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Major article

Applying validated quality indicators to surgical antibiotic prophylaxis in a Brazilian hospital: Learning what should be learned

Cristiane Schmitt MSc [a,*], Rubia Aparecida Lacerda PhD [a], Maria Clara Padoveze PhD [b], Ruth Natalia Teresa Turrini PhD [a]

[a] Department of Medical-Surgical Nursing, University of São Paulo, São Paulo, Brazil
[b] Department of Collective Health Nursing, University of São Paulo, São Paulo, Brazil

Key Words:
Surgical site infections
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Background: Compliance with the best surgical antibiotic prophylaxis practice is usually low despite many published guidelines.
Objective: This study investigated compliance with the Hospital Infection Control Committee guideline for antibiotic prophylaxis in a Brazilian hospital using quality indicators.
Methods: A retrospective study was carried out from November 2009 to March 2010. Medical records from adult inpatients undergoing cardiac, neurologic, and orthopedic clean surgeries were included. The full compliance index was considered 100% when the antibiotic prophylaxis showed adequacy in all evaluated attributes. Analyses were conducted with 5% significance.
Results: Medical records from 101 cardiac, 128 neurologic, and 519 orthopedic surgical patients were evaluated. The compliance index was 4.9%, and the compliance index according to specialty was 5.8%, 3.1%, and 3.0%, respectively, for orthopedic, neurologic, and cardiac surgeries. The attribute route of administration produced the best outcomes, whereas the attribute duration of antibiotic prophylaxis produced the worst. No association was identified between compliance to the attributes and patient characteristics.
Conclusion: This study showed a low level of adherence to Hospital Infection Control Committee guidelines for antibiotic prophylaxis. This suggests that different strategies should be implemented to promote the best possible practice in the field of antibiotic prophylaxis with greater surgeon engagement.

Measuring health care quality is a complex task because outcomes are associated not only to clinical practice but also to population characteristics. Therefore, quality indicators should permit evaluating the different attributes of any practice with identification of areas for improvement.[1]

Approximately 234 million surgeries are performed worldwide, with a complication prevalence of 3% to 16%. Surgical site infections (SSI) have been the most frequent among these complications. Postoperative mortality generally varies between 0.4% and 0.8% but can reach alarming levels, around 10% in developing countries.[2]

Surgical antibiotic prophylaxis is an important tool for reducing wound infection risks. Despite many published guidelines for the best prophylaxis practice, adherence to these recommendations is low.[3-5] A large number of patients are exposed to unnecessary drug intake, favoring the selection of multidrug-resistant mutants and raising hospital costs.[6-11]

In 2006, a group of infection control specialists, supported by the Hospital Infection Division at the São Paulo State Health Department, developed and validated quality indicators for measurement of infection control practices, including surgical antibiotic prophylaxis.[12] This study investigated compliance with the Hospital Infection Control Committee (HICC) guideline for antibiotic prophylaxis in a Brazilian hospital using the quality indicators previously validated.

METHODS

A retrospective study was carried out in a 200-bed hospital located in São Paulo, Brazil, where an average of 500 surgeries/month is performed. Quality assessment was supported by the

* Address correspondence to Cristiane Schmitt, MSc, Department of Medical-Surgical Nursing, University of São Paulo, Vergueiro Street, 8424 ap 104/3, São Paulo 04272-300, Brazil.
E-mail address: cristianeschmmitt@yahoo.com.br (C. Schmitt).
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Table 1
Surgical antibiotic prophylaxis recommended by the Hospital Infection Control Committee according to surgical procedure: São Paulo, Brazil, 2010

Procedure	Antibiotic	Dose before surgery	Course
Arthroplasty	Cefazolin	2 g	24 hours
Open reduction of fracture	Cefazolin	2 g	24 hours
Craniotomy	Cefazolin	2 g	48 hours
Spinal fusion and laminectomy	Cefazolin	2 g	48 hours
Spinal fusion*	Cefuroxime	1.5 g	120 hours
Coronary bypass	Cefazolin	2 g	48 hours
Valve	Cefazolin	2 g	48 hours
Coronary bypass and valve*	Vancomycin + gentamicin	1 g and 80 mg	24 hours

*Prior hospital stay $\geq$ 7 days.

Surgical Antibiotic Prophylaxis Guideline written in 2004 by the HICC and formally approved by the hospital administration and surgical teams (HICC. Protocol for surgical antibiotic prophylaxis. Internal comunication. São Paulo, 2004). A printed version of the HICC guideline is kept available at all the hospital departments.

Medical records from adult inpatients of neurologic, orthopedic, and cardiac specialties who were admitted for surgery classified as clean[3] were included. The inclusion criteria considered patients admitted to any clean surgeries and who had been hospitalized during the complete course of the antibiotic prophylaxis. Procedures in patients undergoing antibiotic therapy at the time of surgical intervention were excluded. The sample size was based on the total number of procedures of each surgical specialty performed during the previous 5 years (from January 2005 to June 2009), and on an expected compliance rate of 50%, resulting in a sample of 748 clean surgical procedures to be followed up. Medical records were selected by a random system. Data were collected from November 2009 to March 2010.

