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AGRICULTURAL SCIENCES

DEFINITION OF THE PESTS' SORT STRUCTURE IN POTATO SOWINGS OF THE WESTERN REGION OF THE AZERBAIJAN REPUBLIC

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Abstract

Growing of the potato plant in the western region of the Azerbaijan Republic for more than 200 years caused collection of the representatives in the fauna and flora concerning the different sorts in agrocnosis. An aim of the research is to work out fight measures integrated to the local condition against the pests in potato sowings of the zones above sea-level, specifying a sort structure, spreading area and biological features of the pests. The route observation-calculation works were performed by involving 30 % of agrocnosis for specifying the pests' sort structure in potato sowings of the western region in 2003-2022. Our researches showed that 31 sorts of the pests spread in potato sowings which are grown in the zones 850-900 meters above sea-level (*Gryllotalpa gryllotalpa* L., *Gryllus desertus* Pall., *Doclostaurus maroccanus* Thnb., *Chaetocnema breviscula* Fald., *Leptinotarsa decemlineata* Say., *Anisoplia leucaspis* Cast, *Melolontha pectoralis* Germ, *Agriotes gurgistanus* Fald and others). An injury of the pests involves underground (mole cricket and wire worms) and surface (Colorado beetle and its larva) organs. 27 sorts of the pests were revealed in agrocnosis while descending 900-1000 meters above sea-level. During the researches aren't found in the zones above 1000 meters. Change of the pests' sort structures depending on geographical zone was determined.

Keywords: potato plant, Colorado beetle, mole cricket, bioecological features.

Introduction

A comparative analyses with the reference information of the research works about sort structure, spreading area, bioecological features and injury of the injurious organisms which assumes negative farming importance extended in agrocnosis besides agrotechnical measures in growing of potato plant, getting of the reach and high harvest. (Kakharov, 2008; Naumova, 2008; Kapustkin, 2009; Zamalieva, 2013. Fisechko, R.N. 2013). There is a great importance of revealing the new sorts which have negative farming importance in harvest preserving (Gerasimova et al., 2007; Anisimov, 2009; Maluga et al., 2013). It is impossible to fight against the pests in an optimal period not studying the sort structure, biology, ecological features, spreading area and other factors of the injurious organisms (Doljenko and Burkova, 2007; Brechko, 2012; Goncharov et al., 2013; Ulyanenko et al., 2015). An analysis of the researches from the reference data shows that injurious organisms more than 100 injure in potato agrocnosis (Vilkova, 2005). But depending on geographical zone the sort structure of the injurious organisms and injuring limit change. The researches show that change of the sort structure and injuring of the pests in agrocnosis is connected with the ecological factors (Bale et al, 2002) . While the microclimate condition that is formed as a result of the ecological factors is fit for the pests the harvest loss happens (Goehring and Oberhauser, 2002; Hodkova and Hodek, 2004; Kosta and Simek, 2000). The seed potato nodule brought from Lvov province (zone of the Ukraine State) was firstly observed in the west region of the republic of Azerbaijan in 1972. At present the pests spread in all the regions of our republic. The Colorado beetle is considered the most dangerous pest not only for the potato

plant but also some more agricultural plants (tomato, aubergine, pepper) (Cannaert, 2011; Yocum, 2001). The various means are used in fight with the pests (pesticides, radiation, gene-modified potato sorts and etc.) (Danks, 2005; Denlinger, 2002; Chen et al., 2004). Being young of the pest from phylogenetic point of view, high ecological plasticity and richness of the nutrient cause mass increase of the Colorado beetle (increase of the population density), it needs for new fight measure preparation against the pest (Arnott and Yan, 2002; Bosa, 2005). An analysis of the statistical indications shows that an arable area of the potato plant (2003-184; 2015-177,6; 2022-178,8 thousand hectares), production volume (2003-1228,3; 2015- 1178,6; 2022- 1089,5 thousand tons), and productivity (2003-153; 2015- 149; 2022-145 cent/ h) decreased under the pests' influence. One of the pests in potato sowings is mole cricket. This pest gnaws firstly planted nodules and developing shoot of the plant, then newly formed nodules seriously during a season (Huseynov, 2012). The wire worms in the potato sowings deteriorate a quality of the marketable produce indications.

Materials and methods

The route observation – account works in the zones above sea-level have been performed for 3 times a month to specify the sort structure of the pests spreading in potato sowings of the western region of the Azerbaijan Republic. They involve 10 % of the arable areas. The surface and underground organs of the plants were looked through during the observations. With this purpose 20 samples and 5 plants in each sample have been examined going in a direction of the arable area diagonal, the observed pests have been gathered in the pots and their account has been performed, a sort structure

of the gathered samples has been specified (Fasulati, 1971).

The hollows were dug by 16 numbers of calculation per hectare in a direction of the area diagonal for specifying the sort structure from the pests on the soil layer. The hollows were dug at 30 cm x 80 cm x 45 cm of size (noticing inter- row of the potato plant). The hollow depth corresponded to the layers (10; 20; 30; 45 cm). The dug soil samples were sieved from the special sieves on the tarpaulin. The observed pests were collected in the testing glass, a table which shows a region, date of revealing pests was pinned on it. The pests investigated as a result of the research were brought to the laboratory and fixed a sort structure (Kosova and Poliakov, 1958).

Definition of the pests in the potato sowings which are grown in the zones above sea-level was performed in the following rules.

1. An injuring percentage of the plants was calculated by the following formula (1).

$$P = \frac{n \cdot 100}{N} \quad (1)$$

Here: P- nodule, shoot and injuring percentage of the leaves, %;

n – injured nodule, shoot and leaves number, number;

N- examined nodule, shoot and a total number of the leaves;

A coefficient turning into 100 %.

2. An injuring intensity of the plants was established over the scores. At this time six-score scale was used.

0 score – plant or organs no injured;

I score- plant or organs were injured till 5 %;

II score – plant or organs were injured till 25 %;

III score – plant or organs were injured from 25 % to 50 %;

IV score – plant or organs were injured from 50 % to 75 %;

V score - plant or organs were injured more than 75 %.

3. An average –score of the injuring intensity was calculated by the following –formula (2):

$$R = \frac{\sum(a \cdot b)}{N} \quad (2)$$

Here: R – average-score of the injuring intensity, score;

\sum - sign of sum

(a○○○○○○○○○ b) -injurious organ or plants quantity (a), is multiplied injuring score (b), num./ score.

N- injured organ or a total number of plants , num;

4. A injuring degree of plant or its organs are fixed by the following formula (3).

$$X = \frac{\sum(a \cdot b) \cdot 100}{N \cdot K} \quad (3)$$

Here: X –injuring degree of the plants or organs, %;

\sum - sign of sum;

a – injurious organ or plants quantity, num;

b – corresponding score of injure , score;

N – quantity of the examined plant or organs, num;

K – the highest score of injure, score;

A coefficient turning into 100 %.

The potato nodules in 20 samples (in plant) in a diagonal direction of the hospital area chosen at the end of the season were examined to determine the potato nodules injured by the soil pests. A percentage of the potato nodules injured by the soil pests (mainly mole cricket and wire worms), an average-score of injurious intensity, injurious degree were calculated as above-mentioned forms (Fasulati, 1971).

Discussion

The route observation-account works were carried out in Goranboy, Samukh, Ganja, Goygol, Shamkir, Dashkasan, Gadabay, Tovuz, Gazakh and Aghstafa districts of the region for specifying the pests' sort structure in the potato sowings of the western region of the Azerbaijan.

A height of the region from sea-level and landscape zones were investigated to specify reasons of the change in a sort structure of the pests. A height of the region from sea-level (Baltic sea) changes by 69 meters (Samukh region) and 2470 meters (Shamkir district, Goygol station). Strong change of the height from sea-level over horizontal zonality exerted a serious influence on pests' sort structure in potato sowings.

More than 67 % of the region were distributed between the foothill, partially low mountainous forest-field (from 500 m to 800 – 1000 m) landscape stripe and mean upland half-field (from 1000 m to 2000 m, partially high) landscape. The foothill half-field (from 200 m-to 500-600 m) gains the second place for the landscape stripe zone.

The forming ecological condition – abiotic, biotic, hydro- edaphic, heliophysics, geographic and anthropogenic factors influence the insects' development directly and complexly. The Colorado beetle, *Gryllotalpa*, wire worm, potato tuber moth, autumn bollworm , marble insects larva and others are found in potato sowings in the zones above 850-900 m of sea-level (Table 1).

A reason of not observing *Gryllotalpa gryllotalpa* L., *Chaetocnema breviscula* Fald., *Lygus pratensis* L., in potato agrocenosis, while ascending higher than 900-1000 m of sea-level is the environment being formed by the vertical zonality. The Colorado insect in the potato areas grown till 900-1000 m above sea-level gives three generations (Huseynov, 2012). But decrease of the pests' generations quantity is observed while the height rises. Its reason is a low temperature. So, while the height rises above sea-level a temperature of the air falls 0,6 °C on average. Its reason is a change of the falling angle of the Sun beam. The air temperature falling while growing height exerts influence on other ecological factors. Consequently, the microenvironment plays an important role in biotope formation. Therefore the changes are observed in bioecological characters of

the pests over the vertical zonality (Mammadova et al., 2011).

Table 1.

Sort structure of the pests from insect classes and arthropoda type (Arthropoda) in early and summer potato agro-cenosis grown in the zone above 850-900 meters of sea-level of the western region in Azerbaijan

Group	Subgroup	Family	Latin names of the insects	Casual	Periodic	Constant
				Plant injuring, %		
<i>Orthoptera</i>	<i>Dolichocera</i>	<i>Gryllotalpidae</i>	<i>Gryllotalpa gryllotalpa</i> L.			11,6
			<i>Gryllotalpa unispina</i> Sauss.			23,0
		<i>Gryllidae</i>	<i>Gryllus desertus</i> Pall.		2,0	
	<i>Brachycera</i>	<i>Acrididae</i>	<i>Dociostaurus maroccanus</i> Thnb.		1,0	
<i>Coleoptera</i>	<i>Poliphaga</i>	<i>Chrysomelidae</i>	<i>Chaetocnema breviscula</i> Fald.		7,0	
			<i>Leptinotarsa decemlineata</i> Say.			35,0
		<i>Scarabaeidae</i>	<i>Anisoplia leucaspis</i> Cast		2,0	
			<i>Melolontha pectoralis</i> Germ	1,0		
		<i>Elateridae</i>	<i>Agriotes gurgistanus</i> Fald			9,0
			<i>Agriotessputator</i> L.			-
			<i>Athous haemorrhoidalis</i> F.			-
	<i>Adephaga</i>	<i>Carabidae</i>	<i>Zabrus tene brioides</i> Goeze		1,0	
		<i>Gelechiidae</i>	<i>Phthorimaea operculella</i> L.			40,0
<i>Tylenchida</i>	<i>Tylenchidae</i>	<i>Various nematodes</i>	<i>Heterodera rostoshiensis</i> Woll.	0,1		

The temperature decreases while the height rises above sea-level, and this causes change of the individual's way out of wintering depending on sea-level. This affects on the Colorado beetle's birthrate and it is a reason for two and least birthrate in the zones higher than 100 m above sea-level.

The changes in spreading and development of the pests observed in agro-cenosis are supervised at a height of 500 m above sea-level, at 500-700 meters, 700-900 meters and higher than 1000 meters. And this shows that the ecological factors can create the environment (cenosis) for biotope formation at the noted heights. So the microclimate changes for development of the pests and potato plant at the shown height (Humbatov, 2011). Becoming wild, abnormal development of the early potato sowings 500-700 m above sea-level and spring sowings of the zone 500 m above sea-level are observed. At a height of 700 – 900 m a spreading area of the mole cricket in potato agro-cenosis becomes limited. Decrease of the Colorado beetle generations' quantity is revealed at a height more than 1000 m (Gulieva and Safarova, 2013).

As is seen from the researches the relief of the western region is very complicated. The different heights above sea-level are found in some districts (Goygol, Shamkir, Goranboy). Our researches showed that the Colorado beetle in potato agro-cenosis of the

Goranboy regions gives two or three generations during a season depending on a height above sea-level. Besides the districts of the same region where the mole cricket spread, there are agro-cenoses in which pests don't spread. An impact of increase of the height above sea-level on wire worms population density was revealed. So, it is observed that the population density descends while the height rises. From this point of view, the region can be divided into four half -zones for the "dangerousness degree" depending on the height above sea-level: I half-zone – 700-900 m height above sea-level, II – 900-1000 m ; III – 500 and 500-700 m height. A reason of 700-900 m height above sea-level belonging to I half-zone is richness of the injurious organisms' sort structure, performing the spring sowings in agro-cenoses. Three generations of the Colorado beetle, one generation of the mole cricket from the primary pests develop in the spring sowings at a shown height. Besides it, a negative impact of the ecological factors causes abnormal development in the potato root bulbs and this is a reason of the strong decrease in productivity.

