INTERNATIONAL CONFERENCE

PROCESS MANAGEMENT AND SCIENTIFIC DEVELOPMENTS

**Birmingham
United Kingdom**

International Conference "Process Management and Scientific Developments"

Birmingham, United Kingdom
(Novotel Birmingham Centre, March 31, 2020)

Materials of the International Conference
"Process Management and Scientific Developments"
(Birmingham, United Kingdom, March 31, 2020)

M67

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Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

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THE ROLE OF PHILOSOPHY OF CONFUCIUS IN THE DEVELOPMENT OF MODERN CHINA

Shalamov Georgy Aleksandrovich
Candidate of Economic Sciences, Associate Professor
Irkutsk National Research Technical University
Fa Rur
Candidate of Economic Sciences, Lecturer
North University of China

Abstract. This article attempts to identify the influence of the teachings of Confucius on the development of the economy in China. The high pace of development of the country's economy, according to various experts, can be explained by a variety of reasons. Nevertheless, the fundamental condition for the development of any society is the high moral values of the members of this society. These values are formed in people, firstly, in the family, and secondly, on the basis of the state's ideological policy that prevails in society. The successes of China to a certain extent are provided by the support chosen by his leadership on the teachings of Confucius, which has exerted its influence on the development of Chinese society for two thousand years.

Keywords: politics, ideology, economics, teaching of Confucius, removability of power.

The successes of the development of the Chinese economy in the late XX and early XXI centuries made an indelible impression on the whole world. The attempts of many authoritative experts to determine the reasons for such an impressive leap of the most populated country on the planet along the path of progress do not stop after mankind has realized the enormity of the tasks successfully solved by China. There are very different opinions on this matter. For example, the well-known Russian philosopher and political scientist Alexander Tsipko believes that the reason for the success of the transformations in China was the departure from an ideological assessment of efficiency to an economic one, expressed in the development of family contracts, market liberalization, etc. [4].

According to professor of Massachusetts University of Technology Yashen Huang, China owes its rapid industrial development to its happy neighborhood with Hong Kong, which has the most liberal economic system in the world. As a result, Hong Kong was a safe haven for a number of talented Chinese entrepreneurs and an alternative to Chinese poorly functioning financial and legal systems [7, p. 27].

Many researchers are inclined to believe that Deng Xiaoping played a decisive role in ensuring the success of reforms in China, which ensured market reforms in the economy while maintaining the state's political system almost unchanged.

Without at all disputing the above statements, we believe that the widespread adoption of a Confucian approach to existing reality in society is of some importance, if not crucial, in the implementation of reforms in China. The fact is that during the construction of socialism in China, the first place, in accordance with the Marxist-Leninist ideology, was taken by the basis, that is, the economy, and politics, culture, ideology – were just a superstructure. This approach found its concentrated expression in the well-known coined classical formulation: politics is a concentrated expression of the economy. Reliance on the teachings of Confucius made it possible, in our opinion, to move away from the indicated dogmatic approach and to rely on a person, on his moral and ethical foundations and on the initiative laid down in him. Let us try to understand the significance of the influence of the views of Confucius on the development of modern Chinese society.

Confucius - is an ancient thinker, philosopher and teacher of China. The founder of a whole philosophical trend, called - Confucianism. Confucius was born in 551 BC in the kingdom of Lu. His teachings had a profound impact on the life of China and all of East Asia, becoming the basis of a philosophical system known as Confucianism.

Confucius formed the basis of Chinese education. He taught music, poetry, literature, civil law, ethics and the natural sciences. Confucius had a lot of followers, he had three thousand students. The philosopher gathered his students around him and lectured to them, sometimes classes were held in the form of conversations. Confucius paid great attention to the moral education of man. The main task, according to the thinker, is the formation of a personality capable of further taking a worthy place in society. He offers the ideas of "Zhen", the ideas of "Li", and the ideas of "Sao".

"Zhen" - is the central category of the teachings of Confucius. Usually it is translated as "human principle", "mercy", "humanity", "humaneness". "Zhen" means both a specific sign of a person and a program of his activ-

ity. This is the human principle in man, which is at the same time his duty. This is not to say what a person is without simultaneously answering the question: what is his moral vocation. In other words, a person is what he makes of himself. Confucius himself, when asked what "Zhen" is replied: "This means loving people."

"Li" is the most important in the teachings of Confucius. Without "Li", we do not know how to honor the spirits of the universe; how to fulfill marital duty; how parents should handle their children and brother and brother. Without "Li", we do not know what the place of the sovereign and nobles, ruling and ruled, elders and minors; what is the measure of leadership in the family. That is why "Li" is so important for a noble husband.

"Sao" - in the basic sense meant respect for parents: a respectful son should devote himself to his parents loyally all his life, serve and cater to them, be ready for anything in the name of their health and welfare, and honor them under any circumstances.

So, according to Confucius, the observance of "Li" will help a person to behave correctly in any situation, and improving "Ren" will help him to treat everyone kindly. According to the idea of Confucius, these principles should bring peace and harmony to society.

In his opinion, the economic activity of the population should be aimed at supporting the state. Confucius relied on a strong state, the accumulation of wealth should be carried out only in the state treasury. Each ruler should exert economic mercy, and more specifically, the gift of some material goods to the common population. He said that material assistance from the state should not go against public interests, that is, translating into an economic language: the amount of social security should not be so large that the state incurs losses or cannot invest enough funds in other projects important to it.

In the political sphere, he offers the power of the emperor to liken the power of his father, and the relations between subjects - to family relations. That is, the younger ones depend on the older ones, and the older ones are obliged to take care of the younger ones [6, p. 60]. Confucius said that the foundation of government should be the education of humanity. But this concept was significantly different from the modern one: parental care for children, filial piety towards elders in the family and a fair relationship between those who are not related by family ties - these are the key components of humanity in Confucius [3, p. 24].

In his opinion, the state as a parent should take care of its population. Only with the well-being of the population and stability in society can a good development of the state be possible.

Speaking about modernity and Confucianism, the Chinese analyst Zhao Chunfu points to the obvious ambiguity of the teachings of Confucius. He believes that the Confucian ethics contain the postulates that contradict modernization and democratization, as well as contribute to them. The first is due to the fact that Confucian ethics is a product of an ancient agrarian civilization. This is a feudal ethics based on the principles of a rigid hierarchy, contrary to the spirit of an industrial society, built on commodity-market relations with equal subjects. However, one should pay attention to the positive aspect of Confucianism, which consists in the fact that during the 2000 years of its development, it has incorporated many provisions of other teachings, philosophical movements, beliefs, social and political traditions that make it compatible with modernization.

Considering the anti-modernization aspects of Confucianism, Zhao Chunfu emphasizes the following.

1. The idea of hierarchy and interdependence (reciprocity) is not consistent with the modern principle of equality and the spirit of democracy.

2. In Confucian ethics, rights are separated from duties, which contradicts democratic principles: in particular, the rights of the emperor are bestowed by heaven and the fact that the country is governed by a sage is elevated to the rank of absolute.

3. The exaltation of the family, the power of the emperor and the cult of the ancestors are contrary to the principle of individualism.

4. The Confucian demand for veneration of antiquity does not correspond to the principle of creativity of modern society.

5. The doctrine of the middle, that is, the Confucian demand for strict social justice, becomes the highest principle of morality, which is incompatible with the principle of competition.

6. In addition, moral values in Confucianism are generally placed above any material interest [8, p. 123].

At the same time, Zhao Chunfu also points out the positive aspects of the teachings of Confucius, which can contribute to the modernization and democratization of society.

1. Strong sense of social responsibility.

2. Energetic and active attitude towards life: Confucian ethics emphasizes that a virtuous person must constantly contribute to progress and that the value of life lies in active creation.

3. In addition, the emphasis on moral values, activities and self-regulation contributed to the development of the spirit of patriotism of the Chinese people.

4. The principle of a positive attitude to others "Ren" (literally "treat others with a loving heart") contributes to the creation of a positive microclimate in Chinese social groups.

5. The spirit of pragmatism [8, 124-125].

It should be emphasized that in China and Vietnam, political elites, despite their political and ideological origin, firmly preserve the Confucian principles of government, which in any circumstances require the preservation of order and the rules that protect it. These elites in their countries began to carry out reforms, relying on existing institutions.

According to the well-known Russian weekly "Profile", the peculiarity of the development of China and Vietnam is that they have chosen the path of transformation of their societies on a market basis. In these countries, institutions - primarily the ruling communist parties - have remained the same, but the change of power is carried out in strict accordance with the rules and instructions approved by the CPC and CPV. Duration of tenure of managers in high positions is strictly limited; there is an age qualification for occupying certain posts. The fact that the representative of the "fifth generation" of leaders Xi Jinping will take the helm of the PRC in 2013 was known back in 2007. He will occupy his post for a strictly limited period of 10 years [5, p. 10-12].

However, these forecasts were not actually realized. After a 10-year term at the head of the People's Republic of China, Xi Jinping continued to rule the state. This means that in reality there was a departure from the fulfillment of the political will of the great Deng Xiaoping. And this cannot but cause some concern for the future of the country.

Nevertheless, if we evaluate what happened in China from the standpoint of Confucianism, then this is completely justified, because in particular: "the rights of the emperor are bestowed by heaven and the absolute value is that the country is governed by a sage." This is the same position that Zhao Chunfu attributed in the anti-modernization provisions of the teachings of Confucius.

Against this background, it is very remarkable that in the post-Soviet space in the newly independent states, no conclusions were drawn from the experience of the USSR, which collapsed due to the irremovability of power as well. For example, Nursultan Nazarbayev (Kazakhstan) and Islam Karimov (Uzbekistan) have been leading their states for 25 years. Alexander Lukashenko (Belarus) and Emomali Rahmon (Tajikistan) have been leading their states for over 20 years. In fifth place on this list is Russian leader Vladimir Putin, who has been the leader of his state for almost 20 years. Numerous statements by the Russian president about the finite-

ness of his presidential term lost their significance in January 2020, when a proposal was put forward to amend the current Russian constitution. Despite a certain disguise, the real purpose of the amendments is to extend the authority of the current president.

In our opinion, it is precisely the irremovability of power in these countries, the elimination of even small hints of the emergence of possible serious political rivals, the redrawing of constitutions in order to extend the term of their stay in power, and the main miscalculations and errors in the management of the political systems and economic development of these states are made.

We believe that the teachings of Confucius had a profound impact on the development of the cultural, economic and political spheres of China. All this helps to understand why most Chinese give so much attention to family ties, hard work, education and consider it important to know their place in life and act accordingly. For better or worse, these Confucian concepts have been instilled into people for centuries and penetrated deeply into the mass consciousness. This, in our opinion, to a certain extent ensured the spiritual and economic revival of China at the end of the last century and at the beginning of the present.

References

Perelomov L.S., Confucius. Lun Yu – M.: "Eastern literature", 2001.

2. "Lun-Yu" // Ancient Chinese philosophy in 2 v., V.1. M., 1972.

3. Buichik A.G., Zainagabdinova E.Ch., Sorokina E.V. History of society and democracy. In 2 b. Book 1: The Ancient World, the Middle Ages, and the Renaissance. – SPb.: NW SRI KiPN, 2007.

4. Vorsobin V. The intelligentsia prevented us from rebuilding the country along the Chinese path // Komsomolskaya Pravda. – May 07, 2015.

5. Ermakov D. Without a successor in the head // Profile. - №12. 2015.

6. History of Chinese philosophy. - M., 1989.

7. Huang Ya. Capitalism in Chinese: State and Business / Yashen Huang: Transl. from English – 2-nd ed. – M.: Alpina Publisher, 2012.

8. Chunfu, Zhao. Confucian Ethics and Modernization: Conflict and Integration // China, Chinese Civilization and the World. History, modernity, prospects: materials of the X Intern. sci. conf., Moscow, 22—24 sept. 1999. P. II: China on the path of modernization and reform / Institute of Far East RAS. M., 1999.

PHASES OF THE GLOBAL OIL MARKET

Shakhovskaya Larisa Semenovna
Doctor of Economic Sciences, Full Professor
Volgograd State Technical University
Timonina Victoria Ivanovna
Master of Economics
Volgograd State University

Abstract. For decades, oil has been at the centre of international policy attention, but it is also a reliable source of wealth and political strength. The emergence of oil, which displaced coal from the world's leading energy mix, has shaped a new energy market concept. This concept is based on the possession of hydrocarbon resources by producing countries, which automatically benefit not only the commodity but also the world market.

Keywords: oil, phases of development, pricing, OPEC.

The evolution of the world oil market has made it possible to establish stages of its development, each stage of which has its own concepts and features that have influenced the development of the world system. Because of the enormous evolution, the world oil market has become the basis for the emergence of new players:

– «hedgers» (since 1980-s) – oil consumers or producers who play on futures markets to reduce price risks (NYMEX);

– «oil speculators» (since 1990-s) –players seeking to profit from price fluctuations without oil supply/purchase and working within the market of «paper» oil;

– «non-oil speculators» (mid-2000s) – players with the goal of oil speculators, but they operate across the spectrum of global financial markets [1].

Oil trade –a key point between two poles of the oil industry: the supply of oil (i.e. geological exploration and production) and the demand (i.e. refining, sales of petroleum products to the consumer). It should be borne in mind that oil has no direct uses (because it is treated), which makes it difficult to estimate its value. Therefore, the pricing system in the world oil market has been subject to changes and has formed its own calculation system, which is characteristic of each development period (see fig. 1).

Periods (who sets prices)	Price formula
1928-1947 (Multinational corporation)	Nat -forward: C cif = C fob (Gulf of Mexico) + Fr. real/fict. (Gulf of Mexico)
1947-1971 (Multinational corporation)	Nat -forward: C cif = C fob (Gulf of Mexico) + Fr. real/fict. (Persian Gulf)
1971-1986 (OPEC)	Nat -forward: C cif = C fob (OPEC) + Fr. real (OPEC)
1986- mid-2000s (exchange, hedgers)	Netback: C fob (count.) = C cif/exchan. - Fr. real (considering C cif = stock exchange quotations)
Since the end of the 2000th	Netback: C fob (count.) = C cif/exchan. - Fr. real (considering C cif = exchange not oil quotations)

C cif - the price (at the consumer);

C fob - the price (at the supplier);

Fr. real/fict. - freight rates on real / fictitious delivery of oil from the area Mexican / Persian gulfs;

Fr. real - freight rates for real oil delivery;

C fob (OPEC) - the official holiday price of OPEC countries;

Fr. real (OPEC) - freight rates for the actual delivery of oil from OPEC states to consumers;

C fob (count.) - price fob alculated according to the "counter" price formula (cif price minus transportation costs);

C cif (exchan.)- price set on the exchange

Fig. 1. Evolution of pricing mechanism in the world oil market
Source: [2]

Oil price movements are influenced by both the smallest and the short-est and the long-term dominant trends in world oil and other related mar-kets. Figure 2 shows the evolution of oil prices since 1861.
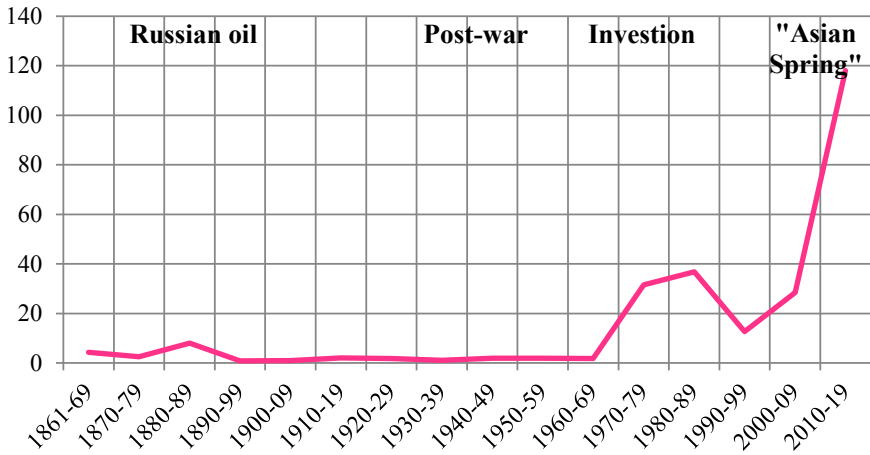
Fig. 2. Dynamics of the oil prices
Source: [3]

Based on Figures 1, 2, highlights can be identified:

- First, in 1880-1899 there were no sharp changes in the price level, as well as in the growth of production. This is due to the restructuring of the institutional structure of the energy system in the world oil market.

- Second, since 1988, there has been a sharp weakening of fluctuations in the range of oil prices and the market relationship between prices and demand, and the decline in prices has consequently affected the growth of demand (oil prices are falling in the face of slow demand growth and slow economic growth). During this period, the activities of OPEC member countries, which sought to regulate in accordance with their strategic guidelines, were actively developed;

- Third, since 2009 there has been a new period in the dynamics of prices, their rapid growth has begun. This happened in the context of accelerating trend growth in the world economy (despite some fluctuations in the rate of economic growth around the trend) and the accompanying acceleration of demand growth.

Notable is the fact that in 1973 in the world oil market began to apply the concept of "official sale prices" for oil (Official Sale/Selling Prices (OSP)). OSP - export prices for raw materials as opposed to traditional reference prices, which are set by producing countries (usually at 92.7% of reference prices). At the same time, it is necessary to take into account the fact that the sales price is not mandatory, as producers are guided by prices that are tied to spot quotations.
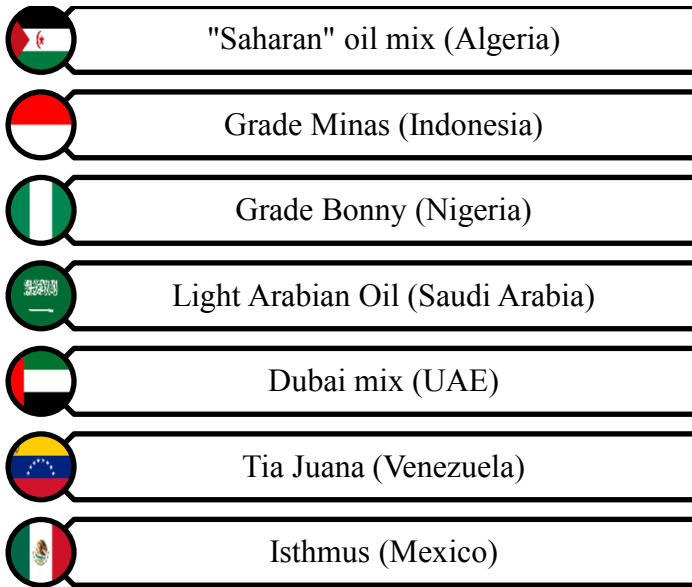
Fig. 3. The composition of the "price basket" on the world oil market [compiled by the author]

In 1974, OPEC practiced a "single sales price" - the price of Arabian oil. It was set at $10,463/barr. However, for participants in the world energy market, the "single sale price" was not applicable to the strategies and objectives that producer countries introduced into their activities. This resulted in a "split" in prices of $12,086 per barrel recognized by Saudi Arabia and $12,704 per barrel by other countries [4].

In 1987, the term "price basket of oil" was introduced. In this concept, the price was set as the arithmetic mean of seven grades of oil (see fig. 3). Currently, the "price basket" includes 13 varieties of oil.

Like any other market, the world oil market has its own development model (see fig. 4).

The traditional model is built on the basis of the oil derivatives market. The modern model was significantly transformed due to a number of factors: the market grew several times in volume; Free market entry for financial investors, various commercial funds, investment banks, etc.; Hedge funds have "dug up" the global oil market while creating a number of diverse instruments.
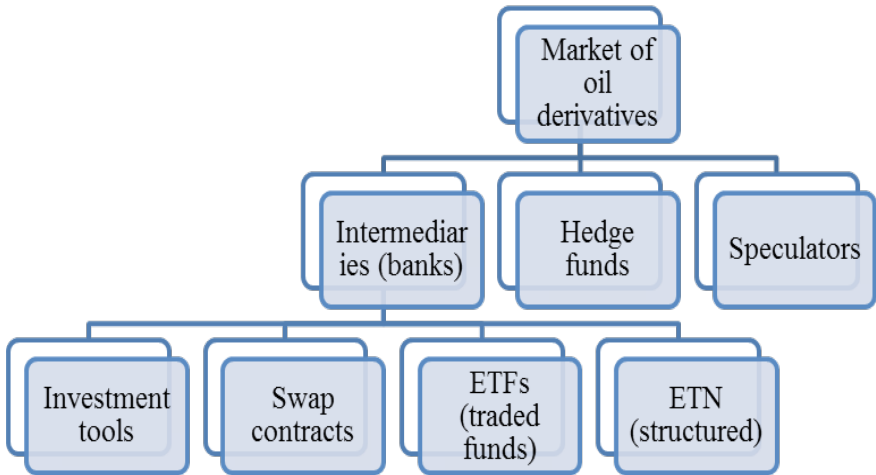
Fig. 4. Modern scheme of development of the world oil market [compiled by the author]

Starting in the 1960s, the world oil market began to be partially controlled by the world oil cartel (OPEC). The countries that entered the cartel became associated with national oil production quotas. The first unsuccessful attempts to limit oil production by OPEC countries date back to 1967. In 1982 OPEC set a single production limit - 17 million 350 thousand barrels/day. [5]

According to some reports, the limits were not met by many countries. Thus, Goldman Sachs estimates that there were 17 OPEC production cuts between 1982 and 2017, when quotas changed at least 52 times. The specified reduction of production was observed by only 60% on average [6].
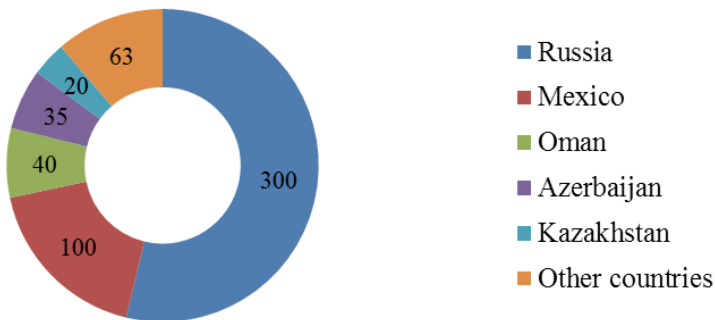
Fig. 5. Reduction of oil production outside OPEC, thousand/barr. (2016) Source: [6]

The oil crisis of 1973 (the "oil embargo") also affected the development of the world market, with six OPEC members (Iran, Iraq, UAE, Kuwait, Qatar, Saudi Arabia) reporting a 5% reduction in production. At the end of 1973, OPEC announced an additional 25% reduction by Arab member states. As a result, oil prices increased from $3 to $12/barr. In early 1974, the embargo was lifted, but prices remained unchanged until 1980. In 2016, plans to reduce production were again implemented (up to 1.2 million/barrel), and the reduction commitment was supported by other non-OPEC countries participating in the world energy market, including Russia (see fig. 5).

According to the author, the oil markets of each country have clear differences not only in their energy policy, but also in the structure of their organization. Despite the fact that Russia is not a member of the OPEC oil cartel and is not the leader in oil production on the world market, it actively participates in the processes of energy development and cooperation. In particular, OPEC - as an active observer. Recently, the development of the Russian oil market, the increase of its competitiveness in the world market has been observed, this is due to the fact that in Russia there are many large projects (including on the Arctic shelf), the purpose of which is to expand the country 's presence in the world energy market and maintain its position not only as the main participant in natural gas production, but also other energy sources.

References

1. Hedgers & Speculators [Online]. Available: https://www.danielstrading.com/education/futures-options-101/hedges-speculators (Jule 17, 2019).

2. Oil pricing systems [Online]. Available: https://www.oxfordenergy.org/publications/oil-pricing systems/?v=f9308 c5d0596 (Jule 17, 2019).

3. Crude oil prices [Online]. Available: https://www.quandl.com/data / BP/CRUDE_OIL_PRICES-Crude-Oil-Prices-from-1861 (Jule 17, 2019).

4. Hartukov, E. Unknown OPEC // Oil of Russia. – 2019. – № 1 – 2. – P. 40–46.

5. Konoplyanik, A. A. Evolution of the world oil market - five stages of development of the organized international market [Online]. Available: www.konoplyanik.ru/130402-Konoplyanik-IOGB-oil-final.pdf (Jule 23, 2019).

6. Goldman Sachs Says OPEC's 'Shock and Awe' Will Drive Oil Higher [Online]. Available: https://www.bloomberg.com/news/ articles/2019-02-13/goldman-sachs-says-opec-s-shock-and-awe-will-drive-oil-higher (Jule 23, 2019).

TECHNOLOGICAL AND INSTITUTIONAL ASPECTS OF WATER REUSE REGULATION

Yerznkyan Bagrat Haykovich
Doctor of Economic Sciences, Full Professor, Head of Laboratory
Central Economics and Mathematics Institute of Russian Academy of Sciences
Fontana Karine Arkadievna
Candidate of Economic Sciences, Senior Research Officer
Central Economics and Mathematics Institute of Russian Academy of Sciences

Abstract. The purpose of this paper is to examine the technological and institutional aspects of water reuse with emphasis on the problem of negative externalities disturbing effective regulation of water supply process. It is shown that the elimination or mitigation of such externality as pollution necessitates at least two kinds of solutions – technological and institutional. The first of them concerns technical methods, such as wastewater treatment and their regular reuse, the second solution deals with the institutional ways of the pollution problem solving. The latter includes (i) a non-market solution, or governmental, as a rule, intervention, (ii) a market solution after the ideas proposed by R. Coase in his famous theorem, and (iii) hybrid way of solution combining the stakeholders' market and non-market activities. All these solutions when being effectively regulated are able to assist to the solution of both economical and environmental problems.

Keywords: water reuse, regulation, pollution, technological aspects, institutional aspects.

JEL Classification Codes: A12, O32, Q25.

1. Introduction

The goal of water reuse regulation is *inter alia* to provide the sustainability of water sector functioning and to reduce the existing and potential pressure on water resources. Effective water resource management involves aligning such strategic decisions that can be minimize potential conflicts and environmental damage within and outside the city, for example, to ensure social justice and economic efficiency in addition to reliable water supply.

Positive outcomes when using water resources emerge frequently in a situation, say, of *automatic irrigation systems* (AIS) functioning in the urban and/or municipal areas, although they may be turned in the opposite being polluted (as in case of urban wastewater).

Ways of the solving the problem of negative externalities depend on two main factors or aspects – technological and institutional. By water re-use we understand above all the use of water based on purified wastewater, especially in the urban area, i.e. in the city limits after cleaning of the households, businesses and organizations. Wastewater is cleaned before reaching a certain quality that is appropriate for its further use in limited applications, taking account of the legislation and the potential risks to human health and the environment. It should be however underlined that urban and industrial wastewaters have different characteristics (e.g., on the content of organic matter, pathogens, heavy metals, etc.) that affect the way they clean for reuse.

As for the institutionalization of the process of water reuse, we stems from the methodology of institutional pluralism which as opposed to institutional monism deals with more than one institutional form or way of realization of economic activity. Such theoretical-methodological demarcation between institutional monism and institutional pluralism has a crucial practical significance. There are some institutional ways to solve the problem of water pollution and its reuse (taxation, regulation, direct intervention, voluntary negotiation, property rights, merges, incentives mechanism design, etc.).

However, two approaches can be underlined – government intervention (because of impossibility of market forces to solve the problem as in the case of market failure) and private way of problem's solving (stems from the possibility, according to famous Coase theorem, of the producer and recipient of externalities to come to the Pareto-optimal result through market transaction). In fact, both of them may theoretically result in Pareto optimum outcomes, but may lead to different income distributions. A kind of another approach, based on relational contracting and regarded as a modification or hybridization of the first two, is given in (Yerznkyan, 2012). In the terms of transactions, the government intervention can be associated with rationing transaction, Ronald Coase solution – with market transaction, and the third approach – with managerial transaction (Yerznkyan, 2012, p. 74).

In this paper, we pay attention to the pollution and its solution bearing in mind that wastewater must be seen not as a waste, from which you want to get rid of, but as a resource, which may be an important ele-

ment in the sustainable management of water resources and become an important lever in solving freshwater shortages, mitigate the effects of climate change, have beneficial effects on the environment (Fontana, Fontana, 2016).

2. Water Reuse Regulation

There are not unified rules and leading principles of treated wastewater reuse regulation – neither in Russia nor in abroad. Taking into account the cultural and institutional differences of countries, to prepare unified rules it is rather insoluble task. As Joseph Stiglitz claims, "countries need to consider the alternatives and, through democratic political processes, make these choices for themselves. It should be – and it should have been – the task of the international economic institutions to provide the countries the wherewithal to make these *informed* choices on their own, with an understanding of the consequences and risks of each" (Stiglitz, 2002, p. 88).

In contemporary Russia, water is counted not as the main resource of life-support of population, but as the expense material. Water reuse of effluents is not examined in a number priority at the decision of ecological and socio-economic tasks, and also as an important element of steady development of water resources. Earlier, in the USSR, for water treatment were used methods that were well shown themselves, including from the point of view of capital investments in sewage treatment plants and their subsequent exploitation, and also positive influence on chemical composition and agro-melioration properties of irrigable soils, productivity of rural economy cultures. The similar systems and practices were recommended to wide introduction in practice of agricultures production, but however in future wide distribution of treated wastewater reuse did not get.

Many of the internationally accepted legislative documents do not have analogues in the Russian legal field. According to the rules and norms accepted in Russia, all effluents (before their up-cast in reservoirs) must be cleared to the level of *maximum to the possible concentration* and *approximately safe levels of influence* corresponding to the up-cast in the reservoirs and currents, intended for the economic-drinkable, cultural and welfare or fishing industry setting.

3. Technological Aspects of Water Reuse Regulation

As it is known, the basic concept of wastewater reuse was formulated by UN Economic and Social Council in 1958, under which the water of high quality shall not, unless it has in abundance, to be used for the purposes that allow use of water of lower quality.

Technologically, this concept can be realized by a lot of ways, say, by using AIS – an engineering complex (equipment with varying degrees of automation – from a simple timer to remote control using specially developed *information technologies*, IT, for such systems), designed to supply water to plants in conditions of limited rainfalls and providing for an accurately calculated volume of water for irrigation each kind of plants.

