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EFFECTS OF VARIOUS ENVIRONMENTAL FACTORS ON THE PROTEOLYTIC ACTIVITY OF *E. FAECIUM* G8 STRAIN

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ВЛИЯНИЕ РАЗЛИЧНЫХ ФАКТОРОВ СРЕДЫ НА ПРОТЕОЛИТИЧЕСКУЮ АКТИВНОСТЬ ШТАММА *E. FAECIUM* Г8

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Abstract

In the present article, the influence of various environmental factors, incubation time, pH, and temperature conditions on the dynamics of changes in the proteolytic activity of the *E. faecium* Г8 strain has been studied.

Аннотация

В представленной статье исследовано влияние различных факторов среды, времени инкубации, pH, а также температурных условий на динамику изменения протеолитической активности штамма *E. faecium* Г8.

Keywords: lactic acid bacteria, fermented foods, lactobacillus

Ключевые слова: молочнокислые бактерии, ферментированные продукты, лактобациллы.

За последние годы исследователи особое внимание уделяют способности лактобактерий продуцировать протеолитические и амилалитические ферменты. Протеазы играют существенную роль в созревании ферментированных мясopодуков, преимущественно сыровяленых и сырокопченых изделий, и твердых сыров, а также формирование их органолептических показателей [5, с.219].

Проведен скрининг среди 48 колоний, изолированных из 9 образцов кисломолочных продуктов по выявлению молочнокислых бактерий (МКБ) с протеолитической активностью. Изолированы 4 штамма (Г3, Г8, Г16 и Г24), обладающие искомой активностью. Проведена предварительная идентификация по морфoфизиологическим и биохимическим признакам. Штамм Г3 идентифицирован как *Enterococcus faecalis*, Г8 - *Enterococcus faecium*, штаммы Г16 - *Lactobacillus paracasei*, Г24 - *Lactobacillus rhamnosus*, соответственно. Протеолитическая система изолированных штаммов бактерий изучалась в двух системах: при росте в молоке (пролиферирующая система) и в неproлиферирующей системе клеток [1, с.49]. Свежие культуры исследу-

емых штаммов инокулировали (5%) в обезжиренное молоко для индукции протеолитических энзимов. Молоко с инокулированными культурами инкубировали при 37°C в течении 24 ч. В качестве контроля использовали молоко без добавления культуры бактерий. Наличие гидролиза белков молока проверяли методом электрофореза (СДС-ПААГ) [4, с.2018].

В предыдущих исследованиях было показано, что степень расщепления отдельных белков фракций в течении первых 3 ч и спустя 24 часа значительно отличались между собою. В связи с этим представился интерес наблюдать динамику протеолиза белковых фракций в составе молока в ходе суточной ферментации субстратов в присутствии продуцентов протеолитических штаммов [3, с.65]. С этой целью использовали наиболее активный штамм – *E. faecium* Г8. Экспозиция опыта была такая, что через каждый промежуток времени сливали с ферментера определенные количество ферментата, определяли динамику гидролиза белковых фракций методом электрофореза [2, с.260]. Полученные результаты представлены на рис. 1 и 2, соответственно.

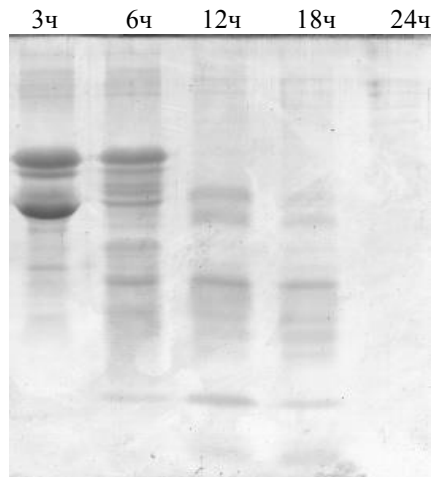


Рис.1 Временная зависимость динамики гидролиза белковых фракций протеолитической системой штамма *E. faecium* Г8

Степень гидролиза белковых фракций молока протеолитической системой штамма *E. faecium* Г8 по мере пролонгирования ферментации увеличивается. Спустя 3 часа ферментации все еще наблюдаются фракции β -казеина и α -лактоглобулина. Остальные фракции молока незначительно расщеплялись и образовывали множество пептидных полос. По мере увеличения времени ферментации протеолиз белковых фракций усиливается, однако

все еще прослеживается фракция α -лактоглобулина [4, с.2016]. Такая картина наблюдается даже на электрофореграмме спустя 18 часовой ферментации. Однако, спустя еще 6 часов фракции не были обнаружены, что указывает на полный гидролиз белковых фракций молока.

На рис. 2 отражена динамика роста протеолитического штамма *E. faecium* Г8.

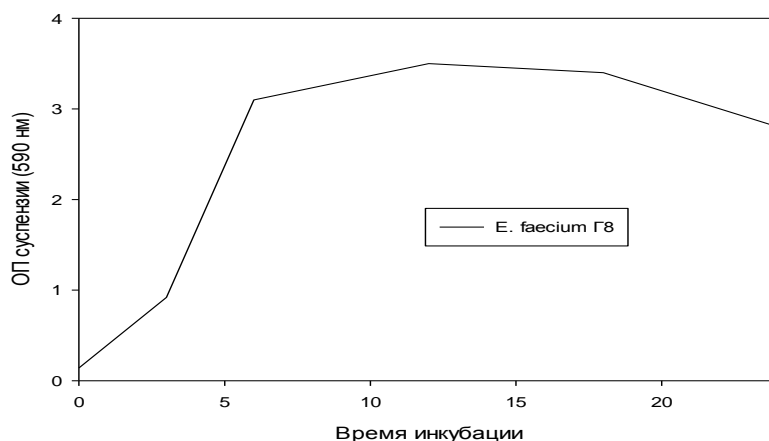


Рис.2 Динамика роста протеолитического штамма *E. faecium* Г8

Максимальная плотность клеток бактерий в суспензии обнаружена после 12 часов культивирования. Далее, плотность постепенно спадает и спустя 6 часов скорость спада оптической плотности увеличивается. Если сравнить эту динамику роста бактерий в суспензии с динамикой их протеолитической активности, несмотря на достижения пика оптической плотности клеток в суспензии протеолитическая активность остается пока сравнительно низкой. Это наводит на мысль о том, что концентрация субстратов в составе молока значительно превосходит количество ферментных белков, для полного гидролиза данных фракций понадобится

время. Видимо, до конца культивирования активность протеолитических ферментов сохраняется, и они продолжают гидролизовать белковые фракции молока. Установлено, что для полного гидролиза белковых фракций нужно как минимум 24 ч.

В следующей серии исследований рассмотрено влияние температуры на протеолитическую активность штамма *E. faecium* Г8. Изученная активность строго зависит от температурных условий инкубирования ферментной системы. Проверена протеолитическая активность *E. faecium* Г8 при 15°, 30°, 37° и 45°C, соответствующие критическим температурным значениям, которые, как правило, используются для идентификации лактобактерий (рис.3).

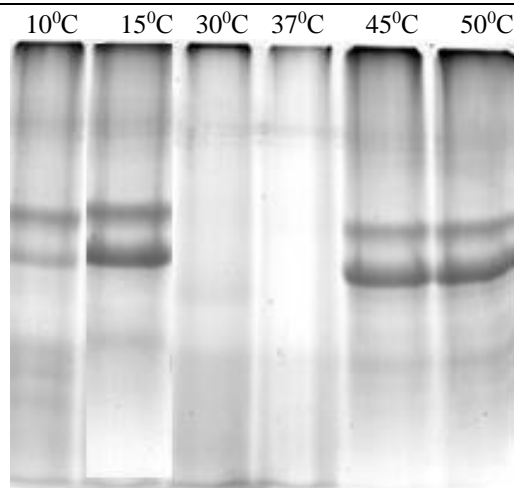


Рис.3 Температурная зависимость протеолитической активности штамма *E. faecium* Г8

С другой стороны, данные температурные условия отчасти соответствуют температуре хранения продуктов (нижний предел), а также условиям проведения технологических процессов, связанных с производством кисломолочных ферментированных продуктов (средние показатели). Верхний предел температуры соответствует критической точке роста и продукции штамма биологически активных компонентов, в том числе и протеолитических ферментов [6, с.1025]. Опыты проводили с культуральной жидкостью штамма *E. faecium* Г8, полученной после суточного культивирования штамма в течение 24 ч. Так при +10°C протеолитическая активность не проявляется. Повышение температуры еще на 5°C не оказывало заметное влияние на исследуемую активность. Однако, при температуре +30°C наблюдался значительный протеолиз белковых компонентов молока. Самая высокая степень активности была обнаружена при +37°C, соответствующая оптимальной температуре роста штамма продуцента.

Результаты исследования влияния pH среды на протеолитическую активность штамма *E. faecium* Г8 отражены на рисунке 4. Изученная активность строго зависит от концентрации ионов водорода в среде инкубирования. В эксперименте исследована протеолитическая активность при pH 7.0, 6.2, 5.0,

4.0 и 3.0. Опыты проводили с культуральной жидкостью штамма *E. faecium* Г8, полученной после суточного культивирования штамма в течение 24 ч. Способность выделенных штаммов бактерий гидролизовать различные фракции молочных белков была изучена в непролиферирующей системе клеток. В данной системе активность штаммов проверялась в стационарной фазе роста и при стабильных значениях pH - 7.2, а также при использовании очищенных фракций молочных белков в качестве субстратов. Исследования показали, что штамм гидролизировал все фракции казеинов при кислых значениях pH. Значения pH ближе к нейтральным не благоприятны для проявления протеолитической активности штамма [7, с.208]. В данной системе непролиферирующих клеток штамм проявил ярко выраженную ферментативную активность и гидролизировал все фракции казеинов при pH 3.0. Предположительно разница в степени протеолитической активности может быть связана с разными значениями pH, а также с различием субстратов в обеих системах. Вполне возможно, что протеазы данного штамма более активны при нейтральных значениях pH. Однако понижения pH в кислую сторону, вызывает конформационное изменение белков молока [4, с.2017].



Рис.4 Влияние pH-среды на протеолитическую активность штамма *E. faecium* Г8

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ECONOMIC SCIENCES

WORK RELATED RISK ASSESSMENT AND MANAGEMENT

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Abstract

Working space Health and safety is a shared responsibility between employer and employee. Acting as an employer, entity is required under the law to create working space harmless for health for employees.

Under this paper small field research will be assessed on Occupational health and safety in Georgia. Paper will show risks at the working place, physical and fatal at workplace, steps taken by Georgian government to eliminate risks or to mitigate and manage them and finally show current situation.

The article below discusses the steps and processes involved to make workplace safe and secure for employees and shows outcomes observing Georgian example. Will be discussed labor legislation changes according to HS field and OSHA and ILO standards taken as manual in Georgia.

Keywords: HSSE, Risk, Management, OSHA, ILO, Georgia

Occupational Safety and Health

Workplace safety is a shared responsibility of employee and employer, all individuals at the workplace have right to be safe and secure while working at the employer. This is the main case while signing official work contract. Occupational health and safety management keeps employer safe from negative aspects of job performed and employees and other people involved from life threatening, health and physical threats. Helps to create safe and secure space for work that under legislation and other management demands.

Job done by employee can be mental or physical but it should not be life and health threatening. Liability

and responsibility chain between employee and employer connect both very tight – employer should give secure and safe workplace to employee.

During 2011-2017 injuries and death at the workplace totaled 882 and 317. Georgian government started working on new legislation that would have protected employees from workplace deaths and injuries. Project was accepted by the government at march 7 2018.

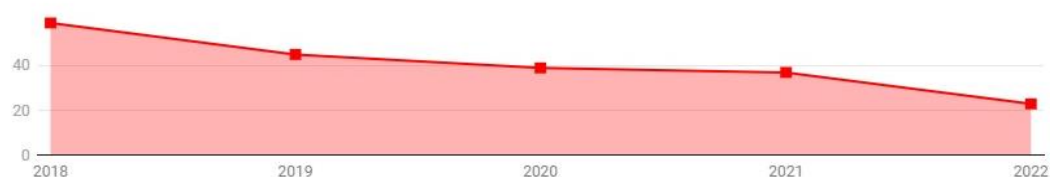
Under the Labor Legislation occupational safety is major at the workplace. Government is obliged to support entities and support competitiveness. Georgian legislation also protects migrated Georgian citizens.

WORKPLACE DEATHS & INJURIES COMBINED BY YEAR



* 2022 data through September 30 only.

WORKPLACE DEATHS BY YEAR



* 2022 data through September 30 only.