For the purpose of the primary pests investigation of the percentage, intensity and degree of the damage in potato plant were specified. It was determined that the Colorado beetle and its larva injured the leaves of

the potato sorts 35,0 % on average . The plant was injured by I-V score and its injurious degree was 13,9 %. The calculation for investigation of the mole cricket injury on green mass of the potato plant showed that the shoots injurious was 13,0 % on average. At the end of the season injuring of the potato bulbs by the mole cricket and wire worms was specified.

The research works showed that the potato bulbs injuring by mole cricket was 23,0 %, by wire worms was 7,0 % (Mammadova and Huseynov, 2010). The product loss was studied to define wide-spread of the pests and their negative farming importance. The researches showed that injuring of the plants by the Colorado beetle till 35,0 % times more than expense spending on chemical fight (was shown in economical-injurious limit).

It was known that a weight of the potato bulb injured by 100 wire worms is 17,6 kg, but a weight of the potato bulb injured by mole cricket is 15,2 kg. It was determined that a weight of 100 health potato bulb is 17,9 kg. The wire worms were a reason for 0,3 kg loss, but mole cricket was a reason for 2,7 kg of the product loss. Injuring of the plant shoots by the potato tuber moth was 22,0 % , but the leaves spreading was 9,0 % in summer sowings (Huseynov, 2003). The potato bulbs infected by the potato tuber moth under the store-house condition become worthless because of loss in sowing material, food and marketable quality and aren't used for any purpose (Table 2). As is seen from Table 2 the population density rises if there is no any fight against the primary pests, and this may be a reason for the product loss and it can make condition for phytosanitary state every year.

Table 2.

Population density of the primary pests and plants infection

Name of pests	Quantity of the dug hollows	Population density of the pests	Quantity of the samples	Injurious percentage of the plants, %			Weight of the potato bulbs, kg		Product loss	
				shoots	leaves	tubers	health	injurious	kg	%
mole cricket	16	1,6	100 plants	13		–	–	–	–	–
			100 potato tubers	–	–	23	17,9	15,2	2,7	11,4
wire worms	16	1,3	100 potato tubers	–	–	7	17,9	17,6	0,3	4,5
Colorado insect	-	107	100 plants	–	352	–	180	73	107	40,5
potato tuber moth	-	-	100 potato tubers	–	–	100	17,9	16,2	100 % seless	–
		22	100 plants	22	9,0	–	145	68	77	53,1

Studying bioecological characters of the Colorado beetle in the investigative zone, A graphics depending on temperature of the Colorado beetle's going out of wintering was compiled and depending of the Colorado beetle development on ecological factors in the potato sowings from the zones 900-1000 m above sea-level shown on bioclimogram (Figure 1). As is seen from the

bioclimogram the precipitations quantity changes 20-60 mm for the pests development. But being more of the rainfalls quantity than these parameters (look at soil-climate condition) causes the best environment for the Colorado beetle development. One generation development continue 48-55 days.

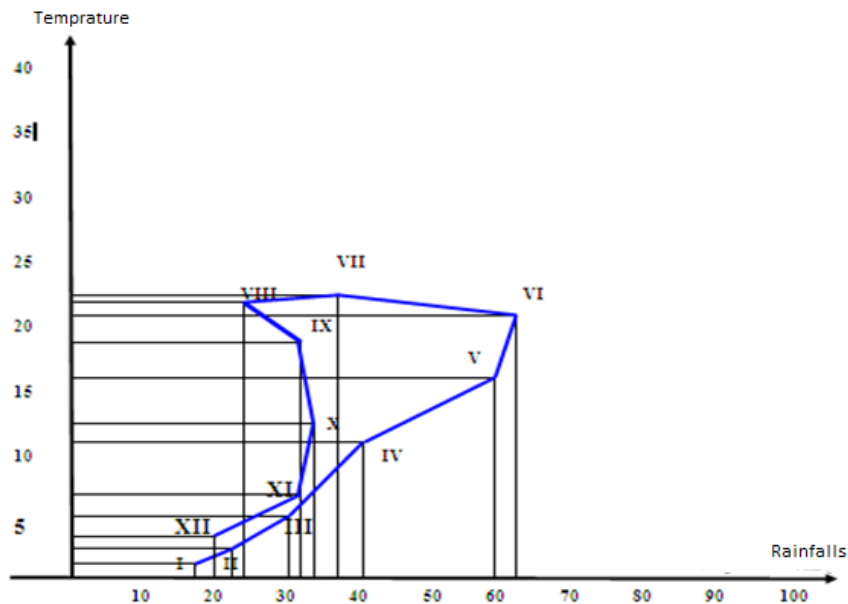


Figure 1. Bioclimogram of the Colorado beetle in the potato sowings of the zones till 900-1000 m above sea-level (Goygol district, Gizilgaya settlement)

The bioclimogram of the Colorado beetle development dependence on ecological factors was shown on Figure 2 (in the potato sowings 1000 m above sea-level). A quantity of the precipitations in the zones

1000 m above sea-level is more and it causes lasting of the Colorado beetle's development period. One generation development continued 65-70 days.

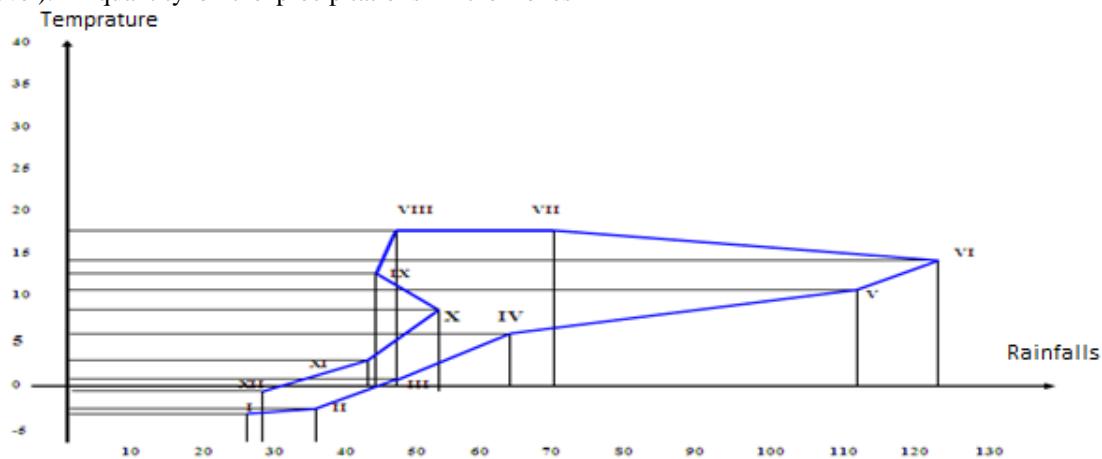


Figure 2. Bioclimogram of the Colorado beetle in the potato sowings of the zones higher than 1000 m from sea-level. (Gadabay ditrict, Slavyanka village)

An application of the limited factors in generating ability (generations' quantity) showed that after a height of 900-1000 m sea-level a low temperature of the soil in spring causes late going out of the wintering insects in various depth of soil. The researches show

that the mature individuals of the Colorado beetle spend winter in the deepest layers of soil, while rising up from sea-level. But gradual heating of the soil layer delays going out of the insect in spring (Table 3).

Table 3.

Factual and prognosticating period of the Colorado insect's going out of wintering in the potato sowings from the zones till 900-1000 m above sea-level in the western region (2003-2022)

Years	Soil temperature in 20-30 cm of depth, C°	Beginning date of going out of wintering, date		Difference between factual and prognosticating dates, day
		factual	prognosticating	
2003	16,0	10 May	13 May	+ 3
2004	14,8	24 April	22 April	- 2
2005	16,0	16 April	17 April	+ 1
2006	17,0	04 may	07 may	+ 3
2007	14,3	28 April	25 April	- 3
2008	14,7	24 April	22 April	- 2
2009	14,3	28 April	25 April	- 3
2010	14,8	22 April	22 April	0
2011	17,0	04 may	07 may	+ 3
2012	16,2	18 April	17 April	- 1
2013	15,9	19 April	18 April	- 1
2014	16,0	16 April	17 April	+ 1
2015	15,1	20 April	19 April	- 1
2016	15,7	16 April	15 April	- 1
2017	14,3	28 April	25 April	- 3
2018	14,7	24 April	22 April	- 2
2019	14,8	24 April	22 April	- 2
2020	15,9	19 April	18 April	- 1
2021	16,2	18 April	17 April	- 1
2022	15,7	16 April	15 April	- 1
On average	15,3	18 April	18 April	-

Conclusion

1. The researches show that the landscape stripes play an important role besides the climate stripes in spreading of the pests from zonality standpoint. Dividing of the western region into four half-zones depending on sea-level causes protection of the potato plant from injurious organisms besides providing a good soil-climatic situation for its development. The researches showed that 31 sort pests in the potato sowings at a height till 900 m from sea-level, but 27 sort pests developed in the zones at a height more than 900 m. Among these pests the Colorado beetle, *Gryllotalpa gryllotalpa* L. and *Gryllotalpa unispina* Sauss., nine sort of the wire worms are primary pests.

2. The half-zones of the western region are divided into three groups according to "dangerousness degree" from product loss standpoint: more product is subjected to loss at a height of 700-900 m from sea-level (I group) for "dangerousness degree". So, the spring sowings of the potato plant are performed at a shown height. The potato plant vegetation involves April – August months. The primary pests in this half-zone (Colorado beetle, mole cricket, wire worms) have full development cycle and this rises product loss and pesticide load.

II group - spring sowings of the potato in the zones higher than 900 m from sea-level. The potato spring sowings involve an end of April and August but the beginnings of September. An ecological condition is good for potato plant in these zones. The Colorado beetle develops in two generations, but the mole cricket isn't found in the potato sowings.

III group – early potato sowings in the zones till 500 m above sea-level. The early potato sowings involve the second ten-day and the first half of June. This period is fit for the potato plant development ecologically. Besides it 1,0 -1,5 generation of the Colorado beetle and wintering individuals of the mole cricket develop in early potato sowings, this causes minimizing of the product injury in connection with the pests incomplete development. The summer sowings of the potato grown in the zones till 700 m above sea-level belong to III group. The summer sowings of the potato plant involve the second half of July and November. Relatively decrease of the temperature, falling dew, (or intensifying of the rainfalls), increase of the relative humidity make a good optimal situation for the plant development and this results in increase of productivity at a period of bulbs formation in the summer sowings. At the same time many parts of the development period in the potato bulbs are found in the period of the third generation of the Colorado beetle, mole cricket and wire worms larva's going to wintering, this causes the product damage.

An adaptation of the sowing period (early, summer, spring sowings) to the local conditions and season causes decrease of the cost price for the fight against the product increase and primary pests.

References

1. Anisimov B.V. 2009: *Protection of the potato from diseases, pests and weeds*. Collection of scientific works by Belov G.L. and others M., "Potato culture", 272 pp.
2. Arnott S.E., Yan N.D. 2002: The influence of drought and reacidification on zooplankton emergence

from resting eggs. – *Ecological Applications*. 12:138–153

3. Bale J.S., Masters G.J., Hodkinson I.D. et al. 2002: Herbivory in global climate change research: direct effects of rising temperature on insect herbivores. – *Global Change Biology*. 8: 1–16

4. Bosa C.F. 2005: *Pheromone- mediated communication disruption in Guatemalan potato moth, Tectia solanivora (povolny)*. Swedish university of agricultural Sciences : 29

5. Brechko E.V. 2012: Optimization of the insecticides application in protection of potato from Colorado insect. – *Guarding and quarantine of plants* . 4:33–37

6. Cannaert F. 2011: Three years of wireworms monitoring with pheromone traps in France. – *IWGO Newsletter*. 31:41–43

7. Chen B., Kayukawa T., Jiang H. et al. 2004: Trypsin, a novel clip-domain serine proteinase gene up-regulated during winter and summer diapauses of the onion maggot. – *Delia radicum*. Gene.:115–123

8. Danks H.V. 2005: How similar are daily and seasonal biological clocks. – *Journal of Insect Physiology*: 609–619

9. Denlinger D.L. 2002: Regulation of diapause. – *Annual Review of Entomology*. 47:93–122

10. Doljenko V.I., Burkova L.A. 2007: Modernizing of the means and protection technologies of potatoes from pests. – *Agro XXI*. 7-9:15–18

11. Fasulati K.K. 1971: *Field investigation of the surface invertebrates* .Moscow, High school, 423 pp.

12. Fisechko R.N. 2013: Peculiarities of the Colorado insect's biology under forest steppe conditions. – *Guarding and quarantine of plants*. 10:42–43.

13. Gulieva N.F., Safarova I.M. 2013: *Insects ecological physiology*. Baku, Bayramoglu, 285 pp.

14. Gerasimova A.V., Zenkevich S.V., Lisov A.K. and others . 2007: Integrated guarding of potato. – *Protection and quarantine of plants*. 7:44–46

15. Goncharov N.P., Ulyanenko L.N., Filipas A.S. and others. 2013: Economical efficiency of the integrated system of the potato seed planting protection in Kaluga region. In: *Materials of the 6th International scientific practical Conference “ Agrotechnical method of the plants protection from injurious organisms”*. Krasnodar , June 17–21. pp. 225–231.

