Original Article

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Antibiotic prophylaxis in clean and clean – contaminated wounds: A descriptive study at University Medical Center Hochiminh city

M.H.T. Nguyen[1], D.T. D. Nguyen[1,2]*
[1] Department of Clinical Pharmacy, Faculty of Pharmacy, University of Medicine and Pharmacy, Hochiminh City, Vietnam
[2] Department of Pharmacy, University Medical Center Hochiminh City, University of Medicine and Pharmacy, Hochiminh City, Vietnam

Abstract

Surgical site infections (SSIs) are the most common and costliest healthcare-associated infections. Antibiotic prophylaxis plays an important role in preventing SSIs, especially for clean and clean – contaminated wounds. Despite evidence of effectiveness and availability of guidelines, antibiotic prophylaxis adherence is often suboptimal. This descriptive cross-sectional study was conducted on 311 medical records of patients undergoing surgeries with clean or clean – contaminated wounds at 5 surgery departments at University Medical Center from January to April, 2017. The appropriateness of antibiotic prophylaxis usage was assessed using guidelines from ASHP, Vietnam's Ministry of Health or University Medical Center. Antibiotic prophylaxis was indicated in 99.3% of cases. The mean duration of postoperative use was 3.4 ± 2.6 days. Overall adherence to antibiotic prophylaxis guidelines was observed in 4.8% of procedures. The proportion of cases with appropriate adherence to antibiotic choice, dosing, timing of the first dose, redosing and duration of prophylaxis were 34.1%, 64.0%, 92.0%, 94.2% and 49.2%, respectively. Department of Obstetrics and Gynaecology, wound classification, length of surgery, antibiotics covered by Health Insurance were found to be significantly associated with the appropriateness of antibiotic choice. Adherence to antibiotic prophylaxis guidelines at University Medical Center was low within the study period. The Antibiotic stewardship program should be enhanced and actions to ensure Health Insurance coverage for all antibiotics used for prophylaxis should be implemented to improve the effectiveness and appropriateness of antibiotic prophylaxis.

Keyword: Surgical site infections; Antibiotic; Prophylaxis; Clean; Clean-contaminated

1. INTRODUCTION

Surgical site infections (SSIs) are potential complications associated with any type of surgery. SSI is one of the most common healthcare associated infection; the incidence varies from 0.5 to 15% depending on the type of operation and patient status[1]. In the United States, the National Healthcare Safety Network (NHSN) estimated that the overall SSIs rate was 1.9%[2]. SSIs were estimated to extend the length of hospital stay on average by 9.7 days and increase costs by $20842 per admission (2009)[3]. In a survey carried out in seven hospitals across Vietnam, the overall crude SSIs incidence was 5.5[4].

The risk of developing an SSI is influenced by many factors including patient- and procedure-specific variables. Preventing SSIs requires a combination of pre-, intra- and post-operative measures. Among these methods, the role of antibiotic prophylaxis is emphasized in clinical settings, especially in clean and clean – contaminated wounds due to significant decreased rate of SSIs[5,6]. Clinical practice guidelines have been published to support physicians in using antibiotic prophylaxis appropriately. However, despite evidence of effectiveness and availability

***Corresponding author:** trang.dnd@umc.edu.vn, dtrangpharm@yahoo.com

of guidelines, antibiotic prophylaxis adherence is often suboptimal[7,8].

This study aims at investigating the antibiotic prophylaxis usage and identifying factors that might associate with the appropriate choice of antibiotic and duration of prophylactic antibiotic administration at University Medical Center HCMC (UMC).

2. MATERIAL AND METHODS

2.1 Study population

Data were obtained from all medical records of patients undergoing surgeries with clean and clean – contaminated wounds at 5 surgery departments (Departments of Gastroenterology Surgery, Obstetrics and Gynaecology, Hepatobiliary and Pancreatic Surgery, Neurosurgery and Orthopaedic Surgery) at University Medical Center from January to April, 2017. Exclusion criteria included patients with immunodeficiency, diagnosis of infection, cardiothoracic surgery, chemotherapy and patients younger than one-year-old.