Shroma 2022

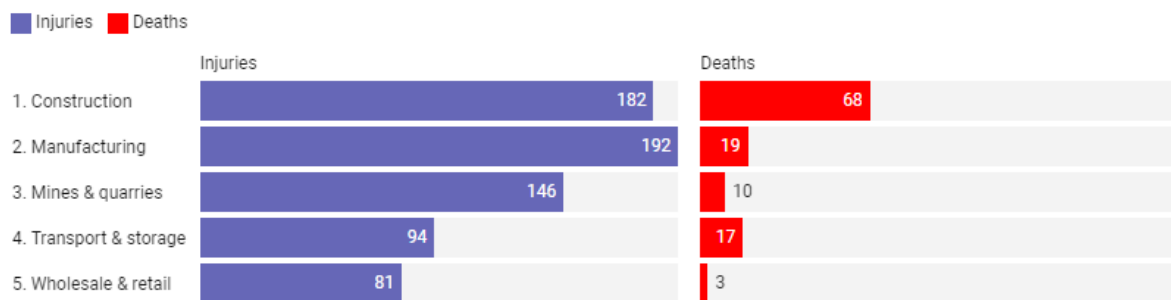
All the inconveniences with the management inside the company of the occupational safety will be monitored and judges under the international HS manuals and ILO and OSHA manuals as well.

All the injuries and health or mental issues raised from workplace will be discussed by the labor code N997, that takes into account remuneration and compensation of injuries and health problems derived from workplace.

All the laws broken at the workplace will be respect of criminal procedure code and sanctions or more serious decisions will be taken from criminal code.

Unfortunately, this law is processed but obliges only for high risk jobs and workplaces and not every company operating in Georgia e.g construction, manufacturing mining transport etc.

TOP 5 SECTORS FOR DEATHS & INJURIES COMBINED (2019-22)



* 2022 data through September 2022 only

(shroma, 2022)

The main reason why labor safety was taken into consideration was 2015-2017 research that showed that from 583 companies checked from different fields (such as agriculture, retail, mining, construction, logistics, warehousing, etc.) none of them had fully safe and secure offices for their employees. Non of them had HSE (Health and Safety Executive), no against fire devices and no trainings what to do in different situations when health risks raise, most companies had poor sanitary and hygiene and there were no collective security systems.

After preparing and presenting changes in labor code, 19 trainings were taken about different up mentioned occupational security and safety procedures.

How workplace safety and security is monitored, assessed and managed worldwide

To identify workplace hazards, OSHA gives us clear instructions.

To identify and assess hazards, employers and workers:

- Collect and review information. This information can be present or likely be in future
- Conduct initial and periodic workplace inspections
- Investigate health damage cases determine causing hazards.
- Group similar incidents and identify trends in injuries.
- Consider nonregular hazards, that arise from emergency situations.
- Determine the severity and likelihood of incidents and prioritize corrective actions.

Companies start to inform employees on workplace hazards byboth internal and external sources. Both employers and employees collect, organize, and review information what type of hazards may be present and potentially exposed. they regularly inspect the workplace for hazards that help prevent an incident to occur, from the information they get by regular inspections of all operations, equipment, work areas and facilities. Workers, who directly work at hazardous place are main sources of information.

Documenting cases ar very important, later to inspect hazardous places make sure conditions are corrected. Photo/video evidence of problem should be taken for meetings how to control them, and for use as learning aids.

What is a risk assessment?

After identifying risks at the workplace risk assessments process occurs. In short, identifying what hazards currently exist or may appear in the workplace and are likely to cause harm to employees and visitors. Risks are/have to be considered at all employee occupied places. Workplace risk assessment process may include such hazards as: electrical and fire safety, manual handling, substances related, repetitive strain injury, stress, violence, diseases. When should risk assessment be done? Risk assessment should be ongoing process and it has to be done all the way down the working process.

How are risks ranked or prioritized?

Ranking hazards, in other words, determining priority to risks which to control first. Priority is given by examining employee vulnerability, potential for incident, damage or injury or illness. After raking risks action list is created.

There are several techniques to determine the level of risk. It is not easy and simple process. The organization determines most effective technique for them to work best for each situation. Ranking hazards requires good knowledge of all workplace activities including all operations with depth.

For the small and easy situations, an assessment can be a discussion or brainstorming session, based on past knowledge or similar situations. For the big companies, special team is working on hazard identification, documentation regulation and assessment. For them checklists or a probability matrix can be helpful.

| RISK ASSESSMENT MATRIX | | | | |
|-------------------------|---------------------|-----------------|-----------------|-------------------|
| SEVERITY PROBABILITY | Catastrophic (1) | Critical (2) | Marginal (3) | Negligible (4) |
| Frequent (A) | High | High | Serious | Medium |
| Probable (B) | High | High | Serious | Medium |
| Occasional (C) | High | Serious | Medium | Low |
| Remote (D) | Serious | Medium | Medium | Low |
| Improbable (E) | Medium | Medium | Medium | Low |
| Eliminated (F) | Eliminated | | | |

(CPC, 2016)

Hazard Control

After risk ranking, the organization can decide on ways to control each specific hazard. A hazard control program is ways to protect workers from exposure to a substance or system, the training and the procedures required to monitor worker exposure and their health to hazards such as chemicals, materials or substance. General ways to control a hazard include Elimination (remove the hazard), Substitution (replace the hazard with a less hazardous one), Engineering Controls (includes plant redesigning, equipment, ventilation systems, and reduce exposure), Administrative Controls (controls how work is done), Personal Protective Equipment (equipment worn by individuals).

SUMMARY

After all, why is risk assessment and management so important?

Once I read an article in the journal that was starting like this : “The biggest work for the occupational safety and security progress was done by the dead employee who dies at the workplace..”

For the effective and efficient work process risk management is crucial. At some point it guarantees likeness of success, as if anything goes out of rails, managers are likely to have plan of corrective acts. Risk management is an important process because it empowers a business with the necessary tools so that it can adequately identify and deal with potential risks.

Risks can be divided based on the nature of their impact on your finances: income risk and expense risk.

Any events or mishaps that reduce your productivity – or your ability to provide services to your clients – will result in a loss of income.

Another positive impact of risk management is on your assets. You can avoid costly expenses that can arise due to damage or destruction of assets if you have precautions taken. Loss of critical assets can have a huge impact, especially if your business is an SME.

Unfortunately, yet in Georgia labor safety and security is not still leveling up but, companies started work on improving this field. There is hope in future that regular inspections will help to prioritize workplace security and safety of the company’s most valuable assets.

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MODERN THEORIES OF LEADERSHIP AND TYPES OF LEADERS

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Abstract

Globalization has opened the borders of countries, due to which the competition between the companies intensified it became necessary to guide and manage not the usual a manager, but a globally minded manager or leader. Even today, the question of the phenomenon of leadership is controversial among scientists about, in particular, how should he be a leader, with qualities or skills, whether it is possible to learn leadership, etc.

Cross-Country Perceptions of Leadership Skills and Traits is different. There are different views on it in terms of vertical management hierarchy and network structuring, of business network structures clearly influence organizational culture he showed us about the leader and leadership.

In such conditions, when Georgia is also one of the members of the global world, in relation to the compatibility of Georgian culture, the issue of how it should be in Georgia should be studied the leader of a functioning company, what qualities and skills should have, what features of Georgian culture should he grasp and, finally, what should he be able to give for the success of the company "As a victim".

The world is changing at lightning speed and also at lightning speed public interest in leadership and leaders is growing. We all have a certain view of what leadership is, however the exact definition of the term is still difficult. Some scientists believe that leadership is the result of successful group dynamics, Others believe that leadership is determined by the grandiose efforts of a person. There is also an opinion that the leader is influenced by circumstances and necessity creates, however, according to another opinion, leadership a person with qualities is always a leader.

It is important to understand that the leadership style or type used by managers or leadership positions in a company always has consequences for workers, even if we do not realize it or confuse these consequences with the inner personality of each person. It is very important to clarify this, since leaders are agents who believe that they are in a privileged position to influence others for better or worse.

Keywords: Management, Leadership, Georgia

Modern approaches to Management

American businessman, founder of Microsoft company and CEO (Gates, Bill, n.d.) rightly notes: "We expect that in the next century, the leader will be the one who makes others authorized".

Transformational leadership is one of the most modern and popular leadership theories. It was founded in the 80s of the 20th century and is "part of the new leadership paradigm" (Peter Guy Northouse, 2010). The theory was based on the works of (Bass, B. M., & Riggio, R. E. ., 2006) (Burton Nanus, Warren G. Bennis, 2006) made important contributions to the development of the theory. According to (Bass, B. M., & Riggio, R. E. ., 2006), the popularity of transformational theory is likely due to its emphasis on intrinsic motivation and follower development. According to this theory, people at the level of change and uncertainty need inspiration and faith in themselves. In their (2001) analysis of articles published in the Quarterly Journal of Leadership, Lue and Gardner concluded that 1/3 of the studies were about transformational or charismatic leadership. Transformational leadership is one of the most comprehensive theories. This is a process that leads to changes and transformations in people. It deals with emotions, values, ethics, standards and long-term goals. Also, it includes evaluation of followers' motivation. meeting their needs and treating them with respect. According to this theory, leaders inspire and motivate followers to do great things and hold followers to high standards. According to this approach, the leader must understand and adapt his actions to the

needs and motives of the followers. In transformational leadership, pseudo-transformational leadership is distinguished, which transforms in a negative way. Leaders who experience transformation in a negative way, are self-absorbed, focused on power and are carriers of distorted moral values are considered pseudo-transformational.

Transformational leadership also has some weaknesses. For example, it lacks conceptual clarity, another weakness relates to the measurement of transformational leadership. Some transformational factors are correlated with transactional and noninterventional leadership factors. It should also be noted that transformational leadership does not present clear assumptions about how leaders should act in specific situations. It focuses on ideals, inspiration, motivation, innovation and individual care.

During the same period, the researcher (Bass, 1985) proposed an even more sophisticated version of transformational leadership, which was based on the work of (House), but did not completely follow it. He believed that transformational leadership can be used in situations where the results are negative. He considered transactional and transformational leadership on the same line. (Avolio, 1999), in 1999, referred to transformational leadership as improving the performance of followers and realizing their full potential.

Transactional leadership includes all types of leadership that focus on agreement between leaders and followers. It encourages high performance through the use of rewards and punishments. When managers reward

subordinates for good performance and, conversely, punish them for poor performance, they increase the motivation of subordinates to ensure the desired action.

Charismatic leadership is often compared to transformational leadership. As mentioned in the previous subsection, charisma was first defined by (Weber, 1974)), who describes it as follows: "It is a personal characteristic that gives a person superhuman, outstanding power, it is not available to everyone, it is of divine origin, and as a result we get a person who is perceived as a leader. and treated as a leader. Later this theory was developed by (House, 1971). the personality characteristics of a charismatic leader developed by (House), which include: dominance, a strong desire to influence others, self-confidence, and belief in one's own moral values.

According to House's charismatic leadership theory, its face-to-face outcome is the follower's trust in the leader's ideology. Recognition of the leader without any doubts or questions.

Authentic leadership is one of the newest areas in leadership research. The theory focuses on how "real" and how authentic leadership is. There are several definitions of authentic leadership that explain it from different perspectives, they are: intrapersonal - processes taking place inside the leader's personality, self-knowledge, self-regulation, and self-evaluation; Developing - leadership behavior that is formed from the positive psychological characteristics and high quality of the leader. This is what is formed in people throughout life. Interpersonal - is built on relationships and involves achieving interactions between leaders and followers. It is a two-way process, as leaders influence followers and vice versa.

Today, one of the most recognized approaches in the field of leadership research is (House). The theory of conformity of means and ends. The essence of this theory lies in what the leader does to motivate subordinates to achieve the group and organization's goal. 1. Effective leaders clearly define the goals that subordinates are trying to achieve by working; 2. They reward subordinates according to the work done and the goal achieved and 3. They make clear the path that leads to the work goal. According to this theory, the steps a leader should take to motivate subordinates depend on both the subordinates and the type of work performed. In the theory of compatibility of the goal and the means, four behaviors of the leader are distinguished: 1. directive behavior; 2. Supportive behaviors; 3. complicity behavior; 4. Achievement-oriented behavior. Therefore, leaders must decide for themselves which behavior to use during the task to be performed by the subordinate in order to motivate them to perform the task.

Leadership concepts address the factors that leaders consider when applying leadership styles and overseeing an individual team. These principles focus on the ideas and perceptions about the qualities that leaders should have and how they should perform in the role of leader. In addition, leadership concepts help professionals understand what kind of skills and character traits they need to develop to advance in leadership roles.

The concepts of leadership differ from leadership theories in several ways. For example, leadership concepts generally serve as a guide for professionals to use in shaping leadership styles, communicating with teams, and leading processes. Leadership theories typically focus on the idea of using different methodologies, styles, and techniques when leading a team. Leadership concepts include different styles, qualities, and principles of employee team management approaches. Essentially, leadership concepts are based on various theories of management, and these qualities serve as the standard for effective managers, leaders, and other positional leaders. In addition, leadership concepts form the basis of standard management style and behavior theories and often include traits such as personality and character, initiative, motivation, influence, decision-making ability.

According to the studies by (Kirkpatrick, S.A. and Locke, E.A, 1991) have identified six traits that distinguish leaders from others. These are: Attitude, motivation, honesty, self-confidence, cognitive abilities and knowledge of the case. They think people with similar traits can be born or acquired over a lifetime They are. These 6 traits are exactly the traits that leaders need. These qualities of a leader distinguish people from each other and therefore, these differences are an important part of the leadership process. Also, empirical research (Peter G Northouse, 2010) conducted in the 1990s has shown that with social intelligence comprehension of feelings, behavior, and thoughts related traits are important traits for an effective leader.

