Original Article

Concordance Between Surgical Antibiotic Prophylaxis Practice at a University Tertiary Care Hospital and the Guideline-Based Recommendations of the Surgical Infection Society of Thailand

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Objective: To determine the concordance between surgical antibiotic prophylaxis (SAP) practices at Siriraj Hospital and the guideline-based recommendations for prevention of surgical site infection developed by the Surgical Infection Society of Thailand.

Materials and Methods: Case record forms and medical records of 303 hospitalized patients at Siriraj Hospital who received antibiotics for prevention of surgical site infection over 24 hours on August 7, 2018 were reviewed for indication of antibiotic prophylaxis, choice of antibiotic, time of initial antibiotic administration, redosing of antibiotic, and duration of antibiotic to determine concordance with the guideline-based recommendations of the Surgical Infection Society of Thailand.

Results: Two hundred twenty-one patients (mean age: 48.4 years, 62.1% female) had data suitable for inclusion in the final analysis. Cefazolin was the most commonly prescribed initial antibiotic for surgical prophylaxis. Fosfomycin, which is not listed in the guideline, was commonly used for neurosurgical prophylaxis. Regarding the concordance between SAP practice and the guideline-based recommendations, 93.8% had indications for SAP, 67.2% received the correct choice of antibiotic, 89.9% received the appropriate initial dose of antibiotic, 82.8% received antibiotic within 60 minutes before surgical incision, 26.1% received appropriate redosing in patients who required additional dose of antibiotic, 32.3% received antibiotic prophylaxis within or for 24 hours, and the proportion of patients in concordance with all guideline-based parameters was 20.9%. Two patients received antibiotic regimens that were discordant with the guidelines developed surgical site infection.

Conclusion: Concordance between SAP practices at Siriraj Hospital and the guideline-based recommendations for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand was found to be low with only 20.9% of study patients having met all guideline parameters. Interventions to promote, monitor, and sustain the appropriate use of SAP at Siriraj Hospital are urgently needed.

Keywords: Concordance, Surgical antibiotic prophylaxis practice, SAP, Guideline-based recommendations, Surgical Infection Society of Thailand

Received 12 October 2020 | Revised 11 January 2021 | Accepted 18 January 2021

J Med Assoc Thai 2021;104(5):853-9

Website: http://www.jmatonline.com

Antibiotic prophylaxis in surgery is among several important measures to prevent surgical site infection[1,2]. Appropriate use of surgical antibiotic prophylaxis (SAP) effectively reduces the risk of surgical site infection; however, overuse or misuse of SAP is associated with unfavorable outcomes, economic loss, and the emergence of antibiotic resistance. Appropriate use of SAP includes appropriate compliance with guideline-based recommendations specific to the following parameters, indication for antibiotic prophylaxis, choice of antibiotic, time of initial antibiotic administration, redosing of antibiotic, and duration of antibiotic prophylaxis. Inappropriate use of SAP is common at many centers in both developed and developing countries[3-19]. A 2015 systematic review of adherence to guidelines for SAP revealed the following performance improvements, appropriate indication for antibiotic prophylaxis from 70.3% to 95%, inappropriate indication from 2.3% to 100%, correct antibiotic choice from 22% to 95%, administration of antibiotic at the correct time from 12.73% to 100%, adequate discontinuation of antibiotic from 5.8% to 91.4%, and overall appropriate antibiotic prophylaxis from 0.3% to 84.5%[20].

Integrated one-day surveillance of antimicrobial

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How to cite this article:

Wangchinda W, Kijsuwanpaisarn N, Rattanaumpawan P, Thamlikitkul V. Concordance Between Surgical Antibiotic Prophylaxis Practice at a University Tertiary Care Hospital and the Guideline-Based Recommendations of the Surgical Infection Society of Thailand. J Med Assoc Thai 2021; 104:853-9.

doi.org/10.35755/jmedassocthai.2021.05.12363

use, antimicrobial consumption, antimicrobial resistance, healthcare-associated infection, and antimicrobial resistance burden among 23,686 patients hospitalized at 183 hospitals in Thailand in 2018 revealed that 51.5% of those patients received antibiotic on the survey date, and approximately 20% of the patients in that group received antibiotics for surgical prophylaxis[21]. Antibiotics prescribed for surgical prophylaxis in Thailand are normally prescribed according to physician preference, physician judgement, or based on various guidelines. Guidelines for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand were published in 2020[22].

