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BIOLOGICAL SCIENCES

DIFFERENCES IN FIELD SOIL MOISTURE AT SOYBEAN SOWING DUE TO DIFFERENT ANNUAL METEOROLOGICAL CONDITIONS

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Abstract

The content of soil moisture in different soil horizons of soybean fields in the 0-150 cm layer was studied in years with different meteorological conditions, including separately for the bare and cénosis soils. The value of moisture reserves in the soil during the spring sowing period are determined by the total amount of precipitation and their relative index (RPI) in the previous period of soil water accumulation (September-April). During the growing season, water losses from bare soil occur mainly from the arable layer; the decrease in the total moisture reserves of the deep layers of the soil of the soybean cénosis is mainly associated with plants.

Keywords: soybean cénosis, soil moisture, relative precipitation index (RPI).

Any decrease in non-beneficial water consumption must result in increased production per unit of consumed water (Blum A., Perry C. et al., 2009). Increasing the efficient water use by cultivated soybean *Glycine max* (L.) Merr. requires an accurate assessment of the moisture reserves of soybean fields in different seasons (Харчук О., 2019). The aim of the work was to assess the content of soil moisture in different soil horizons of agrocénoses in the 0-150 cm layer in years with different meteorological conditions, including separately for the bare and cénosis soils.

The studies were carried out in 2017 -2022 at the fields of the Institute of Genetics, Physiology and Plant Protection (IGFPP), mainly in the cénoses of the Aura variety with traditional cultivation technology (400*10³ plants/ha, row spacing 45 cm). To assess meteorological conditions was used the relative precipitation index (RPI) - the ratio of precipitation sum for the given period P and the long term average for the same period \bar{P} expressed in percent, $RPI = P/\bar{P} \cdot 100\%$; for long period (quarter, year) are such criteria of RPI value: 0-49,9% (extremely dry), 50,0-74,9% (very dry), 75,0-89,9% (dry) and 90,0-110,0% (average) (Kaczorowska Z., 1962; Bąk B., Łabędzki L., 2002). Gravimetric soil moisture samples were taken by hand drill AM-26 at 10-20 cm depth increments to 150 cm deep (both in cénosis and on bare soil). For each horizon, soil samples were taken in triplicate. To determine soil moisture, the samples were dried in an oven at 105 °C to

constant weight (Black C., 1965). To determine the volumetric soil moisture content, the gravimetric data were multiplied by the soil density values, obtained experimentally (Вадюнина А.Ф., Корчагина З.А., 1986; ISO 11272).

The period from autumn to spring in Moldova is slightly dry, as evidenced by the comparison of precipitation during this period with average annual for years 2001-2018 (Table 1). Of the previous years, 1983 was the driest (in total only 463 mm after 431 mm in 1982), of which 168 mm of precipitation fell on the "winter" 1982/1983 and 236 mm on the summer, June-August 1983.

Two consecutive seasons (2018-2019 and 2019-2020), the period from autumn to spring in Moldova was atypically dry (180,0 and 108,4 mm), as evidenced by the comparison of precipitation during this period with average annual 326 ± 26 mm (Table 1). Prior to this season (2022), the period from September 2021 to April 2022 in Moldova was also atypically dry too (69,6 mm).

The definition of drought has continually been a stumbling block for drought monitoring and analysis. Wilhite D. and Glantz M. (1985) completed a thorough review of dozens of drought definitions and identified different overall categories, from meteorological and climatological to agricultural, hydrologic and water management.

Table 1.

The amount of precipitation for the autumn-spring period in Moldova and the IGFPP in different years.

Years (autumn-spring)	Autumn-spring precipitation, mm		
	September-December	January-April	Σ
average (2009-2018)	168 ± 30	158 ± 3	326 ± 26
2016-2017	169,2	159,7	328,9
2017-2018	168,3	174,3	342,6
2018-2019	96,2	83,2	180,0
2019-2020	60,0	48,4	108,4
2020-2021	222,6	86,4	309,0
2021-2022	64,4	103,6	168,0

Note. Data for 2016-2018 refers to Moldova (Climatic Research Unit Country File created on Wed 15 May 2019 11:43:38 BST, from CRU TS run #1905011326), later, for 2019-2022 - directly to the fields of the IGFPP (<http://surl.li/cywwu>).

The *relative precipitation index (RPI)* is the ratio of precipitation sum for the given period P and the long term average for the same period P^* expressed in percent: $RPI = (P/P^*) \times 100\%$; this index was proposed for relatively long period, from quarter to year (Kaczorowska Z., 1962; Bąk B., Łabędzki L., 2002). Regarding the normal average RPI value (90,0÷110,9%), in ac-

cordance with the actual precipitation the autours proposed different classes of total precipitation for long dry periods: 75,0÷89,9 (dry), 50,0÷74,9 (very dry), 0÷49,9% (extremely dry).

In Table 2 are presented the data on the relative precipitation index (RPI) for the autumn-spring period of water accumulation in soil (from September to April) in different years.

Table 2.

The relative precipitation index (RPI) for the autumn-spring period in Moldova and the IGFPP in different years.

(«autumn», IX-XII-«spring», I-IV)	September-December	January-April	Σ
average (2009-2018)	100	100	100
2016-2017	101	101	101
2017-2018	100	110	105
2018-2019	57	53	55
2019-2020	36	31	33
2020-2021	132	55	95
2021-2022	38	66	52

Table 3 shows the gravimetric soil moisture data at soybean sowing, obtained in different years. Before sowing-2020, soil moisture at all soil depths is significantly lower than in previous years. In the first half-meter, the soil moisture content is 5-6% lower than the values of previous years.

Table 4 shows the volumetric soil moisture data at soybean sowing, obtained in different years. The water content in the layer 0-40 cm is not the best parameter of total water balance accordingly to RPI and to the total value of precipitations during long period of water accumulation (from September to April). Only before sowing-2020, soil moisture at all soil depths is significantly lower than in previous years.

As can be seen from Tables 1, 2 and 4, in the autumn-spring period of water accumulation in soil (from September to April) out of 6 years of research, three years (2017, 2018 and 2021) were characterized by precipitations above the average long-term norm (326 mm): 329, 343 and 309 mm, respectively, with RPI values of 101, 105 and 95% (this is within the normal range, which is 90.0÷110.9%). As can be seen from Table 4, after the autumn-spring period of moisture accumulation, these three years (2017, 2018 and 2021) were characterized by the maximum total water reserves in the 0-150 cm soil layer: 417, 380 and 391 mm, respectively.

Table 3.

Gravimetric soil moisture in the field at soybean sowing in different years (2017-2022).

Soil layer, cm	Gravimetric soil moisture during sowing, % of dry soil mass					
	2017 (May, 5)	2018 (May, 7)	2019 (Apr, 25)	2020 (May, 20)	2021 (May, 11)	2022 (Apr., 15)
0-10	25,0 ±0,2	12,4 ±3,1	17,1 ±0,9	11,0 ±2,3	20,7 ±1,0	21,0 ±0,5
10-20	24,2 ±0,2	17,1 ±0,1	18,8 ±0,5	15,2 ±0,2	20,7 ±0,2	22,8 ±0,4
20-30	21,8 ±0,6	17,9 ±0,2	17,8 ±0,4	14,2 ±0,4	20,3 ±0,2	20,9 ±0,2
30-40	20,8 ±0,2	18,1 ±0,1	17,1 ±0,1	13,0 ±0,4	19,2 ±0,3	20,9 ±0,4
40-60	20,8 ±0,3	20,2 ±0,3	18,3 ±0,1	13,2 ±0,1	16,7 ±0,4	15,4 ±0,1
60-80	19,5 ±0,3	20,6 ±0,0	17,9 ±0,1	13,1 ±0,4	18,2 ±0,2	14,9 ±0,2
80-100	21,5 ±0,1	20,0 ±0,1	17,0 ±0,3	11,1 ±0,2	17,8 ±0,5	15,6 ±0,3
100-120	20,6 ±0,2	19,3 ±0,4	16,8 ±0,1	12,1 ±0,2	15,6 ±0,7	14,7 ±0,6
120-140	19,1 ±0,5	17,8 ±0,1	16,4 ±0,3	-	14,1 ±0,6	13,4 ±0,2
140-150	15,7 ±0,2	17,9 ±0,1	16,8 ±0,4	11,8 ±0,1	13,2 ±0,3	13,4 ±0,3

As can be seen from Tables 1, 2 and 4, in the autumn-spring period of water accumulation in soil (from September to April), out of 6 years of research, three years (2019, 2020 and 2022) were characterized by precipitations significantly less than the average annual norm (326 mm): in 2019 and in 2022, 180 mm and 168 mm, respectively, with RPI values of 55% and 52% (very dry, 50,0÷74,9%); in 2020 precipitations in total

were minimal, 108 mm, with an RPI value of 33% (extremely dry 0÷49,9%). As can be seen from Table 4, after the autumn-spring period of water accumulation, these three years (2019, 2020 and 2022) were characterized by the minimum total water reserves in the 0-150 cm soil layer: 354 and 333 mm in 2019 and 2022, respectively. and the smallest value, 256 mm, was in 2020.

