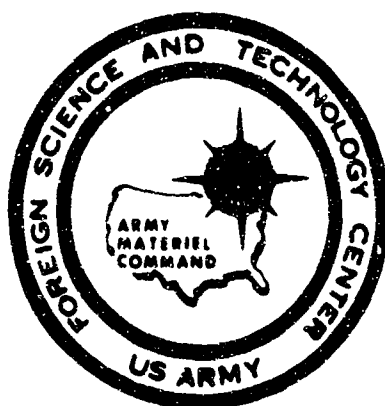


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U.S. ARMY FOREIGN SCIENCE AND TECHNOLOGY CENTER



COMPARATIVE STUDY ON EFFICIENCY ANTIMICROBIAL CLOTH
CONTAINING ANTIBIOTICS AND CERTAIN ANTISEPTICS

COUNTRY: USSR

TECHNICAL TRANSLATION

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CONTAINING ANTIBIOTICS AND CERTAIN ANTISEPTICS

by

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COMPARATIVE STUDY ON EFFICACY ANTIMICROBIAL CLOTH
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The success of surgical treatment is dependent to a significant degree on the prophylaxis of post-operative infection.

For this purpose various methods may be used, among which the application of antimicrobial cloth is extremely timely. The use of the latter in surgical practice may serve as one of the promising possibilities for prevention of infectious complications after an operation.

This method is especially important for patients undergoing reconstructive intervention on the heart, homotransplantation of a kidney and other complicated operations. These patients, as is known, are extremely susceptible to infection, which makes it necessary to keep them in conditions of the maximum sterility possible.

It is known that by means of chemical addition of bactericidal substances to the functional groups of macromolecules of modified cellulose it is possible to obtain cloth possessing antimicrobial properties, which are retained during long, moist treatments./1/ By this method antimicrobial polyvinylalcohol fibers have been obtained /2/.

In the present work fabrics were studied which contained the following chemically bonded antimicrobial preparations: No.1-Neomycin (colimycin) (20,000 units/g), No.2-Mycerin (20,000 units/g), No. 3-Iodine (10%), No. 4 & 5-Copper (3.5 and 2%), No. 6-N-cetylpyridine (2%), No. 7 & 8-Silver (6 & 2.5%) and No. 9-Herachlorophane (4%).

The antimicrobial activity of various fabrics and fibers was determined earlier on the basis of standard test-microbes - Staphylococcus and Escherichia coli /1,2/. However, we considered the research on the properties of antimicrobial fabrics only on these subjects to be inadequate, since the indicated strains possess high sensitivity to antibiotics, and in the clinic post-operative infection, as a rule, is caused by antibiotic resistant microorganisms.

Taking this into account, we carried out a study of antimicrobial activity of fabrics obtained on the basis of a modified cellulose, on bacterial cultures belonging to various species of agents of post-operative infection: Staphylococcus, Bacillus, pyocyanus, E. coli, Proteidae, and also fungus of the species Candida.

Each group of microorganisms was represented by ten strains, isolated from wound secretions, and also from various pathological material (blood, sputum, pharynx smears, urine). Sensitivity was determined of all cultures to penicillin, streptomycin, levomycetin, chlortetracycline, novoblocin, and also to furazoline - a nitrofuran group preparation.

Disks with penicillin, streptomycin, levomycetin and chlortetracycline were made commercially, and the remainder were prepared in the laboratory from calculated ten units per disk.

Staphylococcus cultures were characterized by the generally accepted criteria of pathogenicity. They possess the ability to coagulate plasma, to hemolyze erythrocytes, to cleave mannitol (8 strains out of 10); among them 5 strains had gold pigment, the remainder - white.

The Staphylococcus strains which we selected as indicators were resistant to many antibiotics (from 5 to 11), and one was completely resistant to 11 antibiotics and purezaline.

The strains of E. coli and Bacillus pyocyaneus used in the present work as indicators, were also selected according to the principle of pathogenicity - they possessed hemolytic abilities and high resistance to the overwhelming majority (10-11) of the antibiotics indicated above.

Resistance to all the antibiotics was noted in a similar number of strains of E. coli and Bacillus pyocyaneus, consisting of 7 cultures.

All 10 strains of Proteus were characterized by high antibiotic resistance.

By carrying out research on antimicrobial activity of fabrics on the most pathogenic representatives of the microflora, possessing high resistance to widely used antibiotics, we attempted to make the experiment approximate natural condition as much as possible.

