

Rational drug use analysis of antibiotics in surgical operation with nursing intervention

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Abstract: Rational use of antibiotics is an important part of clinical pharmacy in hospitals. In this paper, we compared and analyzed the use of antibiotics in 2016 and 2017, and put forward corresponding interventions. The results showed that the irrational use of drugs after the intervention was significantly reduced ($p < 0.05$). The antibacterials used before the intervention was mainly cephalosporins (45.4%) and quinolones (26.2%). The antibiotics used after intervention was mainly cephalosporins (77.9%) and clindamycin (11.6%). There is no significant difference in the incidence of SSI in combination with a selection of appropriate antimicrobial agents and a variety of antibiotics and an irrational combination of drugs will increase the incidence of adverse drug reactions. Through the implementation of various intervention measures, the clinicians' awareness of the rational application of antimicrobial drugs has been improved significantly, and the rationality of drug use indications, medication course, drug selection, sample delivery rate and so on have been improved to varying degrees.

Keywords: Antimicrobial agents, surgical incision, drug-resistant bacteria, drug sensitivity, cephalosporins.

INTRODUCTION

Rational use of antibiotics is one of the important contents of clinical pharmacy in hospitals. In the course of the clinical rounds, we found that the selection of antimicrobial agents, the time and the course of treatment in the perioperative period were not standardized and reasonable (Hodyna *et al.*, 2016). The feedback results of the medical quality check also showed that there were some problems in the application of antibiotics in the hospital. In order to standardize the application of clinical antibiotics, improve the level of rational drug use and reduce the economic burden of patients (Liwerska *et al.*, 2015). The perioperation period refers to the operation treatment as the center, the self-designed operation treatment, until the operation related to the completion of the period, can be divided into pre operation, operation and three stages after the operation, time is about 5~7 days before the operation to 7~12 days after the operation, Some special operations can be extended to 1 years after the operation (Sanwald *et al.*, 2017). Surgical site infection (SSI) refers to infection in the surgical incision, deep organ or deep space during the perioperative period (Purkayastha *et al.*, 2015). SSI is the most common type of nosocomial infection of surgical patients after operation. It is also the most common complication during the perioperative period. It is the main position in all kinds of hospital infection.

SSI not only reduces the therapeutic effect of the operation, but also prolongs the hospitalization time of the

patients, which greatly increases the hospitalization expenses and the financial burden of the patients (Sultana *et al.*, 2011). In the United States, patients with SSI have doubled the economic burden than those without SSI. Reasonable operation period prophylactic use of antibiotics can effectively reduce the occurrence of SSI after operation, and is one of the main measures to prevent and control SSI (Karen *et al.*, 2017). But at the same time, the phenomenon of irrational application and abuse is widely used in clinic. It is not only beneficial to human health, but also a global medical and health problem endangering human health (Zhang *et al.*, 2015). The main hazards of irrational application of antibiotics are: accelerating the production of bacterial resistance, increasing the number of multi-drug resistance strain (MDRS), increasing the incidence of infectious diseases, abusing broad-spectrum antibiotics and inappropriate combined application, resulting in the disorder of normal flora of the human body and causing a double infection (Patel *et al.*, 2009). It also aggravates the financial burden of the patients. The adverse drug reactions caused by the abuse of antibacterials can cause serious harm to the human body, such as aminoglycoside antibiotics used in children to cause acquired deafness caused by impaired auditory nerve and kidney damage and renal failure caused by the long-term application of gentamicin, kanamycin and polymyxin (Periasamy *et al.*, 2016). The allergic shock and disulfide like reactions caused by cephalosporins can cause death in severe cases.

This paper investigated and analyzed the application of antimicrobial agents in a grade three grade a hospital in Qingzhou. At the end of 2016, the guidelines for the

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rationalization of the clinical application of antibiotics were implemented, and the evaluation work was carried out in the whole hospital. We compared and analyzed the patient records of 2016 and 2017, and investigated the preventive application of antibiotics in the Department of general surgery before and after intervention, including the usage and dosage, the time of drug use, the way of drug use and so on, and the reasons of the irrational drug use, which provided the experimental basis for the intervention and rational application of antibiotics for clinical pharmacists. Guide the clinicians in the hospital to further standardize the use of antibiotics.