The logical development of the reuse (possibly, one-time) use of water is the formation of a *circular* (multiple) economy – a special type of economy based on the use of renewable resources and which is opposite to a traditional, linear economy based on the creation, use, and disposal of them.

In (Yerznkyan, Fontana, 2018) it is shown the significance of innovative ways of the use of water resources and is underlined that they, being one of the main resources necessary for human life, are capable, when used correctly, of becoming one of the key factors in the sustainable development of the socio-economic system, in particular, urban economy. Such use implies a reliance on innovation and digital technology, as well as effective management based on the opportunities provided by the circular economy.

Water reuse technological problems are a part of the economic-ecological problems whose decision includes water supply and control. Projects being technically feasible, however, may not be realized because of institutional, legal, economic, ecological, organizational and other barriers, bad perception of public, exhaustive quality and quantitative null data. These non-technical barriers are limitation for expansion of planning and adjusting of the water reuse, and they need in regulative documents.

4. Institutional Aspects of Water Reuse Regulation

A lack of standard institutional solutions including the uniform global guidelines and rules governing the reuse of wastewater with technological methods and generally accepted levels of wastewater treatment, based on the further use in specific applications is a significant deterrent to the expansion of water reuse practices (Yerznkyan, Fontana, 2019).

4.1. Government Intervention / Regulation. As it is well known from the classic university course of economics, pollution as an example of the negative externalities leads to a market failure, and to solve this emerged problem parties involved in this process need to appeal to government: the recipients of negative externalities, suffering from external costs, wish them to be reduced or completely vanished at. As a rule, they appeal to the government so that it, by virtue of possessing legitimate authority to pressure the producers of negative externalities, would restore justice and redistribute them – completely or in part – in their own direction.

There are some regulating mechanisms to solve the problem: (i) a Pig-ouvian tax (i.e. a special tax that is often levied on companies that pollute the environment or create excess social costs); (ii) a technical mechanism can be realized through the purchase and implementation of treatment facilities or replacement of environmentally unacceptable equipment and / or technology; (iii) an economical mechanism can be realized through [the threat of using] penalties, forcing the company to resort to technical means of solving the problem; (iv) legal intervention aimed at ameliorat-ing the problem (it may include direct regulation by restricting permissible behavior; (v) injunction (a potential victim can enlist the power of the state to force a potential injurer to take steps to prevent harm); (vi) corrective tax (in Pigou tradition); (vii) financial incentives (society can make use of them to induce injurers to reduce harmful externalities), and so on (Yerznkyan, 2012, p. 75).

The effectiveness of solving the problem depends on the strength of government. When it is weak, the beneficiaries will be the producers of negative externalities. Although the effectiveness of the government in contemporary Russia is not high, it is difficult to find an alternative to the government intervention, which includes regulative, legislative and other institutional forms of the problem solving. In this regard, we recall that many problems of the Russian economy arose directly or indirectly due to the fact that the state did not play its proper role, including the role of the market relations' organizer.

4.2. Coase's Market Bargaining. There are some versions or defini-tions of the Ronald Coase considerations (1960) and what lately George Stigler called "Coase Theorem". Here is one the definitions: "*If* (a) property rights are well-defined, (b) transactions costs are trivial, and (c) wealth effects can be ignored, *then* externalities are internalized through the self-interested negotiations of the parties involved, resulting in the same al-location of productive resources regardless of who possesses the prop-erty rights or liabilities so long as these rights are well specified" (Mitchell, Munger, 1991, p. 532).

According to Coase Theorem, as soon as the powers are in the coun-tries with common law of the market subject of bargaining, then – under certain conditions – the producer and consumer of negative externalities can solve the problem without resorting to a third party – the government. It means that if trade concerning externalities is possible and if there are no transaction costs, bargaining will lead to an efficient outcome regardless of the initial allocation of property rights. It is of great importance that the so-cially efficient level of pollution is by definition a Pareto optimum. If an out-

come is not a Pareto optimum, it could be improved in the process of negotiations between counteragents involved in the bargaining transaction.

And although in this case the government is not a player directly involved in the game, "it may be (even more so, in fact, it should – in a situation of formal and legal transactions) the guarantor of the fulfillment of the market contract" (Yerznkyan, 2012, p. 77).

In (Varian, 1987), such a bargaining according to Coase theorem is illustrated graphically "on the Edgeworth box – a convenient analytical tool of relations between market parties with the help of indifference curves, which allows in visual form to present the process of contracting individuals entering into a mutually beneficial, Pareto-efficient exchange of their goods" (Yerznkyan, 2012, p. 78).

4.3. Relational Contracting. In the case, when the producer and consumer of negative externalities are stakeholders (i.e. players related in some sense to activity in question), not impersonal contracting parties, realization of classic contract is, strictly speaking, impossible. To be more precise, such a contract between personalized parties will not be, by definition, a market one. This kind of interaction is appropriate to describe in the language of relational contracting.

What is the effectiveness of the implementation of managerial transaction? In modern Russia, the reality is that because of the immaturity of civil society, *de facto* authority is on the side of corporations. It is reasonable to wonder why then corporations prefer to chose relational (if market bargaining is impossible) contracting and to ignore government intervention. The answer is that this method is economically more advantageous to the same and more attractive to a broader point of view – public opinion, environmental agreements, preservation / enhancement of reputation, etc.

The realization of the relational contracting depends largely on the characteristics of ways of doing business – formally or informally, legally or illegally, following written or unwritten institutions and so on. One of the popular informal business practices in Russia – business 'po ponyatiyam' – which can be understood as a specific kind of relational contracting, may be explained from either synchronic (high value of transaction costs of interaction giving rise to a *lock-in effect*) or diachronic (historical legacy in combination with weak legal system shaping an effect of *path-dependency*) perspective.

As to these two effects, let us underline that the lock-in effect means that "once reached, a solution is difficult to exit from" and the path-dependance effect – that "the consequents of small events and chance circumstances can determine solutions that, once they prevail, lead one to a particular path" (North, 1990, p. 94).

By its institutional form the situation of relational contracting is fundamentally different from those considered earlier, which were dyadic from the agency perspective. In the first case we deal with the government and company as the pollution producer, in the second case – with the company and society/community involved in the problem's solution. In the last case a significant role plays the third party, however not as a contract enforcer but as a 'gate-keeper', and this role can really be played by the state/government. The notion 'gate-keeper' was offered by Anton Oleinik (see, e.g., 2007, 2011) for explaining a possible transition from a dyadic relationship between two counterparties (say, A and B) to a triad (A. B. and, C) relationship. By 'gate-keeper' it is understood that the third party can regulate access to the field and make it conditional upon acceptance of a particular institution. There is some connotation between this statement and the three forms or general patterns of exchange of Douglas North: personalized exchange, impersonal exchange without third party enforcement, and impersonal exchange with third party enforcement (North, 1990, pp. 34-35).

In addition, we underline that the role of the third party (as gate-keeper, not enforcer) in the Russian practice of the externalities problem solving, can be played only the state (centralized or decentralized government).

Graphically, this case of contracting can be illustrated on the modified form of Edgeworth box by offering a version of Coase theorem based at the fuzzy concepts, "given that decision-makers are often unable to articulate not only their requirements, but also their own preferences, not to mention the difficulties of predicting the preferences of their counterparts" (Yerznkyan, 2012, p. 85).

5. Conclusion

The provision of water resources and their use for one purpose or another is usually accompanied by external externalities – positive and / or negative. The former contribute to the sustainable development of, in particular, "smart cities", while the latter create problems that need to be solved. Generally, such solutions have two dimensions – technological and institutional.

Unfortunately, in the context of growing environmental problems around the world and aggravation of global challenges for humanity in the field of water supply, Russia still does not pay enough attention to the issues of the rational use of water resources, in particular in the urban economy, the search for alternative ways to supply water (for example, treated wastewater) and water saving through a wider use of automatic irrigation systems.

However, a lack of effective regulating guidelines, rules, methods and clear policies of wastewater treatment is a significant deterrent to the expansion of water reuse practices.

In this paper, several institutional ways for solving the problem of negative externalities – government regulation, Coasean internalized solution, and relational contracting – have been presented. We have compared these three institutional approaches with three types of transaction (distributional/rationing, exchange/bargaining, and a kind of managerial, accordingly) and have emphasized that their merits are not uniform and need to be assessed with both the formal institutional rules and the informal institutional norms of real practice, especially in nowadays Russia.

All the three institutional alternatives regarded with the three corresponding types of transactions are based on the idea of *power as a force*: i) possibility of the *rationing* transaction can be explained by the state power to take enforcement of fair from its point of view options of redistribution of negative externalities; ii) possibility of *market solution* or *bargaining* transaction is based on the internalization of enforcement function by counterparts who have enough force to implement this contractual function; iii) possibility of the *managerial* transaction is based on the contracting force to realizing the relational contracting.

In conclusion, it should be mentioned that in order to achieve positive results in the rational and efficient use and reuse of water resources, the uninterrupted supply of clean water to the population, it is necessary a systemic measures including a set of interrelated ways implemented jointly by state authorities and local self-government, private business, the financial sector, and scientific organizations.

References

1. Coase, R.H. (1960). The Problem of Social Cost // Journal of Law and Economics, 3: 1-44.

2. Fontana, K.A., Fontana, C. (2016). Wastewater Use: A New Opportunity for the Green Economy. General overview, Actual Problems of Humanitarian and Natural Sciences, 3, March, Part II: 8–11 (in Russ.).

3. Mitchell, W.C., Munger, M.C. (1991). Economic Models of Interest Groups: An Introductory Survey // American Journal of Political Science, 35, 2, May: 512-546.

4. North, D.C. (1990). Institutions, Institutional Change and Economic Performance. Cambridge: Cambridge University Press.

5. Oleinik, A. (2007). Minimizing Missed Opportunities: A New Model of Choice? // Journal of Economic Issues, 41, 2: 547-556.

6. Oleinik, A. (2011). Market as a Weapon: Domination by Virtue of a Constellation of Interests // Forum for Social Economics, 40, 2: 157-177.

7. Stiglitz, J.E. (2002). Globalization and Its Discontents. London: Allen Lane. The Penguin Press.

8. Varian, H.R. (1987). Intermediate Microeconomics: A Modern Approach. New York and London: Norton.

9. Yerznkyan, B.H. (2012). Pluralistic Institutional Solutions of the Problem of Externalities // Montenegrin Journal of Economics, 8, 2: 73-86.

10. Yerznkyan, B.H., Fontana, K.A. (2019). Water Reuse and Its Regulation in Russia and Abroad // Materials of the International Conference "Scientific research of the SCO countries: synergy and integration" – Reports in English (July 12, 2019. Beijing, PRC): 16-23. DOI:10.34660/INF. 2019. 12.33342.

EVOLUTIONARY LOGIC OF ORGANIZATIONAL DEVELOPMENT

Yerznkyan Bagrat Haykovich
Doctor of Economic Sciences, Full Professor, Head of Laboratory
Central Economics and Mathematics Institute of Russian Academy of Sciences

Abstract. The purpose of this paper is to demonstrate and explain the evolutionary logic of organizational development from enterprises (firms or hierarchies) through hybrid arrangements to ecosystems (networking or non-hierarchical systems). Such logic includes at least two aspects of consideration – existential and transactional. The first of them means that enterprises are treated as existing objects, mainly legal entities entering into explicit contractual relations and/or practicing implicit relations within themselves; other organizational forms may be legal or non-legal entering into explicit or rather implicit contractual relations. The second aspect of consideration accentuates their transactional characteristics studied in dynamics that is matter especially in interaction between firms or between existing or potential elements of hybrid structures with the criterion of minimization of transaction costs of interaction. Another organizational logic emphasizes networks as a fundamental material of the emergence of new – fundamentally non-hierarchical structures – organizations relied on the information power provided by the new technological paradigm. Scientific significance of the study lies on the possibility of existence of different organizational forms simultaneously as well as on the acceptance of varieties of forms within them. Methodologically, the study is based on the system analysis and the concept presentation of systems as objects, environments, processes and projects. The practical significance of the study is based on the possibility of applying the results of the work in the activities of federal and regional authorities involved in the strategic management of innovative organizational forms, especially ecosystems as the most perspective and reliable organizations of the new technological system.

Keywords: hierarchies, hybrids, ecosystems, coexistence of different organizational forms.

JEL Classification Codes: B41, D20, L10, L22.

1. Introduction

The goal of organizations such as enterprises and the like is to provide economic activity with acceptable costs – both transformational and transactional. Historically, they emerged and developed from hierarchical – through hybrid – to non-hierarchical organizational forms with their relevant institutionalization. It should be added that such logic of organizational forms evolution does not deny earlier forms: all forms of business organizing can simultaneously coexistence, however with varying degrees of dominance (Yerznkyan, Omarova, 2016).

Their adequate choice depends largely on the aims and possibilities of economic agents involved in the process. The situation of such a choice can occur at various levels and types / forms of economic organization. It is important to add that organizational choice is corresponded with institutional choice, when economic agents must choose, for example, to which institutional mechanism of the transaction to give preference to – a formal contracting mechanism, informal, based on trust, or some other, possibly, combined hydrochloric contracting form. The outcome may depend, among other things, on the specific carriers of human and social capital involved in the interaction, on the quality of their cognitive diversity and capital. Such demarcation between organizational choice and institutional choice means demarcation between organizations and institutions as well, although in a larger sense a notion of institutions may include a lot of things: firms, states, markets, money, households, and other vital institutions and organizations.

Whereas earlier, both in theory and practice, enterprises (hierarchies, firms) and then hybrid arrangements (devices with market and non-market characteristics, such as groupings of firms, say, financial-industrial groups with Russian, Japanese, Korean and other specifics) were the main basic economic units, ecosystems (non-hierarchical structures, networks, project organizations) nowadays take a more leading place. One of the reasons for the economic drift from hierarchies to non-hierarchical structures is the understanding that in today's institutional environment the traditional focus on competition fails to meet the challenge of achieving economic development, which leads to the need for joint action by various, even competing, economic agents.

It may be shown that peculiarities of different organizational forms and structures of control can be revealed in terms of inherent nature of contracts – implicit or explicit, binary or ternary. It will be shown that intra-firm interactions (transactions) are carried out on the basis of implicit ternary contracts (the role of third party – coordinator – is performed by manag-

ers), market interactions with intermediaries – on the basis of explicit ternary contracts (intermediaries of transactions' counter-parties), market interactions without intermediaries – on the basis of explicit binary contracts, and, finally, network interactions in ecosystems – on the basis of implicit binary contracts.

It should be underlined that our study, based on the four-element system methodology proposed and developed by G.B. Kleiner, uses presentation of systems as (1) objects (with certain form, but without certain configuration of life cycle), (2) environment (without certain spatial form and without certain configuration of life cycle), (3) processes (without certain spatial form, but with certain configuration of life cycle) and (4) projects (with certain form and with certain life cycle) (Kleiner, 2005; 2008).

2. Firms / Enterprises

There are various theories of the enterprise or firms, which may be briefly presented as follows.

In the *traditional* theory, the firm is a device for doing the production function and as such can be adequately described as a *black box,* whose internal arrangement is unknown to the investigator. Such is firm's understanding by the classic of economic theory Adam Smith and his neoclassical followers, A. Marshall (1919) for example.

In the *transactional* theory, whose founder is R.Coase (1937), black box of the firm is changed to the *grey* or *transparent box,* where firm is treated in the first turn as a *governance structure* (Williamson, 1975; 1985).

In the *contractual* theory, firm is regarded as a *nexus of contracts* (Jensen, Meckling, 1976), where both contracts and their nexus are able to demonstrate a certain variety.

In the *evolutionary* theory, fundamental role for firms' understanding play routines – in a certain sense the genes of firms (Nelson, Winter, 1973).

In the *system-integrative* theory, enterprises is understood as a system with four types of subsystems or system types – object, environment, process, and project (Kleiner, 2005).

In all of these and other theories the firm is treated as a certain entity to be studied by various methods and methods adopted in the approaches used.

In contrast to these theories, in (Akinfeeva, Yerznkyan, 2017) it is proposed to approach the firm as a not-yet-proved given, to the firm as its embryo. The meaning of this interpretation is to identify the specific features of the company acquired in its embryonic state, namely, predisposition, inclination, devices for mastering language and thought, etc. As an example of not so many firms in the conventional sense as their forerunners are the

startups, whose main goal of the existence and generic feature is neither production, nor a focus on profits, etc., but aging, in other words, growth, up to the birth of the company as such. A company that is treated as an embryo requires interdisciplinary knowledge for its identification.

Let us now consider some characteristic features of firms / enterprises as given or existing phenomena:

- legal face;
- complete hierarchy;
- market competitive relations between organizations;
- market interactions between them;
- continuous life-time;
- object-type of systemic presentation for outside world and integrating all other types within itself.

Such complex forms of economic organization can also be mentioned in terms of the ecosystems of J. Moore 's business, stressing the importance of building relationships between partners – both large companies and small and medium-sized enterprises – on the basis of interdependence and cooperation (Moore, 1996). Regardless of the organizational form of a particular corporate system, its effectiveness is directly dependent on the relevance of its supporting institutions. As such organizational choice is at the same time institutional choice as well. Institutional reinforcement of the forming the corporate system organizations is a dynamic process that responds to internal and external changes, to changes in the guidelines and imperatives of its development.

3. Hybrid Arrangements

Efficiency of managing the hybrid arrangements activity depends largely on the cultural and institutional contexts specificity (Yerznkyan, Gassner, 2018). These contexts are superimposed on genetics: generally speaking, "Western civilizations with their inherent two-valued logic of thinking are more prone to economic exchanges – transactions, while Eastern civilizations, with their multi-valued logic – to social exchange processes – interactions. At the same time real people in West in certain circumstances may prefer social markets to economic ones and people in the East can give preference to economic markets over the social ones" (Yerznkyan, Vinokurova, 2019, p. 58).It should be added, that the relevance of culture and institutions are of particular importance in the process of reform. In Russia, for example, political factors, with uncritical import of formal institutions, rather than economic factors played a significantly greater role in changing its trajectory of development (Yerznkyan, Gassner, 2018, p. 133, 135).

Such phenomena as codes of conduct, norms of behavior, and conventions, which are "a part of heritage that we call culture" (North, 1990, p. 37), are of great significance especially in hybrid structures, say, many of the contemporary Russian corporations which use hybrid agreements and mechanisms of transaction management. Some specific cultural characters of the organizations of inter-firm cooperation in the Russian industrial market and some of Russian-specific cultural factors applying to these organizations revealed by them are studied in (Popov, Simonova, 2015). Culture and institutions may be well enough understood in the language of information transmission "from one generation to the next, via teaching and imitation, of knowledge, values, and other factors that influence behavior" (Boyd, Richerson, 1985, p. 2).

Hybrid arrangements are characterized be the dominance of networking relations, the combination of vertical and horizontal forms of coordination. Let us consider characteristic features of such type of organizations:
- rather economic, than legal face;
- lesser hierarchy than firms' hierarchy;
- quasi-market and quasi-firm relations between organizations;
- interactions on the base of relational contracting;
- mixture of continuous and discrete life-time;
- process system type.

The fact that hybrid arrangements are characterized by the dominance of networking relations must be interpreted in such way that organizationally they belong to ecosystems, as it is done, say, in (Popov, 2016). However, in this paper hybrids, treating mainly in a sense connected by relational contracting, are considered as separate organizational forms occupying intermediate place between enterprises and ecosystems.

4. Ecosystems

In a paper by V.E.Dementyev (2018), devoted *inter alia* to the study of ecosystems of business, particular attention is drawn to the network organization, which refers to a group of formally independent economic entities, related to each other by trust relationships, the benefits of cooperation, and long-term cooperative and information links. The notions of trust and cooperation are important for an appropriate understanding the very essence of formation and evolution of ecosystems.

Chronologically, development of a variety of business ecosystems includes: (i) a stage of formation; (ii) a stage of expansion; (iii) a stage of increasing role of centralized coordination (the stage of power, it is also the end of the industrial revolution); (iv) a stage of responding to new challenges (associated with the birth of the next technological revolution).

As a whole, ecosystems of different kind, including innovation-oriented ones such as start-ups, technological parks and platforms and so on, are organizational structures of rather middle than micro-economic level contrary to the firms – entities of microeconomic level. They are characterized by the dominance of institutions of trust and cooperation as tools for achieving advantages in an innovative economy. In ecosystems, the abovementioned contexts of culture and institutions matter as well – perhaps more than in the enterprises and hybrids – because of their deeper and more holistic ability to construct and explain the new economic reality (Yerznkyan, 2018, p. 93). Taking it into account, let us consider characteristic features of ecosystems:

- economic face of organization;
- absence of hierarchy;
- cooperative, networking relations between organizations;
- interactions on the base of the implicit and mostly informal institution of trust enforced by explicit contracts;
- discrete life-time;
- project system type.

It is of great interest that ecosystems or networks of enterprises as various forms of interactions between economic agents / entities have been known since the middle ages. However, inter-firm networks became a subject of fixed attention of scholars just in recent decades (Popov, 2016, p. 10, 12).

In modern times there are some globally accepted and world-wide known indicators – integral indices – concerning the ecosystems potential at different levels and network readiness to function: Knowledge Economy Index (KEI), Knowledge Index (KI), Informational Society Index (ISI), Information & Communication Technologies Development Index (IDI), Global Innovative Index (GII) and others. However, the most precise and authoritative source of international evaluation of network technologies influencing the competitiveness and well-beings of a lot of countries is perhaps the Network Readiness Index (NRI).

There are lots of examples of effective functioning of ecosystems, especially innovative ones. An interesting case of innovative territorial cluster is presented in a paper (Fonotov, Bergal, 2019), where the authors examine these kind of clusters, proposing a technological platform to play a role of system-forming element of the cluster functioning mechanism. Let us underline that both cluster and its element – technological platform – are ecosystems.

5. Conclusion

This paper has been brief and highly selective, concerning on the logic of evolution of organizational forms – mainly the enterprises, hybrids and ecosystems – with discussion of their specific characteristics.

The degree of prevalence of organizational characteristics can vary from system to system - up to the transformation of the corporate system into a single hierarchical corporation (firm or enterprise) on one pole and up to its performance in the form of a fundamentally non-hierarchical network organization (ecosystem) on the other.

To shun misunderstanding, it should be underlined that presented in this paper logic of organizational forms' evolution by scheme "firms – hybrids – ecosystems" does not mean that a comparatively new form of organization force out completely the others: all the forms can and in reality do coexist. Moreover, they may intersect, combine more complicated systems and non-traditional organizational configurations, *etc*. Such is reality, and a task of science is to explain the formation and evolution of newly emerged organizations.

References

1. Akinfeeva, E.V., Yerznkyan, B.H. (2017). Project Economy and Network Organization of Innovative Business // Theory and Practice of Institutional Reforms in Russia [Text]: Collection of Scientific Works / Ed. by B.H. Yerznkyan. Issue 43. Moscow: CEMI RAS: 6-17 (In Russ.).

2. Boyd, R., Richerson, P.J. (1985). Culture and the Evolutionary Process. Chicago: University of Chicago Press.

3. Coase, R. (1937). The Nature of the Firm // Economica, 4: 386-405.

4. Dementyev, V.E. (2018). Industrial Revolution and Evolution of Business Ecosystems // Theory and Practice of Institutional Reforms in Russia [Text]: Collection of Scientific Works / Ed. by B.H. Yerznkyan. Issue 42. Moscow: CEMI RAS: 6-13.

5. Fonotov, A.G., Bergal, O.E. (2019). Territorial Clusters as a Mechanism for Spatial Development of Russian Economy // Journal of Economic Theory, 16, 4: 673-687 (In Russ.).

6. Kleiner, G.B. (2005). System-Integrative Theory of Enterprise // Montenegrin Journal of Economics, 1, 2: 21-40 (In Russ.).

7. Kleiner, G.B. (2008). System paradigm and system management // Russian Journal of Management, 6, 3: 27-50 (In Russ.).

8. Marshall, A. (1919). Industry and Trade: A Study of Industrial Technique and Business Organization. L.: Macmillan.

9. Moore, J. (1996). The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. New York: Harper Business.

10. Nelson, R.R., Winter, S.G. (1982). An Evolutionary Theory of Economic Change. Cambridge, Massachusetts, and London, England: The Belknap Press of Harvard University Press.

11. North, D.C. (1990). Institutions, Institutional Change and Economic Performance. Cambridge: Cambridge University Press.

12. Popov, E.V. (2015). Institutions. Ekaterinburg: Institution of Economics, Ural Branch of Russian Academy of Sciences (In Russ.).

13. Popov, E.V. (2016). Networks. Ekaterinburg: Institution of Economics, Ural Branch of Russian Academy of Sciences (In Russ.).

14. Popov, E., Simonova, V. (2015). The Impact of Culture on the Inter-Firm Relations in Corporations // Montenegrin Journal of Economics, 11, 1: 39-52.

15. Williamson, O. E. (1975). Markets and Hierarchies: Analysis and Antitrust Implications. New York: Free Press.

16. Williamson, O. E. (1985). The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. New York: Free Press.

17. Yerznkyan, B.H. Innovation Ecosystems Strategizing in the Conditions of Clokotrization of the Transition Period // Theory and Practice of Institutional Reforms in Russia [Text]: Collection of Scientific Works / Ed. by B.H. Yerznkyan. Issue 47. Moscow: CEMI RAS: 87-94.

18. Yerznkyan, B., Gassner, L. (2018). Cultural and Institutional Differences at the National and Regional Levels // International Journal of Economics, Finance and Management Sciences: 4, 3: 133-138. DOI: 10.11648/j.ijefm.20180604.11.

19. Yerznkyan, B.H, Omarova, Z.K. (2016). Development of the Corporate Forms of Organization of the Production-Business Activity // Microeconomics, 4: 17-22.

20. Yerznkyan, B.H, Vinokurova, N.E. (2019). Has Homo Economicus Nationality? // Theory and Practice of Institutional Reforms in Russia [Text]: Collection of Scientific Works / Ed. by B.H. Yerznkyan. Issue 47. Moscow: CEMI RAS: 58-68. DOI: 10.33276/978-5-8211-0779-4-58-68.

ON THE IMPLEMENTATION OF THE REGIONAL PROJECT "TEACHER OF THE FUTURE" OF THE NATIONAL PROJECT "EDUCATION" IN THE KHANTY-MANSIYSK AUTONOMOUS OKRUG – UGRA

Diveeva Galina Vyacheslavovna
Candidate of Pedagogical Sciences, Director
Institute for Educational Development, Khanty-Mansiysk, Russia

Annotation. The article reveals some features of the implementation of the regional project "Teacher of the Future" through the identification of professional deficiencies of teachers, the implementation of individualized (personified) programs for the professional development of teachers, the creation of a center for the continuous improvement of professional skills of teachers in the autonomous region.

Keywords: national project, teacher of the future, competencies, continuous improvement of professional skills, teachers, digital literacy

The regional project "Teacher of the Future" is one of the significant projects aimed at creating the conditions for the development of the key competencies of teachers that the "teacher of the future" should possess.

And now and in the future, the teacher should not only offer ready-made knowledge, but also teach the student to get it and use it wisely, its task is to teach children to learn. At the same time, in the context of the introduction of digital technologies, teachers will have to master in the new education system. Active inclusion of digital technologies in the educational process will require teachers to develop professional competencies, both in the field of IT, and the development of cross-cutting non-specialized soft skills.

Thus, the key competencies that a teacher of the future should possess, on the one hand, are IT competencies (a system of applied knowledge, skills and attitudes that organize all stages of pedagogical work and improve the quality of education based on the opportunities provided by digital technologies (individualization of instruction, technical solution to creative problems, interactive design work, etc.)). The digital literacy of the teacher must be at a high level. The teacher must demonstrate knowledge of modern technological trends, skills in working with electronic educational resources, modern gadgets and applications, and attitudes towards

the benefits of technological innovations.

On the other hand, the teacher of the future must possess Soft-Skills competencies. This is a teacher with a high level of emotional intelligence, who knows how to work in a team, effectively build communication, has managerial abilities, shows leadership qualities, effectively manages time, and has the skills to quickly make decisions on emerging problems.

The insufficient development of these competencies is a serious professional deficit today, which prevents teachers from adapting to changing conditions of professional activity.

Therefore, in the Autonomous Institution of Continuing Professional Education of the Khanty-Mansiysk Autonomous Okrug - Ugra, the "Institute for the Development of Education", the diagnosis of professional difficulties for teachers is systemic. Organized diagnostic procedures show what professional difficulties (deficits) arise for teachers in the Autonomous Okrug.

First of all, this is the problem of insufficient knowledge of digital skills, which is associated not only with the field of application of personal computers, but with the skills of competent use of information and communication networks and technologies, with the acquisition of the necessary knowledge and experience, and the ability to transfer them to students.

Teachers have certain difficulties in using teaching methods for children with disabilities or having behavioral problems.

Also noteworthy is the level of formation of the emotional-improvisational style of teaching for teachers, which is manifested in a poor knowledge of the technologies for interacting with different types of students, inadequate contact, insight, and underdeveloped skills; it is interesting to present educational material, to captivate children with a subject, to vary various forms and methods learning.

A frequently encountered deficit is the education of gifted children, solving problems of increased complexity with students in the framework of the taught subject.

Young teachers point out the difficulties in applying effective technologies for motivation and assessment of students.

In the framework of the "Teacher of the Future" project, not only deficiencies are identified that cause difficulties in the implementation of pedagogical activities and hinder the full integration of teachers into the modern educational ecosystem, but also the conditions are created for the continuous development of professional competence.

This is aimed at the activities of the Personal Potential Development Program, which is implemented in the okrug from 2019 to 2023 as part of the signed agreement between the Department of Education and Youth

Policy of the Khanty-Mansiysk Autonomous Okrug - Ugra, Sberbank of Russia Public Joint-Stock Company and the Contribution to the Charity Fund future". In 2020, 12 educational organizations of the Autonomous Okrug participate in the project, by 2023 another 60 educational organizations of Ugra will enter the project.

The program is aimed at developing 4 universal competencies (4K) in children - creativity, critical thinking, communication and cooperation. For this, teachers will have to master pedagogical techniques and tools aimed at developing universal competencies (4K). Over the course of 5 years, more than 500 teachers of the district will be included in the process of introducing teaching and methodological kits on the socio-emotional development of children for preschool children and primary school children and the development of the personal potential of adolescents.