2.2 Method

A descriptive cross-sectional study was conducted on 311 hospital profiles randomly selected from patients undergoing surgeries with clean and clean-contaminated wounds to provide descriptive information on the antibiotic prophylaxis usage, assessment of the appropriateness of antibiotic prophylaxis usage and identify factors that might associate with the appropriate choice of antibiotic and duration of prophylactic antibiotic administration at University Medical Center Hochiminh City.

The appropriateness of antibiotic prophylaxis usage was assessed using guidelines from American Society of Health – System Pharmacist (ASHP), Vietnam's Ministry of Health or University Medical Center. The criteria for evaluation of adherence to guidelines are summarized in Table 1. Full adherence was identified if all of five criteria were met (type of antibiotic, dosing, timing of the first dose, redosing and duration of antibiotic prophylaxis usage).

Table 1. Criteria for evaluation of adherence to antibiotic prophylaxis guidelines

Parameter	Criteria
Type of antibiotic	Adopt at least one of the three guidelines*
Dosing	Adopt at least one of the three guidelines*
Timing of the first dose	Within 60 minutes before the surgical incision; fluoroquinolones and vancomycin shoud be administered between 60 and 120 minutes before the incision.
Redosing	- If the duration of procedure exceeds the recommended redosing interval (from initiation of preoperative dose). - If there is excessive blood loss during the procedure (i.e. >1 500 ml for adult and > 25 ml/kg for children)
Duration	The last prophylactic antibiotic dose should be used within 24 hours from the end of procedure

* Guidelines from (1) American Society of Health – System Pharmacist (ASHP), (2) Vietnam's Ministry of Health, (3) University Medical Center

Patients' characteristics, ASA score, number of comorbidities, types of comorbidities (hypertension/diabetes, gastritis/ischemic heart disease/dyslipidemia/thyroid disease), clinical departments (Department of Gastroenterology Surgery/Obstetrics and Gynaecology/Hepatobiliary and Pancreatic Surgery/ Orthopaedic Surgery/Neurosurgery), wound classification

(clean/clean-contaminated), method of surgery (open/endoscopy), length of surgery and Health insurance coverage were analyzed to identify association with adherence to available guidelines (types of antibiotic, duration of prophylactic antibiotic administration) using both bivariate analysis and multivariable logistic regression. Data analysis was performed using R Studio version 3.3.2.

3. RESULTS

3.1 Characteristics of the study population

The mean age of the study population was 46.3 ± 16.8 (7 – 94) years, 68.5% (211) were female, 50.2% (156) were overweight or obese. The mean age of female patients was 45.4 ± 16.3 (7 – 94) years, and that of male patients was 48.8 ± 18.4 (13 – 89) years. The average number of comorbidities was 0.9 ± 1.4 diseases (0 – 8); hypertension (22.5%) and diabetes (8.0%) were the most common comorbid diseases recorded. The average ASA score was 1.8 ± 0.7 (0 – 4) and there was no case with ASA score of 5 observed.

More than half of the procedures were classified as clean – contaminated (54.3%) and the majority was open surgery. The average length of surgery was 1.5 ± 0.9 hours (0.2 – 5.7).

The characteristics of the study population were presented in Table 2.

Table 2. Characteristics of the study population

Variables		Frequency (N)	Percentage (%)
Age	< 18	5	1.6
	18 – 40	136	43.7
	> 40	170	54.7
Sex	Male	98	31.5
	Female	213	68.5
BMI	< 23 kg/m^2	155	49.8
	23 - < 25 kg/m^2	73	23.5
	≥ 25 kg/m^2	83	26.7
ASA score	1	101	32.5
	2	173	55.6
	3	33	10.6
	4	4	1.3
	5	0	0.0
Number of comorbidities	0	184	59.2
	1 – 2	97	31.2
	>=3	30	10.6
Types of comorbidities	Hypertension	70	22.5
	Diabetes mellitus	25	8.0
	Gastritis	17	5.5
	Ischemic heart disease	15	4.8
	Dislipidemia	15	4.8
	Thyroid diseases	12	3.9

