

Antibiotic Use Pattern of Surgical Site Infection Prophylaxis in Surgical Wards of a Teaching Hospital in Shiraz, Iran

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Abstract

Despite the need to use prophylactic antimicrobials to prevent infection at the surgical site, in many cases the use of prophylactic antibiotics is inappropriate. The aim of this study was to determine the pattern use of surgical site infection antibiotics prophylaxis based on standard guidelines in a teaching hospital in Shiraz. In this observational study, information of 338 patients from May to October 2020 received prophylactic antibiotics before surgery at Shahid Faghihi Hospital affiliated to Shiraz University of Medical Sciences was reviewed. Type of antibiotics, combination of antibiotics, dose and duration of treatment for each patient were defined based on both the American Society of Health-System Pharmacists (ASHP) and the National Ministry of Health and Medical Education of Iran guidelines for antimicrobial prophylaxis in surgery. Of the total 338 patients included in this study, only 27.5% received antibiotic prophylaxis according to standard guidelines. The most commonly used antibiotic class for surgical site infection prophylaxis was the first generation cephalosporins. The highest rate of antibiotic prophylaxis appropriateness was identified in the urology ward (11.53%). Few cases of antibiotic prophylaxis have shown complete compliance with the standard guidelines in this preliminary report.

Keywords: Antibiotic prophylaxis, Surgery, Hospital.

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1. Introduction

Preoperative antibiotic prophylaxis is an effective strategy for reducing post-operative infections (1). Surgical site infections are one of the most common complications of surgery (2). The correct antibiotic prophylactic regimens relies on the following items: the need for prophylaxis, type of antibiotic, appropriate dose, time of administration regarding incision, route of administration, duration of antibiotic use, and intervals of administration (3). The incorrect use of pre-operative antibiotic prophylaxis can increase the mortality rate, adverse drug reactions, resistant bacterial infection, treatment costs, and the length of hospital

stay (4-7).

About one-third of patients in hospital receive antibiotics, at least half of which are unnecessary (8). In many hospitals, antibiotics account for more than 10% of drug costs, and additional costs secondary to antibiotic resistance is also considerable (8).

Studies have shown that compliance with the antibiotic prophylaxis guidelines is low. Accordingly, errors in antibiotic prophylaxis before the surgery vary between 52% and 100% (7, 9-12). There are various global guidelines that help adhere to the principles of prescribing pre-emptive surgical antibiotics, based on valid scientific, surgical, pharmacological and infectious resources (13).

Worldwide, several studies have been car-

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ried out, indicating that the use of antibiotics for surgical prophylaxis is not desirable. For example, in France in 2000, only 41.7% of patients under surgery used antibiotics correctly (14). In the same year in another study in France, the total rate of compliance with preventive antibiotic prescriptions was reported to be 53% (15). In India, the percentage of compliance with guidelines in the first-level and third-level hospitals was 51% and 64%, respectively (16).

In Iran, a number of studies have carried out on the use of antibiotics before, during and after surgery (17-19). Therefore, due to the numerous possible complications regarding the incorrect administration of antibiotics and lack of adequate information about their prescription status in our country, we aimed to assess the pattern of preoperative antibiotic prophylaxis in a teaching hospital in Iran.

2. Methods

This was a cross-sectional, observational study, conducted on all eligible patients admitted to 8 surgical wards of Shahid Faghihi hospital, a large referral university-affiliated, 497-bed health-care setting, during 6 months from May to October 2020. The Medical Ethics Committee of Shiraz University of Medical Sciences approved the study.

The inclusion criterion was receiving at least one antibiotic before surgery for preventing surgical site infections. Exclusion criteria included the presence of fever or positive bacterial culture, or requiring antibiotic therapy for a suspected or documented infection before surgery. There is no limitation regarding the type and duration of surgery.

Required information was obtained using a checklist including patients' demographic characteristics, laboratory data, the ward, type of surgery, and the antibiotic regimens (including type, dose, and time of administration).