Table 4.

Soil layer, cm	Volumetric soil moisture reserves at sowing, mm					
	2017 (May, 5)	2018 (May, 7)	2019 (Apr, 25)	2020 (May, 20)	2021 (May, 11)	2022 (Apr., 15)
0-40	117±2	84±3	90±4	69±2	113±5	109±3
40-150	300±3	296±4	264±2	187±2	278±3	224±2
0-150	417±3	380±5	354±3	256±3	391±4	333±2

Thus, during soybean sowing, the total water reserves in the 0-150 cm soil layer fully corresponded to the amount of precipitation and RPI values for the autumn-spring period (September-April), decreasing from seasons with a normal RPI value (average $100\pm 3\%$ for 2017, 2018 and 2021) to seasons with a low RPI value: on average $54\pm 2\%$ for 2019 and 2022, and especially to the 2020 season with a minimum RPI value of 33%: total water reserves in the 0-150 cm soil layer decreased from seasons from normal RPI value to seasons with a low RPI value: for 2017, 2018 and 2021, the total water reserves in soil layer 0-150 cm were on average 396 ± 11 mm, and for 2019 and 2022, the total water reserves were on average 344 ± 11 mm; by sowing-2020, the total water reserves in the 0-150 cm layer are especially small, 256 ± 3 mm.

When comparing the seasonal changes (years 2019 and 2022) in total moisture reserves in the cenosis with areas of bare soil it was found that water losses in black fallow occur mainly from the arable layer. When sowing 2019 (April, 25) was 354 mm (264 ± 2 mm in the layer 40-150 cm), but at harvesting-2019 (September, 6) left in cenosis 218 ± 4 mm (167 ± 2 mm in the layer 40-150 cm; at fallow plot - 305 ± 5 mm (238 ± 1 mm in the layer 40-150 cm). When sowing 2022 (April, 15) was 333 mm (214 ± 2 mm in the layer 40-150 cm), but to 102 days after planting (DAP), July, 26 in cenosis left 179 ± 3 mm (142 ± 2 mm in the layer 40-150 cm; at fallow plot left 281 mm (220 ± 2 mm in the layer 40-150 cm). In 2022 on black fallow for period 102 DAP a decrease in soil moisture (near 60 mm relative to sowing) occurred exclusively in the 0-40 cm layer. In both years, in soybean cenosis the moisture reserves in the soil layer 40-150 cm decreased more, then in the fallow plot (minimum by 80 mm).

Conclusion

The value of moisture reserves in the soil layer 0-150 cm during the spring sowing period are determined by the total amount of precipitation and their relative index (RPI) in the previous period of soil water accumulation (September-April). During the growing season, water losses from bare soil occur mainly from the arable layer; the decrease in the total moisture reserves of the deep layers of the soil of the soybean cenosis is mainly associated with plants.

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ECONOMIC SCIENCES

INTEGRATED MANAGEMENT SYSTEM AS PERSPECTIVES AND OPPORTUNITIES

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Abstract

In the modern world, the integration of markets, even entire economies of various countries, is increasingly manifested and, as a result, the exchange of goods, services, knowledge, and cultural values are becoming increasingly interconnected. In order to function comfortably in such an environment, to ensure an appropriate level of competitiveness, modern organizations must work according to generally established rules. In this article main principles of modern integrated management systems are described in the concept of effective organizational operations.

Keywords: management system, process, natural resources, infrastructure, corporate culture, personnel motivation system, organizational culture, enterprise development.

As it is known, for more than 25 years, many countries have successfully applied in their practice international standards for management systems, the most popular of which are ISO 9001 "Quality management systems. Requirements", ISO 14001 "Environmental Management Systems. Requirements and guidance for use", ISO 27001 "Information technology. Security methods. Information security management systems. Requirements", ISO 45001 (formerly OHSAS 18001) "Occupational safety and health management system. Requirements and guidance for use", ISO 50001 "Energy management systems. Requirements and guidelines for use. All of the above standards are voluntary and companies make their own decisions about their implementation. By ensuring the integration of two and / or more standards into the practice of activity, the management system, accordingly, becomes integrated. All management system standards regulate the requirements for the application of the PDCA Continuous Improvement Cycle (Plan - Do - Check - Improve) [1]. Through the implementation of this cycle by employees and structural divisions, the management is able to ensure control and completeness of the execution of production tasks, timely adjustment of the planned activities with a consistently high level of quality of products and / or services provided. By implementing several standards at the same time, the organization combines their requirements and forms an integrated management system.

Enterprises that have implemented modern management tools are able to increase productivity, respectively, reduce costs, increase customer satisfaction and, as a result, increase economic efficiency and competitiveness. At the same time, it is necessary to realize that four mandatory components are characteristic of any organization's management system: 1) employees; 2) processes; 3) organizational or corporate culture and 4) infrastructure or, in other words, means of work. Improving the management system, it is necessary to design and implement changes in all four listed components. The synergy of all mandatory organizational components allows the company to reach a fundamentally new qualitative level.

When we talk about employees, first of all, functional duties should be formulated and official powers, rights, and responsibilities should be defined. The development of an optimal organizational structure is the logical conclusion of organizational decisions in this part. At this stage, the management of the enterprise must decide which organigram, linear-functional, matrix or divisional, will ensure the normal functioning and development of the company. Much depends on the types of activities of the organization, its scale, business geography and the choice of the appropriate situational management model, which will directly affect the organizational culture of the enterprise. It is important to note that it is advisable to take into account all the multifactorial nature of issues that affect the development of personnel.

It is necessary to develop a transparent and fair system of motivation so that each employee understands what needs to be striven for, what result and in what time frame is expected from him. It is possible to use, for example, a monthly, both collective and individual system for assessing the performance of employees, their combined use, or separately. The following systemic motivation factors can be distinguished: financial, professional, social, the use of which is also allowed jointly or separately.

The financial factor of motivation is aimed at increasing the interest of employees in achieving the goals and objectives set, making the most efficient use of working time. Such a factor is a bonus part of the remuneration and is directly related to the assessment of the achievement by an employee / group of employees of Key Performance Indicators. The financial factor of motivation is paid differentially, depending on the performance of employees as a percentage of wages. As an example, we can consider a system based on the use of KPI (Key Performance Indicators), but not the classical methodology, as a rule, used in evaluating the activities of top management, but a variant of the operational, monthly assessment of the activities of structural units represented by line managers. First of all, it should be noted that before the active use of ISO standards in the post-Soviet space, such concepts as Efficiency and Efficiency, as a rule, were not differentiated,

however, in business terms generally accepted at the world level, these concepts are separated, Efficiency is everything what is associated with the cost of resources (time, money, people, energy costs, etc.) for a certain period of time, and Performance, as a rule, has a quantitative expression (units, percentages, etc.) [1].

The professional motivation factor is aimed at the constant self-improvement of the employee, the desire to improve their skills, professional and career growth, the development and realization of creative potential. The professional motivation factor is a constant, rated value and is paid in the form of a regular bonus to wages for the professional achievements of an employee, based on the results of the next certification and assignment of a qualification category to him. Separately, in the form of one-time monetary bonuses, constructive proposals from employees are encouraged to increase productivity and reduce the costs of production processes.