Within the framework of the program, it is planned in educational organizations to introduce a new spatial solution "Kubrick" into the educational environment (a constructive modular solution, with its help the spatial-spatial part of the educational environment can be made comfortable, attractive and suitable for different types of educational activities, within KUBRIK all events and programs implemented in an Edutainment format (training sessions in a playful way) combining entertainment and learning; priority is given to joint activities of children and zroslyh as cooperative learning - a key motivating factor for development of new), which in turn allows children how to share with the teacher, and individually play, learn, communicate.

An important role in the project is given to the teacher, he, in turn, is a translator, mentor, example for his students, which certainly imposes certain requirements on him, he himself must possess these skills and competencies. Therefore, we are faced with the task of continuing training of teachers, the solution of which will become an integral part of the Center for Continuous Professional Development of teachers.

Thus, the creation of conditions for the development of competencies that meet the challenges of modern education is a priority for the Centers for Continuous Professional Development of Teachers who will be created in the district in 2021-2022. Moreover, the leading principles for the implementation of professional development programs in these centers are individualization and personification, taking into account the needs and professional deficits of teachers.

Highly qualified specialists from the center for continuous professional development of teachers, leading regional universities, leaders and teachers - winners of professional skills contests, members of professional com-

munities of teachers and leaders will be involved in the development of educational programs for continuing professional education implemented at the centers.

Currently, work is underway to modernize the system of continuous training, its transfer to a system of continuous improvement of professional skill.

New in the implementation of additional professional programs is to increase the professional skills of teachers using "horizontal training" within the framework of the functioning of the P2P system (peer-to-peer - equal to equal; in P2P education means the recognition that each of the participants potentially has an important and valuable to everyone else information, and it can enrich anyone who takes part in the process; everyone can act as "students" and "teachers"), which actively involves re a course of professional communities of educators and heads of educational organizations. It is planned to actively involve regional innovation sites for internships, as well as winners and prize-winners of professional skills contests as tutors, mentors and coaches for teachers. All this effectively uses the resource of professional communities of educators.

Professional care for each teacher is the key to the success of the "Teacher of the Future" project.

THE USE OF SOCIAL NETWORKS FOR THE DEVELOPMENT OF UNDERGRADUATE STUDENTS' COMMUNICATIVE COMPETENCE

Vikulina Maria Anatolievna
Doctor of Pedagogical Sciences, Full Professor
Panchenko Yury Yurievich
Senior Lecturer
Linguistics University of Nizhny Novgorod

Abstract. The present articles deals with the possibilities of the use of social networks for developing undergraduate students' communicative competence. An attempt of organization of a series of various communicative web projects is described and the results of measurements of changes in students' communicative dynamics are analyzed. The research was conducted in the Linguistics University of Nizhny Novgorod in a group of undergraduate students on the direction 41.03.01 "Regional studies" (profile "Asian studies (East Asia, Japan)"), studying Japanese as a first foreign language.

Keywords: communicative competence; method of projects; electronic competence; social networks; web project.

One of the tendencies of the modern educational process is an active implementation of information technologies in its various aspects. However, social networking sites and mobile applications tend to be left behind as their use tends to be limited to a mere organization of everyday exchange of current information or ends up in students' passive perception of the information which has been already created in various communities in social networks. Unfortunately, in this form of use the nature of social networks which is communicative in itself and therefore their communicative potential become disregarded.

We consider social networks as a platform to organize students' virtual communication in a foreign language. Such communication can be conducted in the exchange of comments under the posts, pictures, videos or in special sections of discussions. While performing this kind of activity students have to actualize accumulated language tools interacting with each other and thus their communicative competences in foreign language are being fostered.

As S. Hargadon remarks, the development of tools of electronic communication (Web 2.0) contributes to unprecedented development of creativity based on collaboration. Some researchers [1, 2] emphasize colossal possibilities to foster communicative competence by using electronic tools and social networks in particular. An electronic communication can occur at any place at any time and is not limited to the physical space of a classroom. Furthermore, the use of information technologies in itself has an influence on the development of communicative skills. Yu.D. Babaeva and A.E. Voskunsky [2] speak about the revival of written communication as a result of the use of electronic communicative tools.

As a technology for the organization of communicative activity within a social network we chose method of projects [3, 4]. Project activity in the electronic environment is learners' activity which is connected to the use of information technologies for the creation of a certain electronic product. This activity acquires a communicative aspect when a purposeful communication within the virtual environment is fostered [5]. In order for this to become possible an electronic project should include a clearly formulated communicative task.

The diagnostic study conducted among 4 student groups (the total of 40 students) demonstrated that 71 % of students experienced difficulties in starting communication in Japanese and maintaining it. That is why we organized a series of communicative projects in Instagram in order to reduce that percentage and to further develop the students' communicative competences.

Each project of the series was organized according to the following 4-step algorithm.

• on the *preliminary* step the topic of the project is discussed and the project assignment is formulated. The students and the teacher discuss together the possible topics and then decide what content should be created and correspondingly the plan of project is being established;

• on the *constructive* step according to the formulated project assignment the students create in a social network their own profiles where they then start publishing relevant content to;

• the *communicative* step is characterized by interaction in Japanese within the social network by the means of conversations in comments in published posts. Such conversations should be carried out in accordance to the formulated communicative task;

• on the *final* step the results of the projects are discussed and virtual products created by the students in the social network are displayed. Such discussions can be conducted in the classroom or virtually by means of various online tools.

Let us consider the communicative projects that we organized. We will focus mainly on the description of the constructive and communicative steps.

1. An electronic language portfolio

The project assignment was to create in Instagram an educational community on the Japanese language. In the end, the community had to be filled with the content corresponding to learning material acquired by students during a certain period of time.

While working on the project the participants had to distribute regularly parts of the learning material between themselves and make a publication in the social network where to explain their piece of information to the followers and add their own examples. Students found themselves in the place of the teacher and thus had to thoroughly reflect on the subject and to visualize and textualize it in the most understandable manner. The regular work on this ended up in a better systematization of students' knowledge and their better understanding of newly acquired language structures. Lexical, grammatical and cultural publications were united with the previously chosen, unique hash-tag. As a result the group of students has created itself a functioning educational community, which was simultaneously a grammar handbook, thesaurus rich in examples, and a handbook of communicative strategies of Japanese culture.

Virtual organization of speech activities in such a community was conducted by the students themselves, as they were welcomed to think of any communicative situation which would reflect the content of their publication and require it use. After their post was published other participants were expected to react and to type a comment answering to the communicative situation proposed by their group mates.

2. A supplementary project "One day of my life"

The aim of this project was to make students accustomed to the method of conducting electronic communicative projects. The students were asked to during a week take as many pictures reflecting their ordinary day as possible. The range of language tools was limited to the continuous aspect of Japanese verb. The participants had to take a picture, write a small text in Japanese and then publish it in their Instagram profiles. Although not obligatory the students were encouraged to comment the pictures published by other groups. The variety of visualized situations (lexical aspect), the correctness of language use (grammar aspect) and the number of comments were evaluated at the end of the project.

3. "The objects that surround me"

For this project students had to create a virtual museum of personally important objects. Such museums had to be organized as galleries in

their profiles on Instagram. The ultimate goal of this project was to make students to establish conversations in Japanese within the social network. The strategic goal was to raise students' interest in their group mates' lives and personal experience as human beings.

The participants in the project were asked to focus their attention on their surroundings and select 5 objects that would reflect some important facts of their lives or that would be of a certain personal significance to them. Then they had to publish their pictures in their profiles with the description in Japanese, justifying their choice.

Since the current lexical topic was "Gifts and presents" and grammar topic was the verbs of directed actions (*ageru/morau/kureru*) those objects had to be chosen according to these questions:

1. I was happy to receive this object.
2. I was not happy to receive this object.
3. I bought this object to start learning something and actually used it.
4. I bought this object to start learning something but did not use it at all.
5. After having seen this object I wanted to visit Japan.

At the end of this step which can be qualified as a *constructive step* in the participants' profiles galleries with text in Japanese had been created.

During the next (*communicative*) step the participants were engaged in virtual exchange of comments basing on the content created on the previous step. In the comments the main focus was held on articulating a participant's personal opinion on the following questions:

1. Would you be happy to receive this present? (for the objects 1-2)
2. Have you ever thought about learning it too? (for the object 3)
3. What advice could you give in order to finally learn it? (for the object 4)
4. What thought and emotions does this object evoke in you? (for the object 5)

It is important that the communication between participants was not limited to the above mentioned questions, but, on the contrary, it was expected to be further developed, as the principal goal of the project was to stimulate free virtual communication in Japanese about published photos. The minimal limit on the number of exchanged comments was fixed on 4 and closed comments that would not contribute to the development of the discussion were disregarded.

The number of communicative partners was partially determined by the teacher. Upon the analysis of the results of the matrix of personal value one of the communicants were chosen from the negative range and one belonged to the positive range [5]. One or two more communicants were chosen by the participant themselves.

Pic. 1. An example of students' communication

Pic. 2. An examples of a polylogue in the comments

When it was necessary to moderate or give a direction to participants' conversation the teacher joined it and tried to supervise it, asking appropriate questions.

The communicative step lasted for 2 weeks, within which a high attention was paid to maintain the *regularity* and *continuity* of participants' communication with each other.

4. «Our life at the university»

The aim of this project was to reflect the university life in a virtual gallery. Students, working in small groups of 3-4, had to take pictures conveying their own vision of the life at the university and then add some text in Japanese to describe and explain it. Since this project was the final project of the series, students were not restrained to a certain range of language

tools. They were to use all their language knowledge in order to success-fully convey their ideas. After the galleries were completed, the communi-cative step was organized (just as in the previous project).

During the communicative step the participants had to 1) verbalize their emotions and express their opinion on other groups' choices and to 2) ask questions about other participants' photos.

At the end of the projects we organized presentation of the groups' galleries in the classroom. The final mark comprised of the teacher's mark and the mutual evaluation of the groups (*peer assessment)*. The teacher evaluated the correctness of the use of language and the successfulness of the communication. On the other hand, the criteria for the peer assess-ment were the level of completeness of the representation of the university life in the virtual environment and whether the published pictures were interesting or not.

At the end of the series of projects a number of interviews with the participants were conducted. Besides, the participants were asked to do some questionnaires about various aspects of their communicative com-petences and their impressions about the projects. The results show that the participants' level of difficultness of starting a conversation in Japanese decreased by 17 % (from 71 % to 54 %). Besides, it can be said that the shift of the communication into the virtual reality contributed to appearance of beneficial psychological communicative effects connected to the nature of social networks itself. The fact of others' positive reaction (a clicking on the heart-shaped button) and their commenting the participant's publica-tion stimulated their willingness to make another post. This phenomenon was experienced by 60 % of the participants. We think that it led to the automatic emergence of the willingness to continue participating in the project and to maintain a conversation with the partner. There were cases where such communication had exceeded the minimal level established by the teacher. This allows us to talk about the *autocatalytic nature* of virtual communication in a social network.

The results of Ryahovsky questionnaire on sociability show a slight increase in the level of the participants' communicative readiness. The group's average score decreased by 3% (from 13.10 to 12.68 points) that allows us to expect an emergence of positive psychological tendencies in the participants' sociability. Some of these positive changes were wit-nessed in the least sociable students.

The success of the implemented method can also be proved by the fact that 80 % of the participants expressed their readiness to take part in the series of communicative projects again.

To sum up, it can be said that the organization of purposeful communicative activity in Instagram (or – wider – social networking sites and mobile applications) by the means of project activities has a positive influence of the development of students' communicative competences.

References

1. Babayeva, Yu.D., Voyskunsky, A.E. Psychological consequences of the informatization // The psychological journal. 1998. Vol.19(1). pp. 89-100.

2. Titova, S.V. Information and communication technologies in humanitarian education: theory and practice. M: Ikar, 2014. 240 p.

3. Polat, E.S., Buharkina, M.Yu., Moiseeva, M.V., Petrov, A.E. New pedagogical and information technologies in the educational system. M: Academy, 2009. 272 p.

4. Selevko, G.K. The encyclopedia of educational technologies. Vol.1. M.: Research institute of school technologies, 2006. 816 p.

5. Panchenko, Yu.Yu., Avdoshina, E.D. Implementing electronic project activities in the language classroom for the development of students' general cultural competences. // LUNN Bulletin. N.Novgorod: Lunn, 2018. Vol. 42. pp.167-176.

THE ROLE OF DIGITAL NETWORK IN THE POLITICAL SOCIALIZATION OF VIRTUAL AGENTS

Zelenko Boris Ivanovich
Doctor of Political Sciences, Senior Researcher
Institute of Sociology of the Federal Research Sociological Center
of the Russian Academy of Sciences

Annotation. The article was tasked with identifying the role of digital network in shaping the political socialization of Russian network agents. The main idea is that digital networking has become a new agent of political socialization. Political communications broadcast qualitatively different patterns of public opinion and political activism. Political socialization is carried out in the process of accumulation by users of virtual social capital.

Keywords: digital networkization, political socialization, virtual agents, communicative.

General approach

In Russian political science, a clear formulation of political socialization has not yet been developed [1; 2]. This is caused by the rapidly transforming communication system and the emergence of new socialization agents. Which, in turn, complicates the study and prediction of the political behavior of the electorate. This is due to the study of the impact of virtual communication in social networks on the process of political socialization of actors.

The role of digital networking in the process of political socialization of actors seems to be little studied both in the field of virtual communications and in modern forms of the socialization process. Currently, both classical and modern ideas about the process of socialization, in our case the political one, and its agents have become less relevant. A deep conceptual revision of these ideas is ripe, taking into account the ongoing changes.

The research results show that the modern society of Russia cannot be called apolitical with certainty. Apparent political apathy and a tendency towards absenteeism is only a response to the imperfection of the existing democratic system in the country and the mechanisms of political participation. Political sociology indicates that the current state of affairs is

primarily due to gaps in the field of political self-awareness. Added to this is the lack of a clearly structured system of *political socialization* of individuals. Having destroyed the institutions of the political Soviet system, no further steps were taken to build new ones. Internet communications and the advent of digital networks have created a new trend in the field of information technology, changing the culture of consumption of political information and the ways of its dissemination. The impact on the community has become more targeted, and the phenomenon of viral content has opened up new opportunities. Namely: social digital networkization turned *anonymized* Internet communication of anonymous forums of the early 2000s into an *open* interpersonal dialogue. What has become a platform for the formation of political socialization of actors.

It can be stated that the political behavior of Russian society is changing precisely under the influence of social networks on the Internet, which have transformed the patterns of expression of opinion and political participation. The "street politics" is being replaced by a culture of virtual discontent. In the space of informal network communications, new trends appear, determined by the political socialization of actors.

For example, political activism leads to the development of civil society and the strengthening of a democratic regime. On the other hand, barriers are formed that inhibit the activities of power structures. Much has been written about this in political science, including J. Migdell and S. Huntington. The latter believed that in the newly formed democracies, the main conflict unfolded around the effectiveness of power in conditions of civil-controlled activism. Massive political socialization often becomes an obstacle to the stability of a country's political system. It also reduces the effectiveness of the functioning of formal institutions.

Therefore, the issues of the formation of political socialization of Russian society rests on the search for a balance of control over power. Which implies a high degree of development of political consciousness of citizens and the timely effectiveness of power decisions.

Cognitive science issue

The scale of the impact of digital network communication on their users is such that de facto social networks have recently turned into a new non-institutionalized agent of political socialization [3]. Political socialization, under the influence of digital networking, introduces what the traditionalizing agents lack in the socializing influence. This refers to skills and competencies that help to find their place in the real modern world, being guided in the global and local social space. To a large extent, traditional

socializing political institutions are lagging behind in solving this problem due to the general inertness of political and cultural processes. Another quality that distinguishes social networks from other agents of socialization is the high degree of interactivity of the socialization process during network communication. Such interactivity contributes to the assimilation of collective representations and values, social competencies and behaviors transmitted by digital network communication.

The specifics of socializing communication in the digital network field is also associated with their combination, in addition to socialization, as well as information, communication, identification, and recreational functions. As a result, tsifrosetevizatsiya has increased attractiveness, because communication in them allows you to satisfy a whole range of significant needs for the actor. The effectiveness of traditional institutions of political socialization in modern Russian society in practice is reduced and the values and norms that it translates are often perceived at a formal, presentation level. Then it is in the digital network space that political socialization is effective. It is carried out in the process of accumulation of virtual social capital by participants. That is, skills, competencies and abilities, horizontal social connections, values and behaviors that correlate with normal reality.

Moreover, studies show that at present, the socializing effect of social digital networking is carried out spontaneously, uncontrollably and in the absence of targeted participation of the basic institutions of socialization. Therefore, the role of digital networks in the process of political specialization is an urgent and promising research topic.

The heuristically applied theoretical and methodological approaches to the study of political socialization are the concepts of the political culture of G. Almond and S. Verba, as well as the comparative methodology of Smelser. These approaches allow us to formulate the main features of modern Russian political culture. To reveal the role of digital networks in the formation of the political socialization of network agents. And also to analyze the differences in political identity and the motivation of various social groups.

A social network, as an automated social environment, communicates users united by common interests on the basis of a kind of matrix of the real world. Namely: the agenda is formed by the network users themselves; dissemination of information becomes viral; time for press releases is running out; media release is replacing; the role of PR specialists is increasing; cardinally transforms the way consumption of news and information content.

Digital networkization has become a new agent of political specialization. Political communications broadcast to a wide audience qualitatively different patterns of public opinion and political activism.

The role of the digital network environment also lies in the fact that it involves forms of open "non-conventional" political participation of the non-systemic opposition.

References

1. Belichenko N.I. The role and place of social networks in political socialization and the formation of electoral culture of voters (on example of students of St. Petersburg). - St. Petersburg, 2017. p. 104-107.

2. Golovin N.A. Theoretical and methodological foundations of the study of political socialization. - SPB.: S.-Petersburg. un-ty, 2004. 288 p.

3. Chebunina O.A. Social Internet networks in the process of socialization of modern Russian youth: specificity of influence and socialization risks. // Thesis for the degree of candidate of sociological sciences. – Maykop, 2019. pp. 142-144.

AGGRESSION AS A MANIFESTATION OF SOCIAL DEPRIVATION: TOUCHES TO THE PORTRAIT OF A MODERN TERRORIST

Archakov Mikhail Konstantinovich
Doctor of Political Sciences, Full Professor
Blagoveschensk State Pedagogical University

Abstract. The article is devoted to the study of psychological characteristics of the participants of terrorist organizations. Special attention is paid to the study of social deprivation and its impact on the aggressive behavior of a modern terrorist. The author suggests that social deprivation causes the participants of terrorist groups to become more aggressive, angry, disdain for their own and others' lives, isolation from traditions, cultural values, and society as a whole.

Keywords: terrorism; political extremism; social deprivation; aggression; national security.

At the turn of the century, political terrorism has become a widely practiced method of extremist organizations of various kinds forcibly resolving a number of acute problems. Manifesting in open conflict form, it poses a serious threat to the stability not only of the Russian Federation, but also of the entire world community. In this connection, the study of the psychological characteristics of individuals prone to carrying out terrorist activities is of great importance for understanding this phenomenon.

At the same time, the theoretical question of the correlation of these concepts: terrorism and extremism plays a special role in the study of terrorism. Often, authors writing on the topic of terrorism - extremism, identify these two concepts, or vice versa – represent it by two completely different phenomena of political reality.

In our opinion, "not every extremist action is a terrorist act (terrorism), but every terrorist act is a manifestation of extremism. To avoid a logical confusion of the concepts of "extremism" and "terrorism", it is necessary to point out that extremism characterizes a specific, extraordinary type of social action. Whereas the concept of "terrorism" characterizes only one of the types or modes of action. And it is much narrower in its logical sense. Therefore, terrorism is one of the types or methods of extremist action, using which an individual, an organized group (organization) or the state

seeks to achieve the declared goals in politics by carrying out acts of direct physical violence against individuals, social groups, organizations and states "[3; p. 42-43].

Consequently, an extremist organization or community, under certain circumstances, can use terrorist activity as one of the methods to achieve its goals. At the same time, it can be seen from the experience of extremist organizations that not all extremists are always involved in the implementation of terrorist acts, but a certain contingent of people, according to their psychological characteristics, is ready for terrorist activities. Thus, any extremist organization can create special units of militants directly aimed at carrying out terrorist acts.

In general, the study of members of extremist associations, including terrorists, is extremely difficult. While they are free, they are practically inaccessible for a comprehensive study. Terrorists are ready to meet not with researchers, but with media representatives, and use these meetings for self-promotion. Although the information obtained from these meetings can hardly be considered objective.

However, terrorists are quite accessible to psychologists when their groups are neutralized, and while they themselves are in prison. At the same time, there also remains the problem of obtaining incomplete information, since people can actively distort information in the hope of an amnesty or reduction of the term of imprisonment. Nevertheless, the material available on this problem allows us to draw some conclusions about the personality characteristics of representatives of one or another extremist group.

Members of extremist groups are generally maladaptive, not accepted by society, and tend to create their own countercultures. For the most part, these are people who are harassed by failures in obtaining education, employment, careers, difficulties in a team, in relationships with the opposite sex, etc. Therefore, in many ways, it is precisely participation in extremist organizations that allows them to compensate for these failures, i.e. satisfy a sense of identity and belonging to a particular group.

In our opinion, the study of the factors of social deprivation, which have a certain influence on the formation of the personality of a member of an extremist community, is of considerable interest in studying the psychological characteristics of individuals prone to terrorist activities.

According to N.A. Andriyanova: "Social deprivation - specific deviations from real social norms of behavior and communication, which were formed on the basis of the absence of certain conditions of socialization and the ability to comprehensively assimilate sociocultural community values" [1, p. 67].

In other words, social deprivation is manifested as the lack of the individual's ability to communicate with other people, i.e. interact culturally and functionally with society. Moreover, deprivation can be either specially-compulsory, in the case of contact restrictions by relevant state structures (for example, prisoners in places of detention or military servicemen on draft), or optionally - voluntary, associated with a certain lifestyle, deliberately evading broad contacts with by society (e.g. monks, sectarians, hermits).

Members of extremist communities, as a rule, also end up in such voluntary isolation, for example, when their activities are connected with the preparation and implementation of terrorist acts. However, such a lifestyle, in conditions of complete isolation, can deplete the nervous system, lead to intemperance, aggressiveness, mood swings, etc. So, "conditions of group isolation lead to the fact that people are constantly "under the gun" of each other, are forced to constantly control their emotions, suppress their true feelings and desires" [7]. Naturally, all this, over time, affects the emergence of tension in the group, exacerbation of interpersonal contradictions, the growth of conflict situations, which in extremist communities is suppressed by the group leader and his closest associates.

A certain factor of deprivation is the role of the leader, the "elder" of the group. In any terrorist community, there is a strict hierarchy of submission and therefore the leader acts not only as an unquestioned authority, but also as the person responsible for the survival and successful functioning of this team. And it is he who determines and establishes the lifestyle of the terrorist community, regulating various kinds of everyday "little things", such as changing the place of residence of a terrorist, moving around a village, purchasing food, using military or civilian clothes, drinking alcohol, using vehicles, turning off the lights in the apartments of terrorists, etc.

Thus, social deprivation causes the participants in terrorist groups to increase aggressiveness, bitterness, disregard for their own and others' lives, isolation from traditions, cultural values, society as a whole.

At the same time, the internal organization and laws of the functioning of terrorist groups to some extent help the adaptation of yesterday's outsiders to them. Extreme authoritarianism, unquestioning submission to the leader, complete control of all aspects of the life of group members is combined with emphasized humanity in relations with each other, with a willingness to help, with complete and unconditional acceptance of each. The strategy of action is always discussed collectively, everyone has the opportunity to feel like a co-author of great plans. As a rule, in terrorist groups there is a cult of fallen comrades. Every terrorist knows that if he

dies, his memory and his name will be treated with the same care. Of course, all these points would not be enough to attract a balanced and sufficiently successful person, and even more so - to force him to abandon the norms of respect for human life that he has learned since childhood. For a person deeply lonely and unadapted person, a terrorist group may turn out to be an ideal place [6; p. 313 - 314].

However, the researcher of the psychology of terrorists M. Taylor, who in his work "The Terrorist" cited the results of a study of two groups of terrorists: one of which - is losers suffering from inferiority complex, and the other - successful, self-confident people, does not fully agree with this conclusion and emphasizes that in the case of negotiations on the release of hostages, the tactics of delaying them could seriously disorient the first group (losers) and, in general, cause them to disagree and contradictory opinions, whereas in the second group - such contradictions would be hardly expected [9; p. 26].

Participants in terrorist groups, as Yu.M. Antonyan notes experience "painful experiences associated with narcissistic drives, the lack of satisfaction of which leads to an insufficient sense of self-esteem and inadequate integration of the individual" [2; p.73]. This feature can be observed among many representatives of extremist organizations, both leaders and ordinary members, who, as a rule, are convinced of their outstanding abilities, excellence, personal qualities, superiority over others, since they are members of the only "right" organization that advocates the only "right" views and values.

Most terrorists are characterized by extreme intolerance towards those who think differently, as well as fanaticism generated by the maximalist ideas of "saving" their nation, race, religious group and the complete destruction of all hated enemies. Hence the conviction of their mission to save the homeland, race, nation, religion, etc. This conviction may be based on certain ideological postulates, religious attitudes, or belief in the inviolability of established traditions. By the way, this distinguishes true terrorists from random, uninformed people, as well as mercenaries participating in extremist communities out of material, selfish motives.

No less important, for the problem under study, is the phenomenon of sadism and its manifestation in the activities of representatives of extremist groups. According to E. Fromm: "Sadism (and masochism) as sexual perversions represent only a small fraction of that enormous sphere where these phenomena are in no way connected with sex. Non-sexual sadistic behavior manifests itself in finding a helpless and defenseless creature (a person or an animal) and causing it physical suffering up to taking its life.

Prisoners of war, slaves, defeated enemies, children, the sick (especially insane), those who are in prison, defenseless colored dogs, all of them were subject to physical sadism, often including brutal torture. Starting from the cruel spectacles in Rome and to the practice of modern police teams, torture has always been used under the guise of religious or political goals, sometimes even quite openly to amuse the crowd. The Roman Colosseum is actually one of the greatest monuments of human sadism" [6; p. 371 - 372].

According to M.V. Vinogradova: "The overwhelming majority of terrorists are born sadists, but there are also those in whom the psychotechnologies of terrorism have raised sadistic tendencies. Actually, sadism - is the main feature inherent in terrorists" [4; from. 238].

However, for many representatives of extremist organizations that do not even use terrorist methods of struggle, sadistic inclinations are also characteristic. According to V.V. Vityuk and S.A. Efirov: "It should be borne in mind that in the formation and development of modern terrorism there are various levels. In the early stages, the forms of their violent activities do not always look distinctly like the actual terrorist ones. Often the extremist group developing towards terrorism for the time being uses non-terrorist (including sometimes non-violent) forms of political struggle" [5; p. 223].

To assess the psychological characteristics of extremist activity, it is important to understand the problem of the relationship between life and death or, using the language of E. Fromm, "malignant aggression: necrophilia". According to E. Fromm: "The development of necrophilia occurs as a result of mental illness (disability), but the roots of this disease grow from the deep layers of human life (from an existential situation). If a person cannot create and is unable to "awaken" someone to life, if he cannot break free from the shackles of his narcissism and constantly feels his isolation and worthlessness, the only way to drown out this intolerable feeling of insignificance and some kind of "vital impotence" - assert itself at any cost, at least at the cost of the barbaric destruction of life. An act of vandalism does not require any special effort, no mind, no patience; all that the destroyer needs is strong muscles, a knife or a revolver..." [8; p. 478].

The psychological and psychiatric characteristics of a terrorist's personality are largely determined by the way he comes into contact with death (participation in terrorist acts, killings, guerrilla warfare, etc.), which undoubtedly affects his psyche and actions, despite the fact that his personality is that he seeks death. Moreover, a member of a terrorist group begins to comply with it, destroying the last obstacles that separate him from death, allowing it to directly influence himself. For all the psychological

characteristics and personal characteristics, this is a terrorist necrophile who is unprotected from death by the task of survival, most often he does not set such a task for himself. According to Yu.M. Antonyan: "Once approaching death, such a person begins to gain experience that is either realized and becomes the basis of internal development, or is not recognized and determines behavior at the level of personal meaning, including through the need to experience the trembling of contact with that what is beyond. The narcotic atmosphere of proximity to death can push for committing suicidal terrorist acts, but also other murders, not necessarily terrorist ones, for example, when participating in military conflicts" [1; p. 77].

Terrorists who see death as the only way to solve various problems, as a rule, do not fear their possible death. Many of them are not afraid of death or do not realize it for themselves, and the prospect of prolonged imprisonment is usually not considered by them, they do not think about it. Only after the verdict is passed, the terrorists begin to realize that a significant part or all of their life they will spend in prison. Therefore, the realization of the deed, the personal suffering associated with the serving of the impending punishment, begin for many from this very moment.

The psychological characteristics of the personality of a member of a terrorist group considered by us within the framework of an extremist community make it possible to see its deeply conflicting nature. Therefore, no matter what motives the extremists (and terrorists) are guided by, their main goal remains unchanged and is to maximize the aggravation of the socio-political situation, create various conflict situations, and discredit authorities and administrations. Only such situations, according to the ideologists of political extremism and the organizers of terrorist activities, can lead to the destruction of the "old" world, the implementation of their revolutionary projects, the triumph of "absolute justice and freedom."

References

1. Andriyanova N.A. The phenomenon of social deprivation in the military professional activity: the experience of comprehension // Psychopedagogy in law enforcement agencies. - 2015. - № 3(62). P. 67-72.

2. Antonyan Yu.M. The nature of ethno-religious terrorism. - M., 2008. – 312 P.

3. Archakov M.K. Political extremism: essence, manifestations, countermeasures. - Yekaterinburg: Publishing House of the Ural Un-ty, 2013. – 296 P.

4. Vinogradov M.V. Terrorism: psychological portrait // Terrorism. Legal aspects of the struggle / Gen. Ed. I.L. Trunov. - M., 2005. – 453 P.

