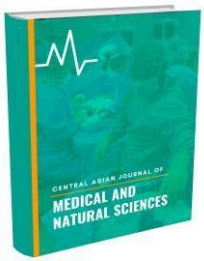

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Article

Safe use of Antibiotics in Surgery

Normatova Kamola Yuldashevna[1], Sherova Zebo Norboboevna[2]

1. Tashkent State Medical University
2. Tashkent State Medical University

* Correspondence: kamolanormatova89@mail.ru

Abstract: This study examines the safe use of antibiotics in surgery, focusing on perioperative antimicrobial prophylaxis and its role in preventing postoperative infectious complications. The effectiveness of cefoperazone was evaluated in patients undergoing emergency abdominal surgery. The results showed that proper antibiotic prophylaxis significantly reduces the risk of surgical wound infections without increasing adverse effects. A rational, evidence-based approach to antibiotic use, considering risk factors and pharmacokinetics, is essential for improving surgical outcomes.

Keywords: Antibiotics, Surgery, Antimicrobial Prophylaxis, Cefoperazone, Surgical Site Infection, Perioperative Care, Antimicrobial Resistance

1. Introduction

Currently, antibacterial therapy is widely used worldwide as a preventative measure after surgical interventions. Some data indicate the benefits of a short course, while others, in turn, indicate the benefits of a long course of antibacterial drugs as a prevention of postoperative complications. The problem of bacterial strains' pan-resistance to virtually all available groups of antibacterial drugs necessitates the search for ways to overcome resistance, searching for new potential bases for creating antimicrobial drugs[1].

The use of antibacterial drugs in modern surgical practice to prevent the development of wound infectious complications in the postoperative period can be presented as a logical consequence of the well-known postulate that "prevention is better than treatment". At the same time, the permanent emergence of increasingly effective antimicrobial drugs in clinical practice gives grounds to assume that the preventive administration of broad-spectrum antimicrobial substances leaves no chance for microorganisms to grow and develop in harmful conditions[2]. However, the discussion on the problem of antimicrobial prevention, which has been ongoing for the past 30 years, cannot be closed today, which indicates its urgency and unresolved nature. To date, there are still a number of generally accepted postulates regarding the prevention of postoperative infection, and postoperative wound complications are not accidental or fatal[3]. When analyzing the causes of surgical wound suppuration in each clinical case, one can point to one or another cause, a factor predisposing to the development of the infectious process. Risk factors for postoperative wound infection include: the patient's age exceeding 60 years, the emergency nature of the operation, surgical interventions for intracavitary purulent-inflammatory processes, the expansion of the surgical wound during the intervention, the duration of the operation exceeding 3 hours, drainage through

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the surgical wound, and the implementation of pre- and intraoperative hemotransfusions[4].

The causative agents of postoperative wound infection in abdominal surgery are well-known today: Enterobacter spp., Escherichia coli, Proteus spp., Staphylococcus spp., Streptococcus spp. Despite the fact that in a number of cases, the causative agents of wound infection are typical nosocomial types of microorganisms (Ps. aeruginosae, MRSA, Acinetobacter spp.), most authors are not inclined to consider the suppuration of surgical wounds as a manifestation of nosocomial infection and indicate a predominantly endogenous (contact, hematogenous, lymphogenous) route of infection[5]. In other words, the composition of microbial flora in postoperative wound infection is a direct consequence of the elimination of saprophytic microflora from its habitat as a result of the development of an inflammatory or (or) necrotic process, disruption of anatomical barriers during surgical intervention, and translocation of microflora. The small role of exogenous infection in postoperative wound suppuration today is determined by the standardized use of aseptic means and methods, which once again emphasizes the necessity of fulfilling its requirements[6].

The main methods for preventing postoperative infection development are, in essence, methods for preventing endogenous infection and include specific and non-specific measures. Non-specific measures traditionally include preoperative correction of homeostasis disorders, normalization of oxygen delivery, correction of concomitant pathology and immune imbalance, improvement of surgical technique with reduction of trauma and duration of interventions (especially stages accompanied by opening the cavity of a hollow organ), careful hemostasis, use of synthetic resorbable monofilament suture material[7]. Specific preventive measures are understood as various methods of influencing potential pathogens of infectious complications (primarily using antimicrobial drugs)[8].

To date, the following provisions regarding the specific prevention of postoperative wound infection are generally accepted. Indications for prophylactic perioperative administration of antimicrobial drugs are situations where a combination of risk factors indicates a high probability of wound suppuration development, as well as situations where, with a low probability of its development, postoperative wound infection poses a real threat to the patient's life[9]. The purpose of preventive administration of an antimicrobial drug is not the complete eradication of microorganisms from the tissues, but only a significant reduction in the microbial count to a level that assumes the effective functioning of the immune system in preventing the development of a purulent infection. Throughout the operation - from skin incision to the application of the last skin suture - an effective concentration of antimicrobial drug (MPC50) should be maintained in the tissues in the projection of the surgical approach, which is especially important at the end of the operation, when the maximum level of microbial contamination of the tissues is observed[10]. When an antimicrobial drug is administered, the risk of wound infection significantly increases after surgery. The administration of an antimicrobial drug more than a day after the end of surgery does not affect the frequency of postoperative wound suppuration. When choosing an antibacterial drug for prevention, the sensitivity of the most likely wound infection pathogens to this drug, the extent of drug penetration into tissues susceptible to infection during surgery, and the period of drug half-life that ensures the bactericidal concentration of the drug in tissues throughout the intervention are considered. In addition, a small degree of toxicity also plays a significant role in drug selection[11]. These requirements are most fully met by representatives of II-III generation cephalosporins, which are quite deservedly most popular during perioperative antimicrobial prevention[12].