The social factor of motivation is aimed at meeting the social needs of the employee, recognizing his achievements, forming and developing corporate values. The social factor of motivation is expressed in meeting the social needs of employees, in the form of additional social guarantees, starting with the provision of food, delivery to work and home by company vehicles, medical insurance and ending with the provision of company housing, etc., partially or completely at the expense of the organization, including moral encouragement of employees. When assigning social motivation, it is advisable to take into account the work experience of the employee in the company.

The next mandatory component of the life of an organization, which will be considered in the context of

this article, is management, main and auxiliary business processes. In fact, any process is a clearly described technological sequence of activities, when the main tasks of such processes are to ensure the predictability of its results, both in terms of resource costs and in terms of ensuring the achievement of mandatory qualitative and quantitative indicators.

When considering and analyzing the organization's activities from the point of view of the process approach, it becomes obvious that it is the process approach that allows achieving predictable results, ensures the transparency of the transformation process, and reduces the variability of performance results. From the point of view of development, organizations that apply the process approach, in order to ensure maximum customer satisfaction, standardize their activities, and when market priorities change, they are ready for operational optimization / adaptation of business processes, thereby ensuring stable competitiveness and continuous development.

It is advisable to start with the algorithmization of business processes, which will allow you to look at the technology of carrying out activities from the outside, determine the "inputs" and "outputs" of processes, clearly understand and appoint "owners" of processes, see the relationships at the operational and linear levels, bring some clarity and understanding which processes are duplicated by different employees are unnecessary, ensure the formalization (standardization) of the business process. Below, in Figure 1, the Model of the organization's management system from the point of view of the process approach [2] is shown.

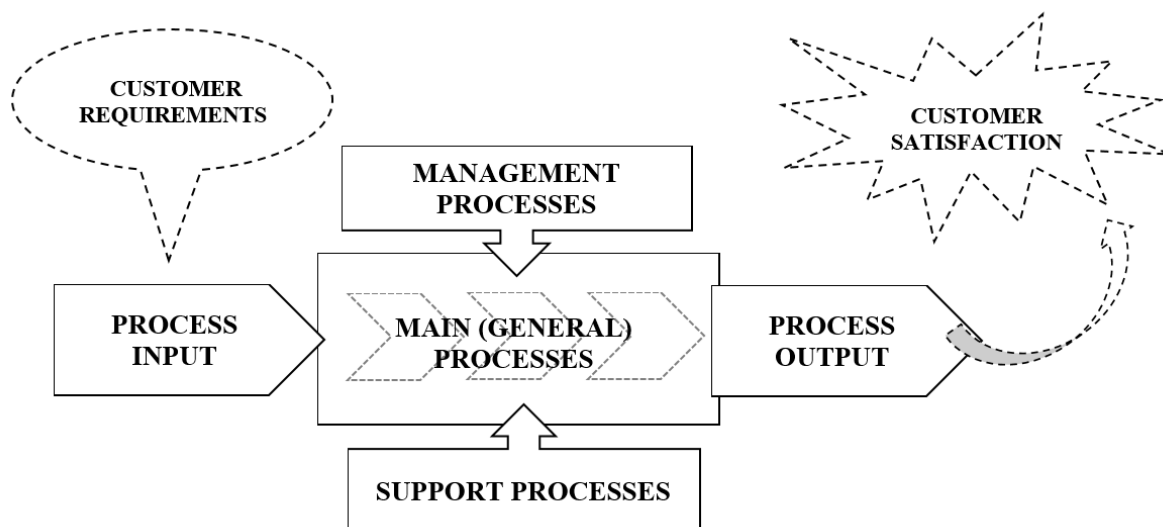


Figure 1. Organizational management system model [2].

At the heart of improving business processes is the task of optimizing them in order to reduce cycle time through the use of advanced technologies, robotization / automation, the introduction of such lean management tools as:

Value Stream Mapping to identify and optimize (eliminate/minimize time) processes that do not add value;

✓ the use of the "Pull" cascade system, in which the internal supplier, who is ahead of its internal consumer in terms of production technology, or the organization itself, in relation to the external client, does nothing until he informs him about it;

✓ visual management, which provides visibility into work in progress, cost levels and areas of competence of employees, determines and visually presents work priorities, daily process performance indicators,

creates favorable conditions for communication in the work area, as well as between management and staff;

- ✓ application in the work of a production cell with a continuous flow, through which production operations are carried out in a clear technological sequence, without interruptions / downtime;

- ✓ the use of SMED (Single Minute Exchange of Die) technologies - quick changeover of equipment, literal translation: "Change of the die in 1 minute", allows you to reduce the time spent on excess production, which is expressed in the fact that more products are produced than required, or earlier than required by the customer and / or internal consumer, respectively, those resources that could be spent on improving quality are spent on increasing the quantity [3].

In recent years, the concept of "corporate culture" is not used only by the lazy. Of course, the initiator of creating a model of corporate culture should be the first manager or owner of the company. As a rule, a typical owner of a domestic small / medium-sized business created his company on a whim, without using calculations, feasibility studies, business plans or development strategies, often using the Napoleonic rule: "The main thing is to get involved in battle, and the war plan will show ...". Therefore, at the past stage there was no time, and often no knowledge, to create and develop a unique culture of relationships that characterize the company in relation to internal (employees) and external (suppliers, customers, partners) parties. In such conditions, in organizations there is a conditional differentiation of employees into management and other employees, who by default are perceived as "low-skilled" personnel, while being the main production personnel. The turnover rate of the main production personnel in such organizations, as a rule, is 100%. By management, the bulk of employees, by default, are perceived as loafers and loafers. Quite consciously, repressive management is used, when, when inconsistencies in work are identified, the question is immediately raised: "Who is to blame"? and the punishment mechanism is activated. Under such conditions, the company suffers irretrievable losses of time, ideas, opportunities for improvement and gaining experience due to such an attitude towards employees, while it is obvious that the organization always incurs losses when employees leave, taking with them the acquired knowledge and experience. First of all, the management of the organization must realize that the attitude towards employees, methods of personnel management come from the first head. It is the first manager, who today, often, concurrently, is also the owner of the business, must realize the importance and responsibility for determining the corporate culture in his organization, which includes a system of values and relationships in the team, creates a psychological and moral climate, forms the company's business philosophy according to relation to internal and external parties. It is very important to realize that the consumer can be both internal and external. In other words, these are not only buyers of the final product / service produced by the organization (external consumer), but also any of your work colleagues (internal consumer) to whom you transfer the results of your work. It is important to strive to create a harmonious internal business environment of the company, in which colleagues are focused

on each other, and all together show an increased interest in the achievements of the organization as a whole.

By definition, infrastructure is a system that includes facilities, equipment and services necessary for the activities of an organization [1]. In fact, without the creation of an infrastructure of a certain level, the start of any activity is not possible. Therefore, it is safe to say that in one form or another the infrastructure takes place in every operating organization.

Depending on the specifics of the company's activities, the set of infrastructure elements also changes. So, manufacturing enterprises have such infrastructural components as: production workshops, repair, tool, transport services, warehouses, production areas, etc. For companies providing intellectual services, software and communication facilities will be mandatory components of the infrastructure. For service organizations, these are specialized premises equipped with the necessary technological and interior equipment, etc. As a rule, at the stage of creating a company, the focus is on infrastructure, because, without the availability of appropriate buildings, structures, premises, equipment, tools, transport, communications, etc. it is simply not possible to carry out this or that activity. However, it is necessary to realize that the infrastructure, like other mandatory components of life, at one or another evolutionary stage of the organization must be purposefully optimized and improved, including:

- a) elimination of unscheduled and development of preventive maintenance;
- b) optimization of warehouse stocks and reduction of costs for maintenance of warehouses;
- c) optimization of the use of production space;
- d) cost optimization for consumables, etc.

Separately, we should mention such an important infrastructural component inherent in any organization as information. Given current trends and the dynamics of scientific and technological progress, in order to consistently improve the infrastructure, it is necessary to focus on information management, which plays a paramount role in the modern business world. It is important to constantly expand and develop hardware, software, system tools and technologies that ensure the creation, storage, processing and use of information, while the speed of response to changes should be equal to the speed of the Internet.

