Practice of Perioperative Rational Use of Antibacterial Drugs Based on Drug Pathway

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Abstract [**Objectives**] To establish a new management model for rational use of perioperative antibacterial drugs in surgical departments. [**Methods**] Based on evidence-based medicine, the department's drug pathway was formulated, and the new mode of rational drug use control was established by using fine pharmaceutical technology intervention, and the intervention effect was evaluated by the intensity of antibacterial drug use, per capita drug costs and the proportion of drugs. [**Results**] After adopting drug pathway in departments, the intensity of antibacterial drug use, per capita drug costs and the proportion of drugs decreased significantly, and the effect of rational drug use control was remarkable. [**Conclusions**] The drug pathway provides a new management and control mode for the rational use of perioperative antibacterial drugs in surgical departments of hospitals. Thus, it is worthy of popularization and application.

Key words Perioperative period, Antibacterial drugs, Drug pathway, Rational drug use, Management model

1 Introduction

Infection is a postoperative complication with high incidence in hospitals. For surgical patients, postoperative wound infection is the most common type of infection. In surgical departments, preventive use of antibacterial drugs in perioperative period is an important means to prevent postoperative wound infection, and can also effectively reduce patient mortality, reduce hospitalization costs, and shorten hospital stay[1]. Perioperative improper use of antibacterial drugs may have serious consequences, such as the abuse of antibacterial drugs, the increase of bacterial resistance, the increase of surgical site infection, and the huge waste of public health resources[2-3]. However, in China, the phenomenon of improper preventive use of antibacterial drugs during perioperative period is still very common. The reasons may be related to the following two points: the lack of evidence-based medicine and pharmacy-based medication guidelines for specific departments and specific operations, and the poor clinical acceptance of the existing rational use of drugs control model. Although a number of guidelines, consensus and guidelines have been issued, there is still a lack of perioperative antibacterial drugs prevention programs for specific departments, and it is even more difficult to cover all types of surgery in specific departments and to take into account the individual characteristics of patients. Therefore, the previous management and control mode of preventive use of antibacterial drugs in perioperative period is still "extensive" management, and hospital surgical departments urgently need a new mode of fine management and control of perioperative rational use of drugs based on evidence-based medicine and pharmacy. The pharmaceutical team formulated the clinical pathway of drug treatment in the surgical department based on evidence, and carried out pharmaceutical technology intervention in the clinical department with the rational use of drugs as the evaluation indicator, while continuously using PDCA (plan, do, check, and act) cycle management and improvement[4], to explore a new management and control mode for the rational use of antibacterial drugs in perioperative surgical departments of hospitals in China.

2 Definition of clinical pathway and drug pathway

Clinical pathway has been relatively mature in China. It is a set of standardized treatment model and treatment procedures for a disease, and it can make disease management more standardized, medical behavior more standardized, and medical costs lower. However, the specification of clinical pathway for the drug treatment of diseases is relatively rough, and some evidence-based evidence is not updated in time and the level of evidence-based is low, which makes it more difficult for clinicians to implement and make individualized medication plans for patients. However, the drug pathway is the part of drug treatment for diseases, and it can be used as an effective supplement to the clinical pathway, and the two belong to the collaborative relationship[4]. The drug pathway takes the drug treatment of the disease as the main line, comprehensively considers the individual characteristics of the patient (liver and kidney function, allergic history, immune function, weight, *etc.*), and on the premise of defining the type of operation, the drug pathway formulates a systematic, standardized and homogeneous drug treatment plan for the selection, usage and course of treatment of perioperative period drugs for the patient (such as drug pathway of joint surgery, Fig. 1). The establishment of drug pathway effectively ensures the treatment of the same disease and further guarantees the quality and safety of medical care.

After the drug pathway of the department is formulated, the

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pharmacist's participation in clinical work mainly includes the following aspects. The responsible pharmacist of the department reviews the medication of patients who implement the drug pathway every week, forms a review report and feeds back the problems found in the review to the clinical and medical departments, and formulates the patient's Pharmaceutical Care Form based on the guidelines, expert consensus and drug pathway; participates in ward rounds of clinical departments, formulation of drug treatment plan for special patients, consultation of departments, discussion of difficult cases, *etc.*; provides the whole process of pharmaceutical care covering pharmaceutical rounds, medical order review, patient pharmaceutical care, patient medication education, and adverse drug reaction monitoring. The rational use of drugs is the core link in the implementation of drug pathway technology intervention. In the process of drug pathway implementation, pharmacists can provide scientific pharmaceutical technical services for doctors and patients by using professional pharmaceutical knowledge, which can further ensure the safety, effectiveness and economy of clinical drug treatment. Clinical drug pathway combines evidence with clinical practice, evaluates drug research evidence with reference to guidelines and guidelines to obtain drug efficacy, safety and economic data, and provides systematic, standardized and homogeneous drug treatment for patients on the premise of clear diagnosis and operation type. At the same time, combined with the patient's individual characteristics, imaging examination, laboratory indicators, *etc.*, the drug pathway can standardize the drug selection, usage and dosage, and course of treatment throughout the whole process of drug use. It adopts a simple and intuitive path diagram form, so it is very easy to accept and implement clinically.