Purpose of the Work

The purpose of this study is to study the need for a modern approach to antibiotic therapy during surgical operations to avoid further complications.

2. Materials and Methods

A study of the dynamics of cefoperazone concentration in the tissues of the surgical wound after bolus intravenous administration of 1.0 g of the drug 30 minutes before skin incision was conducted in 20 patients (average age M±m 48.8±17.8 years). All patients underwent emergency surgery through laparotomy due to acute abdominal pathology: acute appendicitis - 6 patients, perforated duodenal ulcer - 4 patients, bleeding gastric or duodenal ulcers - 3 patients, compressed inguinal hernia - 4 patients, acute destructive cholecystitis - 3 patients. In the postoperative period, repeated bolus intravenous administration of 1.0 g of cefoperazone was carried out 12 hours after the first administration. The clinical effectiveness of antimicrobial prophylaxis was assessed by the presence or absence of wound suppuration (clinical symptoms of the local infectious process in the surgical wound area, presence of purulent exudate, opening of a part or the entire wound, microbiological verification of the infectious process). The control group consisted of 20 patients operated on from a laparotomy approach for acute abdominal pathology. Antimicrobial perioperative prevention was not carried out in this group of patients. The control group was comparable to the main group in terms of age, indications for urgent surgical interventions (acute appendicitis - 5 patients, perforated duodenal ulcer - 5 patients, bleeding gastric or duodenal ulcers - 4 patients, compressed inguinal hernia - 3 patients, acute destructive cholecystitis - 3 patients) and the timing of their implementation.

3. Results and Discussion

When analyzing the clinical effectiveness of antimicrobial prevention, it was established that in the group of patients receiving cefoperazone during the perioperative period, there were no cases of surgical wound suppuration. On the contrary, in the control group of patients, suppuration of the surgical wound occurred in 2 (10.0%) patients, E. coli was detected in the exudate in both cases. Cases of poor tolerance of cefoperazone in the studied contingent of patients were not detected[13].

It should be noted that increasing the administered dose of cefoperazone by more than 1 g to increase its tissue concentration is unlikely to be justified, as the effectiveness of β-lactams depends on the time during which the antibiotic concentration exceeds the MPC. Our observations allow us to conclude that administering 1 g of cefoperazone is quite sufficient to maintain adequate concentration of the drug in the tissues during the surgical intervention. After 90 minutes of administration, the penetration of cefoperazone into the subcutaneous fat and muscles reaches 50% of the serum concentration and does not change in later periods. We believe that achieving the maximum tissue concentration of cefoperazone precisely in the subcutaneous fat tissue and muscles is of fundamental importance, as the subcutaneous fat layer is essentially an "incubator" for the development of microbial flora in the wound, and the spread of the purulent process to the muscle layer is fraught with eventation[14]. In this context, we note that the prophylactic use of cefoperazone, which penetrates well into the subcutaneous fat, can potentially neutralize such a factor in the development of wound infection as obesity.

An indispensable condition for choosing an antibiotic for the prevention of infectious postoperative complications in emergency abdominal surgery is the spectrum of antimicrobial action of the drug during its empirical use. Cefoperazone essentially covers the spectrum of possible main wound infection pathogens: enterobacteria, enterococci, proteus, staphylococci, streptococci, bacteroids. These microorganisms, under conditions of endogenous infection, exhibit high sensitivity to third-generation cephalosporins and primarily to cefoperazone[15]. The ability of cefoperazone to affect bacteroids determines

the possibility of its use in the monovariant. The data obtained during the research allow us to draw the following conclusions.An indispensable condition for choosing an antibiotic for the prevention of infectious postoperative complications in emergency abdominal surgery is the spectrum of antimicrobial action of the drug during its empirical use[16]. Cefoperazone essentially covers the spectrum of possible main wound infection pathogens: enterobacteria, enterococci, proteus, staphylococci, streptococci, bacteroids. These microorganisms, under conditions of endogenous infection, exhibit high sensitivity to third-generation cephalosporins and primarily to cefoperazone[17].

4. Conclusion

The ability of cefoperazone to affect bacteroids determines the possibility of its use in the monovariant. Undoubtedly, the issue of the duration of the course of preventive use of antibiotics is also relevant. If, with regard to "pure" operations, it is resolved and limited to the stage of surgery, then in emergency abdominal surgery, this issue requires discussion. Emergency interventions in abdominal surgery are classified as "contaminated" operations, which determines the duration of preventive antibiotic use. This type of operation serves as an indication for short-term prevention lasting 48-72 hours. The course of prophylactic use of cefoperazone is determined by the peculiarities of its pharmacokinetics and provides for intravenous bolus administration of 1.0 g every 12 hours twice after the first (preoperative) administration. Choosing a dose of the drug - 1.0 g for intravenous bolus injection ensures the rapid creation of the necessary and sufficient concentration of the antibiotic in the surgical wound tissues.

Undoubtedly, currently, there is no unified scheme for antibiotic prophylaxis in surgery. No antibacterial drug can prevent suppuration of surgical wounds without considering risk factors for the development of purulent complications. A comprehensive approach to the prevention of complications, taking into account the patient's condition, the characteristics of the microbial flora, the nature and extent of the surgical intervention, its trauma and duration, using the possibilities of nonspecific and specific prevention, allows for success in preventing surgical purulent complications.

The established features of cefoperazone's pharmacokinetics during prophylactic use and its high antimicrobial activity, confirmed by observations on wound infection prevention, allow us to recommend this drug for use in the surgical clinic as a means of specific prophylaxis of surgical wound suppuration.

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