Usage of Surgical Antibiotic Prophylaxis in Routine Otolaryngologic Surgeries in Turkey

Mümtaz Taner Torun[1]

[1] Department of Otolaryngology, Bandirma Onyedi Eylul University, School of Medicine, Balıkesir, Turkey

Address for correspondence Mümtaz Taner Torun, MD, Çanakkale Road 6th km. Bandırma/ Balıkesir 10500, Turkey (e-mail: mumtaztanertorun@gmail.com).

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Abstract

Introduction: Inappropriate antibiotic use in the world leads to an increase in both health care costs and antibiotic resistance. Surgical antibiotic prophylaxis (SAP) is used by most surgeons, especially in the postoperative period.

Objective The aim of the study is to determine the approach of ear, nose, and throat (ENT) specialists to surgical antibiotic prophylaxis in routine surgeries, and to raise awareness regarding inappropriate antibiotic use.

Methods ENT specialists from all over Turkey participated in the study by filling out a data collecting form. The form consisted of 6 questions and was sent to specialists via email. Routine ENT operations such as adenoidectomy, tonsillectomy, adenotonsillectomy, ventilation tube application, septoplasty, rhinoplasty, septorhinoplasty (non-complicated), tympanoplasty, and simple mastoidectomy were chosen for the study. Data were analyzed statistically.

Results The form results of 110 ENT specialists were evaluated. The rate of participants who used and did not use SAP was 77.3% and 22.7%, respectively. The SAP usage rates of septoplasty, rhinoplasty, and septorhinoplasty operations were 84.7%, 81.2%, and 75.3%, respectively. For tympanoplasty and ventilation tube application operations, the rates were 82.4% and 24.7%, respectively. Finallly, the SAP usage rates of adenoidectomy, tonsillectomy, and adenotonsillectomy were 57.6%, 75.3%, and 72.9%, respectively.

Conclusion Otolaryngological surgeries are often classified as clean or clean-contaminated surgeries. In most studies in the literature, it is reported that SAP use is unnecessary in routine otolaryngological surgery. Providing inservice training, regularly updating the prophylaxis guidelines and sharing these guidelines with surgeons may prevent inappropriate SAP use.

Keywords
- infection
- antibiotic prophylaxis
- ear nose and throat

Introduction

Antibiotic resistance has become a serious problem all over the world. More than 20,000 antibiotic-related deaths occur in the United States and the European Union annually.[1] An Australian study reported that 21.9% of antibiotic prescriptions were inappropriate and 23.3% of antibiotics were incompatible with the guidelines.[2] In the same study, the most common reasons of inappropriate antibiotic

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prescriptions were no need of antimicrobials (19.6%), incorrect antimicrobial choices (spectrum too broad: 25.2%), the duration of treatment (17.7%) or the incorrect dosage (19.5%).[2] Surgical antibiotic prophylaxis (SAP), the application of an antimicrobial agent before contamination of sterile areas or liquids, is the major indication for antibiotic prescription.[3] Guidelines show that appropriate SAP is effective in preventing surgical field infections.[4] In addition, the effectiveness, duration, dose and timing of antibiotics against possible pathogens are also important factors. More than 40% of antibiotics prescribed for surgical prophylaxis are reported to be inappropriate.[3] With the increase of population in the world, the number of surgical interventions has also increased. About 60,000 elective otolarygologic operations are performed annually in Australia and approximately 90,000 in New Delhi, India.[5,6] Because of the high operation rates all over the world, appropriate antibiotic usage becomes very important for the economic and health fields.

The infection rate for clean surgeries is reported as less than 1%.[7] In clean-contaminated surgeries, prophylaxis is recommended in a few studies, but not recommended in most other studies. The uses of SAP vary according to the surgeon's choices. Since a standard SAP guide cannot be established in our country, antibiotic applications vary in each region. Additionally, the surgeon's clinical experience and old habits also affect SAP applications. Some studies show that compliance with guidelines in surgical prophylaxis applications ranges from 17 to 41%.[8,9]

The objective of our study is to examine SAP usage by otolaryngologists in routine operations and to determine their antibiotic preferences, antibiotic usage reasons, and SAP protocols in Turkey. Our secondary aim is to investigate the opinions of ENT specialists about SAP and to raise awareness of inappropriate antibiotic use.

