Original Article

Factors related to adherence of recommendations for redose administration in clean surgeries

Fatores relacionados à adesão às recomendações para administração de redose em cirurgias limpas

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ABSTRACT

Surgical site infections (SSIs) are one of the main adverse events among surgical patients, being responsible for 20% of healthcare-associated infections (HAIs). Surgical antibiotic prophylaxis is one of the practices used to prevent SSIs, however, compliance with recommendations is low. A retrospective observational cross-sectional study investigated the index of compliance with redose and its relationship to characteristics of the procedures and individuals. A total of 748 records of cardiac, orthopedic and neurological surgeries were assessed. Of these, 90 had an indication of redose, which was administered in 26.6% of the surgeries. Compliance was significantly higher in cardiac surgeries (34.3%) and those of greater SSI risk index. In conclusion, compliance with recommendations for redose administration is low and improving the process of surgical antibiotic prophylaxis use is needed. The use of technologies in association with awareness, motivation of the teams and involvement of the nursing staff may constitute alternatives.

Descriptors: Antibiotic Prophylaxis; Cross Infection; Patient Safety; Nursing Care.

RESUMO

A ISC é um dos principais eventos adversos entre pacientes cirúrgicos e é responsável por 20% das IRAS. A antibioticoprofilaxia cirúrgica é uma das práticas para prevenção de ISC, entretanto a adesão às diretrizes é baixa. Foi realizado um estudo observacional, transversal, retrospectivo que investigou o índice de adesão à redose e sua relação com características dos procedimentos e dos indivíduos. Foram avaliados 748 prontuários de cirurgias cardíacas, ortopédicas e neurológicas. Destes, 90 tinham indicação de redose, administrada em 26,6% das cirurgias. A adesão foi significativamente maior nas cirurgias cardíacas (34,3%) e de maior IRIC. Concluiu-se que a adesão às diretrizes para administração de redose é baixa e é necessário atuar na melhoraria do processo de uso de antibioticoprofilaxia cirúrgica. O uso de tecnologias aliado a conscientização, motivação das equipes e envolvimento da enfermagem podem ser alternativas.

Descritores: Antibioticoprofilaxia; Infecção Hospitalar; Segurança do Paciente; Cuidados de Enfermagem.

INTRODUCTION

Safety constitutes one of the healthcare challenges worldwide. Because of the deaths caused by preventable adverse events[1], in 2004 the World Health Organization (WHO) created the project World Alliance for Patient Safety, by means of what was denominated "Global Challenges". The first challenge is related to reduction of Health-Care Associated Infections (HAIs). The second, "Safe Surgery Save Lives", involves actions to reduce surgery adverse events, including surgical site infections (SSI) [2].

Global surgical volume is estimated in 234 million of procedures per year, with complication indexes of up to 16% in developing countries[3]. ISS are figured between the main events and they are responsible for 20% of all HAIs[4-6], increasing hospitalization time from seven to 11 days[7], doubling risk of death[8] and having an annual cost estimated in 10 billion of dollars in the United States[9].

In parallel, microbial resistance is a global concern, it is affected by HAIs in consequence of antimicrobial prescriptions in hospitals, including surgical antibiotic prophylaxis[10]. In Europe, between 2011 and 2012, 35% of admitted patients received at least one antibiotic, 19.1% were indicated for treatment of HAIs. Prescriptions for surgical prophylaxis corresponded to 16.3% of total and in more than half of cases (59.2%), they were kept for more than a day[11].

Globally, the reduction of HAIs indexes is needed to reduce microbial resistance indexes. Thus, actions to reduce SSI are indispensable, considering the global surgical volume and the impact of those on the incidence of HAIs. Improving surgical results involves action in the pre, intra and post-operatory, including practices of use of surgical antibiotic prophylaxis.

Appropriate use of surgical antibiotic prophylaxis is in among practices for ISS prevention and implementation of recommendations reduces adverse events and effects related to microbial resistance[12-13]. However, its efficacy is linked to the implementation of all parameters of use, including the type of drug, dose, beginning moment, duration and redose or additional dose in cases of prolonged procedures[12-13]. Nevertheless, many publications show evidence of low adherence to recommendations, being most of inadequacies related to the beginning moment and duration[14-17].

There are few publications about the conformity of redose administration[18-22]. Possibly because it is not needed in all surgeries, but only in those with the duration surpassing the drug's half-life. Hypothetically, adherence to this parameter can be lower in comparison with others, as seen that redose administration occurs during surgery, which could facilitate forgetfulness. Thus, it is pertinent to quantify adequacy to guidelines for redose so that it becomes possible to apply improvement actions that could reduce levels of SSI.