Compliance with surgical antibiotic prophylaxis was evaluated based on the HICC surgical prophylaxis guideline (Table 1). The indicator of compliance was composed of 6 attributes: (1) appropriateness of antibiotic indication, (2) drug type, (3) duration of prophylaxis, (4) administration route, (5) initial time of antibiotic prophylaxis, and (6) drug dosage.

Full compliance (100%) was achieved when all the attributes of the quality indicator met the criteria of the HICC surgical prophylaxis guideline. For surgeries with recommendation of antibiotic prophylaxis, we evaluated each attribute of the quality indicator regarding its compliance. For surgeries with recommendation of no antibiotic prophylaxis use, full compliance was determined by evaluation of just 1 attribute, ie, the appropriateness of antibiotic indication.

Association between attribute compliance and patients characteristics such as age, gender, and surgical site risk index category (RIC)[3] was evaluated by χ^2 test and, when appropriate, Fisher exact test or Likelihood ratio. All analyses were conducted at 5% significance using the Statistical Package for Social Sciences (SPSS Inc, Chicago, IL) software version 7.0.

RESULTS

The surgeries evaluated (748) were of the following specialties: 101 (13.5%) cardiac, 128 (17.1%) neurosurgical, and 519 (69.4%) orthopedic. Full compliance with the quality indicator occurred in only 4.9% of evaluated surgeries. Considering the surgical specialty, full compliance was 5.8%, 3.1%, and 3.0%, respectively, for orthopedic, neurologic, and cardiac surgeries.

According to the HICC guidelines, 325 (43.4%) of these surgeries had recommendation for no use of surgical antibiotic prophylaxis. For these surgeries, the compliance index was 8.7% (n = 29), meaning that a large number of patients received surgical antibiotic prophylaxis despite there being no indication from the HICC for this. The largest number of surgeries in which surgical antibiotic prophylaxis was used without HICC indication occurred among orthopedic procedures (n = 293; 91.3%), mainly arthroscopies (93.6%). All cardiac surgeries evaluated in this period were compatible with surgical antibiotic prophylaxis indication as per the HICC guidelines.

Table 2
Compliance with attributes of the quality indicator for surgical antibiotic prophylaxis: São Paulo, Brazil, 2010

Attributes	Surgical specialty			
	Cardiac n (%)	Neurologic n (%)	Orthopedic n (%)	Total n (%)
Indication				
Yes	101 (100.0)	121 (97.6)	191 (96.5)	413 (97.6)
No	-	3 (2.4)	7 (3.5)	10(2.4)
Total	101 (100.0)	124 (100.0)	198 (100.0)	423 (100.0)
Initial time of antibiotic prophylaxis*				
Compliant	72 (71.3)	79 (65.3)	107 (56.0)	258 (62.5)
Too early	3 (3.0)	3 (2.5)	5 (2.6)	11 (2.7)
Too late	18 (17.8)	15 (12.4)	19 (9.9)	52 (12.6)
No data available	8 (7.9)	24 (19.8)	60 (31.4)	92 (22.3)
Total	101 (100.0)	121 (100.0)	191 (100.0)	413 (100.0)
Drug type*				
Compliant	63 (62.4)	90 (74.4)	181 (94.8)	334 (80.9)
Noncompliant	38 (37.6)	31 (25.6)	10 (5.2)	79 (19.1)
Total	102 (100.0)	121 (100.0)	191 (100.0)	413 (100.0)
Administration route*				
Compliant (EV)	101 (100.0)	121 (100.0)	191 (100.0)	413 (100.0)
Noncompliant	-	-	-	-
Total	101 (100.0)	121 (100.0)	191 (100.0)	413 (100.0)
Dose drug*,†				
Compliant	58 (90.5)	90 (100.0)	179 (98.9)	326 (97.6)
Noncompliant	6 (9.5)	-	2 (1.1)	8 (2.4)
Total	63 (100.0)	90 (100.0)	181 (100.0)	334 (100.0)
Duration of antibiotic prophylaxis*,†				
Compliant	6 (9.5)	6 (6.7)	4 (2.2)	16 (4.8)
Too short	34 (54.0)	49 (54.4)	97(53.6)	180 (53.9)
Too long	23 (36.5)	35 (38.9)	80 (44.2)	138 (41.3)
Total	63 (100.0)	90 (100.0)	181 (100.0)	334 (100.0)

*Ten procedures (3 neurologic and 7 orthopedic) without the use of antibiotic prophylaxis were excluded, although recommended otherwise by the HICC.
†Seventy-nine procedures with antibiotic prophylaxis diverging from the HICC recommendations were also excluded.

There was HICC indication for surgical antibiotic prophylaxis in 423 (56.6%) surgeries. The compliance index for this group of surgeries was 1.9%. Evaluating the specialties, the compliance index of this group of surgeries was 3%, 2.4%, and 1.0%, respectively, for cardiac, neurologic, and orthopedic surgeries.