3 Exploration of drug pathway

3.1 Establishment of PDCA cycle management mode Through the special review on the use of antibacterial drugs in perioperative period, it was found that there were many unreasonable situations in the use of antibacterial drugs in perioperative period in surgical departments. As a result, the utilization rate of antibacterial drugs, the proportion of first-class incision prevention, the use intensity of antibacterial drugs and the proportion of drugs in the department exceeded the standard. Pharmacists in the Department of Pharmacy followed the PICOS principle, systematically collected literature for clinical problems to be solved, and referred to data such as *Febrile Diseases*, *ABX Guidelines*, *and Guidelines for the Clinical Use of Antibacterial Drugs* (2015). Through the convening of a special working meeting, the drug pathway was formulated for specific departments in line with their surgical medication. After the formulation of drug pathway, in order to promote the implementation of drug pathway in relevant departments, the hospital set up a clinical drug pathway implementation team for antibacterial drugs and established a two-level quality control system. The drug pathway implementation department is responsible for appointing a physician as the drug pathway quality controller and a senior nurse as the drug pathway supervisor, and establishing a quality control circle (QCC) of "physician implementation-nurse supervision-pharmacist review".

The formulation and modification of drug pathway shall be subject to the PDCA cycle management mode: Pharmacists are responsible for preparing the clinical drug pathway and submitting it to the medical affairs department; the medical affairs Department sends the drug pathway to the clinical department, solicits the feedback of the department and sends it to the pharmacy department, and repeats several times to reach a consensus; the pharmacy department and the clinical department jointly conduct drug pathway training for the medical staff of the department; the medical affairs department informs clinical departments to implement drug pathway; the pharmacy department reviews the completion of drug pathway in relevant departments every week, and forms a feedback report to the medical department; the medical affairs department feeds back the problems found in the comments to the department and urges it to rectify, and at the same time, feeds back the questions existing in the implementation of the drug pathway to the pharmacy department, and the three parties will jointly revise and improve the drug pathway.

3.2 Formulation of the drug pathway Taking joint surgery as an example, pharmacists commented on the medical records of joint surgery in the early stage and found that there were some problems in preventive drug use in the perioperative period, such as unreasonable timing, unreasonable drug selection and long course of treatment. It was found that the main reasons for the improper use of drugs included that physicians were not aware of the relevant guidelines or consensus on perioperative preventive use of antibacterial drugs, worried about medical disputes caused by infection in patients after surgery, and were not familiar with the antibacterial spectrum and pharmacokinetic characteristics of commonly used antibacterial drugs.

In view of the above problems, the implementation team of clinical drug pathway for antibacterial drugs in the hospital focused on the analysis of the problems, and pharmacists searched the National Guideline Clearinghouse (NGC), China National Knowledge Infrastructure (CNKI) and other databases, and consulted the Instructions for the *Use of Medicines in Chinese Pharmacopoeia*, and other professional books to obtain evidence-based evidence, analyzed and evaluated the research evidence with reference to evidence-based medicine, selected the most valuable information to formulate drug pathway as the basis for clinical decision-making, and formulated the drug pathway for the department's antibacterial drugs in the perioperative period.

The clinical drug pathway recommends drugs for different patients and different types of surgery in the department, and presents them in the form of technical roadmap, which is convenient for clinicians to operate daily. The clinical drug pathway is equivalent to the department's specification for the use of antibacterial

drugs during perioperative period. The drug pathway classifies joint surgery into two categories: elective and emergency. The selection of antibacterial drugs should be combined with the specific analysis of the patient's surgical site, the degree of wound contamination, skin test allergy, and whether there is infection, and based on evidence-based medicine. Pharmacists actively communicate with clinicians to improve the drug pathway and form the drug pathway roadmap of clinically approved antibacterial regimens in the perioperative period (Fig. 1). The developed drug pathway has the characteristics of sufficient evidence-based basis, department recognition, simplicity and intuition, which significantly improves the enforceability of drug pathway.

