

Evaluation of General Surgery Physicians' Approaches to Surgical Antimicrobial Prophylaxis by Questionnaire Method

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Abstract

Aim: Surgical site infections (SSIs) are infections of the incision site, organ or cavity that occur after surgery, causing a significant burden in terms of morbidity, mortality and healthcare costs. SSIs are the most common healthcare-associated infections in low- and middle-income countries and may affect one-third of surgical patients. This study aimed to conduct a face-to-face survey to evaluate general surgeons' approaches and knowledge levels before and after the training seminar on the use of surgical antimicrobial prophylaxis (SAP).

Methods: An information-oriented questionnaire consisting of 10 questions was administered to a total of 18 surgeons working a General Surgery Department before and after the education meeting to evaluate their knowledge and attitudes towards the use of SAP. Data were presented as number, percentage, mean (standard deviation) and Fisher exact test was used to compare categorical data.

Results: All participants answered the question regarding the time of prophylactic antibiotic administration correctly in both surveys. According to the current American Society of Health-System Pharmacists (ASHP) guideline for cefazolin, 42.2% of the patients had the correct time of antibiotic administration. The proportion of patients whose cefazolin selection, dose and time of administration were appropriate was 14.6%. The number of physicians who thought that postoperative antibiotic prophylaxis was not significantly increased from 16 (88.8%) before the meeting to 18 (100%) after the meeting ($p>0.05$). In our study, the number of patients who continued to be given antibiotics unnecessarily postoperatively was 66 (16.4%).

Conclusions: In order to increase the rate of optimal application of the theoretical knowledge to patients in practice, it is important to organize routine trainings based on current literature and service data for surgeons with a high workload and to follow the reflection of these trainings to the clinic in order to improve SAP compliance rates.

Keywords: Surgical antimicrobial prophylaxis, general surgery, survey, surgical site infection, guideline


1. Introduction

Surgical antimicrobial prophylaxis (SAP) refers to the application of antimicrobial agents before exposure to contamination during surgery to prevent infectious complications.¹ Guidelines based on high-quality studies have stated that appropriate SAP is among effective measures to prevent surgical site infections (SSI). For optimal benefit, it is necessary to determine appropriate indications, select agents covering potential pathogens for wound contamination, and apply sufficient bactericidal concentrations throughout the per-

iod when the incision is open to the risk of bacterial contamination.² Treatment guidelines and antibiotic regimens have significantly evolved from aggressive and prolonged antibiotic prophylaxis regimens in the 1980s and 1990s to a more moderate practice today.³ SAP guidelines are considered significant interventions for antimicrobial resistance. Compliance with guidelines is weak in many countries, leading to inappropriate and excessive antibiotic use. Creating awareness about the importance of rational antibiotic use and adherence to guidelines are crucial initiatives recommended for appropriate SAP use.²

Preoperative doses should be initiated within 60 minutes before surgical incision (120 minutes for fluoroquinolones and vancomycin). Pharmacokinetics of drugs may vary in obese patients, hence dose adjustments based on body weight may be necessary. In patients with impaired kidney and/or liver function, dose adjustments are often unnecessary in this patient group as antimicrobial

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prophylaxis is usually given as a single preoperative dose before surgical incision. In cases where the procedure duration exceeds twice the half-life of the drug, or there is excessive blood loss during the procedure, or in cases of extensive burns, intraoperative re-dosing is necessary in all patients to ensure adequate serum and tissue concentrations of the antimicrobial agent. New recommendations are provided for the shortened course of postoperative antimicrobials for single-dose or antimicrobials lasting less than 24 hours. Post-operative antimicrobial prophylaxis may not be necessary depending on the presence of permanent drains and intravascular catheters.⁴

In this study, a face-to-face survey (10 minutes) was planned to evaluate the approaches and knowledge levels of general surgeons before and after an educational seminar (approximately 1 hour) regarding the use of SAP.

2. Materials and methods

This study was a face-to-face questionnaire survey of physicians working in a department of general surgery of a university hospital who volunteered to participate in the study. The questionnaire questions were prepared in consensus with the senior surgeons involved in the study, taking into account the current literature and guidelines. On 4 January 2023, the head of the general surgery department provided an education on SAP to the faculty members and resident physicians of the general surgery department in accordance with the American Society of Health-System Pharmacists (ASHP) guidelines and current scientific literature. The questionnaire with the same questions was applied to the participating physicians right pre-education questionnaire phase (pre-EQP) and post-education questionnaire phase (post-EQP) with informed consent. In order to anonymize the physicians' answers, the number for coding written on the questionnaire before the education session was also asked to be written on the questionnaire applied after the education.