16. Goehring, L., Oberhauser K.S. 2002: Effects of photoperiod, temperature, and host plant age on induction of reproductive diapause and development time in *Danaus plexippus*. – *Ecological Entomology*, 27:674–685

17. Huseynov K.G. 2003: Working out of the fight measures against the soil pests in potato sowings of the Ganja-Gazakh . – *IPPTGR annual account* : pp.22

18. Humbatov A.M. 2011: *Entomology . Insect ecology and fight methods against injurious insects*. III Part. Baku, 105 pp.

19. Huseynov K.G. 2012: Pests sort structure from vertical zonality standpoint in potato sowings of the Ganja-Gazakh region. – *Scientific works of ASAU*. 3:19–22

20. Huseynov K.G. 2012: Dependence of the period of potato sowings on vertical zonality. – *Agrarian Russia*. 6: 13–17

21. Hodkova M., Hodek I. 2004: Photoperiod, diapause and cold-hardiness. – *European Journal of Entomology*. 101:445–458

22. Kapustkin D.V. 2009: *Biological peculiarities of the Colorado insect . Leptinotarsa decemlineata Say. (Coleoptera. Chrysomelidae) in the North- West region of Russia*. Ph. D diss., Sankt-Peterburg ,Pushkin, 219 pp.

23. Kakharov K.Kh. 2008: *Biological peculiarities of the Colorado insect 9Leptinotarsa decemlineata Say) and measures of the fight against them under Tajikistan conditions*. Ph.D diss. Dushanbe. 240 pp.

24. Kosta V., Simek, P. 2000: Overwintering strategy in *Pyrrhocoris apterus* (Heteroptera): the relations between life-cycle, chill tolerance and physiological adjustments. – *Journal of Insect Physiology* 46:1321–1329

25. Kosova B.B., Poliakov I.Y. 1958: *Prognosis of the primary pests and diseases of the agricultural plants*. Moscow, 626 pp.

26. Mammadova S.R. and Huseynov K.G. 2010: Colorado potato beetle and fight against it. – *Scientific works of ASAU*. 1:34–38

27. Maluga A.A., Chulikova N.S., Omelchenko N.A. 2013: Selection of the optimal period for potato processing against the Colorado insect. – *Protection and quarantine of plants*. 6:34–36

28. Mammadova S.R., Huseynov K.G. , Ibrahimov D.E. 2011: Ecological plasticity of the Colorado insect under Ganja-Gazakh conditions of Azerbaijan. – *Head agronomist*. 9:45–47

29. Naumova N.I. 2008: *Colorado insect and potato guarding from pests under various conditions of land use in North-West of Russia Federation*: Ph.D.Diss. Pushkin, 20 pp.

30. Ulyanenko L.N., Filipas A.S. and others . 2015: Integrated system of the potato seed planting protection in Kaluga. – *Guarding and quarantine of plants*. 1:23–25.

31. Vilkova N.A. 2005: Strategy of the agricultural plants guarding from advent sorts insects-phyto-fags as an example of Colorado insect. – *News of the Plant protection*. 1:3–15.

32. Yocum G.D. 2001: Differential expression of two HSP70 transcripts in response to cold shock, thermoperiod, and adult diapause in the Colorado potato beetle. – *Insect Physiology*. 47: 1139–1145

33. Zamalieva F.F. 2013: Potato protection in Tatarstan. – *Guarding and quarantine of plants*. 6:43–45

BIOLOGICAL SCIENCES

ON THE STATE OF FISH STOCKS AND THEIR POSSIBLE CATCHES IN THE AYDAR-ARNASAY SYSTEM OF LAKES OF UZBEKISTAN

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Abstract

In 2020 - 2021, research of state of commercial fish stocks and the volume of permissible fish capturing in the Aydar-Arnasay lake system in Uzbekistan (the middle reaches of the Syrdarya River) has been conducted. The data on the coefficients of loss, natural and commercial mortality of fish and statistical data on catches by species are given. The total ichthyomass of the commercial fish species mature part of the populations in the system of lakes is about 20 - 21 thousand tons in total (without species separation). The number of fish that can be captured without damage (total commercial stock) in these years is about 7 - 7.5 thousand tons. At present, the main commercial fishes are roach (*Rutilus rutilus*), pike perch (*Sander lucioperca*) and common carp (*Cyprinus carpio*), in some years there may be noticeable catches of gibel carp (*Carassius gibelio*).

Keywords: Fish stocks, allowable catch of fish, common carp, pike-perch, roach, Aydar-Arnasay lake system, Uzbekistan

Fish is the most important food product, the most balanced, and rich in valuable protein. Doctors have set the minimum rate of fish consumption necessary for the growth of a healthy population of the country - 16 kg/person, / per year. Unfortunately, fish consumption in Uzbekistan is about 4 kg/person/year. This means that there is a deficit in the full nutrition of the population of the republic. Objectively, this is due to the remoteness of the republic from the World Ocean, its location in the very center of the largest continent, and the poverty of fish resources. It is necessary to use every opportunity to increase fish production, one of the directions of which is the rational use of available water resources.

But fish production should not come into conflict with the conservation of biodiversity, in which the anthropogenic factor becomes the most important. At the present time, issues related to the state of fish stocks are especially acute, because stocks limit catches, and the whole nature of the fisheries of one or another reservoir is determined by-catches.

The Aydar-Arnasay system of lakes (Uzbekistan) is located in a saline depression in the east of the Kyzylkum desert in the middle reaches of the Syr Darya and has a total area of more than 400 thousand hectares and extends for more than 250 km in length (**Fig. 1**). The system of interconnected lakes of Aydarkul, Tuzkan and the East Arnasay reservoir (formerly the East Arnasay channel of lakes) is the largest fishery reservoir in terms of area and fish catches in the republic. However, catches fluctuate greatly, only in the 2000s the annual figures varied within 1-8 thousand tons. This raises the question of the rational use of available fish resources for the needs of fisheries. With regard to the Aydar-Arnasay system of lakes, there are no objective data either on stocks or on possible and reasonable catches for any species of fish from the local ichthyofauna. The purpose of this work was to assess the state of the stocks of the lake system and the volume of allowable fishing of the main objects of fishing, in which there is no negative pressure of fishing on the emerging stocks of fish stocks in reservoirs at the present time.



Figure-1. Aydar-Arnasay system of lakes and its location on the territory of Uzbekistan

Material and Method

Material from June 2019 to June 2020 (the first analyzed year, assumed to be conditionally 2019) and further to June 2021 (the second year under study, assumed by us conditionally to be 2020) during research fishing. Fish were caught with fixed nets with a mesh size of 24–120 mm in East Arnasay (Arnasay reservoir with fresh water), in Tuzkan and Aidar lakes throughout the water area. The nets were set according to generally accepted methods, in the same order during research fishing, one net 24, 36, 45, 55, 60, 70, 80, 90, 100 mm was included. We also analyzed the commercial catches of fishing brigades working in the Aidar-Arnasay system of lakes.

In the studied fish, the standard body length (to the end of the scale cover) (SL , cm) was measured with an accuracy of 0.1 mm, the scales were collected, from which the age was determined by conventional methods (Pravdin, 1966).

Used data on fish catches.

Calculations were carried out according to the method of analysis of fish stocks in inland waters (Metodicheskie..., 1990). Numerical data were processed on computers using the methods of variation statistics.

Results

Carp (carp), *Cyprinus carpio*. According to the current Fishing Rules in the republic, the fishing measure is set for carp at 28 cm. But commercial fishermen in the studied system of lakes actually catch larger carp due to consumer demand. The smallest commercially significant body size of carp is currently 31 cm. As a result of the above, we took into account and used in the calculations only carp larger than 31 cm. life (SL_{t+1} and SL_t - standard body length of a carp at the age of t and $t+1$) in carp, according to our data for the period of research years, looks like:

$$SL_{t+1} = 16.7 + 0.89 * SL_t$$

Table 1.

Size composition of the commercial carp stock in 2019-20, pcs.

Year	Standard body length (cm)													
	31	34	37	40	43	46	49	52	55	58	61	64	66	69
2019	71	60	fifty	32	fifty	58	43	24	fifteen	eight	6	5	0	3
2020	83	65	fifty	thirty	48	65	42	28	19	eight	9	5	2	3

In the first year of research, there were 425 carp pieces with a body length of 31 cm or more in the control catches. During the year, these fish grew, according to the formula, up to 44 cm or more. There were 229 of them in the second year of research. The loss amounted to 196 pieces. The calculation shows that the overall mortality rate in this case can be estimated as 0.46. For carp, according to long-term studies, the natural mortality rate is 0.25. Then the estimated fishing mortality rate is 0.21. For the data obtained, we introduce a correction factor equal to 0.04 according to the literature data for the indicated mortality rates (Methodological ..., 1990). Then the fishing mortality rate is 0.25, and natural 0.21.

The average weight of fish with a length of 31 cm or more in catches was 1.1 kg, and that of fish with a length of 44 cm or more was 2.1 kg. Then the average weight of one carp in catches is 1.6 kg.

The catch of carp in 2019 amounted to 300 tons, in this catch, there are only 190 thousand individuals of the species on average. The total loss is estimated at 350 thousand individuals with a total weight of 551 tons. Natural mortality - 251 tons. The rest amounted to 400 thousand fish or 644 tons of fish. The total commercial biomass of carp in the system of lakes can be estimated at 1194 tons.

Pike perch (*Sander lucioperca*). The commercial measure of pikeperch according to the current fishing measures in the republic is 36 cm. The data of research catches on the number of pikeperch of different body sizes in the studied system of lakes are given in **Table 2**. The calculated dependence of the growth of pike perch for the year has the form:

$$SL_{t+1} = 7.7 + 1.0 * SL_t$$

Table 2.

Structure of the commercial herd of zander in 2020-2021, pcs.

Year	Body length, cm													
	36	39	42	45	48	51	54	57	60	63	66	69	72	75*
2020	85	75	40	28	29	25	26	27	ten	9	6	one	3	3
2021	79	68	36	35	thirty	29	24	25	eleven	eight	5	2	2	3

* - 75 cm and more are indicated.

According to the results of research catches and comparison of data for 2 years, the calculations showed: out of 367 individuals of commercial size in the first year, 139 individuals remained in the reservoir in the second year (42 cm or more), a decrease was 228 individuals. Thus, the attrition rate was 0.62. Calculations have shown that the natural mortality rate for the applied technology is 0.21, and the commercial mortality rate is 0.41.

The average weight of fish with a length of 36 cm or more is 2.2 kg, a length of 42 cm or more - 2.5 kg, in total in catches - 2.4 kg.

The commercial catch of zander in the studied system of lakes in 2020 amounted to 340 tons. The average catch included 213,000 zanders. According to calculations in 2020, in the entire system of lakes, the commercial stocks of pike perch are at least 520 thousand individuals with an ichthyomass of 830 tons (i.e., that part of the herd that can be safely removed without the

threat of biological or economic overfishing). Estimated natural mortality of zander is 124 tons.

The rest of the fish can be divided into two groups:

- roach, *Rutilus aralensis*, is the main object of fishing in the Aydar-Arnasay system of lakes, in the mass - short-cycle fish, in catches it is represented mainly by two age groups (2-3-year-olds), according to which it is not practical to determine the state of the stocks and the impact of commercial loss;

- The rest of the fish, which in the catches in some years can take 2-10%. It is not possible to calculate their stocks using this method due to too strong fluctuations in catches, because it is possible to calculate only the reserves of that herd or that part of the herd that is fished.

We present tabular data obtained similarly to the above for carp and pike perch (**Table 3**).

Table 3.

Assessment of fish stocks in the AASO and their use in 2021

View	Stock, t	Commercial catch, t	Natural mortality, t	Remaining, t
<i>Cyprinus carpio</i>	1191	300	251	644
<i>Sander lucioperca</i>	830	340	174	316
<i>Rutilus aralensis</i>	3400	1730	714	956
<i>Carassius gibelio</i>	1120	466	157	497
Other	5640	200	205	5440
TOTAL	12181	3036	1501	7853

Discussion

The Aydar-Arnasay system of lakes has been the largest fishery reservoir in Uzbekistan in recent decades. However, it should be understood that this is a very young, artificially created reservoir. Until 1965, such lakes did not exist, and in the Syrdarya region of Uzbekistan, there was the Arnasay channel of small lakes with a total area of up to 20,000 hectares. All the lakes were in a state of disrepair; silted, and overgrown with reeds and cattails. There was no fishing on the lakes. Also, there was a saline lake Tuzkan (periodically appearing from the runoff of flood waters in the spring and drying up by the end of the summer) (Luzanskaya, 1965). As a result of the release of extreme flood waters in the spring of 1969, the Aydar-Arnasay system was formed from the emergency discharge of the Chardarya reservoir, which has been used since then as a drainage water storage lake. In fact, it was the flooding of steppe landscapes in a natural depression. At the end of the 20th century, the area of the lakes was about 170,000 ha. When water was released into the newly formed system of lakes from the Chardarya reservoir, an indefinite but significant number of fish got into it, which gave an outbreak of catches taken by the

newly created and fishing brigades of the State Fisheries Committee of Uzbekistan for several years. The system of reservoirs began to be used as a fishery. Taking into account the potential of the lakes and the extremely poor naturally formed ichthyofauna, a system was created for stocking the lakes with cultivated cyprinids and fishing brigades. In the 1980s, there was even such a system of pasture aquaculture as a lake-commercial farm. Catches amounted to 3-5 thousand tons per year, once reaching about 8 thousand tons (from a total lake area of 170,000 ha.). By the beginning of the 1990s, due to the drying of the Aidar and Tuzkan lakes, the salinity of the water increased (up to 10 - 15 ‰), the fishery significance of the lakes fell sharply, and the question arose of closing the fishery on these lakes.

