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INFLUENCE OF THE CURRENTS OF MINOR INTENSITY WITHOUT EXTERLAL SOURCES OF POWER ON THE CULTURE OF PR.VULGARIS (INFORMATION 1)

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The article reveals the results of the research of the influence of currents of minor intensity without external sources of power on the culture of Pr. vulgaris. It has been proved, that the usage of currents of minor intensity in complex therapy does not require much of investment; it is efficient and available non-pharmacological method of influence on the micro flora of the thermal injury.

Key words: thermal injury, infection, micro flora, antibiotics, micro current.

У статті викладені результати вивчення впливу струму низької інтенсивності без зовнішніх джерел на культуру Pr. vulgaris. Доведено, що використання струмів низької інтенсивності без зовнішніх джерел в комплексній терапії є маловартісним, ефективним і доступним безмедикаментозним методом впливу на мікрофлору опікових ран.

Ключові слова: опік, інфекція, мікрофлора, антибіотики, мікроструми.

В статье изложены результаты изучения влияния тока низкой интенсивности без внешних источников на культуру Pr. vulgaris. Доказано, что использование токов низкой интенсивности без внешних источников в комплексной терапии является малостоящие, эффективным и доступным без медикаментозным методом воздействия на микрофлору ожоговых ран.

Ключевые слова: ожог, инфекция, микрофлора, антибиотики, микротоки.

Introduction

According to the scientific literature, thermal injury possesses a good environment for the development of infection-based complications that challenge effective treatment. Infection-based complications, in combustiology, are the main causes of lethal outcomes [2]. For the prevention and treatment of infection-based complications, that patients usually face with, antibacterial drugs are usually used during pre- and post-operational periods.

Antibacterial prevention practice is usually based of the prescription of broad spectrum antibiotics. In addition, the usage of durable de-escalation schemes of antibiotic therapy results in the development of high resistance level. Thus, thermal injuries becomenidi of poliresistant microorganisms [1]. One of the ways of struggle against poliresistant micro flora, which vegetates in thermal injuries, is the development and usage of non-pharmacological, effective and available means and methods of influence on the agents of complications [2,3]. The specific method of influence is the usage of the currents of minor intensity without external sources of power. The aim of our research was the action of the current of minor intensity without external sources of power on the culture of Pr. vulgaris.

Materials and methods. We studied the possible change of sensitivity of Pr. vulgaris to the direct influence of antibiotics under the durable action of the currents of minor intensity without external sources of power. For this purpose, we had developed and patented the device for the assessment of the influence of currents of minor intensity (fig.1) on the cultures of microorganisms (Ukrainian patent № 43358).

The change of sensitivity of Pr. vulgaris to antibiotics in the result of durable action of the current of minor intensity without external sources of power was studied in the series of researches that covered 12 experiments. Each of the experiments was studied according to the development of the colonies of Pr. vulgaris that were located in the test tubes with saline solution within inter-electrode environment with the constant action of a

micro current. The strength of the micro current was 40mcA and the voltage 0,03V under the temperature of 36^0C.

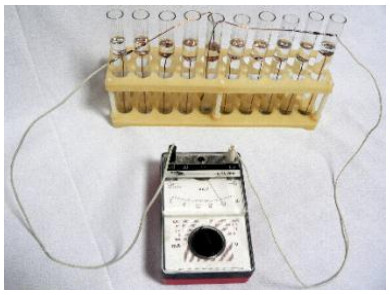

Fig.1 The device for the study of the BA influence on the cultures microorganisms: support 1, test tubes with microorganisms 2, electrode-donor of electrons (DE) 3, electrode-acceptor of electrons (AE) 4, measuring device 5, conductor 6.

In 24 hours, from every series of the test tubes we took samples (0,1 ml) of the culture Pr. vulgaris, diluted with 1000 ml of the saline solution, seeded in Petri dishes on meat-peptonic agar. Further, we placed standard discs antibiotics on the samples and put them within thermostat for 24 hours under the temperature of 36^0C. In 24 hours we estimated the sensitivity of Pr. vulgaris to antibiotics according to the diameter of growth inhibition. A culture of Pr. vulgaris without micro current influence served as the control sample.

The action of the current of minor intensity without external sources of power was also studied according to the character of its influence on the development of the colonies of Pr. vulgaris on meat-peptonic agar. For this purpose, we located discs with activated and non-activated xenoskin, discs with ceftriaxonum and discs with electrodes on the suspension of the microbe culture in Petri dishes. The suspension was taken according to the process of standard turbidity (500 thousands of microbe bodies per 1 ml). The entire test was designed to create different conditions of influence on the microbe test-objects.