The present study aimed to investigate the index of redose adherence in cardiac, neurologic and orthopedic surgeries, as well as its relationship with characteristics of procedures and individuals.

METHOD

A retrospective cross-sectional observational study, conducted in a hospital of 200 beds, in the city of São Paulo-SP, with an average of 500 surgical procedures/month. Inclusion criteria were cardiac, orthopedic and neurologic clean surgeries, performed in adult patients (18 years or more). Exclusion criteria were patients using antibiotic therapy and procedures not classified as clean. The sample calculation was based on total number of procedures from those specialties (7.404), performed between January of 2005 and June of 2009. It was predicted 50% of adherence to recommendations of surgical antibiotic prophylaxis, considering a margin error of 6% and sample power of 90%, totalizing 748 surgeries, randomly selected through drawing of patient's registries using a table of random numbers.

Practices referred to the use of surgical antibiotic prophylaxis were assessed based on institutional guidelines, developed in 2004 by the Service of Hospital

Infection Control (SHIC), and approved by the clinical directory. The guidelines preconize redose administration in procedures with duration of 180 minutes or more. Redose, or additional dose, was defined as administration of a second antibiotic dose before closing the surgical wound.

Data were obtained from medical records. Only surgeries in which the administered drug was in accordance with the recommendation were considered, once there was not a standard period for the redose administration of drugs not related in the institution guidelines.

Data were collected between November of 2009 and March of 2010. Results found were correlated with type of surgery, mean procedure duration, age and index of surgical risk (ISR) that could vary from zero to three, considering the ASA index' sum, wound contamination potential and procedure duration. For associations, Chi-Square test, Fisher's Exact test or Likelihood Ratio test were used. The T test was used to compare means. An α of 0.05 was adopted for all tests.

The study was oriented as described in the Health Ministry Resolution nº 196/1996, formally authorized by the institution and submitted for approval of the Ethics in Research Committee of the Nursing School from the Universidade de São Paulo (CEP-EEUSP), process 824/2009-CEP-EEUSP. The data collection method (from medical records) did not implicate in any physical or psychological risks, and the results are presented in an aggregated way, keeping anonymity of subjects composing the sample.

RESULTS

From the 748 surgeries, 252 (33.6%) had a duration of 180 minutes of more, thus, with redose indication. From those, 90 surgeries were excluded due to missing data, 68 due to use of a distinct antimicrobial from the recommended and four because the administered prophylactic drug was not identified. Therefore, 90 surgeries were considered for redose adherence assessment, being 45 neurological (50.0%), 35 cardiac (38.9%) and 10 orthopedic (11.1%) as presented in Table 1.

Table 1: Distribution of procedures with redose indication according to the specialty. São Paulo, SP, Brazil, 2010.

Specialty	Surgeries N (%)	Redose Indication N (%)	Losses N (%)
Cardiac	101 (13,5)	35 (38,9)	41 (25,3)
Neurosurgery	128 (17,1)	45 (50,0)	48 (29,6)
Orthopedics	519 (69,4)	10 (11,1)	73 (45,1)
Total	**748 (100,0)**	**90 (100,0)**	**162 (100,0)**

From the 90 surgeries with redose indication, administration registry was identified in only 24 (26.6%) (Table 2). There was no significant difference regarding redose use and the mean age of patients, gender and duration of surgical procedures, despite assuming higher number of additional doses between procedures with longer duration.

When comparing surgical specialties, it was observed that redose was not administered in orthopedic surgeries. Adherence was significantly higher between cardiac surgery procedures (Table 2).

About the type of procedure, there was redose indication, especially for spinal fusion, myocardial revascularization and fracture correction. Among neurosurgeries, the proportion of redose was higher between craniotomies, but without statistical significance. A Statistically significant difference was found among cardiac surgeries, with lower adherence in myocardial revascularization and other procedures (a tumor resection, a commissurotomy, three aneurism corrections, three valve exchanges associated with myocardial revascularization and one aorta coarctation correction), as presented in Table 2.

Table 2: Characteristics of patients and surgical procedures according to redose administration or not of antibiotic prophylaxis during prolonged surgeries. São Paulo, SP, Brazil, 2010.