3.2 Characteristics of surgery

3.2.1 Surgery departments

Distribution of cases into the surgery departments was presented as followed: Department of Gastroenterology Surgery: 17.4%; Department of Obstetrics and Gynaecology: 23.5%, Department of Hepatobiliary and Pancreatic Surgery: 23.8%, Department of Orthopaedic Surgery: 23.8% and Department of Neurosurgery: 11.6%

3.2.2 Wound classification and methods of surgery

Among 311 cases investigated, 45.7% were clean and 54.3% were clean-contaminated, using Altemeier wound classification[9]. Open surgery accounted for 57.2% of cases; the remaining belonged to endoscopy surgery.

3.2.3 Length of surgery

The average length of surgery reported was 1.5 ± 0.9 hours, ranging from 0.2 to 5.7 hours. Cases with length of surgery less than one hour accounted for 42.8% and 6.4% of cases were found with length of surgery exceeding 3 hours.

3.4 Antibiotic prophylaxis usage

3.4.1 Types of antibiotic indicated

The most common antibiotics indicated were amoxicillin – clavulanate (38.9%), cefazolin (17.0%), ceftazidime (13.4%) and ampicillin – sulbactam (10.0%). Monotherapy for antibiotic prophylaxis was indicated in 289 cases (92.9%). Cefazolin was the most commonly recommended antibiotic for prophylaxis in the three guidelines applied. Cefazolin is the first line antibiotic for prophylaxis of neurosurgeries, orthopaedic surgeries and gynecological surgeries. However, cefazolin was used in only 17.1% of cases in the study population. The proportions of cases indicated with cefazolin in the Departments of Orthopaedic Surgery, Neurosurgery and Obstetrics and Gynecology were 69.3%, 2.7% and 0%, respectively.

The combination of two antibiotics was indicated in 20 cases (6.4%); 65% of which was the combination of ceftazidime and metronidazole. Only two cases (0.6%) were not indicated with antibiotic prophylaxis. However, these two cases were cases that should have been treated with prophylactic antibiotic based on available guidelines. On the contrary, prophylactic antibiotics were used in 29 cases that did not meet the criteria for antibiotic prophylaxis. The choice of antibiotic that met all criteria of the available guidelines was observed in 106 out of 311 surgical procedures (34.1%).

Combination with metronidazole was observed only in gastrointestinal surgeries to prevent infection caused by anaerobic bacteria.

3.4.2 Antibiotic dosing

Appropriate dosing was observed in 64% of cases. Appropriate dosing was found in all cases indicated with metronidazole and vancomycin. Higher dose than recommended was observed in 17.1% of cases, all of which were cases indicated with amoxicillin-clavulanate. Lower dose than recommended was observed in 18.0% of cases

3.4.3 Timing of the first dose

The average timing of the first dose was 20.73 ± 25.1 minutes before surgical incision. The distribution of antibiotics by timing of the first dose was presented in Figure 1. The majority of cases (92.0%) were assessed as appropriate in terms of timing of the first dose (within 60 minutes before incision).

3.4.4 Redosing

The proportion of appropriate redosing was 94.2%.

3.4.5 Duration of antibiotic prophylaxis usage

The average duration of antibiotic prophylaxis in this study was 3.4 ± 2.6 days, ranging from 0 to 14.1 days. Only 49.2% of patients had their antibiotic prophylaxis discontinued within 24 hours after the end of surgery, which met the guidelines.