The discussion of leadership as a trait has aroused great interest among foreign scholars. (Bryman, A, 1992) and an analysis by (Ellinger, A. D, 1986) found that personal qualities are closely related to a person's views on leadership. Even according to (Kirkpatrick, S.A. and Locke, E.A, 1991) effective leaders with distinctive qualities in some respects there are people. It is interesting to note that in the 1990s leadership as a trait became the subject of special attention to those for researchers who are distinguished by visionary, or charismatic leadership. These are: (Bass, B. M. , 1985), (Burton Nanus, Warren G. Bennis, 1985), (David A. Nadler, 1989)

It will not be uninteresting to discuss all those theories and systematic research devoted to the topic of leadership and identifying the characteristics of prominent leaders, since, naturally, the achievements of great people lead to universal recognition.

Followers of **The Trait Theory** as the starting point of leadership consider the individual characteristics of a leader and try to study the leader through these characteristics. This approach known as The Great Man Theory. This theory was formulated by Scottish philosopher, writer and teacher Thomas Carlyle. The theory is based on two main assumptions: 1) Great leaders are born, they have certain qualities that allows a person to be guided, guided and to be promoted; 2) Great leaders emerge when their need arises exists. Significant research and agreement have been reached today that leadership comes from a combination of both theories - and more. As already mentioned, there is a wide selection of qualities and characteristics of a leader. The

University of Santa Clara and the Tom Peters Group identified the following leadership characteristics: Honesty - Show sincerity, integrity and sincerity in all your actions. Deceptive behavior does not inspire confidence. Competent - base your actions on common sense and moral principles. Do not make decisions based on childish emotional desires or feelings. Prudent - Set goals and have a vision for the future. The vision should be owned by the entire organization. Effective leaders see what they want and how to get it. They usually choose priorities based on their core values. Inspiring - Show confidence in everything you do. By displaying mental, physical and spiritual endurance you inspire others to reach new heights. Take responsibility if necessary. Intelligent - Read, study and search for difficult tasks. Righteous Thinker - Treat all people fairly. Superstition is the enemy of justice. Show empathy for the feelings, values, interests, and well-being of others. Broad thinking - seek diversity. Brave - have the patience to achieve the goal, despite seemingly insurmountable obstacles. Exercise self-confidence in times of stress. Direct - Use common sense to make the right decisions at the right time. Imaginative - Make timely and appropriate changes in your thinking, plans and methods. Show creativity by thinking of new and better goals, ideas and problems. (John Whitehead, 2016)

Leadership theories study the qualities of effective leaders, including the qualities of effective and influential leaders, patterns of behavior, and actions. Leadership theories focus on explaining what makes good leaders by focusing on different behaviors and qualities that professionals can develop to become good leaders. While the concepts of leadership are qualities in themselves, leadership theories are the study and explanation of these qualities and their impact on professionals and their work environment.

Do not lose sight of the fact that there is no one type of leadership that is universally good or desirable. Organizations are characterized by their complexity, and therefore they can undergo changes at various and different rates, so you need to know how to adapt to momentary requirements; This also happens through his leadership, through the distribution of roles, etc. In

all cases, the truth is that a leader is not a leader by tenure: leadership is exercised, it is not inherited, something you place in an organization chart.

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MEDICAL SCIENCES

EXTRAGENITAL PATHOLOGY AND CLINICAL SYMPTOMS IN MEN WITH PATHOSPERMIA

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Abstract

The most difficult form of male infertility to treat is azoospermia. Azoospermia is defined as the complete absence of spermatozoa in the ejaculate. The age of the patients who underwent clinical and diagnostic studies varied between 22 and 45 years. Among 119 examined patients with azoospermia, 69 (58.0%) were diagnosed with secretory infertility. In 50 (42.0%) patients, the presence of spermatogenesis in excretory-obstructive infertility was established. Among 69 patients with secretory infertility, 23 had azoospermia in the absence of spermatozoa and spermatogenic cells, which accounted for 33.3% of all patients with secretory infertility (in particular, 2 with leukocytospermia, which indicated damage to the tubular apparatus as a result of previous orchitis). In 46 (66.6%) patients, azoospermia was observed in the absence of spermatozoa, but in the presence of precursor cells of spermatogenesis. Eight (11.6%) patients out of 69 (group 1) were diagnosed with concomitant diseases. We see that arterial hypertension, diseases of the gastrointestinal tract, liver, and kidneys occur. Hereditary diseases were not detected in the examined patients. One (4.3%) patient suffered from viral orchitis, one (4.3%) had an operation for phlegmon of the peritesticis, three (13.0%) suffered from non-viral epididymitis, four underwent bilateral orchiectomy at an early age. Pain of varying intensity was found in 6.7% of patients, varying degrees of testicular hypoplasia were found in 7.6%, dysuria in 13.4%, epididymitis in history - 8.4%; history of epidemic mumps - 6.7; 12.6% had depression, restlessness, sleep disorders, and 21.0% had erectile dysfunction. According to clinical examination and ultrasound, chronic prostatitis is suspected in 19.2% of patients. An increase in the number of leukocytes in the blood was found in 15 (13.2%) patients.

Keywords: infertility, azoospermia, genitalia, extragenital pathology, clinical symptoms.

Introduction. In recent years, a progressive increase in cases of male infertility has been recorded in Ukraine and all over the world [1, 2]. The most difficult form of male infertility to treat is azoospermia. Azoospermia is defined as the complete absence of spermatozoa in the ejaculate. Depending on the nature and causes of impaired spermatogenesis, azoospermia is divided into obstructive (excretory, OA) and non-obstructive (secretory, NOA) [1-5]. In male infertility, azoospermia is detected in 10-15% of cases, while the share of obstructive and non-obstructive forms is approximately 40 and 60%, respectively [2-4]. The problem is the differential diagnosis of OA and NOA. OA occurs as a result of secondary obstruction of the male reproductive tract. It is determined on the basis of a comprehensive study of the anamnesis, physical methods, laboratory diagnostic tests, as well as ultrasound and genetic research methods, and histological examination of testicular biopsies. NOA, which develops against the background of primary or secondary damage to the testicular parenchyma, is differentiated from OA based on such features as the consistency and vol-

ume of the testicles, hormone levels, microscopic examination of testicular biopsies, genetic studies (karyotype, microdeletions of the Y-chromosome). Treatment of OA is based on surgical restoration of the patency of the vas deferens, or extraction. However, at present, the most reliable method of diagnosing azoospermia is a testicular biopsy. It allows not only to differentiate excretory and secretory forms of infertility, but also to determine the degree of impaired spermatogenesis based on the histological picture of the biopsy [6-11]. Since obtaining biopsies is a complex and traumatic process, there is an active search for biochemical, genetic, immune markers of azoospermia and expansion of the spectrum of clinical indicators.

Based on this, the aim of the work was the clinical characteristics of patients with various forms of azoospermia.

Materials and Methods. Inclusion and exclusion criteria were taken into account when selecting the research groups.

Inclusion criteria: reproductive age of patients (22-45 years), established fact of infertility, absence of

female infertility factor in marriage, normal testosterone level, absence of acute and chronic infectious-inflammatory processes in the urogenital tract, absence of hormonal correction of infertility.

Exclusion criteria: age < 22 years and > 45 years, severe general systemic diseases, diseases that require taking drugs capable of affecting spermatogenesis, in particular hormonal drugs, varicocele, presence of spermatozoa in the ejaculate, sexually transmitted infections in the anamnesis, presence in history of previously performed testicular biopsy.

The criteria for azoospermia are the absence of sperm in the ejaculate or the absence of ejaculate.

The criteria for the obstructive form of azoospermia are the absence of spermatozoa in the ejaculate with preserved spermatogenesis.

The criteria for non-obstructive form of azoospermia is the absence of sperm in the ejaculate due to a violation of the process of spermatogenesis.

Diagnosis of infertility, like other diseases, is based on the patient's complaints, anamnesis data, objective status and the results of special research methods. It is known that men with infertility, especially with azoospermia, belong to a difficult category of patients, due to the difficulty of diagnosing the causes and degree of impaired spermatogenesis, as well as the choice of treatment methods.

Before the ultrasound examination with dopplerography and elastography, the following tests were performed on all patients: spermogram, blood hormones - FSH, LH, total testosterone, prolactin, estradiol, inhibin B.

Ultrasound with the help of color Doppler mapping and dopplerography was used to determine the volume of the testicles and hemodynamic changes in the parenchyma. The research was carried out on a Logiq 3 device from General Electric (USA).

The state of the seminal vesicles, prostate, sonography and dopplerography of the organs of the vestibule-appendages of the testicles, vessels of the vestibule were performed with the help of ultrasound examinations [12]. So, normally, the testicle has an oval shape, a clear and even contour, homogeneous parenchyma, average echogenicity. The protein shell is visualized as a thin continuous strip of high echogenicity located along the edge of the testicle. The mediastinum has the appearance of a hyperechoic thin strip or wedge in the upper parts of the organ. A protrusion with a diameter of 2-3 mm can be visualized at the upper pole of the testicle. The testicle is surrounded by a small amount of serous fluid, which appears as a thin hypoechoic zone 1-3 mm wide. The epididymis is located at the upper pole of the back surface of the testicle. Its structure is heterogeneous and in terms of echogenicity, it is similar to the testicular parenchyma. In the absence of pathological changes in the appendix, only its head, measuring 10-15 mm, is determined. When diagnosing forms of azoospermia, it is important to assess the size and structure of the testicles, the presence of signs of obstruction (dilation of the ducts of the testicle and epididymis), and blood reflux.

Results. The age of the patients who underwent clinical diagnostic tests and testicular biopsy varied between 22 and 45 years. The average age of patients with testicular (secretory) male infertility was 28.6 years, and with posttesticular (excretory) – 31.5 years (Fig. 1).

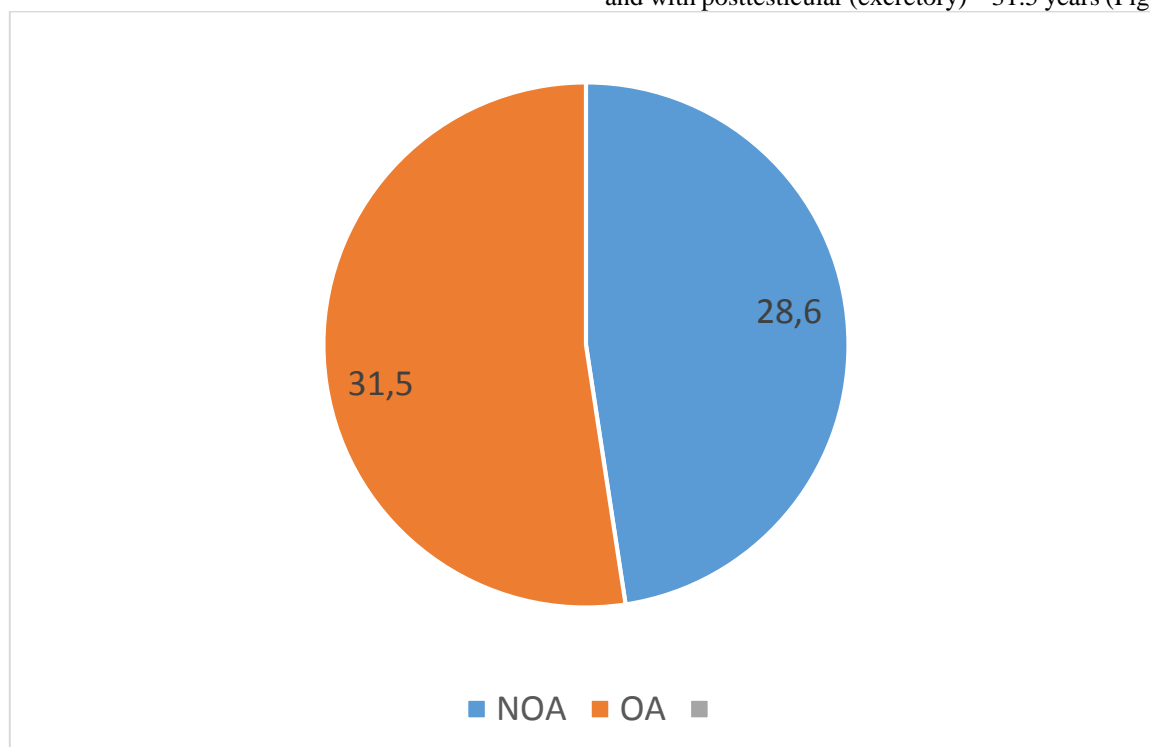


Fig. 1. Average age of patients.

The average period of infertility was 4.2 years. This testifies to the patient's long journey to the specialist doctor and his likely unjustified treatment at the polyclinic level without a clearly established diagnosis.

Among 119 examined patients with azoospermia, 69 (58.24 %) were diagnosed with secretory infertility. In 50 (41.76 %) patients, the presence of spermatogenesis in excretory-obturation infertility was ascertained (Fig. 2).