Based on both the American Society of Health-System Pharmacists (ASHP) and National Ministry of Health and Medical education of Iran guidelines for antimicrobial prophylaxis in surgery (20), the appropriateness of the prescribing was determined in terms of the choice of antibiotic

type, dose, route of administration, starting time, and also the duration of treatment.

2.1. Statistical analysis

The Statistical Package for the Social Sciences (SPSS) 21.0 version was used for all statistical analyses. Continuous and descriptive variables were reported as mean \pm standard deviation (SD) and percentage, respectively. Possible association between continuous and categorical variables were evaluated using Independent t-test and Chi-square test, respectively. P-values less than 0.05 were considered statistically significant.

3. Results

The study population comprised 338 patients. Table 1 lists general characteristics of the cohort. More than half of the cohort (50.8%) were males. However, the number of male and female patients was comparable ($P=0.78$). On the other hand, the mean \pm SD age of the male and female patients was 48.09 ± 18.08 and 46.15 ± 17.88 years, respectively. The age difference was not statistically significant between male and females ($P=0.29$).

Among all patients undergoing surgery, only 105 (27.5%) were treated with antibiotics in accordance with all aspects of the studied guidelines. In addition, type, time interval, and dose of antibiotic prophylaxis were considered to be appropriate in 251 (63.2%), 177 (44.6%), and 242 (61%) patients, respectively ($P=0.54$). According to Table 2, the highest rate of antibiotic prophylaxis appropriateness was identified in the urology ward (11.53%), followed by obstetrics (4.4%). These differences between wards reached the level

Table 1. General characteristics of the study population (N=338).

Age, mean \pm SD (years)		41.18 \pm 17.98
Gender	Female	166 (49.2)
N (%)	Male	172 (50.8)
Type of ward	Obstetrics	31 (9.2)
N(%)	Urology	83 (24.6)
	General	63 (18.6)
	Oncology	54 (16.0)
	Colorectal	60 (17.7)
	Cardiac	47(13.9)

Table 2. Frequency distribution of preoperative antibiotic prophylaxis compliance with standard guidelines divided by type of ward.

Type of ward	Compliance with standard guidelines		P
	Yes	No	
Obstetrics	15(4.4%)	16(4.7%)	<0.001
Urology	39(11.53%)	44(13.0%)	
General	7(2.1%)	56(16.6%)	
Oncology	10 (2.9%)	44(13.0%)	
Colorectal	7(2.1%)	53(15.7%)	
Cardiac	11(3.2%)	36(10.7%)	
Total	89(26.3%)	249(73.7%)	

of statistical significance ($P < 0.001$).

Table 3 shows the distribution of the frequency of preoperative antibiotic prophylaxis based on the antibiotic class. The most commonly prescribed antibiotic class was the first generation cephalosporins including cefazolin. On the other hand, penicillins was the least frequently used antibiotic. This difference was statistically significant ($P < 0.001$).

4. Discussion

Prescription of antimicrobial prophylaxis before and after surgery is an essential practice in reducing the incidence of surgical site infections. The correct antibiotic type, dose, interval, route of administration, start time, and duration of treatment will bring us closer to this goal (20). According to our knowledge, there are very few studies performed in the Iranian population to evaluate the pattern of preoperative antibiotic prophylaxis.

Findings of this study showed that antibiotic use was in accordance with the standard guidelines in only about one-fourth (27.5%) of patients. In other words, correct practice on antibiotic prescription in our study was found to be low and the total rate of inappropriate administration of pre-operative antibiotics was 73.7%. In line with our finding a study by Raeeszadeh and Berenjian in surgical wards of a teaching hospital in Isfahan showed that 64.5% of patients had received the prophylactic antibiotics based on standard prescribing protocol (21); In contrast, a descriptive, cross-sectional survey carried out in 2011 in Iran (7) and an observational study performed in Nicaragua (22), the rate of compliance with the international guidelines was only 4.6% and 7%, respectively. Finally, Vessal et al in 2010 reported that all parameters of antibiotic prophylaxis in only 1 out of 155 (0.65%) surgical procedures was according to the ASHP guideline at

Table 3. Frequency distribution of preoperative antibiotic prophylaxis compliance with standard guidelines divided by antibiotic class.

