International Journal of Infectious Diseases and Therapy
2020; 5(4): 145-148
http://www.sciencepublishinggroup.com/j/ijidt
doi: 10.11648/j.ijidt.20200504.17
ISSN: 2578-9651 (Print); ISSN: 2578-966X (Online)

The Intervening Effect of Preventive Use of Antibacterials During the Perioperative Period in Neurosurgery

Lianfang Xue[1], Suishan Qiu[1], Qinai Zhu[2], Hui Liu[1, *]

[1]Department of Pharmacy, The First Affiliated Hospital of Jinan University, Guangzhou, China

[2]Department of Laboratory Medicine, The First Affiliated Hospital of Jinan University, Guangzhou, China

Email address:

xlf18666@163.com (Lianfang Xue), 494490817@qq.com (Suishan Qiu), 270327330@qq.com (Qinai Zhu), liu_ui@hotmail.com (Hui Liu)
[*]Corresponding author

To cite this article:

Lianfang Xue, Suishan Qiu, Qinai Zhu, Hui Liu. The Intervening Effect of Preventive Use of Antibacterials During the Perioperative Period in Neurosurgery. *International Journal of Infectious Diseases and Therapy*. Vol. 5, No. 4, 2020, pp. 145-148. doi: 10.11648/j.ijidt.20200504.17

Received: October 10, 2020; **Accepted**: October 22, 2020; **Published**: December 16, 2020

Abstract: Objective: Surgical site infections (SSI) is a serious complication of surgery. Perioperative antibacterial prophylaxis is one of the most effective methods to prevent SSI. The aim of this study was to evaluate the effect of interventions on perioperative antibacterial prophylaxis in neurosurgery. Method: We intervened and assessed the perioperative antibacterial prophylaxis from adult patients with a neurological surgery in the First Affiliated Hospital of Jinan University (Guangzhou, China) between May 2014 and December 2014. A total of 279 neurosurgical cases were chosen among which 145 cases were before intervention and 134 after intervention. This study discussed the indications, selection of varieties, timing of the first dose, and application time of antibacterial drugs before and after intervention. Results: Investigation and analysis were performed in the perioperative antibacterial prophylaxis. Compared with the pre-intervention phase, rationalities of perioperative antibiotics prophylaxis in the post-intervention phase were significantly increased. The rational drug selection and the rational timing of using antibacterial after intervention were significantly increased. In addition, the average duration of antibiotic prophylaxis in the post-intervention phase was significantly shorter than the pre-intervention phase. Conclusion: The intervention of perioperative antibiotics prophylaxis was effective and feasible. It contributed to promoting the rational use of perioperative antibiotics prophylaxis in neurosurgery.

Keywords: Perioperative, Antibiotics Prophylaxis, Surgical Site Infections, Intervention, Neurosurgery

1. Introduction

Surgical site infections (SSI) is a serious complication of surgery, which is associated with poor outcomes such as increased morbidity, mortality, hospital length of stay, and cost. Patients with an SSI have a 2- to 11-fold increase in risk of death, 77% of which are directly attributable to SSIs [1]. In addition, approximately 7 to 10 additional postoperative hospital days is due to SSI [1, 2]. However, many of the SSIs are considered as preventable complication [3]. Perioperative antibiotics prophylaxis is one of the most effective methods to prevent SSI [4, 5]. However, overuse or inappropriate use of antibacterial would increase the incidence of SSI. To better normalize the prophylactic use of antibacterial, the Ministry of Health of People's Republic of China has published "Guidelines for clinical application of antibacterial" (2009 version) and "Guidelines for antibacterial on prevention and treatment of surgical site infection" (2003 version). In order to evaluate the effect of interventions of prophylactic use of antibacterial in perioperative period, we did statistical analysis of use of antibacterial in neurosurgical cases.