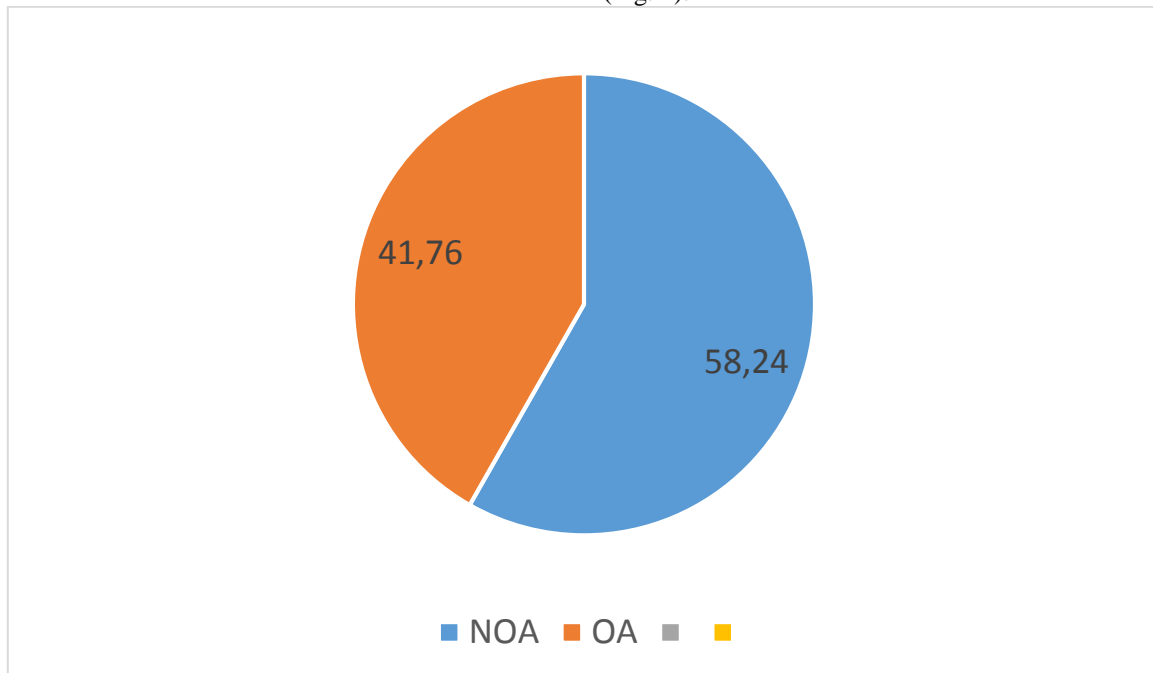


Fig. 2. Number of patients with azoospermia.

Among 69 patients with a secretory form of infertility, 23 were found to have azoospermia in the absence of spermatozoa and spermatogenic cells, which accounted for 34.0 % of all patients with secretory infertility (in particular, 2 with leukocytospermia, which

indicated damage to the tubular apparatus as a result of previous orchitis) (Fig. 3). In 46 (66.0 %) patients, azoospermia was observed in the absence of spermatozoa, but in the presence of precursor cells of spermatogenesis.

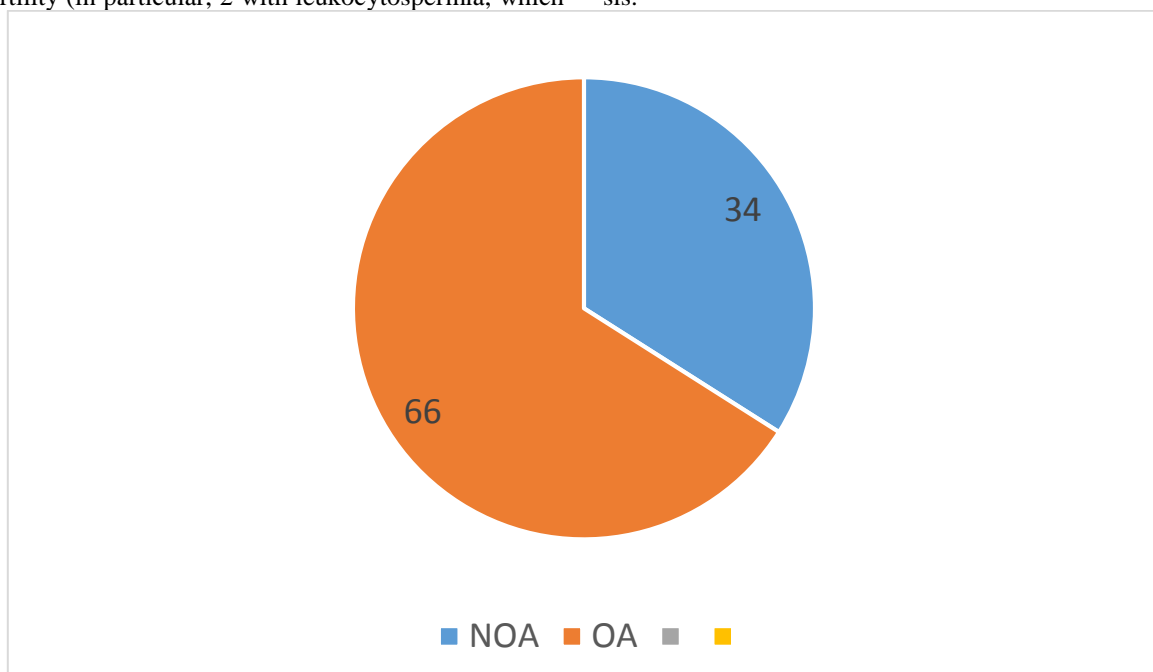


Fig. 3. Distribution of patients with the secretory form of non-obstructive azoospermia

Eight (11.6%) patients out of 69 (group 1) were diagnosed with concomitant diseases (Table 1). We see

that arterial hypertension, diseases of the gastrointestinal tract, liver, and kidneys occur. Hereditary diseases were not detected in the examined patients.

Table 1

Frequency of extragenital pathology in examined patients with non-obstructive form of azoospermia

| Concomitant diseases | Number of patients | |
|----------------------------------|--------------------|-------------------|
| | abs. | % of all patients |
| Chronic gastritis, stomach ulcer | 2 | 2,9 |
| Chronic pyelonephritis | 1 | 1,4 |
| Liver disease | 1 | 1,4 |
| Arterial hypertension | 4 | 5,8 |

One (4.3%) patient suffered from viral orchitis, one (4.3%) had an operation for phlegmon of the portucallis, three (13.0%) suffered from non-viral epididymitis, four underwent bilateral orchopexy at an early age. According to clinical examination and ultrasound, chronic prostatitis is suspected in 19.2% of patients. An increase in the number of leukocytes in the blood was found in 15 (13.2%) patients.

Table 2

Frequency of clinical symptoms in all examined patients

| Clinical symptoms | Number of patients | |
|---|--------------------|------|
| | abs. | % |
| Pain of varying intensity in the area of the external genitalia | 8 | 6,7 |
| Testicular hypoplasia | 9 | 7,6 |
| Epididymitis in the anamnesis | 10 | 8,4 |
| Epidemic mumps in the anamnesis | 8 | 6,7 |
| Dysuria in history | 16 | 13,4 |
| Depressive state, restlessness, sleep disorders | 15 | 12,6 |
| Erectile dysfunction | 25 | 21,0 |

According to ultrasound, 44 (95.7%) patients with normozoospermia had normal testicle sizes. In 72 (60.5%) patients with azoospermia, the size of the testicles was normal, and in 47 (39.5%) they were reduced.

CONCLUSIONS

1. It was shown that among the patients examined by us, 58.0% were diagnosed with a non-obstructive form of azoospermia, and 42.0% with an obstructive form. According to ultrasound, the volume of the testicles in patients with azoospermia was on average 1.3 times smaller than in patients with normozoospermia.

2. Among the extragenital pathologies, the most frequent cases of the examined patients with non-obstructive form of azoospermia were arterial hypertension and chronic gastritis.

3. The most common clinical symptoms in the examined patients were erectile dysfunction, dysuria, depressive states, and epididymitis.

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FEATURES OF DIAGNOSIS AND TREATMENT OF TIBIAL PYLON FRACTURES**Pankov I.,**

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ОСОБЕННОСТИ ДИАГНОСТИКИ И ЛЕЧЕНИЯ ПЕРЕЛОМОВ ПИЛОНА БОЛЬШЕБЕРЦОВОЙ КОСТИ**Панков И.О.**

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Abstract

The article presents the features of the most severe types of fractures of the distal articular part of the shin bones – fractures of the distal articular plateau of the tibia (pylon fractures). It is noted that in the surgical treatment of such injuries, both osteosynthesis with immersion fixators and transosseous osteosynthesis with external fixation devices are successfully used, which allows, in some cases, to produce a bloodless, sparing reposition of fractures. At the same time, the possibility of using transosseous osteosynthesis as a stage of fracture reposition before submerged osteosynthesis is not excluded. The analysis of the immediate and long-term results of treatment of 62 patients with intra-articular fractures of the tibial pylon was carried out.

Аннотация

В статье представлены особенности наиболее тяжелых видов переломов дистального суставного отдела костей голени – переломов дистального суставного плато большеберцовой кости (переломов пилон). Отмечено, что при оперативном лечении таких повреждений с успехом применяются как остеосинтез погружными фиксаторами, так и чрескостный остеосинтез аппаратами внешней фиксации, который позволяет, в ряде случаев, произвести бескровную щадящую репозицию переломов. При этом, не исключается возможность применения чрескостного остеосинтеза как этапа репозиции перелома перед погружным остеосинтезом. Проведен анализ ближайших и отдаленных результатов лечения 62 пациентов с внутрисуставными переломами пилон большеберцовой кости.

Keywords: tibial pylon fractures, ankle joint, surgical treatment, transosseous osteosynthesis with external fixation devices.

Ключевые слова: переломы пилон большеберцовой кости, голеностопный сустав, оперативное лечение, чрескостный остеосинтез аппаратами внешней фиксации.

Актуальность проблемы. Переломы пилон большеберцовой кости относятся к наиболее тяжелым повреждениям дистального суставного отдела костей голени. Такие переломы, в большинстве случаев, влекут длительные функциональные расстройства нижней конечности и нередко являются причиной стойкой утраты трудоспособности и значительного снижения качества жизни. Внутрисуставные переломы пилон большеберцовой кости,

по данным специальной литературы, составляют до 10% переломов костей голени и около 1% переломов костей нижних конечностей [2, С. 139-146; 3, С. 23-29; 4, С. 188-193]. Также значителен процент осложнений и неудовлетворительных исходов лечения. Наиболее частые и тяжелые осложнения при внутрисуставных переломах пилон – развитие посттравматического деформирующего артроза и стойких контрактур голеностопного сустава как

следствие значительных разрушений опорной суставной поверхности большеберцовой кости. При этом, по данным литературы, существуют различные взгляды на лечение и сроки оказания специализированной хирургической помощи при таких повреждениях [1, С. 1-3; 6, С. 89-93; 7, С. 612-622].

В механизме переломов пилона основное значение придается не прямой травме. Падение с небольшой высоты на ноги, падения с подворотом стопы кнутри или кнаружи и впереди. При этом, более прочный блок таранной кости внедряется в дистальный эпиметафиз (дистальное плато или платфон) большеберцовой кости, вызывая его повреждение. При таком механизме травмы формируются крупно-фрагментарные переломы медиального, передне-медиального краев большеберцовой кости, а также оскольчатые переломы в сочетании с подсиндесмозными переломами наружной лодыжки. Нередки случаи переломов пилона большеберцовой кости при пронационном механизме травмы в положении стопы крайнего эквинуса. В таких случаях давлением блока таранной кости происходит перелом заднего или задне-медиального краев большеберцовой кости, чрез- или надсиндесмозный перелом малоберцовой кости, повреждение дистального межберцового синдесмоза, подвывих или вывих стопы кзади [6, С. 89-103; 10, С. 266-276].

В настоящее время оперативный метод является единственно возможным при лечении различных типов внутрисуставных переломов пилона большеберцовой кости [5, С. 346-352; 8, С. 293-298; 11, С. 975-982; 12, С. 131; 13, С. 757-963].

В отделении травматологии Научно-практического центра травмы Республиканской клинической больницы при лечении переломов пилона с успехом применяются как погружной остеосинтез пластинами и компрессирующими винтами, так и чрескостный остеосинтез аппаратами внешней фиксации на основе метода Илизарова. Нами на ос-

нове изучения биомеханических особенностей голеностопного сустава, клинко-рентгенологического анализа течения процесса восстановления и исходов лечения были разработаны оригинальные клинически обоснованные компоновки аппаратов внешней фиксации при различных типах переломов дистального суставного отдела костей голени. Разработанные нами компоновки обеспечили достижение точной закрытой репозиции переломов с устранением всех видов смещений, восстановление конгруэнтности в поврежденном суставе, а также стабильную фиксацию на период консолидации.

Материалы и методы исследования. В статье представлены ближайшие и отдаленные результаты лечения 48 пациентов с внутрисуставными переломами пилона большеберцовой кости, находившихся на лечении в клинике Научно-исследовательского центра Татарстана «Восстановительная травматология и ортопедия» – Научно-практического центра травмы Республиканской клинической больницы в течение последних 15 лет (2008-2020 гг.). Для оценки результатов лечения применялись клинический, методы лучевой диагностики (рентгенографический, КТ), биомеханический (исследование опорной, динамической функции нижней конечности, баланс в вертикальной стойке на аппарате NeurocomBalanceMaster® 7.0) методы исследования.