Antibiotic class	Compliance with standard guidelines		P
	Yes	No	
Cephalosporins (1st generation)	18(21.2%)	128(50.2%)	<0.001
Cephalosporins (3th generation)	47(55.3%)	58(22.7%)	
Carbapenems	3(3.5%)	3(1.2%)	
Glycopeptides	1(1.2%)	5(2.0%)	
Penicillins	0	1(0.4%)	
Aminoglycosides	8(9.4%)	4(1.6%)	
Fluoroquinolones	7(8.2%)	16(6.3%)	
Metronidazole	1(1.2%)	32(12.5%)	
Lincomycin	0	8(3.1%)	

Namazi Hospital in Shiraz, Iran (23). Disparity in the rate of non-adherence to standard protocols of pre-operative antibiotic prophylaxis in different studies can partially attribute to variation in relevant reference guideline used, type of studied surgery, and also the number of investigated items for antibiotic prophylaxis.

In terms of the class of antibiotic used in the our cohort, the most commonly prescribed antibiotic was the first generation of cephalosporin; while, penicillin class was the least frequent prescribed agents. Non-compliance with standard guidelines in the participants mostly related to first and third generation of cephalosporins. Similarly, Montazeri *et al.* (24) have reported that the most commonly used antibiotics as antibiotic prophylaxis before surgery at a teaching hospital in Tehran, Iran were the first generation of cephalosporins. In a study by Afhami *et al.* (7), cefazolin was also the most common prophylactic antibiotic before surgery. The same results were noticed by Bull *et al.* in Australia (25). Furthermore, Askarian *et al.* have indicated that cefazolin was prescribed in 97% of cases of neurological procedures in 2 teaching hospitals in Iran (18). Conversely, in orthopedic surgeries, cefuroxime and cefoperazone were the most commonly prescribed antibiotics

(26). The combination of ampicillin and cloxacillin or cloxacillin and metronidazole were other usual pre-orthopedic operative choices (27). Physician preference, the presence of hospital or national guidelines based on local antibiotic resistant pattern, and diversity in the type of surgeries may account for possible differences about the class of antibiotic used for surgical site infection prophylaxis in various studies.

5. Conclusion

Considering all aspects of the appropriate use of antibiotic prophylaxis for surgical site infections, our preliminary study demonstrated that only a few cases have shown complete compliance with the standard guidelines. It is recommended to provide and educate standard instructions of antibiotic prophylaxis to surgical team through electronic bulletins and on-line or face-to-face workshops. Additionally, implementing a continuous supervisory system by the pharmaceutical care unit and giving surgeons feedback on how to administer prophylaxis can improve the rational use of antibiotic prophylaxis before surgery.

Conflict of Interest

None declared.