5. Vityuk V.V., Efirov S.A. Left-wing terrorism in the West: history and modernity. - M., 1987. – 317 P.

6. Gozman L.Ya., Shestopal E.B. Political Psychology. - Rostov-on-Don, 1996. – 283 P.

7. Social deprivation [Electronic resource]. URL: http://scorcher.ru/axiomatics/axiom_show.php?id=430 (appeal date 26. 10. 2019).

8. Fromm E. Anatomy of human destructiveness. M., 1994. – 512 P.

9. Taylor M. The Terrorist. - L– N. Y., 1988.

NARROW-BAND OPTICAL RADIATION IN THE COMPLEX TREATMENT OF PSORIASIS

Kiryanova Vera Vasilievna
Doctor of Medical Sciences, Full Professor, Head of Department
Mechnikov North-West State Medical University
Petrova Elena Vadimovna
Postgraduate
Mechnikov North-West State Medical University
Physiotherapist
Leningrad regional center of specialized types of medical care
Egorova Julia Sergeevna
Candidate of Medical Sciences, Head physician
Leningrad regional center of specialized types of medical care
Marieha Grigory Leonidovich
Head of the day hospital, Dermatovenerologist, Ultrasound diagnostic doctor
Leningrad regional center of specialized types of medical care
St. Petersburg, Russia

Abstract. 137 patients with exacerbation of common psoriasis were examined at the State Budgetary Institution of Health "Leningrad regional center of specialized types of medical care". All patients by randomization according to the table of random numbers were divided into four groups: Group I (25 patients) received standard drug therapy (SDT); Group II (47 patients) received SDT and PCT (NOR λ=540 nm); Group III (48 patients) received PCT (NOR λ=650 nm); Group IV (21 patients) received SDT and simulated PCT (placebo). Photochromotherapy was carried out under the influence of narrow-band optical radiation (NOR) with a wavelength of 650 nm and a wavelength of 540 nm from the laser-LED therapeutic apparatus "Spectrum - LC" (model 02, passport ONTSI.941549.001 PS2). For a comparative assessment of the effectiveness of the applied treatment methods, a "weighted structure" was used, which is based on the methods of statistical data processing, methods for testing statistical hypotheses (Fisher, Student's t-test, R criterion). To formulate a generalized (integral assessment) of effectiveness, the methods of the theory of "decision making" are used. Integral assessment was taken as a criterion for the effectiveness of therapy. Integral assessment of psoriasis treatment methods

demonstrated a statistically significant advantage of complex therapy in patients with exudative psoriasis with the inclusion of NOR λ=540nm (integral score 17.61), and in patients with advanced vulgar psoriasis NOR λ=650nm compared with standard drug therapy (integral assessment 14.49) and standard drug treatment and PCT imitation (cumulative score of 13.94). Based on the studies, two new methods for the treatment of the progressive stage of common psoriasis have been developed.

Keywords: psoriasis, visible light phototherapy, photochromotherapy (PCT), narrow-band optical radiation (NOR)

Relevance. The relevance of the work is determined by an increase in the incidence of psoriasis, especially among young people, an increase in the frequency of relapses of the disease, the severity of the pathological process, the lack of clear etiopathogenetic data on the occurrence of the disease and the lack of a stable therapeutic effect [1,2]. Chronic dermatosis is the cause of a decrease in the quality of life, a violation of the psychoemotional state, social maladaptation and often disability in articular forms of the disease [1,2,3].

Psoriasis therapy is carried out in accordance with the Federal Clinical Recommendations for Dermatovenereology [1,2]. The standard physiotherapeutic methods for treating psoriasis are ultraviolet therapy. However, numerous literature presents data on the results of studies regarding the carcinogenic effect of ultraviolet radiation associated with the cumulative effect of UV therapy. More than 50% in the structure of dermatological oncopathology that arose after long multi-course phototherapy is occupied by basal cell carcinoma, squamous cell carcinoma accounts for 20 to 30% and melanomas occupy the last place [1,4,6]. With the use of PUVA therapy, the occurrence of highly differentiated spinaliomas and pseudoepithelialomatous epidermodysplasias is associated [1]. In the scientific literature there is evidence of the development of psoriatic erythroderma with the use of UV therapy in the progressive stage of dermatosis [1]. Given the above, it is important to develop new phototherapy methods for psoriasis that do not have a photo-damaging effect on the skin.

Attention is currently attracted by the actively developing section of physiotherapy - photochromotherapy [6,7]. Photochromotherapy (PCT) is the therapeutic use of electromagnetic waves in the visible part of the optical range [6,7]. PCT is based on the use of narrow-band optical radiation (NOR) of different wavelengths. The use of this type of radiation is physiological, safe and contributing to the reduction of economic costs for the purchase of expensive equipment [6,7].

Purpose of the study. Substantiate the use of PCT (NOR λ=540 nm

and NOR λ=650 nm) in the complex treatment of the progressive stage of psoriasis and develop PCT methods.

Materials and methods. Scientific and qualification work was carried out in the design of a randomized controlled trial based on SBHI "LenoblCenter". 137 patients with exacerbation of common psoriasis were under observation. The average age of patients was 48.34 years, the average duration of dermatosis was 13.93 years. 49.6% (68) of patients were diagnosed with vulgar psoriasis with a predominance of the proliferative component of inflammation, and 50.4% (69) of patients suffered from exudative psoriasis with a predominance of exudative component of inflammation. All patients were randomly divided into 4 groups, by the method of treatment. The first group (26 patients) received standard drug therapy (SDT). The second group (47 patients) received SDT and PCT (NOR λ=540 nm). The third group (46 patients) received SDT and PCT (NOR λ=650 nm). The fourth group (21 patients) received SDT and simulated PCT (placebo). The second group was dominated by patients (29 patients) with exudative psoriasis, and the third group was dominated by patients (33 patients) with common vulgar psoriasis.

Patients of all groups received standardized basic drug treatment. Photochromotherapy (PCT) was carried out from the "Spectrum LC" laser-LED therapeutic apparatus (model 02), passport ONTSI.941549.001 PS2, registration certificate for a medical device dated August 25, 2016 № RZN 2016/447.

Uniform survey algorithm was used. The severity of the course of psoriasis and the effectiveness of the therapy according to clinical signs before treatment and after the course of treatment were evaluated using the prevalence and severity of psoriasis (PASI). The severity of pruritus was assessed using the Behavioral rating scores (BRS) questionnaire [1]. For a non-invasive assessment of skin morphology, the method of ultrasonic dermoscanning was used, which was carried out using the Logiq e medical diagnostic ultrasound system, with utensils (S/n 253723WX1), China. In order to determine the level of quality of life in patients with psoriasis, the dermatological index of quality of life (DIQL) was used [1]. The psychoemotional state in patients with psoriasis was studied on the Spielberg - Hanin anxiety scale. To form groups of different treatment methods, the random selection method was used. To confirm the belonging of the formed groups to one general population, the STATISTICA for Windows software system (version 10 lic. BXXR310F964808FA-V) was used. For a comparative assessment of the effectiveness of the applied treatment methods, a "weighted structure" is used, which is based on the methods

of statistical data processing, methods for testing statistical hypotheses (Fisher, Student's t-test, R criterion). To formulate a generalized (integral assessment) of effectiveness, the methods of the theory of "decision making" were used.

Results and discussion. As a result of processing the initial data arrays in all groups, the average values of the main indicators $M(X_i)$ (M – mathematical expectations, i – i- th indicator i=1…7) and variance $D(X_i)$ were obtained. The significance level p was chosen so that the condition of equality of variances was satisfied. Thus, equality of means was guaranteed not only at the indicated level (p = 0.05), but also at higher (p = 0.025; 0.01; 0.005; 0.001) (table 1).

Table 1- The average values of the indicators $M(X_i)$, variance $D(X_i)$, significance level p.

Indicators	Group	M[x]	D=S²	N	Significance level p
PASI, score	1	16,45	57,8	25	X1=X2; X1=X3; X1=X4; X3=X4 p=0,05
	2	16	88	47	X2=X3; X2=X4 p=0,01
	3	15,7	37,9	46	
	4	14,6	30,8	19	
DIQL, score	1	14,12	49,9	25	X1=X2; X1=X3; X1=X4; X2=X3; X2=X4 ;
	2	13,02	39,85	47	X3=X4 P=0,05
	3	13,9	46,4	46	
	4	13,2	37,7	19	
Personal Anxiety (PA), score	1	47,23	101,5	26	X1=X2; X1=X3; X1=X4; X2=X3; X2=X4 ;
	2	44	79	47	X3=X4 P=0,05
	3	45	66	46	
	4	43,5	112	19	
Situational Anxiety (SA), score	1	44,38	139	26	X1=X4; X2=X3; X3=X4 P=0,05
	2	42,6	60	47	X1=X3 p=0,01
	3	43	78	46	X1=X2; X2=X4 P=0,005
	4	42	157	19	
Quantitative indicator of the epidermis by US of the skin, cm	1	0,08	0,00016	6	X1=X2 p=0,01
	2	0,0675	0,000085	10	X1=X3; X1=X4; X2=X3; X2=X4 ; X3=X4
	3	0,068	0,000147	6	P=0,05
	4	0,08	0,00037	5	

Indicators	Group	M[x]	D=S²	N	Significance level p
Quantitative indicator of the dermis by US of the skin, cm	1	0,292	0,002	6	X1=X2; X2=X3; X2=X4 ; X3=X4 p=0,05 X1=X3; X1=X4 p=0,01
	2	0,357	0,0063	10	
	3	0,36	0,0129	6	
	4	0,334	0,013	5	
BRS, score	1	3	10,16	26	X1=X2; X1=X4; X2=X3; X2=X4 ; X3=X4 p=0,05 X1=X3 p=0,01
	2	2,94	6,97	47	
	3	2,28	4,87	46	
	4	2	7,5	19	

Thus, we confirm the hypothesis that 4 independent samples belong to the same general population and are homogeneous (which indicates the statistical equality of variances and averages for all indicators).

Then, as a result of statistical processing, we obtained average values of the dynamics of changes in the deviation of indicators from the norm M $M(X_i)$ (M – mathematical expectation, i – i-th indicator i=1...7) and the variance $D(X_i)$ at a significance level of p=0.05 in all groups and in all indicators. $M(\Delta Xi)$ and $D(\Delta Xi)$ are presented in table 2. The dynamics of the deviation of the indicators from the norm $M(X_i)$ and variance $D(X_i)$, presented in table 2 demonstrate a significant (p≤0.05) advantage of complex therapy with PCT (NOR λ=540 nm and NOR λ=650nm).

The aim of the next stage of the study was to formulate an integrated assessment of each of the treatment methods. Integral assessment was taken as a criterion for the effectiveness of therapy. The presence of such a criterion made it possible to rank treatment methods. This part of the work contained three stages: Pairwise comparison of treatment results for all indicators, between all groups; rationing of comparison results; formation of an integrated assessment. The results of processing the dynamics, pairwise comparison, the formation of an integrated assessment are combined in table 2.

Table 2 – Dynamics, pairwise comparison and integral estimates.

Indicator/ group	Group I (SDT)	Group II (NOR λ=540nm)	Group III (NOR λ=650nm)	Group IV (placebo)
PASi M(X); D(X)	5.84±2.24; 10.42	8.74±3.14; 41	8,38±0,81; 10,33	5,16±1,13; 8,08

Comparison Result/ Normalized value	D1≠D2 / 0,841	D2≠D1 / 0,845	X3>X1 / 1	X4=X1 / 0,878
	X1>X3 / 0,697	D2≠D3 / 0,845	D3≠D2 / 0,911	D4≠D2 / 0,821
	X1=X4 / 0,878	D2≠D4 / 0,845	X3>X4 / 1	X4<X3 / 0,626
Amount by PASi	2,416	2,535	2,911	2,315
DIQL M(X); D(X)	2, 52±0,86; 6,34	4±0,82; 11,07	5,44±1,16; 10,33	2,42±1,45; 13,48
Comparison Result/ Normalized value	X1<X2 / 0,63	X2>X1 / 1	X3=X1 / 0,847	X4=X1 / 0,763
	X1=X3 / 0,847	X2=X3 / 0,871	X3=X2 / 0,871	X4<X2 / 0,605
	X1=X4 / 0,763	X2>X4 / 1	X3>X4 / 1	X4<X3 / 0,605
Amount by DIQL	2,241	2,871	2,719	1,813
PA M(X); D(X)	2,85±1,7; 25,97	3,17±1; 16,1	2,71±1,23; 11,57	2,32±4,75; 66,34
Comparison Result/ Normalized value	X1=X2 / 0,78	X2=X1 / 0,78	X3=X1 / 0,774	X4=X1 /
	X1=X3 / 0,774	X2=X3 / 0,82	X3=X2 / 0,82	D4≠D2 / 0,417
	X1=X4 / 0,618	D2≠D4 / 0,762	X3=X4 / 0,705	X4=X3 / 0,705
Amount by PA	2,172	2,361	2,3	1,74
SA M(X); D(X)	2,61±6; 78,25	4,5±1,95; 16,12	5,16±1,95; 29,28	2±4,37; 56,11
Comparison Result/ Normalized value	D1≠D2 / 0,469	D2≠D1 / 0,819	X3=X1 / 0,758	X4=X1 / 0,534
	X1=X3 / 0,758	X2=X3 / 0,854	X3=X2 / 0,854	X4=X2 / 0,778
	X1=X4 / 0,534	X2=X4 / 0,778	X3=X4 / 0,77	X4=X3 / 0,77
Amount by SA	1,761	2,451	2,382	2,082
US (Epidermis) M(X); D(X)	0,013±0,0094; 0,000142	0,0104±0,0054; 0,000088	0,0127±0,006; 0,000055	0,023±0,018; 0,00043
Comparison Result/ Normalized value	X1=X2 / 0,723	X2=X1 / 0,723	X3=X1 / 0,726	X4=X1 / 0,675
	X1=X3 / 0,726	X2=X3 / 0,754	X3=X2 / 0,754	X4=X2 / 0,706
	X1=X4 / 0,675	X2=X4 / 0,706	X3=X4 / 0,693	X4=X3 / 0,693
Amount by US (Epidermis)	2,124	2,184	2,173	2,074
US (Dermis) M(X); D(X)	0,025±0,046; 0,0034	0,0776±0,04; 0,0057	0,096±0,05; 0,0044	0,031±0,014; 0,00025

Comparison Result/ Normalized value	X1<X2 / 0,311	X2>X1 / 1	X3.X1 / 1	X4=X1 / 0,546
	X1<X3 / 0,251	X2=X3 / 0,735	X3=X2 / 0,735	D4≠D2 / 0,671
	X1=X4 / 0,546	D2≠D4 / 0,639	X3=X4 / 0,721	X3=X4 / 0,721
Amount by US (Dermis)	1,109	2,374	2,456	1,937
BRS M(X); D(X)	2,19±0,86; 6,64	2,76±0,64; 6,72	2,09±0,5; 4,26	1,53±0,94; 5,6
Comparison Result/ Normalized value	X1=X2 / 0,835	X2=X1 / 0,835	X3=X1 / 0,828	X4<X1 / 0,696
	X1=X3 / 0,828	X2>X3 / 1	X3<X2 / 0,756	X4<X2 / 0,553
	X1>X4 / 1	X2>X4 / 1	X3>X4 / 1	X4<X3 / 0,731
Amount by BRS	2,663	2,835	2,584	1,98
Integral score	14,49	17,61	17,52	13,94

As a result of normalizing the results of the comparison, integral estimates were formed. Integral assessment of psoriasis treatment methods demonstrated a statistically significant advantage of complex therapy in patients with exudative psoriasis (with a predominance of the exudative component of inflammation) with the inclusion of NOR λ=540nm (integral score of 17.61), and in patients with advanced vulgar psoriasis (with a predominance of proliferative component) NOR λ=650nm compared with standard drug therapy (integral score 14.49) and standard drug treatment and simulated PCT (integral score 13.94).

The next stage of work was calculating the correlation coefficients between the indicators before treatment and after treatment, which are presented in table 3.

Table 3 – Correlation coefficients between indicators before and after treatment

Indicator	Group	R (corr. coeff.)	N	p
PASI	group 1 (SDT)	0,935	25	0,002
	group 2 (SDT and NOR λ=540nm)	0,81	45	0,002
	group 3 (SDT and NOR λ=650nm)	0,901	44	0,002
	group 4 (SDT and PCT placebo)	0,86	19	0,002
DIQL	group 1 (SDT)	0,934	25	0,002
	group 2 (SDT and NOR λ=540nm)	0,81	45	0,002
	group 3 (SDT and NOR λ=650nm)	0,74	45	0,002
	group 4 (SDT and PCT placebo)	0,79	19	0,002

Indicator	Group	R (corr. coeff.)	N	p
PA	group 1 (SDT)	0,91	26	0,002
	group 2 (SDT and NOR λ=540nm)	0,664	46	0,002
	group 3 (SDT and NOR λ=650nm)	0,91	45	0,002
	group 4 (SDT and PCT placebo)	0,68	19	0,002
SA	group 1 (SDT)	0,705	26	0,002
	group 2 (SDT and NOR λ=540nm)	0,83	46	0,002
	group 3 (SDT and NOR λ=650nm)	0,81	45	0,002
	group 4 (SDT and PCT placebo)	0,78	19	0,002
US (Epidermis)	group 1 (SDT)	0,42	6	nk
	group 2 (SDT and NOR λ=540nm)	0,51	10	nk
	group 3 (SDT and NOR λ=650nm)	0,866	6	0,02
	group 4 (SDT and PCT placebo)	0,256	5	nk
US (Dermis)	group 1 (SDT)	0,48	6	nk
	group 2 (SDT and NOR λ=540nm)	0,34	10	nk
	group 3 (SDT and NOR λ=650nm)	0,837	6	0,05
	group 4 (SDT and PCT placebo)	0,48	5	nk

The data before and after treatment for all indicators (except for ultrasonic dermoscanning, apparently due to the small sample sizes) are associated with rather high correlation coefficients (r_{xx}). The correlation coefficient characterizes the tightness of the linear relationship between quantitative features in the sample: the closer the correlation coefficient to unity, the stronger the relationship; the closer the correlation coefficient to zero, the weaker the connection. On this basis, we can conclude that when using all four methods of therapy, the result depends on both the treatment method and the patient's condition before treatment. Since the sample has a sufficiently large volume and well represents the general population (is representative), the conclusion on the tightness of the linear relationship between the characters obtained from the data of the sample can be extended to the general population, in other words, complex treatment with PCT should be used in practice, i.e. in the treatment process as the most effective for exudative psoriasis with a predominance of exudation (NOR λ=540nm), and with common vulgar psoriasis with predominant proliferation (NOR λ=650nm).

Conclusions.

1. An analysis of the obtained integral estimates showed that the greatest therapeutic effect in the treatment (within 10 days) of patients with exudative psoriasis in the progressive stage of the disease is achieved with complex treatment with PCT (NOR λ=540nm).

2. An analysis of the obtained integral estimates demonstrated that the greatest therapeutic effect in the treatment (within 10 days) of patients with advanced vulgar psoriasis in the progressive stage of the disease is achieved with complex treatment with PCT (NOR λ=650nm).

3. Based on the studies approved by the Local Ethics Committee (LEC) of FSBEI HE Mechnikov North-West State Medical University, two methods have been developed for treating patients with progressive psoriasis against the background of standard drug treatment.

Practical recommendations.

1. In patients in a progressive stage with exudative psoriasis (mainly with a predominance of the exudative component of inflammation), the PCT technique (NOR λ=540nm) for psoriatic skin plaques with a radiation power of 225 mW, radiation power density of 12.5 mW/cm^2, and total radiation dose of 202.5 J is recommended per one procedure, energy exposure (specific energy dose) 1.35 J/cm^2, in continuous mode, lasting 15 minutes, 3 minutes per field, the total skin irradiation area per procedure no more than 750 cm^2, area of one field 150 cm^2, no more than 5 fields per procedure, contact by a labile manner, in a course of 10 treatments conducted daily per one procedure.

2. In patients in a progressive stage with common vulgar psoriasis (mainly with a predominance of the proliferative component of inflammation), the PCT method (NOR λ=650 nm) for psoriatic skin plaques with a radiation power of 50 mW, radiation power density of 2.8 mW/cm^2, and a total radiation dose of 30 J per procedure, energy exposure (specific energy dose) 0.2 J/cm^2, in continuous mode, lasting 10 minutes, 2 minutes per field, the total area of skin irradiation per procedure no more than 750 cm^2, area of one field 150 cm^2, no more than 5 fields per one procedure, contact, by labile method, in a course of 10 treatments conducted daily per one procedure.

The radiation source -laser-LED therapeutic apparatus "Spectrum LC" (model 02, passport ONTSI.941549.001 PS2, registration certificate for medical device dated August 25, 2016 № RZN 2016/447). Applications for the grant of a patent of the Russian Federation for an invention to the Federal Service for Intellectual Property were filed.

References

1. Raznatovsky, K.I. Psoriatic disease. Diagnosis, therapy, prevention / K.I. Raznatovsky, O.V. Terletsky. - M.: GEOTAR - Media, 2017. - 352 P.

2. Rodionov, A.N. Dermatovenerology: complete guide for doctors / A.N. Rodionov - SPb: Science and Technology, 2014. - 1200 P.

3. Olisova, O.Yu. Epidemiology, etiopathogenesis and comorbidity in psoriasis - new factors / O.Yu. Olisova, L.G. Garanyan // Russian journal of skin and sexually transmitted diseases. - 2017. - V. 20, № 4. - P.214-219.

4. Seebode, C. Photocarcinogenesis and skin cancer prevention strategies / C. Seebode, J. Lehmann, S. Emmert // Anticancer Res. - 2016. - V. 36, №3. - P.1371-1378.

5. Zhilova, M.B. Molecular markers of the risk of developing malignant neoplasms of the skin in psoriasis patients receiving phototherapy / M.B. Zhilova, A.A. Kubanov // Bulletin of Dermatology and Venereology. - 2014.- № 6.- P. 62-68.

6. Phototherapy and photochromotherapy in the complex treatment of patients with asthenodepressive syndrome in neurotic disorders / V.V. Kiryanova [et al.] // Questions of balneology, physiotherapy and therapeutic physical culture. - 2012. - V.89, №1. - P.3-6.

7. Kiryanova, V.V. Possibilities of using LED radiation with a wavelength of 650 nm (red light) in the correction of involutional changes in facial skin / V.V. Kiryanova, T.N. Korolkova, A.S. Kirillova // Scientific and medical journal "Herald of Avicenna" of the Tajik State Medical University named after Abu Ali Ibn Sino - 2012. - V.53, № 4. - P.141-147.

PREVENTION OF VENOUS INSUFFICIENCY ASSOCIATED WITH INTRAOPERATIVE DAMAGE TO THE LARGE SAPHENOUS VEIN IN THE SURGICAL TREATMENT OF ANKLE AND LOWER LEG FRACTURES

Kukushkin Evgeni Petrovich
Orthopedic Traumatologist, Ultrasound diagnostic doctor.
Clinical Hospital № 6 named after G.A. Zakharyin, Penza, Russia
Kukushkina Ekaterina Sergeevna
Student
Medical Institute
Penza State University, Penza, Russia
Midlenko Vladimir Ilyich
Doctor of Medical Sciences, Full Professor, Head of Department
Director of the Institute of Medicine, Ecology and Physical Culture
Ulyanovsk State University, Ulyanovsk, Russia
Midlenko Oleg Vladimirovich
Doctor of Medical Sciences, Full Professor
Director of the Inzen branch of Ulyanovsk State University, Ulyanovsk, Russia

Purpose of the study: evaluate the effectiveness of restoring the integrity of the large saphenous vein damaged during surgical treatment of ankle and lower leg fractures in preventing the development of the initial signs of venous insufficiency.

Materials and methods: 215 patients with closed fractures of the lower and middle third of the lower leg and ankle were observed, who were operated on at Clinical Hospital №. 6 named after G.A. Zakharyin, Penza. Patients were divided into 3 groups. 1 group of 78 patients with iatrogenic damage to the large saphenous vein. 2 group of 112 people without iatrogenic damage to the large saphenous vein. 3 group of 25 patients with iatrogenic damage to the large saphenous vein, but the integrity of the vessel was restored during the initial operation.

In all patients observed by us in the postoperative period, the presence and dynamics of clinical and instrumental signs of venous insufficiency were assessed.

The restoration of the damaged large saphenous vein was carried out after the completion of the main stages of the operation.

Results of the study: In patients operated on for fractures of the ankles and lower third of the leg in case of iatrogenic damage to the large saphenous vein in the postoperative period, the initial signs of venous insufficiency develop, which is confirmed clinically and by instrumental studies. If the integrity of the vessel was restored immediately after the completion of the main stages of the operation, venous insufficiency did not develop.

Keywords: venous insufficiency, large saphenous vein, fracture of the ankles and lower third of the leg.

List of abbreviations
LSV - large saphenous vein
SSV - small saphenous vein

Introduction
Due to the anatomical features of the intervention zone, most traumatological operations on the lower extremities performed during fractures of the ankle, lower and middle third of the lower leg create conditions for iatrogenic damage to the large saphenous vein at the place where it passes near the inner ankle. Currently, traumatologists practically do not attach any importance to this, and when a large saphenous vein is damaged, they are limited to hemostasis, by bandaging it. This inevitably leads to impaired blood flow and the development of the initial signs of venous insufficiency of the lower limb. In this case, with a good consolidation of the fracture and the absence of serious problems on the part of the skeletal system, the quality of life still worsens in patients due to developing venous insufficiency of the lower limb. Therefore, it seems appropriate to pay attention to the prevention of iatrogenic damage to the large saphenous vein. [1]. From the point of view of most surgeons who have extensive experience in the surgical treatment of patients who have suffered iatrogenic vascular injury, one can't confine oneself to stating the occurrence of a vascular complication and stopping bleeding; in modern conditions, it is necessary to strive to restore the integrity of the damaged vessel. [2-9].

Relevance of the problem: in the literature available for study, both by domestic and foreign authors, the problem of developing the initial signs of venous insufficiency of the lower extremities after intraoperative damage to the great saphenous vein during operations for closed fractures of the lower third of the lower leg and inner ankle is not sufficiently disclosed [10].

Of course, the role of the saphenous veins (jointly small and large) in the outflow of blood from the lower extremities is no more than 10%, and the main way of returning blood is through the deep veins. The main reason for the development of chronic venous insufficiency in bone fractures of the lower extremities should be considered the development of deep vein thrombosis of the lower extremities with the formation of post-thrombotic disease. The main ... but not the only one. In this regard, in our work, the emphasis is on 10% of changes in the superficial veins, the role of which, in our opinion, is underestimated.

Purpose of the study: evaluate the effectiveness of restoring the integrity of a large saphenous vein damaged during surgical treatment of ankle and lower leg fractures in preventing the development of venous insufficiency.

Materials and methods

We observed 215 patients with closed fractures of the lower and middle third of the lower leg and ankle who were operated on at Clinical Hospital № 6 named after G.A. Zakharyin of the city of Penza from 2016 to 2018. Exclusion criteria were open injuries, signs of venous insufficiency, or post-traumatic vein thrombosis of the lower extremities. Also, all patients in the preoperative period underwent ultrasound examination of the vessels of the lower extremities in order to assess the speed of blood flow and patency through deep and perforating veins, as well as the presence of blood clots. All patients received a set of measures according to the protocol for the prevention of thrombosis.

In the first, retrospective comparison group, there were 78 people who had intraoperative damage to the large saphenous vein.

The second comparison group consisted of 112 patients who did not have damage to the large saphenous vein during the operation, mainly using proprietary techniques.

Third, the group consisted of 25 patients with iatrogenic damage to the large saphenous vein during surgery, but the integrity of the vessel was restored by the application of a vascular suture.

In all patients observed by us in the postoperative period, the presence and dynamics of clinical signs of venous insufficiency were evaluated. All patients underwent standard laboratory tests, including a coagulogram study. Prophylactic measures to prevent blood clots formation   continued. In order to objectify the data, patients underwent ultrasound examination of the venous system of the lower extremities using the Medison SonoAce x8 apparatus.

The initial absence of signs of venous insufficiency was confirmed clinically by ultrasound data. At the level of the lower third of the lower leg, 5 cm above the inner ankle, the diameter of the large and small saphenous veins of healthy and damaged limbs and the blood flow through these vessels were evaluated, and patency of the deep and superficial veins was also evaluated.

None of the patients observed showed signs of deep vein thrombi.

Surgical treatment was performed under spinal anesthesia. The operation was performed in the amount of restoration of the anatomical ratio of bone structures with fixation by metal structures. The restoration of the damaged large saphenous vein was carried out after the completion of the main stages of the operation by stitching end-to-end, with severe tissue edema in 9 cases, a small mobilization of the vessel was required.

In the postoperative period, while patients were in the hospital during daily examinations, complaints, skin characteristics were assessed, circles in the ankle joint, lower third of the leg and foot, and ultrasound were measured. During ultrasound examination of the vessels of the lower extremities, both superficial and deep veins, in patients in the postoperative period (on the 1st day after surgery, on the 3rd day and the day before discharge) the absence of any reliably confirmed changes in deep veins was recorded, although changes in superficial veins were already noticeable.

Results of the study

In the first comparison group, the most frequent complaint was fatigue (61.2%). Night cramps bothered 38.8% of patients. Swelling of the extremities was noted by 20.4% of patients; in 12.6%, "vascular asterisks" appeared. An increase in the circumference of the lower leg, foot, and ankle joint region was determined in 90.3% of patients.

Analysis of the data of patients of the second comparison group showed that there were no statistically significant differences with the previous group in terms of pain. But in terms of signs of venous insufficiency, the picture was completely different. So, swelling of the limbs was noted only by 8.41% of patients, and such indicators as fatigue, night cramps and the appearance of "vascular asterisks" were not observed in the second control group. Also, when measuring the circumference of the lower leg, foot and ankle joint, there was no significant increase.

The indicators of patients of the third group in the postoperative period did not have statistically significant differences from the indicators of the second control group.

The data are presented in the table.

Table 1. Assessment of patient indicators depending on the course of the operation.