In the first half of the 1990s, as a result of the discharge through the emergency locks of the Chardarya reservoir of huge amounts of water discharged along the Syr Darya from the Toktogul reservoir (Kyrgyzstan), the area of the Aidar-Arnasay system increased significantly and reached up to 370,000 ha. As a result of these processes, a much larger steppe was flooded, and the entire coastal infrastructure of the fishing crews was disrupted. At the same time, there was a noticeable

improvement in the ecological state of lakes as freshwater reservoirs, the ichthyofauna quickly revived, and fishing was resumed both in Jizzakh and Navoi regions. The rational use of emerging fish resources was also affected by the transition of the economy from planned to market principles, including the privatization of the entire fishery sector of now independent Uzbekistan. As a result, completely unprepared people entered the newly created fishing enterprises, as well as the fishery administration managing the system. Fishing is completely transferred to the use of fixed nets. The modern fishery system was established under greatly changing conditions of its organization. Until 2003, there was a system for setting fishing limits and distributing quotas between fishing enterprises by the State Committee for Nature Protection. Quotas were based on catch statistics (essentially). Further, as a result of a number of decisions of the Government of the Republic, fishing began to be carried out on the basis of lease agreements without quotas, which fishing enterprises concluded with the local regional administration. The leadership of the management of the fishery was entrusted to the

newly created Association "Uzbekbaliksanoat" and LLC "Aydar Arnasoy system lakes" under inaccurately negotiated terms of the relationship. At the same time, small-scale activities for stocking lakes with fish continued, but no biological justifications were developed. At present, there is a huge shortage of specialists who are familiar with at least the basics of fishing at all levels (management, fishing, storage, fish processing, and marketing). status of fish stocks in the system of lakes.

The total fish catches in the Aydar-Arnasai system of lakes from the 1990s - 2000s after the completion of the phased privatization of the fisheries sector increased by 2014, which can be considered the result of the involvement of capital in fishing by newly organized fishing enterprises (**Fig. 2**), at the level of 7.8 - 8 thousand tons catches were maintained until 2017, fish productivity in 2014-2017 reached the level of 20 kg/ha, and this is the average level of the technology that has been used at AASO since the 1980s (pasture aquaculture option). Subsequently, the catches began to fall sharply.

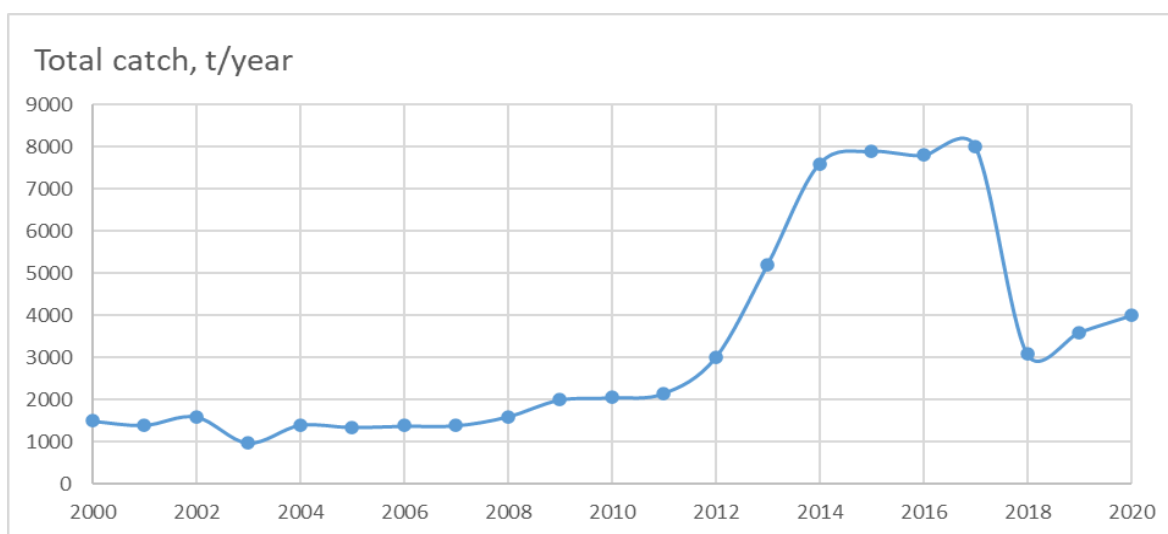


Figure 2. Total fish catches in the Aydar-Arnasai system of lakes

Note that reserves do not mean the entire number of fish of a particular species that lives in the studied reservoir, but only the number of fish that can actually be caught by the technologies used. This value is less than the total number of fish species in the reservoir. In addition, if there are stocks of fish species in the lakes that are not caught, they are also not counted as stocks. Those. stocks of fish stocks is a fishery assessment that shows how efficiently fish stocks are used. Since in Uzbekistan the fish stocks in the AASO are the absolute property of the state, the assessment shows how effectively these resources are used.

Fish stocks are a renewable natural resource. Those. every year there is a renewal of fish production in the lake, regardless of whether the fisheries use it or not. If these products are not used, then the fish will die naturally.

According to the statistics and the results of our research catches, fishery in the system of lakes in recent years is based on three types of fish: roach (an average of 50% of the catch), pike perch (23.7%), carp (carp)

(17.7%); then. their total share exceeds 90% of fish catches. Another 6 species of fish (Aral asp, goldfish, eastern bream, common catfish, Amur snakehead) in total make up to 10%, although in some years one or another species can give an outbreak of catches (like silver carp in 2019, when its catches popped up to 466 tons).

Let us especially note the catches of roaches in the Aydar-Arnasai system of lakes. Until 2000, only large roaches were caught, which was regulated by the minimum mesh size allowed for fishing in the net material. At the same time, fishing did not master the slow-growing form of roach, which is very abundant in lakes. At that time, fishing was regulated by the State Committee for Nature Protection to prevent the negative impact of fishing on the ichthyofauna by controlling the fishing measure. After the biological substantiation of the then-existing State Joint Stock Association "Uzbekbaliksanoat", starting from the autumn of 2000, the State Committee for

Nature Protection allowed catching smaller roaches, after which its catches began to grow, and roach became the main object of fishing in the lake system.

It should be borne in mind that the most important limiting factor for any large-scale activities (acclimatization, development of the latest fishing technologies, construction of coastal infrastructure, etc.) at the Aydar-Arnasai system of lakes is currently quite unusual in world practice for water bodies of this kind. size - the instability of the size of lakes. Due to the instability of lakes, it is risky to build coastal infrastructure. Spawning grounds may change annually. It is impossible to create a developed coastal infrastructure, and prepare and clean the tony.

Our analysis showed that the herd of carp in the studied system of lakes is caught weakly. The commercial loss is comparable to the natural one. And in the lakes remains a very large part of the fish stocks. Recall that we took as a commercial measure not 28 cm of fish, but a larger one - 31 cm. Otherwise, the size of the stocks will increase even more.

With regard to zander, it should also be noted that stocks are used inefficiently, and catches can be increased without fear of economic overfishing.

Stocks of other fish species in the AASO are not used at all without any reservations.

Thus, without changing the technology of fishing, but only by optimizing the mode of operation and organizing fishing, it is possible to increase fishing by 4-5 thousand tons of fish more than today without damage to fish stocks. Indeed, in such southern reservoirs as ours, up to 50-70% of fish of a commercial measure can be caught. According to long-term research data in the region, including in the Aydar-Arnasai system of lakes, the ratio of the commercial stock (i.e., the possible catch of fish per year) to the value of the total fish biomass (and this indicator is relatively constant over a number of subsequent years and found empirically for each major fishery water body subject to relative hydrological stability) is at least 30%.

The main underlying reason for the low efficiency of the use of AASO fish stocks is in the organization of fishing. It is not professional, there is no biological justification, there is no clear strategy for managing the

fishery. A water leasing regime, when even the Fisheries Rules are not applied, could only be effective if well-designed industrial programs were in place. To optimize just fishing, the mode of renting water bodies does not make much sense. It should be introduced only for the implementation of various pasture or other aquaculture technologies.

Even with the objective poverty of the fish resources of the Aydar-Arnasai system of lakes, the State can raise the issue of organizing a much more efficient fishery of at least 7.5 - 8 thousand tons of fish, with a focus on inefficient fishing with fixed nets. The issue of transferring fishing to active fishing gear (trawls, nets, etc.) remains open, since the lakes do not have a resource base for such fishing technologies (there is not even a corresponding schooling object).

Comparison of the results of catches from the beginning of privatization to the present shows that in the last decade the indicators of the food supply do not change significantly, there is some stability. Taking into account the size and stability of the food base of water bodies and the given catches per fishing effort, the following conclusion can be made: the total ichthyomass of the mature part of the populations of commercial fish species in the Aydar-Arnasai system of lakes in the first years of the 2020s will be about 20-21 thousand tons in total (t.e. without division into types). Based on this, the number of fish that can be removed from water bodies without damage (total commercial stock) in these years is about 7 - 7.5 thousand tons. All technologies are based on specific fish species, at present the main fisheries are roach, pike perch and carp, in some years there may be noticeable catches of silver carp.

References

1. Luzanskaya D.I. Fishery use of inland water bodies of the USSR (lakes, rivers and reservoirs). Directory. Moscow, Food industry, 1965, 599 p.
2. Guidelines for estimating the number of fish in freshwater reservoirs, Moscow, Publishing house of NPO on fish farming, 1990, 51 p.
3. Pravdin I.F. Guide to the study of fish (mainly freshwater). Moscow, Food industry, 1966, 376 p.

ECONOMIC SCIENCES

UDC 33 – 338

«GREEN» FUTURE FOR THE OIL AND GAS INDUSTRY OF UZBEKISTAN

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Abstract

In the past few years, investments in the green economy in the world have been steadily increasing, and the shares of companies focusing on ESG principles have shown steady growth. In this regard, this article analyzes international experience in the implementation of innovative solutions by large energy companies in order to reduce or achieve complete absence of damage to the environment in the process of hydrocarbon production and processing. It is also proposed the production of fuel briquettes from industrial waste as one of the perspective areas on the path to the formation of a «green» economy in Uzbekistan.

Keywords: Oil and gas industry, environmental policy, «green» economy, innovative solutions, zero emissions, fuel briquettes, carbon neutrality, alternative fuel

Transitioning the world to a zero-emissions lifestyle is one of the biggest challenges humanity has ever faced. This will require a fundamental change in how we produce, how we consume and how we move. Due to the fact that today the oil and gas industry is the “first” among other sectors of the economy of Uzbekistan in terms of its negative impact on the environment, reducing the intensity of emissions in the production and processing of hydrocarbons remains a strategically important direction for the next 15-20 years. On July 8-9, 2019, the Regional Ministerial Conference of the countries of Europe and the CIS on the “green” economy was held in Tashkent, aimed at improving the regulatory framework and policies for the “green” economy, encouraging innovative “green” investments through partnerships between public and private sectors.

On April 19, 2022, Uzbekistan signed an agreement with the French Development Agency, the purpose of which is to prepare, finance and implement a new strategic mechanism for the “green economy”. The main task is to preserve the environment and adapt to climate change. The cooperation is designed for 5 years and the amount of the first loan agreement (150 million euros) will be directed to the development of a program that will facilitate the transition of Uzbekistan to a more efficient model in terms of resources and hydrocarbon emissions. [1]

According to studies, Uzbekistan annually spends at least 4.5% of its GDP due to the use of hydrocarbon energy - oil, gas and coal. However, most of the country's generating capacities are outdated and require huge funds for restoration and modernization. That is why the transition to “green” energy is an economically and environmentally effective solution. [2, 562]

Looking at the activities of regional and global companies, we can see that the leaders of the oil and gas sector are ambitious in planning and setting “Net Zero” targets for greenhouse gas emissions over the 2030-2050 horizon.