Material and Method

We planned to investigate the use of antibiotics in routine surgical operations by ENT physicians. A 6 question data collection form was planned, including simple questions that can be understood easily and did not consist of recall bias or the social desirability bias. One of the questions is open-ended and the remaining 5 questions were optional, with a total of 22 sub-tabs. This form has been designed in accordance with the questionnaire development process, as follows: Stage 1–Problem Identification: aimed to evaluate the use of antibiotics in routine surgical operations of ENT physicians. As many hospitals have their own protocol, a standard template has not been established. Preventing unnecessary antibiotic use is important both for the health of the patient and the treatment costs. Stage 2–Determining the Questions and Creating the Pre-Application Form: 10 ENT physicians working in different hospitals (2nd and 3rd stage) and different institutions (university hospitals, private hospitals) were contacted via e-mail and asked to evaluate the data collection form. They were also asked if they had any suggestions of additional questions for developing the data collection form. Stage 3–Finalizing the Form: after the pre-application form was revised with the feedback of the experts, the data collection form was finalized. The Cronbach Alpha value of the data collection form was 0.411.

About 5000 ENT specialist from Turkey who are in the same database participated in the study by filling out a data collection form. The form was sent to them via e-mail. The participants were informed about the use and anonymization of the data, and those who agreed were asked to fill out the form. Incomplete forms were not included in the study. The participants did not receive any gift or financial compensation. The data collection form consisted of 6 questions. The data collection form was active during the month of September 2019, after which the responses were analyzed. The surgeons were asked how many years they have been ENT specialists in the first question. Routine ENT operations such as adenoidectomy, tonsillectomy, adenotonsillectomy, ventilation tube (VT) application, septoplasty, rhinoplasty, septorhinoplasty (non-complicated), tympanoplasty, and/or simple mastoidectomy were chosen for the study. The surgeons were asked in which operations they use antibiotics in the second question. They were also asked when they use SAP such as preoperative, during operation, postoperative, or combined in the third question. Their antibiotic choices were asked at the fifth question (1. Penicillin, 2. Cephalosporin, 3. Macrolide, 4. Others [tetracycline, quinolone, etc.]). In the sixth question, hey were asked why they use the SAP, with 4 options (1. Habit, 2. I'm afraid of surgical field infection, 3. Because it reduces postoperative morbidity (pain, acceleration of healing), 4. Others).

Tympanoplasty and/or simple mastoidectomy were evaluated in the category of clean surgery and other procedures in the category of clean-contaminated surgeries.[5] All procedures contributing to this work complied with the ethical standards of the relevant national and institutional guidelines on human experimentation, and with the 1975 version of the Declaration of Helsinki, as revised in Seoul in 2008.

Statistical Analysis

The G*Power 3.1.9.7 (Heinrich Heine University. Düsseldorf, Germany) software was used to determine the required number of participants. The effect size: 0.36 (medium-large), α error: 0.05, 1-β: 0.80, and degrees of freedom: 3 were chosen, and we calculated that it could reach 80% power with 85 participants.

The Statistical Package for Social Sciences (SPSS, IBM Corp., Armonk, NY, USA) software, version 25.0, was used for statistical analysis. Results were presented as median, minimum, and maximum for numerical data, and as frequency and percentage for categorical variables. The compatibility of numerical variables to normal distribution was evaluated with the Kolmogorov-Smirnov test. The Mann Whitney U test was used in comparison of numerical data, and the Chi-square or Fisher exact tests were used for the comparison of categorical data.