A questionnaire consisting of 10 questions was prepared according to the SAP compliance rate reports (obtained from the specialty thesis in which SAP compliance status and SSI development rates of 404 patients hospitalized and operated in the general surgery service between 24 January and 6 May 2022 were evaluated⁴) and the 2013 ASHP guideline.⁵ The study was approved by local ethics committee.

There is a hospital protocol prepared in cooperation with the Department of General Surgery and the Department of Clinical Microbiology and Infectious Diseases within Hacettepe University. This protocol entered into force on 06.09.2021 and was made available to clinicians via the hospital information management system. Some of the recommendations in the SAP protocol are as follows:

- The recommended time is 30 minutes to an hour before surgery.
- If the operation lasts more than three hours and there is excessive fluid loss, an additional dose of antibiotics is recommended.
- Antibiotic prophylaxis started in the perioperative period should not be continued after surgery. The maximum duration of postoperative prophylaxis is 24 hours.
- Cefazolin should be administered as 2 g in patients weighing more than 80 kg and 3 g in patients weighing more than 120 kg.
- The team conducting CAE surveillance should include a senior surgeon, operating staff (anaesthetists and/or nurses) and infection control committee.

The data obtained from the research were analyzed using SPSS Version 23.0 statistical analysis software. As descriptive statistics, mean and standard deviation or median and minimum-maximum values for numerical variables and number and percentage values for categorical variables were given. In the comparison of numerical data, Student T Test was used for normally distributed data and Mann Whitney U test was used for non-normally distributed data. Chi-Square test was used to compare the ratios. In analyzing the change over time, the significance test of the difference between two pairs or Wilcoxon test was used. The relationship between numerical variables was analyzed using the appropriate correlation test (Pearson or Spearman). Mc Nemar test was used to determine whether there was a difference between two related groups on a dichotomous dependent variable. $p < 0.05$ was considered statistically significant.

Table 1
Survey Questions & Answers

<p>Q1. Which of the following is incorrect regarding the timing of preoperative and intraoperative antibiotic administration in adult patients?</p> <p>A) The first dose should be started within 60 minutes before the surgical incision. B) The first dose of fluoroquinolones and vancomycin should be started within 120 minutes before the surgical incision. C) Intraoperative re-administration is necessary to ensure adequate serum and tissue concentrations of the antimicrobial in patients if the duration of the procedure exceeds the two half-lives of the drug. D) Corrected body weight is used to calculate the dose of aminoglycosides in patients with a body mass index ≥ 30 kg/m². E) The first dose should be started immediately after surgical incision.</p>
<p>Q2. Which of the following is true about cefazolin, which is frequently used for surgical prophylaxis?</p> <p>A) Vancomycin is more effective than cefazolin in preventing Surgical Site Infections (SSIs) caused by <i>methicillin-sensitive Staphylococcus aureus</i> (MSSA). B) Cefazolin is more effective than vancomycin in preventing CAIs caused by methicillin-resistant Staphylococcus aureus (MRSA). C) The preoperative dose for adult patients is 2 g. For patients weighing ≥ 120 kg, it is 3 g. D) Because of its long half-life, intraoperative re-dosing is not required. E) If major blood loss (e.g., >1500 mL) occurs, a repeat dose should be administered before fluid resuscitation.</p>
<p>Q3. Which of the following statements is incorrect?</p> <p>A) The Operation Start Time indicates the moment when the incision is made for a surgical procedure. B) End of Surgery Time refers to the time when all instrument counts have been completed and verified, all postoperative radiological studies to be performed in the operating room have been completed, all dressings and drains have been secured, and physicians/surgeons have completed all procedure-related activities on the patient. C) While current guidelines recommend a maximum duration of surgical antimicrobial prophylaxis of 24 hours, increasing evidence suggests that a single preoperative dose (and possible additional intraoperative doses) may have a similar effect. D) Depending on the presence of indwelling drains and intravascular catheters, antimicrobial agents should be continued in the postoperative period. E) Long-term antibiotic administration may increase the development of antibiotic resistance, antibiotic-specific side effects (e.g., acute kidney injury), fungal superinfections and the risk of <i>Clostridium difficile</i> infection.</p>
<p>Q4. Which of the following is correct to reduce the risk of SSI in adult patients undergoing elective colorectal surgery?</p> <p>A) The oral antibiotic agent(s) used should only have anaerobic activity. B) Oral antibiotic agent(s) are administered before mechanical bowel preparation to reduce the microbiota load of the colon. C) Oral antibiotic + mechanical bowel preparation is not superior to mechanical bowel preparation alone without oral antibiotic administration. D) Oral antibiotics are for preoperative use only and should not be continued postoperatively. E) The risk of anastomotic leakage is much higher in patients undergoing mechanical bowel preparation.</p>
<p>Q5. Which of the following statements is incorrect?</p> <p>A) Superficial incisional SSIs are only followed for a period of 30 days for all procedure types.</p>