MATERIALS AND METHODS

Data sources

In this study, a retrospective case study was carried out in a group of two time periods from January 2016 to June (pre intervention group) and January 2017 to June (after intervention group) in a group of three hospitals in Qingzhou, which were in accordance with the inclusion and exclusion criteria of 240 (pre intervention group) and 240 (after intervention group). The data collection and processing are carried out, and the database is established. The study was approved by the medical ethics committee of the hospital, ethical approval number as 2014YDCHW2 and all patients signed on the informed consent.

Inclusion of exclusion criteria

Case inclusion criteria: (1) Surgical cases. (2) The incision was type I incision or class II incision. (3) Cases of non malignant tumor patients. (4) The medical record is perfect.

Case exclusion criteria: (1) The presence of other infectious diseases before the operation. (2) Patients are discharged from hospital automatically or transferred to hospital. (3) During the period of hospitalization, patients who underwent more than 2 operations for various reasons (except SSI). (4) Death. (5) Other cases which can not collect complete information.

Intervention measures

Since the promulgation and implementation of the guiding principles for the clinical application of antibacterial drugs, the hospitals in Qingzhou area have changed the irrational use of antibiotics in the hospital. These measures reduce the production of drug-resistant bacteria, prevent the occurrence of SSI, so as to ensure the quality and safety of medical treatment, that is, a series of relevant policies and systems have been formulated and the management of the application of clinical antibacterial drugs is gradually increased (Patel *et al.*, 2010). Since the special regulation of antibacterial drugs has been carried out, the hospital has gradually increased the implementation of various policies and systems in

accordance with the management measures for the clinical application of antimicrobial drugs.

In 2016, the hospital actively carried out special rectification activities for antibiotics. First, we should further improve the relevant policies and systems of the Institute, set up a special management institution, be responsible for the special people, participate in and coordinate the work of many institutions and departments. The clinical pharmacists go deep into the clinical frontline, work together with clinicians to formulate and implement the guidelines for the clinical application of various disciplines and antibiotics, strengthen management and control and quantify the rationality of the application of antibiotics and include the examination of the department and the core of the comprehensive objectives of the staff. The department of pharmacology regularly organizes the standardized application training of antimicrobial agents, attending clinicians and pharmacists, and organizes relevant experts to collect, analyze, review and publicized the monitoring data of antimicrobial drugs, and investigate the completion of the data and the use of antimicrobial agents in various departments and the use of antimicrobial agents (Schulster *et al.*, 2016). The departments and individuals who have exceeded the standard and unreasonable use of antibiotics should make suggestions on how to handle antimicrobial drugs. The clinical pharmacists went to the clinical departments to carry out the clinical application of antimicrobial agents, check out, make the medication plan with the clinicians, carry out the consultation of the special use of antibiotics and carry out the management and control of the antibacterials (Qin *et al.*, 2015). The inspection department carried out the monitoring of bacterial resistance, promptly reported and reported the critical value of the bacterial resistance, reported the data of the bacterial resistance of the hospital infection management department in time, and worked with the hospital infection management department and the pharmacy department to do the early warning of bacterial resistance. The clinical isolates and their drug resistance and the trend of change were reported to the whole hospital every quarter.