Net Zero - carbon neutrality - is a state with zero carbon dioxide emissions. This can be achieved by balancing carbon dioxide emissions with carbon removal (often by offsetting carbon emissions) or by excluding emissions from society. [3, 82]

For example, the Russian multinational energy company «Gazprom» aims to reduce emissions by 30% by 2030. According to the low-carbon development program for 2022-2031, the target for the Kazakh national oil company «KazMunayGas» for 2031 is a 15% reduction in greenhouse gas emissions. The National Oil Company of Saudi Arabia “Saudi Aramco” aims to reduce gas emissions to zero by 2050. [4, 136]

If we consider the actions of global oil and gas companies (Figure 1), we can see that by using renewable energy sources for its own operations, the Norwegian international energy company «Equinor ASA» is going to achieve zero greenhouse gas emissions by 2030. «British Petroleum» plans to launch a pilot project to use green hydrogen to achieve zero emissions by 2050. The largest Italian oil and gas company «Eni S.p.A.» through the use of renewable energy sources for its own operations and the transition to biorefineries, has set itself the goal of reducing emissions by 15% (2035), and by 55% (2050). Spain's largest oil and gas company, Repsol, will gradually reduce its greenhouse gas emissions and thereby reach net zero emissions by 2050 through the production of fuel from waste, as well as the use of a pilot plant for the production of green hydrogen. [5, 62]

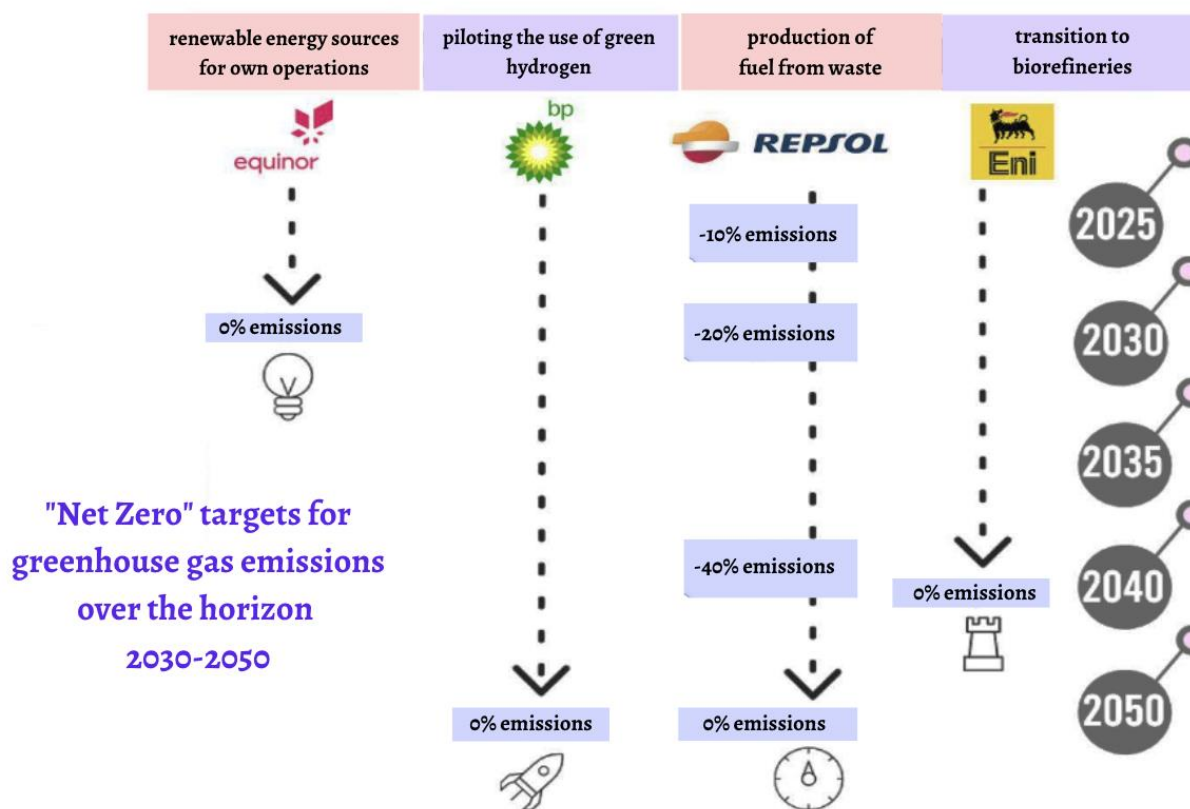


Figure 1. Net Zero targets for greenhouse gas emissions over the horizon 2030-2050 developed by global oil and gas leaders [5, 62]

In our country, due to the reduction of natural sources: oil, coal, the problems of waste disposal and the prevention of their negative impact on the environment and directly on the population have become increasingly important in recent years. Processing of industrial and household waste will provide alternative, renewable energy sources. Many developed countries are already solving these problems (Japan, USA, Germany, France). [6, 74] Thus, the processing of consumer waste also brings economic benefits.

In the developed countries of the world, on the basis of efficient technology, the use of industrial and municipal solid waste (MSW), including wood, is practiced as a comparable high-calorie fuel with a lower working calorific value of 5 to 16.5 MJ / kg: in Switzerland 80%, in Denmark, Japan 85%, France 65%, Germany 60%. At present, there are technologies for obtaining fuel pellets and briquettes from wood waste from municipal services and timber industry enterprises and are being applied in practice. It should be noted that one ton of wood briquettes replaces 5 cubic meters of wood, 480 cubic meters of gas, 500 liters of diesel fuel or 700 liters of fuel oil. Fuel briquettes (TB) are not only inferior to traditional types of fuel, but also a surpass them in a number of indicators.

For example, the cost of obtaining heat energy from fuel briquettes is lower than coal, lower than heating oil and can compete with natural gas in a number of parameters. They have a high calorific value, comparable to natural traditional sources. When burning, wood briquettes give a stable high and even flame, reaching complete burning within 1-1.5 hours, and in the smoldering mode, high-quality briquettes can give heat for several hours. Ash residue after burning of a briquette does not exceed 1%, while coal has 30-40%. In addition, it is an environmentally friendly, renewable and economic fuel. With heat release comparable to that of classic fuel, carbon dioxide emissions into the air are 10-50 times lower, ash is formed 20 times less, and there is no sulfur content in briquettes. [7, 60]

During long-term storage, briquettes practically do not absorb water, have no smell, unlike standard fuels (gas, diesel fuel, fuel oil), so their high calorific value does not decrease over time, unlike traditional fuels, which depend largely on impurities. When burning a briquette, an efficiency of up to 94% is achieved, and the resulting ash residues can be used as fertilizer by agricultural enterprises. Thus, even now it is possible to replace coal, fuel oil in thermal boiler houses with fuel briquettes as an alternative fuel for generating heat, and burning fuel briquettes on an industrial scale is more profitable than burning coal, fuel oil or gas.

Table 1.

Draft development goals of the ESG JSC "Uzbekneftegaz" by key indicators [8]

Index	Unit of measurement	UNG 2021	Goal	Period
GHG emissions	tons CO ₂ e/thousand tons oil equivalent	198	-25%	2030
Company carbon footprint	million tons CO ₂ e	6,3	0	2050
Emissions of sulfur oxides	tons/thousand tons oil equivalent	2,83	-50%	2030

Uzbekistan also needs to introduce technologies that will help reduce the harm from the development of oil and gas fields. Applying the above-mentioned technology in one of the largest companies in Uzbekistan – JSC «Uzbekneftegaz», will not only ensure the preservation of natural complexes, but also obtain economic benefits and achieve the environmental performance that was planned (Table 1).

Thus, in order for the oil and gas complex of Uzbekistan to switch to the path of a "green economy", it is necessary to modernize the energy industry and update the technological and material base, outdated equipment does not have the ability to efficiently use fuel resources, and leads to environmental pollution. To eliminate such an impact, it is necessary to introduce progressive resource-saving technologies - one of which may be the technology for obtaining fuel pellets, briquettes from wood waste from municipal services and timber industry enterprises. One of the biggest advantages of wood briquettes is that when they are burned, no gas is released that destroys the ozone layer of the atmosphere, and the emission of sulfur is less than 0.05%, which is quite environmentally friendly. Briquettes do not require expensive re-equipment of furnaces and boilers, as it is necessary when burning gas or fuel oil. This technology should pay off in the shortest possible time. Further involvement of other oil and gas companies in solving environmental problems will contribute to the speedy transition of the oil and gas industry of Uzbekistan to a "green economy".

References

1. Decree of the President of the Republic of Uzbekistan "On approval of the strategy for the transition of the Republic of Uzbekistan to a "green" economy for the period 2019-2030" dated 04.10.2019 No. PP-4477 - URL: <https://lex.uz/ru/docs/4539506>
2. Kuchеров A. V., Shibileva O. V. The concept of "green" economy: main provisions and development prospects // Young scientist. - 2020. - No. 4. - p. 561–563.
3. Gribova E. V. "Green economy": realities and prospects // Vestn. RGGU. Ser.: Economics. Control. Right. - 2014. - No. 21 (144). – p. 82.
4. Ulanova O. V. Management of solid household waste: European experience: textbook. allowance. - 2009. - Part 1. - 136 p.
5. Arsentiev V. A. Waste processing: the use of resource potential / V. A. Arsentiev, N. V. Mikhailova // Solid household waste. - 2007. - No. 8. - p. 60–63.
6. Matsuto T. Japan: solid waste management methods // Tverdye dot. - 2007. - No. 5. - P. 72–76.
7. Virlich E. M. Sweden: saving resources - the main principle of waste disposal // Solid household waste. - 2010. - No. 6. - p. 60–61.
8. Porfiriev B. "Green" economy: realities, prospects and growth limits // Carnegie Endowment for International Peace. – URL: http://carnegieendowment.org/files/WP_Porfiriev_web.pdf.

MATHEMATICAL SCIENCES

ON SOLVING A QUADRATIC DIOPHANTINE EQUATION

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Abstract

Diophantine Equations named after ancient Greek mathematician Diophantus, plays a vital role not only in number theory but also in several branches of science. In this paper, we will solve one of the quadratic Diophantine equations and provide its complete solutions. The method adopted to solve the given equation is using the concept of polar form of a particular complex number. This concept can be generalized for solving similar equations.

Keywords: Quadratic Diophantine Equation, Polar Form, Euler's Formula, Positive Integer Solutions.

1. Introduction

Diophantine Equations were equations whose solutions must be in integers. Since the solutions are integers and most often positive integers, such equations have more practical applications compared to other equations in mathematics. In this paper, we will solve one of the quadratic Diophantine equations in a novel way and present its complete solution in a compact form.

2. Quadratic Diophantine Equation

Now, we will try to determine the polar form of $(2 + i\sqrt{3})^n$

$$2 + i\sqrt{3} = r(\cos \theta + i \sin \theta) \Rightarrow r \cos \theta = 2, r \sin \theta = \sqrt{3}$$

$$\text{From this, we obtain } r^2 = 4 + 3 = 7 \Rightarrow r = \sqrt{7}, \theta = \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \quad (2)$$

Hence the polar form of $(2 + i\sqrt{3})^n$ is given by

$$(2 + i\sqrt{3})^n = 7^{n/2} e^{i n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right)} \quad (3)$$

Now using Euler's Formula in (3), we obtain

$$(2 + i\sqrt{3})^n = 7^{n/2} \left[\cos \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) + i \sin \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \right] \quad (4)$$

$$\text{If we now assume } y + i\sqrt{3}x = (2 + i\sqrt{3})^n \quad (5) \text{ then } y - i\sqrt{3}x = (2 - i\sqrt{3})^n \quad (6)$$

Now multiplying (5) and (6), we get

$$(y + i\sqrt{3}x) \times (y - i\sqrt{3}x) = (2 + i\sqrt{3})^n \times (2 - i\sqrt{3})^n$$

Simplifying, we obtain $3x^2 + y^2 = 7^n$ which is (1), the original problem which we have considered. Thus the solutions to (1) are given by equating real and

In this paper, we will try to solve the quadratic Diophantine equation $3x^2 + y^2 = 7^n$ (1), where x, y are positive integers. We will try to obtain a general solution of (1) in closed form. For doing this, we will make use of a particular complex number and a fabulous formula proposed by the greatest mathematician of all times, Leonhard Euler.

3. Solutions to the Equation

We will try to obtain all positive integer solutions (x, y) satisfying (1) for any given natural number n .

imaginary parts of (5). Now using (4) in (5), and for $n \geq 1$ we get

$$\sqrt{3}x = 7^{n/2} \sin \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \Rightarrow x = \frac{7^{n/2}}{\sqrt{3}} \sin \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \quad (7)$$

$$y = 7^{n/2} \cos \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \Rightarrow y = 7^{n/2} \cos \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \quad (8)$$

Now from (7) and (8), if we consider $(|x|, |y|)$ then these pairs would provide all positive integer solutions to the given Quadratic Diophantine Equation $3x^2 + y^2 = 7^n$ for any natural number n .