Summing up, we can confidently say that a modern organization that seeks to achieve success in a particular segment of the economy must realize that changes, in order to ensure compliance with the constantly changing requirements of the market, are a natural component of modern times, but must itself, in - firstly, be ready to quickly adapt, and secondly, strive to create a new product that anticipates the wishes of consumers.

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**МЕТОДИКА РАСЧЕТА ЗАТРАТ НА ОБЕСПЕЧЕНИЕ БЕЗОПАСНОСТИ И ОХРАНЫ ТРУДА
СПЕЦИАЛЬНОГО ХАРАКТЕРА***Айтимова Ш.Т.**магистр экономики,**Республиканский научно-исследовательский институт по охране труда,**Нур-Султан, Республика Казахстан***METHODOLOGY FOR CALCULATING THE COSTS OF ENSURING SAFETY AND LABOR
PROTECTION OF A SPECIAL NATURE***Aitimova Sh.**Master of Economics,**Republican Research Institute for Labor Protection,**Nur-sultan, Republic of Kazakhstan*DOI: [10.5281/zenodo.7070004](https://doi.org/10.5281/zenodo.7070004)**Аннотация**

В данной статье рассматривается методика расчета затрат на обеспечение безопасности и охраны труда специального назначения куда входят затраты на проведение аттестации производственных объектов по условиям труда, затраты на проведение периодических медицинских осмотров и предсменное медицинское освидетельствование работников, затраты на выплату обязательных профессиональных пенсионных взносов, затраты на обеспечение средствами индивидуальной защиты, затраты на выдачу молока или равноценных пищевых продуктов и/или специализированных продуктов для диетического (лечебного и профилактического) питания, затраты на предоставление сокращенной продолжительности рабочего времени, дополнительного оплачиваемого ежегодного трудового отпуска и повышенного размера оплаты труда.

Abstract

This article discusses the methodology for calculating the costs of ensuring safety and labor protection for special purposes, which includes the costs of certification of production facilities according to working conditions, the costs of conducting periodic medical examinations and pre-shift medical examination of employees, the costs of paying mandatory occupational pension contributions, the costs of providing personal protective equipment, the costs of providing milk or equivalent food products and/or specialized products for dietary (therapeutic and preventive) nutrition, the costs of providing reduced working hours, additional paid annual leave and increased wages.

Ключевые слова: аттестация рабочего места, медицинский осмотр, обязательные профессиональные пенсионные взносы, средства индивидуальной защиты, лечебно-профилактическое питание, сокращенная продолжительность рабочего времени, дополнительный отпуск, повышенный размер оплаты труда.

Keywords: workplace certification, medical examination, mandatory occupational pension contributions, funds. personal protection, therapeutic and preventive nutrition, reduced working hours, additional leave, increased wages.

На основании анализа требований трудового законодательства Республики Казахстан выделено три категории затрат с учетом нормативного характера. К первой категории относятся общие обязательные затраты для всех предприятий. Ко второй категории относятся специальные обязательные затраты, под которыми понимаются затраты, в случае наличия работников, занятых во вредных и/или опасных условиях труда. К третьей категории относятся компенсационные затраты, т.е. затраты, связанные с наступлением несчастного случая и штрафы за невыполнение требований по охране труда.

К затратам на обеспечение безопасности и охраны труда специального характера относятся следующие затраты:

- на проведение аттестации производственных объектов по условиям труда;
- на проведение периодических медицинских осмотров и предсменное медицинское освидетельствование работников;

- на выплату обязательных профессиональных пенсионных взносов;

- на обеспечение средствами индивидуальной защиты, на выдачу молока или равноценных пищевых продуктов и/или специализированных продуктов для диетического (лечебного и профилактического) питания;

- на предоставление сокращенной продолжительности рабочего времени, дополнительного оплачиваемого ежегодного трудового отпуска и повышенного размера оплаты труда.

Затраты на проведение аттестации производственных объектов по условиям труда. В соответствии со пунктом 1 статьи 183 Трудового кодекса РК, работодатель в обязательном порядке должен проводить аттестацию производственных объектов по условиям труда (далее- АПО) регулярно, не реже 1 раза в 5 лет. Порядок проведения АПО регламентируется Правилами обязательной периодической аттестации производственных объ-

ектов, утв. приказом №1057 Министерства Здравоохранения и социального развития РК от 28.12.2015 года (далее-Правила АПО)

При проведении аттестации производственных объектов по условиям труда затраты на замеры определяются с учетом количества измеряемых вредных и (или) опасных производственных факторов (физические, химические, биологические факторы, а также тяжесть и напряженность труда). Для оценки степени вредности и опасности труда на 1 (одно) рабочее место необходимо провести минимум 8 замеров опасных и вредных производственных факторов. Для расчета затрат на проведение аттестации производственных объектов по условиям труда применяется формула 1:

$$C_A = S_A \times N_{pm} \quad (1)$$

где,

C_A – затраты на проведение аттестации производственных объектов по условиям труда;

S_A – стоимость услуги по аттестации производственного объекта (рабочего места) (на основании сведений предоставляемых специализированной организацией);

N_{pm} – количество рабочих мест, подлежащих аттестации.

В себестоимость услуг по аттестации производственного объекта формируется из заработной платы специалиста, налогов и отчислений из заработной платы, амортизации, проверки приборов, расходы на материалы и прочие расходы.

В таблице приведен примерный расчет стоимости услуг на проведение АПО специализированной организации:

Таблица 1

Расчет стоимости услуг на проведение АПО

№ п/п	Статьи затрат	Сумма, в тенге
1	Оплата труда специалиста	7122
2	Налоги (социальный налог -6%, социальные отчисления -3,5%, обязательное социальное медицинское страхование-2%)	819
3	Амортизация оборудования	645
4	Проверка приборов	271
5	Расходы на материалы	306
	Итого себестоимость	9240
8	Плановая прибыль	2720
9	НДС 12%	1414
	Всего стоимость услуги АПО на 1 рабочее место	13200

Для расчета затрат на проведение аттестации производственных объектов по условиям труда применим формулу 1:

$$C_A = S_A \times N_{pm} = 13200 \times 124 = 1\,636\,800 \text{ (тенге)}$$

В данном примере за 1 рабочее место стоимость услуги по аттестации производственных объектов по условиям труда составляет 1 3200 тг, количество рабочих мест, подлежащих аттестации - 124 ед. Затраты работодателя на проведение аттестации производственных объектов по условиям труда составили 1 636 800 тг.

Затраты на проведение периодических медицинских осмотров и предсменное медицинское освидетельствование работников. Подпунктом 15 пункта 1 статьи 317 Трудового кодекса Республики Казахстан предусмотрена обязанность работодателя проводить обязательные, периодические (в течение трудовой деятельности) медицинские осмотры и предсменное медицинское освидетельствование работников в случаях, предусмотренных законодательством Республики Казахстан, а также при переводе на другую работу с изменениями условий труда либо при появлении признаков профессионального заболевания.

Работники, не прошедшие предварительные или периодические медицинские осмотры или признанные непригодными к работе по состоянию здоровья, к выполнению трудовых обязанностей не допускаются.

Периодичность проведения обязательных периодических медицинских осмотров:

– ежегодный медицинский осмотр – 1 раз в год;

– предсменное медицинское освидетельствование - за 1 час и за 30 минут перед началом рабочей смены.

Для медицинской организации, оказывающей услуги по проведению медицинских осмотров, при обращении работодателя важно быстро и точно рассчитать объемы и стоимость услуг. Это одно из условий достижения конкурентного преимущества на рынке. Как правило, этот процесс в медицинской организации является наиболее длительным и трудоемким по причине наличия межфункционального взаимодействия и сложного механизма определения объемов оказываемых услуг.

По отношению к затратам на медицинские затраты можно провести аналогию и считать их носителями те «продукты» охраны труда, на производство которых данные затраты направлены: обучение персонала, предоставление компенсаций, обеспечение СИЗ и т.д.

Существует 2 варианта организации проведения медицинских осмотров организации:

1 вариант – Медицинские осмотры проводятся на договорной основе с медицинской организацией.