The aim of the present study was to determine the concordance between SAP practices at Siriraj Hospital and the guideline-based recommendations for the prevention of surgical site infection developed and published by the Surgical Infection Society of Thailand.

Materials and Methods

Study design and ethical approval

The present study was done cross-sectionally, approved by the Siriraj Institutional Review Board (SIRB) of the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand (approval no. Si 711/2017) with waive of individual patient consent.

Study patients

The study population comprised of 303 hospitalized patients at Siriraj Hospital who received antibiotics for prevention of surgical site infection over 24 hours on August 7, 2018, which were among 23,686 patients included in an integrated one-day surveillance study of antimicrobial use, antimicrobial consumption, antimicrobial resistance, healthcare-associated infection, and antimicrobial resistance[21].

Study procedures

The case record forms and medical records of the 303 study patients were reviewed for the indication for antibiotic prophylaxis, the choice of antibiotic, the time of initial antibiotic administration, the redosing of antibiotic, and the duration of antibiotic to determine if those parameters were in accordance with the guideline-based recommendations of the Surgical Infection Society of Thailand for prevention of surgical site infection[22].

Data analysis

The data were analyzed using descriptive statistics with mean ± standard deviation, median and range, or number and percentage. The inferential statistics for comparison of variables were analyzed using chi-square test, Fisher's exact test, Student's t-test, Mann-Whitney U test, or Kruskal-Wallis test, as appropriate. A p-value of ≤ 0.05 was considered statistically significant, and SPSS Statistics software (SPSS, Inc., Chicago, IL, USA) was used for all statistical analyses.

Results

Of the 303 study patients, 92 were excluded due to a lack of SAP recommendation in patients who received a particular type of surgery or procedure such as eye surgery or invasive medical procedures, in the guidelines for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand. Therefore, the remaining 211 patients were included in the final data analysis.

The demographic and clinical characteristics of 211 study patients are shown in Table 1. The mean age of patients was 48.4 years and 62.1% were female. More patients received surgery from the Department of Surgery than from the Department of Orthopedic Surgery, the Department of Obstetrics and Gynecology, and the Department of Otorhinolaryngology. The prevalence of clean wound was similar to that of clean contaminated wound. Endoscopic surgery and emergency surgery were performed in 14.2% and 10.0% of patients, respectively. The median operative time and median estimated blood loss were 105 minutes and 50 mL, respectively. Beta-lactam allergy was observed in 9.0% of patients. Cefazolin was the most commonly used initial antibiotic for surgical prophylaxis followed by ceftriaxone or cefotaxime with metronidazole, fosfomycin, coamoxiclav, cefoxitin, clindamycin, ampicillin-sulbactam, amoxicillin, meropenem, or cephalexin. The continued oral antibiotics in 117 patients were cephalexin, coamoxiclav, cefditoren, cefdinir, dicloxacillin, ciprofloxacin, amoxicillin, clindamycin, metronidazole, ampicillin-sulbactam, and levofloxacin.

Regarding the concordance between SAP practices in 211 study patients and the guideline-based recommendations for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand, 198 patients (93.8%) had a guideline-based indication for SAP, whereas the remaining 13 patients (6.2%) had no guideline-based indication for SAP due to a lack of an SAP recommendation in the guideline for the following types of surgery

Table 1. Demographic and clinical characteristics of 211 study patients

Characteristics	Values; n (%)
Sex: female	131 (62.1)
Age (year); mean±SD	48.4±22.8
Range	5 months to 88 years
Body weight (kg); mean±SD	58.3±19.9
Range	2.8 to 132
Department where the patients received surgery	
Surgery	111 (52.6)
• General surgery	22 (10.4)
• Urosurgery	22 (10.4)
• Cardiothoracic and vascular surgery	20 (9.5)
• Neurosurgery	18 (8.5)
• Plastic surgery	11(5.2)
• Pediatric surgery	10 (4.7)
• Head, neck, breast surgery	8 (3.8)
Orthopedic Surgery	51 (24.2)
Obstetrics and Gynecology	37 (17.5)
Otorhinolaryngology	12 (5.7)
Type of wound	
Clean	110 (52.1)
Clean contaminated	101 (47.9)
Endoscopic surgery	30 (14.2)
Laparoscopic surgery	18 (8.5)
Emergency surgery	21 (10.0)
Operative time (minute); median (range)	105 (10 to 737)
Estimated blood loss (mL); median (range)	50 (0 to 5,000)
Antibiotic allergy	19 (9.0)
Beta-lactam allergy	11 (5.2)
Name of initial prophylactic antibiotic	
IV cefazolin	118 (55.9)
IV ceftriaxone or cefotaxime	25 (11.8)
IV ceftriaxone or IV cefotaxime with IV metronidazole	21 (10.0)
IV fosfomycin	20 (9.5)
IV coamoxiclav	11 (5.2)
IV cefoxitin	6 (2.8)
IV clindamycin	4 (1.9)
IV ampicillin/sulbactam	2 (0.9)
PO amoxycillin	2 (0.9)
IV meropenem	1 (0.5)
PO cephalexin	1 (0.5)