B) Breast surgery (BRST) and hernia repair (HER); deep incisional SSI and organ/space SSI are followed for a period of 90 days.
C) When calculating the surveillance period, the date of operation is recorded as Day 0.
D) Limiting the duration of antimicrobial prophylaxis to a single preoperative dose may reduce the risk of Clostridium difficile disease.
E) Since the predominant organisms in SSIs after clean procedures are gram positive, the addition of vancomycin may be appropriate for a patient with a life-threatening allergy to β -lactam antimicrobials.
Q6. Which of the following is not the aim of the study titled 'Evaluation of Prophylactic Antibiotic Use in General Surgery Service' conducted in your clinic?
A) To evaluate the compliance of prophylactic antibiotic use in operated general surgery patients with the American Society of Health-System Pharmacists (ASHP) guidelines and hospital protocol
B) To determine the level and rate of SSIs developed in patients within the surveillance period.
C) Explaining the findings obtained to the residents and lecturers of the Department of General Surgery in accordance with the guidelines and conducting a pre- and post-training status assessment questionnaire.
D) To evaluate the attitudes and behaviors of operated general surgery patients about prescribing antibiotics to ward physicians.
E) To compare the changes, if any, in prophylactic antibiotic use before (x number of patients) and after (x number of patients) the training.
Q7. Which of the following do you think is the most common comorbidity according to ICD-11 diagnosis code in general surgery patients operated in our University Hospital?
A) Neoplasms
B) Digestive system diseases
C) Respiratory system diseases
D) Endocrine, nutritional and metabolic diseases
E) Circulatory system diseases
Q8. Which of the following do you think is the most common type of surgery performed in general surgery patients operated in our University Hospital?
A) Thyroid and/or parathyroid surgery
B) Colon surgery
C) Rectal surgery
D) Hernia repair
E) Gastric surgery
Q9. According to the ASHP guideline for cefazolin administered as prophylactic antibiotic in general surgery patients operated in our University Hospital, in what percentage (%) do you think the antibiotic selection was correct ?
A) 90-100%
B) 80-90%
C) 70-80%
D) 60-70%
E) 50-60%
Q10. According to the American Society of Health-System Pharmacists Guidelines on Antimicrobial Prophylaxis in Surgery, for cefazolin administered as prophylactic antibiotic in general surgery patients operated in our University Hospital, in what percentage (%) of patients do you think antibiotic selection, antibiotic dose and antibiotic administration time were performed correctly ?
A) 50-60%
B) 40-50%
C) 30-40%
D) 20-30%
E) 10-20%

3. Results

There are 25 surgeons in the general surgery department, 10 of whom are faculty members and 15 of whom are research assistants. A total of 23 (92%) surgeons attended the education session. However, 5 participants were excluded because of participation only in the pre-EQP and one participant was also excluded because of participation only in the post-EQP. Accordingly, the data of a total of 18 (72%) participants who participated in both phases were evaluated. Six of the participants (33.3%) were female, 5 (27.8%) had been working in general surgery for less than 6 months, 4 (22.2%) for 6-24 months, and 9 (50%) for more than 24 months. In addition, 15 (83.3%) of the physicians were residents, 2 (11.1%) were specialists and 1 (5.6%) was a faculty member. The answers given by the physicians to the questionnaire (Table 1) are given in Table 2. The

median (min-max) number of correct answers given to the survey questions was 5 (2-6) in the pre-EQP and 7 (2-9) in the post-EQP ($p=0.001$).