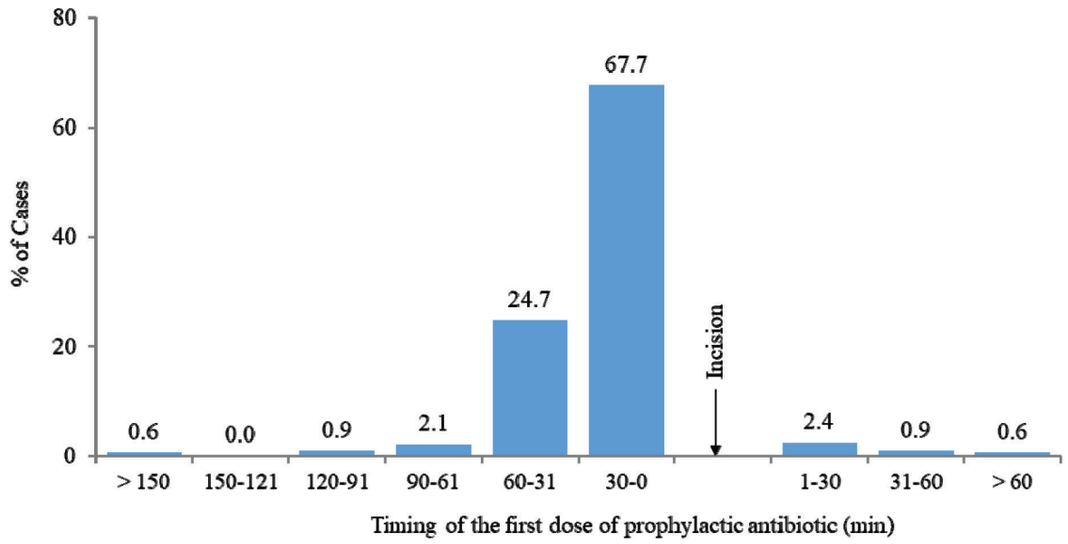

Figure 1. Distribution of prophylactic antibiotics by timing of the first dose

3.4.5 Overall assessment of adherence to guidelines on antibiotic prophylaxis usage

When assessing all parameters, only 15 cases (4.8%) was found with full adherence to at least one of the three guidelines applied for antibiotic prophylaxis.

3.5 Factors associated with adherence to guidelines for antibiotic prophylaxis

3.5.1 Bivariate analysis

Age, number of comorbid diseases, ASA score, hypertension, departments of Obstetrics and Gynaecology, Orthopaedic Surgery, Neurosurgery, length of surgery, wound classification and antibiotics covered by Health insurance were found to be significantly associated with appropriateness in types of prophylactic antibiotics using bivariate analysis ($p = 0.02$ for ASA score, $p = 0.02$ for hypertension, $p = 0.004$ for Department of Neurosurgery, $p = 0.006$ for length of surgery, $p = 0.007$ for wound classification and $p < 0.001$ for other factors) (Table 3)

Gender, age, number of comorbid disease, ASA score, hypertension, dyslipidemia, departments of Obstetrics and Gynaecology, Hepatobiliary and Pancreatic Surgery, Orthopaedic, Neurosurgery, wound classification, length of surgeryand antibiotic covered by Health Insurance were found to be significantly associated with appropriateness in duration o f prophylactic antibiotic administration using bivariate analysis ($p = 0.004$ for dyslipidemia, $p < 0.001$ for other factors) (Table 3).

3.5.2 Multivariate analysis

Factors significantly associated with appropriateness in types or duration of prophylactic antibiotics usage were subsequently analyzed by multivariable logistic regression. Department of Obstetrics and Gyneacology (OR = 0.26; 95%CI: 0.1 - 0.72), wound classification (OR = 6.9; 95%CI: 2.04 - 22.33), length of surgery (OR = 1.65; 95%CI: 1.19 - 2.29) and antibiotics covered by Health Insurance (OR = 0.03; 95%CI: 0.01 - 0.11) were shown to be significantly associated with the appropriate choice of types of prophylactic antibiotics. Factors significantly associated with the appropriateness in duration of prophylactic antibiotic administration included the department of Obstetrics and Gyneacology (OR = 4.14; 95%CI: 1.01-17.05), Orthopaedic Surgery (OR = 0.03; 95%CI: 0.01 - 0.16), Neurosurgery (OR = 0.04; 95%CI: 0.01 - 0.21); length of surgery (OR = 0.28; 95%CI: 0.17 - 0.45) and antibiotics covered by Health Insurance (OR = 6.34; 95%CI:1.32 - 30.43).