References

1. Shabaniyan A, Karimi Nasab M, Shayesteh Azar M, Esmailnezhad Ganji S. Type and Rate of Prophylactic Antibiotic Use in the Orthopedic Patients Underwent Elective Surgeries in Shahid Beheshti Hospital in Babol. *J Babol Univ Med Sci.* 2018;20(5):68-73.
2. Lucet JC, Nicolas-Chanoine MH, Roy C, Riveros-Palacios O, Diamantis S, Le Grand J, *et al.* Antibiotic use: knowledge and perceptions in two university hospitals. *J Antimicrob Chemother.* 2011 Apr;66(4):936-40. doi: 10.1093/jac/dkq541. Epub 2011 Jan 26. PMID: 21393217.
3. Vogtländer NP, Van Kasteren ME, Natsch S, Kullberg BJ, Hekster YA, Van Der Meer JW. Improving the process of antibiotic therapy in daily practice: interventions to optimize timing, dosage adjustment to renal function, and switch therapy. *Arch Intern Med.* 2004 Jun 14;164(11):1206-12. doi: 10.1001/archinte.164.11.1206. PMID: 15197046.
4. Tefera GM, Feyisa BB, Taye GM, Tesfaye Umeta G, Negash Bereded F, Dinsa Ayeno H, Alemayehu Gadisa D, Melaku Kebede T. The Association Between Incorrect Use of Antibiotic Prophylaxis and in-Hospital Surgical Site Infections - A Prospective Observational Study. *Infect Drug Resist.* 2020 Sep 7;13:3063-3072. doi: 10.2147/IDR.S260238.
5. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. *J Hosp Infect.* 2008 Nov;70 Suppl 2:3-10. doi: 10.1016/S0195-6701(08)60017-1. PMID: 19022115.
6. Menz BD, Charani E, Gordon DL, Leather AJM, Moonesinghe SR, Phillips CJ. Surgical Antibiotic Prophylaxis in an Era of Antibiotic Resistance: Common Resistant Bacteria and Wider Considerations for Practice. *Infect Drug Resist.* 2021 Dec 7;14:5235-5252. doi: 10.2147/IDR.S319780.
7. Afhami S, Esmailpour BN, Boujar AN,