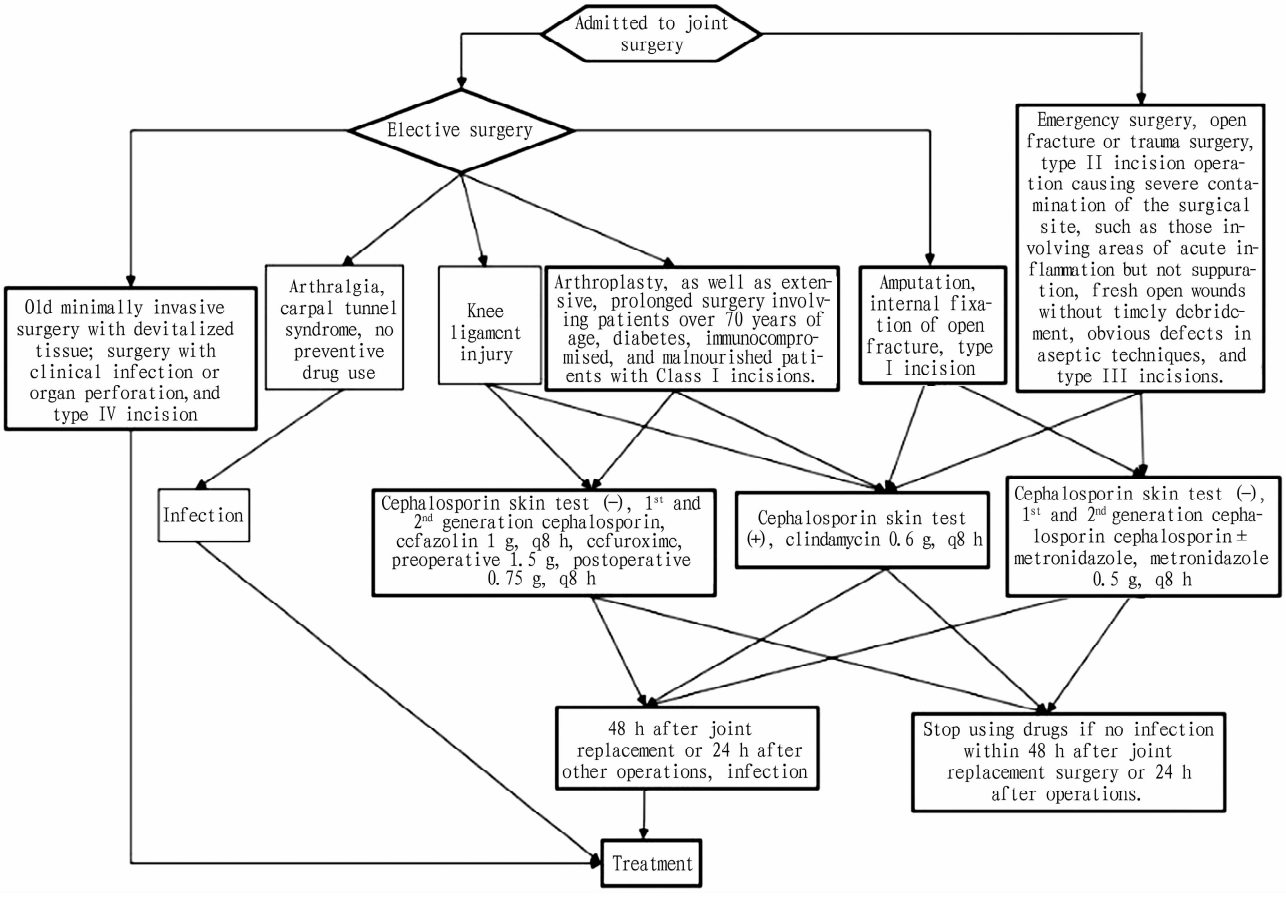

Fig. 1 Clinical drug pathway for perioperative antibacterial drugs in joint surgery

3.3 Establishment of reward and punishment mechanism

After the implementation of drug pathway in the joint surgery, the responsible pharmacist of the pharmacy department is responsible for tracking the use of antibacterial drugs in the department during the perioperative period, and collecting all the discharged medical records of the department every week for special comments on drug pathway. The total number of cases, deducting the number of patients without surgery, patients with preoperative infection, and patients with preoperative use of antibacterial drugs, is the final number of cases included in the drug pathway. The evaluation items include preoperative indications, timing of administration, drug selection, usage and dosage, and course of treatment. If any one item is unreasonable, it will be judged that the drug pathway is not completed. According to the completion of drug pathway, the department will calculate the completion rate of drug pathway in the department. And in view of the problems exposed in the evaluation, the department will communicate with the clinical department at the first time and put forward specific suggestions. According to the pharmacist's comments, the medical affairs department shall summarize the problem medical records and issue a report every week, and form a monthly report. Later, the hospital president shall inform the relevant departments and responsible persons at the weekly meeting of the hospital, directly interview the directors of the departments with lower drug pathway completion rate for rectification, and reward and punish the departments and relevant responsible persons according to the notification. At the same time, the drug pathway completion rate indicator of the department is included in the year-end assessment, which is directly linked to the year-end performance of the department.

