibiotics in the study were administered intravenously (97.8%), and intravenously (55.4%). Oral administration was used in 9.4% of patients in the study sample. The prophylactic antibiotic is mostly recommended for intravenous use because the drug is delivered directly into the blood, thus quickly reaching drug concentrations in tissue and easily predicting drug concentrations at the surgical site. Intramuscular injection can also be used but the absorption rate is slower and unstable. Oral administration is often used in rectal and colon surgery (11), (9). The oral antibiotics used in the study sample were not included in any recommendations, so this indication was unreasonable. The overall rate of the appropriate route of administration is 90.9%. This rate is lower than the study at Binh Dan

Hospital (100%) and lower than the study at Pho Noi General Hospital (72.2%) (10, 11).

Recommended doses of prophylactic antibiotics are usually double the usual therapeutic dose below the maximum dose threshold or equivalent to the strongest therapeutic dose of that antibiotic (8),(9). Among commonly used antibiotics, Ampicillin/Sulbactam is used at a dose of 2000mg + 1000 mg in 18.2%, while a dose of 1000mg + 500mg is used in 8.1% of patients; Cefazolin was used at a dose of 2g in 11.4% of patients and at a dose of 1g in 4.4% of patients. In addition, Metronidazole is used at a dose of 1000mg in 16.8% of patients and 500mg in 0.3% of patients, however, the recommended dose is only 500mg. In general, the use of prophylactic antibiotics at recommended doses is still limited. Usually, antibiotics are mainly used at normal doses, and the proportion of antibiotics used at doses is not consistent with recommendations reported as high as 56.2%. Along with that, the rate of patients assessed as suitable for prophylactic antibiotic dosage is 49.5%, this rate is higher than the study at Ho Chi Minh City University of Medicine and Pharmacy hospital in 2018 (46.8%) and Pho Noi General Hospital in 2019 (39.2%) (10, 13).

According to the instructions for using prophylactic antibiotics issued by the Ministry of Health, prophylactic antibiotics should only be used within 24 hours after surgery. In case the surgical patient is infected and dirty, additional antibiotics can be used for treatment. In the study sample, only 3 patients stopped antibiotics within 24 hours after surgery (1.6%), and the duration of antibiotic use after wound closure was usually 8-14 days (73.1%). Most patients received antibiotics until the day of discharge and were prescribed additional antibiotics at discharge. The results of this study are similar to other studies (10, 14). Prolonged use of antibiotics after surgery in surgical patients without preoperative infection may be due to many risk factors such as poor hospital environment and operating room

environment; Characteristics of complicated infections in clinical patients or due habits in clinical practice and overload in the number of patients. However, the use of antibiotics after surgery as long-term prophylaxis needs to be considered and changed accordingly due to waste in concurrent drug use along with increased risk of antibiotic resistance and side effects. clinically undesirable.

CONCLUSIONS AND RECOMMENDATION

The overall appropriateness of prophylactic antibiotic use was very low with only 1.6%. The main problems were prolonged prophylactic duration, inappropriate antibiotic selection, inappropriate administration time, and inappropriate antibiotic dosage. Therefore, developing the guidelines for surgical prophylactic antibiotics in the hospital is necessary to prevent surgical site infections and antibiotic resistance.

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