SAP administration time was answered correctly by all participants in the pre-EQP. All participants correctly answered the time of SAP administration, the duration of SAP continuation and the most common type of surgery performed in the post-EQP. In the case of surveillance time calculation, all participants answered incorrectly in both periods. In the post-EQP, the best improvement in the correct response rate was in the question given to the most common disease group in patients.

Table 2

Comparison of the answers given to the questions

	Question no	Answer	After training		p	
			Incorrect	Correct		
Before training	1	Incorrect	0	0	0.508	
		Correct	0	18		
	2	Incorrect	2	6		
		Correct	3	7		
	3	Incorrect	0	2		0.500
		Correct	0	16		
	4	Incorrect	11	1		>0.05
		Correct	1	5		
	5	Incorrect	18	0		>0.05
		Correct	0	0		
	6	Incorrect	2	2		>0.05
		Correct	2	12		
	7	Incorrect	3	14		<0.001
		Correct	0	1		
	8	Incorrect	0	1		>0.05
		Correct	0	17		
	9	Incorrect	7	8		0.109
		Correct	2	1		
	10	Incorrect	10	7		0.016
		Correct	0	1		

According to the data in the thesis used to prepare the survey questions, among 404 patients evaluated for SAP compliance report, the proportion of patients with at least 1 comorbidity according to the International Classification of Disease (ICD) was found to be 91.3%. The most common disease were neoplasms. The most common types of surgery were hernia repair. The most preferred prophylactic antibiotic (404 patients) was cefazolin (352 patients, 87.1%). The number of patients whose cefazolin choice was appropriate according to ASHP guidelines was 315 (89.5%). The dose compliance rate of patients whose cefazolin choice was appropriate according to the ASHP guideline was 41%. The proportion of patients whose cefazolin selection was appropriate according to the ASHP guideline and whose time of administration was appropriate according to the ASHP guideline was 42.2%. The proportion of patients whose cefazolin selection, dose and time of administration were appropriate was 14.6%. Intraoperative repeat cefazolin administration was performed in 7 (50%) of a total of 14 patients who required intraoperative repeat cefazolin administration, and the time of administration was correct in 1 (14.3%) of these patients. The rate of preoperative oral antibiotic administration in patients undergoing elective colorectal surgery was 63.6% for oral ornidazole and 56.8% for oral cefuroxime.

However, when the time of mechanical bowel preparation (MBP) application was analyzed, it was noticed that it was usually

performed after oral antibiotic administration. When the patients who received antibiotics while hospitalized in the ward in the postoperative period were evaluated in terms of the presence or absence of infectious diseases specialist (IDS) approval and the presence or absence of indication, the number of patients who received antibiotics without indication was 66 (16.4%).⁴

4. Discussion

In this study, 10-question questionnaire was administered twice to surgeons' pre-EQP and post-EQP in order to evaluate their approaches and knowledge levels on SAP use. Not all physicians in the Department attended the meeting due to their workload in the operating rooms.

When the answers given by a total of 18 participants were evaluated, all participants answered the question about the time of prophylactic antibiotic administration correctly in both questionnaires. However, according to the data at the thesis data, it was found that the correct time of antibiotic administration according to the ASHP guideline for cefazolin was 42.2%. Intraoperative repeat cefazolin administration was performed in 7 (50%) of a total of 14 patients who required intraoperative repeat cefazolin administration, and the time of administration was correct in 1 (14.3%) of these patients. The number of patients who continued to be given antibiotics unnecessarily postoperatively was 66 (16.4%). The number of physicians who thought that there was no need to continue postoperative antibiotic prophylaxis increased from 16 (88.8%) before the meeting to 18 (100%) after the meeting ($p > 0.05$). Even though, surgeons are well-qualified in theoretical knowledge on the time of prophylactic antibiotic administration, application of this knowledge into their practice is lower.

In a survey study conducted to evaluate the use of SAP and compliance with ASHP guidelines among general surgeons in Turkey, the overall compliance rate of 317 participants with ASHP guidelines was found to be 26.8%. Although 96.5% of the participants correctly reported the time of SAP first dose administration, this rate decreased to 79.5% for intraoperative redosing of prophylaxis. The proportion of surgeons who continued antibiotic treatment of clean and clean-contaminated cases at discharge was 22.7% and 38.5%, respectively. As a result of this study, it has been shown that inappropriate SAP use is common in Turkey and antibiotics are continued to be prescribed at discharge.⁶ According to our survey results, although 100% of the participants could correctly report the time of administration of the first dose of SAP, this rate decreased to 33.3% of those who reported that prophylaxis did not need to be continued in the postoperative period.