Results

The results of the data collection form, filled out by 110 ENT specialists, were evaluated. While 25 of the participants did

not use SAP for routine surgery (22.7%), 85 of them used antibiotics for routine surgery (77.3%). The average of the ENT specialization years in the group using SAP (11.75 ± 9.86) and not using SAP (10.92 ± 9.90) were similar . In the comparison, no statistically significant difference was detected between those who used antibiotics (median: 9, 1–45) and those who did not use them (median: 8, 2–44) in terms of duration of expertise (Z: 0.708, $p = 0.479$). The number and rates of participants using SAP for septoplasty, rhinoplasty, and septorhinoplasty operations were 72 (84.7%), 69 (81.2%), and 64 (75.3%), respectively. The number and rates of participants using SAP in tympanoplasty and VT application operations were 70 (82.4%) and 21 (24.7%), respectively. The number and rates of participants using SAP for adenoidectomy, tonsillectomy, and adenotonsillectomy operations were 49 (57.6%), 64 (75.3%), and 62 (72.9%), respectively.

Participants used SAP at the rate of 16.5% ($n = 14$) preoperatively, 18.8% ($n = 16$) perioperatively, and 41.2% ($n = 35$) postoperatively. Additionally, 23.5% ($n = 20$) of the participants used a combined protocol. In terms of antibiotic usage timing in septoplasty, 9 of the participants used SAP preoperatively, 10 of them perioperatively, 34 of them postoperatively, and 19 of them used it in combined protocol. In rhinoplasty, 8 of the participants used SAP preoperatively, 12 of them perioperatively, 34 of them postoperatively, and 15 of them used it in combined protocol. In non-complicated septorhinoplasty, 7 of the participants used SAP preoperatively, 10 of them perioperatively, 33 of them postoperatively, and 14 of them used it in combined protocol. In terms of antibiotic usage timing in tympanoplasty, 8 of the participants used SAP preoperatively, 11 of them perioperatively, 34 of them postoperatively, and 17 of them used it in combined protocol. In VT application, 4 of the participants used SAP preoperatively, 1 of them perioperatively, 10 of them postoperatively, and 6 of them used it in combined protocol. In terms of antibiotic usage timing in adenoidectomy, 6 of the participants used SAP preoperatively, 6 of them perioperatively, 26 of them postoperatively, and 11 of them used it in combined protocol. In tonsillectomy, 8 of the participants used SAP preoperatively, 8 of them perioperatively, 31 of them postoperatively, and 17 of them used it in combined protocol. In adenotonsillectomy, 9 of the participants used SAP preoperatively, 7 of them perioperatively, 30 of them postoperatively, and 16 of them used it in combined protocol.

The antibiotic preferences of 85 participants were penicillin 37.6% ($n = 32$), cephalosporin 50.6% ($n = 43$), and the other groups (different or multiple groups of antibiotics) 11.8% ($n = 10$). When the participants were asked why they used SAP, 2 of them (2.4%) answered with "habit," 54 of them (63.5%) answered "I'm afraid of surgical field infection," 24 of them (28.2%) chose "as SAP reduces postoperative morbidity," and 5 of them (5.9%) answered "other reasons."

The collected data of the descriptive characteristics of the participants are shown in ►**Table 1**. When the reasons for antibiotic use were compared according to the period of antibiotic use, a statistically significant difference was found between some of the groups (►**Table 2**). It was determined that the use of antibiotics to prevent infection in the postoperative period was significantly higher than its use in other periods. However, the use of cephalosporins was higher before and during operation compared with the postoperative period. Additionally, penicillin was preferred significantly more than cephalosporins in the postoperative period. However, there is no statistically significant difference between the type of antibiotic and the reason of antibiotic use (^{F}: 7.370, $p = 0.223$).

