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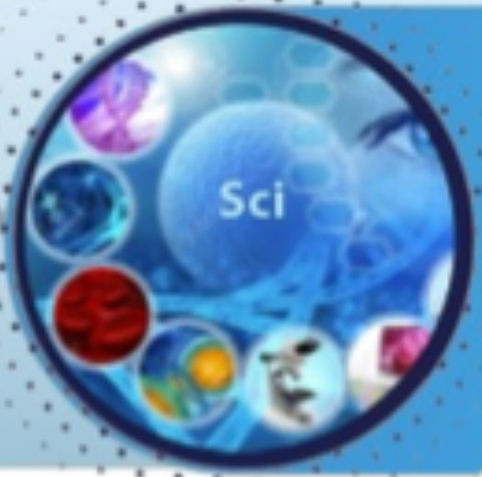

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The Rationale for the Choice of Antiseptics in the Treatment of Osteoarticular Purulent Infection

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ABSTRACT

Polymeric antiseptics from the group of polyhexamethylene guanidines prevent the formation of microbial biofilms and have an antitoxic effect. These antiseptics, including in combination with complexes from the bisphosphonate group and Unitiol, inhibit metallo-beta-lactamase and beta-lactamase of multidrug-resistant gram-negative bacteria while enhancing the effect of carbapenems and cephalosporins. The composition based on high-molecular-weight polyvinylpyrrolidone, amikacin and dioxidine has a prolonged effect, antitoxic properties, the ability to localize the infectious focus and impart antimicrobial activity to the tissues surrounding the wound.

Keywords: purulent infection, antiseptics, local treatment of purulent wounds

INTRODUCTION

At present, purulent complications of bone and joint injuries occupy a leading position in the general structure of surgical infections and are distinguished by the fact that they often lead to long-term disability of the victim for many years [1, 3].

Microorganisms of various taxonomic groups, which pose a potential danger to the development of the infectious process, have a number of properties that can be divided into several groups with a certain degree of conventionality, the first of which includes bio cyclicity, reactivity, tropicity, adaptogenicity to environmental conditions, and reproduction.

The second group of properties includes pathogenicity, toxin formation, and quorum sensing (QS), which are expressed only in the presence of certain conditions [2, 6].

An important property of microorganisms is their ability to form biofilms, which are formed by pathogens in the process of most purulent-inflammatory processes [5, 11].

At the same time, microorganisms tolerate high doses of antibiotics and exhibit their virulent properties, leading to damage to host tissues, which significantly limits the possibility of their eradication [7, 10].

Considering a bacterial infection at the cellular level, we can say that it is the result of the interaction of a bacterial cell with a cell of the host organism, whereby after irreversible attachment (adhesion) of bacteria to host cells and their subsequent colonization, a primary microbial focus is formed.

Pathogenicity factors with invasive function and the function of protection against phagocytosis can be combined into one group of factors that ensure the develop-

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ment of the initial, often clinically unpronounced, stage of the infectious process - adhesion, bacterial colonization and bacterial biofilm formation. Another group of pathogenicity factors includes biologically active biomolecules that exhibit the toxicity of the pathogen and cause a disease syndrome with a pronounced clinical picture, up to a lethal effect [9].

There are few publications that testify to the effect of antiseptics on the early stages of the infectious process in the wound, on the antimicrobial effect at the population level, and on the sensitivity of the wound microbiota to them. Biodegradable antiseptics and antiseptics are particularly promising [12].

In recent years, antiseptics and medicines based on polymeric polyhexamethylene guanidines have been considered the most effective and promising [4, 8].

Chronic purulent-inflammatory infections associated with the formation of so-called medical biofilms are becoming more and more common, including due to the widespread use of implants (catheters, various prostheses, suture material, etc.), in connection with which the development of drugs that inhibit the formation of bacterial biofilms or disorganize already formed biofilms is a very urgent problem.

The aim of the study is to develop criteria for the selection of antiseptics for the treatment of wounds at different stages of the wound process and to create medical devices that prevent the formation of microbial biofilms.

MATERIALS AND METHODS

In the studies, reference strains and test strains of microorganisms isolated from patients were used: Staphylococcus aureus, S. aureus, Escherichia coli, Pseudomonas aeruginosa, Candida albicans, Clostridium perfringens, Proteus vulgaris.

The antiphase effect of antiseptics was studied against staphylococcal bacteriophages, and strains of S. aureus were used for transduction experiments.

When assessing the inhibition of metallo-beta-lactamases of gram-negative microorganisms, the P. aeruginosa strain was considered to be the control strain.