Затраты на проведение медицинского осмотра медицинской организацией рассчитываются по формуле 2.

$$C_{mo} = \sum_{i=1}^n N_p \times S_{mo} \quad (2)$$

где,

C_{mo} – годовые затраты на проведение медосмотров на договорной основе с медицинской организацией;

N_p – количество работников в i -ой профессий, которые проходят медицинский осмотр;

S_{mo} – стоимость 1-го медосмотра;

n – количество профессий.

2 вариант. Работодатель для проведения обязательных медосмотров сотрудников, занятых на вредных работах, имеет медицинский пункт (здравпункт).

Затраты на оснащение и содержание медпункта (здравпункта) включают в себя:

$$C_{мп} = E_p + W_{мп} + T_{ax} + A + E_t \quad (3)$$

$C_{мп}$ – затраты на оснащение и содержание медпункта (здравпункта);

E_p – первичные расходы (приобретение медицинского оборудования, мебели, инвентаря, мебели, регистрационные расходы и т.д.)

$W_{мп}$ – заработная плата медицинского персонала;

T_w – налоги и отчисления с заработной платы;

A_{mo} – амортизация;

E_t – текущие расходы (коммунальные расходы, текущий ремонт, приобретение медикаментов и перевязочных материалов и т.д.)

При 1-ом варианте расчета медицинские осмотры проводятся на договорной основе с меди-

цинской организацией со следующей последовательностью:

1) Определить количество сотрудников, подлежащих медосмотрам, согласно приложению 1 к приказу Министра здравоохранения Республики Казахстан от 15 октября 2020 года № ҚР ДСМ-131/2020 г. с указанием должности или профессии работника по штатному расписанию, участки, цеха, вредные работы и вредные производственные факторы.

2) Определить категории должностей, для которых осмотр нужно проводить 1 раз в год, либо 1 раз в 2 года.

3) Указать дату приема по каждому принятому менее года назад, сотруднику (медосмотр при приеме пройден), или дату последнего осмотра (по постоянно работающим) добавляем к ней 12 месяцев или 24 месяца, таким образом, получаем ориентировочную дату следующего планового осмотра.

4) Сопоставляем плановую дату осмотра, с месяцем на который мы можем заключить договор с на медицинский осмотр с медицинской организацией.

5) Также необходимо из списка отобрать тех новых работников, по которым разница между датой их планового осмотра и датой периодического медицинского осмотра по договору составляет менее полугода.

6) В итоге получаем плановую численность сотрудников для периодического медицинского осмотра, указанную в таблице 2.

Таблица 2

Список сотрудников, подлежащих медосмотру за март месяц

№ п/п	ФИО сотрудника	Должность	Периодичность медосмотра	Дата приема на работу	Дата последнего медосмотра	Дата планового медосмотра*
1	Ахметов Ернар Булатович	Мастер	1 раз в год	01.08.2019	01.03.2021	01.03.2022
2	Петров Геннадий Олегович	Начальник отдела	1 раз в два года	01.02.2018	01.03.2021	01.03.2023

* - дата планового медосмотра определяется, добавляя в периодичность медосмотра 12 или 24 месяца соответственно.

Далее согласно договора с медицинской организацией об оказании услуг по медицинскому осмотру стоимость 1 медицинского осмотра на одного работника составляет 14500 тг. соответственно расходы на медицинский осмотр по договору составит 29000 тг.

2-вариант. Работодатель для проведения обязательных медосмотров сотрудников, занятых на вредных работах, имеет медицинский пункт.

В таблице 3 приведены затраты на содержание медпункта за отчетный период, на основе этих данных рассчитаем затраты на содержание медицинского пункта:

Таблица 3

Затраты на содержание медицинского пункта

№	Виды затрат	Сумма, тг
1	Заработная плата медработника	212 520
2	Налоги с оплаты труда	24440
3	Расходы на коммунальные услуги	9582
4	Амортизационные отчисления	1670
6	Расходы на приобретение медикаментов, оборудования и тд.	26850
ИТОГО		275 062

Таким образом, затраты работодателя на содержание медицинского пункта за отчетный период составляют 275062 тг.

В соответствии с п.1 статьи 26 Закона Республики Казахстан «О пенсионном обеспечении в Республике Казахстан» размер пенсионных взносов утвержден на уровне 5% от ежемесячного дохода работника. При планировании затрат на осуществление обязательных профессиональных пенсионных взносов производится исчисление с учетом численности среднего размера дохода работников за предыдущий год на основе утвержденного размера взносов (5%). Необходимо также учитывать планируемое уменьшение или увеличение штатной численности работников. Для расчета затрат обязательных профессиональных пенсионных взносов применяется формула 4.

$$C_{\text{оппв}} = \sum_{k=1}^n W_k \times 5\% \times 12 \quad (4)$$

где,

$C_{\text{оппв}}$ – затраты предприятия на выплату обязательных профессиональных пенсионных взносов;

W_k – ежемесячный доход k -работника, за исключением выплат, указанных в п.9 Правил осуществления обязательных профессиональных пенсионных взносов

n – количество работников, заключивших договор о пенсионном обеспечении за счет обязательных профессиональных пенсионных взносов.

На предприятии работают 21 человек, которых 5 работников являются физическими лицами, заключившие договор о пенсионном обеспечении за счет обязательных профессиональных пенсионных взносов. Ежемесячный доход 1-го работника составил в 2021 году 300000 тенге. Рассчитаем затраты на предприятиях на выплату обязательных профессиональных пенсионных взносов.

$$C_{\text{оппв}} = (300000 \times 5) \times 0,05 \times 12 = 900000 \text{ тенге}$$

Таким образом, затраты работодателя на выплату обязательных профессиональных пенсионных взносов составляют 900 000 тенге.

Затраты на обеспечение средствами индивидуальной защиты. В соответствии с подпунктом б) пункта 2 статьи 181 Трудового кодекса Республики Казахстан от 23 ноября 2015 года № 414-V ЗРК работник обязан неукоснительно применять и использовать по назначению средства индивидуальной и коллективной защиты, предоставляемые работодателем.

Работодатель при расчете потребностей работника определенной профессии в СИЗ должен учитывать нормы и сроки выдачи, которые регламентируются Приказом Министра здравоохранения и социального развития РК от 8 декабря 2015 года №

943 «Об утверждении норм выдачи специальной одежды и других средств индивидуальной защиты работникам организаций различных видов экономической деятельности» (далее – Нормы выдачи)

При расчете затрат на обеспечение средствами индивидуальной защиты необходимо определить:

1. Затраты на приобретение СИЗ;
2. Затраты на обслуживание СИЗ (стирка, профилактическая обработка и ремонт).

При расчете затрат на приобретение СИЗ необходимо:

- определить потребность в приобретении СИЗ в разрезе должностей, видов экономической деятельности согласно утвержденных *Норм выдачи специальной одежды и других СИЗ*, также в потребность необходимо учитывать остатки СИЗ на складах;

- систематизировать данные потребности по видам СИЗ;

- корректировать общую потребность с учетом резерва на уровне 10%;

- установить общую стоимость СИЗ на основе рыночных цен поставщиков;

- определить общую сумму затрат на приобретение СИЗ.

Затраты на приобретение Сиз приведены в формуле 5:

$$C_{\text{сиз}} = \sum_{i=1}^n (N_p \times P_{\text{сиз}}) \times R_{\text{сиз}} \quad (5)$$

где,

$C_{\text{сиз}}$ – затраты на приобретение СИЗ;

N_p – количество работников i -ой профессии;

$P_{\text{сиз}}$ – цена СИЗ для работника i -ой профессии;

$R_{\text{сиз}}$ – потребность в СИЗ для i -ой профессии, который определяется исходя из норм выдачи.

n – количество профессий на предприятии;

Затраты на обслуживание СИЗ рассчитываются по формуле (6):

$$C_m = \sum_{i=1}^n N_p \times (n_d \times P_d) \times t + (N_{\text{сиз}} \times S_{\text{рем}}) \quad (6)$$

где,

C_m – затраты на обслуживание СИЗ;

N_p – количество работников i -ой профессии;

n_d – норма моющих и дезинфекционных средств для ухода за СИЗ;

P_d – цена моющих и дезинфекционных средств;

t – периодичность проведения профилактической обработки

$N_{\text{рем}}$ – количество СИЗ, которые подлежат ремонту;

$S_{\text{рем}}$ – стоимость услуг по ремонту СИЗ.