Characteristics	Redose		
Variable	**Yes**	**No**	**P**
Age (mean, variation)	53,34 (30-73)	50,46 (25-80)	0,3464[a]
Procedure duration in minutes (mean, variation)	285,62 (180-390)	261,36 (180-460)	0,710[a]
Gender n (%)			0,674 [a]
Female	9 (10,0)	28 (90,0)	
Male	15 (28,3)	38 (71,7)	
Specialty n (%)			0,027[b]
Cardiac	12 (34,3)	23 (65,7%)	
Neurological	12 (26,7)	33 (73,3%)	
Orthopedic	-	10 (100%)	
Cardiac n (%)			0,002 [b]
RM	10 (41,7)	14 (58,3)	
Others*	-	9 (100,0)	
Valve exchange	2 (100,0)	-	
Neurosurgery n (%)			LH 0,140 [b]
Arthrodesis	6 (20,0)	24 (80,0)	
Craniotomy	6 (46,2)	7 (53,8)	
Laminectomy	-	2 (100,0)	
Orthopedics n (%)			Not applicable
Fracture correction	-	5 (100,0)	
Knee arthroplasty	-	2 (100,0)	
Hip arthroplasty	-	2 (100,0)	
ISR n (%)			0,057 [b]
0	1 (7)	14 (93,3)	
1	17 (27,9)	44 (72,1)	
2	6 (42,9)	8 (57,1)	

[a] T test, [b] Chi-Squared test, [c] Likelihood Ratio test.

* Others: tumor resection (1); commissurotomy (1); aneurism correction (3); valve exchange associated with myocardial revascularization (3); aorta coarctation correction (1).

Regarding the ISR, 61 (67.8%) patients were classified as ISR-1, 15 (16.7%) as ISR-0 and 14 (15.5%) as ISR-2. Redose administration was more frequent as higher the ISR was, with statistical significance (Table 2).

The procedures classified as ISR-0 correspond to arthrodesis and myocardial revascularization. Although those surgeries are not classified as prolonged, in accordance to the National Healthcare Safety Network (NHSN) cut-point, those had duration longer than 180 minutes, with redose indication, following the institutional protocol.

DISCUSSION

The available publications regarding adherence to guidelines of antibiotic prophylaxis use in surgeries, in relation to other parameters, present indexes varying between 4.9% and 25%[14-17]. Regarding redose, adherence indexes vary between 20% and 30%[18-22]. In the present investigation, redose adherence was 26.6%, slightly higher than adherence indexes to other parameters[14-17] of surgical antibiotic prophylaxis use and similar to redose adherence, in accordance with the available literature[18-22]. Thus, results from the present study and other publications[14-22] refute the initial hypothesis that redose adherence would be lower when compared to other parameters of surgical antibiotic prophylaxis use. However, it shows equally critical indexes.

In relation to IRIC, it was observed higher proportion of redose as higher the IRIC was, possibly showing more preoccupations from the team with patients of higher surgical risk. Regarding surgical specialties, there was worse adherence between neurological and orthopedic procedures when compared to cardiac.

A retrospective cohort involving 1.886 cardiac surgeries, with 240 minutes or more of duration, performed during a 17 months period, showed adherence of 30% to redose administration recommendations[19]. There was no reduction in the risk for ISS occurrence with administration of additional doses during intra surgical period in general. However, between procedures with duration higher to 400 minutes, the ISS risk was reduced in 56%, Odds Ratio 0.44 (CI 0.23-0.86)[19]. Evidence of higher risk for ISS between procedures with longer duration clearly shows the importance of redose administration, especially considering the relationship between duration and surgery complexity.

The redose adherence index in this cohort[19] was similar to the one found in the present investigation. However, there was no statistical significance regarding adherence when compared to the duration of procedures, contrary to the referred study, in which adherence was higher between longer procedures. In both studies there were no statistically significant differences for gender and age.

A multicenter randomized study involving 29 hospitals and 4.472 surgeries (cardiac, orthopedic and gynecological) prospectively evaluated the association between the moment of surgical antibiotic prophylaxis administration and the use of redose with the SSI risk. There was redose indication for 690 surgeries, but only 21% of patients received additional dose, which apparently reduced infection risk when the initial dose was administered in the ideal moment (Odds Ratio = 3,08; CI 0,74-12,90)[21].

There are few studies available addressing redose adherence of surgical antibiotic prophylaxis. Within the existing ones, adherence to recommendations is really low and not all studies showed association between redose and SSI, maybe because of the low number of surgeries evaluated[18-22]. Regarding the lack of evidence to establish the relationship between redose and ISS, if we consider the premise that antimicrobial tissue level should be kept adequate during all surgical procedure[12-13], low adherence to redose should be presented as a relevant problem. Investigations about this matter would be useful to recognize the relationship between redose and ISS and to provide subsides to increase its adherence.

About this last aspect, some strategies were already studied, between them, the introduction of an electronic system signaling to the anesthesiologist the need to administer redose. The alert was given 30 minutes before redose infusion for surgeries in which duration surpassed the drug's half-life. Conducted in 2005, this study analyzed data from 148 procedures before the implementation of the electronic system and 139 after it. Results showed increase from 20% to 58% in redose administration after the electronic system introduction. After the alert introduction, 20% had the wound closure until 30 minutes after the anesthesiologist received the electronic alert. That is, they were in accordance with the recommendations considering that there was no need for additional dose, once the wound had been already closed[18].

