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Research article

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The effect of change in educational model on surgical antimicrobial prophylaxis

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Permission was granted by Ordu University Faculty of Medicine local ethics committee (Date: 19.12.2019, No: 2019-181). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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Abstract

Background/Aim: Surgical antibiotic prophylaxis is one of the important steps in preventing surgical site infections. Compliance with the guidelines is particularly important and there are problems in this regard. Innovative approaches are needed in education. In our study, the effects of the novel face-to-face training and feedback model, with which we obtained positive results, were shown.

Methods: In this retrospective cross-sectional study, surgical site infections and the use of antibiotics in surgical prophylaxis in all patients undergoing certain operations were examined in pre-determined departments. The quarterly or annual changes in compliance rates were compared with the new education model.

Results: A total of 3697 clean surgeries were assessed in three departments. The cardiovascular surgery department had annual compliance rates of 2.5% and 8.6% in 2010 and 2011, respectively, which increased between 2012-2017 from 64.5%, 90.7%, 85.4%, 98.8%, 90.6% to 97.4%, respectively (P<0.001), with the new training model. In the Orthopedics and Traumatology department, within eight 3-month periods between 2014 and 2016, compliance rates increased from zero to 92.4% (P<0.001). The general surgery department had a 3.3% compliance rate at the beginning of 2015, which increased up to 98.3%, 95.3%, 96.8% and 93.5% in three-month intervals in 2017 (P<0.001). No significant changes were identified in surgical site infection rates.

Conclusion: Continuous training, monitoring and feedback is required for guideline compliance in surgical antibiotic prophylaxis. We think narrow-scoped and target-oriented face-to-face training is effective and applicable.

Keywords: Antibiotics, Surgical site infection, Prophylaxis, Education, Intervention

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Introduction

Surgical site infections (SSI), the most observed nosocomial infections [1], increase duration of stay in the hospital and the intensive care unit, along with mortality rates [2]. The use of preoperative antibiotics for prophylactic purposes is a major step in preventing surgical site infections [3]. Guidelines regarding the antibiotics, doses and durations recommended according to surgery type are published by national and international organizations [4]. In line with scientific publications and guidelines, every organization implements these by creating their own directives. The use of prophylactic antibiotics with broader spectrum than necessary and for longer durations results in side effects, increased cost, and antibiotic resistance. As a result, hospital infection control committees perform surveillance, feedback, and training studies in line with their duties and responsibilities. However, it is highly challenging to create permanent behavior changes in Turkey, as in the entire world. In this study, we aimed to report the outcome of a new training model which provided dramatically positive results when applied in some departments with lower antibiotic compliance rates than targeted despite classical feedback and training studies.

Materials and methods

In line with infection control committee decisions, surgical site infections in clean surgical operations in pre-determined departments and the suitability of antibiotic prophylaxis used in these operations were observed.

Within this scope, cardiac surgery surveillance results in 2010-2017, hip and knee prosthesis operation surveillance outcomes in the Orthopedics and Traumatology Department in 2014 and 2016 and thyroid operation surveillance results in the General Surgery Department in 2015 and 2017 were retrospectively investigated to reveal the effects of the new training model.

In line with the surgical prophylaxis guidelines which were created by the infection control committee, and provided to surgeons, prophylaxis was not used for thyroid surgery, and cephazolin was used in knee and hip prosthesis operations and cardiac surgeries for a maximum of 24 and 72 hours, respectively.

Classic training involved the invitation of all branches and clinicians to the hospital conference room for a seminar given by infectious diseases specialists. The new training model only targeted clinicians in the relevant branch and was held as an interactive chat around the same table either in their clinical ward or in a small meeting room. Clinicians were informed about inappropriate antibiotic use rates on both clinical and individual clinician basis and the desired procedure was clearly communicated.

Surveillance was performed by infection control nurses and data were reported in 3-month intervals.

In our study, the CVS department rates are provided annually, while General Surgery and Orthopedics and Traumatology clinical data are presented in three-month intervals for non-consecutive two-year periods.

Statistical analysis

The Statistical Package for Social Sciences (IBM SPSS for MacOS, Ver.21) program was used for statistical analysis. Independent groups of categorical variables were compared with the chi-square test. Significance level was defined as $P<0.05$. Intragroup comparisons were carried out by the two-proportion z-test with Bonferroni correction for significant chi-square test results.

Results

The total number of surgeries in the CVS clinic was 2591, with the distribution shown in Table 1. In this clinic, the compliant prophylaxis rate was only 2.5% in 2010. Written feedback was given to clinicians and classic seminar training studies were held for the whole hospital. With similar poor results (8.6% incompliant) in 2011, the infection control team held a meeting to determine a new training strategy with more targeted focus. At the end of 2011 and in the first 3 months of 2012, CVS clinicians were invited twice, and the new meeting model was implemented. Dramatic positive responses were obtained in the following two years. The compliant prophylaxis rates for all years in the CVS clinic are shown in Table 2 and variation by year is presented in Figure 1.