Table 3. Bivariate analysis identifying factors associated with appropriate choice of prophylactic antibiotic and appropriate duration of antibiotic prophylaxis

	Total	Appropriate choice of prophylactic antibiotic		Appropriate duration of antibiotic prophylaxis	
	N = 311	N = 106		N = 153	
		N	%	N	%
Patients' characteristic					
Gender					
Male	98	32	32.7	28	28.6
Female	213	74	34.7	125	58.7
		p = 0.82		**p < 0.001**	
Age (year)	46.3 ± 16.8 (7 – 94)	51.5 ± 17.7 (19 – 94)		40.0 ± 13.1 (7 – 87)	
		p < 0.001		p < 0.001	
BMI (kg/m²)					
< 23	155	58	37.4	66	42.6
23 - < 25	73	22	30.1	40	54.8
≥ 25	83	26	31.3	46	55.4
		p = 0,44		p = 0,10	
Number of comorbidities	0.9 ± 1.4 (0 – 8)	1.3 ± 1.7(0 – 8)		0.5 ± 0.9 (0 – 4)	
		p < 0.001		**p < 0.001**	
ASA score	1.8 ± 0.7 (0 – 4)	1.9 ± 0.6 (1 – 3)		1.5 ± 0.5 (1 – 3)	
		p = 0.02		**p < 0.001**	
Types of comorbidities					
Hypertension					
Yes	70	33	47.1	18	25.7
No	241	73	30.3	135	56.0
		p = 0.01		**p < 0.001**	
Diabetes					
Yes	25	11	44.0	8	32.0
No	286	95	33.2	145	50.7
		p = 0.3839		p = 0.11	
Gastritis					
Yes	17	6	35.3	8	47.1
No	294	100	34.0	145	49.3
		p = 1		p = 1	
Ischemia heart disease					
Yes	15	8	53.3	4	26.7
No	296	98	33.1	149	50.3
		p = 0.18		p = 0.13	
Dyslipidemia					
Yes	15	6	40.0	3	20.0
No	296	100	33.8	150	50.7
		p = 0.83		**p = 0.04**	
Thyroid disease					
Yes	12	6	50.0	7	58.33
No	299	100	33.4	146	48.8
		p = 0.38		p = 0,75	

Table 3. Bivariate analysis identifying factors associated with appropriate choice of prophylactic antibiotic and appropriate duration of antibiotic prophylaxis (continued)

	Total	Appropriate choice of prophylactic antibiotic		Appropriate duration of antibiotic prophylaxis	
	N = 311	N = 106		N = 153	
		N	%	N	%
Surgery department					
Gastroenterology Surgery					
Yes	54	18	33.3	30	55.6
No	257	88	34.2	123	47.9
		p = 1		p = 0.38	
Obstetrics and Gynaecology					
Yes	73	8	11.0	66	90.4
No	238	98	41.2	87	36.6
		p < 0.001		**p < 0.001**	
Hepatobiliary and Pancreatic Surgery					
Yes	74	27	36.5	49	66.2
No	237	79	33.3	104	38.9
		p = 0.72		**p = 0.001**	
Orthopaedic Surgery					
Yes	74	49	66.2	5	6.8
No	237	57	24.1	148	62.4
		p < 0.001		**p < 0.001**	
Neurosurgery					
Yes	36	4	11.1	3	8.3
No	277	102	36.8	150	54.15
		p = 0.004		**p < 0.001**	
Surgical procedure characteristic					
Wound classification					
Clean	142	58	40.8	30	21.1
Clean-contaminated	169	48	28.4	123	72.8
		p = 0.03		**p < 0.001**	
Method of surgery					
Open	178	53	29.8	86	48.3
Endoscopy	133	53	39.8	67	50.4
		p = 0.08		p = 0.806	
Length of surgery (days)	1.5 ± 0.9 (0.2 – 5.7)	1.6 ± 0.9 (0.4 – 4.8)		1.1 ± 0.6 (0.2 – 4.2)	
		p = 0.006		**p < 0.001**	
Prophylactic antibiotic characteristic					
Covered by Health Insurance					
Yes	253	58	22,7	150	59,5
No	56	48	85,7	3	5,4
		p < 0.001		**p < 0.001**	

4. DISCUSSION

The most common prophylactic antibiotics indicated in the study population were amoxicillin-clavulanate. This result was different from results from previous studies conducted in Vietnam[10,11]. Amoxicillin - clavulanate is not recommended for prophylaxis by ASHP and Ministry of Health of Vietnam. However, in UMC's guideline, this drug is the prophylactic antibiotic for some gastroenterological surgical procedures. The antibiotic resistance and the availability of medication resource at the hospital may lead to this distinction.