Classification management of antibacterial drugs

Strict implementation of antibiotics classification management, according to the provisions of the corresponding prescriptions of the right to prescribing antibiotics at all levels, the inpatient can open a non restrictive antibacterial drug; the physician may open the limits and the following antibacterial drugs; special use level control in the authority of the director of the department. Through the information technology, we must strictly enforce the management of prescription permissions, implement the classification management system in depth, and eliminate the illegal prescribing behavior from the institutional level. We should strictly

implement the clinical application of “special use level” antibiotics and use the consultation process. Special use level antibiotics should be applied by the director of the Department, which is approved by an infection expert and an infectious professional clinical pharmacist, and the process is embedded in the hospital's HIS system. At the same time, “special use level” antibacterial drugs are prohibited from outpatient use. Strengthen the implementation of surgical SSI prevention and control work standard and management system. As far as possible to shorten the time of hospitalization, improve the general condition of the patients, actively control the blood sugar, combine the characteristics of the patients with the operation, make full use of the preoperative preparation, such as skin preparation and disinfection, improve the environment of the operation room, optimize the operation process, strictly implement the hand hygiene and aseptic operation, keep the heat preservation in the operation, and ensure the various drainage tubes. Smooth dressing should be replaced in time. Once the incision is exuded, the specimen should be taken for examination. The appropriate antibiotics should be selected after infection.

Investigation content

The questionnaire included general information, admission diagnosis, drug allergy history, high risk factors, type of surgical incision, duration of operation, time of drug use, drug use, cost, healing, SSI, sample delivery, adverse drug reactions, days of hospitalization, evaluation of rational drug use and remark. Using EMR and HIS system, with the key words of “category of incisions” and “admission time”, all cases of eligible surgical patients were divided into two groups.

Standard of reasonableness evaluation

According to the operation period guide for the prevention and application of antibiotics, the guidelines for the preventive application of anti infectious drugs in the surgical field (USA), the guidelines for the clinical application of antibiotics and the corresponding pharmaceutical instructions, the rational evaluation standard of drug use was formulated to judge the rationality of the use of antibiotics. Refer to the above criteria for evaluating the rationality of the formulation of drugs, specific indicators are shown in table 1.

Drug selection

According to the guiding principle of the guiding principle of clinical application of antibacterial drugs, the common bacteria in the Department of general surgery I and II were mainly gram-negative bacilli, and a small amount of gram-positive and anaerobic bacteria were found. The one or two generation cephalosporins, such as cefazolin or cefuroxime, are commonly used for prophylaxis. According to the incision condition, metronidazole can be used in combination. Clindamycin

can be used in patients with allergic reactions to beta lactam or serious adverse reactions. The drug should be given at the time of 0.5 to 1 hours before the incision of the skin or mucous membrane, and the drug concentration in the local soft tissue when the incision is exposed is sufficient to kill the contaminated bacteria that invade the incision during the operation. When the operation time exceeds 2 times or 3 hours of the half-life of the antibiotics used, or the amount of bleeding in the operation exceeds 1500ml, it should be added once in time to ensure the effective concentration of antibiotics to cover the entire operation process. The total preventive medication time should not exceed 24 hours. In some cases, it can be extended to 48 hours. For patients suspected of having SSI, the result of bacterial culture can be converted to therapeutic medication, prolonging the medication time. For clean operation, the operation time cannot exceed 2 hours, and the effective coverage of drug concentration can be achieved by single medication before operation.

STATISTICAL ANALYSIS

After sorting the original data, the Excel database was introduced into SPSS for statistical analysis, the general measurement data were analyzed by t test, and the counting data were analyzed by χ^2 test. $P < 0.05$ before and after intervention was statistically significant difference, $p < 0.01$ was statistically significant difference.

RESULTS

Irrational drug use

The use of antibacterials in the two groups of cases of operation period before and after intervention was compared and analyzed. It was found that there were irrational use of drugs in the aspects of medication indication, treatment course, drug selection, time of medication, usage and dosage, and the way of drug use. After the intervention, the irrational use of drugs in all the above aspects was clearly retrieved ($p < 0.05$), as shown in table 2.