Основными жалобами пострадавших являются боли в области поврежденного голеностопного сустава, невозможность нагрузки на поврежденную конечность. Во всех случаях имелись указания на предшествующую травму. При объективном исследовании имели место значительные отек, деформация, резкая болезненность при пальпации в области голеностопного сустава и голени на уровне нижней трети диафиза; пассивные и активные движения в голеностопном суставе затруднены, болезненны. Данные рентгенографического исследования, а также компьютерной томографии подтверждают диагноз.



Рис.1. Рентгенография внутрисуставного перелома пилона (дистального эпиметадиафиза) большеберцовой кости, перелом н/3 малоберцовой кости со смещением отломков.



Рис.2. КТ внутрисуставного перелома пилона (дистального эпиметафиза) большеберцовой кости, перелом н/3 малоберцовой кости со смещением отломков.

Лечение внутрисуставных переломов пилона большеберцовой кости.

Целью операции является достижение репозиции с восстановлением анатомии поврежденного голеностопного сустава, профилактика возможного повторного смещения отломков, обеспечение стабильной фиксации на период консолидации переломов.

При лечении внутрисуставных переломов пилона большеберцовой кости нами применялись как остеосинтез погружными конструкциями (металлические пластины с угловой стабильностью винтов, компрессирующие винты), так и чрескостный остеосинтез аппаратами внешней фиксации на основе метода Г.А. Илизарова. В двух случаях наблюдений при крупноскольчатых переломах в процессе оперативного вмешательства нами применено временное наложение 2-секционного аппарата внешней фиксации для предварительной репозиции перелома и устранения грубых смещений фрагментов. Затем, из малых операционных доступов была осуществлена окончательная репозиция перелома, остеосинтез пластиной. По завершении репозиции в условиях стабильной фиксации пластиной и винтами аппарат был демонтирован, снят. Фиксация пластиной и винтами до полной консолидации перелома – 4-6 месяцев с момента операции.

При применении метода чрескостного остеосинтеза аппаратами внешней фиксации монтаж аппарата осуществлялся в зависимости от вида перелома и величины смещений фрагментов дистального отдела большеберцовой кости. Нами разработаны оригинальные, клинически обоснованные, компоновки аппаратов внешней фиксации для лечения различных типов и видов переломов области голеностопного сустава (Патент на изобретение № 2551303). Как правило, компоновка аппарата состояла из одной или двух кольцевых, одной полукольцевой (дуговой) опор, которые устанавливались на костях голени в дистальном отделе и на пяточной кости и одного или двух репозиционных узлов на смещенных фрагментах большеберцовой кости. Тракцией по оси нижней конечности по резьбовым стержням (штангам) между опорами голени и стопы достигалась предварительная репозиция

перелома. Окончательная репозиция с восстановлением конгруэнтности суставных поверхностей осуществлялась перемещением по стержням Шанца, установленным в репозиционных узлах аппарата. При этом, не исключается возможность открытой репозиции наиболее значительно смещенных фрагментов большеберцовой кости. Сроки фиксации в аппарате зависели от вида перелома и составляли, в среднем, 7-9 недель.

Результаты лечения. Проведен анализ результатов лечения у 48 пациентов с внутрисуставными переломами пилона, находившимся в клинике травматологии в 2008-2020 гг. Анализ проводился на основании изучения данных клинорентгенологического, а также биомеханического методов исследования. Необходимо отметить, что биомеханическая оценка результатов позволяет объективно, с позиции доказательной медицины, оценить ближайшие и отдаленные исходы лечения, а также на ранних сроках, до появления первых клинорентгенологических данных определить развитие возможных статико-динамических нарушений нижней конечности.

Применяемая клинорентгенологическая система оценки результатов лечения с учетом отдельных параметров по R. Marty, E.H.F.B. Raaymakers, P.A. Nolte (1990) включает следующие параметры: боль (отсутствие, наличие, степень интенсивности), возможность ходьбы, нагрузки конечности, активность пациента с восстановлением обычного ритма жизни, восстановление трудоспособности, отношение к спорту (что выявлялось на основании данных анамнеза), болезненность при пальпации и выполнении активных и пассивных движений в голеностопном суставе, деформацию, состояние мышц голени (наличие или отсутствие атрофии), восстановление оси конечности, местные сосудистые расстройства (отсутствие или наличие отеков), результаты измерения движения в голеностопном суставе в градусах, восстановление сводов стопы. При рентгенологическом исследовании оценивались качество репозиции переломов области голеностопного сустава, сращение отломков, состояние

рентгеновской суставной щели голеностопного сустава, отсутствие или наличие остеопороза [9, С. 709-713].

Помимо клинико-рентгенологической оценки результатов лечения повреждений области голеностопного сустава, в настоящее время применяется Балльно-оценочная система для заднего отдела стопы и голеностопного сустава (AOFAS), включающая такие показатели, как болевой синдром (отсутствие, степень выраженности), ограничение активности, использование дополнительной опоры при ходьбе, расстояние, которое может преодолеть пациент, сложности при передвижении по неровной поверхности, нарушение походки, объем движений в надтаранном и подтаранном суставах, стабильность капсулярно-связочного аппарата. Каждая группа включает в себя от трех до четырех показателей, соответствующих системе оценок. Согласно данной системе оценки, при общей сумме 90-100 баллов функция признавалась отличной, от 80 до 89 баллов – хорошей, от 70 до 79 баллов – удовлетворительной, ниже 69 баллов – неудовлетворительной.

Биомеханические исследования нижних конечностей в норме, а также на этапах восстановительного лечения пациентов с переломами области

голеностопного сустава проводились на Аппаратно-программном комплексе NeurocomBalance-Master® версии 7.0. Наиболее важными компонентами системы BalanceMaster® являются компьютер и платформа, смонтированная на основании. При выполнении биомеханических исследований проводились три вида тестов с целью выявления опорной (удержание веса тела), динамической (длина шага, ширина шага, скорость шага) функции нижней конечности, а также баланса в вертикальной стойке (модифицированный клинический тест сенсорного взаимодействия баланса). Данные исследования позволяют объективно оценить имеющиеся место посттравматические нарушения функции нижних конечностей, а также проследить процесс восстановления в процессе медицинской реабилитации. При этом, наиболее объективными являются тесты определения опорной функции нижних конечностей и баланса. Тесты определения динамической функции носят более субъективный характер и могут изменяться в течение дня в зависимости от функционального состояния опорно-двигательной системы.

В таблице 1 приведены результаты лечения различных типов переломов пилон большеберцовой кости.

Таблица 1.

Результаты лечения переломов пилон большеберцовой кости

| Вид перелома/результат | отлично | хорошо | удовлетворительно | неудовлетворительно | всего |
|---|---------|--------|-------------------|---------------------|-------|
| Переломы заднего края большеберцовой кости | 4 | 22 | 10 | - | 36 |
| Переломы медиального края большеберцовой кости | - | 4 | 4 | - | 8 |
| Многооскольчатые переломы дистального отдела большеберцовой кости | - | - | 4 | - | 4 |
| Итого переломов | 4 | 26 | 18 | - | 48 |

Как следует из данных таблицы, отличные и хорошие функциональные результаты лечения получены в 30 из 48 (62,5%) случаев различных типов внутрисуставных переломов пилон; в 18 (37,5%) случаях результаты оценены как удовлетворительные. Детальный анализ результатов лечения, представленный в таблице показывает: при крупнофрагментарных переломах заднего края большеберцовой кости из 36 случаев повреждений отличные результаты достигнуты в 4, хорошие в 22 и удовлетворительные – в 10 случаях; при переломах медиального края большеберцовой кости из 8 случаев переломов отличные результаты не отмечены, хорошие достигнуты в 4 и удовлетворительные результаты в 4 случаях. Наиболее тяжелая группа повреждений – многооскольчатые переломы дистального суставного отдела большеберцовой кости. Здесь из 4 случаев повреждений отличные и хорошие результаты не отмечены, во всех 4 случаях результаты были оценены как удовлетворительные. В наших материалах плохие исходы повреждений, которые требовали применения реконструктивно-восстановительных или стабилизирующих оперативных вмешательств не получены. Анализ удовлетворительных результатов показал, что последние

были обусловлены тяжестью повреждений и развитием на различных сроках после травмы явлений посттравматического деформирующего артроза, в различной степени выраженного, что требовало применения длительного восстановительного лечения в периоде реабилитации.

Заключение. Внутрисуставные переломы пилон большеберцовой кости относятся к категории наиболее тяжелых повреждений дистального суставного отдела костей голени по причине массивного разрушения опорной суставной поверхности тibia. При этом, наиболее тяжелую группу переломов составляют переломы медиального края дистального эпиметафиза большеберцовой кости, а также полифрагментарные, в том числе, раздробленные, переломы. Лечение оперативное. Основной задачей лечения является точная репозиция перелома с устранением всех видов смещений и восстановлением конгруэнтности суставных поверхностей. Применяемые в клинике методики оперативного лечения как с применением погружных конструкций, так и разработанные нами компоновки аппаратов внешней фиксации позволили достижению положительных результатов лечения у пациентов во всех группах повреждений.

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PRINCIPLES OF SPECIALIZED URGENT TREATMENT FOR PATIENT WITH SEVERE POLYTRAUMA

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ПРИНЦИПЫ ОКАЗАНИЯ СПЕЦИАЛИЗИРОВАННОЙ МЕДИЦИНСКОЙ ПОМОЩИ ПОСТРАДАВШИМ С ТЯЖЕЛОЙ ПОЛИТРАВМОЙ

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Abstract

The article presents the results of the next specialized assistance for 224 patients with severe polytrauma limb bones brought to the emergency department of the trauma center in the Republican Clinical Hospital. The main directions and stages of the treatment and diagnostic procedures in patients with severe multiple injuries depending on the type and severity of injury and on the severity of the patients condition. The most reasonable method of surgical treatment of multiple extremity fractures at the first stage is a method to assist external fixation apparatus of external fixation. In all cases we reach the positive results of the treatment.

Аннотация

В статье представлены результаты оказания специализированной помощи 224 пострадавшим с тяжелой политравмой, находившихся на лечении в отделении травматологии Центра травмы Республиканской клинической больницы. Определены основные направления и этапы лечебно-диагностических мероприятий у пациентов с тяжелой скелетной в зависимости от вида и тяжести повреждений, тяжести состояния пациентов. Наиболее оправданным методом хирургического лечения множественных переломов костей конечностей на первом этапе оказания помощи является метод чрескостного остеосинтеза аппаратами внешней фиксации. Во всех случаях достигнуты положительные результаты лечения.

Keywords: multiple injuries (polytrauma), multiple fractures of the extremities, external fixation, external fixing device.

Ключевые слова: тяжелая политравма, множественные переломы костей конечностей, чрескостный остеосинтез, аппарат Илизарова, аппарат внешней фиксации.

Актуальность проблемы. Пострадавшие с тяжелой политравмой костей конечностей представляют особую категорию пациентов с повреждениями опорно-двигательного аппарата. К особенностям таких повреждений следует отнести шок и острую массивную кровопотерю, сопровождающие большинство переломов, а также развитие ранних тяжелых осложнений со стороны свертывающей системы крови, сердечно-сосудистой, дыхательной и других систем организма, нередко приводящих к летальному исходу. Клиническая картина и тяжесть состояния пациентов значительно отягощаются нередким сочетанием переломов костей конечностей с тяжелой черепно-мозговой травмой, тяжелой травмой груди и живота.

Летальность при тяжелой политравме достигает 40% и выше. Основными причинами летальных исходов в первые часы после таких повреждений являются шок и острая массивная кровопотеря, в более позднее время – тяжелые мозговые расстройства и сопутствующие осложнения [1, С. 5; 3, С. 17]. В ряду ранних осложнений на первое место выступают осложнения со стороны свертывающей системы крови. Частота возникновения тромбозов глубоких вен нижних конечностей, по данным литературы, составляет 40-60%, тромбоэмболия легочной артерии отмечена в 2-10% случаев. Другим тяжелым осложнением множественных переломов костей конечностей, а также сочетанных повреждений является развитие синдрома жировой эмболии,

по частоте не уступающем венозным тромбоэмболическим осложнениям [2, С. 57-62; 5, С. 127-137; 9, С. 1].

Среди поздних осложнений, нередко приводящих к стойкой утрате трудоспособности и снижению качества жизни, необходимо отметить замедленную консолидацию переломов, формирование ложных суставов, развитие тяжелых стойких контрактур и деформирующих артрозов суставов конечностей. Выход на инвалидность достигает 25-45% [4, С. 53; 6, С. 43-47].

Лечение переломов костей конечностей при тяжелой политравме представляет одну из наиболее актуальных проблем современной травматологии и ортопедии. Оперативное лечение в настоящее время является основным при рассматриваемой категории повреждений. При этом, большинство травматологов придерживается концепции раннего оперативного лечения переломов. В последние десятилетия наибольшую актуальность приобретает концепция организации лечебного процесса и оказания высоко квалифицированной помощи пациентам с переломами костей конечностей при политравме с учетом принципа damage control (контроля повреждения) при их поступлении в приемное отделение специализированных стационаров многопрофильных клиник [7, С. 78-84; 8, С. 81-84].