2. Methods

2.1. Setting

This study was performed in a total of 279 neurosurgical cases of the 1900-bed University Hospital, the First Affiliated Hospital of Jinan University in China, with 145 cases before intervention and 134 cases after intervention between May

2014 and December 2014.

2.2. Retrospective Studies

We used the electronic hospital administrative system to identify eligible patients that received prophylactic antibacterial during perioperative period of neurological surgery. Patient characteristics (gender, age), types of surgical site incision, prophylactic use of antibacterial (dosage, application, duration, combined drugs) were included in the collection of data.

2.3. Intervention and Criterion

According to "Guidelines for clinical application of antibacterial" (2009 version) and "Guidelines for antibacterial on prevention and treatment of surgical site infection" (2003 version) issued by the Ministry of Health in China, pharmacist participated in the medical treatment along with the physician. The criterion of prophylactic antibacterial in SSI were made as follows: For neurosurgery, the rational antibacterial included ceftriaxone, cefuroxime, and cefazolin. Antibiotics should be used 30 min before operation, and duration should be no longer than 48 h. We focused on the use of prophylactic antibacterial in SSI, especially those used inappropriately, then discussed with the physicians of the recommendations and made better choices of clinical drug use.

2.4. Statistics

The Pearson's $\chi 2$ test [6] was used for comparison of differences between pre- and post- intervention. In all tests, *P < 0.05 was considered statistically significant. The statistical analysis was conducted using Microsoft Office Excel 2010 and SPSS 14.0.

3. Results

3.1. Patient Characteristics

In the pre- and post-intervention phase we included 145 and 134 patients, respectively. As shown in Table 1, the male/female ratio, average age, age ≥60 y, and the percentage of type I and type II incision were of no significant difference ($P \geq 0.05$).

Table 1. *Patient characteristics of patients included pre- and post-intervention.*

	pre-intervention		post-intervention	
	n	(%)	n	(%)
Study participants	145		129	
Female	77	53.10	55	42.64
Age, years				
Mean (range)	45.81		45	
≥60	34	23.45	33	25.58
Type I, II incision	143	98.62	127	94.78

Patient characteristics of patients included pre- and post-intervention.

3.2. Appliance of Antibacterial

As shown in Table 2, the prophylactic antibacterial used in pre-intervention phase were ceftriaxone (37.24%), cefoperazone-tazobactam (24.83%), latamoxef (13.10%), cefazolin (8.28%) and cefuroxime (6.21%). However, the antibacterial used in post-intervention phase were ceftriaxone (39.53%), cefathiamidine (16.28%), latamoxef (15.50%), cefoperazone-tazobactam (10.08%) and cefuroxime (7.75%). The use of cefoperazone-tazobactam, an inhibitor of β-lactamases, which was not recommended, was reduced by 14.75%; at the same time, the use of cefathiamidine, the first-generation cephalosporins, although not identified by evidence-based medical researches, was increased by 16.28%.

Table 2. *Appliance of antibacterial included in pre- and post-intervention.*

Antibiotic agent	Pre-intervention (%)	Post-intervention (%)	Percentage-point difference (%)
Cefoperazone-tazobactam	24.83	10.08	-14.75
Ceftriaxone	37.24	39.53	2.29
Latamoxef	13.10	15.50	2.40
Levofloxacin	4.14	3.1	-1.04
Vancomycin	2.76	4.65	1.89
Cefuroxime	6.21	7.75	1.54
Cefazolin	8.28	1.55	6.73
Cefathiamidine	0	16.28	16.28
Others	5.52	1.56	-3.96

Appliance of antibacterial included in pre- and post-intervention. Comparison of prophylactic antibacterial in pre- and post-intervention, expressed as percentage-point difference.

3.3. Rational Drug Use Index

We compared rational drug use index including drug selection, dosage, timing and duration as shown in Table 3. The rational drug selection had increased by 17.09% after intervention, and the duration of antibiotics which <48 h had increased by 11.62% ($P<0.01$). All antibiotics were used 30 min before operation, which indicated that the intervention was effective.