Another study involving 331 cardiac surgeries, longer than 225 minutes of duration, also compared the percentage of administered redose between procedures with and without electronic alerts. Among the assessed procedures, 137 were allocated in the intervention group (with electronic alert) and 136 in the control group (without the electronic alert). Redose use was significantly higher in the intervention group (68%) than in the control group (40%), odds ratio 3,31 (CI 1,97-5,56). The percentage of redose adherence was higher during the study period (40%), even for surgeries in the control group, when compared to indexes found six months before intervention (27%). This finding is probably associated to the fact that teams were informed about the study and, therefore, would be more attentive to surgical antibiotic prophylaxis. The incidence of ISS was similar between groups (6% without and 4% with the electronic alert), but significantly lower than before the intervention (10%; p=0.02) [20].

The efficacy of two different types of electronic signal for redose administration was assessed in a university hospital. The first was part of a computerized system used by anesthesiologists and sent alerts in a previously defined interval. The fact that the system in use sent alerts even without the administration of the first antibiotic dose and not allowing the insertion of distinct times in accordance with the type of drug, led to the development of a new alternative capable of identify if the antibiotic prophylaxis was administered and what was the drug used. Based in that information, the new system sends repetitive alerts every six minutes, in accordance with the drug used. Three hundred and seventy five procedures with redose indication were assessed, 188 with the existing system and 187 with the new one. Adherence to redose index increased from 62.5% to 83.9% ($p<0.001$)[22].

Those three studies[20-22] demonstrated that using electronic resources provide better adherence to recommendations regarding redose administration, and possible risk reduction to ISS occurrence. Yet, there is the need to ask why, although there are evident resources, it is given so little attention to redose, seen that it is an error that can negatively impact results in surgical treatments. However, this aspect was not discussed in these studies[20-22].

The check list proposed by the WHO involves participation of all surgical team, including nurses, and proposed verification of safety items before anesthesiology, before the incision and before the patient leaves the surgical room. However, in relation to the use of surgical antibiotic prophylaxis, it is recommended to check the administration of the first dose, up to 60 minutes before the incision. The redose administration is not contemplated in the original document[2].

Administration of surgical antibiotic prophylaxis, is generally under responsibility of the anesthesiologist. But, complying with the WHO considerations about relevance of team work, the responsibility of this practice should be multi-professional. Improvements in practices through multi-professional action are evident through results of a study involving cesarean sections. After involving nurses in the process, adherence to antibiotic prophylaxis administration increased from 25% to 100%, with significant reduction in infection indexes. Authors of this study argued that due to direct assistance to patients, nursing is in a privileged position to detect medication flows and therefore, act to prevent adverse events, which could be useful for redose administration in prolonged procedures[23].

Although this study[23] does not addresses redose, it addresses a similar situation, that is the forgetfulness of surgical antibiotic prophylaxis administration in obstetrics. It also rescues the relevance of the human element, in this case, the historical participation and appreciation of nursing in safety actions towards the patient in health care. About the surgical antibiotic prophylaxis, although the decision about its use is attributed to the physician, the adherence guarantee, including the redose, can be shared by actions of other professionals.

CONCLUSION

The present study identified low percentage of redose application adherence in prolonged surgeries, being higher among cardiac surgeries and between those with higher ISR. Despite the scarce literature on this theme, the results obtained are inserted in the variation found in other investigations, showing that adherence to recommendations of surgical antibiotic prophylaxis use is not a problem observed only in developing countries, but globally. Mapping indexes of adherence to guidelines for the use of surgical antibiotic prophylaxis allow us to have a dimension of the problem and thus, propose actions to improve the process.

As in the present study, in few cited publications, data collection was retrospective, a fact that can be treated as a limitation. This methodology could have underestimated adherence to redose administration,

once it is possible that the antibiotic was administered but not registered in the records.

It is needed to act on the process of using surgical antibiotic prophylaxis. Actions in real time can increase consistently adherence to guidelines, including redose. However, the use of technology alone is not sufficient to solve the problem. It is indispensable to act directly on the human element and, for that, it is needed to invest on awareness and motivation of teams, once the problem is not exclusively about lack of knowledge. To involve the team in building guidelines, to present performance results related to adherence to guidelines of use of surgical antibiotic prophylaxis and SSI rates, can be alternatives to be added to available technologies in order to obtain better results. Safety in surgery implicates in joint coordination team, and nursing has an important role in this aspect. Its participation in the process of using surgical antibiotic prophylaxis can contribute to better redose use adherence in prolonged surgeries.

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