Table 1: Surgery numbers and yearly distribution in cardiovascular surgery clinic

	2010	2011	2012	2013	2014	2015	2016	2017	Total
AAA	11	32	31	14	21	27	11	9	156
CARD	47	91	57	71	80	42	58	54	500
CABPS	215	248	262	183	234	259	250	284	1935
Total	273	371	350	268	335	328	319	347	2591

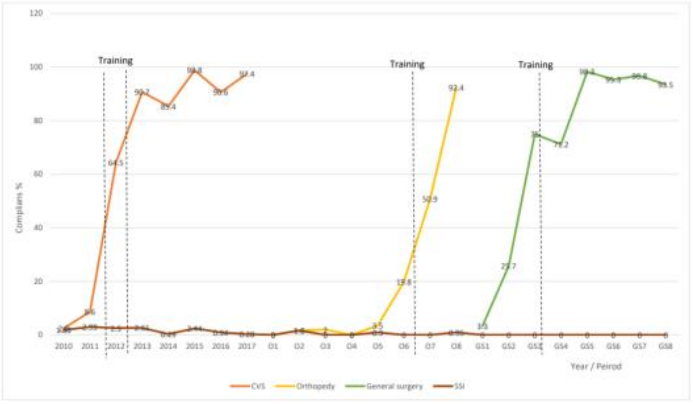
AAA: Aorta aneurysm, CARD: valve surgery, CABPS: Coronary artery by-pass surgery

Table 2: Variation in antibiotic prophylaxis compliance rates and surgical site infection rates according to year in the cardiovascular surgery clinics

Years	Compliance rate	Compliance* %	Form of incompliance**	SSI rates† % (rate)
2010	7/273	2.5[a]	100/0	1.83[a] (5/273)
2011	32/371	8.6[b]	100/0	2.99[a] (11/371)
2012	226/350	64.5[c]	99/1	2.5[a] (9/350)
2013	243/268	90.7[d]	60/40	2.61[a] (7/268)
2014	286/335	85.4[d]	94/6	0.29[b] (1/335)
2015	324/328	98.8[e]	50/50	2.44[a] (8/328)
2016	289/319	90.6[d]	84/16	0.94[a] (3/319)
2017	338/347	97.4[e]	88/12	0.28[b] (1/347)

* Difference between groups without common letters is significant, $P<0.001$, ** Duration incompliance/antibiotic choice incompliance (%), † Difference between groups without common letters is significant, $P<0.001$, SSI: Surgical site infection

Figure 1: Prophylaxis compliance rates and surgical site infection rates in clinics



CVS: Cardiovascular surgery, GS: General surgery, SSI: Surgical site infections, O: Orthopedics and Traumatology

The knee and hip prosthesis operations in the Orthopedics and Traumatology department were monitored in 2014 and 2016. The number of surgeries was 255 in 2014 (152 knee prostheses and 103 hip prostheses) and 366 in 2016 (232 knee prostheses and 134 hip prostheses), with a sum of 621 operations. Data from all 3-month periods in 2014 and the first 3-month period in 2016 were close to zero. The new training model

was implemented, and 19% compliance rate was observed in the second period of 2016. The compliance rates increased in the following periods to reach over 90%. Rates are presented in Table 3 and Figure 1.

In the general surgery clinic, a total of 485 thyroid surgeries were observed with 305 in 2015 and 180 in 2017. In the 3rd period in 2015, the new training model meeting was held with general surgery clinicians. While the highest compliance rate was 75% in 2015, rates were above 90% in all periods in 2017. The periodic variation in compliance rates through the years is shown in Table 4 and Figure 1.

Table 3: Variation in antibiotic prophylaxis compliance rates and surgical site infection rates according to year in the Orthopedics and Traumatology clinic

Years	Period	Compliance * Rate	Compliance %**	SSI Rate %
2014	1. Period	0/113	0[a]	0
	2. Period	1/63	1.6[a]	1.6 (1/63)
	3. Period	1/50	2[a]	0
	4. Period	0/29	0[a]	0
2016	1. Period	4/113	3.5[a]	0.9 (1/113)
	2. Period	18/91	19.8[b]	0
	3. Period	29/57	50.9[c]	0
	4. Period	97/105	92.4[d]	0.95 (1/105)

* In 2014 all antibiotic use durations were incompliant, while in 2016 97% were duration incompliant and 3% were antibiotic choice incompliant, ** Difference between groups without common letters is significant, *P*<0.001, SSI: Surgical site infection

Table 4: Variation in antibiotic prophylaxis compliance rates and surgical site infection rates according to year in the general surgery clinic