Table 1 Descriptive characteristics of the participants regarding antibiotic use

		n	%
Group	User	85	77.3
	Not user	25	22.7
Antibiotic use period	Preoperative	15	17.6
	During surgery	15	17.6
	Postoperative	35	41.2
	Combined	20	23.5
Surgery procedures (more than one option was ticked.)	Septoplasty	72	84.7
	Rhinoplasty	69	81.2
	Septorhinoplasty	64	75.3
	Tympanoplasty	70	82.4
	Ventilation tube application	21	24.7
	Adenoidectomy	49	57.6
	Tonsillectomy	64	75.3
	Adenotonsillectomy	62	72.9
Type	Penicillin	32	37.6
	Cephalosporin	43	50.6
	Other	10	11.8
Reason of antibiotic use	Habit	2	2.4
	Infection	54	63.5
	Morbidity	24	28.2
	Other	5	5.9

When the type of antibiotic was compared with the type of the surgery, a statistically significant difference was found only in tonsillectomy operations ($p = 0.004$). It was determined that the participants who performed this surgery preferred the penicillin group more as prophylactic antibiotics. A comparison of surgery type related to antibiotic type is shown in ►**Table 3**.

Discussion

The most common pathogens in surgical field infections of head and neck surgery are S. aureus, streptococci and oropharyngeal anaerobes.[10] Since there are various guides for surgical prophylaxis, there are different applications in our country.

Table 2 Comparison of variables regarding antibiotic use period

		Antibiotic use period								Test value	*p*-value
		Preoperative		During surgery		Postoperative		Combined			
		n	%	n	%	n	%	n	%		
For how many years have you been a specialist? (med / min–max)		10	1–45	10	3–36	9	1–42	9	1–30	0.086[H]	0.993
Reason of antibiotic use	Habit	1[a]	6.7	0[a]	0.0	0[a]	0.0	1[a]	5.0	23.393[F]	< **0.001**
	infection	6[a]	40.0	6[a]	40.0	31[b]	88.6	11[a]	55.0		
	Morbidity	6[a]	40.0	9[a]	60.0	3[b]	8.6	6[a, b]	30.0		
	Other	2[a]	13.3	0[a]	0.0	1[a]	2.9	2_a	10.0		
Type	Penicillin	4[a]	26.7	4[a]	26.7	19[a]	54.3	5[a]	25.0	15.625[F]	**0.010**
	Cephalosporin	11[a]	73.3	11[a]	73.3	10[b]	28.6	11[a, b]	55.0		
	Other	0[a]	0.0	0[a]	0.0	6[a]	17.1	4[a]	20.0		

Notes: [F] Fisher exact test. [H] Kruskal-Wallis test. [a, b] Each subscript letter denotes a subset of antibiotic use period categories whose column proportions do not differ significantly from each other at the 0.05 level.

Table 3 Comparison of surgery type and antibiotic type

		Antibiotic						Test value	*p*-value
		Penicillin		Cephalosporin		Other			
		n	%	n	%	n	%		
Septoplasty	No	2	15.4	10	76.9	1	7.7	4.030[F]	0.124
	Yes	30	41.7	33	45.8	9	12.5		
Rhinoplasty	No	4	25.0	11	68.8	1	6.3	2.632[K]	0.268
	Yes	28	40.6	32	46.4	9	13.0		
Septorhinoplasty	No	7	33.3	13	61.9	1	4.8	2.006[K]	0.367
	Yes	25	39.1	30	46.9	9	14.1		
Tympanoplasty	No	4	26.7	10	66.7	1	6.7	1.917[K]	0.384
	Yes	28	40.0	33	47.1	9	12.9		
VT application	No	25	39.1	31	48.4	8	12.5	0.494[K]	0.781
	Yes	7	33.3	12	57.1	2	9.5		
Adenoidectomy	No	13	36.1	22	61.1	1	2.8	5.693[K]	0.058
	Yes	19	38.8	21	42.9	9	18.4		
Tonsillectomy	No	4	19.0	17	81.0	0	0.0	10.927[K]	**0.004**
	Yes	28	43.8	26	40.6	10	15.6		
Adenotonsillectomy	No	6	26.1	16	69.6	1	4.3	4.838[K]	0.089
	Yes	26	41.9	27	43.5	9	14.5		

Abbreviation: VT, ventilation tube. **Notes:** [F] Fisher exact test. [K] Chi-square test.