Table 3. *Comparison of rational drug use index.*

Rational drug use index	Pre-intervention (%)	Post-intervention (%)	Percentage-point difference (%)
Drug selection	56.55	73.64	17.09**
Dosage	100	100	0
Timing	93.10	100	6.90**

Comparison of rational drug selection, timing and duration in pre- and post-intervention phase, expressed as percentage-point difference, **P<0.01.

3.4. Irrational Drug Use Index

We next compared irrational drug use index including drug combination, and change of drug without indication as shown in Table 4. The cases of rational drug combination were increased from 1 to 4 cases after intervention. However, there were 4 more cases of drug change without indication after intervention.

Table 4. *Comparison of irrational drug index.*

Irrational drug use index	Pre-intervention	Post-intervention
Rational drug combination	1	4
Change of drug without indication	2	6

Comparison of irrational drug selection, drug combination and change of drug without indication were included.

4. Discussion

To investigate the effect of intervention of the use of prophylaxis antibacterial in perioperative period, this study was performed in a total of 274 neurosurgical cases with 145 cases before intervention and 134 cases after intervention between May 2014 and December 2014, excluding the cases with either invasive operation or antibiotics administration due to definite infection. Table 2 and Table 3 indicated that compared with pre-intervention phase, the rationality of prophylaxis antibacterial during perioperative period was significantly improved after intervention, manifested as the decreased irrational drug selection and reduced duration of antibacterial. In addition, the rate of SSI had not increased. Therefore, the intervention was effective although there still remained some minority anomaly in antibiotics medicine use.

The main bacterial for SSI was staphylococcus aureus and coagulase negative staphylococci, thus the recommended antibacterial are the first- or second-generation cephalosporin or ceftriaxone. Consistently, the recommended antibacterial in guideline are ceftriaxone, cefuroxime, and cefazolin. However, the third-generation cephalosporin (except ceftriaxone), cephamycins and inhibitor of β-lactamases show a broad spectrum antimicrobial. They are used against gram-negative bacteria, thus they have no advantage over infections by staphylococcus that resulted in cost burden on patients. Cefoperazone-tazobactam [7], an inhibitor of β-lactamases, is used for single-drug resistance of cefoperazone, and for which the middle-serious infections cause by β-lactamases-producing bacteria are sensitive to. The use of cefoperazone-tazobactam was only 10.08%, which was reduced by 14.75% after intervention. Latamoxef [8], which ranked top three in both pre- and post-intervention phase, is very stable for β-lactamases, and it shows powerful antibacterial property against gram-negatives and anaerobe. However, it is less effective against gram-positives. However, the use of latamoxef was not reduced significantly after intervention. Cefazolin [9] and cefradine [10] are first-generation cephalosporins, which have evidence-based medical research, and they are recommended in the perioperative period. Cefathiamidine [11] is the first-generation cephalosporins and the applicant of which is not a mistake in matters of principle, was significantly increased in use after intervention. However, it is not recommended due to less evidence-based medical research. Vancomycin [12] is not recommended for routine use as prophylaxis antibacterial. It is used after artificial material implantation in organizations with high methicillin-resistant staphylococcus (MRSA).

In neurosurgery, the incision was mainly type I and type II, and antibiotics should be used 0.5-2 h before scalp incision for no longer than 48 h. One of the characteristics of neurosurgery was that the drainage tube was remained after most of the surgeries, so that it was reasonable to use antibiotics for each surgery. However, most surgeons considered that the drainage tube would increase the risk of infection because it was connected outside. Thus the use of prophylaxis antibacterial was more than 48 h, which need further consideration.