We used a copper plate as the electrode-donor of electrons. For the electrode-acceptor of electrons we used aluminum-magnesium-zinc (AMZ) plate. The action of the current of minor intensity without external sources of power on the culture Pr. vulgaris was studied in the conditions of closed and disconnected electric circuit. A standard disc with ceftriaxonum and the culture of hemolytic staphylococcus served as the control sample for the research of the strength of the antibacterial action of the micro current on the culture of Pr. vulgaris.

Results and discussion. The series of 12 experiments has shown that the number of colonies of Pr. vulgaris was equal to the number in the test sample. At the same time, after the action of the current of minor intensity without external sources of power on the culture of Pr. vulgaris, sensitivity of the latter to antibiotics grew (fig. 2) from 7,1% to 66,7 %. Thus, after 24-hour action of the micro current, sensitivity of Pr. vulgaris to gentamycin grew by 7,1%, ceftriaxonum and ciprofloxacinum by 15,0%, cefasolin by 66,7. In addition, changes of sensitivity of Pr. vulgaris to cefipime, cefuroxime, norfloxacin, ophlocaine and sulbactame after the influence of the current of minor intensity without external sources of power was not observed.

Fig.2 Sensitivity of Pr. vulgaris to the antibiotics in the experimental sample (1) and control sample (2).

The result of the experiment revealed that the diameter of growth inhibition of the culture Pr. vulgaris under activated xenoskin (fig. 3) was 11,0 ± 1,8 mm, which was in

27,3% bigger than the diameter of growth inhibition under non-activated xenoskin (P<0,05). Additionally, the character of influence was similar to bacteriostatic.

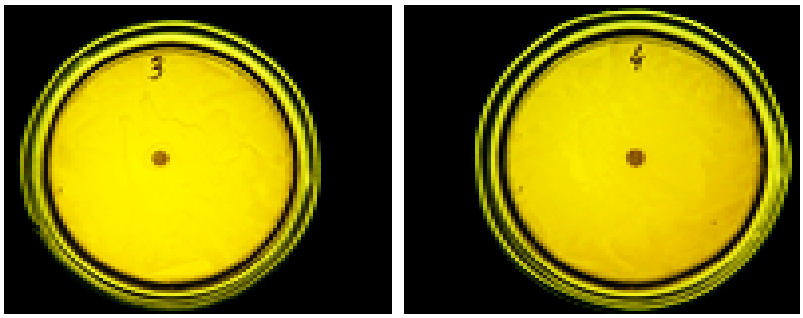

Fig.3 diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) under activated (a) and non-activa-ted (b) xenoskin.

Antibacterial action of the activated xenoskin on the culture of hemolytic staphylococcus had the character of a bactericidal action and was in 48,1% stronger in comparison with antibacterial action of activated xenoskin on the culture of Pr. vulgaris (21,2±1,9mm versus 11,0±1,8mm – P<0,001), and in 35,5% stronger in comparison with non-activated xenoskin (12,4±0,9 mm versus 8,0±0,3 mm – P<0,01). It was found, that the diameter of growth inhibition of the culture of Pr. vulgaris under standard discs with ceftriaxonum was 15,0 ± 0,2 mm (P<0,05), which was in 32,1% smaller than the diameter of growth inhibition of hemolytic staphylococcus under the analogical discs with ceftriaxonum (fig. 4).

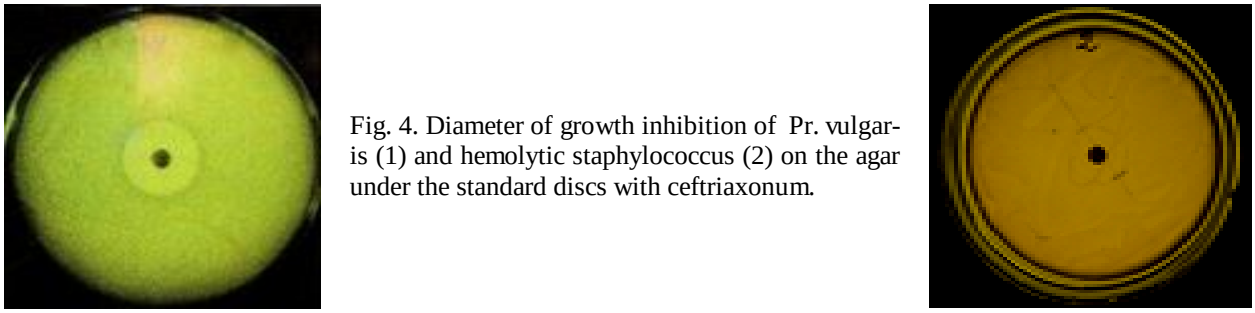

Fig. 4. Diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) on the agar under the standard discs with ceftriaxonum.