In different studies, antibiotic use in tonsillectomy and/or adenoidectomy is controversial. Although SAP is preferred in tonsillectomy for the risk of postoperative infection, pain and bleeding risk, Dhiwakar et al. reported that antibiotics have no effect on pain and delayed bleeding.[11] Moreover, a study with child patients reported that oral antibiotic usage after tonsillectomy has a higher incidence of nausea, vomiting, and abdominal pain .[12] There are studies that normal flora elements, when colonized on the secondary healing tonsillar fossa after tonsillectomy, increase inflammation and postoperative morbidity; however, it has not been proven yet. There have also been studies reporting that SAP reduces post-operative halitosis, fever, and pain.[13] In tonsillectomy, antibiotic use is recommended to prevent sepsis and infective endocarditis in patients with fever and cardiac diseases.[13] In the United States, the rate of SAP use in tonsillectomy, adenoidectomy, and adenotonsillectomy is reported between 30 and 40%.[14,15] In our research, the rates

in our country were 57.6%, 75.3%, and 72.9% respectively in adenoidectomy, tonsillectomy and adenotonsillectomy and more SAP use was found high compared with the literature. In our study, penicilline group was especially preferred in tonsillectomy operations. They may have used penicilline to prevent some morbidities, initially bleeding, caused by surgical field infection after tonsillectomy operations.

According to the literature, *Klebsiella spp.*, *Escherichia coli*, and *S. aureus* can colonize in the nasal cavity in 77% of healthy individuals.[16] The various possible complications after septoplasty operations such as toxic shock syndrome, osteomyelitis, cavernous sinus thrombosis, and meningitis are considered extremely rare.[17] In previous studies, SAP was recommended in septoplasty, but recently there has been an increasing number of studies reporting that AP is not necessary in septoplasty. Studies an increase in the risk of infection in complicated conditions such as graft usage, and revision cases in rhinoplasty and septorhinoplasty.[18] It has been reported that postoperative morbidity and infection risk are not reduced in septoplasty with or without nasal packing.[19,20] Furthermore, SAP does not protect against *S. aureus* colonization.[16] Non-complicated rhinological surgeries are in the category of clean contaminated surgeries and SAP usage has not been recommended in the literature.[20] In a study with 630 patients, parameters such as purulent rhinorrhea, postoperative pain, bleeding, fever, and septal hematoma or abscess were evaluated and it was reported that SAP usage had no effect on these complications.[19] In a study from New Zealand, the SAP usage rate was 62.3% when nasal packing was used in septoplasty with or without turbinate surgery.[3] In our study, the rates of SAP usage for septoplasty, rhinoplasty and noncomplicated septorhinoplasty were 84.7%, 81.2%, and 75.3%, respectively. Compared with the literature, the usage of the SAP in noncomplicated rhinologic surgeries is extremely high in our country.

Tympanoplasty is a clean surgery procedure and SAP is not recommended in these surgeries.[21] In clean surgeries, surgical field infections are extremely rare when asepsis and antisepsis rules are followed. Although SAP is not recommended in this group of surgeries, various studies have reported the usage of SAP in clean surgeries at the rate of 13 and 60%.[8,9] In case of immunosuppression, foreign body application during operation, and areas where serious problems may occur in case of infection, SAP is recommended even for clean surgical procedures.[4] In conditions such as cholesteatoma and preoperative otorrhea, SAP is also reccomended as they are in the category of clean-contaminated or contamined surgeries.[22] According to Verschuur et al., ears without effusion are considered clean and those with seromucous effusion are clean-contaminated.[22] In some studies, SAP usage is not recommended for VT application.[10,17] In our study, the rate of the SAP usage in tympanoplasty (noninfected) and VT application were found as 82.4% and 24.7%, respectively. Compared with the literature, the SAP usage rate for tympanoplasty is higher in our study.