Материалы и методы исследования. В статье представлены результаты лечения 224 пострадавших с тяжелой скелетной политравмой, находившихся на лечении в отделении травматологии Центра травмы Республиканской клинической больницы в 2016-2020 гг. Все пациенты с тяжелой политравмой были доставлены в приемное отделение Центра травмы Республиканской клинической больницы с явлениями травматического (как правило, II-IV ст.) шока. Пострадавшие с тяжелой черепно-мозговой травмой имели различные степени утраты сознания. Все это требовало принятия экстренных мер оказания специализированной медицинской помощи. При поступлении пациентов в состоянии тяжелого травматического шока на первое место выступают противошоковые мероприятия. Весь комплекс лечебно-диагностических мероприятий проводится на фоне противошоковой терапии. Оказание экстренной помощи пострадавшим проводится в условиях шоковой операционной приемного отделения.

Нами определены основные направления и этапы лечебно-диагностических мероприятий у пациентов при их поступлении в приемное отделение, — это точность и своевременность диагностики всех видов повреждений, включая полноценное клинико-рентгенологическое исследование; своевременность и адекватность оказания высококвалифицированной помощи, выбор метода лечения, способ репозиции и фиксации переломов; своевременность и правильность выполнения лечебных манипуляций и оперативных пособий; преемственность в лечении пациентов (принцип damage control). Здесь необходимо отметить, что последовательность оказания помощи, проведение комплекса лечебных мероприятий, в том числе,

оперативных пособий, должны проводиться в соответствии с видом и тяжестью повреждений, определяющими возможное развитие травматической болезни.

При переломах костей конечностей в сочетании с повреждениями внутренних органов, интракраниальными гематомами оперативные вмешательства по экстренным показаниям выполняются двумя и более операционными бригадами в условиях шоковой операционной приемного отделения. Оперативная репозиция и стабилизация переломов является важнейшим компонентом противошоковой терапии и профилактикой осложнений травматической болезни. Непременным условием оказания помощи являются точность выполнения оперативных манипуляций и минимализация времени оперативного вмешательства.

При тяжелых повреждениях у пациентов в критическом состоянии оказание высококвалифицированной оперативной помощи должно сводиться к минимуму (принцип damage control). На первом этапе лечения выступает противошоковая терапия. Оперативные вмешательства при переломах костей конечностей выполняются в отсроченном порядке после вывода пострадавших из состояния тяжелого шока и нормализации основных физиологических показателей. Попытка оперативной репозиции у пациентов, находящихся в критическом состоянии, может привести к усугублению шока с возможным летальным исходом. На данном этапе лечения необходимо ограничиться полноценным шинированием поврежденных конечностей.

При множественных переломах костей конечностей без угрозы кровотечений оперативные вмешательства выполняются после выведения пострадавших из шока и стабилизации артериального давления. Оперативная репозиция переломов и стабилизация отломков костей является важнейшим мероприятием, направленным на устранение шокогенных очагов и профилактику возможного развития синдрома жировой эмболии и нарушений со стороны свертывающей системы крови. Наиболее оправданным методом лечения при поступлении пациентов в стационар является чрескостный остеосинтез аппаратами внешней фиксации. При открытых переломах по экстренным показаниям производится первичная хирургическая обработка, чрескостный остеосинтез под визуальным контролем. При закрытых переломах костей конечностей оперативные вмешательства выполняются по неотложным показаниям. Оперативная репозиция достигается на операционном ортопедическом столе; применяется закрытый чрескостный остеосинтез аппаратами внешней фиксации.

При угрожающей или развившейся жировой эмболии оперативные вмешательства выполняются по экстренным показаниям с целью стабилизации переломов. Применяется закрытый чрескостный остеосинтез аппаратами внешней фиксации.

При поступлении пострадавших с переломами костей конечностей в зависимости от вида и тяжести повреждений, а также состояния пациентов

применяется чрескостный остеосинтез по Илизарову как наиболее щадящий метод оперативного лечения. Нами разработаны и успешно применяются оригинальные клинически обоснованные компоновки аппаратов внешней фиксации на основе метода Г.А.Илизарова, а также методики оперативного лечения переломов. Одномоментная закрытая репозиция на операционном ортопедическом столе достигается в минимальные сроки (5-10 минут). Обезболивание – наркоз или центральная сегментарная блокада в зависимости от вида повреждения.

Как правило, аппарат монтируется из 2-3 дуговых или кольцевых опор комплекта Илизарова с кронштейнами, которые соединяются между собой с помощью резьбовых стержней. В отломки выше и ниже места перелома вводятся костные стержневые винты Шанца, которые закрепляются в кронштейнах на опорах аппарата. Крупные промежуточные фрагменты при оскольчатых и двойных переломах также фиксируются винтами Шанца или спицами с упорами. Перемещения в опорах по винтам Шанца достигается репозиция перелома. По достижении репозиции перелома аппарат переводится в режим стабильной фиксации.

По улучшении состояния пациентов с целью их ранней активизации в ряде случаев возможна замена аппарата внешней фиксации на различные современные погружные конструкции. Принцип *damage control* в травматологии заключается в замене, в ряде случаев, (как правило, при переломах бедра, костей голени) аппаратов внешней фиксации на погружные конструкции. В процессе повторного оперативного лечения производится последовательный демонтаж аппарата внешней фиксации без нарушения ранее достигнутой репозиции перелома. При переломах трубчатых костей применяется остеосинтез штифтами с блокированием, обеспечивающий стабильный остеосинтез. Дополнительная внешняя иммобилизация конечностей не применяется. Это способствует началу ранних активных движений в суставах, а также нагрузке поврежденных конечностей, что является профилактикой возможного развития стойких контрактур суставов, а также условием восстановления функции поврежденных конечностей.

Результаты лечения и их обсуждение. Оценены результаты оперативного лечения у 224 пациентов с тяжелой политравмой костей конечностей, находившихся на лечении в отделении травматологии Центра травмы РКБ за период 2016-2020 г.г. Летальные исходы в ближайшие после госпитализации сроки отмечены у 12. Это были пострадавшие, доставленные в приемное отделение в крайне тяжелом, в ряде случаев, терминальном, состоянии, получившие травмы в результате падения с большой высоты, дорожно-транспортных происшествий. Всем пострадавшим была оказана специализированная и высоко квалифицированная помощь по экстренным показаниям. В зависимости от вида повреждений, тяжести общего состояния пациентов им были выполнены оперативные вмешатель-

ства по экстренным или неотложным (в отсроченном порядке ввиду крайне тяжелого состояния после проведения комплексной противошоковой терапии) показаниям. У всех пролеченных пациентов с тяжелыми множественными переломами костей конечностей на момент выписки и в отдаленном периоде отмечены положительные результаты лечения.

Таким образом, алгоритм оказания специализированной, в том числе, высоко квалифицированной, помощи пострадавшим с тяжелой скелетной политравмой, поступившим в приемное отделение Центра травмы РКБ определялся с учетом вида и тяжести повреждений, степени травматического шока, тяжести общего состояния пациентов.

Все лечебно-диагностические мероприятия проводились по экстренным или неотложным показаниям на фоне комплексной противошоковой терапии.

При тяжелых множественных переломах костей конечностей без угрозы кровотечений оперативная репозиция и стабилизация переломов производилась по неотложным показаниям также после купирования явлений травматического шока, нормализации основных клинико-лабораторных показателей в условиях шоковой операционной приемного отделения. При этом, репозиция и стабилизация костных фрагментов является важнейшим мероприятием, направленным на устранение шокогенных очагов и профилактику возможного развития осложнений со стороны нарушенной крови (синдрома жировой эмболии, венозных флелотромбозов). Наиболее оправданным и щадящим методом оперативного лечения при поступлении пациентов в стационар является чрескостный остеосинтез аппаратами внешней фиксации на основе метода Илизарова. При этом, в дальнейшем не исключается замена аппарата внешней фиксации на погружные конструкции с целью скорейшего восстановления функции поврежденных сегментов опорно-двигательного аппарата (*damage control* в травматологии и ортопедии).

Во всех случаях оказания специализированной, в том числе, высоко квалифицированной, помощи пациентам с множественными переломами костей конечностей получены положительные ближайшие и отдаленные результаты лечения.

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THE CHOICE OF THE OPTIMAL STATIN IN THE TREATMENT OF ATHEROSCLEROSIS

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ВЫБОР ОПТИМАЛЬНОГО СТАТИНА В ЛЕЧЕНИИ АТЕРОСКЛЕРОЗА

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Abstract

Cardiovascular diseases firmly hold leading positions in the structure of mortality. Atherosclerotic vascular lesions play a decisive role in the pathogenesis of these diseases. This article compares two drugs for the treatment of atherosclerosis: atorvastatin and simvastatin.

Аннотация

Сердечно-сосудистые заболевания прочно удерживают лидирующие позиции в структуре смертности населения. В патогенезе данных заболеваний решающую роль играет атеросклеротическое поражение сосудов. В данной статье проводится сравнительная оценка двух препаратов для лечения атеросклероза: аторвастатина и симвастатина.

Keywords: atherosclerosis, lipoproteins, cholesterol, atorvastatin, simvastatin.

Ключевые слова: атеросклероз, липопротеины, холестерин, аторвастатин, симвастатин.

Актуальность. Сердечно-сосудистые заболевания прочно удерживают лидирующие позиции в структуре смертности населения и остаются социально значимой и экономической проблемой как в развивающихся, так и в экономически развитых странах, в том числе и в России. А в патогенезе данных заболеваний решающую роль играет атеросклеротическое поражение сосудов. Рост числа летальных осложнений атеросклероза остаётся одной из важных и нерешенных задач медицины.

В настоящее время выделено несколько теорий атерогенеза, и все они имеют право на существование. Однако ведущую роль в происхождении атеросклероза по-прежнему занимает "липидная теория", сформулированная нашим соотечественником Н.Н.Аничковым более 100 лет назад, согласно

которой атеросклероз развивается вследствие нарушения метаболизма липопротеинов. Два главных ХС-переносящих класса липопротеинов плазмы - ЛПНП (липопротеины низкой плотности) и ЛПВП (липопротеины высокой плотности) имеют в организме разные назначения. "Атерогенные" ЛПНП контактируют с определёнными рецепторами, в результате чего осуществляется рецептор-опосредованный захват ЛПНП и транспорт холестерина в клетки. "Антиатерогенные" ЛПВП способны захватывать избыточный холестерин при контакте с мембранами клеток и транспортировать его в печень его в печень, где происходит дальнейший катаболизм ХС с образованием желчных кислот. У больных с гиперхолестеринемией заметно отслеживается взаимосвязь между высоким уровнем

ЛПНП в крови и образованием атеросклеротических бляшек в сосудах.

Статины являются препаратами выбора в лечении атеросклероза. Они проиллюстрировали свою эффективность в большинстве рандомизирующих клинических исследованиях (РКИ) и выступают терапией первой линии у больных атеросклерозом. Механизм их действия заключается в ингибировании одной из стадий синтеза холестерина, блокируя фермент ГМГКоА-редуктазу, уменьшение количества холестерина в свою очередь приводит к увеличению числа свободных рецепторов ЛПНП в гепатоцитах, что ускоряет их удаление из кровотока и катаболизм в печени.

В настоящее время в России применяются 6 групп статинов, что делает выбор препарата нелегким для врача.

Цель исследования. Данное исследование преследует цель сравнительной оценки эффективности аторвастатина и симвастатина у пациентов с гиперхолестеринемией.

Задачей данного исследования является контроль за изменением уровня холестерина в крови и побочными эффектами в двух группах пациентов, принимающих аторвастатин и симвастатин в среднетерапевтических дозах.

Материал и методы исследования. В исследование, проведенное на базе ГБУ РД

Городская клиническая больницы 1, были включены 40 пациентов с гиперхолестеринемией. Перед началом и в конце исследования всем больным определили уровни ОХС, ТГ, ХС

ЛПНП и ХС ЛПВП для выявления эффективности принимаемого статина, а также уровень КФК, АЛТ и АСТ для определения побочных эффектов. 20 пациентов получали аторвастатин в дозе 20 мг/сутки, остальные 20 принимали симвастатин в такой же дозе (20 мг/сутки).

Результаты исследования. К концу исследования в обеих группах прослеживаются следующие изменения: снижение уровня общего холестерина в крови, триглицеридов и снижение уровня ХС

ЛПНП и некоторое повышение уровня ХС ЛПВП по сравнению с исходными данными. В группе, которая принимала аторвастатин наблюдается снижение уровня общего холестерина на 1,8 ммоль/л от исходного значения, уровня ХС ЛПНП на 0,8 ммоль/л и снижение ТГ на 19%, а в группе, которая получала симвастатин - снижение уровня ОХС на 1,1 ммоль/л, ХС ЛПНП на 0,4 ммоль/л и снижение ТГ на 14,7%.

Повышение уровней АЛТ и АСТ в обеих группах было незначительным и не имело клинического значения, повышение уровня КФК в группе, принимающей аторвастатин достигло 2,1 Е/л, а в группе, получившей симвастатин - 3,2 Е/л.