The antimicrobial activity of the fabrics was studied in dense nutritive medium by the infected agar method. A suspension of each species of microbe was added in the cold to 48-50° agar, prepared in Hottinger digest with amine nitrogen content of 133 mg% and pH 7.2-7.4 adjusted so that 1 ml of agar contained 20 million microbial bodies. About 20 ml of infected agar was poured into Petri dishes. On the surface of the solidified media the samples of various antimicrobial fabrics 100 mm² in area were placed. After 18-20 hours of incubation at 37° data were taken. The antimicrobial activity of the fabrics studied was characterized by the dimensions of the zone of prevention of growth of the microorganisms.

The results of the experiments are summarized in Table 1, with a minimal-maximal variation in dimensions of the zone are indicated in millimeters from the edge of the sample.

Table 1

Activity of Antimicrobial Fabrics in Relation to the Indicated Strains of Microorganisms

Number of Fabric	Test-Culture				
	Staphylococcus	E. coli	Bacillus pyocyaneus	Proteus	Fungus Species Candida
1	1-5	1,5-5	0	2-4	
2	1-4	2-3	0	2-3	
3	0,5-1	0,5-2	1-3,5	1-2	0,5-3
4	0,5-3	1-4	1-4	1-3	1-3
5	1	0,5-2	0,5-2	0,5-1	1
6	1-2	0,5-2,5	0	1-3	0,5-1
7	1-4	1,5-4	1-3	1-2	1,5-3
8	2-3	1,5-3	1-3	2-4	1-3

Analysis of the data obtained indicated that the most pronounced antimicrobial effect (the greatest zone of inhibition of growth) on pathogenic Staphylococci, which is the major causative agent of post-operative infection, is demonstrated by fabric containing neomycin (No.1) and mycerin (No.2). Adequate activity was also demonstrated by fabric with silver (No. 7 & 8), copper (No. 4), iodine (No.3) and N-cetylpyridine (No.6).

Table 2

Comparative Evaluation of Effect of Antimicrobial Fabrics

Number of Fabric	Number of Strains of Microorganisms, whose development is suppressed by the fabric				
	Staphylococcus	E. coli	Bacillus pyocyaneus	Proteus	Fungus Species Candida
1	10	6	0	10	
2	10	5	0	10	
3	10	10	10	10	6
4	10	10	10	10	2
5	2	4	8	10	1
6	10	6	0	6	4
7	10	10	10	10	10
8	10	10	10	10	10
9	2	0	0	2	0

The growth of all strains of *E. coli* and *Bacillus pyocyaneus* were inhibited by fabric with silver (No. 7 & 8), copper (No. 4) and iodine (No. 3). The strongest effect on *Proteus* is demonstrated by fabric containing neomycin (No. 1) and mycerin (No. 2), considerable activity was noted in fabric with silver (No. 7 & 8), copper (No. 4) and iodine (No. 3). Inhibition of fungus species *Candida* was achieved mainly by fabric with silver (No. 7 & 8).

Table 2 presents a comparative evaluation of the effect of antimicrobial fabrics.

Conclusions

1. Fabric with neomycin and mycerin possesses high activity. They suppress growth of *Staphylococcus*, *Proteus* and *E. coli*.
2. Fabric with silver inhibits growth of all the indicator strains studied, while fabrics containing 6 and 2.5% of it, possess approximately identical activity.
3. Fabrics with copper and iodine are effective in relation to *Staphylococcus*, *Bacillus pyocyaneus* and *E. coli*, and also to *Proteus*, but are less active to fungus species *Candida*. The concentration of copper in the fabric should be above 2%, while fabric No. 5 (2% copper) proved to be considerably less active than No. 4 (3.5% copper).
4. Fabric containing N-oethylpyridine inhibits growth of all strains of *Staphylococcus* and *Proteus* studied, and to a lesser extent it is active in relation to *E. coli* and fungus species *Candida*.
5. The fabric with hexachlorophene (No. 9) investigated in this experiment, proved to have low activity in relation to the majority of the strains of microorganisms studied. The absence of antimicrobial activity of this fabric, apparently, can be explained by the very high stability of the bond between the macromolecule of the modified cellulose and the molecule of hexachlorophene.
6. The results obtained permit recommendation for further comprehensive study and clinical approval primarily of fabrics containing neomycin (colimycin), mycerin, silver, copper, and iodine.

Literature

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13. ABSTRACT The efficacy of nine samples of cloth containing various antimicrobial drugs was tested on fifty indicator strains of Staphylococcus, E. coli, Bacillus pyocyaneus, Proteus, and Candida, obtained from wounds secretions. The anti-microbial substances were chemically bound to functional groups of modified cellulose of the cloth. It was found that cloths containing neomycin (20,000 units /g), mycerin (20,000 units /g) silver (2.5 and 6%), copper (3.5%) and iodine (10%) were most effective. Hexachlorophene had very little effect on any of the microorganisms tested. This method is recommended for clinical use in preventing post-operative infection.		

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