Antibacterial action of the current of minor intensity without external sources of power on the culture of Pr. vulgaris in the conditions of closed circuit of energy circulation was insignificant (fig.5), depended of the nature of the electrochemical electrodes and was in 1,5 times stronger under the negative electrode (12,0 ± 0,46 mm versus 8,0 ± 0,3 mm – P < 0,001) in 3,4 times weaker under the positive electrode, and in 1,4 times stronger under the negative electrode, in comparison with the anti-bacterial action of the current of minor intensity without external sources of power on hemolytic staphylococcus.

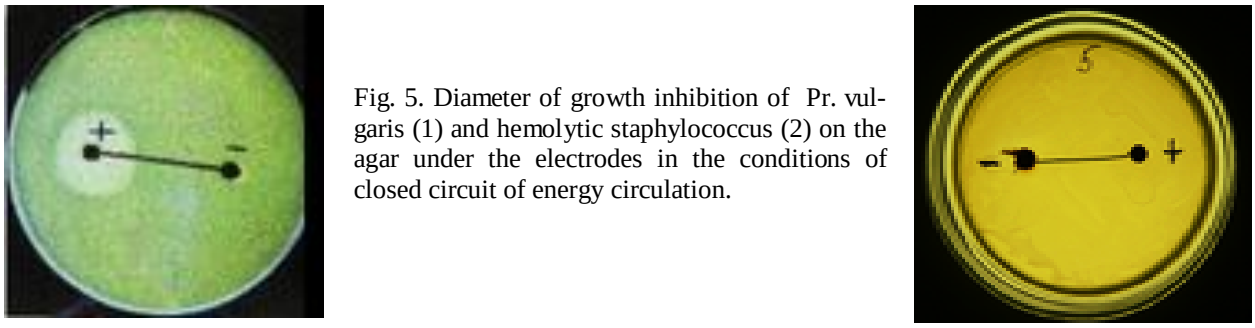

Fig. 5. Diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) on the agar under the electrodes in the conditions of closed circuit of energy circulation.

Additionally, analogical action of the current of minor intensity without external sources of power on the culture of hemolytic staphylococcus revealed strong dependency of lysogenic phenomenon on the nature of electro-chemical electrode. Thus, the zone of

growth inhibition on meat-peptonic agar under the positively charged electrode was in 3,2 times stronger than under the negative: 27,2 ± 2,4 mm versus 8,5 ± 0,7 mm (P < 0,001).

The bactericidal influence under the positive electrode was in 1,2 times stronger in comparison with the standard disc with ceftriaxonum and in 3,4 times stronger in comparison with antibacterial action on Pr. vulgaris. Under the negative electrode, antibacterial action against Pr. vulgaris was 29,2% stronger, in comparison with the antibacterial action against hemolytic staphylococcus.

Bacteriostatic action of the current of minor intensity without external sources of power on the culture of Pr. vulgaris in the conditions of disconnected circuit of energy circulation (fig. 6) was insignificant and did not depend of the nature of electrochemical electrode. t was in 1,1 times stronger in comparison with the action of the positive electrode on hemolytic staphylococcus (7,0 ± 0,2 mm versus 7,4 ± 1,2 mm – P < 0,05) and in 2,9 times weaker under the influence of the negative electrode on the culture of Pr. vulgaris (7,0 ± 0,2 mm versus 20,5 ± 2,6 mm – P < 0,001), and in 2,4 times weaker in comparison with the action of the standard disc with ceftriaxonum (7,0 ± 0,3 mm versus 17,0 ± 0,1 mm – P < 0,05).

Fig.6 Diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) on the agar under the electrodes in the conditions of disconnected circuit of energy circulation.

In order to check the validity of the results, we located the electrodes - donor and acceptor of electrons in separate Petri dishes (fig. 7).

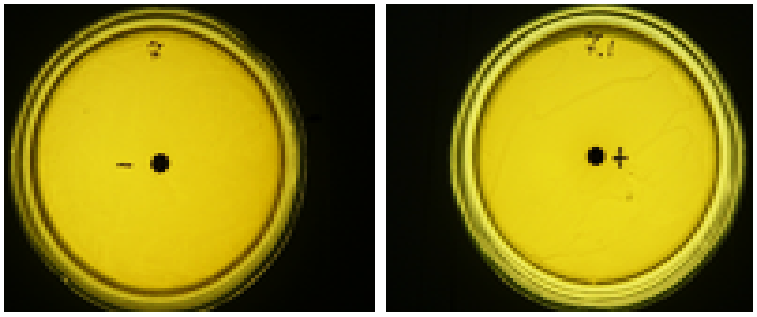

Fig. 7. Diameter of growth inhibition of Pr. vulgaris on the agar under the electrodes in separate Petri dishes.