На фоне приема аторвастатина 3 пациента жаловались на тошноту, 2-на головную боль и слабость. Прием симвастатина вызвал тошноту у 4 пациентов, головную боль у 1 пациента и боль в животе у 2 пациентов.

Выводы. Прием аторвастатина более существенно снизил уровень ОХС, ТГ и ХС ЛПНП, чем прием симвастатина. В группе, получившей симвастатин побочные эффекты развились у 7 пациентов, а уровень КФК повысился более существенно, чем в группе, получившей аторвастатин. В последней побочные эффекты развились у 5 пациентов.

Полученные результаты свидетельствуют о том, что прием аторвастатина оказался более эффективным и безопасным, нежели прием симвастатина.

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PHYSICAL SCIENCES

WHY IS AN INCORRECT VERSION OF THE SPECIAL THEORY OF RELATIVITY THAT DENIES THE POSSIBILITY OF THE EXISTENCE OF RADIO AND ELECTRICAL ENGINEERING BEING STUDIED IN TEXTBOOKS OF PHYSICS? ¹

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Abstract

The article states that the existing version of the special theory of relativity (STR) is incorrect, since relativistic formulas obtained therein are incorrect; they have been incorrectly explained by using the incorrect principle of speed of light non-exceedance and entailed wrong conclusions about physical unreality of imaginary numbers and existence of only our visible universe. It mentions experimental evidence of the foregoing, obtained by the author within study of transient and resonant processes in linear electric circuits. It is shown that the existing version of the STR implies conclusions on nonexistence of tsunami and bell ringing, piano music and swinging children's swings, as well as many other real processes. It is also shown that the existing version of the STR denies even the possibility of existence of radio- and electrical engineering. Therefore, it is concluded that existing university physics textbooks should be corrected.

Keywords: Special theory of relativity, physical reality of imaginary numbers, theory of linear electrical circuits, radio engineering, electrical engineering.

1. Introduction

The special theory of relativity is now presented for study in all university physics textbooks and its creation by Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other prominent scientists is rightfully considered the greatest achievement of physics of the 20th century. However, its creation stopped halfway due to the lack of necessary experimental knowledge at that time and the inability of its authors to correctly explain the relativistic formulas obtained in STR. They did not know how to explain that according to these formulas all the results of calculations at superluminal velocities turned out to be imaginary numbers discovered by Scipione del Ferro, Niccolò Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli [5] 400 years ago. It is also possible that Paolo Valmes [6] was even first to make the scientific discovery, for which he was burned by the sentence of Spanish inquisitor Thomas de Torquemada. But it was necessary to explain these formulas, because a theory that even its authors could not explain would be of no use to anyone. Therefore, a postulate called the principle of light speed non-exceedance was introduced into the STR. The postulate implied that a situation at superluminal velocities might be unexplained, as people would never face it. Consequently, a belief that imaginary numbers were physically unreal turned out to be possible. Thus, relativistic formulas appeared to be explainable.

It was convenient, but unproven and, as it turned out later, incorrect. But in this form, the generally accepted version of the STR was studied in all university physics textbooks. And it is still studied today.

However, this postulate was refuted by the discovery of Cherenkov radiation [7], for which Pavel Alekseyevich Cherenkov, Igor Evgenyevich Tamm and Ilya Mikhailovich Frank received the Nobel Prize in 1958. And at that time the generally accepted version of STR was saved by specification that the principle of non-exceeding the speed of light refers to the speed of light only in a vacuum. But by numerous experiments [8]-[23] performed in the 21st century it was proved that such corrected formulation of the principle of non-exceeding the speed of light is also incorrect. As it turned out, this formulation was refuted by the existence of natural phenomena known from time immemorial - tsunami, bell ringing, music created by pianos and even swinging after pushing by parents children swings, which the authors of STR at its creation did not take into account. This formulation was also refuted by the existence of radio- and electrical engineering.

As a result by all these experiments and the mentioned natural phenomena a very important general scientific principle of physical reality of imaginary (and consequently also complex and hyper-complex) numbers by which the really existing huge and still completely unknown to the modern science world is described was proved. And the use of the principle of physical reality of imaginary numbers as applied to the universally accepted version of STR allowed us to con-

¹ This is reprint of the article "Antonov A. A. "Why the physics textbooks teach an incorrect version of the special theory of relativity which denies the existence of radio- and electrical engineering". Challenges and problems of modern science. Proceedings of the III International Scientific and Practical Conference. London, United Kingdom. 2022. pp. 78-86. <https://conference-w.com/>

clude that the relativistic formulas obtained in this version are wrong in general, because at hyperluminal speeds they correspond to an unstable, i.e. instantly self-destructive, physical world.

What is the most surprising is that, despite all the aforementioned sensational experimental refutations² [24]-[44], the incorrect version of the STR has still been groundlessly believed to be correct and studied in all university physics textbooks, as well as naturally used by physicists in their fruitless scientific research - for example, in attempts to understand what is dark matter and dark energy while performing research at the Large Hadron Collider. It is completely unclear why a single disproving experiment is enough to refute other hypotheses and theories in physics and other sciences, whereas the existing version of the STR turned out to be irrefutable despite all the experimental and theoretical proofs of its falsity. Moreover, in the USSR even three times in 1934, in 1942 and in 1964 by the decisions of the Central Committee of the All-Union Communist Party (Bolsheviks) and the Presidium of the Academy of Sciences of the USSR, which have not yet been canceled, it was generally forbidden to criticize this theory. That's why the question raised in the article title is very important and ways and rates of further science development would depend on answer thereto.

Further, we will try to answer this question.

2. From STR it follows that radio engineering and electrical engineering should not exist in nature

And we will make this attempt on the example of one more refutation of the generally accepted version of STR. On the assertion that STR on the one hand and radio engineering (and electrical engineering too) on the other hand mutually refute each other [45]-[54]. But since there can be no doubt about the existence of radio engineering and electrical engineering, it is obvious that then the existing interpretation of SRT is incorrect.

But do the STR and radio engineering actually refute each other? Let's check it out. Let's look at the arguments of SRT. It follows from the fundamental principle of the STR on light speed non-exceedance that imaginary numbers³ have no real physical content. In other words, objects and phenomena described using imaginary numbers do not exist. This expressly follows from the version of the STR set forth in all university physics textbooks. And neither authors of the textbooks nor anyone else can still explain what, for example, 5i meters, 200i grams or 300i meters, where $i = \sqrt{-1}$ is, whereas everyone knows what 5 meters, 200 grams or 300 meters is. That's why the principle of light speed non-exceedance used in the STR has caused no objections.

However back in 1893 Charles Proteus Steinmetz (original name Karl August Rudolf Steinmetz) offered, as applied to linear AC circuits, his interpretation⁴ of

Ohm's law, discovered by Ohm in 1826 as applied to DC circuits. According to his theory, called a linear circuit symbolic analysis method, not only resistors, but also capacitors and inductors have resistance referred to in Ohm's law. Herewith, resistance of resistors R is measured by real numbers, and resistance of capacitors C and inductors L is measured by imaginary numbers $j\omega L$ and $-j/\omega C$, where $j = \sqrt{-1}$ is the so-called imaginary unit⁵, and ω is the frequency of applied voltage. But in accordance with the principle of light speed non-exceedance their resistances do not actually exist, just as on the same basis in accordance with the STR there are no relativistic mass, time and length at superluminal velocities. They are even called imaginary resistances in the theory of electric circuits.

Consequently, real electrical resistance of any LCR - circuit must always be determined only by resistors R included in this circuit and be measured by real numbers. Therefore, the current flowing through such an electrical circuit should not depend on the value of the frequency of the applied voltage. This means that there could be no resonance in such electric circuits, and electrical filters could not be created. For this reason, existence of radio engineering and electrical engineering is also completely impossible.

3. However, it follows from the existence of radio engineering and electrical engineering that the version of SRT studied in all physics textbooks is incorrect

Now, let us come to think of it.

There is no doubt that nature is one and the laws of nature are also one. Always and everywhere. Be it on Earth, or in the depth of space, or in the microcosm, or in animate or in inanimate nature. However, people, due to their limited intellectual capacity, are able to absorb only a very small part of this knowledge. Norbert Wiener wrote in this regard: "Important researches sometimes delayed by the unavailability in one field of results that may have already become classical in the next field"

That was what happened in physics in the 20th century.

Physical reality of imaginary numbers unknown in physics to this day had been known in radio engineering even before the STR was created. Moreover, there are other sciences that use imaginary numbers besides physics. Unlike physics that has still had no idea of physical interpretation of relativistic formulas of the STR at superluminal velocities (therefore, the principle of light speed non-exceedance proved to be in demand in the STR), radio engineering textbooks perfectly explain the use of imaginary numbers.

² Which, in contrast to the widely publicized unsuccessful OPERA experiment, were quite reliable and, having been done before the OPERA experiment, made it unnecessary

³ Naturally, it makes sense to talk about the physical reality of imaginary numbers, as well as real numbers, only in relation to named numbers, equipped with indications of the units used for the corresponding parameters of physical objects and processes.

⁴ On which he made a presentation at the International Electrical Congress and, in addition, in the proceedings of the American Institute of Electrical Engineers published an article "Complex quantities and their use in electrical engineering."

⁵ In the theory of electric circuits the imaginary unit is commonly denoted by the letter j , whereas the letter i denotes electric current.

In 1826, when there had been no electrical measuring equipment, Georg Simon Ohm discovered a law applicable to DC circuits. The law was named after him [55], [56]. And in 1893 Charles Proteus Steinmetz proposed his interpretation of Ohm's law in respect to linear AC circuits [57],

Now millions of engineers all over the world use it daily in their practice. According to the symbolic electric circuit analysis method proposed by him, resistance of any LCR-circuit would be measured by complex numbers whose values depend on frequency of voltage applied to an electric circuit.

This makes it possible to carry out a very simple and comprehensible experiment that answers the question whether imaginary numbers are physically real. And all we need for this is to change the frequency applied to a considered LCR-circuit and once again measure the value of current flowing in it. If the value of

current does not change, resistances of capacitors and inductors included in the circuit are actually imaginary by its physical nature. And if the value of current changes, then these resistances are imaginary only in name and since they are measurable, they are actually existent. After all, most of what we know about the world around us, we have learned in physics, biology, chemistry and all other sciences particularly with the help of measuring devices. And if we learnt about the world around us directly with the help of our senses and trusted only them, there would be no science.

All engineers who have ever held a soldering iron in their hands know that resistance of LCR-circuits always depends on frequency of voltage applied to them. This dependence is called the frequency response. For many decades, the industry has even mass-produced devices for measuring frequency responses (see fig.1).

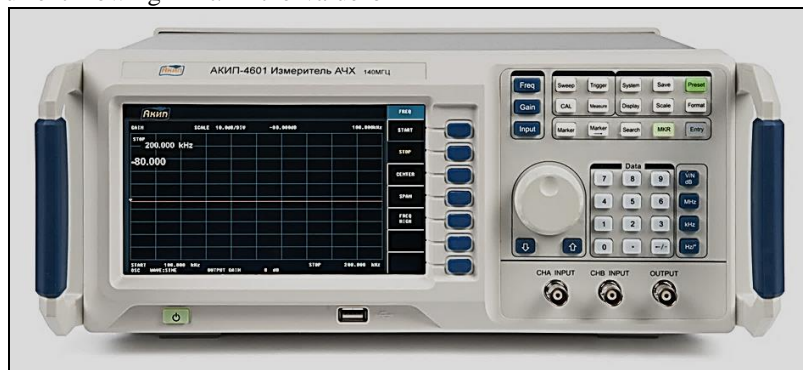


Fig. 1. In any radio engineering laboratory there are devices (one of them is shown in the figure), called frequency response meters, which by their very existence prove the physical reality of imaginary numbers. Thus they prove the incorrectness of the existing version of SRT, and the OPERA and ICARUS experiments at the Large Hadron Collider made it unnecessary

Thus, radio engineering undoubtedly proves physical reality of imaginary numbers and thereby refutes the principle of light speed non-exceedance, and, consequently, the version of the STR presented in all university textbooks of physics.

4. Why did the existing version of STR turn out to be irrefutable?

Despite all the refutations mentioned above, the version of the STR set forth in modern textbooks continues to dominate in physics and is studied even in the most prestigious universities. And involuntarily the question "why?" arises. Why is it that in other sciences one experiment that refutes them is enough for the corresponding hypothesis or theory to cease to exist? And in physics, SRT, in spite of everything, turned out to be irrefutable. Why did the existing version of STR turn out to be irrefutable?

The answer to this question is obvious - because this version of SRT is in demand. But this answer raises another question - by whom and why is it in demand? And the answer to it is also simple - by relativistic physicists and for career reasons. But it's not entirely obvious.