SD=standard deviation; IV=intravenous; PO=oral

or procedure such as clean ear, nose and throat surgery, clean orthopedics surgery without prosthesis implantation, clean plastic surgery, and clean pediatric surgery. Data from 198 patients who had indications for SAP specific to the choice of antibiotic, the initial dose of antibiotic, the time of initial antibiotic administration, the need for antibiotic redosing, and the duration of antibiotic are shown in Table 2. The concordance for the indication of SAP and for the choice of antibiotic was observed in 198 patients (93.8%) and 133 patients (67.2%), respectively. Sixty-five patients (32.8%) received antibiotics not recommended for some surgeries such as cefotaxime or ceftriaxone instead of cefazolin, fosfomycin for neurosurgery and orthopedic surgery, meropenem for urosurgery in a patient without previous antibiotic-resistant bacteria colonization, and postoperative oral antibiotic prophylaxis with a total duration of longer than 24 hours. The doses of antibiotics were concordant with the guideline-recommended doses in 178 patients (89.9%); however, the doses of fosfomycin given to 20 patients (10.1%) were not guideline-based because there is no recommendation for fosfomycin in the current guideline. Antibiotic was given within 60 minutes before surgical incision according to the guideline in 164 patients (82.8%). Thirty-four patients (17.2%) received an initial dose of antibiotic at a time earlier than 60 minutes prior to surgical incision, after surgical incision, or after the surgery was completed. Six of 23 patients (26.1%) who required additional doses of antibiotics received perioperative redosing of antibiotic, whereas 17 patients (73.9%) did not receive perioperative redosing of antibiotic or received insufficient doses of antibiotics. Twelve patients received Fosfomycin and did not receive additional doses of fosfomycin due to lack of information on fosfomycin redosing. Sixty-four patients (32.3%) received a single dose of antibiotic, antibiotic within 24 hours, or antibiotic for only 24 hours, as recommended; however, 134 patients (67.7%) received antibiotic prophylaxis for longer than 24 hours. The mean, median, and range of duration of antibiotic prophylaxis was 9.4 days, 7.0 days, and a single dose to 22 days, respectively. The median duration of antibiotic prophylaxis for clean wound and clean contaminated wound was eight and six days, respectively. The median duration of antibiotic prophylaxis for patients of the Department of Obstetrics and Gynecology was significantly shorter than that of patients who underwent surgery at other departments, and the 8.5-day median duration of antibiotic prophylaxis for patients operated upon at the Department of Orthopedic Surgery was significantly longer than that of patients who were surgically treated at other departments. The proportion of 211 patients that received SAP who were in concordance

Table 2. Concordance between surgical antibiotic prophylaxis practices and the guideline-based recommendations for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand

Guideline-based parameters	Concordance with the guidelines; n (%)
Indication for antibiotic among 211 patients who received surgical antibiotic prophylaxis	198 (93.8)
Choice of antibiotic among 198 patients who had indications for surgical antibiotic prophylaxis	133 (67.2)
Initial dose of antibiotic among 198 patients who had indications for surgical antibiotic prophylaxis	178 (89.9)
Antibiotic was given within 60 minutes before surgical incision among 198 patients who had indications for surgical antibiotic prophylaxis	164 (82.8)
Perioperative redosing of antibiotic in 23 patients who required additional doses of antibiotics among 198 patients who had indications for surgical antibiotic prophylaxis	6 (26.1)
Duration of antibiotic prophylaxis ≤24 hours among 198 patients who had indications for surgical antibiotic prophylaxis	64 (32.3)
All aforementioned parameters among 211 patients who received surgical antibiotic prophylaxis	44 (20.9)

Table 3. Comparison of the patients who received surgical antibiotic prophylaxis in accordance with the guidelines with the patients who received surgical antibiotic prophylaxis that was discordance with the guidelines among 211 patients