Indications of drug use

The indications of drug use before and after intervention were compared in four cases, such as non basal disease of type I incision, basic disease of type I incision, type II incision without foundation disease, and basic disease of class II incision. It was found that the phenomenon of non indication of drug use before intervention was more than that of dry prognosis. The irrational use of drugs in the prognosis improved significantly compared with that before intervention. By reviewing the questionnaire, it is found that the irrational use of drug indications after intervention is much associated with the duration of the operation, the general physical state of the operation, and the risk of infection. It shows that the clinicians are

Table 1: Evaluation criteria for rational use of drugs

Standard	Reasonable	Unreasonable
Indication	Yes	Nothing
Drug selection	Correct	Incorrect
Usage and dosage	Correct	Incorrect
Pre operation time	0.5 to 1 hours before the start of the operation	After more than 1 hours or unused before operation
Intraoperative medication	Operation time exceeds 3 hours or intraoperative blood loss is greater than 1500m L	Not added as required
Combined use of drugs	Synergetic effect	No indication or combination without synergism
Way of drug use	Correct	Incorrect
Solvent volume	≤250m L	> 250m L
ADR processing	Correct processing method	Improper treatment

Table 2: Irrational drug use

Group	Cases	Indications of drug use	Medication course	Drug selection	Time of drug use	Usage and dosage	Way of drug use
Pre intervention group	240	165	152	113	89	42	17
Post intervention group	240	71	24	15	10	6	2

Table 3: Statistics of the indications of drug use before and after intervention

Group	Type I incision without basal disease	Type I incision with basal disease	Type II incision without basal disease	Type II incision with basal disease
Pre intervention group	113	35	78	28
Post intervention group	0	6	17	19

predisposed to the operation period under the guidance of the guidelines for the clinical application of antibiotics and the intervention of the clinical pharmacists. The antiseptic application of antibacterials has improved significantly before intervention, but for the care of the patients and the fear of SSI, for some special patients, clinicians still insist on the use of preventive antibiotics, such as table 3.

Drug selection

The antibacterials used before intervention was mainly cephalosporins (45.4%), quinolones (26.2%) and other kinds of antimicrobial agents. The antibiotics used after intervention was mainly cephalosporins (77.9%), clindamycin (11.6%) and other kinds of antibiotics. The highest proportion of cephalosporins in the group before and after intervention, and the proportion in the prognosis group is higher, the second one is replaced by quinolones as clindamycin, indicating that after the intervention, the clinicians are mainly first, second generation cephalosporins. Clindamycin or other drugs will be selected when the allergy or drug skin test of cephalosporins is positive, while the nitromidazole and beta lactam / enzyme inhibitors appear in the surgical records of critical patients with the risk of anaerobes and more critical and more complicated cases, such as shown in table 4.

Time of drug use

In the pre intervention group, the preventive application of antibiotics to the use of indications is not considered, and the opportunity for preventive application of antibiotics preoperatively is not good. Most cases are used earlier than 1 hours and even 24 hours earlier, the cases of preventive use of antibiotics are not in a small number. In cases requiring more than three hours of operation or intraoperative bleeding exceeding 1500ml, only 47.4% of those who needed additional medication during the operation were required. The rationality of the timing of preoperative medication in the intervention group improved significantly compared with that before intervention and no preventive medication was given 24 hours in advance. However, 22 cases were still given prophylactic use of drugs 1 hour ahead of time. The indications for additional medication in the operation were obviously improved. Only 2 cases should be supplemental and unused, and the rate of additional use was 96.2%. The rationality of medication timing was significantly higher than that before intervention (p<0.01), as shown in table 5.

Change of medicine and the way of drug use

The replacement of drugs in the treatment group before and after intervention, but in the 4 cases of the case group before the intervention, the replacement of antibiotics was no indication; no sample delivery was supported, so it was

Table 4: Drug category statistics before and after intervention

Group	Cephalosporins	Quinolones	Cindamycin	Penicillins	Nitazolate	β -lactam/enzyme inhibitor
Pre intervention group	109(45.4%)	63(26.2%)	12(4.8%)	8(3.2%)	5(2.1%)	21(8.7%)
Post intervention group	184(77.9%)	2(0.8%)	28(11.6%)	2(0.8%)	3(1.2%)	4(1.6%)