4. Conclusion

Considering a quadratic Diophantine equation $3x^2 + y^2 = 7^n$ we have used a novel method to solve

$$x = \frac{7^{n/2}}{\sqrt{3}} \left| \sin \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \right|, y = 7^{n/2} \left| \cos \left(n \tan^{-1} \left(\frac{\sqrt{3}}{2} \right) \right) \right| \quad (9)$$

Thus, for $n = 1, 2, 3, 4, 5, 6, 7, 8, \dots$ all positive integer solutions to $3x^2 + y^2 = 7^n$ are given respectively by (1,2); (4,1); (9,10); (8,47); (31,118); (180,143); (503,254); (752,2017); \dots

Thus the values of x and y from expression (9) provides all possible solutions to the given quadratic Diophantine equation $3x^2 + y^2 = 7^n$. We can adopt similar methods to solve other types of quadratic Diophantine equations using polar forms of suitable complex numbers.

References

1. Andreescu, T., D. Andrica, and I. Cucurezeanu, An introduction to Diophantine equations: A problem-based approach, Birkhäuser Verlag, New York, 2010.
2. Andrews, G. E. 1971, Number theory, W. B. Saunders Co., Philadelphia, Pa.-London- Toronto, Ont.
3. Isabella G. Bashmakova, Diophantus and Diophantine Equations, The Mathematical Association of America, 1998.

it completely in this paper. In particular, equations (7) and (8) provide all required positive integer solutions to the given equation. Further, by considering the polar form of a particular complex number, we have obtained nice closed expressions for the given equations.

In fact, from (7) and (8), we notice that for $n \geq 1$, all positive integer solutions to $3x^2 + y^2 = 7^n$ are given by

4. R. Sivaraman, J. Suganthi, A. Dinesh Kumar, P.N. Vijayakumar, R. Sengothai, On Solving an Amusing Puzzle, Specialusis Ugdyms/Special Education, Vol 1, No. 43, 2022, 643 – 647.

5. R. Sivaraman, R. Sengothai, P.N. Vijayakumar, Novel Method of Solving Linear Diophantine Equation with Three Variables, Stochastic Modeling and Applications, Vol. 26, No. 3, Special Issue – Part 4, 2022, 284 – 286.

6. R. Sivaraman, On Solving Special Type of Linear Diophantine Equation, International Journal of Natural Sciences, Volume 12, Issue 70, 38217 – 38219, 2022.

7. R. Sivaraman, Recognizing Ramanujan's House Number Puzzle, German International Journal of Modern Science, 22, November 2021, pp. 25 – 27.

8. R. Sivaraman, Generalized Lucas, Fibonacci Sequences and Matrices, Purakala, Volume 31, Issue 18, April 2020, pp. 509 – 515.

MEDICAL SCIENCES

THE COURSE OF ISCHEMIC STROKE IN PATIENTS WITH CARDIAC PATHOLOGY IN THE STROKE CENTER OF ALMATY (KAZAKHSTAN)

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Abstract

In the stroke center of the multidisciplinary clinic in Almaty (Kazakhstan), for the period from 2019 to 2020, 774 patients with a clinical diagnosis of "Acute cerebrovascular accident" were treated. We analyzed 489 medical records of an inpatient with only a diagnosis of "Ischemic stroke"; of these, the average age was 65.5 ± 0.8 years, ischemic stroke predominated in women (1.4 times). We tried to identify the causes of ischemic stroke and found that, in general, of the admitted patients with ischemic stroke, it is ($63 \pm 2.6\%$), of which 84.04% fall on the share of cardiac pathology, which confirms the causes that often lead to acute ischemic strokes. As a result of the study, 411 patients were divided into groups due to the development of a stroke, namely, cardiac pathology. We have identified: the severity of ischemic stroke according to the NIHSS scale, and localization in the affected area. The increase in the proportion of elderly and senile people substantiates the need for special attention of neurologists and cardiologists, aggravating the severity of ischemic stroke and leading to complications such as thrombosis, recurrent strokes.

Keywords: ischemic stroke, acute cerebrovascular accident, cardiac arrhythmia, cerebrocardial syndrome, ischemic heart disease.

Relevance

Ischemic strokes in the structure of total mortality in Russia and Kazakhstan in the early recovery and long-term period account for a large share - 21.4%, with a tendency to early and long-term disability of the population from strokes. Mortality from stroke among people of working age has increased over the past 10 years by more than 30% (247.1 per 100,000 population) and tends to increase annually up to 3-4% [1, 2].

Stroke is an important medical and social problem. The most common type of stroke is a cerebral infarction. In this regard, in recent years, the system of care for this disease has been actively improved, mostly at the inpatient stage. The problem of acute cerebrovascular accident has become more acute due to a significant incidence of cardiac diseases and a high percentage of disability and mortality in diseases of the circulatory system [3, 4].

According to the official statistics of the Ministry of Health of the Republic of Kazakhstan, more than 40 thousand cases of stroke are registered annually in the Republic of Kazakhstan, of which only 5 thousand die in the first 10 days and another 5 thousand within 1 month after discharge at home. Stroke is one of the main causes of disability in the adult population both in Kazakhstan and in the world [5, 6].

A high degree of correlation between an increase in the age of patients and an increase in the number of strokes has been proven, therefore, before the age of 60, a stroke occurs in a third of patients, two-thirds of acute cerebrovascular accidents occur in the age category

over 60 years. According to various authors, patients with ischemic brain damage die more often from cardiac causes than directly from acute cerebrovascular accident [7,8].

The purpose of the study: to identify patients with cardiac pathology who had ischemic stroke in the acute period and to analyze their course.

Material and methods

We analyzed the medical documentation (medical record of an inpatient patient - MRIP - further) in the stroke center of the city of Almaty (Republic of Kazakhstan) for the period from 2019 to 2020. During this period, a total of 774 patients with a clinical diagnosis of "Acute cerebrovascular accident" were treated: 489 ($63 \pm 2.6\%$) of them were patients with ischemic stroke, and 285 ($36.8 \pm 4.8\%$) patients with hemorrhagic stroke. Repeated ischemic strokes amounted to 24%.

Taking into account the anamnestic data of the admitted patients, it can be determined that this is mainly a cardiological pathology, because upon admission to a multidisciplinary clinic, all patients were consulted at the level of the admission department by a neurologist, therapist, neurosurgeon, who are part of the multidisciplinary team of the stroke center.

In the hospital, all patients with ischemic stroke were examined: CT/MRI of the brain to exclude/confirm stroke, echocardiography, ultrasound of the vessels of the head and neck, consultation of a therapist/cardiologist, neurosurgeon, laboratory tests according to the clinical protocol in force in the Republic of Kazakhstan.

As a result of the study, we divided the patients into groups due to the development of a stroke, namely, cardiac pathology.

We tried to determine the causes of ischemic stroke and found that most of the admitted patients had a history of cardiac pathology.

By age category, patients aged 50 to 80 years prevailed (mean age 65.5 ± 0.8 years), and by gender, ischemic stroke prevailed in women (by 1.4 times). Upon admission, all patients, along with basic therapy, are prescribed symptomatic treatment in accordance with the clinical protocol and those who have a concomitant disease.

Results

Among the patients analyzed by us, ischemic stroke developed for the first time in 77.5% of patients, and again in 24%.

Of 411 patients with acute ischemic stroke, cardiac diseases were identified: stenting - 46 (11.19%), coronary artery bypass grafting - 34 (8.27%), chronic coronary heart disease 2 B - 123 (29.92%), coronary heart disease, heart rhythm disturbance - 52 (12.65%), arterial hypertension 3 tbsp. - 115 (27.98%), condition after coronary angiography - 41 (9.97%).

Analyzing the medical records of inpatients with ischemic stroke, we identified the course and localization. Taking into account the classification based on pathophysiological signs according to the TOAST criteria, we analyzed cardiac embolisms and occlusions of small coronary vessels.

We present the results. Of our group of patients with ischemic stroke, cardiac embolism was detected in 38%, atherosclerosis of large arteries in 46.7%, and occlusion of small blood vessels in 11%. As for the localization of cerebral infarction, depending on the affected arterial pool, we got the following picture:

- vertebral arteries and their branches - 11%
- main artery and branches - 17%
- middle cerebral artery - 46%
- anterior cerebral artery - 4%
- posterior cerebral artery - 22%.

When patients were admitted to the clinic, we assessed the severity of the condition using the NIHSS scale and obtained the following data: moderate severity - 18 points - 11%;

- medium severity - 20 points - 27%;
- medium severity - 21 points - 34%;
- severe stroke - 22 points - 16%;
- severe stroke - 23 points - 12%.

From this, it follows that hemodynamic disturbances, a decrease in myocardial contractility and the presence of arrhythmia negatively affect the course of ischemic stroke in the acute period.

We see that 84% of patients with ischemic stroke ($63 \pm 2.6\%$) suffer from cardiological diseases, which are under the supervision of a cardiologist for a long time.

Of the treated patients with ischemic stroke after discharge from the hospital, only 68% are observed by general practitioners, although according to the documentation, doctors of the stroke center electronically transmit a notice of discharged patients to all clinics in Almaty.

Discussion

The MRIP analyzed by us confirmed that only 52% of patients were observed by a cardiologist, an endocrinologist at the place of attachment and are registered with a general practitioner at the dispensary. Consequently, not all patients timely control blood pressure and take antihypertensive therapy, as well as antiarrhythmic, anticoagulant, hypoglycemic drugs, etc.

This can be explained by the fact that people in this age group already have chronic diseases such as pathology of the cardiovascular system, arterial hypertension, diabetes mellitus, high cholesterol, lipids, obesity and other diseases that are a provoking factor in the development of stroke, leading to ischemic stroke. In this category of patients, the severity of ischemic stroke is exacerbated by concomitant diseases. More attention is paid to such patients with cardiac arrhythmias (atrial fibrillation, extrasystole) (10.63%) and after CABG (6.95%), because This is an age group (70 years and older) and are more often accompanied by the presence of type 2 diabetes mellitus, complicating the correction of hypoglycemic drugs and the selection of oral anticoagulants of indirect action. Therefore, this category of patients do not take indirect anticoagulants at home and do not control blood biochemical parameters.

As a result of our analysis of medical records (MRIP), we can conclude that more often cardiac diseases lead to ischemic stroke, so it remains one of the important problems not only for neurologists, but also for cardiologists, requiring special attention from the outpatient service.

Conclusions

Thus, the patients analyzed by us for the period 2019-2020 who had ischemic stroke in the acute period more often have cardiac diseases, which increases the high risks of complications and the severity of the course of the stroke itself. The proportion of elderly and senile people in the stroke center of Almaty for the period 2019-2020 is growing, which justifies the need for special attention to patients with cardiac pathology, which exacerbates the severity of ischemic stroke and leads to complications such as thrombosis, recurrent strokes.

References

1. Ischemic stroke. The current state of the problem / Gusev E.I., Martynov M.Yu., Kamchatnov P.R. / Doctor.Ru. 2013. No. 5 (83). pp. 7-12.
2. Vascular diseases of the brain: a reference book / Kadykov A.S., Shakhparonova N.V. M.: Miklosh, 2010. 200 p.
3. Nurguzhaev E.S., Izbassarova A.Sh. Assessment of the quality of life in patients with ischemic stroke in the city of Almaty // Scientific and Practical Journal "Neurology and Psychiatry named after. S.S. Korsakov. Materials of the XI All-Russian Congress of Neurologists and the IV Congress of NABI. - St. Petersburg, - 2019. - No. 5 (119). pp.344-345.
4. Izbassarova A.Sh., Mukhambetova G.A. Neurological manifestations in the late period of ischemic

stroke in the age aspect // Scientific and practical journal "Neurology and Psychiatry named after S.S. Korsakov". - 2014. - Moscow. - T.89. - No. 8. pp.112-115.

5. S.K. Akshulakov, E.B. Adilbekov, Z.B. Akhmetzhanov. Organization and state of the stroke service of the Republic of Kazakhstan at the end of 2016.

6. Neurosurgery and neurology of Kazakhstan. No. 1 (50), 2018, pp. 31-35.

7. Spirin, N. N. Data from the hospital stroke registry in Kostroma / N. N. Spirin, N. N. Korneeva // Fundamental research. - 2012. - No. 4-1. - S. 123-128.

8. Vertkin, A. L. Neurological problems of the therapeutic patient / A. L. Vertkin, A. S. Skotnikov, E. A. Algiyan, E. M. Mikhailovskaya // Attending physician. - 2012. - No. 5. - P. 16-21.

SOME EPIDEMIOLOGICAL DATA CONCERNING COLORECTAL CANCER IN THE REPUBLIC OF BELARUS

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Abstract

Colorectal cancer (CRC) is one of the most common forms of malignant neoplasms in the world, which at the initial stage is almost asymptomatic, thereby making the process of diagnosing difficult. In the Republic of Belarus, over the past 10 years there has been a constant increase in the incidence of CRC.

This study analyzes the diagnostics, sickness and mortality rate from colorectal cancer in Minsk in 2016 and 2021 in different age groups of patients.

Keywords: colorectal cancer, symptoms, sickness rate, mortality rate, Minsk City Oncological dispensary, epidemiological data.