3.4 Achievements Taking joint surgery as an example, since the implementation of drug pathway in June 2018, compared with the indicators of the previous six months, the proportion of drugs in the department, the use intensity of antibacterial drugs and the per capita drug cost indicators during July and December were significantly reduced, as shown in Figs. 2, 3 and 4.

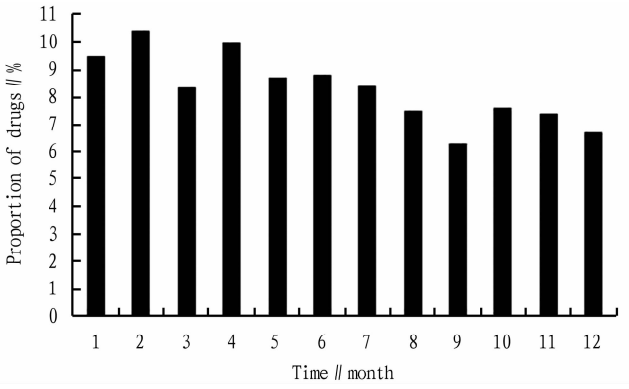

Fig. 2 Proportion of drugs during January and December 2018

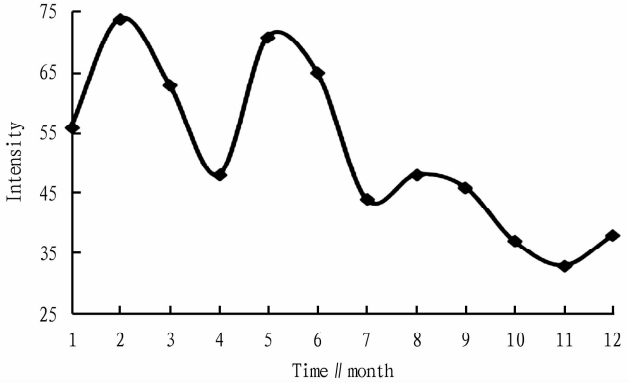

Fig. 3 Intensity of antibacterial drug use during January and December 2018

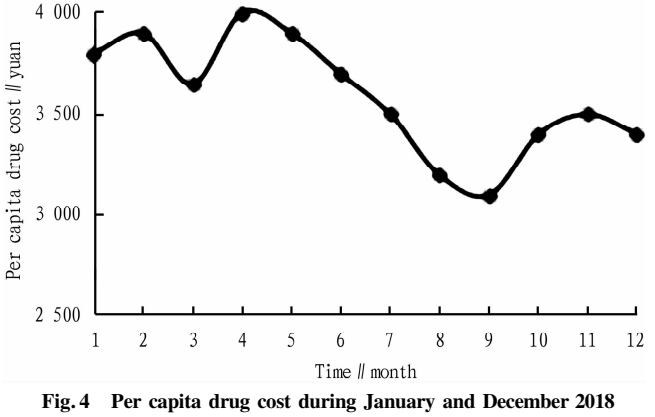

Fig. 4 Per capita drug cost during January and December 2018

4 Discussion

At present, antibacterial drugs are the most widely used drugs in hospitals. With the progress of medical technology, the upgrading of antibacterial drugs has become more frequent. Over-reliance on antibacterial drugs and high utilization rate has become a common phenomenon in the medical field. Bacterial resistance has become one of the most pressing public health problems facing the world today[5]. Relevant research statistics show that in recent years, about 80 000 people die directly or indirectly from the abuse of antibacterial drugs every year in China. The abuse of antibiotics not only brings serious side effects to patients, but also causes the increase of drug-resistant strains, increases the incidence of nosocomial infection, prolongs the average length of stay, and brings a certain economic burden to patients. The rational use of antibacterial drugs in perioperative period is the focus of attention.