На основе методики произведем расчет затрат на приобретение и обслуживание СИЗ. В таблице 4 приведены расходы на профилактическую обработку

Таблица 4

Расходы на профилактическую обработку СИЗ

Профессия или должность работника	Кол-во работ-в, чел.	Норма выдачи работникам моющих и дезинфицирующих материалов, кг	Цена моющих средств	Сумма, тг	Цена дезинфекционных средств, тг.	Сумма, тг	Общая сумма расходов, тг
Электромеханик	10	0,5	215	2150	318	3180	5330
Электрогазосварщик	10	0,5	215	2150	318	3180	5330
Токарь-фрезеровщик	10	0,5	215	2150	318	3180	5330
Механик	2	0,5	215	430	318	636	1066
Слесарь	1	0,5	215	215	318	318	533
Итого расходов							17589

Профилактическая обработка СИЗ для вышеуказанной профессии производится еженедельно, соответственно затраты составили:

$$17589 \times 52 \text{ недели} = 914628 \text{ тенге}$$

В течении года отремонтированы 3 комплекта СИЗ на сумму 36950 тенге.

$$C_m = 914628 + 36950 = 951578 \text{ тенге в год}$$

Таким образом, годовые затраты работодателя на приобретение и обслуживание СИЗ составили 951578 тенге.

Затраты на выдачу молока или равноценных пищевых продуктов и/или специализированных продуктов для диетического (лечебного и профилактического) питания. В соответствии с Трудовым кодексом РК в компетенции уполномоченного государственного органа по труду в области регулирования трудовых отношений находится утверждение порядка выдачи работникам молока или равноценных пищевых продуктов и (или) специализированных продуктов для диетического (лечебного и профилактического) питания, специальной одежды и других средств индивидуальной защиты, а также устанавливается порядок обеспечения их средствами коллективной защиты, санитарно-бытовыми помещениями и устройствами за счет средств работодателя.

Затраты, связанные с обеспечением работников молоком или равноценными пищевыми продуктами и (или) специализированными продуктами для диетического (лечебного и профилактического) питания относят по квалифицирующему признаку регламентированности затрат на охрану труда: к правомерным затратам, в том числе обязательным, под которыми понимаются затраты, регламентированные в Трудовом Кодексе и в других международных стандартах безопасности и имеющие обязательный характер при планировании.

Расчет годовых затрат на выдачу молока или

равноценных пищевых продуктов производится по действующим Нормам, утвержденным Приказом Министра здравоохранения и социального развития Республики Казахстан от 28 декабря 2015 года №1056, в соответствие с формулой 7:

$$C_m = (N_{\text{раб}} \times Q_{\text{раб}} + N_{\text{ауп}} \times Q_{\text{ауп}}) \times V_m \times S_m \quad (7)$$

где,

C_m – годовые затраты на выдачу молока или равноценных пищевых продуктов, тенге;

$N_{\text{рс}}$ – численность работников смены, которым положена выдача молока, человек;

$Q_{\text{раб}}$ – количество рабочих смен в году на предприятии для рабочих специальностей, с учетом отпусков смена;

$N_{\text{ауп}}$ – численность сотрудников АУП в смену, которым положена выдача молока, человек;

$Q_{\text{ауп}}$ – количество рабочих смен в году на предприятии для АУП, с учетом отпусков, выходных и праздничных дней, смена

V_m – объем молока или равноценных пищевых продуктов на одного работника, литр или грамм;

S_m – стоимость молока или равноценных пищевых продуктов, тенге.

Рассмотрим пример годового расчета объема молока, на примере одного из цехов предприятия с вредными условиями труда.

В таблице 5 представлена информация о должностях и количестве работников, которым подлежит выдача молока за вредные условия труда. В соответствие с данной таблицей, в 2021 году было всего сотрудников, получающих молоко, 15 человек, работающих по четырем профессиям, из них три человека, относятся к управленческому персоналу.

Таблица 5

Информация о работниках, которым выдается молоко

№ п/п	Наименование профессий работников	Количество, чел.
1	Начальник цеха	1
2	Заместитель начальника цеха	1
3	Механик цеха	1
4	Электромонтер по ремонту и обслуживанию электрооборудования	12

Расчет годовых затрат на выдачу молока производится по действующим Нормам, утвержденным Приказом Министра здравоохранения и социального развития Республики Казахстан от 28 декабря 2015 года №1056, в соответствии с формулой (8):

Исходя из условий примера:

$N_{pc} = 3$ чел. (учитывается сменный режим работы $12/4 = 3$ чел.)

$N_{ауп} = 3$ чел.

$Q_{pc} = 730$ см. в году – 60 см. отпуска (30 дней) = 670 см.

$Q_{ауп} = 245$ рабочих дней – 30 дней отпуска = 215 см.

$V_m = 0,5$ л.

$S_m = 280$ г. за литр молока 3,2%.

$C_m = (3 \times 670 + 3 \times 215) \times 0,5 \times 280 = 1327,5 \text{ л.}$
 $\times 280 = 371\ 700 \text{ тенге}$

Годовые затраты на выдачу молока по рассматриваемому цеху составили 371 700 тенге

Затраты на предоставление гарантии работникам, занятым на тяжелых работах, во вредных и опасных условиях труда являются одним из основных затрат на охрану труда на предприятиях в Республике Казахстан.

Таким образом, выше указанная методика расчета затрат на обеспечение безопасности и охраны труда специального характера дает возможность работодателю при составлении годового бюджета затрат определить удельный вес затрат на охрану

труда в общем объеме затрат общепроизводственного и административного назначения.

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MEDICAL SCIENCES

AMPLITUDE-FREQUENCY AND INTEGRAL PARAMETERS OF SKIN BLOOD CIRCULATION IN PATIENTS WITH ROSACEA

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Abstract

The purpose of the work was to determine the amplitude-frequency and integral criteria for assessing the condition of the skin microvasculature in patients with rosacea.

Materials and methods. The total of 57 patients with rosacea (39 women and 18 men) were under observation. Erythematous form of dermatosis was diagnosed in 22 patients, erythematous-papular – in 19 and papulopustular – in 16 individuals. In all patients LDF-examination of lesions was performed. A_{max} , F_{max} , MI, σ , CV in the E , H , M ranges were determined. The control group included 15 healthy individuals.

Results and discussion. It was found that in patients with rosacea, there is a probable increase in A_{max} E and A_{max} M , which was combined with the suppression of A_{max} H . F_{max} E and F_{max} M remained within the control values, and F_{max} H increased. This reflects the amplitude-frequency imbalance. The increase in MI and σ indices was combined with CV inhibition, which illustrates the presence of hyperemic type hemodynamics in patients with rosacea and a decrease in the microvasculature efficiency. The data obtained testify to the development of branched and multi-vector disorders of the skin microvasculature in the observed patients, covering several hemodynamic components. This should be taken into account when choosing the means of therapeutic effect.

Conclusions. 1. Patients with rosacea should be prescribed LDF-examination of lesions to assess the condition of skin microvasculature. 2. LDF-parameters of the dermal blood circulation should be taken into account when choosing the means of therapeutic correction as criteria for the the prescribed treatment efficacy in patients with rosacea. 3. It is expedient to include vasoactive means with a wide range of action to comprehensive therapy of patients with rosacea in order to improve the treatment results.

Keywords: LDF-study, rosacea, clinical forms, microvasculature, blood circulation.

Introduction. Rosacea belongs to the category of common dermatoses, because its population frequency reaches 1.5–10 %; and in the structure of dermatological pathology – 2-8 % [1,5]. Rosacea is characterized by unclear etiology, multifactorial pathogenesis, polymorphism of clinical manifestations, chronic recurrent course, frequent resistance to traditional therapies. Favorite localization of the elements, rash on the face, also leads to a significant negative impact on the quality of life in patients [3, 4].