- Sayadi L. Antibiotic Prophylaxis before Surgeries. *Iran J Surg*. 2011;19(3):28-32 [In Persian].
8. Solomon DH, Van Houten L, Glynn RJ, Baden L, Curtis K, Schrager H, Avorn J. Academic detailing to improve use of broad-spectrum antibiotics at an academic medical center. *Arch Intern Med*. 2001 Aug 13-27;161(15):1897-902. doi: 10.1001/archinte.161.15.1897. PMID: 11493132.
 9. Davey P, Brown E, Charani E, Fenelon L, Gould IM, Holmes A, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database Syst Rev*. 2013 Apr 30;(4):CD003543. doi: 10.1002/14651858.CD003543.pub3. Update in: *Cochrane Database Syst Rev*. 2017 Feb 09;2:CD003543. PMID: 23633313.
 10. Al-Momany NH, Al-Bakri AG, Makahleh ZM, Wazaify MM. Adherence to international antimicrobial prophylaxis guidelines in cardiac surgery: a Jordanian study demonstrates need for quality improvement. *J Manag Care Pharm*. 2009 Apr;15(3):262-71. doi: 10.18553/jmcp.2009.15.3.262. PMID: 19326957.
 11. Rosario MO, Peña AC, Ampil IDE. Adherence to surgical antimicrobial prophylaxis guidelines in a tertiary private medical center. *Phil J Microbiol Infect Dis*. 2010;39:51-8.
 12. Parulekar L, Soman R, Singhal T, Rodrigues C, Dastur FD, Mehta A. How good is compliance with surgical antibiotic prophylaxis guidelines in a tertiary care private hospital in India? A prospective study. *Indian J Surg*. 2009 Feb;71(1):15-8. doi: 10.1007/s12262-009-0004-9. Epub 2009 Mar 13. PMID: 23133102; PMCID: PMC3452567.
 13. Ebrahimzadeh A, Najafi M, Bijari B, Amouzesi A, Abedini MR, Mosavi T, Pagheh AS. The compliance of surgical prophylactic antibiotics with standard protocols in Imam Reza teaching hospital of Birjand, Iran. *Iran J Microbiol*. 2021 Dec;13(6):801-807. doi: 10.18502/ijm.v13i6.8082. PMID: 35222858
 14. Bailly P, Lallemand S, Thouverez M, Talon D. Multicentre study on the appropriateness of surgical antibiotic prophylaxis. *J Hosp Infect*. 2001 Oct;49(2):135-8. doi: 10.1053/jhin.2001.1064. PMID: 11567560.
 15. Bedouch P, Labarère J, Chirpaz E, Allenet B, Lepape A, Fourny M, et al. Compliance with guidelines on antibiotic prophylaxis in total hip replacement surgery: results of a retrospective study of 416 patients in a teaching hospital. *Infect Control Hosp Epidemiol*. 2004 Apr;25(4):302-7. doi: 10.1086/502396. PMID: 15108727.
 16. Thomas M, Govil S, Moses BV, Joseph A. Monitoring of antibiotic use in a primary and tertiary care hospital. *J Clin Epidemiol*. 1996 Feb;49(2):251-4. doi: 10.1016/0895-4356(95)00520-x. PMID: 8606327.
 17. Hatam N, Askarian M, Moravveji AR, Assadian O. Economic burden of inappropriate antibiotic use for prophylactic purpose in shiraz, iran. *Iran Red Crescent Med J*. 2011 Apr;13(4):234-8. Epub 2011 Apr 1. PMID: 22737471; PMCID: PMC3371955.
 18. Askarian M, Reza Moravveji A, Assadian O. Prescription of prophylactic antibiotics for neurosurgical procedures in teaching hospitals in Iran. *Am J Infect Control*. 2007 May;35(4):260-2. doi: 10.1016/j.ajic.2006.04.214. PMID: 17482997.
 19. Nabavizadeh MR, Sahebi S, Nadian I. Antibiotic prescription for endodontic treatment: general dentist knowledge + practice in shiraz. *Iran Endod J*. 2011 Spring;6(2):54-9. Epub 2011 May 15. PMID: 23130054; PMCID: PMC3487514.
 20. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Am J Health Syst Pharm*. 2013 Feb 1;70(3):195-283. doi: 10.2146/ajhp120568. PMID: 23327981.
 21. Raeeszadeh M, Berenjani S. Prescription of Antibiotics Before and After Surgery at the Surgical Wards of Isfahan Amiralmomenin Hospital Compliance with the Standard Guidelines. *Health Res J*. 2016;1(1):133-40.
 22. van Disseldorp J, Slingenberg EJ, Matute A, Delgado E, Hak E, Hoepelman IM. Application of guidelines on preoperative antibiotic prophylaxis in León, Nicaragua. *Neth J Med*. 2006 Dec;64(11):411-6. PMID: 17179571.
 23. Vessal G, Namazi S, Davarpanah MA, Foroughinia F. Evaluation of prophylactic antibiotic administration at the surgical ward of a major referral hospital, Islamic Republic of Iran. *East Mediterr Health J*. 2011 Aug;17(8):663-8. PMID: 21977569.
 24. Montazeri M, Shayeste SH, Haddadi A. Survey of Antibiotic Prophylaxis Administered Before Surgery in a Teaching Hospital in Tehran

2014. Iran. *J Infect Dis Trop Med.* 2017; 21(75): 37-42 [In Persian].

25. Bull AL, Russo PL, Friedman ND, Bennett NJ, Boardman CJ, Richards MJ. Compliance with surgical antibiotic prophylaxis--reporting from a statewide surveillance programme in Victoria, Australia. *J Hosp Infect.* 2006 Jun;63(2):140-7. doi: 10.1016/j.jhin.2006.01.018. Epub 2006 Apr 18. PMID: 16621135.

26. Yeap JS, Lim JW, Vergis M, Au Yeung

PS, Chiu CK, Singh H. Prophylactic antibiotics in orthopaedic surgery: guidelines and practice. *Med J Malaysia.* 2006 Jun;61(2):181-8. PMID: 16898309.

27. Giri BR, Pant HP, Shankar PR, Sreeramareddy CT, Sen PK. Surgical site infection and antibiotics use pattern in a tertiary care hospital in Nepal. *J Pak Med Assoc.* 2008 Mar;58(3):148-51. PMID: 18517124.