Combination of prophylactic antimicrobials is not recommended in perioperative period. It is only accepted in situations with expected anaerobic infection, in which anti-anaerobic antibacterial such as metronidazole would be used. Neurosurgery is mainly for staphylococcus, thus for most cases combination drug use is not necessary. Aimless combination therapy may cause adverse reactions and toxicity, promote drug resistant strains, and result in a waste of resources and an increase of financial burden on patients. The numbers of cases of rational antibacterial combination was increased from 1 to 4 after intervention, which further indicated that the intervention was effective.

5. Conclusion

The prophylactic use of antibacterial in perioperative period has significantly improved after intervention. However, there still remains some minority anomaly in drug use that needs further improvement.

Acknowledgements

This work was financially supported by the research project of Guangdong Provincial Bureau of traditional Chinese Medicine (No. 20201082 and No. 20191089) and Guangdong Provincial Hospital Pharmaceutical Research Fund (No. 2020A27).

References

[1] Anderson DJ, Kaye KS, Classen D, Arias KM, Podgorny K, Burstin H, Calfee DP, Coffin SE, Dubberke ER, Fraser V, Gerding DN, Griffin FA, Gross P, Klompas M, Lo E, Marschall J, Mermel LA, Nicolle L, Pegues DA, Perl TM, Saint S, Salgado CD, Weinstein RA, Wise R and Yokoe DS. (2008). Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol 29 Suppl 1: S51-S61.

[2] Diaz V and Newman J. (2015). Surgical site infection and prevention guidelines: a primer for Certified Registered Nurse Anesthetists. AANA J 83: 63-68.

[3] Ng WK and Awad N. (2015). Performance improvement initiative: prevention of surgical site infection (SSI). BMJ Quality Improvement Reports 4: u203279-u205401.

[4] Orsi GB, Scorzolini L, Franchi C, Mondillo V, Rosa G and Venditti M. (2006). Hospital-acquired infection surveillance in a neurosurgical intensive care unit. Journal of Hospital Infection 64: 23-29.

[5] Bachy M, Bouyer B and Vialle R. (2012). Infections after spinal correction and fusion for spinal deformities in childhood and adolescence. Int Orthop 36: 465-469.

[6] Hogli JU, Garcia BH, Skjold F, Skogen V and Smabrekke L. (2016). An audit and feedback intervention study increased adherence to antibiotic prescribing guidelines at a Norwegian hospital. BMC Infect Dis 16: 96.

[7] Patankar M, Sukumaran S, Chhibba A, Nayak U and Sequeira L. (2012). Comparative in-vitro activity of cefoperazone-tazobactam and cefoperazone-sulbactam combinations against ESBL pathogens in respiratory and urinary infections. J Assoc Physicians India 60: 22-24.

[8] Hagiya H, Tasaka K, Sendo T and Otsuka F. (2015). Clinical ineffectiveness of latamoxef for Stenotrophomonas maltophilia infection. Infect Drug Resist 8: 353-357.

[9] Himebauch AS, Sankar WN, Flynn JM, Sisko MT, Moorthy GS, Gerber JS, Zuppa AF, Fox E, Dormans JP and Kilbaugh TJ. (2016). Skeletal muscle and plasma concentrations of cefazolin during complex paediatric spinal surgery. Br J Anaesth 117: 87-94.

[10] Chen J, Zheng F and Guo R. (2015). Algal Feedback and Removal Efficiency in a Sequencing Batch Reactor Algae Process (SBAR) to Treat the Antibiotic Cefradine. PLoS One 10: e133273.

[11] Feng X, Yun L, Yuan LU, Jian L, Wei-wei Y and Jia Z. (2018). Study on minimum inhibitory concentrations and its influence factors of cefathiamidine. The Chinese Journal of Clinical Pharmacology 34: 25-29.

[12] Van Hise NW, Bryant AM, Hennessey EK, Crannage AJ, Khoury JA and Manian FA. (2016). Efficacy of Oral Vancomycin in Preventing Recurrent Clostridium difficile Infection in Patients Treated with Systemic Antimicrobial Agents. Clin Infect Dis 63: 651-653.