The priority factors inducing the development of rosacea include: the presence of mites *D. folliculorum*, pathological condition of the gastrointestinal tract, endocrine disorders, immunological imbalance [6, 8, 9]. However, a special place in the pathogenesis of rosacea is given to the impairment of facial skin vascularization. The redistribution of blood flow is slowed down and the venous stasis is formed in the area of the facial vein, which corresponds to the favorite location of the lesions. This also explains frequent involvement of the conjunctiva in the pathological process, which is also located in the above area of vascularization. However, at the same time, the secondary involvement of blood and lymphatic skin vessels in the inflammatory phenomena is assumed.

It is believed that the mechanisms of vascular disorders in such patients, due to various factors, are vari-

able, but not sufficiently elucidated [2,7,10]. The available studies relate mainly to the study of the microcirculatory bed's skin morphological state in rosacea. Its functional capacities remain neglected. In addition, it is very promising to assess the condition of the microcirculatory bed in skin using laser Doppler flowmetry (LDF), which is a modern technology in the field of assessing the circulatory system's functionality, permitting to control the features of vascularization in real time. It is known to be based on the registration of the amplitude-frequency characteristics of the laser beam reflected from blood components, mainly erythrocytes, which move in its direction. Due to the penetration of the beam into the skin to a depth of 1.5 mm, information is obtained about blood circulation in the superficial microvessels. Tissue circulation with LDF is determined, as a rule, in the E , H and M ranges. Superslow oscillations in the E range are due to the rhythmic activity of the capillary endothelium. Waves in the H range (actually vasomotor ones, are rhythmic changes in the diameter of precapillary vessels) reflect active contractions of the precapillary sphincters and are under neurogenic influence. Fluctuations in the M range are related to the functioning of the juxtacapillary "shunt" circulation. Their source is the activity of smooth muscle cells of the vascular wall and precapillary sphincters. The above structural elements constantly respond to changes in intravascular pressure,

i.e., provide the implementation of the so-called myogenic reaction. One of the LDF signal parameters, which integrally characterizes the movement of erythrocytes in the probed volume of tissue, is the microcirculation index (MI). Since the LDF gram is recorded in the monitoring mode, this index reflects the flow of hemoelements for a unit of time through a unit of tissue volume. However, it is quite difficult to unambiguously interpret the MI level. After all, on the one hand, the higher is its value, the more intense is the tissue perfusion. But, on the other hand, the increased MI can be caused by the phenomena of blood stagnation in a venular link of microvasculature. Therefore, the free space among the parameters characterizing the flow of erythrocytes is occupied by the mean-square deviation of MI (σ), i.e., statistically significant fluctuations in the erythrocytes movement velocity. This index reflects the temporary variability of microcirculation or variability in the flow of hemoelements. The ratio between tissue perfusion and the magnitude of its variability is identified as the variation coefficient of MI (CV) [11-13].

The purpose of the work was to determine the amplitude-frequency and integral criteria for assessing the condition of the skin microvasculature in patients with rosacea.

Therefore, LDF-study permits to comprehensively assess the condition of the skin microvasculature in patients with rosacea.

Materials and methods. We observed 57 patients with rosacea (39 women and 18 men) aged 18 to 45 years. The duration of the disease ranged from several months to 16 years. Erythematous form of dermatosis was diagnosed in 22 patients, erythematous-papular – in 19 and papulo-pustular – in 16. The control group included 15 healthy individuals, compared by gender and age. Studies were performed on the lesions in the cheek area with the “BLF 21” device for LDF (produced by “Transonic System Inc.”, USA). With the help of a special fixing device that ensures the immobility of the fiber light guide’s position (otherwise it is possible to register a large number of artifacts), the sensor was installed. Blood flow was recorded for 20-30 minutes. Analysis of LDF-grams was performed using wavelet transform. A_{\max} (maximum oscillation amplitude), F_{\max} (maximum oscillation frequency), MI (microcirculation index), σ (mean-square deviation of MI) and CV (coefficient of MI variation) in the ranges E , H and M were determined.

Results and discussion. It is established that in patients with rosacea, regardless of the pathological process’ es clinical course, a probable increase in A_{\max} E is observed. In particular, in the erythematous form of dermatosis, the values reached 0.582 ± 0.019 perf. U (perfusion units); in persons of the control group A_{\max} $E = 0.336 \pm 0.011$ perf. U ($p < 0.05$), with erythematous-papular – A_{\max} $E = 0.601 \pm 0.025$ perf. U ($p < 0.05$) and in papulopustular form – A_{\max} $E = 0.571 \pm 0.007$ perf. U ($p < 0.05$).

A_{\max} H , in contrast, was inhibited and was, respectively, 0.212 ± 0.016 perf. U (in the control group A_{\max} $H = 0.313 \pm 0.010$ perf. U; $p < 0.05$), 0.203 ± 0.018 perf. U ($p < 0.05$) and 0.195 ± 0.023 perf. U ($p < 0.05$). This indicates an increase in the amplitude of oscillations in the

capillary endothelium, which is combined with the suppression of neurogenic effects on the skin microvasculature in the form of a decrease in the amplitude of precapillary sphincters contractions.

A_{\max} M probably increased, reaching 0.634 ± 0.026 perf. U in the erythematous form of dermatosis (in the control group A_{\max} $M = 0.420 \pm 0.017$ perf. U; $p < 0.05$), in erythematous-papular – 0.657 ± 0.034 perf. U ($p < 0.05$) and at papulopustular – 0.612 ± 0.041 perf. U ($p < 0.05$). These data illustrate the increased activity of the juxtacapillary circulation.

Somewhat other processes were recorded in the frequency spectrum of dermal blood circulation oscillations. Thus, F_{\max} E remained within the control values, regardless of the pathological process’ es clinical course. With the erythematous form of dermatosis the index made 0.010 ± 0.003 Hz (in persons of the control group F_{\max} $E = 0.014 \pm 0.004$ Hz; $p > 0.05$), in erythematous-papular – 0.017 ± 0.004 Hz ($p > 0.05$) and in papulopustular form – 0.015 ± 0.003 Hz ($p > 0.05$). This reflects the amplitude-frequency imbalance of capillary endothelial oscillations. Probable increase in F_{\max} H in the erythematous form of rosacea to 0.046 ± 0.003 Hz (in the control group F_{\max} $H = 0.027 \pm 0.005$ Hz; $p < 0.05$), in erythematous-papular – up to 0.051 ± 0.005 Hz ($p < 0.05$) and in papulopustular form – up to 0.049 ± 0.003 Hz ($p < 0.05$) reflects the modulating neurogenic effect on vasomotions, because the decrease in the amplitude of precapillary sphincters’ contractions is compensated by an increase in their frequency. Thus, there is a redistribution of the proportion of factors that form the active mechanism of microcirculation. up to 0.051 ± 0.005 Hz ($p < 0.05$) and papulopustular - up to 0.049 ± 0.003 Hz ($p < 0.05$) reflects the modulating neurogenic effect on vasomotor, because the decrease in the amplitude of contractions of the precapillary sphincters is compensated by an increase in their frequency. Thus, there is a redistribution of the specific weight in factors that form the active mechanism of microcirculation.

Changes in F_{\max} M have not been reliably confirmed. The index values in the erythematous form of dermatosis reached 0.126 ± 0.012 Hz (in the control group F_{\max} $M = 0.132 \pm 0.009$ Hz; $p > 0.05$), in erythematous-papular – 0.138 ± 0.007 Hz ($p > 0.05$) and in papules-pustular form – 0.136 ± 0.011 Hz ($p > 0.05$). This proves the uncoordinated nature of the increased juxtacapillary circulation activity, which is only due to an increase in the amplitude of its oscillations.