The studies evaluated the specific activity of antiseptics from various chemical groups: polyhexamethylene guanidines, iodophores, a derivative of oxyquinoline (dioxidine), a silver preparation (poviargol), as well as sorbent carbon fibre application dressings, low-molecular food water-soluble chitosan with a molecular weight of 30 kDa. Antibiotics from various chemical groups were tested: ceftazidime, imipenem, meropenem, amikacin, vancomycin; complexions.

The model of experimental osteomyelitis was reproduced by the method of Riegels-Nielsen P. et al. Acute toxicity and general toxic effect of bone cement extracts in vivo were studied using the method of Deichmann and Le Blanc in mice weighing 18.0-20.0 g.

Mathematical processing of the obtained data was carried out using STATISTICA for Windows v.5.0 computer programs, calculating the arithmetic mean, the arithmetic mean standard error and the confidence interval. The significance of the differences between the mean values was assessed using the Student's t-test (significance level $P<0.05$).

RESEARCH RESULTS AND DISCUSSION

The cup-suspension method of bacteriological analysis makes it possible to obtain reliable results for assessing the antimicrobial activity of various drugs at short exposures from a few seconds to 24 hours in the presence of natural neutralizers, which, in turn, contributes to the rational use of effective and non-toxic agents by clinicians. In this case, the criterion for the effectiveness of the antiseptic is the coefficient of reduction in the number of test microorganisms - Cred (reduction coefficient). It is expressed in decimal logarithms and characterizes the order of reduction of contamination as a result of exposure to an antiseptic at a given exposure [10].

The efficacy of antiseptics in Cred>1 is considered sufficient. According to the results of the studies, we can talk about the high antimicrobial activity of antiseptics of various chemical groups, the antibiotic amikacin and the antiseptic gel "ARGAKOL". The reduction factor in all cases ranged from 3.5 to 9.5 lg.

The use of the method of serial dilution made it possible to simultaneously determine the intrinsic antimicrobial activity of drugs and their various combinations, as well as their ability to inhibit clinical strains of resistant gram-negative bacteria. The obtained data indicate a high level of resistance of the P. aeruginosa strain to meropenem, as well as the presence of bacteriostatic and bactericidal action of the complexions Unitiol, Xydifon, Bonefos, the antiseptic "PRONTOSAN" against the strains of P. aeruginosa and A. baumannii. In our studies, it has been shown that the combined use of meropenem or ceftazidime with sub-bactericidal concentrations of the antiseptic "PRONTOSAN" and complex ones enhances the effect of the antibiotic.

It was found that the antimicrobial activity of the drugs in the therapeutic composition remained in biological substrates (bone marrow, bone and muscle tissue) for

up to 21 days. The maximum zones of growth retardation were recorded on days 7-14 of follow-up during the examination of bone marrow tissue and muscle tissue. Differences in the indicators of the growth retardation zone for different periods in experiments with bone marrow were not significant ($P>0.05$). By 21 days of observation in experiments with muscle tissue, the zone of growth retardation was slightly reduced (differences from similar indicators for periods of 7-14 days are significant, $P<0.05$).

It is important to note that the studied polymer composition, gradually dissolving, remained in the bone marrow and soft tissues for up to 21 days, without showing a negative effect on them. It can be assumed that the gradual degradation of the polymer occurs due to its oxidation by radicals to the point where antiseptic residues can be excreted from the body, for example, by the kidneys (with a molecular weight of no more than 80,000).

CONCLUSION

The results of the studies demonstrate the presence of antimicrobial and anti-inflammatory activity of the studied polymer composition with a single application for the prevention of acute postoperative osteomyelitis.

Conflict of interest – The authors declare that there is no conflict of interest.

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OSTEOARTRIT YIRINGLI INFEKTSIYANI DAVOLASHDA ANTISEPTIKLARNI TANLASH UCHUN ASOS

Okhunov A.O.
Toshkent tibbiyot akademiyasi

ABSTRAKT

Polihexametilen guanidinlar guruhidan olingan polimerik antiseptiklar mikrob bioqavatlari hosil bo'lishiga to'sqinlik qiladi va antitoksik ta'sir ko'rsatadi. Ushbu antiseptiklar, shu jumladan bisfosfonat guruhi va Unitioldan olingan kompleksonlar bilan birgalikda karbapenemlar va sefalosporinlarning ta'sirini kuchaytirish bilan birga, ko'p qirrali gramm-manfiy bakteriyalarning metallo-beta-laktamasi va beta-laktamasidan to'sib qo'yadi. Yuqori molekulyar og'irlikdagi polivinilpirrolidon, amilatsin va dioksidin asosidagi tarkib uzoq muddatli ta'sirga ega, antitoksik xususiyatlar, yuqumli diqqatni lokalizatsiya qilish va yara atrofidagi to'qimalarga antimikrobiyal faollik berish qobiliyati.

Kalit so'zlar: yiringli infektsiya, antiseptiklar, yiringli yaralarni mahalliy davolash