Years	Period	Compliance Rate*	Compliance %**	SSI Rates (%)
2015	1. Period	4/125	3.3[a]	0
	2. Period	19/74	25.7[b]	0
	3. Period	30/40	75[c]	0
	4. Period	47/66	71.2[c]	0
2017	1. Period	59/60	98.3[d]	0
	2. Period	41/43	95.3[d]	0
	3. Period	30/31	96.8[d]	0
	4. Period	43/46	93.5[d]	0

* Compliant prophylaxis number/total number of surgeries, **34% non-cephazolin antibiotic selection present. Difference between groups without common letters is significant, *P*<0.001, SSI: Surgical site infection

Discussion

The data in this study show that narrow scope and target-oriented face-to-face training positively affected compliance rates at satisfactory levels. However, this improvement and positive advance required time. Additionally, it is necessary for interaction between units and feedback to continue after the intervention for the increased compliance rates become permanent. In our study, despite the shorter use of narrow-spectrum antibiotics for surgical prophylaxis, an increase in SSI rates was not observed.

When the preoperative antibiotic prophylaxis use in Turkey is investigated, prevalence studies found that 40.9% of cases used incompliant antibiotics and 29.1% prescribed them for incompliant durations. Antibiotics with incompliant use for surgical prophylaxis were mostly ceftriaxone, glycopeptides, and aminoglycosides. Again, a study found that nearly half of surgical interventions did not comply with guidelines in terms of duration of prophylactic antibiotic use [5]. In a study in Turkey assessing a total of 2398 patients with preoperative antibiotic prophylaxis, after training and surveillance were performed for 8 months, correct timing of the first antibiotic dose rose from 91.7% to 99.0%, while excessive antibiotic use fell from 77.0% to 44.7%. Full compliance rates to guidelines rose from 15.5% to 40.2% [6]. A study by Prado et al. created a prophylaxis guide prepared by a team of surgical department representatives, which was signed by all parties. According to this guide, preparation forms were completed and signed by surgeons to request antibiotics. Just as in the control system of the hospital pharmacy, the compliant surgical prophylaxis rate rose from 56.4% to 100% [7].

Training does not always have the desired effect, or the same training may be successful in some clinics and hospitals, and not in others [8-11]. Effective training comprise work involving multidisciplinary approaches encompassing more administrative and technical strategies [12, 13]. One of the greatest fears of surgeons is that a patient will develop a surgical site infection, which results in unnecessary broad spectrum and long-term antibiotic use, especially for operations with foreign objects, prosthesis use and those involving vital systems, like the cardiovascular system. However, prophylactic antibiotic use is only one of the SSI prevention stages, and unnecessarily long and broad-spectrum agent use does not resolve deficiencies and errors in other stages.

In the face-to-face training and feedback model, we discussed the clinical compliance rates and hesitations about the topic in more detail, so we observed increased chance of ensuring consensus about prophylaxis administration. Additionally, we think that informing surgeons about the lack of increase in SSI rates despite the use of short-term and narrow-spectrum antibiotics during feedback increased future compliance with the prophylaxis guides and made it more permanent.

Countries and even hospitals should prepare their own surgical antibiotic prophylaxis guidelines in line with local resistance data and international guidelines. We can say the inclusion of surgeons while creating these guides and protocols will be beneficial to increase compliance. When infection was suspected based on clinical and/or laboratory findings, rapid and effective infectious disease consultations were performed, and we saw that inter-clinical confidence, and consequently, guideline compliance, increased.

In Turkey, since 2003, the use of broad-spectrum antibiotics requires the approval of an infectious disease specialist from the first dose. Some antibiotics, like third generation cephalosporins and quinolones, require approval after 3 days of use. This requirement is supported by hospital automation systems and inappropriate antibiotic use for treatment and prophylaxis by other branch clinicians has been significantly overcome. It caused a significant improvement in antibiotic use in our country [14, 15]. Antibiotics like ampicillin sulbactam and cephazolin do not require infectious disease specialist approval, which explains increased incompliance in terms of antibiotic choice in our hospital compared to duration.

Limitations

Data in our study were retrospectively obtained from the national hospital infection surveillance network and the surveillance forms of our hospital's infection control committee. Therefore, only selected antibiotics and the duration of use could be investigated. The compliance in terms of antibiotic timing, additional dose administration and dose information could not be determined. Additionally, these surveillance and report forms did not include demographic information about the patients. It is necessary to try new training strategies which will create a convincing and lasting effect in this regard.

Conclusions

Organizations are required to determine policies to monitor surgical prophylaxis and antibiotic use and provide appropriate training as well as give feedback. It is important that these processes requiring continuity are effective and permanent. Creative implementations unique to each unit may be required. We think that rather than training the organization in general, narrow-scope comprehensive face-to-face training models targeting specific units may be more effective and should be recommended.

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