Clinical picture	Detection rate (%)		
	With LSV damage	**Without LSV damage**	**With LSV Damage, restoration of the motion**
"vascular asterisks"	12,6	-	-
fatigue	61,2	-	1,2
night cramps	38,8	-	-
swelling of legs	20,4	8,41	8,39
fracture pain	3,88	3,73	3,75
motion restriction	-	15,9	-

An ultrasound study found that statistically significant differences in blood flow were only when compared between groups. Similar indicators in patients with different localization of the fracture (ankle or lower third of the leg) did not have significant differences.

The data is given in the tables.

Table 2. Venous system parameters after surgery for ankle fractures without intraoperative damage and iatrogenic intraoperative LSV damage

Veins	Indicators	Condition after surgery		
		Group 1	**Group 2**	**Group 3**
SSV	Diameter, mm	3,28	3	3,1
	Speed, cm/s	2,8	3,1	3,0
LSV	Diameter, mm	3,9	3,64	3,75
	Speed, cm/s	none	7,3	6,8

Table 3. Indicators of the venous system after surgery for fractures of the n/3 lower leg without intraoperative damage and iatrogenic intraoperative damage to LSV

Veins	Indicators	Condition after surgery		
		Group 1	**Group 2**	**Group 3**
SSV	Diameter, mm	3,28	3,1	3,16
	Speed, cm/s	2,8	3,1	3,0
LSV	Diameter, mm	3,75	3,4	3.64
	Speed, cm/s	none	7,3	6,9

In patients with intraoperative damage to the saphenous vein in the post-operative period, an increase in its diameter to an average of 3.75-3.9 mm and a sharp decrease in blood flow velocity were noted. The diameter of the small saphenous vein changed, increasing to 3.28 mm, versus 3.1 mm in the absence of intraoperative damage to the large saphenous vein. The blood flow velocity in the small saphenous vein did not change so significantly.

The data of an ultrasound examination in the postoperative period in patients with intraoperative damage to the large saphenous vein, if the integrity of the vessel was restored during the primary operation, did not statistically significantly differ from the data of the patients of the second control group.

Conclusion:

1. Timely initiated and carried out prophylaxis of thrombosis in patients can effectively prevent the development of thrombotic complications from deep veins.

2. Unrepaired iatrogenic damage to the great saphenous vein during surgery for fractures of the ankles and lower third of the lower leg leads to the development of initial signs of venous insufficiency in the postoperative period.

3. Immediate restoration of the integrity of the large saphenous vein damaged during surgery significantly reduces the risk of developing initial signs of venous insufficiency in the postoperative period in patients operated on for fractures of the ankles and lower third of the leg.

4. The role of the saphenous veins (jointly small and large) in the outflow of blood from the lower extremities is not more than 10%, and the main way of returning blood is through the deep veins. Changes after iatrogenic damage to the large saphenous vein, without recovery, during surgery occur faster in the superficial vessels, without affecting the deep veins in the initial stages.

References

1. Sharipov M.A. Prevention and treatment of iatrogenic vascular damage. – Dushanbe, 2010. – P. 10-12.

2. Gaibov A.D. Clinic, diagnosis and surgical treatment of post-traumatic arterial obstruction. / A.D. Gaibov, U.A. Kurbanov, W.A. Gulov // Surgery. Journ. n.a. N.I. Pirogov 2004 -№ 11.-P. 15-21.

3. The value of various methods of reconstructive vascular and microvascular surgery in oncology / M.I. Davydov [et al.] // Questions of Oncology. - 2005.- V. 51.- № 3. P. 311- 313.

4. Kamolov A.N. Surgical tactics for damage to the main veins. autoref. dis. cand. med. sci. 14.00.27. / A.N. Kamolov. Dushanbe. - 1998. - 17 P.

5. Karimova N.R. Indications and choice of the method of surgery on the main vessels during the removal of tumors of various localization and morphology, dis. cand. med. sci. 14.00.27. / N.R. Karimova. Dushanbe. - 2005.- 133 P.

6. Knyazev M.D. Iatrogenic damage to the main blood vessels. / M.D. Knyazev, I.A. Komarov, V.Ya. Kiselev. // Surgery. journ. n.a. N.I. Pirogov - 1985. - № 12. P. 85-87.

7. The technique of duplex scanning of the veins of the lower extremities // Textbook // E.V. Osipova, L.V. Melnikova, A.V. Krylova // 2010

8. Minachenko V.K. Iatrogenic damage to the great vessels / V.K. Minachenko // Soviet medicine. - 1986.- № 10. - P. 102-105.

9. Sapelkin C.B. Iatrogenic damage to the femoral vein during phlebectomy, followed by the successful restoration of its patency. / C.B. Sapelkin, I.E. Timina. // Phlebology. -, 2009. - V. 3.-№1.- P. 63-64.

10. Lokhvitsky C.B. Damage to the main veins during operations. / C.B. Lokhvitsky, S.I. Tokpanov // Bulletin of surgery n.a. I.I. Grekov - 1981. - №4.- P. 118-120.

HEMODYNAMIC CHANGES DURING TOXEMIA IN THERMAL BURNS IN INFANTS

Muhitdinova Hura Nuritdinovna
Doctor of Medical Sciences, Full Professor
Tashkent Institute of Postgraduate Medical Education
Hamraeva Gulchehra Shahabovna
Candidate of Medical Sciences, Associate Professor
Tashkent Institute of Postgraduate Medical Education
Krasnenkova Maryana Borisovna
Candidate of Medical Sciences, Full Professor
Tashkent Institute of Postgraduate Medical Education

Annotation. The work shows that burn injury at the age of 10.1 ± 2.1 months with a burn area of 3B 6 ± 2.7% of the skin surface, increases IF to 71.3 ± 8.4 units, necessitates intensive care in ICU not less than 26.3 ± 2.4 days, the duration of inpatient treatment is 49.3 ± 3.8 days. A thermal burn of the skin surface area of 6 ± 2.7% with a severity of 3B degree in infants (10.1 ± 2.1 months) causes a steady increase in heart rate up to 152.4 ± 10.5 per minute, which requires medical correction over the period toxemia. In the 3rd group of children, a direct correlation between systolic and diastolic blood pressure was revealed, which we regarded as an unfavorable factor requiring correction.

Keywords: burn, hemodynamics, period of toxemia, children

Relevance

At an early age (up to 3 years), the development of the sympathetic nervous system predominates, which determines the development of protective reactions, which leads to the appearance of a more severe symptom complex of shock, a period of toxemia, septic toxemia and burn exhaustion. With imperfection of the subcortical parts of the brain, a higher metabolism is noted, a high water content in the brain tissues provokes frequent convulsive reactions, impaired respiration, cardiovascular and excretory systems. The immaturity of the autonomic nervous system leads to inconsistency of autonomic reactions, instability of respiration and pulse with the development of complications. The cardiovascular system in young

children has great compensatory capabilities, which leads to persistent circulatory disorders, a state of decompensation of the contractile function of the heart develops due to its increased contractility. Due to the high risk of complications and mortality, the problem of developing the effectiveness of timely corrective measures remains relevant.

Purpose of study

To study the change in hemodynamics during toxemia during thermal burns in infants.

Material and research methods

In total, research data from 25 children aged 5 months to 3 years was studied. Patients were examined depending on the severity and area of damage, age, duration of treatment in the ICU. So in infancy, the number of children in ICU up to 10 days was 15 (1 subgroup), 11-20 days - 5 children (2 subgroups), more than 21 days (21-40 days –5 babies). Assessment of the severity of the burn was carried out by calculating the surface area of the damaged skin and using the Frank index. When calculating the Frank index, it is taken into account: a) The burn surface area (Burn 1, 2 and 3a degree), expressed as a percentage; b) The area of the burn surface (Burn 3b and 4 degrees), expressed as a percentage and multiplied by a coefficient of 3; c) A burn of the airways, which is 30% of the index and type A + B + C (for example, the victim has a surface burn of degree 3b, 40%, and a deep burn of degree 3b, is 12%, there is also a burn of the airways, which means 30). Frank index = (40 - 15 takes a deep burn) + (15 * 3) + 30 = 100 units. The prognosis is favorable if the IF is less than 30 units. The prognosis is relatively favorable if IF = 31-60 units. The forecast is doubtful if IF 61 - 90 units. The prognosis is unfavorable if the IF is more than 90 units. Hemodynamics were assessed by hourly recording of systolic (SBP), diastolic (DBP), mean (sPS), pulse pressure (PAD) and heart rate (HR). A detailed analysis of reliably significant deviations, intergroup differences of the studied indicators was carried out. The results were obtained by monitoring with hourly recording of the studied parameters. The research data were processed by the method of variation statistics using the Excel program by calculating arithmetic mean values (M) and mean errors (m). To assess the significance of differences between the two values, Student's parametric criterion (t) was used. The relationship between the dynamics of the studied parameters was determined by the method of pair correlations. The critical level of significance was taken equal to 0.05. Intensive therapy from the moment of admission was aimed at eliminating from burn shock, simultaneous anesthesia and intravenous administration of

crystalloids, volemic solutions under the control of hemodynamics, volume of diuresis. Regular, every 8-12 hours, the introduction of painkillers, cardiotonic, desensitizing, stress-limiting agents, vitamins. According to indications, hormones and blood substitutes were used. Inhaled oxygen was inhaled. All children use vitamins C and group B, antipyretic and hypersensitizing agents, as well as drugs against stressful damage to the gastrointestinal tract, convalescence, septicotoxemia and toxemia. According to indications, early surgical necrectomy, prophylaxis of coagulopathy, energy-deficient state, volemic disorders, and correction of "tachycardial syndrome" were successfully carried out.

Results and its discussion

Table 1

Characteristics of infants who received thermal burns

Groups	Age, month	Height, cm	Weight, kg	S, %	2-3 A	3 B	IF, units	days in the hospital	ICU days
1	19,3±6,2	81,6±8,8	10,9±2,2	32,7±9,8	32,7±9,8	0,1±0,03	33,4±10,1	15,4±3,5	6,8±1,8
2	14,2±4,6	79,7±5,7	10,1±1,9	33,6±7,6	24,8±7,4	9±2,8	48,4±11,28	41,6±10,2	12,8±1,3
3	10,1±2,1*	71±2,5	9,9±0,8	32,7±4,9	26,7±2,2	6±2,7*	71,3±8,4*	49,3±3,8*	26,3±2,4*

* reliably relative to data in 1 group

As shown in Table 1, there were no significant differences in anthropometric data (height, body weight), burn surface area, or lesion area of grade 2-3A. However, a significantly significant difference in age was found. Children of group 3 were younger than patients of group 1 by 9 months (p <0.05). The area of 3B degree lesion reliably prevailed by 5.9% (p <0.05), IF was more than twice as large (p <0.05), which accordingly led to an increase in the duration of intensive therapy in ICUs by 20 days (p <0.05) and treatment in a hospital for 34 days (p <0.05) due to the severity of the condition. Thus, the main factors affecting the severity of the condition of children with thermal burns of infancy turned out to be age (the younger the child, the more severe the condition), the area of skin surface damage of grade 3B, and IF. Thus, age, IF indicator, and area of thermal damage of 3B degree can serve as objective indicators of the severity of a thermal burn and can predict the duration of intensive care in ICU and inpatient treatment, making it also possible to objectively assess future economic costs.

<div align="right">Table 2</div>

Change in hemodynamics during toxemia depending on the severity of a burn injury

Days	SBP, mmHg			DBP, mmHg			Heart rate		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
1	100,2±5,3	97,0±3,2	94,8±6,8	56,9±3,7	56,8±3,6	53,3±3,1	133,4±7,3	147,5±15,0	142,7±14,0
2	100,3±5,5	96,2±4,1	93,1±8,6	59,1±4,2	55,9±2,8	52,6±7,9	130,9±7,8	136,4±6,6	152,4±10,5*
3	100,0±8,4	98,4±5,3	93,9±3,5	57,0±3,8	56,7±3,7	54,1±4,1	136,0±5,0	136,3±5,5	130,5±10,3
4	99,7±6,5	99,1±3,1	98,0±4,8	58,2±2,9	58,0±1,3	55,6±2,5	139,3±5,1	139,3±1,6	139,7±11,6
5	102,3±5,1	101,6±6,3	98,2±2,9	59,1±3,5	57,7±4,3	55,7±1,0	138,8±4,0	138,2±2,6	136,7±10,5
6	103,1±5,3	100,3±5,8	95,4±2,2	58,1±2,7	57,0±4,0	53,6±2,6	139,8±3,2	138,0±4,5	137,3±5,5
7	104,5±4,3	100,5±6,6	95,5±1,3	60,4±2,2	61,8±3,2	54,8±2,49	140,7±4,6	137,1±6,1	137,3±5,1
8	105,5±5,4	99,1±4,1	99,7±8,0	60,5±2,1	58,7±1,5	59,4±5,2	139,6±2,1	136,6±6,3	141,8±3,9
9	106,6±1,5	98,7±2,1	100,3±8,9	57,8±1,1	57,7±2,2	55,6±4,2	139,2±2,0	134,9±4,0	135,8±6,5
10		99,6±3,9	99,7±6,4		57,1±2,2	57,6±2,3		136,7±5,4	136,8±7,0

*- reliably relative to data in 1 group

As shown in Table 2, in 1 day, the indicators of SBP, DBP, heart rate did not significantly differ from the normative values (95 ± 5 mm Hg; 55 ± 5 mm Hg; 115 ± 5 beats per minute), characterized the effectiveness of hemodynamic correction performed by anti-shock intensive care in general. In the following days, hemodynamics was maintained at a stable level throughout the entire period of toxemia. Only the heart rate indicator exceeded generally accepted normative values by 15-20%. On the second day, a significant increase in tachycardia was detected in children of the 3rd group, which exceeded the indicator of the 1st group by 17% (p <0.05). In the process of corresponding correction in the following days, the indicator did not differ from the data of other groups. In patients of the 1st group, a direct correlation of SBP and PAD (0.8649), SBP and SBP (0.9450), DBP and SBP (0.7589) was revealed. In group 2, a direct relationship was found between the dynamics of SBP and SBP (0.8754), and DBP with SBP (0.8770). That is, the compensatory GARDEN and PAD decreased. In the 3rd group, along with the preserved direct relationship between the SBP and the SBP (0.9681), the DBP and the SBP (0.9486), a direct dependence of the SBP on the DBP (0.8392) appeared. Thus, in the 1st group of children, the direct correlation of SBP and PAD as the severity of burn injury increases, respectively, of the general severity of the condition in groups 2 and 3, the dependence of PAD on the level of SBP disappeared. However, in group 3, there was a direct strong dependence

of SBP on DBP. Direct correlations between SBP and SAD, DBP and SAD were found to be constant regardless of severity. In more severe patients of group 3, the direct compensatory relationship between the level of SBP and DBP is significantly strengthened. Thus, in contrast to the first two groups of children, the tendency to increase the tone of peripheral vessels in response to a reflex increase in cardiac output in conditions of stressful oxygen deficiency at the cellular level is a factor not only in increasing peripheral vascular resistance, but also as a mechanism contributing to the development of acute heart failure in conditions stress tachycardia, most pronounced in infants, a deeper lesion (3B) of the skin surface. Thus, for patients of group 3, adequate vasodilator therapy is advisable.

Conclusions: Burn injury at the age of 10.1 ± 2.1 months with a burn area of 3B 6 ± 2.7% of the skin surface, increases IF to 71.3 ± 8.4 units, necessitates intensive care in ICU of at least 26.3 ± 2.4 days, the duration of inpatient treatment is 49.3 ± 3.8 days.

A thermal burn of the skin surface area of 6 ± 2.7% with a severity of 3B degree in infants (10.1 ± 2.1 months) causes a steady increase in heart rate up to 152.4 ± 10.5 per minute, which requires medical correction over the period toxemia.

In the 3rd group of children, a direct correlation between systolic and diastolic blood pressure was found, which was regarded by us as an unfavorable factor, when peripheral vessels respond to an increase in cardiac output in response to increasing oxygen debt, increasing the tendency to spasm, further complicating peripheral blood flow, and capillary perfusion.

References

1. Kurek V.V., Kulagin A.E., Furmanchuk D.A. Anesthesia and intensive care in children. - Moscow, Medical literature, 2006. 230 p.

2. https://studfile.net/preview/6439898/page:7/

PHYSICAL REHABILITATION OF MOTOR DISORDERS OF MIDDLE-AGED PEOPLE WITH ISCHEMIC STROKE AT THE STATIONARY STAGE USING ROBOTICS

Ilina Ekaterina Sergeevna
1st year Master's degree student
Moscow State Academy of Physical Education
Glembockaja Janina
Senior Teacher
Moscow State Academy of Physical Education

Abstract. The article deals with physical rehabilitation of motor disorders of middle – aged people with ischemic stroke. It should be noted that study was conducted at the stationary stage using robotics. It gives a detailed analysis of:
1. Dynamometry;
2. Test for determining the amplitude of movements in the knee joint;
3. Test to determine the rate of execution of movements;
4. Scale of functional independence of FIM.
Keywords: physical rehabilitation,motor disorders,middle – aged people, ischemic stroke, robotics.

Introduction

Currently, rehabilitation is carried out for patients who have suffered from an ischemic stroke. There is a tendency to all cerebrovascular diseases in all economically developed countries. Morbidity and ischemic violence occur in the most able-bodied and professionally active part of the population - middle-aged people from 40 to 60 years. Strokes take first place in primary disability among all neurological patients. Only 20,2% of the population working before a stroke return to work.

The basis for the restoration of impaired motor function is the mechanism of neuroplasticity - the ability of the nervous tissue to structurally functional restructuring that occurs after its damage. In the process of previous studies, it was proved that the mechanism of neuroplasticity is activated in the process of repeated targeted repetition of movements.

Taking into account the foregoing, the aim of this work is to improve the traditional methods of physical rehabilitation with subsequent recommendations to patients who have suffered ischemic stroke.

The object of the work is the rehabilitation of patients with ischemic stroke at the age of 42 - 63 years.

The subject of the work is the study of the effect of physical exercises in combination with the Irigo robotics on the rehabilitation of patients with the consequences of ischemic stroke.

To achieve the aim, the following tasks were put forward:

1. To analyze the scientific and methodological literature in order to familiarize themselves with existing methods of physical rehabilitation after strokes.

2. To develop a method for the physical rehabilitation of post-stroke middle-aged patients in combination with the Irigo robotics.

3. To substantiate experimentally the effectiveness of the proposed method.

To solve these problems, the following research methods were used:

1. Theoretical analysis and generalization of literary sources.
2. Dynamometry.
3. Test for determining the amplitude of motion in the knee joint.
4. Test to determine the rate of execution of movements.
5. The scale of functional independence of FIM.
6. Pedagogical experiment.
7. Methods of mathematical statistics.

The most informative risk factors for stroke are: hypertension, arteriosclerosis, age, gender, burdened by cardiovascular disease heredity, heart disease, peripheral vascular and coagulation properties of blood, diabetes, oral contraceptives, eating habits, overweight, mental stress, alcohol abuse and smoking, lack of exercise, professionparticularities, increased meterability, as well as some of the climate-meteorological and Heliophysical factors, arterial hypertension, atherosclerosis, obesity, kidney disease, brain tumors, changes in blood coagulation system, old age, heredity.

Discussion and research results

About 6 million people suffer a stroke annually in the world. In Russia, more than 450 thousand people per year have a stroke. At the same time, the incidence of acute cerebrovascular accident is 2.5-4 per 1000 population, which is one of the highest rates in the world. Mortality in strokes is high - up to 34.6-38%. Among the causes of death, stroke occupies the second or third place, being also the main cause of disability. Thus, cerebral stroke has severe moral, social and economic consequences.

The most informative risk factors for cerebral stroke are: arterial hypertension, atherosclerosis, age, sex, burdened by cardiovascular diseases, heredity, diseases of the heart, peripheral vessels and blood coagulation, diabetes mellitus, oral contraceptives, eating habits, overweight, nervous mental stress, alcohol and smoking abuse, physical inactivity, occupational characteristics, increased meteorolability, as well as some climatic and meteorological and eliofizicheskie factors, hypertension, atherosclerosis, obesity, kidney disease, brain tumors, changes in the blood clotting system, old age, heredity.

Stroke, as a rule, is not a rapidly developing disease. This is a long process that goes through stages from minor functional changes to irreversible structural damage to the brain-necrosis (necrosis of brain cells). This severe disease is the result of a violation of the function of blood vessels, and the resulting neurological disorders are called cerebrovascular diseases (from cerebrum – brain, vascularis – vascular, lat.). The severity of the consequences of a stroke depends on where the blood supply or hemorrhage occurred in the brain.

In the scientific literature, the terms "hemorrhagic stroke" and "nontraumatic intracerebral hemorrhage" are either used as synonyms, or nontraumatic subarachnoid hemorrhage is also referred to as hemorrhagic strokes, along with intracerebral hemorrhage. Some researchers note that after a stroke, patients have a violation of the idea of the organization of movements, balance, posture, movement, which negatively affects motor activity (motor component), as well as when controlling violations of vertical posture, a sensory component is allocated that processes the information received from the somatosensory, visual and vestibular systems.

Many authors agree that the active rehabilitation of post-stroke patients is hindered by severe cognitive (reduced memory, attention, intelligence) and psychoemotional disorders (reduced mental and motor activity, astheno-depressive syndrome), severe concomitant somatic diseases that negatively affect the recovery of movements. Depressive States are observed in 25-30% of patients and are caused not only by a reaction to the disease, but also by damage to certain brain structures.20% of post-stroke patients develop apathy associated with emotional and cognitive disorders.

Thus, it is necessary and justified to modernize various methods and programs of physical rehabilitation, taking into account the peculiarities of the stroke, the localization of the lesion, the causes of the disease.

Most authors agree that the most specific consequences of strokes, both of ischemic etiology and hemorrhagic, can include motor disorders, as well as sensitive, speech and trophic disorders.

Dynamometry-a method that allows you to determine the muscle strength of the hands, arms, legs and torso. To measure the strength of the flexor muscles of the hand, hand dynamometers were used, corresponding to the age capabilities of the subjects (DRP-30, DRP-90). Measurements were made three times on the healthy and affected limb, with a rest of 40-60 seconds in the standing position freely, with the arm slightly forward and to the side, the subject squeezed the dynamometer, without bending the arm at the elbow joint. The best result from three attempts was recorded in the Protocol.

To determine the functional state of the musculoskeletal system, we used a test to determine the amplitude of movements in the knee joint, which allows you to diagnose the volume of movement in a particular joint (in angular degrees) and a test to determine the pace of movement, which allows you to identify deviations in the coordination abilities of the patient.

The measurement of the amplitude of movements was performed using a goniometer (angle finder) consisting of two branches (movable and stationary) connected to a measuring scale from 0° to 180°. The anatomical position of the joint was assumed to be 0°; the normal volume of movement was 135°. Measurement of the volume of movements in the knee joint is performed in the lying position on the stomach. The active type of movement is studied, i.e. the subject makes movements independently, without the help of the researcher.

Test for determining the pace of movement execution; Test for determining the pace of movement execution. The patient from the "standing" position performs squats of the possible depth for him. The number of squats performed per minute is measured.

FIM functional independence scale.

In our work, we used the FIM functional independence scale (Functional Independence Measure), the questionnaire included 18 questions on self-care, pelvic function control, movement, and communication. Below is a sample response form that was used for the survey. The answer sheet: 1. Meals (using cutlery, bringing food to the mouth, chewing, swallowing) 2. Personal hygiene (brushing teeth, combing hair, washing face and hands, shaving or makeup) 3. Taking a bath/shower (washing and wiping the body, except for the back area) 4. Dressing (including putting on prostheses/orthoses), upper body (above the waist) 5.Dressing (including putting on prostheses/orthoses), lower torso (below the waist) 6. Toilet (use of toilet paper after visiting the toilet, hygiene bags) 7. Bladder (control of urination and, if necessary, the use of devices for urination-catheter, etc.) 8. Rectum (control of the act of defecation and, if necessary, the use of special devices-enemas,

colostrums, etc.) 9. Bed, chair, wheelchair (the ability to get out of bed and lie on the bed, sit on a chair or wheelchair and get up from them) 10. Toilet (ability to use the toilet — sit down, get up) 11.Bath, shower (ability to use a shower cabin or bathtub) 12. Walking/moving with a wheelchair (score " 7 "corresponds to the ability to walk without assistance for a distance of at least 50 meters, score" 1 " - the inability to cover a distance of more than 17 meters) 13. Climbing the stairs (score "7" corresponds to the possibility of climbing 12-14 steps without assistance, score "1" - the inability to over- come the height of more than 4 steps) 14. Perception of external information (understanding speech and / or writing) 15. Expressing your own desires and thoughts (oral or written) Social activity. 16. Social integration (interac- tion with family members, medical staff, and others) 17. Decision-making (ability to solve problems related to finances, social and personal needs). 18. Memory (the ability to remember and reproduce the received visual and auditory information, learning, recognizing others)

We used The FIM functional independence scale, which consists of 18 points that reflect the state of motor and intellectual functions. The points are evaluated by the nursing staff on a 7-point scale, then the sum of points is calculated for all the points in the questionnaire.

Statistical analysis of the research results was performed using math- ematical statistics methods. We used a parametric method of statistical data processing – the student's t-test.

The arithmetic mean (X) and the error of the arithmetic mean (x) were calculated using generally accepted formulas for interpreting the results of the study.

The pedagogical experiment was conducted on the basis of the FSB Military hospital in Moscow. The experiment involved 20 people (men) aged 42 to 63 years.

The subjects were divided into two groups: control and main (experi- mental) groups of 10 people each. Patients received inpatient treatment. The duration of the proposed method was 20 days.

Patients of the control group, whose average age was 57.8 years, were engaged in a generally accepted method: therapeutic gymnastics,

The subjects of the main group, whose average age was 58.3 years, were engaged in an experimental method of adaptive physical rehabilita- tion: from the first days, therapeutic gymnastics was prescribed. On the second day from the beginning of the disease-additional classes on Irigo robotics.

Using the Erigo rehabilitation unit allows you to achieve several goals simultaneously:

1. Prevent pneumonia, lower limb thrombosis, pulmonary embolism, bedsores, urination disorders and other complications associated with prolonged immobility,

2. Smoothly adapt the cardiovascular system to physical exertion,

3. To restore muscle strength of the legs, to avoid muscle atrophy,

4. To restore walking skills,

5. Mobilize the patient through verticalization.

Contraindications:

1. acute thrombophlebitis, thrombosis of the veins of the lower limbs;

2. instability of blood pressure figures ;

3. acute inflammatory, infectious diseases, fever;

4.severe cognitive impairment

Procedure:

- the first procedure is performed in a horizontal position and does not exceed 10 minutes;

- with each procedure, the tilt on the verticalizer increases and the time spent;

- also increases such indicators as the frequency of movements and the load on the lower limbs;

- the duration of the procedure increases from 10 to 30 minutes, classes are held daily

The height of the Erigo vertical table can vary between 45-78 cm, and the angle of inclination can range from 0 to 80 degrees.

At the same time, motor therapy can be performed at any tilt of the table, starting from a lying position to an almost vertical position. Reliable fixation of the patient is provided by special belts, cuffs and supports for the feet, equipped with springs. The movement of the legs and the supporting load on the feet during the training are controlled by a computer. All indications are displayed on the screen, and information is stored and processed to determine the optimal parameters of rehabilitation therapy.

Advantages of rehabilitation therapy on Erigoverticalizer:

- the combination of verticalization of the patient, movement of the legs and the base load on the foot,

- smooth stimulation and maintenance of the cardiovascular system,

- significant reduction in the risk of secondary complications associated with immobilization,

- high functionality, manufacturability;

- reliability and security;

- computer control, programming of individual rehabilitation plan.
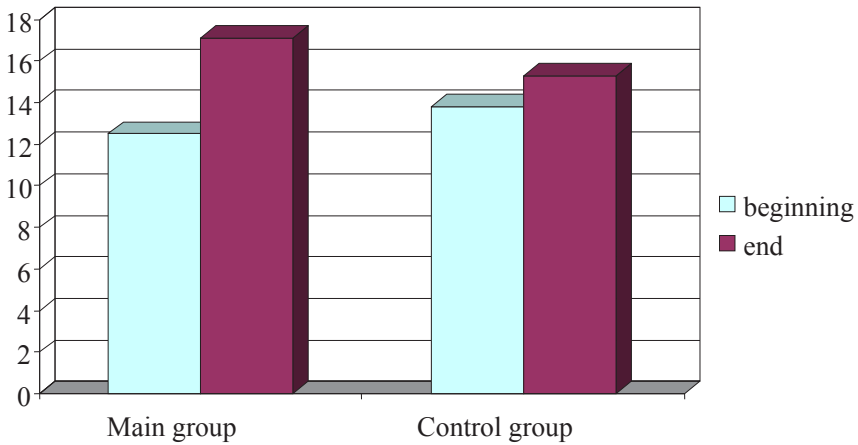
Picture 1. Dynamics of indicators of paretic limb dynamometry (kg)

From table 2, we can see that before the experiment in the main and control groups, the dynamics of muscle strength indicators of the paretic upper limb is almost identical.

But at the end of the study, although improvement was observed in both groups, the indicators of changes in the strength of the paretic limb muscles were slightly higher, with a confidence of $p < 0.05$, in the main group than in the control group. This is also explained by the use of the proposed methodology in the main group.
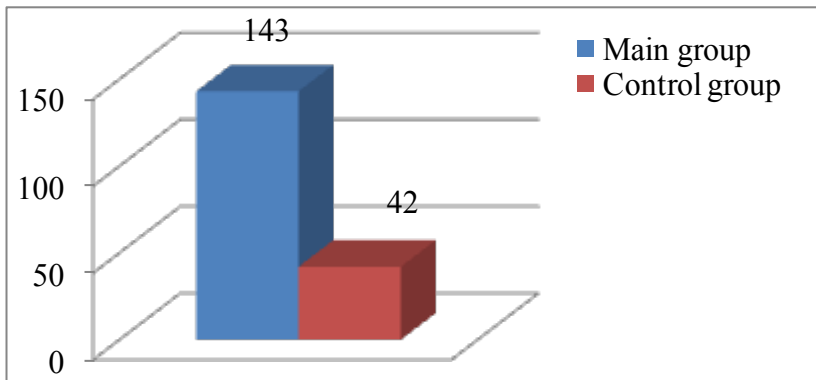
Picture 2 .Dynamics of indicators of the pace of execution of movements (number/min)

Analyzing the rate of movement performance, we can observe a significant (p ≤ 0.05) improvement in the functional state of the musculoskeletal and neuromuscular apparatus in the main group by 143%, and in the control group-by 42%, which is explained by the use of motor therapy using Irigo robotics, which largely makes up for the lack of movement.