Parameters	Concordance with the guidelines; n (%)		
	Yes (n=44)	No (n=167)	p-value
Sex: female	37 (84.1)	94 (56.3)	0.001*
Age (year); mean±SD	49.4±20.4	48.2±23.5	0.751
Antibiotic allergy	3 (6.8)	16 (9.6)	0.770
Beta-lactam allergy	1 (2.3)	10 (6.0)	0.465
Type of wound			0.094
Clean	18 (40.9)	92 (55.1)	
Clean contaminated	26 (59.1)	75 (44.9)	
Endoscopic surgery	0 (0.0)	30 (18.0)	0.002*
Laparoscopic surgery	0 (0.0)	18 (10.8)	0.016*
Emergency surgery	9 (20.5)	12 (7.2)	0.019*
Department			
Surgery	11 (25.0)	100 (59.9)	<0.001*
Orthopedic Surgery	12 (27.3)	39 (23.4)	0.589
Obstetrics and Gynecology	21 (47.7)	16 (9.6)	<0.001*
Otorhinolaryngology	0 (0.0)	12 (7.2)	0.076
Surgical site infection	0 (0.0)	2 (1.2)	1.000

SD=standard deviation

* A p≤0.05 indicates statistical significance

with all guideline-based parameters for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand was unacceptably low 20.9%.

A comparison between patients that received SAP and those who were in accordance with the Thai SAP guidelines and patients that received SAP and those who were not in accordance with Thai SAP guidelines is shown in Table 3. Concordance between SAP practices and the guideline-based recommendations was significantly greater in female patients, in patients who received emergency surgery, and in surgical patients of the Department of Obstetrics and Gynecology, but it was significantly lower in patients who received endoscopic surgery and in surgical patients of the Department of Surgery when compared with patients who received SAP that were not in accordance with the guidelines. Two patients (1.2%) who received SAP developed surgical site infection. Of those, one patient received fosfomycin at the ward two hours prior to being transferred to the operating room followed by cephalexin and coamoxiclav for a total duration of 22 days. That patient developed superficial surgical site infection on day 23 after total hip arthroplasty. The other patient received cefazolin earlier than 60 minutes before surgical incision without redosing of antibiotic in the operating room followed by coamoxiclav for a total duration of 20 days. That patient developed superficial surgical site infection on day 22 after penectomy with groin node dissection.

Discussion

In the present study, the recommendations of the local SAP guideline for prevention of surgical site infection of the Surgical Infection Society of Thailand[22] were compared with SAP practices in 211 patients who received SAP at Siriraj Hospital on one data collection day in 2018. This local guideline was developed by the Surgical Infection Society of Thailand in collaboration with other relevant medical societies. Although the recommendations of the studied local guideline are similar to those of several international guidelines, including clinical practice guidelines for antimicrobial prophylaxis in surgery jointly developed by the American Society of Health System Pharmacists, the Infectious Diseases Society

of America, the Surgical Infection Society, and the Society for Healthcare Epidemiology of America[23,24], this local guideline has several important limitations. First, recommendations for antibiotic prophylaxis in many types of surgery and invasive procedures are not included in the guideline. Second, the antimicrobial agents recommended for surgical prophylaxis in the local guideline were determined based on antibiotic susceptibility patterns in Thailand in 2018 and 2019 reported by the National Antimicrobial Resistance Surveillance Center of Thailand (NARST). However, these drug recommendations may not be appropriated because the antibiotic susceptibility data from NARST are derived from the bacteria isolated from clinical specimens collected from patients who had or who were suspected of having infections, whereas the bacteria caused surgical site infection are usually bacterial florae from the patients or bacteria transmitted from medical devices, medical personnel, or the hospital environment.

The concordance rate of the indication for SAP between 211 study patients received SAP and the local SAP guidelines was high (93.8%). It should be noted, however, that this figure was not computed from all patients who had surgery on the survey day. It is, therefore, possible that this figure might underestimate or overestimate the true prevalence of the concordance rate of the indication for SAP because the patients who had surgery or invasive medical procedures without receiving antibiotic prophylaxis on the survey day might or might not have needed SAP. The 93.8% rate of appropriate indication for SAP observed in the present study was higher than the 85.0% rate found in 197 patients reported from another university tertiary care center in Thailand[9] that evaluated SAP concordance with the international SAP guidelines[22]. The concordance rate of the choice of SAP between 198 patients who had indications for SAP and the local SAP guideline was only 67.2%. One of the factors that contributed to a low concordance rate was that nearly 10% of the patients who had neurosurgery received fosfomycin, which is not recommended in the local SAP guideline. A review of the role of fosfomycin for surgical prophylaxis revealed that oral fosfomycin appeared to be effective for preventing infection after urological surgery or urological procedures, and that parenteral fosfomycin might be effective for preventing infection after colorectal surgery, but fosfomycin was not included as a recommended antibiotic for surgical prophylaxis in many guidelines[25]. The incidence of surgical site infection in 30 patients with closed brain injury that underwent craniotomy procedure without implant who received fosfomycin as antibiotic prophylaxis was 3.3% in a non-comparative study in 30 patients[26]. Therefore, convincing evidence of the effectiveness of fosfomycin for SAP to prevent infection after neurosurgery is not available, and clinical study in the effectiveness of fosfomycin for SAP after neurosurgery is needed.