The average duration of antibiotic prophylaxis in this study was 3.4 ± 2.6 days (0 - 14.1 days). The duration of antibiotic administration effective for preventing SSIs is still controversial. Many evidence-based guidelines support the fact that postoperative prophylactic antibiotics are not necessary for most surgical procedures and duration of prophylaxis should be less than 24 hours after the end of surgery[12]. In fact, prolonged antibiotic usage as prophylaxis is very common in clinical settings. The mean duration of antibiotic usage after surgery in two studies conducted by Rafiti M. *et al* and Steinberg J. *et al* was 1.7 ± 3.2 days and 6.6 ± 5.6 days, respectively[13,14]. Another study carried out at 62 acute-care hospitals in Japan showed that the mean duration of antibiotic prophylaxis for inguinal hernia repair, appendectomy, and laparoscopic cholecystectomy were 2.5, 4.7 and 3.4 days, respectively[15]. Prolonged administration of prophylactic antibiotics could contribute to the development of antimicrobial resistance and increase risk of adverse effects and cost of healthcare[16].

This study is a considerably comprehensive assessment of the antibiotic prophylaxis usage in surgical procedures and the factors that may associate with the appropriate choice of antibiotic prophylaxis usage and duration of prophylactic antibiotic administration at UMC. The results showed that overall adherence to available guidelines was still low. A study conducted in 13 Dutch hospitals showed that antibiotic choice, duration, dose, dosing interval and timing of the first dose were concordant with the hospital guidelines by 92%, 82%, 89%, 43% and 50%, respectively. However, overall adherence to all aspects of the guideline occurred in only 28%[11]. Many other studies conducted in multiple countries did report similar results[10, 13, 17].

The results from multivariable logistic regression analysis showed that several factors emerged as being significantly associated with the appropriateness of antibiotic choice and duration of antibiotic prophylactic administration. In particular, the covering of Health Insurance had a profound impact on antibiotic indication. At UMC during the study period, cefazolin is the only antibiotic which was not covered by Health Insurance due to problems in procuring and supplying. Although this drug was recommended as the only choice for many clean procedures (i.e. neurosurgeries, orthopaedic surgeries) and some clean-contaminated procedures (i.e. gastroduodenal surgeries, cesarean delivery), a number of physicians alternated cefazolin by another antibiotic in order to decrease financial burden for patients. For the duration of prophylaxis, surgeons in Department of Neurosurgery and Department of Orthopaedic Surgery tended to prolong prophylactic antibiotic usage, possibly due to major surgeries. In this study, the mean postoperative prophylactic antibiotic duration of Neurosurgery and Orthopaedic Surgery departments were 5.0 days and 3.6 days, respectively, compared to 0.3 days in Obstetrics and Gynaecology department. Patients' characteristics including age, gender, comorbidities, ASA score were unlikely to associate with the appropriateness of antibiotic choice and duration of prophylactic. This finding was similar to an investigation in Japan that patient's age, gender and risk factors for surgical site infections were not associated with inappropriate usage of antibiotic[15]. However, a study conduct in Italy showed that patients, who were older and had an ASA score of 1 were highly predictive of receiving appropriate antibiotic prophylaxis[18].

This study did not include the department of Proctology, Otorhinolaryngology, Urology, Thoracic and Cardiovascular Surgery. Therefore, data could not reflect exactly antibiotic prophylaxis usage in the entire hospital. Further studies with

larger sample size should be conducted in all surgical departments of UMC to provide more accurate data on antibiotic prophylaxis usage. Only one case of surgical site infection was observed during the study period. Factors associated with the risk of surgical site infection were thus not considered for analysis in the study.

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