As can be noticed of movement volume indicators before the experiment, the dynamics of indicators in the main and control groups were almost identical. On day 20, after the end of the experiment, we see a significant improvement in indicators (p < 0.05) in both the main and control groups, but in the main group, changes in the volume of movements are more pronounced than in the control group, which we explain by using the proposed method in the main group.

As for the scale of functional independence of FIM, there is also an improvement in all parameters observed in the main group in a shorter period of rehabilitation in relation to the control group.

According to the data obtained, the state of motor and intellectual functions on the FIM functional independence scale in the main group significantly improved by 57.7% (p< 0.05), and in the control group – by 45.3%.

Based on the above, we came to the conclusion that the complex method of motor rehabilitation for post-stroke patients developed by us in combination with the robotic Irigo technique gives a high therapeutic effect in relation to the traditional method of physical therapy.

Conclusion

1. As a result of the analysis of scientific and methodological literature, it was determined that the disease develops as a result of an acute violation of the blood flow to a specific area of the brain (ischemic stroke or cerebral infarction). It has been established that, to date, mechanisms for the recovery of post-stroke patients based on the continuity and complexity of pedagogical influences have not been sufficiently developed; the use of theoretical exercises to gain knowledge about the means and methods of physical rehabilitation to restore impaired body functions, increase motivation for physical exercises, the formation of the need for independent physical exercises, as conditions for successful socialization of patients in society.

2. We have developed a comprehensive methodology for the physical rehabilitation of stroke patients at the inpatient stage, including: the technique of passive and active muscle correction of the paretic upper limb, as well as active training of a healthy upper limb. On day 2, the Irigo robotic technique was used to restore motor impairment in patients. The first procedure is carried out in a horizontal position and does not exceed 10 min-

utes, with each procedure the inclination on the verticalizer and the time are increased, such indicators as the frequency of movements and the load on the lower extremities also increase, the procedure time increases from 10 to 30 minutes,

3. According to the dynamics of the dynamics of the upper extremities, we note a significant p <0.05 improvement in muscle strength in the main group relative to the control group, where the above parameters also increased, but this required a longer rehabilitation period.

4. We can observe similar results in terms of the rate of execution of movements, where the results were slightly higher, with a confidence of p <0.05, in the main group than in the control group, which is also explained by the use of the technique proposed by us in the main group. As for the FIM functional independence scale, there is also an improvement in all parameters in the main group in a shorter period of rehabilitation in relation to the control.

5. Based on the foregoing, we came to the conclusion that we developed a comprehensive method of motor rehabilitation for post-stroke patients in combination with the Irigo robotic technique gives a high therapeutic effect in relation to the traditional exercise therapy technique.

References

1. Akimov, G.A. Initial manifestations of vascular diseases of the brain / GAAkimov.- SPb.: Medicine, 2003. - 224 p.

2. Cognitive disorders in post-stroke patients / A. B. Mineeva, Ya.S.Nikitina // 72nd Interuniversity (VII All-Russian) Final Scientific Student Conference with international participation, 2018. - P. 161.

3. Application of robotic complexes in the rehabilitation of patients / A.F. Sabbakhova // XXX All-Russian Scientific and Technical Conference of Students, Young Scientists and Specialists. Ryazan State Radio Engineering University, 2017. - p. 563-566.

4. Stolyarova L.G., Kadykov A.S., Holland E.B. Principles of organization of rehabilitation treatment of neurological patients // Questions of the organization of rehabilitation treatment of patients and disabled people. - M., 2012. - p. 14-20.

ANALYSIS OF THE ANTITUMOR PROPERTIES OF RECOMBINANT L-PHENYLALANINE-AMMONIUM-LYASE [1]

Babich Olga Olegovna
Doctor of Technical Sciences, Lead Research Officer
Kemerovo State University, Kemerovo, Russia
Ivanova Svetlana Anatolyevna
Doctor of Technical Sciences, Full Professor
Kemerovo State University, Kemerovo, Russia

Abstract. In this work, the antitumor properties of the recombinant L-phenylalanine-ammonium-lyase (PAL) were studied by assessing the effect on the viability of tumor cells of various origins. The number of live tumor cells was determined using the MTT colorimetric method. In order to establish the molecular mechanism of recombinant PAL cytotoxicity, the possibility of the enzyme binding to cancer cells of the studied strains and inducing their apoptosis was studied.

Keywords: antitumor properties, recombinant L-phenylalanine-ammonium-lyase, tumor cells, cytotoxicity.

L-phenylalanine-ammonium-lyase (PAL, EC 4.3.1.5) catalyzes the reversible deamination of the amino acid L-phenylalanine to trans-cinnamic acid and ammonia. This enzyme is also used as an independent product in the treatment and/or diagnosis of patients with phenylketonuria, as an auxiliary product in the production of special food products, in the biotechnological production of L-phenylalanine from trans-cinnamic acid, to suppress the growth of malignant cells, stimulate plant growth, etc. [1].

The aim of this work is to analyze the antitumor properties of the recombinant L-phenylalanine-ammonium-lyase, as a promising agent for targeted therapy of cancer.

The antitumor properties of recombinant L-phenylalanine-ammonium lyase in a concentration range of 0.00015-2.5 µg/ml were studied by assessing the effect on the viability of tumor cells of various genesis: Burkitt's lymphoma cells LBR2, human prostate cancer DU 145, human breast cancer MCF7, HepG2 hepatocellular carcinoma (Bank of tumor strains of the

N.N. Blokhin National Medical Research Center of Oncology of RAMS). A recombinant PAL solution with a concentration of 5 μg/ml in a 0.9% sodium chloride solution was used as the initial sample. Before the study, working solutions of the initial preparation were prepared by sequential five-fold dilution in a 0.9% sodium chloride.

he experiment was carried out as follows. Cells were cultured at 37 °C and 5% CO_2 in RPMI 1640 medium containing 10% fetal bovine serum inactivated at 56 °C for 30 minutes, 2 mM L-glutamine, 100 μg/ml penicillin and 100 μg/ml sulfate streptomycin. Light microscopy of the cells was performed using the AxioVision 4 system (Zeiss, Germany). Cell viability was determined by the exclusion of trypan blue dye in the Goryaev chamber.

Tumor cells that reached the logarithmic growth phase were passaged into flat-bottomed 96-well microplates (Costar) at $5 \cdot 10^4$ - $6.5 \cdot 10^4$ cells per well and incubated for 24 hours before the addition of test solutions under conditions of 5% CO_2 and 37 °C. The resulting solutions in a wide range of progressively decreasing concentrations were added to the cell culture wells (20 μl to 180 μl of the cell suspension) and incubated for 48 hours. A 0.9% sodium chloride solution was added to the control wells(20 μl). The number of living cells in the wells at the end of the incubation period was determined using the MTT colorimetric method based on the ability of living cell dehydrogenases to restore 3- (4,5-Dimethyl-2-Thiazyl) -2,5-Diphenyl-2H-Tetrazolium Bromide (MTT) to violet formazan crystals soluble in dimethyl sulfoxide [2].

The optical absorption of the colored dimethyl sulfoxide solutions was measured on a Multiskan MS plate photometer (Labsystem, Finland) at λ=540 nm. The cytotoxicity of the tested PAL solutions was evaluated by the formula:

$$1 - \frac{N_0}{N_k}$$

where N_0 – optical absorption in experimental samples,

N_k – optical absorption in control.

The nonlinear regression method was used to calculate the inhibitory concentration of protein in the medium, which caused a 50% decrease in the number of living cells (IC_{50}).

The results of studying the cytotoxic effect of recombinant L-phenylalanine-ammonium-lyase on tumor cells of LBR2, DU 145, MCF7 and HepG2 after 12 and 24 hours of incubation are presented in Figure 1. Analysis of Figure 1 showed that the recombinant PAL exhibited a pronounced cytotoxic effect in relation to cells Burkitt's lymphomas LBR2, human prostate cancer DU 145, human breast cancer MCF7, hepatocellular carcinoma HepG2, and the cytotoxic effect of the enzyme increases with increasing concentration.
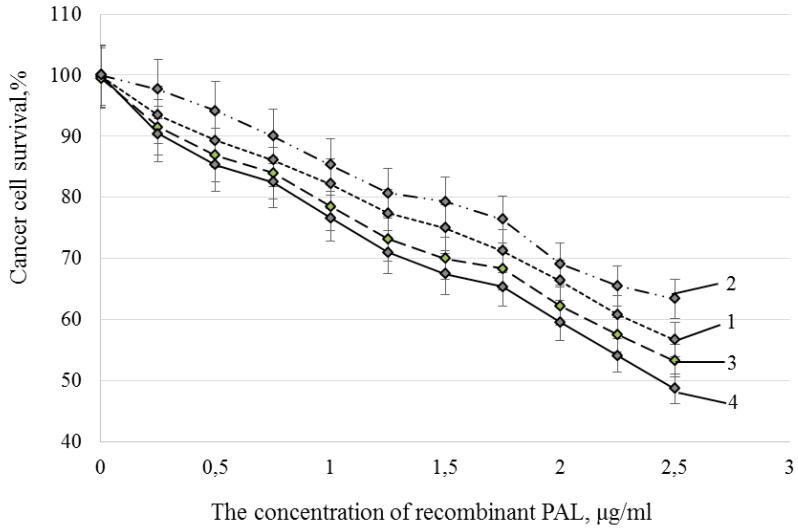
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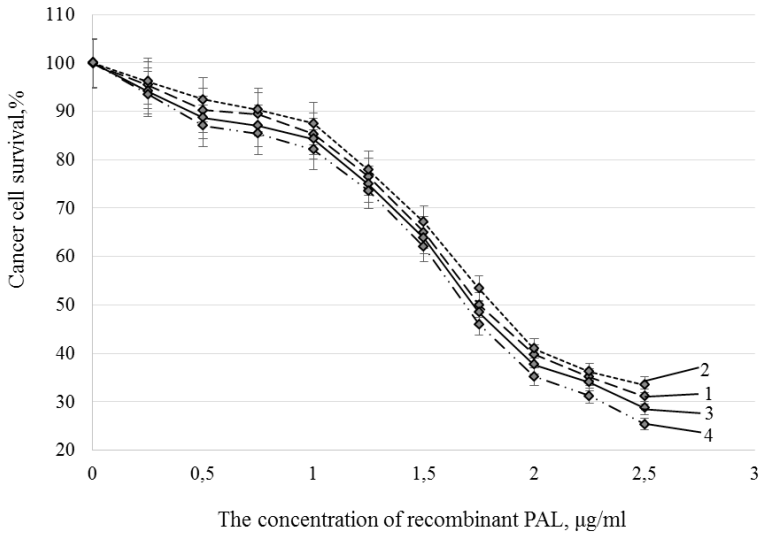
b

Figure 1– Cancer cell survival in the presence of recombinant
L-phenylalanine-ammonium-lyase: a – incubation time 12 h,
b – incubation time 24 h; 1 – cell strain LBR2,
2 – cell strain DU 145, 3 – cell strain MCF7, 4 – cell strain HepG2

With a 24-hour incubation, the antitumor effect of PAL is more pronounced (cancer cell survival decreases to 25.4-33.5%) than with a 12-hour incubation (cancer cell survival decreases to 48.7-63.4%).

Based on the data obtained, IC_{50} values were calculated (table 1).

Table 1 – Calculated IC_{50} values for recombinant PAL

Cell strain	IC_{50}, µg/ml
Cell strain LBR2	1,75±0,09
Cell strain DU 145	1,87±0,09
Cell strain MCF7	1,72±0,09
Cell strain HepG2	1,68±0,08

From table 1 it follows that the selectivity of recombinant PAL in relation to tumor cells of different genesis is approximately the same, IC_{50} varies in the range from 1.68 to 1.87 µg/ml.
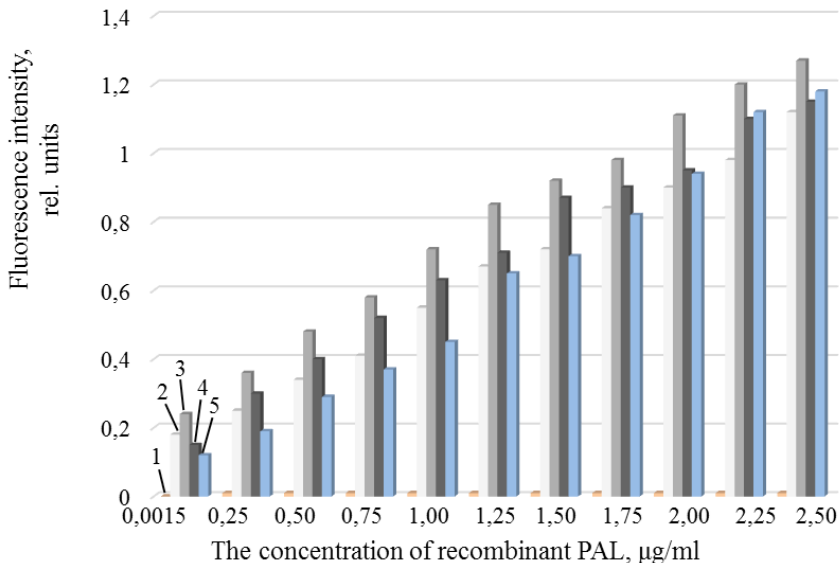
Figure 2 – The results of a study of the ability of recombinant PAL to bind to peripheral blood lymphocytes (a), cancer cells LBR2 (2), DU 145 (3), MCF7 (4), HepG2 (5)

In order to establish the molecular mechanism of recombinant PAL cytotoxicity, we studied the possibility of the enzyme binding to cancer cells of the studied strain and inducing their apoptosis. The experiment was carried out as follows: fluorescently-labeled molecules of L-phenylalanine-ammonium-lyase were obtained, then they were incubated with LBR2, DU 145, MCF7 and HepG2 cells at 4 °C for 2 hours, the cancer cells were washed and fixed, and then their fluorescence was measured by means of a flow cytometer. In a control experiment, human peripheral blood lymphocytes were used. The results are presented in Figure 2.

According to the data in figure 2, recombinant L-phenylalanine-ammonium-lyase binds effectively to cancer cells of all tested strains, after which their apoptosis obviously occurs. At the same time, the interaction of the PAL enzyme with peripheral blood lymphocytes is not observed, thus, healthy body cells are not affected. This property of recombinant PAL allows us to consider it as a promising agent for targeted therapy of cancer.

References

1. Babich, O.O. Cloning and expression of the L-phenylalanine-ammonium-lyase gene in Escherichia coli and isolation of the recombinant protein / O.O. Babich, L.S. Dyshlyuk, I.S. Razumnikova // Technique and technology of food production. – 2011. –V. 1 (20). – P. 8–13.

2. The detection of bovine lactoferrin binding protein on Trypanosoma brucei / T. Tanaka, Y. Abe, N. Inoue et al // J. Vet. Med. Sci. – 2004. – V.66. – P. 619–625.

ANALYSIS OF REPRODUCTIVE AND EMBRYONIC TOXICITY OF ENZYMATIC HYDROLYSATES OF COCONUT OIL [1]

Noskova Svetlana Yuryevna
Candidate of Technical Sciences, Research Officer,
Kemerovo State University, Kemerovo, Russia
Sukhikh Stanislav Alekseevich
Candidate of Technical Sciences, Lead Research Officer,
Kemerovo State University, Kemerovo, Russia
Belova Daria Dmitrievna
Candidate of Technical Sciences, Research Assistant,
Immanuel Kant Baltic Federal University, Kaliningrad, Russia

Abstract. At the previous stages of the study, coconut oil hydrolysis products were obtained using various lipolytic enzymes. In this work, the reproductive toxicity of enzymatic hydrolysates of coconut oil was studied on spermatozoa of outbred white rats, and embryonic toxicity on mouse embryos. The results obtained indicate the absence of reproductive and embryonic toxicity in enzymatic hydrolysates of coconut oil.

Keywords: coconut oil hydrolyzate, reproductive toxicity, embryonic toxicity.

Reproductive toxicity is the harmful effect of a chemical on male and female sexual function and fertility, as well as toxic effects on offspring.

The reproductive toxicity of enzymatic coconut oil hydrolysates was studied in spermatozoa of outbred white rats. Sperm cells for the experiment were prepared as follows: sperm cells were isolated by centrifugation in a percoll gradient. Percoll solutions were prepared on HBS + BSA buffer, pH 8.0 (0.13 M NaCl, 0.004 M KCl, 0.001 M $CaCl_2$, 0.0005 M $MgCl_2$, 0.014 M fructose, 0.01 M N2-hydroxyethylpiperazine-N'-2-ethanesulfonic acid and 1 mg/ml bovine serum albumin) [1]. The washed spermatozoa were diluted with Guinea fluid to a concentration of $2 \cdot 10^6$/ml. Guinea fluid preparation algorithm:

1) preparation of solution №1 with the composition: NaCl – 20%, CaCl$_2$ – 0,5%, KCl – 0,5%, MgCl$_2$ – 0,25%);

2) preparation of solution №2 with the composition: NaHCO$_3$ – 0,5%, Na$_3$PO$_4$ – 0,25%;

3) mixing 4 ml of solution № 1 in 50 ml of distilled water and 2 ml of solution № 2 in 50 ml of distilled water;

4) adding to the resulting solution 1.5 g of fructose in 33 ml of distilled water.

During the experiment, coconut oil enzymatic hydrolysates were added to 100 µl of prepared sperm of mice (the concentration of hydrolysates was from 0.5 mg/ml to 5.0 mg/ml in increments of 0.5 mg/ml). Control — 100 µl of 0.9% sodium chloride solution was added to 100 µl of prepared sperm. The experimental and control samples were incubated at a temperature of 37 °C for 2 h, after which the motor activity, functional activity and hypoosmotic swelling of spermatozoa were studied.

Sperm motility was studied using a standard technique in accordance with the recommendations of the WHO 4th edition guide [2].
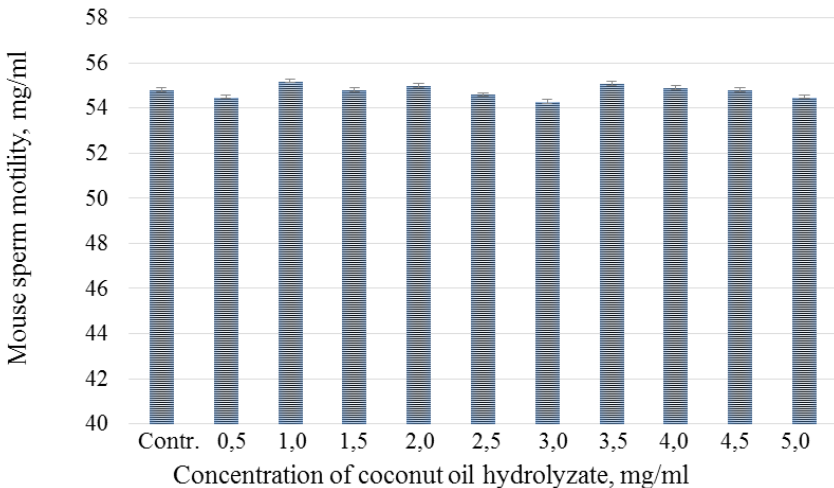
Figure 1 – Effect of enzymatic coconut oil hydrolysates on mouse sperm motility

To evaluate the functional activity of spermatozoa, a resazurin test was used, which is based on a spectrophotometric estimate of the reduction in the amount of resazurin due to the formation of resarufin. Spermatozoa were diluted in 50 µl of Ringer/Tris solution and 5 ml of a 0.1% solution of

resazurin was injected, incubated for 1 h at a temperature of 48-50 ° C and absorbance was measured at a wavelength of 610 nm.

Test for hypoosmotic swelling of spermatozoa (HOS test) and evaluation of its results was carried out according to standard methods in accordance with the recommendations of the WHO Guidelines 5th edition [3].

The results of testing the reproductive toxicity of enzymatic coconut oil hydrolysates are shown in Figure 1 and Table 1.

Table 1 – The effect of enzymatic coconut oil hydrolysates on the functional activity of mouse sperm (resazurin test) and the functional state of mouse sperm membranes (HOS test)

Concentration of enzymatic hydrolyzate, mg/ml	Optical density	HOS test results,%
Control (without hydrolyzate)	1,75±0,09	83,88±4,19
0,5	1,77±0,09	84,12±4,21
1,0	1,70±0,09	83,85±4,19
1,5	1,73±0,09	83,80±4,19
2,0	1,79±0,09	84,05±4,20
2,5	1,75±0,09	84,02±4,20
3,0	1,76±0,09	83,92±4,20
3,5	1,80±0,09	83,90±4,20
4,0	1,74±0,09	83,84±4,19
4,5	1,75±0,09	84,00±4,20
5,0	1,77±0,09	83,96±4,20

In accordance with Figure 1, enzymatic hydrolysates of coconut oil in the entire range of tested concentrations do not affect the sperm motility of mice: in the control experiment, sperm motility is 54.8%, in the experimental - from 54.3 to 55.2%. This data is confirmed by the results of the resazurin test and HOS test (table 2) - the effect of enzymatic coconut oil hydrolysates on the functional activity of mouse spermatozoa and the functional state of mouse sperm membranes was not revealed.

Embryonic toxicity is understood as the property of a substance to exert (if it enters the mother's body) a negative effect on the offspring during the initial period of pregnancy, i.e., between the conception and the formation of the embryo.

The embryonic toxicity of enzymatic coconut oil hydrolysates was studied in mouse embryos. For this, mouse embryos from the stage of two blastomeres were cultured in drops of a nutrient medium (Witten's modified medium - WMM) under a layer of paraffin oil with the addition of various

concentrations (from 0.5 mg/ml to 5.0 mg/ml in increments of 0.5 mg/ml) enzymatic hydrolysates of coconut oil. Cultivation was carried out at a temperature of 37 °C and high humidity in an atmosphere of 5% CO_2. Control - the cultivation of embryos in a nutrient medium without the addition of coconut oil hydrolysates. Cultivation was carried out in a multi-gas incubator for 3 days. At the end of cultivation, changes in the total cell mass and the number of blastocysts in the process of hatching were recorded. The results are presented in figures 2-3.
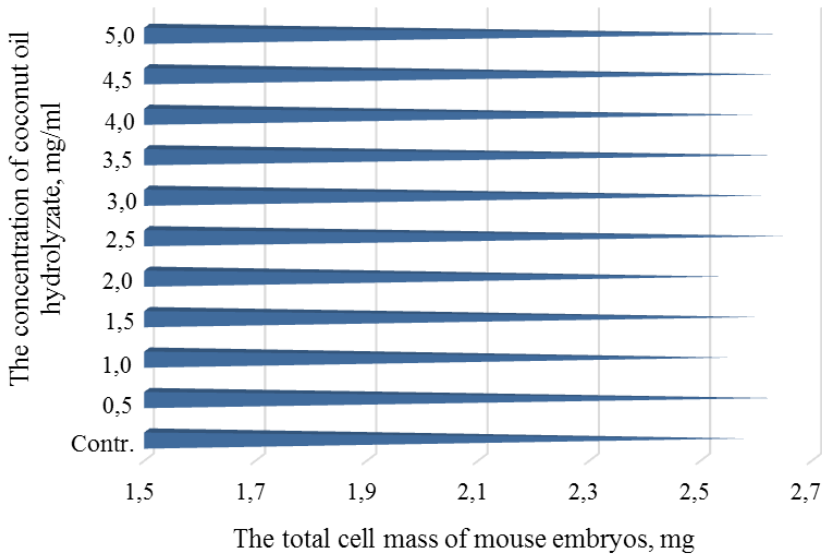
Figure 2 – The effect of enzymatic hydrolysates of coconut oil on the total cell mass of mouse embryos

An analysis of figures 2-3 allows us to conclude that the enzymatic hydrolysates of coconut oil have no embryotoxic effect. Test samples do not affect the total cell mass of mouse embryos, nor the proportion of blastocysts that are in the process of hatching.

Thus, *in vitro* experiments showed the absence of reproductive and embryonic toxicity in coconut oil enzymatic hydrolysates. This fact, along with the antimicrobial properties of coconut oil hydrolysates, opens up prospects for their use as components of bactericidal agents for oral care.
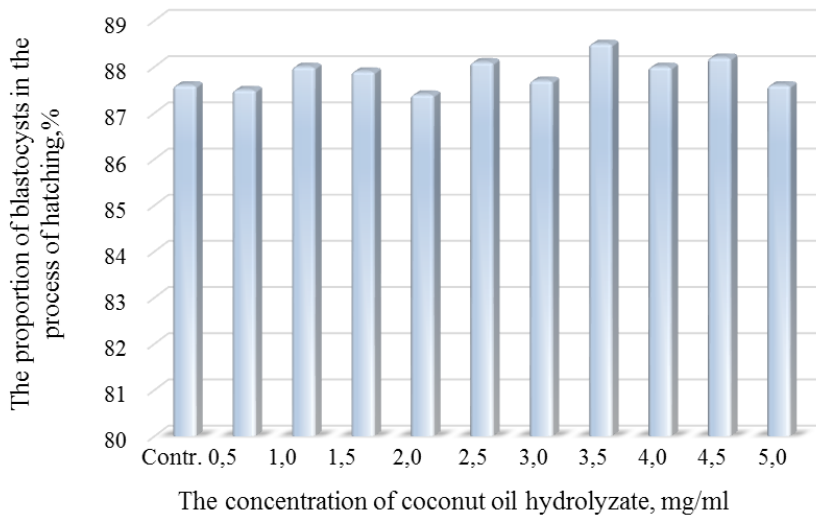
Figure 3 – The effect of enzymatic hydrolysates of coconut oil on the proportion of blastocysts that leave the cell wall

References

1. Lutsky, D.L. Factors of liquefaction of a coagulated human ejaculate / D.L. Lutsky, A.A. Nikolaev, V.M. Miroshnikov // Successes in modern science. – 2003. – №9. – P. 10-14.

2. WHO laboratory manual for the examination of human semen and sperm-cervical mucus interaction. 4th ed. - New York: Cambridge University Press, 1999. 128 P.

3. WHO laboratory manual for the examination and processing of human semen. 5th ed. – Geneva: WHO Press, 2010. 271 P.

ASSESSMENT OF ANTIBIOTIC RESISTANCE AND BIOCOMPATIBILITY OF PSYCHROPHILIC MICROORGANISMS ISOLATED FROM BOTTOM SEDIMENTS OF LAKE BAIKAL [1]

Sukhikh Stanislav Alekseevich
Candidate of Technical Sciences, Lead Research Officer
Kemerovo State University, Kemerovo, Russia
Shevchenko Margarita Andreevna
Research Assistant
Immanuel Kant Baltic Federal University, Kaliningrad, Russia
Belova Daria Dmitrievna
Candidate of Technical Science, Research Assistant
Immanuel Kant Baltic Federal University, Kaliningrad, Russia

Abstract. In this work, antibiotic resistance and minimal inhibitory concentrations of strains of psychrophilic microorganisms isolated from the bottom sediments of Lake Baikal were evaluated using the disk diffusion method. The biocompatibility of the studied strains was also determined by direct co-culture on a solid nutrient medium.

Keywords: psychrophilic microorganisms, Lake Baikal, antibiotic resistance, minimal inhibitory concentration, biocompatibility.

Today, antimicrobial substances produced by bacteria are of great interest both from the point of view of applied and fundamental science. Despite the obvious importance of the search for bacteriocins of different groups, most applied research is focused on lactic acid bacteria, while microorganisms isolated from natural communities also have high potential for use in this field of biotechnology. A promising place to search for new types of microorganisms, producers of bacteriocins is Lake Baikal. In this regard, at the previous stages of the study, cultures of microorganisms *Bacillus megaterium*, *Pseudomonas fluorescens, Pseudomonas putida, Pseudomonas aeruginosa*, *Pseudomonas oleovorans*, isolated from mi-

crobial communities of bottom sediments of Lake Baikal (coastal zone of Slyudyanka, Listvyanka village, Kultuk village) were obtained.

The aim of this work is to evaluate the antibiotic resistance and biocompatibility of selected psychrophilic microorganisms.

The antibiotic resistance of the studied strains and the minimum inhibitory concentrations were evaluated by the disk diffusion method using MUK 4.2.1890-04 [1]. To determine the sensitivity of the studied strains, four antibiotics were selected with confirmed antibacterial activity against the studied species of organisms (ampicillin, tetracycline, kanamycin, chloramphenicol).

Cultivation of the strains was carried out on a dense nutrient medium LB (agar - 1.5%, tryptone - 1%, yeast extract - 0.5%, NaCl - 1%), as well as liquid nutrient medium LB (tryptone - 1%, yeast extract - 0.5%, NaCl - 1%) at a temperature of 25 ℃. To obtain the inoculum, five colonies of the same type, taken from a daily culture seeded with a thinning bar, were placed in 5 ml of LB liquid medium and cultured in a shaker thermostat at 25 ℃ to an OD_{450} of 0.10–0.11, which corresponds to a cell content of approximately $1{,}5 \cdot 10^8$ CFU/ml. Next, the obtained inoculums in a volume of 1 ml were applied to Petri dishes with LB agar and distributed by shaking, after which the excess was removed by automatic pipetting. For ten minutes, Petri dishes with inoculums were dried at room temperature, after which they applied the prepared sterile paper disks soaked in antibiotic solutions with a concentration of 500 mg/l. Dry discs were used as negative controls. After the 15 minutes required for prediffusion of the antibiotic into agar, the studied strains were incubated for 24 hours at a temperature of 25 ℃. To determine the minimum inhibitory concentrations of antibiotic-sensitive microorganisms, the experiment was carried out according to a similar scheme using the following dilutions of antibiotics: 500 mg/l, 50 mg/l, 25 mg/l, 10 mg/l, 5 mg/l.

The results of the evaluation of the antibiotic resistance of microorganisms are presented in table 1.