Introduction. In the structure of the incidence of oncological diseases, colorectal cancer (CRC) occupies one of the first positions. According to the official statistics of oncological diseases, in 2021 colorectal cancer (CRC) in Minsk ranked 2nd (16.1%), slightly second only to breast cancer (16.2%).

The purpose of this work is a comparative analysis of the sickness and mortality rate from colorectal cancer in Minsk based on various parameters.

Research materials and methods: the research material was the official statistical data of the Minsk City Clinical Dispensary on patients with colorectal cancer (CRC), collected at intervals of 5 years (for 2016 and 2021).

Results and discussion: The main risk factor for colorectal cancer in a formally healthy person is age [1]. Thus, the incidence of CRC in patients aged 40 years and younger is 8 cases per 100,000 of population,

and in people 60 years and older is 150 cases per 100,000 of population, and this applies to both men and women. 95% of patients with colorectal cancer in the UK are patients over 50 [2]. Of the 7 CIS countries, the highest sickness rate of CRC was registered in the Republic of Belarus, and the lowest in Uzbekistan.

According to the statistics of the Minsk City Clinical Dispensary, in 2016, CRC was first detected in 1,194 people (women – 52.7%; men – 47.3%), in 2021 – in 1,065 people (women – 48.5%; men – 51.5%). Thus, in 2016 and 2021, the diagnosis of CRC was made with approximately the same frequency for men and women. Using official statistics on the population in Minsk in 2016 (1,959,800) [3] and 2021 (2,009,786) [4], the incidence of CRC per 100,000 of population was calculated. In 2016, it was 60.9 cases, and in 2021 – 53.0.

The distribution of newly detected cases of colorectal cancer according to the age of patients in 2016 and in 2021 (the number of cases is indicated in parentheses) is approximately the same: in the age group 15-19 is 1 case (1), age group 20-24 – 0 (0) cases, age group 25-29 – 2 cases (1), age group 30-34 – 8 cases (4), age group 35-39 years – 18 (9) cases, age group 40-44 – 16 (23) cases, age group 45-49 – 33 (47) cases, age group 50-54 – 58 (37) cases, age group 55-59 – 135 (101) cases, age group 60-64 years – 163 (170) cases, age group 65-69 – 209 (188) cases, 70-74 years – 145 (213) cases, age group 75-79 – 218 (110) cases, age group 80-84 – 128 (103) cases, age group 85 years old and above – 60 cases (58). It can also be noted that if in 2016 the largest number of newly identified cases of CRC occurred in the age group of 75-79, then in 2021 it was 70-74 years of age.

In the course of the study, the figures for the detection of CRC in various stages were compared. In 2016, stage I cancer was diagnosed in 183 patients (15.3%), in stage II the disease was detected in 427 patients (35.7%), stage III cancer was diagnosed in 241 patients (20.2%), in stage IV – in 310 patients (26.0%), the stage was not established in 33 patients (2.8%). In 2021, stage I cancer was diagnosed in 153 patients (14.4%), in stage II – in 341 patients (32.0%), in stage III the disease was detected in 278 patients (26.1%), stage IV cancer was diagnosed in 277 patients (26.0%), the stage was not established in 16 patients (1.5%). Thus, the figures for the detection of CRC in 2016 and 5 years later are quite comparable.

As for the distribution of newly identified cases of CRC in accordance with the gender, 565 cases were detected in men in 2016, among them 544 cases with an established stage of the disease. Namely, stage I – 80 cases (14.2%), stage II – 202 cases (35.8%), stage III – 115 cases (20.4%), stage IV – 147 cases (26.0%), stage was not established in 21 cases (3.7%). Among women in 2016, 629 cases of CRC were detected, among which 617 cases with an established stage of the disease. Including, stage I – 103 cases (16.4%), stage II – 225 cases (35.8%), stage III – 126 cases (20.0%), stage IV – 163 cases (25.9%), stage was not established in 12 cases (1.9%). In 2021, 548 cases of CRC were detected, of which 541 cases with an established stage of the disease, including: stage I – 81 cases (14.8%), stage II – 173 cases (31.6%), stage III – 154 cases (28.1%), stage IV – 133 cases (24.3%), the stage is not established in 7 cases (1.3%). As for the 2021 there were 517 cases of CRC detected in women, among them there were 508 cases with the established stage of the disease, including stage I – 72 cases (13.9%), stage II – 168 cases (32.5%), stage III – 124 cases (24.0%), stage IV – 144 cases (27.9%), the stage has not been established in 9 cases (1.7%). Thus, both in 2016 and 5 years later, CRC is detected mainly in stage II (a third of all cases). In 2021, in comparison with 2016, there is a tendency to increase the detection of CRC in late stages (III and IV), which accounted for both men and women, totaling more than half of all cases of CRC.

As follows from the figures below, in general, CRC has been detected recently (2021) during preventive examinations (79.3%). In 2016, CRC was detected

preventive examinations only in 46.6%. Contacting a doctor due to the appearance of symptoms of CRC helped to identify the disease in 47.8% of cases in 2016 and in 16.9% of cases in 2021. In other cases, CRC was detected during the cancer screening, respectively, in 5.6% (2016) and 3.8% (2021).

The total number of men who died from CRC in 2016 was 303 and women – 250. At the same time, the peak of mortality in men (23.8%) was in the age group 65-69, in women (22.1%) – in the age group 75-79. In 2021, the total number of men who died from CRC was 236, and women – 241. The peak of mortality in men (22.1%) was the same as 5 years before at the age of 65-69 with almost the same indicators as in 2016 (22.1%). In women, the mortality rate from CRC in 2021 in the age group 75-79 was noticeably lower and amounted to only 9.1%. The maximum mortality from CRC in 2021 in women was in the age group of 85 years and older (16.6%) and in the age group 80-84 (14.9%). Thus, despite the comparability of figures in all stages of CRC in 2016 and 2021, there is a tendency to increase life expectancy in women with this type of cancer. It can be assumed that this is due to more modern and effective treatment. At the same time, the number of patients who received radical surgical treatment for 5 years has practically not changed. It was 58.8% (2016) of all patients with CRC and 55.5% (2021).

Conclusions. As a result of the study, it can be concluded that CRC occurred in 2016 and in 2021 with approximately the same frequency in both men and women.

In the analyzed years, the largest number of newly identified cases of CRC occurred in the age range of 70-79 years.

In 2021, compared with 2016, there is a tendency to increase the detection of CRC at late stages (III and IV), which accounted for more than half of all cases.

The effectiveness of preventive examinations for the detection of CRC has significantly increased in 2021 compared to 2016 and occupies a leading place in the detection of this oncological disease.

In 2021, compared with 2016, there is a tendency to increase life expectancy in women with CRC, which is probably due to more effective treatment.

References

1. Nechai, I. A. Colorectal cancer // I. A. Nechai // – [electronic resource]. – Access mode. – <https://koloproktolog.ru/stati-o-zabolevaniyakh/kolor-cancer> (Printed in Russian).
2. Huang T, Braun D, Lynch H T, Parmigiani G. Variation in cancer risk among families with genetic susceptibility. *Genet Epidemiol.* 2021 Mar;45(2):209-221. doi: 10.1002/gepi.22366. Epub 2020 Oct 8. PMID: 33030277; PMCID: PMC7902332.
3. Population of Minsk – [electronic resource]. – Access mode. – <https://myfin.by/wiki/term/naselenie-minska> (Printed in Russian).
4. Official statistics – [electronic resource]. – Access mode. – https://www.belstat.gov.by/ofitsialnaya-statistika/publications/izdania/public_bulletin/index_28097/ (Printed in Russian).

EPIDEMIOLOGY, CLINICAL ASPECTS AND MODERN METHODS OF THE TREATMENT OF CHRONIC LYMPHOCYTIC LEUKEMIA

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Abstract

Chronic lymphocytic leukemia is the most common type of leukemia in Western Europe and North America. It is mainly a disease of the elderly [9]. Average age of incidence - 72 years [5]. The pathological substrate is cells of the immune system - predominantly mature lymphocytes with a B-phenotype [1]. The clinical picture is variable, the rate of development of the disease is characterized by a wide range both in objective data and in hematological analyzes. The disease can be asymptomatic for many years, and is detected only during routine examination as an incidental finding. In such cases, a strategy of observation and waiting is chosen, without applying specific treatment. The main goals of treatment are to achieve complete or partial remission with improvement and stabilization of the clinical and hematological picture. [10].

To study the features of the epidemiology, clinical course and modern methods of treating CLL, a study was conducted on the basis of a database of 50 patients registered at the Consultative and Diagnostic Center of the Oncological Institute, Chisinau, Republic of Moldova. It was found that the main group with this diagnosis is people 55-75 years old (62%). The mean age of diagnosis among the selected group is 63 years. The incidence of CLL among men (58%) is slightly higher than among women (42%). The use of bio immunotherapy allows you to establish a positive trend in the course of the disease, as well as improve the quality of life of patients [4].

Keywords: chronic lymphocytic leukemia, epidemiology, clinical course, treatment.

Introduction

Chronic lymphocytic leukemia is a malignant lymphoproliferative process characterized by progressive accumulation of lymphoid cells in the peripheral blood, bone marrow, and lymphoid tissue. [6, p.146]. The pathogenetic mechanism is a mutation in the progenitor cell - lymphopoiesis, being malignant, the cell retains the ability to differentiate into an adult cell. The morphological substrate of this process is atypical mature lymphocytes, characterized by functional incompetence. In most cases (95-98%) cells involved in the pathological process are B-cells, in some cases (2-5%) the substrate is represented by T cells. Patients with B-cell form are characterized by the presence of CD19/CD5/CD23/CD20/CD24 - positive immunophenotype [6, p.146]. Approximately 90% of patients have chromosomal mutations, the most common of which is a deletion of the long arm of chromosome 13, that is found in 55% of cases. In 18% of cases, there is a deletion of the long arm of chromosome 11, in 7% of cases, a deletion of the short arm of chromosome 17 is detected, 4% of cases - translocation of chromosome 14. [1, p. 209] CLL ranks second after acute leukemia in the overall incidence of leukemia. It is the most common type of leukemia among Caucasians. More than 70% of patients diagnosed with CLL are in the age group of 50-70 years. On average, it is diagnosed at age 55. CLL is more common in men [2, p.5] In the Republic of Moldova, the overall incidence of CLL is 1.2 cases per 100,000 inhabitants [2, p.5]. In the United States, between 2015 and 2019, the incidence of new

cases of chronic lymphocytic leukemia was 4.7 per 100,000 people per year, the death rate is 1.1 per 100,000 people per year. The prevalence for 2019 is about 200,766 people [3]. The incidence increases by more than 30 out of 100,000 people per year over the age of 80 [5, p.1]. Presence of chromosomal mutations suggests a genetic predisposition to CLL, which increases the risk for family members of patients by 6-9 times. [1-p.210, 6-p.147] CLL includes several stages according to the clinical and hematological classification: the initial stage, the stage of clinical and hematological manifestations and the terminal stage [8, p.158]. Stadiation of the disease has been proposed in systems K. Rai (1975) и J. Binet (1981), that take into account the presence of clinical signs, objective examination data peripheral lymph nodes, hepatosplenomegaly), instrumental studies, laboratory changes [5,2-p.14, 8, p.161]

Aim of the study

Study of the epidemiology, clinical aspects, laboratory changes and modern methods of treatment of chronic lymphocytic leukemia.