The usage of SAP in clean-contaminated surgeries is controversial. If SAP use is necessary, ampicillin/sulbactam, cefazolin, and clindamycin (in case of β-lactam allergy) are preferred.[17,23] Ottoline et al. suggested that if SAP is necessary during surgery, it is generally recommended to apply 30 minutes before the operation.[17] If there is a risk of postoperative infection, antibiotic use can be continued by adjusting the dosage, but the benefit of prolonged prophylaxis hasn't been documented in the literature.[17] Generally, the recommended time in the guidelines for SAP is 24 hours postoperatively at most, with exceptions.[4] In a study investigating antibiotic use in Eastern European countries, Turkey was the country with the highest antibiotic usage, with the rate of 42.3%.[24] In a study from Turkey involving 16 centers and 166 surgical interventions, it was found that antibiotics selected for SAP were not appropriate in 41% of cases and the duration of the prophylaxis was longer than recommended in 29.1%.[25] In an other study, it was found out that the duration of prophylaxis was longer than 24 hours in 80% of cases and longer than 48 hours in 46% of all procedures.[26] Oppelaar et al. stated in their meta-analysis that no difference was found in the occurrence of postoperative infections between short-course and extended-course antibiotic prophylaxis after ear, nose, throat, oral, and maxillofacial surgeries.[27] Surgeons determine their own protocols in these surgeries. In a study from Southern Italy authors stated that antibiotics cannot be indiscriminately administered to any surgical patient to prevent surgical site infections, since SAP is not necessary in many elective minor surgical procedures, which is in agreement with our study.[28] Finally, we noted that participants of our study often prefer penicillin or cephalosporin.

Various side effects such as penicillin allergy, antibiotic-induced *Clostridium difficile* infections, and penicillin-induced anaphylaxis have been reported in the use of prophylactic antibiotics.[20] In a study conducted at the United States, antibiotic-induced *Clostridium difficile* is the cause for approximately 4.8 billion dollars of unnecessary expenses per year.[29] Prolonged antibiotic prophylaxis leads to increased bacterial resistance rates and treatment costs.[30] Prophylactic antibiotic use can be reduced by 35% and cost per procedure can be reduced by 25% when in compliance with antimicrobial use protocols.[31] Additionally, inappropriate antibiotic use leads to an increasing worldwide antibiotic resistance. So, it is important to avoid inappropriate antibiotic in Turkey, and in the world. There are variations in the SAP guidelines used in different provinces in our country. It is very important to prepare guidelines with a scientific approach, as well as to provide trainings, monitor guideline compliance, and offer feedback to physicians. In our study, no statistically significant difference was found between the reasons for antibiotic use. The English form of data collecting form was show below as ►**Supplementary file** (File Online).

Since the data collection form consists of easy-to-understand simple questions, we believe that it does not contain recall bias or social desirability bias. The limited number of participants, the need for more procedures to be questioned, the participants' hesitations when answering, the possibility of giving biased answers, the small number of questions, and the results depending on the individuals' declarations are

limitations of this study. Those using our data collecting form should understand the limited representativeness when generalizing results in the analyses. Another limitation is that there were no questions directed to the group who did not use antibiotics. Although the use of antibiotics was not often required in routine otolaryngologic operations, SAP usage rates were found to be high in our study. Although the questionnaire development stages were followed while the data collection form was being developed, we anticipate that all possible deficiencies in this study's design can be eliminated in future complementary studies.

Conclusion

Increased training activities and collaboration with the surgical team can improve compliance with guidelines and reduce inappropriate antibiotic use. Furthermore, prophylaxis guidelines can be prepared and health costs can be reduced throughout the country. Additionally, studies with a high number of participants and including other ENT procedures may support our study. Finally, our work may lead to the development of a comprehensive questionnaire on this subject.

Conflict of Interests

The authors have no conflict of interests to declare.

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