The bacteriostatic influence of the electrode potentials on the culture of Pr. vulgaris in different Petri dishes was analogical and did not differ from the bacteriostatic action of the electrodes that were located in a single Petri dish. However, it was less apparent in comparison with antibacterial action of the electrode potentials in separate Petri dishes on the culture of hemolytic staphylococcus (fig. 8). Thus, under the positive electrode in was smaller in 1,1 times (7,0±0,5 mm versus 7,4±1,2 mm – P< 0,05), while under the negative electrode in 1,7 times (7,0±0,4 mm versus 12,1±1,4 mm – P<0,05). It was also in 2,4 times smaller in comparison with antibacterial action of the standard disc with ceftriaxonum (7,0±0,5 mm versus 17,0±0,1 mm – P< 0,001).

Fig. 8. Diameter of growth inhibition of hemolytic staphylococcus on the agar under the electrodes in separate Petri dishes.

There was also conducted a series of experiments for the research of the bactericidal action of xenoskin on the culture of Pr. Vulgaris in the conditions of the disconnected cir-

cuit of energy circulation.

For this purpose, standard discs of xenoskin that had been located on the culture of Pr. vulgaris (previously seeded on the meat-peptonic agar), were covered with standard discs of the electrodes (donor and acceptor of electrons with the diameter of 5 mm).

According to the fig.9, the bactericidal action of xenoskin in the conditions of disconnected circuit of energy circulation on the culture of Pr. vulgaris was insignificant and under the electrode-donor of electrons was 8,0±0,5 mm, which in 2,0 times weaker in comparison with the electrode-donor of electrons on the culture of hemolytic staphylococcus (8,0±1,5 mm versus 15,8± 1,9 mm, P<0,01) and in 2,1 times weaker in comparison with antibacterial action on hemolytic staphylococcus under the electrode-acceptor of electrons (8,0±0,4 mm versus 16,6±1,5 mm, P< 0,001).

Fig.9 Diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) on the agar under xenoskin in the conditions of disconnected circuit of energy circulation.

Antibacterial action of xenoskin in the conditions of disconnected circuit of energy circulation on the culture of Pr. vulgaris was also weaker in 2,1 times in comparison with antibacterial action of the standard disc with ceftriaxonum (8,0 ± 0,5 mm versus 17,0 ± 0,1 mm – P < 0,01). The results of the research of the antibacterial action of xenoskin on the culture of Pr. vulgaris in the conditions of closed circuit of energy circulation (fig.10) suggest that under the electrode-donor of electrons is weaker in 3,2 times (7,1 ± 1,2 mm versus 22,5 ± 1,3 mm – P < 0,001) and in 1,4 weaker (12,9 ± 1,3 mm versus 18,7 ± 0,8 mm – P < 0,05) in comparison with antibacterial action on hemolytic staphylococcus.

The bactericidal action of xenoskin under the electrode-donor of electrons in the conditions of closed circuit of energy circulation decreased in 1,1 times (7,1±1,2 mm versus 8,0±0,5 mm). At the same time, under the electrode-acceptor of electrons it increased in 1.6 times (12,9±1,3 mm versus 8,0 ± 0,4 mm, P<0,05).

Fig.10 Diameter of growth inhibition of Pr. vulgaris (1) and hemolytic staphylococcus (2) on the agar under xenoskin in the conditions of closed circuit of energy circulation.

In addition, in comparison with the antibacterial action of the standard disc with ceftriaxonum it was weaker in 1,3-2,4 times (7,1±1,2 mm, 12,9±1,3 mm versus 17,0 ± 0,1 mm – P < 0,05). the growth of sensitivity of Pr. vulgaris to antibiotics by 7,1% - 66,7% under continuous and durable action of the current of minor intensity without external sources of power, and moderate and high antibacterial action of the micro current on hemolytic staphylococcus in the conditions of closed circuit of energy circulation condition its urgent usage in combustiology.

Conclusions and perspectives for further development

1. Antibacterial influence of the electrodes and xenoskin on the culture of Pr. vulgaris in the conditions of closed and disconnected circuit of energy circulation is moderately apparent, which testifies to its natural resistance to the influence of the currents of minor intensity without external sources of power.

2. Lysogenic phenomenon of the action of the micro current without external sources of power depends of the nature of the electrochemical electrode and is stronger in 33,3% under the acceptor of electrons.

3. Durable action of the current of minor intensity without external sources of power in 7,1% - 66,7% increases the sensitivity of Pr. vulgaris to antibiotics, and also possesses moderate bactericidal and bacteriostatic action. in this view, the method can be recommended for the usage in complex therapy of pyoinflammatory diseases.

For the complete discovery of the bactericidal action of the current of minor intensity without external sources of power it is necessary and reasonable to continue to study its influence on the micro flora of thermal injuries, especially on gram-negative bacteria.

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