Determination of integral indices permitted to state the probability of MI growth, which reached 24.32 ± 0.26 perf. U in the erythematous form of dermatosis (in the control group $MI = 6.13 \pm 0.17$ perf. U; $p < 0.05$), in erythematous-papular – 25.08 ± 0.31 perf. U ($p < 0.05$) and in papulopustular form – 23.17 ± 0.40 perf. U ($p < 0.05$). These data indicate an increase in the number of erythrocytes in the skin microvessels. The σ index probably increased, too, amounting in the erythematous form of rosacea to 1.91 ± 0.07 perf. U (in the control group $\sigma = 0.42 \pm 0.05$ perf. U; $p < 0.05$), in erythematous-papular – 1.95 ± 0.08 perf. U ($p < 0.05$) and papulopustular form – 2.03 ± 0.09 perf. U ($p < 0.05$). This proves the stressful state of the regulation mechanisms

of tissue blood circulation in the affected areas. In addition, the increase in both MI and σ indicates the presence of hyperemic type of hemodynamics in such patients. CV in the observed patients, on the contrary, decreased, regardless of the pathological process's clinical course: in the erythematous form of dermatosis – to 7.12 ± 0.15 % (in the control group $CV = 9.14 \pm 0.21$ %; $p < 0.05$), with erythematous-papular – up to 6.95 ± 0.27 % ($p < 0.05$) and with papulopustular form – up to 7.18 ± 0.23 % ($p < 0.05$), reflecting a decrease in the microcirculation efficiency.

Thus, disorders of the skin microvasculature in patients with rosacea are branched and multi-vector in nature, covering several hemodynamic components. This should be taken into account when choosing a means of therapeutic effect.

Conclusions

1. Patients with rosacea should be prescribed LDF examination of lesions to assess the condition of the skin microvasculature.

2. LDF-parameters of the dermal blood circulation should be taken into account when choosing the means of therapeutic correction as criteria for the prescribed treatment efficacy in patients with rosacea.

3. The comprehensive therapy of patients with rosacea, is advisable to include vasoactive drugs with a broad spectrum of action in order to improve treatment outcomes.

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REVERSIBLE CARDIOMYOPATHY WITH PERICARDIAL EFFUSION IN A MYXEDEMA PATIENT*Ismibayli Z.,
MD**Nazirova V.
MD**Cardiology Department, XMSK Hospital, Baku, Azerbaijan*DOI: [10.5281/zenodo.7070028](https://doi.org/10.5281/zenodo.7070028)**Abstract**

We report a case of secondary cardiomyopathy with pericardial effusion due to long-standing untreated hypothyroidism with a successful resolution of clinical symptoms and improvement of echocardiographic parameters in a relatively short period of time.

Keywords: Cardiomyopathy, myxedema, heart failure, pericardial effusion.

Introduction

Cardiomyopathy is the second leading cardiovascular cause of death after coronary artery disease. Despite the major advances in defining the etiopathogenic mechanisms of different types of cardiomyopathies, and evolution of medical treatment options, prognosis of such patients remains poor. Hypothyroidism-induced cardiomyopathy on the other hand is an example where good results can be achieved. We present a case of such example, with great improvement of clinical and hemodynamic parameters in a patient with secondary cardiomyopathy.

Case Report

A 50-year-old woman presented to our hospital with progressive weakness and dyspnea rated as New York Heart Association Functional Class III. She reported at least 5-year history of general weakness, hair loss, dry skin and cold intolerance. Several months ago she had a pleural puncture due to bilateral pleural effusion with no further work up.

On physical examination the patient was awake and oriented, but strikingly apathetic with slow mentation. Vital signs showed a temperature of 32.5°C, blood pressure 119/90 mm Hg, heart rate 103 beats per minute, respiratory rate 18 breaths per minute and oxygen saturation 93% on room air. She had cool, dry skin, mild bilateral lower extremity non-pitting edema. The thyroid was not palpable. Cardiovascular examination showed distant heart sounds, no crackles were heard on lung auscultation.

The cardiac silhouette was enlarged on CXR and the lung fields were clear. ECG revealed a sinus rhythm with non-specific repolarization changes (Figure 1).

Transthoracic echocardiography (Figure 2a,b,c) showed a dilated left ventricle with a diastolic dimension of 58 mm and severely depressed systolic ejection fraction (LVEF) of 15–20%, severe diffuse hypokinesis, a moderate degree of mitral regurgitation, mild-to-moderate circumferential pericardial effusion with signs of pre-tamponade physiology (right atrial collapse and plethoric inferior vena cava, with no diastolic RV collapse or exaggerated respiratory mitral and tricuspid valve in-flow velocity changes).

Blood tests revealed normal platelets and white blood cell count, low hemoglobin (116 g/l), normal MCV (81.4 fL), RBC ($4.41 \times 10^6/\mu\text{L}$), ferritin (84.61 ng/ml), glucose (4.73 mmol/l) and creatinine (72.1 $\mu\text{mol/l}$). The level of TSH was grossly elevated (>100 $\mu\text{IU/ml}$).

Given the fact that there were no clinical features of cardiac tamponade and no risk factors suggesting ischemic etiology of heart failure, medical treatment consisting of 50 mcg/day of Levothyroxine and starting doses of Ramipril and Carvedilol was initiated and gradually increased during close follow-up visits.

Three months after the initial presentation patient had excellent clinical improvement with complete resolution of symptoms. On transthoracic echocardiography (3a,b) there were no signs of pericardial effusion, LVEF went up to 50%, with LVDD diameter of 48 mm. TSH was normal (2.3 $\mu\text{IU/ml}$). Medical treatment continued with Levothyroxine 75mcg/day, Carvedilol 6.25 mg BID, and Ramipril 2.5 mg BID. Further up-titration of ACE inhibitors and β -blockers was difficult due to persistent hypotension. The patient continued to be followed-up and altogether showed a good outcome.



Figure 1

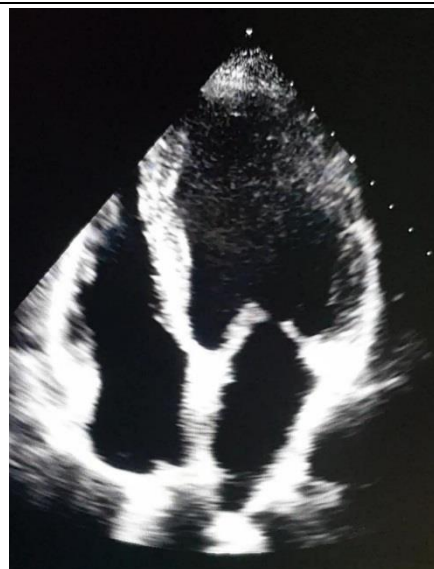


Figure 2

Discussion

Cardiomyopathy is a myocardial disorder in which the heart muscle is structurally and functionally abnormal, in the absence of coronary artery disease, hypertension, valvular disease and congenital heart disease sufficient to cause the observed myocardial abnormality. (1)

According to the latest classification proposed by American Heart Association in 2006, the term primary should be used to describe diseases in which the heart is the sole or predominantly involved organ and secondary to describe diseases in which myocardial dysfunction is part of a systemic disorder. (2) Primary cardiomyopathies are divided into genetic, mixed (genetic and nongenetic), and acquired forms. Secondary cardiomyopathies, previously referred to as specific cardiomyopathies, are diseases with myocardial involvement as part of a large variety of multiorgan disorders. Hypothyroidism-induced cardiomyopathy therefore is one of the examples of secondary cardiomyopathy.

It is well known that thyroid hormone has a great effect on the heart and vascular system. (3) Minor alteration of thyroid hormone can change vascular resistance, cardiac contractility, blood pressure, and heart rhythm.

The concept that the heart could be affected in hypothyroidism is at least a hundred years old. First time the 'myxedema heart' term was proposed by Zondek in 1918, and the concept has ever since been investigated by a vast number of clinical studies. (4), (5), (6)

The prognosis of primary, and especially genetic cardiomyopathies is usually quite poor due to a progressive and irreversible myocardial dysfunction, whereas hypothyroidism-induced cardiomyopathy carries a better prognosis and can be reversed with hormone supplementation. It is therefore recommended to investigate an underlying hypothyroidism in all patients newly presenting with Heart Failure (HF). (7)

In our patient, repletion of thyroid hormone deficiency led to complete resolution of clinical signs and symptoms of HF along with dramatic improvement of echocardiographic parameters in quite a short period of time despite the presumably long-standing hypothyroid state and the use of suboptimal doses of HF medications. This case confirms previous reports of reversibility of heart failure after substitutive hormonal treatment. (8), (9)

Written consent

Obtained from patient

Disclosures

Nil

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