Resistance and minimal inhibitory concentrations were evaluated by the presence and diameter of the lysis zone. The study showed that the studied strains of microorganisms B. megaterium and Ps. fluorescens exhibit pronounced antibiotic resistance to all four antibiotics, while Ps. aeruginosa and Ps. oleovorans are sensitive to ampicillin. *Ps. putida* is sensitive to kanamycin. it was found that the minimum concentration of kanamycin needed to inhibit *Ps. putida*, equal to 25 mg/l. Minimum inhibitory concentration of ampicillin to inhibit the growth of *Ps. aeruginosa* and *Ps. oleovorans* - 50 mg/l. The diameters of the lysis zone are presented in table 2.

Table 1 – Antibiotic resistance of psychrophilic microorganisms isolated from the bottom sediments of Lake Baikal

Microorganism	The presence of a lysis zone			
	Ampicillin	Tetracycline	Kanamycin	Chloramphenicol
Bacillus megaterium	–	–	–	–
Pseudomonas fluorescens	–	–	–	–
Pseudomonas putida	–	–	+	–
Pseudomonas aeruginosa	+	–	–	–
Pseudomonas oleovorans	+	–	–	–

Table 2 – Minimum inhibitory concentrations of psychrophilic microorganisms isolated from the bottom sediments of Lake Baikal

Microorganism/ antibiotic	The diameter of the lysis zone, mm				
	From 500 mg/l	From 50 mg/l	From 25 mg/l	From 10 mg/l	From 5 mg/l
Pseudomonas putida/ kanamycin	20	13	9	0	0
Pseudomonas aeruginosa/ ampicillin	15	8	0	0	0
Pseudomonas oleovorans/ ampicillin	14	8	0	0	0

To determine the biocompatibility of the studied strains, the direct co-cultivation method on a solid nutrient medium proposed by N.A. Glushanova [2] was used. For this, a culture grown on a liquid nutrient medium LB up to OD_{450} equal to 0.10–0.11 was applied with a bacteriological loop 3 mm in diameter onto a dense nutrient medium. After the droplet was absorbed, a drop of another test culture was applied to the surface of the same medium, which, when spreading, covered half of the first drop, after which Petri dishes were incubated for 24 h at a temperature of 25 ºC. In the superimposed part of the culture, they develop with mutual presence (co-cultivation), competing with each other. Each experiment was carried out in five repetitions with a change in the position of the cultures. As a control, two drops of the same culture applied using the described technique were used.

The results of the study, presented in Figures 1-10, were interpreted as follows: growth retardation of one of the strains – antagonism; "Fusion of spots" or increased growth of the studied strains – biocompatible cultures; the exit of one of the cultures up regardless of the sequence of application is – weak antagonism.
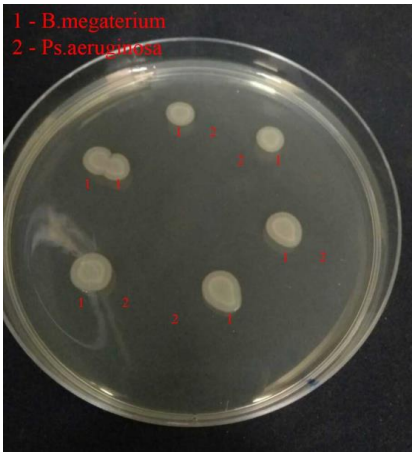
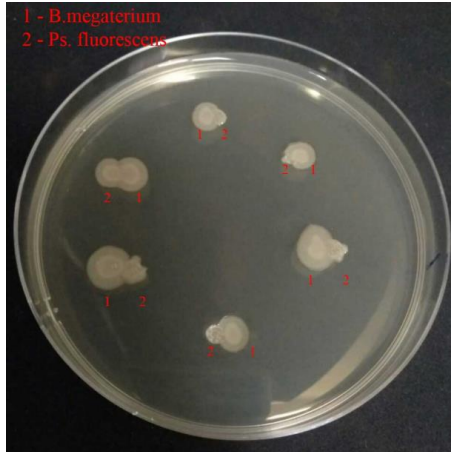**Figure 1 – Results of co-cultivation
of *B. megaterium*
and *Ps. aeruginosa***

**Figure 2 – Results of co-cultivation
of *B. megaterium*
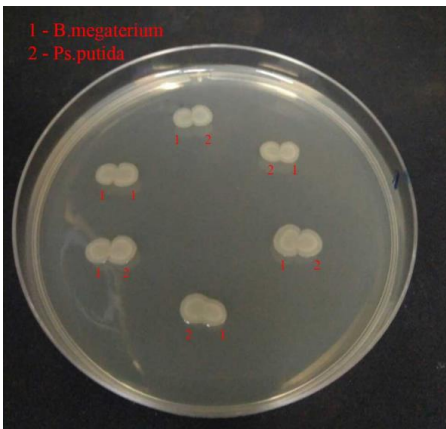and *Ps. fluorencens***

**Figure 3 – Results of co-cultivation
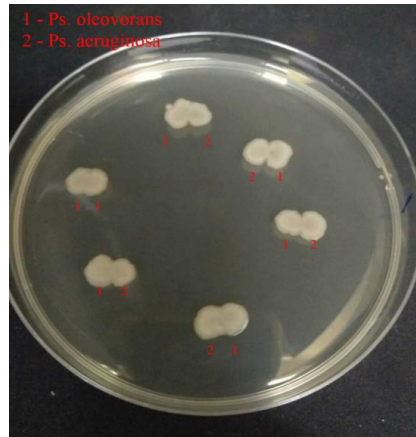of *B. megaterium* and *Ps. putida***

**Figure 4 – Results of co-cultivation
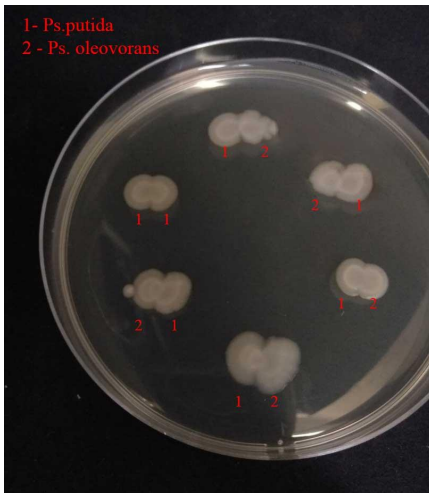of *Ps. oleovorans*
and *Ps. aeruginosa***

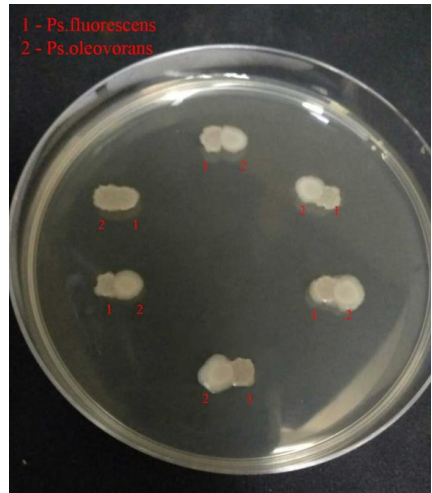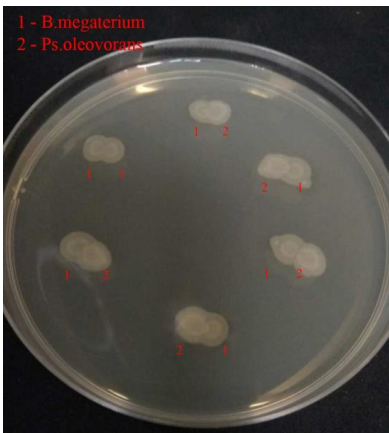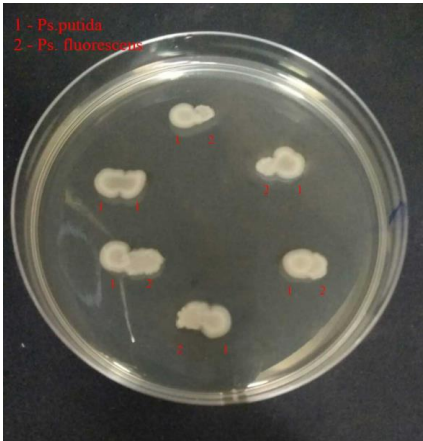**Figure 5 – Results of co-cultivation of *Ps. oleovorans* and *Ps. putida***

Figure 6 – Results of co-cultivation of *B. fluorences* and *Ps. oleovorans*

Figure 7 – Results of co-cultivation of *B. megaterium* and *Ps. oleovorans*
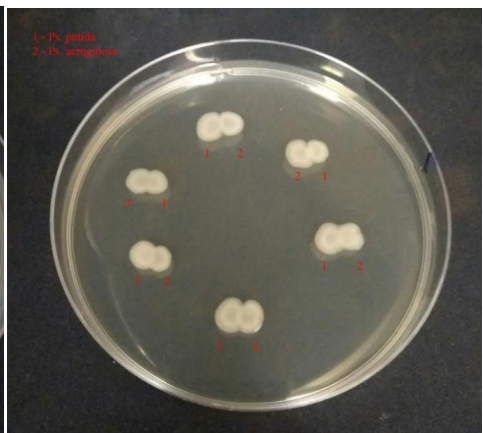
Figure 8 – Results of co-cultivation of *Ps. putida* and *Ps. aeruginosa*

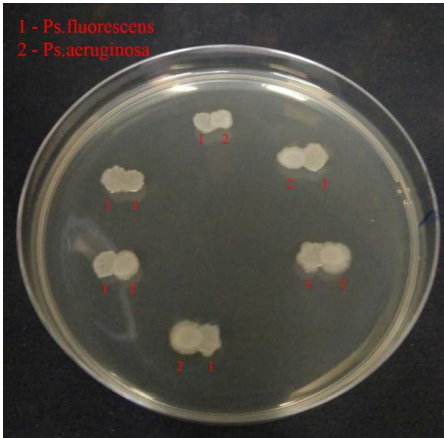**Figure 9 – Results of co-cultivation of *Ps. putida* and *Ps. fluorencens***

Figure 10 – Results of co-cultivation of *Ps. aeruginosa* and *Ps. fluorencens*

During co-cultivation of microorganisms, *B. megaterium* was shown to exhibit strong antagonism against *Ps. aeruginosa*, which is expressed in the complete suppression of the growth of the second culture (Figure 1), antagonism against *Ps. fluorescens* (strong inhibition of culture growth) (Figure 2) and is biocompatible with *Ps. putida* (Figure 3). *Ps. oleovorans* is biocompatible with *Ps. aeruginosa (Figure 4)* and *Ps. putida* (Figure 5) exhibits weak antagonism against *Ps. fluorescens (*Figure 6*)* and *B. megaterium* (Figure 7). *Ps. putida* is a biocompatible strain with *Ps. aeruginosa* (Figure 8) exhibits weak antagonism against *Ps. fluorescens* (Figure 9). *Ps. aeruginosa* exhibits weak antagonism against *Ps. fluorescens* (Figure 10). Weak antagonism in the case of co-cultivation is expressed in the layering of one culture on another.

In further work, it is necessary to study the chemical composition and properties of metabolites produced by selected psychrophilic microorganisms and determine their affiliation with known bacteriocins and fungicides.

References

1. MUK 4.2.1890-04 Determination of the sensitivity of microorganisms to antibacterial drugs. Methodical instructions. – M.: Federal Center for State Sanitary and Epidemiological Supervision of the Ministry of Health of Russia, 2004. – 91 P.

2. Glushanova, N.A. Experimental substantiation of new approaches to the correction of intestinal microbiocenosis: dis. ... dr. med. sciences: 03.00.07 / Glushanova, Nina Alekseevna. – Moscow, 2006. – 265 P.

INFLUENCE OF THE IMMUNOMODULATOR "SUBTILIS-C" ON THE PHYSIOLOGICAL STATE OF *SYMPHYSODON HARALDI* DISCUS BY HEMOTALOGICAL AND CYTOCHEMICAL PARAMETERS

Pronina Galina Iozepovna
Doctor of Biological Sciences, Head of Laboratory
All-Russia Research and Development Institute of Irrigation Fishery
Full Professor
Russian Timiryazev State Agrarian University
Sanaya Olga Vladimirovna
Master of Agricultural Sciences, Postgraduate
Russian Timiryazev State Agrarian University

Abstract. Discus, one of the most expensive tropical aquarium fish, tops the list of the most bought fish in the world. Under aquaculture conditions, fish are exposed to stress factors, which reduces immunity. A typical representative of probiotics is the domestic drug "Subtilis-C". *Bacillus subtilis* is an antagonist of pathogenic microorganisms. "Subtilis-C" does not affect fish growth. Myeloid cells differentiated, the number of stab neutrophils significantly decreased, and fish erythropoiesis was activated.

Keywords: Diskus, *Symphysodon haraldi*, Probiotic "Subtilis-C", hematological, cytochemical indicators.

Discus is one of the most expensive tropical aquarium fish, tops the list of the most bought fish in the world, but it is not only a matter of price, but also of aesthetic perception, calm majestic swimming. Discus is highly valued in the world and in our country because of the unusual shape and complexity of breeding [3].

Discus are free-living organisms from the early embryonic stages of life and their survival depends on the innate immune system. Nonspecific immunity is the main defense mechanism in fish. Under aquaculture conditions, fish are exposed to additional stress factors, such as temperature changes, limited space, and the absence of shelters, including soil, plants, different daylight hours, pathogens atypical for discus, etc. This reduces the immunity of cultivated objects. In addition, the aquatic environment

is a favorable substrate for the development and reproduction of various pathogenic microorganisms. In this regard, it is important to strengthen the immunity of fish, and some food additives and immunostimulants can increase its effectiveness.

Immunomodulatory products, including nucleotides, glucans and probiotics, are increasingly used in aquaculture. The use of these drugs reduces the need for medical procedures, enhances the effect of vaccines [8].

A typical representative of probiotics is the domestic drug "Subtilis-C", the active component of which are 2 types of bacteria *Bacillus subtilis* and *Bacillus licheniformis*. The bacterial strains of the "Subtilis-C" drug have pronounced antagonistic activity against pathogenic microorganisms. They have an immunomodulatory effect: they activate macrophages, stimulate the production of interferon by B-lymphocytes and the synthesis of immunoglobulins by B-lymphocytes.

The use of the probiotic "Subtilis-C" helps to stimulate the vitality of fish in the early stages of ontogenesis and increase natural immunity, helps to modulate the immune system of the mucous membranes increasing resistance to intestinal infections and pathogens [1, 2, 6]. An increase in carp resistance to saprolegniosis (*Saprolegnia parasitica*) was noted against the background of the consumption of the probiotic "Subtilis-C". In this case, there is an increase in the content of hemoglobin, erythrocytes, activation of leukopoiesis [4].

It was revealed that the bacteria *Bacillus licheniformis* and *Bacillus subtilis* cause protein uptake and a more intensive use of nitrogen metabolites by the intestinal microflora for the synthesis of their own biomass. At the same time, the average daily weight gain of carp and sterlet increases by 25 and 35% [9]. *Bacillus subtilis* is an antagonist of pathogenic and opportunistic microorganisms, such as salmonella, staphylococci, streptococci, yeast; produce enzymes that remove products of putrefactive tissue breakdown; synthesize amino acids, vitamins and immunoactive factors.

Studies of immunomodulation by probiotics of the Nile tilapia, a species close to the discus of the Cichlov family, showed that the mortality rate of fish exposed to *A. hydrophila* and supplemented with probiotic was significantly lower than that of fish fed the main diet. In tilapia treated with a probiotic, immunity is enhanced [7].

In connection with the foregoing, the **purpose** of this work is to study the effect of feeding with the probiotic "Subtilis-S" on the discus according to hematological and cytochemical parameters.

Materials and methods

The objects of research were sexually mature discus (*Symphysodon haraldi* Schultz, 1960). The age was 1 year.

Blood sampling was carried out intravitally from the caudal vein (Fig. 1).

Figure 1. Blood sampling from discus

Physiological and immunological assessment of fish was carried out according to hematological and cytochemical parameters.

Blood smears (2 pcs. From each fish: one for the leukogram, the second for the cytochemical reaction for determining the cationic protein) was made immediately after blood sampling [5].

The leukocyte formula was determined by differential counting in Pappenheim-stained peripheral blood smears. The level of fish hematopoiesis was determined by the proportion of immature forms of red blood cells and white blood cells.

The phagocytic activity of fish neutrophils was evaluated using a lysosomal-cationic test adapted for hydrobionts of G.I. Pronina (2014) by the cytochemical method with bromphenol blue. The content of non-enzymatic cationic protein in the lysosomes of peripheral blood neutrophils was de-

termined. According to the degree of phagocytic activity, the studied cells were divided into 4 groups:

0 degree – no cationic protein granules

1 degree – singular granules

2 degree – granules occupy approximately 1/3 of the cytoplasm

3 degree – granules occupy 1/2 cytoplasm or more

The average cytochemical coefficient (ACC) was calculated by the formula:

$$ACC=(0 \times N_0 + 1 \times N_1 + 2 \times N_2 + 3 \times N_3)/100,$$

where N_0, N_1, N_2, N_3 — the number of neutrophils with activity 0, 1, 2 and 3 points, respectively.

Mathematical processing of digital materials was carried out by the method of variation statistics according to Student using the Microsoft Office Excel program package.

Results and discussion

The results of the study showed that during the experiment, the fish of the experimental and control groups gained weight (table 1).

Table 1. Dimensional-weight, hematological and cytochemical indicators of discus in the experiment M±m

Indicators	Intact control (Background indicators before the experiment)	After 2 months of experiment	
		control	experiment
	a	b	c
Dimensional-weight			
Body weight g	**56,1±3,5**	**73,9±4,9a**	**85,7±5,2a**
Body length TL, cm	**9,7±0,2**	**10,7±0,2a**	**11,3±0,2a**
Erythropoiesis, %			
Hemocytoblasts, erythroblasts	**1,0±0,1**	**1,0±0,1**	**2,0±0,2ab**
Normoblasts	3,4±1,0	4,0±0,4	5,7±1,0
Basophil red blood cells	**16,0±1,8**	**12,0±2,0**	**6,1±0,3ab**
Mature red blood cells	79,6±2,9	83,2±1,9	86,2±2,2
White blood cell differential, %			
Myeloblasts	1,0±0,1	1,0±0,1	1,0±0,1
Promyelocytes	1,0±0,1	1,2±0,3	1,2±0,1
Myelocytes	1,0±0,1	1,3±0,3	1,0±0,1

Indicators	Intact control (Background indicators before the experiment)	After 2 months of experiment	
		control	experiment
	a	b	c
Metamyelocytes	2,0±0,1	2,0±0,4	2,0±0,1
Stab neutrophils	**5,0±0,7**	**1,5±0,5a**	**1,8±0,1a**
Segmented	2,7±0,6	1,4±0,3	1,8±0,1
Eosinophils	1,0±0,1	1,0±0,1	1,0±0,1
Basophils	-	-	1,0±0,1
Monocytes	**2,0±0,5**	**2,2±0,2**	**3,8±0,3ab**
Lymphocytes	84,8±2,4	88,4±1,4	86,4±1,4
Lysosomal-cationic test			
ACC,cu.	1,38±0,05	1,20±0,05a	1,31±0,01b

Hereinafter: abc - differences significant at $P<0,05$

Discus, which received and did not receive a probiotic, did not have significant differences in body weight. Obviously, "Subtilis-C" does not affect fish growth.

Nevertheless, the probiotic enhances immune defense by activating erythropoiesis: the fish of the experimental group are more intensive, judging by the content of blast forms of red blood cells - they are twice as high as in the fish at the beginning of the experiment. The proportion of more mature basophilic red blood cells in the total number of erythroid cells in the discus of the experimental group is less than in the control groups.

The percentage of stab neutrophils after 2 months of the experiment decreased in fish of both groups. This is probably due to the improvement of immune defense in ontogenesis, since stab neutrophils are immature forms.

A significant increase in the proportion of monocytes in the leukogram of fish from the experimental group indicates an increase in cellular immunity, namely phagocytosis, as a result of stimulation with an immunomodulator.

The results of the lysosomal-cationic test showed a decrease in ACC in the control group after 2 months of the experiment, while in the experimental discus the value of the indicator did not change relative to the beginning of the experiment.

It should be noted that two years after the use of the probiotic in the household, there were no cases of manifestation of hexamitosis in fish.

Thus, it was shown that the probiotic-immunomodulator "Subtilis-C" strengthened erythropoiesis and the immune response, this is seen by an

increase in the number of monocytes and differentiation of neutrophils in the experimental group of discus.

Differentiation of myeloid cells occurred, the number of stab neutrophils significantly decreased, basophils were also found in blood smears, which was not observed in fish before the experiment and in the control group.

References

1. Burlachenko I.V., Malik E.V. The use of probiotics in the early stages of embryonic development of the Lena sturgeon // Veterinary medicine. 2007. № 3. P. 47-51.

2. Vlasov V.A., Artemenkov D.V., Panasenko V.V. The use of the probiotic "Subtilis" as an additive in animal feed for the cultivation of Clarias catfish (Clarias gariepinus) // Fisheries. 2012. № 5. P. 89-93.

3. Gurzhiy, A. Discus / A. Gurzhiy – M.: Aquarium-print. 2007. 32 P.

4. Pronina G.I. The effect of immunomodulation by probiotics on the immuno-physiological status of aquaculture objects // Veterinary medicine, zootechnics and biotechnology. 2019. №4. P. 37-42.

5. Pronina G.I., Koryagina N.Yu. Reference values of physiological and immunological parameters of hydrobionts of different species // Bulletin of the Astrakhan State Technical University. 2015. № 4. P. 103-108.

6. Rudenko R.A., Rudenko T.G., Tishchenko N.N. The use of probiotics in starter feed for cyprinids // News of universities. Food technology. 2009. № 1. P. 23-25.

7. Elkamel A.A., Mosaad G.M. Immunomodulation of Nile Tilapia (Oreochromis niloticus) by Nigella sativa and Bacillus subtilis// Journal of Aquaculture. 2012. № 3(6). P. 3-6.

8. Uribe C., Folch H., Enriquez R., Moran G. Innate and adaptive immunity in teleost fish: a review // Veterinární medicína. 2011. № 56 (10). P. 486-503.

9. Zuenko V.A. Laktionov K.S, Pravdin I.V., Kravtsova L.Z., Ushakova N.A. Effect of Bacillus subtilis in feed probiotic on the digestion of fish cultured in cages // Journal of Ichthyology. 2017. № 57 (1). P. 152-157.

DETERMINATION OF OPERATION PARAMETERS OF AN HF MAGNETRON WITH A MODIFIED MAGNETIC SYSTEM DESIGN

Tereshchenko Ivan Borisovich
Postgraduate
ITMO University
St. Petersburg, Russia
Gubanova Lyudmila Aleksandrovna
Doctor of Technical Sciences, Full Professor
ITMO University
St. Petersburg, Russia

Abstract. This work describes a designed and manufactured magnetron operating at a high frequency current of 10.56 MHz with an increased erosion zone for reactive deposition of dielectric interference coatings. The modified design of the magnetic system makes it possible to obtain an erosion zone of ~70% on a target with an area of 101.6 mm. Statistical results of changes in the magnetic field during the operation of the magnetron in different spraying modes, as well as the profile of erosion of the target are presented.

Keywords: HF magnetron sputtering, erosion profile, increased erosion zone, magnetron magnetic field

Introduction

Currently, several technologies are known for the formation of interference layers on a substrate, including deposition from the chemical (CVD) and physical phases (PVD) [1-3]. A relatively new type of PVD deposition is magnetron sputtering. The principle of the action of film formation by this method is the effect of a magnetic field on an ionizing gas, which leads to an increase in ion density near the target [1, 2, 4].

Magnetron sputtering allows the use of a large number of materials to form layers, including metals and semiconductors. One of the drawbacks of magnetron design is the low share of the use of target material (about 40-50%) [5-10]. Publications reflecting research aimed at improving the operational characteristics of magnetron sputtering systems are extremely few in view of the existence of competition between companies producing

vacuum installations with magnetron sputtering [6]. As a rule, magnetrons are manufactured to implement a specific task and optimized for the existing vacuum installation. An alternative is to optimize the vacuum system for a specific magnetron.

This paper describes a designed and manufactured magnetron operating at a high frequency current (HF) of 10.56 MHz with an increased erosion zone for reactive deposition of dielectric interference coatings. Statistical results of changes in the magnetic field during the operation of the magnetron in different spraying modes, as well as the profile of erosion of the target are presented.

1. Description of the design of the magnetron

In most modern magnetron designs, the magnetic system is located under the sputtered target [7–9]. To increase the erosion zone of the magnetron target, it is proposed to move some of the magnets beyond the target limit (Fig.1.a)

(a)   (b)
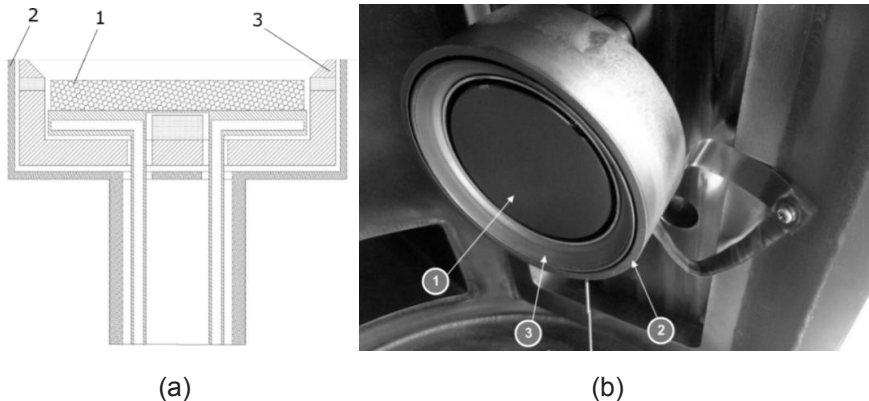
Figure 1. (a) - Schematic diagram of a magnetron for RMS. (b) – photograph of a magnetron. 1 – target, 2 – grounded electrode, 3 – magnetic system

The HF voltage is applied to the loaded electrode with the target 1 fixed to it. Sputtering of the target occurs when the target surface is bombarded with working gas ions. The magnetic system 3 creates a magnetic field above the target in such a configuration that localizes the electrons in a narrow region of space near the surface of the target. Electron localization allows ionization of the gas only above the target, avoiding the side sputtering of surrounding materials. Elements of the magnetic system are

made of soft magnetic steel ARMCO. The grounded electrode 2 is all the grounded elements of the vacuum chamber, and its special design is not required. Additionally, the grounded electrode serves as a shielding electrode, eliminating the discharge at the periphery of the magnetron.

The shape of the magnetron is determined by the selected geometry of the target. In this case, these are standard billets made of silicon with a diameter of 101.6 mm and a thickness of 12 mm, widely used in the microelectronic industry. In addition to accessibility, the small size of the target is due to the fact that such targets are more durable and easier to maintain. In view of the fact that the loaded electrode is under the action of the HF potential, its reliable isolation from other nodes is required with a minimum gap (~ 2 mm) between the loaded electrode and the magnetic system which prevents stray discharge. The design of the HF electrode provides for forced cooling of the live part. The silicon target is not cooled, because of its low thermal conductivity, a temperature gradient arises, which creates mechanical stresses, which can lead to cracking of the target. The target is attached to the loaded electrode with minimal thermal contact. The magnetron's magnetic system must be cooled, since during prolonged processes its heating leads to a change in the configuration of the magnetic field, and, as a consequence, the discharge parameters. The magnets used are an alloy of neodymium, iron and boron N35, have a residual induction of B_r = 1.1 T and a limiting operating temperature of 80 °C.

The magnetic system should provide maximum field strength above the target. This will increase the concentration of electrons above the target and work in a wider pressure range. The magnetic field above the target should be as uniform as possible to provide a large area of effective sputtering. Figure 2 presents a model of the distribution of magnetic field lines near the target.
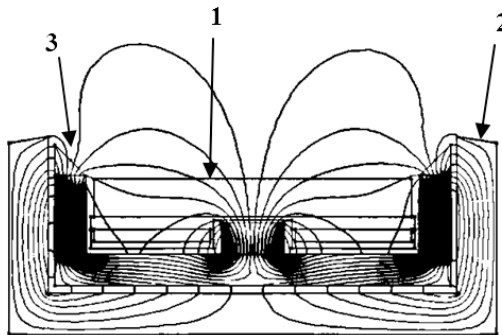

Figure 2. Distribution of magnetic field lines of the designed magnetron. 1 – target, 2 – grounded electrode, 3 – magnetic system

2. Analysis of the magnetic field of the magnetron

To ensure reproducibility of the resulting coatings, it is necessary to monitor the change in the profile of the magnetic field before and after the deposition process. Figure 3 (a) shows the distribution of the tangential component of the magnetic field vector. The measurements were performed on a PIE.MG R-2 device, having a measurement error of 1%. Also, the ambiguous position of the probe during each measurement introduces an error of ±0.2 mT.
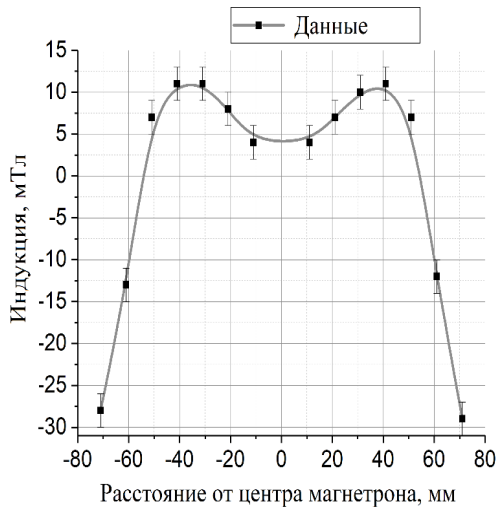

Figure 3. The distribution of the intensity of the tangential component of the magnetic field from the center of the magnetron (point 0).