Then let us remember. At the beginning of the 20th century, the STR was met with hostility. Nobody understood and accepted it, since scientists had previously carried out their research based on classical physics,

which even now is much more requested than relativistic physics. However, the STR overcame general scepticism of physics community and began to be studied in textbooks. Now history repeats itself. For more than 100 years of its existence, many studies have been done, many theses have been defended, many articles and books have been published, and many physicists have created their careers on the basis of the STR. Many physicists-relativists have headed academic departments and journal editorial offices. Considering that there is no antimonopoly law in science, but rather competition, physicists have naturally begun to use their position to stifle scientific dissent. Sir Karl Raimund Popper [58] wrote: "... *Struggle of opinions in scientific theories is inevitable and is a necessary prerequisite for the development of science.*"

Therefore, in order to answer the question posed in the title of the article, it is necessary to take into account the psychological aspect of the problem of competition in science, which is actually a kind of business. Hans Christian Andersen's fairy tale "The Emperor's New Clothes" perfectly illustrates the paradoxical nature of the solution of this problem in STR. It is clear from the tale that the indisputability of the existing version of the (essentially incorrect) STR was achieved by taking the problem of its existence beyond the bounds of common sense. The same way in Andersen's fairy tale, in which knavish tailors suggested to the king that

he make clothes invisible to the unwise courtiers and visible to the wise courtiers, thereby creating a situation beyond common sense in which:

- courtiers, in order for the king to consider them smart, began to pretend that they see the king's clothes that do not actually exist;
- courtiers who would like to tell the truth about emperor's non-existent clothes knew in advance that they would be regarded stupid;
- thus, the situation forced courtiers to tell a lie for career reasons, and thereby contribute to the successful activities of the swindlers.

And as shown in the monograph of the Nobel Prize winner Sir Roger Penrose "The New Mind of the King" [59], which is an allusion to Andersen's fairy tale, quite recently in computer science it was similarly argued about the inevitability of the emergence of a computer civilization [60]-[64], which over time supposed to enslave people. This witty reception of Sir Penrose was so effective that now no one remembers the possible enslavement of people by computers.

And in the situation considered in the article:

- the physical community now recognizes as "smart" those scientists who understand (and at first no one understood and accepted STR) the generally accepted version of STR and believe it to be unconditionally correct, despite the fact that it is refuted by many well-known physical realities;
- and these "smart" scientists even deliberately created – for example, by the OPERA and ICARUS experiments – an incorrect public opinion about the infallibility of the existing version of STR presented in university physics textbooks, which justified their unsuccessful long-term multi-billion dollar costs for the implementation of erroneous scientific concepts;
- at the same time, scientists who try to criticize the generally accepted version of STR, the physical community creates a dubious reputation and difficulties in creative activity.

Thus, from the set forth it follows that the universally accepted version of STR stated in physics textbooks, as it is incorrect, it is quite possible to call on terminology H. H. Andersen's "New King's Delusion". And in fact this new theory is as non-existent as the king's non-existent new dress. But the physical community, ignoring the physical realities refuting this version of STR, as well as the "clever" courtiers in Andersen's fairy tale praises it. And it is even studied in physics textbooks. Nevertheless, as Hans Christian Andersen argued, "the king is naked" and so the generally accepted version of the STR in physics textbooks must be corrected.

5. Conclusions

Therefore it is time to realize that, despite the great significance for science of the principle of relativism, this principle, due to the lack of the necessary experimental knowledge in the 20th century in the generally accepted version of STR, was incorrectly stated using the incorrect postulate about non-exceeding the speed of light, that replaced this knowledge. And over the past century since creation of this obsolete version of the STR, physics community has canonized it, instead of

correcting and developing it further using the alternative version of the STR created in the 21st century [65]-[69]. But Albert Einstein himself does not claim that his version of STO is infallible. He wrote: "*There is no idea in which I am confident that it will stand the test of time*"

Therefore, the conclusion is logical: modern higher physical education is imperfect, because now even in the most prestigious universities students are still being taught knowledge that has already been refuted by modern science.

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TECHNICAL SCIENCES

THE DEVELOPMENT RENEWABLE ENERGY SOURCES PROBLEMS DURING THE WAR

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Abstract

Analyzed the main factors of influence on the development of renewable energy in Ukraine at various stages and provided recommendations on forms of RES support and maintaining investor's interest in this field during the post-war recovery period.

Keywords: renewable energy sources, war, Schedules of emergency shutdowns, power network.

In the conditions of emergency power outages and regular missile attacks on Ukraine, the search for alternative sources of energy has become extremely important. Increasingly, the most optimal option in conditions of permanent power outages is the implementation of decentralized energy supply solutions.

As practice shows, they can be implemented using renewable energy sources (RES). The industry has developed quite rapidly, but also in the last almost 3 years, a lot of problems have arisen that are currently not being solved. As a result, the prospects for the development of the RES sector are decreasing, investors are afraid to invest, and the unsettled legal field prevents the surviving RES electricity producers from working, and the owners of the destroyed stations from receiving funds for reconstruction.

Thousands of consumers throughout the country remain without electricity every day. Schedules of emergency shutdowns are introduced in an emergency order to stabilize the work of the energy system and ensure the balance of energy generation and consumption. Second, if before the war the switchover from fossil fuels to carbon-neutral energy was considered exclusively in the context of overcoming the climate crisis, now the entire democratic world has united against Russian energy resources. Russian gas and oil should

gradually be replaced by new technologies and even more renewable energy sources.

That is, there are more than enough prerequisites for the further development of renewable energy in Ukraine. In addition, its development is legislated in strategic documents. Renewable energy also finds its place in plans for post-war reconstruction and development of Ukraine.

Also, in the plans for the "green" reconstruction of the country, it is necessary to pay attention also to the problem of local accumulation of energy resources. Ukrainian government should think about the diversification of this energy resources.

It is very important to develop the area of RES, in particular, decentralized energy as a way to democratize the energy sector in Ukraine. Today, due to excessive centralization of the energy system, the sector has a number of disadvantages. Some of them relate to safety indicators, which were appeared in excessive dependence on the import of resources to ensure the power system. Including their excessive concentration in specific places.

According to the official data of NEURC (National Energy and Utilities Regulatory Commission), it is possible to observe the dynamics of the development of RES in the last four years.

The dynamics of the development of the RES 2018-2022

Source: BULLETIN TO THE 2021 NEURC ANNUAL REPORT, June 2022

At the beginning of 2022: total power of RES stations - 11435 MW; annual release of electricity from RES - 11436 million kW*h.

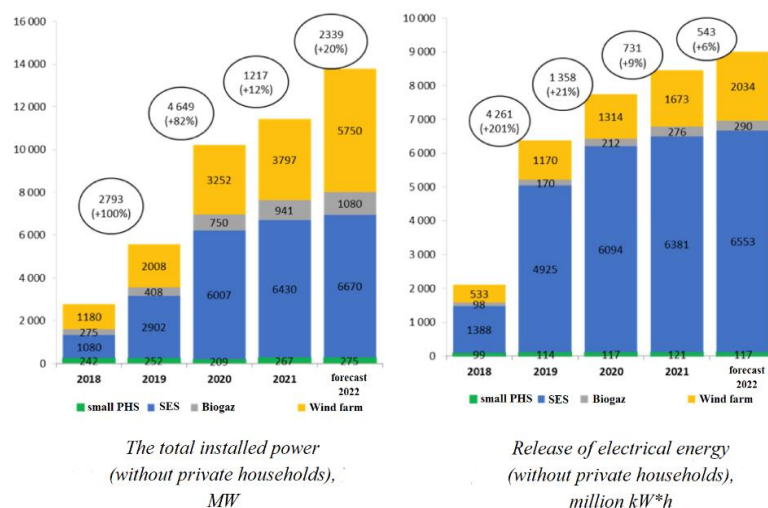


Figure 1

Despite the growth, the industry has accumulated three characteristic problems: technical, economic and legal

As for technical barriers, we are talking about the difficulty in issuing technical conditions and connecting new RES generation facilities to the energy system of Ukraine. It is difficult at the moment, because the system has suffered a lot of damage.

The establishment of the "feed-in tariff", the calculation of which is unchanged for producers until 2030, was the first step in the legalization of green energy and a mechanism for supporting RES facilities.

However, closer to 2020, problems started to affect the RES industry. In order to improve the rules of the game in the market, was adopted the Law "On amendments to some laws of Ukraine regarding the improvement of the conditions for supporting the production of electricity from alternative energy sources" No. 810-IX dated 21 July 2020 and the Regulation of the Cabinet of Ministers of Ukraine dated 2 August 2022 № 889.

Legislative acts guaranteed the charter of RES producers to participate in auctions for the allocation of support quotas:

- Required participation for WPPs(Wind Power Plants) over 5 MW and SPPs (Solar Power Plant) over 1 MW, on a voluntary basis - for other RES.
- Guaranteed purchase of electricity for 20 years from the commissioning of the station within the quota at the price determined at the auction.
- Auctions for the distribution of annual quotas are expected to be held in accordance with the schedule of auctions for the relevant year in the period from July 1, 2019 to December 31, 2029. Support quotas must be approved by the CMU (Cabinet of Ministers of Ukraine) for the next year with indicative prognosis for 4 years.
- The size of the quota for each type of RES is not less than 10%.

However, as of November 2022, no annual quota allocation auction has been held. Such cases limit the ability of manufacturers to predict the financial and economic performance of their enterprises. Unreliability on the part of the authorities expands to the legal

segment, which control the sector of "green" energy. As follows, over the past 4 years, the situation in the sector of RES has worsened also because the authorities executed their obligations with violations to the producers of "green" energy.

Restructuring of "green tariffs" was carried out, namely:

1) Introduction of the restructuring mechanism "green" tariff.

On July 21 2020, Law 810-IX was adopted:

- retrospective reduction of the "green" tariff (adjustment coefficients) depending on the production technology and the date of commissioning of the power station;
- increasing the responsibility of RES producers for imbalances;
- additional guarantees of legal immutability.

2) Assessment of the impact of restructuring conditions on the solvency of RES producers within the credit programs.

On August 18, 2020, the National Bank of Ukraine adopted Resolution № 118, according to which it created flexible conditions for banks to restructure loans provided for the production of "green" electricity.

3) Repayment of debt until 31.12.2021.

The debt of the Guaranteed buyer for 2020 has been repaid in full, but in violation of the settlement schedules provided for in the Memorandum.

4) Timely and in full calculations.

Settlements between the Guaranteed Buyer and the producers were delayed and violated the terms of the electricity purchase and sale contracts.

As of 01.11.2022, the settlements for 2021 are 99%, for 2022 - 50%.

5) Financing of the "green" tariff.

The unjustified level of the tariff for the transmission of electricity does not allow the OSP to finance the deficit of the Guarantee Buyer's funds.

Cases of appeals to the Constitutional Court regarding recognition of the "green" tariff as illegal also

added significant risks. While the court is considering the case, the entire "green energy business" is in limbo.

Another negative factor for the sector is a number of orders of the Ministry of Energy, which violated the procedure for calculating generation with RES producers, due to which many RES producers were on the verge of bankruptcy for some time. Even maintaining

those projects that were launched was problematic. In this situation, financial institutions, which granted permission for loan restructuring and credit holidays, played a major role.

On the basis of the conducted analysis, we will highlight short-term and long-term projects of solutions to the mentioned problems. Including:

Table 1

Improvement of transmission mechanisms

| The procedure for compensation for the unreleased energy of RES | Exit from the balancing group of the Guaranteed buyer with the right of return | Launch of "green" auctions | Avoidance of actions that worsen the conditions for RES projects |
|---|--|--|---|
| The resolution of the NEURC dated 24.06.2019 No. 1168 defines the procedure for calculation and compensation of electricity not released as a result of the execution of the OSP command (clause 4.18.12). The changes entered into force on January 1, 2021. | On July 29, 2022, Law 2479-IX was adopted with the relevant regulations, but it is impossible to apply them in practice for RES manufacturers due to the lack of regulatory and by-laws, which must be developed by the Regulator. | As of November 2022, the quotas have not been approved, and no "green" auction has been held | Additional responsibility for RES manufacturers for imbalances that are not caused by deviations of their generation schedules, due to the new formula for calculating the imbalance of the Guaranteed buyer (by the decision of the Supreme Court of Ukraine dated September 8, 2022 on recognizing the formula as illegal). |

By the end of 2022

Creation of conditions for the successful completion of previously started RES projects and the launch of work on market measures.

1) overcoming technical risks associated with joining networks;

2) start work on preparation for activities aimed at:
- abolition of the mechanism of special duties and equalization of competition on the market;

- effective mechanisms for supporting RES and balancing capacities that will work in practice;

- ensuring legality and preventing violations and abuses in the process of regulating the electric energy market;

- expansion of opportunities for realization (sale) of electric energy on the foreign market (system of certificates of origin, or "green" certificates), etc.

By the end of 2023

- Economic predictability for new RES projects in the post-war period of energy system modeling and creation of development scenarios as a basis for updating the industry's strategic documents;

- review of development plans for distribution and transmission systems;

- adoption of final strategic documents - 6 months after the termination (cancellation) of martial law;

- completion of previously initiated market measures.

From 2024

Gradual access to foreign markets of sales of "green" energy:

- measures to ensure the integration of the electricity markets of Ukraine and the EU (European union);

- coordination of conditions and opportunities for exporting electricity from RES;

- compliance with the requirements of EU legislation, in particular, regarding state aid in the electricity market.

Conclusion: Solving the problems in the field of RES will allow producers of electricity from RES to gain stability, will contribute to overcoming the energy crisis and recovery of Ukraine with a focus on safe and sustainable energy. The development of renewable energy also has a global character - together with the European Union, Ukraine is developing a sphere that provides heat and electricity without the participation of the terrorist country Russia.

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