The concordance rates of the initial dose of antibiotic (89.9%) and the time of initiation of antibiotic within 60 minutes before surgical incision (82.8%) among 198 patients who had indications of SAP were rather high. However, there is still room for improvement in these two parameters of SAP. In contrast, the concordance rates of perioperative redosing of antibiotic in 23 patients who required additional doses of antibiotics (26.1%) and the duration of antibiotic prophylaxis of 24 hours or less (32.3%) among 198 patients who had indications of SAP were both low. The responsible medical personnel might be unaware of the need for perioperative redosing of antibiotic or may forgot to provide additional doses of antibiotics for patients who had prolonged operations. The duration of antibiotic for surgical prophylaxis of 24 hours or less in 2,431 patients who received SAP at 183 hospitals in Thailand in 2018 was only 10.1%[21]. The duration of antibiotic for surgical prophylaxis in 197 patients who received SAP at another university tertiary care hospital in Thailand was 36.9% for antimicrobial use in 24 hours or less after surgery, except for cardiac surgery, which was 48 hours or less[9]. The concordance rates of all parameters for SAP between SAP practices in 211 patients who received SAP and the local guidelines observed in the present study (20.9%) was more than that (0%) in 197 patients who received SAP at another university tertiary care hospital in Thailand in 2016[9] that met all recommendations on SAP according to the American Society of Health-System Pharmacist guidelines[23].

It is worth mentioning that two patients in the present study developed surgical site infections even though both received antibiotic prophylaxis. One of those patients received antibiotic much earlier than the time of surgical incision and continued to receive antibiotic for 20 days. The other patient received antibiotic much earlier than the time of surgical incision, did not receive redosing of antibiotic in the operating room due to prolonged operative time, and continued to receive antibiotic for 20 days. The incidence of surgical site infection in patients who received SAP was not significantly different between those in and not in accordance with the local SAP

guidelines (Table 3), because the overall incidence of infection was so low. Concerning a limitation of the present study, it should be kept in mind that the data and results of the present study were limited to hospitalized patients who received SAP at Siriraj Hospital on Tuesday, August 7, 2018. Therefore, the parameters of SAP of patients on other days of the week may be different from those on Tuesday due to differences in the volume of surgical patients, the types of operation and the surgeons who perform surgery on different days of the week.

Conclusion

It is clear from the present study and other studies in SAP that have been conducted in Thailand, that the concordance between SAP practices and the recommendations of the local and the international SAP guidelines is unsatisfactory. Therefore, a study to identify the factors significantly associated the inappropriate use of antibiotics for surgical prophylaxis should be conducted, and the development and implementation of a multifaceted intervention to promote the appropriate use of SAP at healthcare facilities in Thailand is urgently needed.

What is already known on this topic?

Inappropriate SAP is common at many centers in both developed and developing countries, including Thailand. A previous study in a hospital in Thailand compared SAP data with the recommendations of the international SAP guidelines.

What this study adds?

The concordance between SAP practices at a university tertiary care hospital in Thailand and the recommendations of the local SAP guidelines for the prevention of surgical site infection developed by the Surgical Infection Society of Thailand was found to be unacceptably low.

Acknowledgements

The authors gratefully acknowledge Mr. Nuttapong Srasrisom for organizing data collection and Ms. Wanida Cheewathammarat for managing the supporting fund.

Funding disclosure

The present study was funded by grants from the Health Systems Research Institute, Nonthaburi, Thailand and the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. The two funders were not involved in the design or execution of the study, the analyses of the study results, the preparation of the manuscript, or the decision to publish.

Conflicts of interest

All authors declare no personal or professional conflicts of interest relating to any aspect of the present study.

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