Table 5: Comparison of the time of medication before and after intervention

Group	Preoperative (case)			Intraoperative (case)		
	Unused	0.5 -1 hours	1~24 hours	Additional drug cases	Actual addition	Occupation ratio
Pre intervention group	42	113	85	154	73	47.4%
Post intervention group	84	121	35	132	127	96.2%

Table 6: Comparison of the rationality of drug use before and after intervention

Index	Pre intervention group (n=240)		Post intervention group (n=240)	
	Reasonable (cases)	Proportion (%)	Reasonable (cases)	Proportion (%)
Indications of drug use	35	14.5%	207	86.2%
Medication course	48	20.0%	215	89.5%
Drug selection	121	50.4%	214	89.1%
Usage and dosage	176	73.3%	208	86.6%
Route of administration	185	77.0%	193	80.4%
Time of administration	124	51.6%	201	83.7%
Combined use of drugs	83/165	50.3%	52/52	100%%

an irrational change. After the intervention, 2 cases of antibacterial were replaced by bacteria culture and drug sensitive experimental results. The results showed that the replacement of antibiotics was based on the results of bacterial culture after the specimen examination, and the irrational replacement of drugs and usage could be corrected.

Comparison of rational use of antibacterial drugs

To sum up the above results, the rationality of the operation period preventive application of antibacterial in the two groups of cases before and after intervention were compared, and the rationality of the medication indication, the treatment course, the drug selection, the usage and dosage, the way of administration, the timing of the administration, the joint drug use and the specimen examination in the treatment process were reasonable. The improvement of different degree and the rational improvement of medication indication, medication course, drug selection, and timing of drug delivery were particularly significant ($P < 0.05$), such as shown in table 6.

DISCUSSION

Prophylactic use of antiseptic drugs to prevent SSI during the operation is limited to the infection of the surgical incision and the surgery involved in the organs and lacunae, and does not include the infection that may occur after the operation and other parts of the operation that are not directly related to the operation (Bajusz et al., 2015).

Whether operation period of surgery needs to choose the preventive application of antibiotics and selected species and course of treatment should not only consider the site of the operation, the type of incision, the species of contaminated bacteria, the duration of the operation, the size of the surgical trauma, the possibility of infection, and the consequences of the infection after the infection (Cormier et al., 2012). It is necessary to consider comprehensively the influence of antibiotics on the formation of drug-resistant strains, the evidence-based medical evidence and cost-effectiveness.

But the preventive use of antibiotics cannot replace other preventive measures, such as strict aseptic technique and disinfection and sterilization conditions, and cannot replace the cryogenic measures and blood glucose control in the operation (Bergmann et al., 2016). The type of surgical incision is an important indicator of whether or not antibiotics are selected (Charan et al., 2015). There is no injury to the operation, no inflammation, and it does not involve the organs connected with the human body. It belongs to the aseptic part of the human body. It is a type I incision operation. The preventive application of antibiotics is unnecessary. But prophylactic use of antibiotics is not prohibited by dogma. The following special cases can be considered: (1) The operation time is long, the trauma is great, and the pollution is very likely. (2) The operation involves important organs and the SSI will cause disastrous consequences once it occurs. (3) Artificial heart valve implantation, artificial joint

replacement and other foreign body implantation. (4) Patients receiving organ transplant, diabetes and other risk factors and severe malnutrition. There are a large number of normal colonies in the human body, and the type II incision may cause the normal colonies to pollute the surgical site. If the preventive measures are inappropriate, it may lead to SSI (Christen *et al.*, 2017). Therefore, the preventive application of antibiotics is usually necessary for these type II incision operations.