This graph is based on processing of 19 measurements of the magnetic field when the magnetron is turned on in different modes (100 W, 200 W, 300 W, at a pressure of 2.9E-3 mbar in Ar, lasting 30 minutes). An analysis of the above dependence shows that the magnetic field profile remains symmetric, which indicates the stable operation of the magnetic system at high temperatures. The temperature was measured using a thermocouple made on the basis of alloys of chromel drops, welded to the end of the body of the grounded electrode as close to the remote magnetic system (Fig. 4).
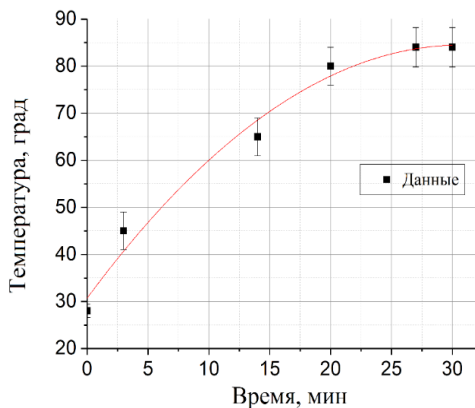
**Figure 4. Graph of temperature increase in the place
of thermocouple mounting by time. Mode: 300W, 2.9E-3 mbar.**

Figure 4 shows that during the operation of the magnetron with a working power of 300 W, the temperature on the body of the grounded electrode near the magnetic system did not exceed 84 °C. Since the limiting operating temperature of neodymium magnets is lower than that obtained, we can say that the cooling system works efficiently.
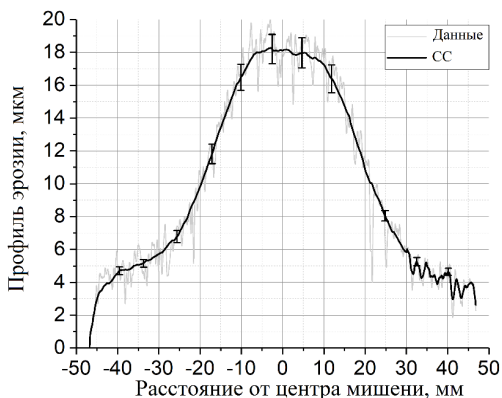

**Figure 5. Erosion profile of a silicon target. The graph shows the
source data and averaged using a moving average (MA). The
magnitude of the measurement error at each point is ~ 5%.**

Figure 5 shows the erosion profile of the target obtained with a Taylor Hobson Talysurf PGI 1240 profilometer. The profile was obtained in the region bounded by a diameter of 95 mm with a pitch of 0.02 mm. A sharp descent near the edges of the profile is caused by the presence of a chamfer on the edge of the target.

The initial graph shows the presence of strong signal fluctuations, as well as random emissions, which are most likely associated with the deformation of the probe of the profilometer. In this regard, the original chart was processed using a moving average. From the obtained profile it is seen that the sputtering zone of the target is more than 60%.

3. Conclusions

The paper presents the results of an experimental study and numerical calculation of the operation parameters of an HF magnetron with an increased target erosion zone.

The results of the influence of the sputtering regimes of a silicon target on the shape of the erosion profile are shown.

The results showed that the magnetron erosion zone is ~ 70%.

References

1. Sigmund, P. Sputtering by Particle Bombardment I: Physical Sputtering of Single-Element Solids / P. Sigmund // Sputtering by ion bombardment: Theoretical concepts - Heidelberg: "Springer" Publisher, 1981. – V.1. – P.9-71

2. Berlin E.V. Reception of thin films by reactive magnetron sputtering / E.V. Berlin, L.A. Seidman. – Moscow: Technosphere Publishing House, 2014. -256P.

3. Berlin E.V. Ion-plasma processes in thin-film technology / E.V. Berlin, L.A. Seidman. – Moscow: Technosphere Publishing House, 2010. -528 P.

4. Danilin B.S. Magnetron Spray Systems / B.S. Danilin, V.K.Syrchin. – Moscow: Radio and Communications Publishing House, 1982. -72 P.

5. Kuzmichev A. I. Magnetron sputtering systems. Book 1. Introduction to the physics and technology of magnetron sputtering. – Kev.: Overse, 2008. – 277 P.

6. M. Ruske. Properties of SiO2 and Si3N4 layers deposited by MF twin magnetron sputtering using different target materials / M. Ruske, G. Brauer. // Thin Solid Films – "Elsevier Inc." Publisher, 1999. – V. 361 (1-2). - P.158 – 163.

7. J. Gudmundsson. Introduction to magnetron sputtering / J. Gudmundsson, D. Lundin // High Power Impulse Magnetron Sputtering – "Elsevier Inc." Publisher, 2020. - P 1-48

8. C.H. Shon. Modeling of magnetron sputtering plasmas / C.H. Shon, J.K. Lee // Applied Surface Science – "Elsevier Inc." Publisher, 2002. – Vol. 192. – P. 258 – 269.

9. C. Liu. Enhancement of Substrate Deposition Rate and Target Erosion Profile in a DC Magnetron Sputtering System / C. Liu, M. Lai, C. Hwang, C. Tu // IEEE Transaction on magnetics – "IEEE" Publisher, 2009. – Vol. 45. – P. 4391 – 4394.

10. S. Swan. Film thickness distribution in magnetron sputtering / S. Swan, W. Sussex // Vacuum - "Elsevier Inc." Publisher, 1988. – Vol. 38 (8-9). – P. 791-794

RESEARCH ON THE ABRASION OF CUTTING PICKS ON SHEARERS DUE TO THE INFLUENCE OF CLAMPING SOIL IN COAL SEAMS

Nguyen Van Xo[1*],
Nguyen Khac Linh[1],
Tran Ba Trung[2]
[1]Ha Noi University of Mining and Geology, Ha Noi, Vietnam
[2]Faculty of Engineering and Applied Science Memorial University
of Newfoundland, Newfoundland and Labrador, Canada

Abstract. As working under complex geological conditions of mine and inappropriate use, the cutting picks of shearers are quickly broken down, which would likely bring about a considerable increase in the cost of mining. This cutting picks' failure is one of the main reasons hindering the application of mechanization in synchronous coal mining.

This article analyses the broken shapes of the cutting picks when being operated in the geological conditions of different seams. As a consequence, providing the causes associated with the wear and tear of the cutting picks during the operation of the shearers. Results achieved from the paper could be considered as a reference for scientists in their study of design calculations to enhance the lifespan of shearer cutting picks.

Keywords: cutting picks; shearers; clamping soil.

1. Introduction

These days, coal mines in the world have already utilized shearers in order to take full advantage of their compactness, productivity and high reliability. On the cutting drum, picks are attached to the outer edges of the scroll. The cutting process is relatively complicated, relying on multiple factors [1,2,3,4]. Some of them are technical parameters and properties of the coal seam (the length, the thickness, the width of the web, the average cutting intensity of coal and clamping rock, reservoir moisture (shown in Figure 1); machine's operating mode parameters (velocity of the shearer, cutting speed of cutting picks); the specifications of the drum (its diameter, the arrangement of cutting picks on it, the cutting depth, the distance of two adjacent scrolls, the number of cutting picks per scroll); other factors like the method and the capability of transferring coal to the scraper conveyor, the schematic diagram of the shearer, etc.
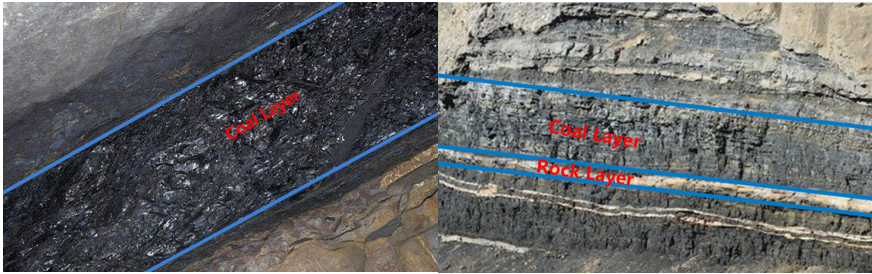
Figure 1 - The structure of the coal seam

In the functional process, compression and bending act upon the shearer's cutting picks, and under the condition of continuously changing loads, the cutting picks are then going to cut every single layer of coal from the seam. That cutting process is periodic and has a jump property based on the brittle fracture of the material being broken, and consists of two underlying stages, namely crushing and breaking (Figure 2).
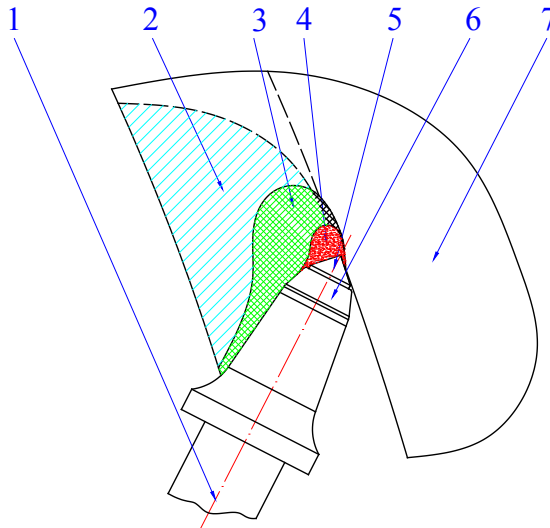

Figure 2 - The working diagram of cutting picks in coal seam
1 - Cutting pick; 2 - Elastic deformation region;
3 - Elastic broken compression region; 4 - Local crushing region;
5 - Hard alloy head; 6 - The alloy cover of the crown; 7 - Block of coal

The cutting process begins as cutting pick pushes the crushed rock in front of the head of cutting pick (zone 4) and spread it to the surrounding regions (zone 2) through the elastic broken compression region (zone 3). Cracks are later formed before they damage the natural structure of the coal. Afterward, the coal layer is completely removed from the coal block.

2. Some research findings and discussions

Studies of some coal mines in Russia demonstrated that when the clamping soil appears at a coal seam, the consumption of cutting picks is likely to increase rapidly. Plus, when cutting picks work in coal seams of 1.8 m thickness, the solidity of coal f = 1-1.5 has 21% of sandstone with the hardness f = 4-5, the quantity of consumed cutting picks has climbed by nearly 90 times compared to that under the similar geological condition without clamping soil (see Table 1).

Table 1 - The quantity of consumed cutting picks per 1,000 tons of coal

Company	Coal seam	Clamping soil	Shearer	Cutting picks	Number of consumed cutting picks (per 1,000 tons)
Komsomolets	"Breevsky" № 1726	Coal seam of 2.72 m thickness, the solidity of coal f = 1.5, the solidity of clamping soil f = 2-3	K500Ю	РШ32-70/16Ж	0,52
Zarechnaya	Polysaevsky 2 No. 804	Coal seam of 4.0 m thickness, the solidity of coal f = 1.5, the solidity of clamping soil f = 2	MB12	РШ32-70/16	1,7
Khakass	"Giant" № 44	Coal seam of 2.08 m thickness, having 3.07% clamping soil, in which 2.3% has the solidity of coal f = 6-7 and 0,77% siltstone f = 4-5	K500Ю	РШ32 - 70/18Ж	12,9
Romanovskaya-1	"Abramovsky" № 2	Coal seam of 1.8 m thickness, the solidity of coal f = 1-1.5, and 21% sandstone f = 4-5	K500Ю	РШ32-70/18Ж	89,1
Khakass	"Giant" № 42	Coal seam of 2.16 m thickness, having 7,4% clamping soil, in which 3.7% has the solidity of coal f = 6-7 and 0,37% siltstone f = 4	K500Ю	РШ32-70/16Ж	59,3

Several actual research results in some mines in Vietnam revealed that during the operating procedure, the number of consumed cutting picks witnessed a noticeable jump along with the presence of clamping soil in the seam [5].

From the above research results, the paper has indicated that the cutting picks being damaged by abrasion, will lead to the following incidents:

- When the cutting picks are in function with a coal seam without clamping soil (i.e., f = 0.8-1.5), the cutting picks have a minor abrasive rate, and the hard alloy head is almost not abraded. Also, abrasive cutting picks around the hard alloy head will degrade the link between the alloy head and the crown (Figure 3-a), resulting in the loss of hard alloy heads. Apart from that, the consumption of cutting picks is only 0.5-2 picks per 1,000 tons of coal.
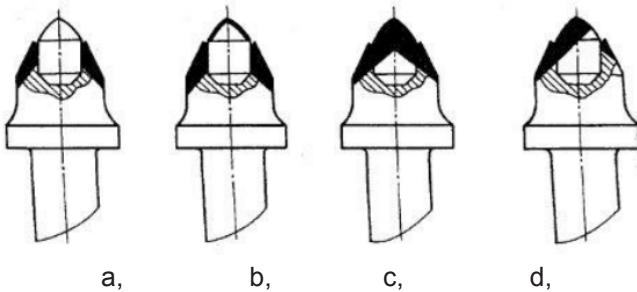

a,   b,   c,   d,

Figure 3. The worn form of the cutting teeth

- When the cutting picks are utilized in a medium solidity coal seam (i.e., the solidity of coal with clamping soil f = 2-5), the hard alloy head is negligibly abraded. Nevertheless, the metal part surrounding the alloy head will wear out quickly (Fig. 3, b), leading to a degradation of its connection with the alloy tip, and rapidly losing the hard alloy tip. The fluctuation of cutting picks is from 12-50 picks per 1,000 tons of coal;

- As the cutting picks work in a high solidity coal seam (i.e., the solidity of coal with clamping soil f = 5-10), the cutting picks are subsequently eroded both at the top and the crown with heavy wear (Figure 3- c, d).

From the above analyses and based on the datasheet (Table 1), it is immediately evident that the cutting picks are rapidly damaged during the exploitation process. Especially when working in medium solidity coal seam with a significant failure derived from grinding the crown around the hard alloy head (Fig. 3, b).

Via the analysis of the structure and material of conventional cutting picks, it can be seen that the material of the cutter-head is usually made of hard alloy with high hardness (not less than 87 HRC). Thus, it is possible to ensure the durability when working in the solidity of coal with clamping soil f = 2-4; The material of crown is commonly made of steel 30CrM with a hardness of up to 50 HRC. However, if there is an existence of clamping soil in the coal seam, the pressure from the rock on the cutting picks will dramatically increase, inevitably causing a rise in temperature of the cutting pick surface, followed by a fast, abrasive rate, etc.

In accordance with the graph describing the effect of temperature on the mechanical properties of steel 30CrM (Figure 5), it is apparent that the mechanical properties of the material will drop rapidly from 4,700 MPa to 2,500 MPa as the temperature fluctuates between 200⁰C and 700⁰C. Therefore, while designing and manufacturing cutting picks which operate under the conditions of clamping soil, it is essential to pay attention to the selection of suitable materials to boost the lifespan of the cutting picks.
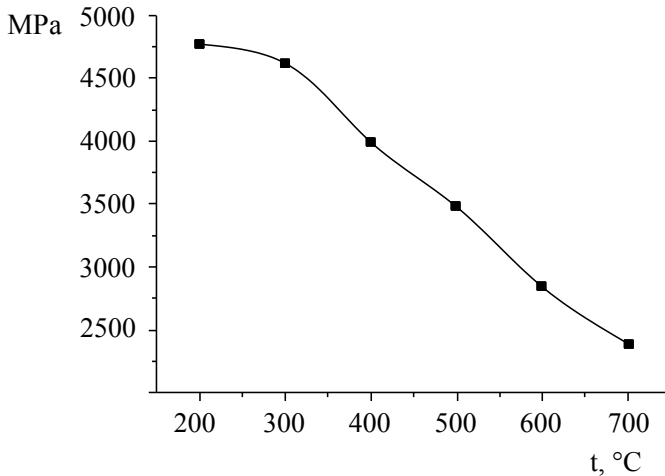

Figure 5 - The effect of temperature on the mechanical properties of steel 30CrM [6]

3. Conclusions

From the mentioned remarks, the article has illustrated the following:

- The abrasive rate of the cutting picks depends on the hardness and thickness of the clamping soil layer.

- The cutting picks of the shearer are often broken as the machine is operating under coal seam conditions with clamping soil and the solidity f = 2 - 6, the broken shape is, after that, mainly due to the abrasion of the crown around the hard alloy head area.

- The temperature and its lifetime on the contact surface of the cutting pick throughout operation will largely determine the lifetime of the cutting picks. For the purpose of improving the lifespan of the cutting picks, some measures need to be applied to minimize the working temperature of the crown around the alloy head and reduce the direct influence of rock on this region.

References

1. Nguyen K. L, Gabov V.V., Zadkov D. A. 2019. Improving efficiency of cleanup and coal flow formation on conveyor by shearer loader with accessorial blade // Eurasian mining. No.1. pp. 37-39.

2. Солод В.И., Гетопанов В.Н., Рачек В.М., 1982. Проектирование и конструирование горных машин и комплексов. -М.: Недра, 350 с.

3. Daolong Yang, Jianping Li, Liping Wang, Kuidong Gao, Youhong Tang & Yanxiang Wang, 2014. Experimental and theoretical design for decreasing wear in conical picks in rotation-drilling cutting process // The International Journal of Advanced Manufacturing Technology, Springer. 75: 12.

4. Peng S.S., 2006. Longwall Mining. U.S.: 2nd edition, 621 p.

5. Vinacomin, 2016. Báo cáo và tham luận tổng kết công tác cơ giới hóa khai thác đào lò 2013÷2015 và định hướng đến 2020. Quảng Ninh, - 299 p.

6. Попов А. А., Попова Л. Е. Справочник термиста. Изотермические и термокинетические диаграммы распада переохлажденного аустенита. Свердловск, 1961. - 431 с.

DETERMINATION OF OPTIMAL PARAMETERS OF THE PROCESS OF CLOSING THE LAYER DURING SURFACING

Erofeev Vladimir Alexandrovich
Candidate of Technical Sciences, Professor,
Tula State University
Devyatkina Vera Olegovna
Student
Tula State University

Annotation. In this paper, we examined an algorithm for numerical simulation of a plasma-arc surfacing process with transverse oscillations of a plasmatorch for computer simulation. A typical technological problem (determining the optimal parameters of the process of closing the layer during surfacing) is solved using this algorithm. It is shown that due to an increase in the plasma arc current, it is possible to compensate for a powerful heat sink to the initial part of the surfacing bead It is also necessary to reduce the speed of sample movement.

Key words: laser-powder surfacing, computer analysis, transverse vibrations, layer closure, heat sink.

As a rule, it is advisable for us to solve the main tasks of developing a technology for surfacing blanks using computer engineering analysis methods. It is based on numerical modeling of physical phenomena that are essential for the formation of a surfacing layer. Solving engineering problems is the inverse problem of modeling, because we need to determine the process parameters that are necessary to obtain the specified quality characteristicsWe have proposed solutions to a typical technological problem in plasma-arc surfacing. We considered an example of computer engineering analysis for the surfacing process, which is performed by two arcs with transverse vibrations of the plasmatorch of a wide weld of copper alloy on a substrate of low alloy structural steel.

This process has parameters, the main of which is the current of the main arc I_O, heating the substrate, and additional I_p melting the wire from the deposited alloy, the rotation speed of the workpiece v_w and the filing of the deposited alloy v_f, period τ, amplitude Y and shape t_o transverse vibra-

tions. The process parameters surfacing the deposition of copper layers at the beginning and end are changed in time to ensure uniform formation and closure of the layer.

As a rule, it is extremely difficult to determine the optimal value of all these parameters of layer closure by experiment. Therefore, we will use computer methods of engineering analysis [3]. In this case, the search for acceptable solutions is carried out on a virtual process model. We use a computer program that implements a numerical solution of a system of equations describing the physical phenomena that occur during this process.

The feature of surfacing is an unsteady formation during the process of closing the copper layer.

We set the general process parameters to solve the technological problem:

- workpiece material, its diameter D, wall thickness s,
- the width B and the thickness of the deposited layer h_f,
- material and diameter of the wire d_f of the deposited alloy,
- surfacing speed (turnaround time T),
- characteristics of the plasma torch (maximum current, flame diameter).

The current values of the main arc during the closure of the layer and the duration of this closure must be determined to complete the process.

We showed a solution to this engineering analysis problem using the example of the process of surfacing a layer of copper alloy on a steel substrate which has a wall thickness of 15 mm from low alloy structural steel. We need to surfacing a layer with a width of at least 50 mm and a thickness of at least 4 mm. The surfacing speed was set to 1.6 mm / s, the oscillation amplitude of the burner was ±20 mm, the oscillation period was 4.5 s. The filler wire had a diameter of 3 mm, the wire feed speed is necessary for surfacing a layer with a given cross section of 150 mm / s. The plasmatorch creates a plasma torch with a diameter of 18 mm on the surface of the workpiece.

Determination of the parameters of the closure layer.
The conditions for the formation of a surfacing pool when the surfacing layer is closed vary greatly. Because a powerful heat sink to the initial part of the surfacing bead occurs when the circuit, fig. 1.
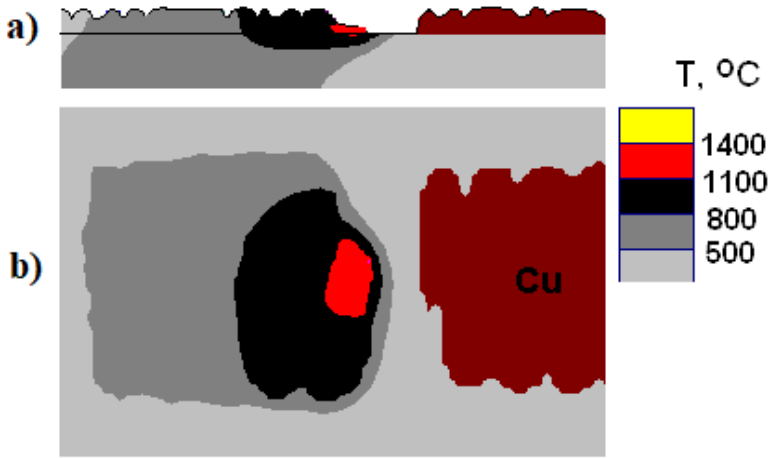
Fig. 1. The temperature distribution in the middle section of the deposited layer (a) and on the metal surface (b) before the closure of the layer (Cu)

The heat sink can be compensated by increasing the plasma arc current by ΔI_o, fig. 2.
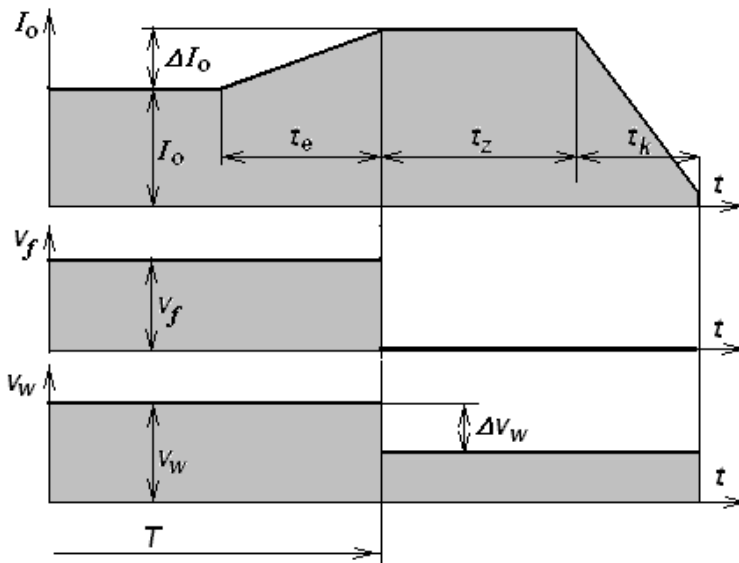

Fig. 2. Change of parameters upon completion of layer surfacing

The time t_e of the beginning of the increase in current corresponds to the moment the arc touches the radius R of the beginning of the layer, i.e. $t_e \approx R/v_w$. The wire feed is turned off at the moment of completion of a full revolution of the housing and the remelting of the initial section of the layer begins during the time t_z. The time is set by the number of full periods when the layer is closed. The power of the process decreases when the additional arc is turned off, while it may be necessary for us to reduce the rotation speed of the housing by Δv_w. The duration t_z of the closure of the layer of at least one oscillation period of the plasma torch and is approximately $t_z \approx t_e \approx R/v_w$.

The value of the increase in the current of the main arc ΔI_o should ensure the existence of a surfacing pool weld seam with a depth equal to the layer thickness during the period t_z. This is determined by the simulation result of the process of closing the layer, Fig.3.
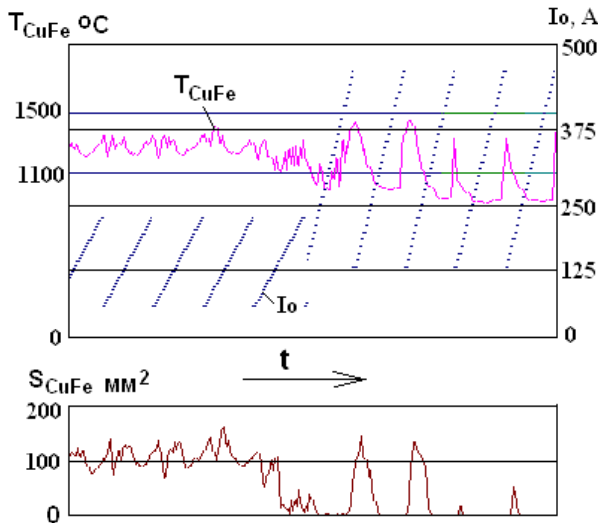

Figure 3. Change in the maximum temperature T_{CuFe} and the S_{CuFe} area of contact of liquid copper with the surface of the steel and the plasma arc current Io when the deposited layer is closed

The arc current reduction time at the end of surfacing t_k is approximately equal to half the burner oscillation period. The times t_e, t_z can be adjusted to obtain more stable values of the contact area of liquid copper with steel and the volume of the surfacing bath, which when modeling in the form of time plots.

A layer in the closing area is formed without excessive bulge and crater with a well-chosen program for changing the arc current, Fig. 4.
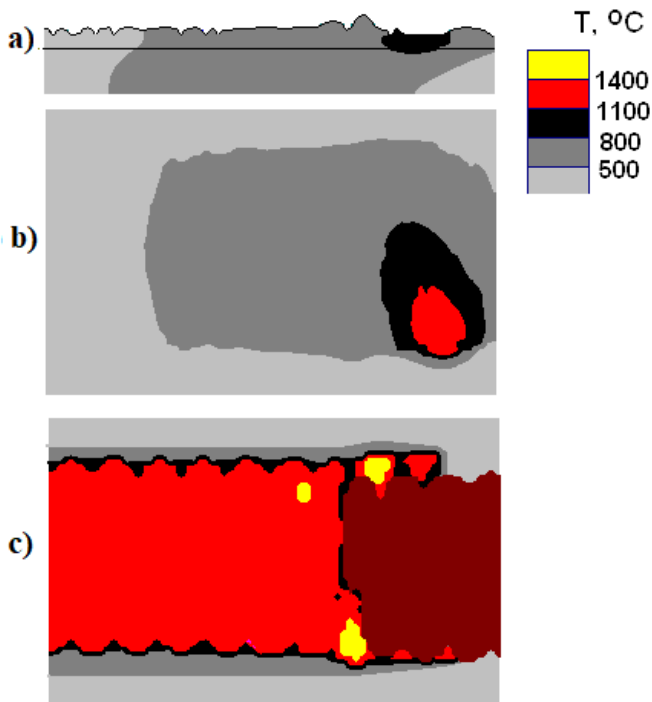

Fig. 4. The results of modeling the formation of the deposited layer in the region of its closure: a, b) the temperature distribution in the longitudinal section (a) and in the contact of the layer with the body (b) at the time of completion of the process and the maximum temperature of this contact (c)

In table 1 we presented the obtained parameters of the process of closing the layer during surfacing, determined by computer simulation

Table 1 – Optimal parameters of the process of closing the layer during surfacing

Parameter name	Parameter value
Main arc current	310 A
Amplitude of current oscillations of the main arc	±80 A
Locking duration	13 sec

In fig. 5, we showed the cross section of the layer deposited at the parameters indicated in table 1, and the result of modeling the process in a quasi-steady state.
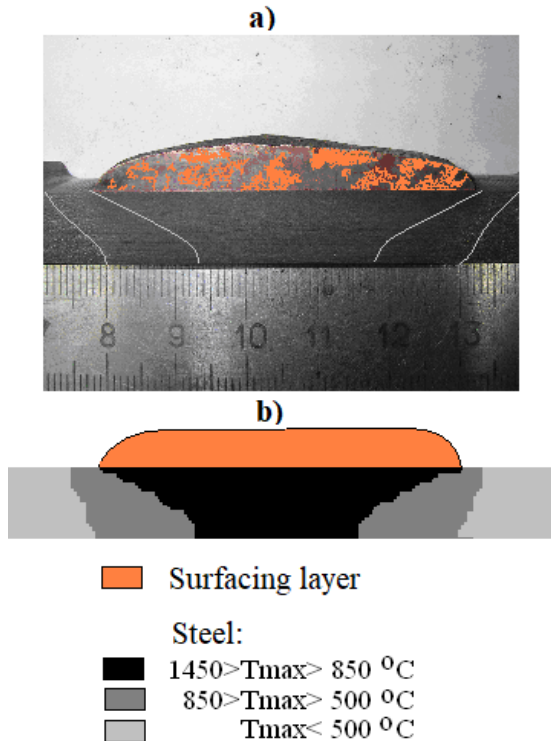

Fig. 5. Cross section of the deposited layer (a) and simulation result (b) of the surfacing process with the parameters of table

Thus, we examined the procedure for solving a typical technological problem in plasma-arc surfacing with transverse oscillations of the plasma torch. It is shown that it is possible to compensate for a powerful heat sink to the initial part of the deposited bead by increasing the plasma arc current. It is also necessary to reduce the speed of sample movement.

References

1. Erofeev V.A., Strakhova E.A. Computer engineering analysis of the process of plasma-arc surfacing of a non-ferrous alloy layer on steel bodies of revolution. Procurement in Engineering, 2011, No.12, pp. 12-18.

2. Krasulin Yu.L. Kulagin I.D. Regulation of the temperature of the weld pool during surfacing by a plasma jet. Automatic Welding, 1966, No 9. pp. 11-15.

3. Strakhova EA, Erofeev VA, Sudnik V.A. Modeling of the surfacing process with transverse oscillations of the plasma torch. Welding and Diagnostics, 2009, No. 2, pp. 12-15.

Scientific publication

International Conference
"Process Management and Scientific Developments"

Birmingham, United Kingdom
(Novotel Birmingham Centre, March 31, 2020)