Based on the differentiated design of surgical departments, surgical types and patients' drug use, a drug pathway management model was established for perioperative drug use. Relevant data showed that after the implementation of drug pathway in surgical departments, the use intensity of antibacterial drugs, the proportion of type I incision prevention, the per capita drug cost and the proportion of drugs decreased significantly. Clinicians have significantly improved the rationality of drug use in the selection, dosage and course of use of antibacterial drugs during perioperative period, and drug pathway can guide departments to improve the level of drug use of antibacterial drugs, effectively promote that rational use of drugs in the perioperative period, is beneficial to reduce the abuse of antibacterial drugs, reduce the occurrence of bacterial drug resistance, and ensure the safety of drug use and the quality of medical treatment. Evaluation on drug pathway Chinese pharmacists found that most physicians had a long course of postoperative prophylaxis, because they were not familiar with the process and significance of drug pathway, and could not completely exclude infection in patients with high hemogram and high C-reactive protein within 24 – 48 h after operation. In this case, pharmacists and physician need to make a comprehensive assessment of patients to determine the rationality of drug use, and blindly prolonging the course of preventive drug use can not reduce the incidence of postoperative incision infection[6-7]. Some aspects of the drug pathway still need to be further improved. For example, some surgical drugs do not meet the requirements of the *Guidelines for the Clinical Use of Antibacterial Drugs* (2015); the classification and stratification of surgery, disease and population are not detailed enough; due to the limitation of information technology, the drug pathway is still not fully embedded in the clinical pathway.

Medical reform measures such as DRGs (Diagnosis Related Groups) payment and drug purchase with quantity have been implemented one after another, which put forward higher requirements for rational use of drugs in hospitals, and the future path management of drug use in clinical departments is bound to be the development direction of rational use of drugs management and control. Drug therapy clinical pathway is flexible in form and can include antibacterial drugs, anticoagulants, analgesics and other drugs, which is a new method of fine hospital pharmaceutical technology intervention, creating new opportunities for pharmacists to give full play to their professional and technical advantages and the transformation of pharmaceutical care. The role of drug pathway in solving the problem of cost control and promoting rational use of drugs shows that it is worth popularizing and applying in China as a new mode for management and control of rational use of drugs.

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and relieve stagnant qi. The combination of the two drugs can not only clear heat, reduce phlegm, and eliminate stagnation, but also strengthen the effect of the sovereign drugs to clear lung heat. The three are minister drugs. Armeniacae Semen Amarum is bitter and warm, and can disperse the lungs and expel wind to relieve asthma and cough. It can be compatible with honey ephedra or raw gypsum. Descurainiae Semen Lepidii Semen. is bitter and warm, and can purge the lungs and relieve asthma. Armeniacae Semen Amarum has the main effect of diffusing the lungs and relieving asthma, while the main effect of Descurainiae Semen Lepidii Semen. is purging the lungs and relieving asthma, so their compatibility can diffuse and purge the lungs and relieve asthma. Eriobotryae Folium can reduce and relieve lung qi, and relieve cough and asthma. The combination of the three drugs has the effect of purging the lungs and relieving cough and asthma. Phlegm and dampness are easy to block qi into stasis. Dioscoreae Nipponicae Rhizoma and *Artemisia rupestris* L. can be used to promote blood circulation and remove blood stasis. Folium Isatidis can help gypsum clear heat and remove toxicity. Fructus Schisandrae Chinensis as corrigent is astringent, and has the effect of supplementing qi and promoting the production of body fluid. Ginkgo leaves can constrain the lungs and relieve asthma, and astringe lung qi. Licorice is used to blend the various drugs and is as conductant drug. Yinhuang Qingfei capsules have the effects of diffusing the lungs, clearing heat, detoxification, reducing phlegm, and relieving asthma, which is consistent with the treatment of the disease, corresponding with its pathogenesis, so the curative effect was good.

According to the report of Academician Zhong Nanshan's team, among the patients infected with SARS-CoV-2, the proportion of mild cases is 83.25%. Therefore, strengthening the treatment of mild/ordinary cases and preventing further transmission of the disease are of great significance for preventing the spread of the epidemic[6]. The results of this study show that the overall response rate in the treatment group was 97.52%, higher than 95.00% in the control group ($P<0.05$); the average length of hospital stay and mean time for nucleic acid clearance in the treatment group were shorter than those in the control group ($P<0.05$). The average TCM syndrome score after 7 d of treatment was lower than that in the control group ($P<0.05$). It shows that compared with the single use of the standard treatment plan, the use of Yinhuang Qingfei capsules could more effectively shorten the length of hospital stay and the time for nucleic acid clearance of asymptomatic and mild/ordinary patients with SARS-CoV-2 infection, and improve the symptoms of traditional Chinese medicine, with certain advantages and good safety.

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