Despite the very low compliance, the majority (92.4%) of surgeries with HICC recommendation for surgical antibiotic prophylaxis met the adequacy target on at least 3 out of 6 attributes evaluated (Table 2). The administration route was the attribute with the best outcome in all surgical specialties, and the worst performance occurred regarding duration of the surgical antibiotic prophylaxis. All 3 specialties showed almost the same proportion of compliance regarding duration of the prophylaxis attribute.

The initial time of antibiotic prophylaxis occurred before the time recommended in 11 cases (2.7%) and after in 52 cases (12.6%). The initial time could not be evaluated in 92 cases (22.3%) because of missing records, mainly in the orthopedic surgeries (n = 60) (Table 2). There was no association between the compliance index and studied patients characteristics (Table 3).

DISCUSSION

Literature on antibiotic prophylaxis shows low rates of compliance with the guidelines. The compliance index in Europe can vary

Table 3
Index of compliance with the Hospital Infection Control Committee surgical antibiotic prophylaxis recommendations, according to patient characteristics, São Paulo, Brazil, 2010

Patient characteristics	Category	Compliance index		
		No	Yes	*P* value
≥60 years of age	No	224 (97.4)	6 (2.6)	.3*
	Yes	191 (99.0)	2 (1.0)	
Sex	Female	237 (98.8)	3 (1.3)	.3*
	Male	178 (97.3)	5 (2.7)	
Surgical site Infection risk index‡	0	173 (97.2)	5 (2.8)	.4†
	1	163 (98.2)	3 (1.8)	
	2	33 (100.0)	-	
Location on IP	SU	165 (98.2)	1 (1.8)	1*
	ICU	244 (98.8)	5 (2.0)	

IP, immediate postoperative; *SU*, surgical unit; *ICU*, intensive care unit.
*Fisher exact test.
†Likelihood ratio.
‡Only cases in which surgical site infection risk index was determined, were considered.

from 19% to 41%, whereas, in developing countries, most of the published studies showed no more than 10% compliance.[6–11] This demonstrates that adherence to good prophylaxis practices is a worldwide challenge in health care-associated infections. In Brazil, Heineck et al[7] found that the adherence to HICC recommendations was similar to the present study with a full compliance of 3.0%.

The results in our study are also in agreement with those by Lallemand et al,[8] showing that orthopedics is the specialty with the best results regarding HICC guideline adherence. However, compared with other studied specialties, patients of orthopedic procedures were more likely to receive antibiotic prophylaxis despite there being no recommendation from the HICC. Among the problems related to inadequate antibiotic prophylaxis, there is the unnecessary exposure of patients to drugs and potential adverse effects.[5]

The low compliance index does not mean that all attributes were not met. Compliance to at least 3 attributes was met in most situations. This partial adherence, also observed by Van Disseldorp et al,[10] may suggest that surgeons are not fully confident about all HICC recommendations. The most remarkable example is the very low compliance index regarding the attribute duration time of antibiotic prophylaxis. There is enough evidence related to the short duration of antibiotic prophylaxis in rapid and low risk procedures[4,13]; however, there are controversies regarding long cardiac surgeries with extracorporeal circulation and systemic hypothermia.[14] Therefore, the divergences in the literature on this subject could be influential in the low compliance with the HICC recommendations. Moreover, we were surprised by situations in which it was observed that the antibiotic prophylaxis had a shorter duration than that recommended by the HICC. According to Miliani et al,[9] errors in prophylaxis duration put the patient at great risk of SSI.

We should also point out the large number of procedures in which the initial time for prophylaxis was not recorded. This deficiency shows the need for making room for audits and improvement strategies and also for the anesthesiology team, which is usually in charge of this activity.

Contrary to our expectations, no difference in the compliance index associated to specific patient characteristics was found. Patients with a higher SSI risk index, admission to intensive care unit, and aged above 60 years, were expected to have received extended prophylactic schemes. However, the very low full compliance index found in the study may represent a bias for this analysis. Patient characteristics other than those studied may have influenced the compliance index.

The inappropriate use of antibiotics wastes a precious resource in health care, not only by potential promotion of microbial resistance selection, but also by causing unnecessary extra costs. Other authors have identified additional costs from US $47,905 to US $6,000,000 because of inadequate antimicrobial use.[15] One study revealed a US $8,322 extra cost attributed to a divergence in the use of antibiotic prophylaxis compared with the HICC recommendation.[6] In a developing country with limited resources such as Brazil, this amount is simply unaffordable.

This study showed a low level of adherence to the HICC guidelines for antibiotic prophylaxis, and this result should be fed back to surgical teams on a regular basis to improve surgical prophylaxis. Knowing the real adherence to the HICC recommendation is the first step to plan educational interventions focused on the target population. By applying these validated quality indicators, we learned what had to be learned to improve work on this plan.

The failures in complying with the HICC recommendation found in the present study suggest that different strategies must be used to promote the best practice in the antibiotic prophylaxis field with greater engagement by the surgeons. Among these strategies, we suggest that feedback of quality indicator results be provided to surgical teams on a regular basis to improve surgical prophylaxis.

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