The effect of antibacterials used in surgical procedures will not be further improved by prolonging the time of drug use. On the contrary, more than 48 hours of preventive medicine will greatly increase the production of resistant strains and the incidence of SSI. Standardized short range regimens, even before the operation, can achieve effective prevention of SSI (Cahill *et al.*, 2015). The excessive extension of the course after the operation cannot reduce the pollution and the chance of infection. On the contrary, it can significantly reduce the sensitivity of pathogenic bacteria to antibiotics, lead to the emergence of acute resistant strains and double infection of the body, prolong the process of treatment, increase the economic burden of the patients, and lead to the waste of social medical resources (Ceylan *et al.*, 2016). But in clinical application, it is often overextended the course of medication. The phenomenon of low fever and higher hematogram often occurs in the patients after the operation. Most of them are caused by the absorption of bleeding and the stress reaction caused by the operation (Demberelnyamba *et al.*, 2004). It should not be taken for granted as the basis of infection, and no immediate use of antibiotics can be used. The changes of the condition and the local incision were closely observed and the results of the suitable specimens sent for examination of bacterial culture and the result of drug sensitivity test were decided (Danir *et al.*, 2017). However, in clinical work, it is often wrong to use this as a basis for prolonging the time of drug use for preventive antibiotics. These practices are unreasonable. It is the right way to choose a timely collection of specimens and guide the treatment according to the results of bacterial culture.

After the special rectification activities, there has been great progress in the prevention of drug use in type I incision operation. However, the irrational rate of drug selection is still 13.5% (Dindo *et al.*, 2004). The 1 type of incision to prevent the use of antibiotics are high, and the first, second generation cephalosporins are not high in the use of the guidelines for clinical application of antibiotics (Elagbar *et al.*, 2016). Previ trials have shown that cephalosporins are the preferred drugs for the prevention of SSI, because the main pathogenic bacteria that cause type I incision infection are coagulase negative *Staphylococcus epidermidis*, and cefazolin has a strong effect on Gram-positive bacteria and has a longer half senescence in plasma, which can be used as a type I

incision operation (Eissa *et al.*, 2017). Anti sex drugs are the first choice, while some patients are positive for cephalosporin skin test, or have an allergy history of cephalosporins and clindamycin can be selected as a preventive medication. It was found that cephalosporins, quinolones and other antibiotics were the main drugs before intervention, while the main drugs were cephalosporins, clindamycin and other antibiotics (Fardeau *et al.*, 2014). It was suggested that cephalosporins were the main preventive drugs before and after intervention, and the proportion of the intervention group was higher. Quinolones are changed from quinolones to clindamycin (Ghoneum *et al.*, 2015). The distribution of operation period prophylactic use of antimicrobial agents is more consistent with the guiding principles of clinical application of antibiotics. In several cases of severe illness and high risk of SSI, we have retrieved the application of beta lactam/enzyme inhibitors, which are considered reasonable. It can be seen from the results of the study that, after the clinical pharmacist's dry prognosis, the clinician can combine the types of surgical incision and the common contaminants in the selection of antimicrobial agents.

Surgery in the Department of general surgery was mostly open, and the most common bacteria were gram-negative bacilli, with a small amount of gram-positive cocci, such as *Escherichia coli*, *Escherichia coli*, *Klebsiella pneumoniae* and *Staphylococcus aureus*. In view of the above common bacteria, the preventive application of antiseptic drugs to the prevention of SSI in the Department of general surgery is recommended as the first, second generation cephalosporin. The combination of metronidazole can be used in the operation of hepatobiliary pancreas or gastrointestinal tract which may have many kinds of contaminated bacteria. There is no significant difference in the incidence of SSI in combination with a selection of appropriate antimicrobial agents and a variety of antibiotics, and an irrational combination of drugs will increase the incidence of adverse drug reactions.

CONCLUSION

Through the implementation of various interventions, clinicians' awareness of the rational use of antibiotics increased significantly. Before and after intervention, the two groups of cases in the indications of medication, the course of medication, drug selection, usage and dosage, the way of administration, the timing of administration, the combination of drugs and the rate of specimen examination in the process of treatment have been improved to some extent. Specific performance in: after intervention, Department of general surgery clinicians can follow the guiding principles of clinical application of antibacterial drugs, combined with the general physical conditions of the patient, the operation incision, the

duration of the operation, and the types of bacteria that may cause pollution. It is necessary for doctors to take comprehensive consideration and choose safe, effective and affordable drugs and take the correct way, suitable course of treatment, effective and rational use of antibacterial drugs.

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