It is known that especially plastic surgeons lack knowledge and awareness about optimal SAP.⁷ For this reason, it is recommended that SAP trainings for specific surgical branches should be given regularly. In a survey of Italian surgical (General, Cardiac, Thoracic, Plastic, Vascular, Orthopedics, Obstetrics, Gynecology, Urology, Otorhinolaryngology and Ophthalmology) and anesthesiology residents involving a total of 466 respondents, a total of 36.3% of respondents had an adequate knowledge score on SAP. General surgery residents were more likely than anesthesiology residents to agree that SAP should be performed within 60 minutes prior to surgical incision and to be aware of the existence of national guidelines on SAP. In addition, 14% of respondents were concerned about patients contracting SSIs during their hospitalization. It was concluded that organizing a training course on SAP, especially promoting educational intervention for surgical and anesthesiology residents, would be useful to improve correct antibiotic use and prevent healthcare-associated infections.⁸

In another survey study in which orthopedic surgeons were asked about the time of preoperative antibiotic administration, 47.4% of 395 surgeons stated that they administered preoperative antibiotics within 30 minutes before incision, 42.9% within 30 minutes to 1 hour before incision, and 8.2% within 1-3 hours before incision. Regarding the necessity of intraoperative redosing for prolonged surgical procedures, 77.8% of surgeons stated that redosing was necessary. In the postoperative period, 40.4% of the surgeons stated that they used antibiotics for 1 day, 44.4% for 2-7 days, 14.5% for 8-14 days, and 0.7% for more than 14 days.⁹ In a questionnaire study in which the approach to prophylactic antibiotic use in hernia repair was evaluated with the participation of 81 surgeons who performed at least 75 hernia repairs per year, 44.4% of the participants used routine antibiotic prophylaxis, 49.4% used selective SAP, and 6.2% stated that they never used SAP. The lack of clear guidelines emphasizes that the surgeon bases prophylactic antibiotic use on perceived risk or SSI experience.¹⁰

In a questionnaire study conducted in England in which 97 surgeons performing elective colorectal surgery were included, all of the participants reported that they gave prophylactic antibiotics preoperatively; 24% continued antibiotics in the postoperative period; 62% performed oral antibiotics and MBP and 29% performed only MBP without oral antibiotics¹¹. According to thesis data, the rate of preoperative oral antibiotic use in elective colorectal surgery was 63.6% for oral ornidazole and 56.8% for oral cefuroxime. The rate of MBP is 95.5%. In our survey study, 6 (33.3%) of the physicians gave the correct answer in accordance with the guideline regarding SAP application in elective colorectal surgery. The only shortcoming of MBP and oral antibiotic administration, which was higher compared to the other study, was observed in compliance with the timing of oral antibiotic administration.

The limitations of our single-center study are that not all faculty members and resident physicians were able to attend the educational meeting, the educational messages could not be conveyed in detail due to the insufficient duration of the meeting, and for this reason, the survey questions were simplified and as a result, we could not adequately measure the level of knowledge of physicians.

5. Conclusion

SSI is an undesirable situation that patients may frequently encounter in the postoperative period. Low compliance with SAP increases the risk of possible SSI development. In order to reduce preventable risk factors, the entire team in the operating theatre, especially the surgeons, and the personnel caring for patients in the ward should be informed about this issue and necessary precautions should be taken together. Providing education at regular intervals is beneficial for surgeons in order to improve their knowledge on rationale antibiotic use in SAP.

Statement of ethics

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by Hacettepe University Scientific Research and Publication protocol number 2022/17-11.

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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Author Contributions

Conceptualization, N.Y and C.Z.D.; Methodology, C.Z.D.; Software, N.Y.; Validation, N.Y., C.Z.D. and K.D.; Formal Analysis, Ö.D.; Investigation, C.Z.D.; Resources, N.Y.; Data Curation, C.Z.D.; Writing – Original Draft Preparation, C.Z.D. and N.Y.; Writing – Review & Editing, K.D., and K.Y.; Visualization, K.D.; Supervision, K.Y.; Project Administration, K.D. All authors read and approved the final version of the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Originality Assertion

The authors have not submitted this article to another journal previously.

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