Materials and methods

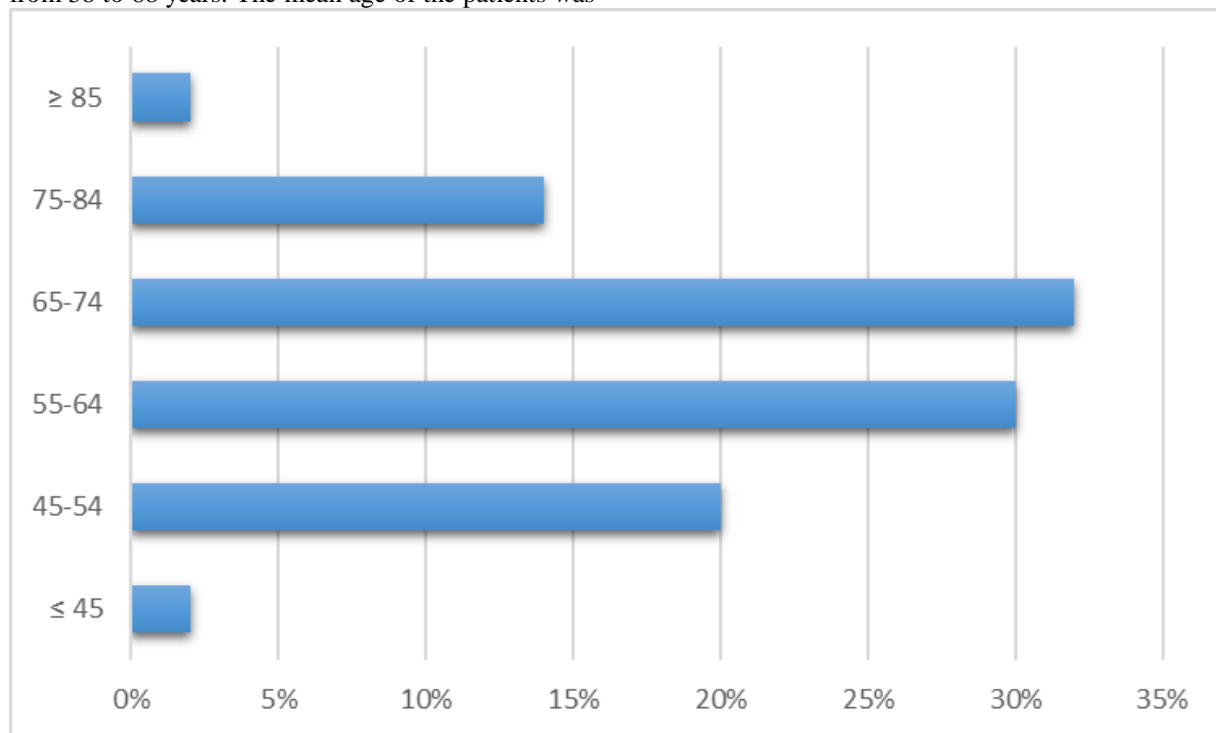
The study included 50 patients diagnosed with chronic lymphocytic leukemia, registered at the Consultative and Diagnostic Center of the Oncological Institute from 2015 to 2022. A retrospective method of statistical research was used. To fill in statistical questionnaires, data from medical records of patients observed in the outpatient clinic were used: gender, age of patients, clinical signs and examination data, laboratory

tests, bone marrow aspirates, treatment methods depending on the stage, as well as the results of immunohistochemical and immunophenotypic studies.

Results

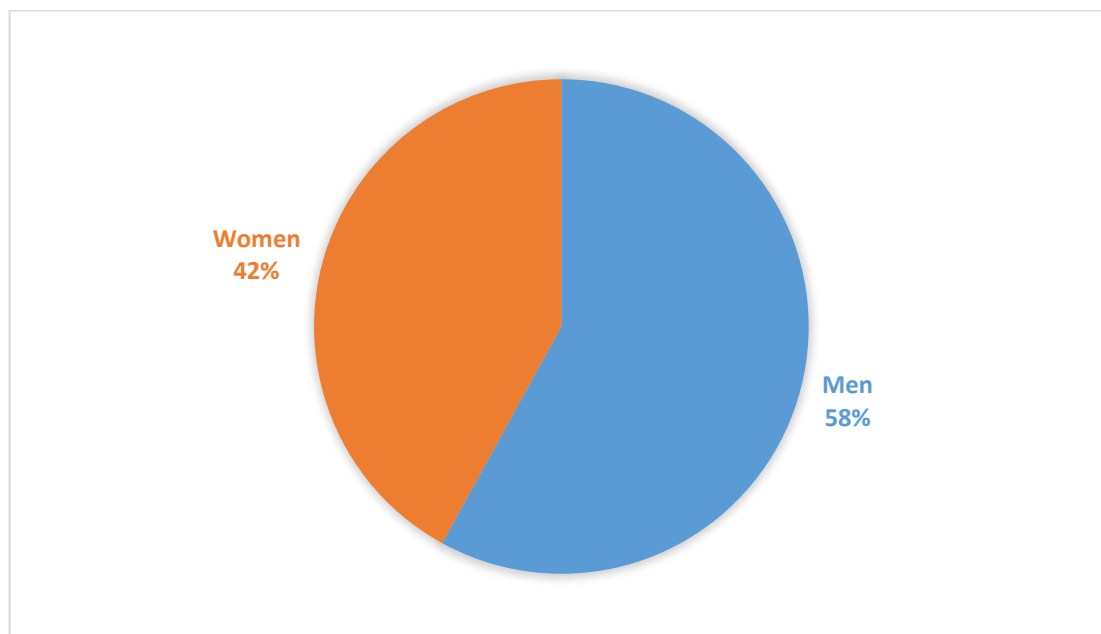
The age of patients included in the study ranged from 38 to 88 years. The mean age of the patients was

63.88 years. The largest group consisted of patients of the age group 65-74 (16-32%) and 55-64 (15-30%). Least of all, CLL was diagnosed in groups over 84 (1-2%) and under 45 years (1-2%). (Pic.1).



Pic. 1 Distribution of patients with CLL depending on age

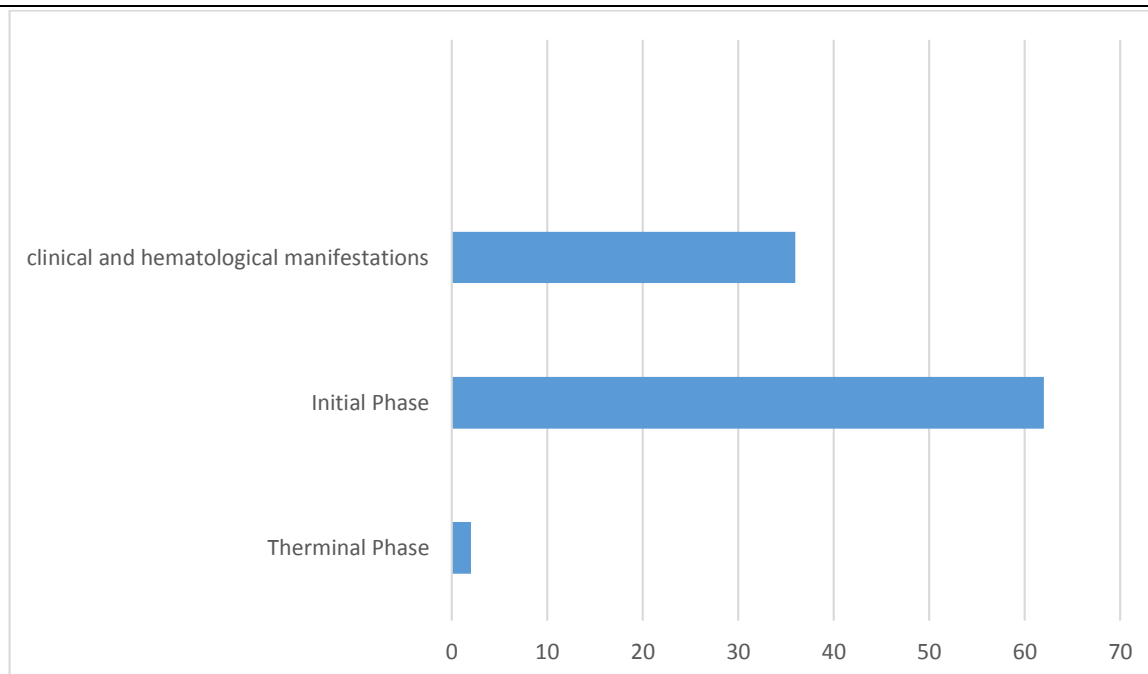
In the distribution depending on sex, with a slight advantage, the highest incidence is observed in men (29 - 58%). (Pic.2)



Pic. 2 Distribution of patients by gender

As for the social aspect of this disease, since the main percentage of morbidity occurs in groups of 55-64 (30%) and 65-74 (32%) years, most patients are people of retirement and pre-retirement age. In total, out of

50 people in the observed group, 27 (54%) are pensioners, 7 (14%) are persons with disabilities, and another 7 (14%) patients are employed and able-bodied population



Pic. 3 Distribution of patients depending on the phase of the disease

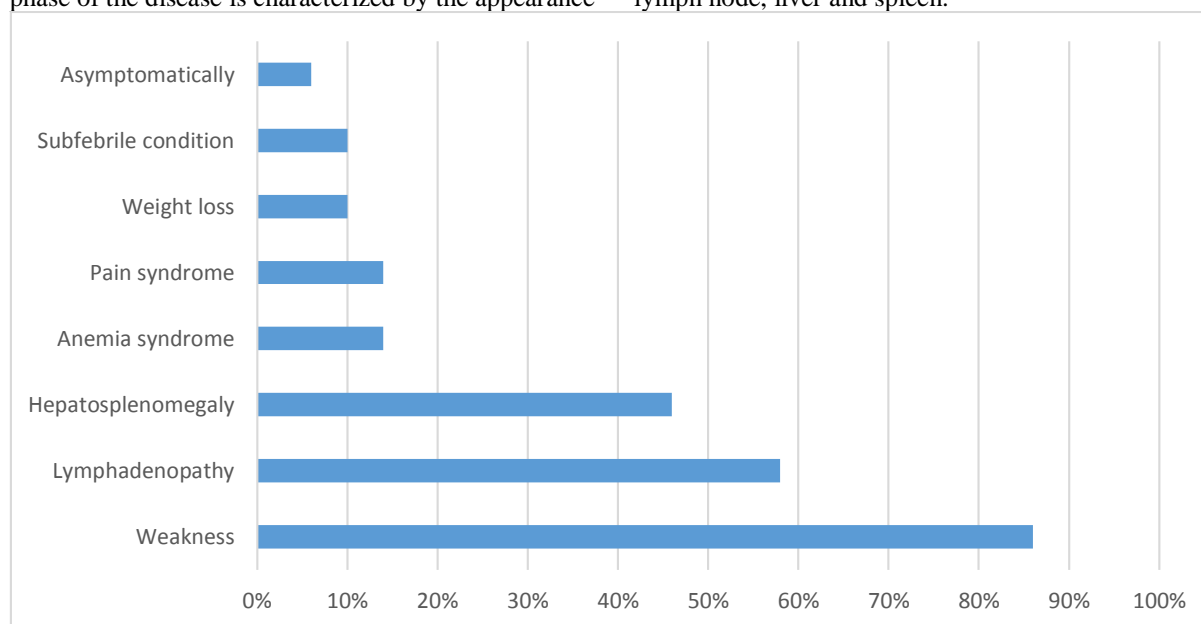
At the time of diagnosis, 31 patients (62%) were in the initial phase of the disease. The initial phase of the disease is characterized by the absence of clinical manifestations (90.3%) and is most often detected during routine laboratory tests (leukocytosis $< 30.0 \times 10^9/l$ and lymphocytosis in peripheral blood). In some patients in the initial phase of the disease, non-specific clinical manifestations (9.6%) were observed: general weakness, asthenia, subfebrile condition or weight loss.

In the stage of clinical and hematological manifestations, CLL was diagnosed in 18 patients (36%). This phase of the disease is characterized by the appearance

of clinical signs such as: general weakness (86%), lymphadenopathy (58%), anemic syndrome (14%), hepatosplenomegaly (46%), weight loss (10%), general pain (18%), headache (14%), fever (10%). In 6% of cases, an asymptomatic course of the disease was observed for the patient. (Pic.4)

In the general blood test, leukocytosis is observed (max. value $393 \times 10^9/l$), and lymphocytosis with an increase of up to 80-90% in peripheral blood.

The terminal phase of the disease (2%) is characterized by somatic decompensation: weight loss, fever, progression of anemia, marked enlargement of the lymph node, liver and spleen.



Pic. 4 The main complaints of patients in the phase of clinical and hematological manifestations.

As CLL progressed, patients developed autoimmune complications (8%), anemia (16%), and infectious diseases (12%).

Immunophenotyping methods were used to diagnose CLL in some patients (32%) in order to detect diagnostic markers CD10, CD5, CD19, CD23, CD20.

In 28% of patients, a bone marrow puncture was performed as a diagnostic method with the detection of lymphocytes over 30%, in 16% of cases a puncture of peripheral lymph nodes was performed.

CLL was treated both on an outpatient basis (46%) and in a hospital setting (16%), 38% of patients did not need specific treatment. When Rituximab was used in monotherapy, as well as in R-CHOP, R-COP regimens, complete remission was observed in 67% of cases, and partial remission in 33% of cases. When using schemes with the use of chimeric monoclonal antibodies, positive dynamics in the clinical picture was noticed, a decrease in tumor formations, the absence of significant lymphadenopathy during physical examination, a significant decrease in the level of lymphocytosis and leukocytosis in the peripheral blood.

In cases of autoimmune manifestations, especially hemolytic anemia and autoimmune thrombocytopenia, glucocorticoids (dexamethasone, prednisolone) were used in 9.6% of cases.

RBC transfusion was used as replacement therapy for hemoglobin levels < 7.0-8.0 g/dL in 3.2% of cases.

Discussion

Chronic lymphocytic leukemia is an incurable disease. Despite how far modern treatments have come, CLL therapy aims to improve the patient's symptoms and quality of life. The main age group with these diagnoses is people 55-75 years old (62%), with an average age of diagnosis of 63.8 years. With a slight advantage, the incidence rate among men (58%) is higher than among women (42%). Most patients were diagnosed with CLL at the initial stage of the disease 62% - 90.3% of which were asymptomatic. In the phase of clinical manifestations (36%), the dominant symptom is general weakness 86% and peripheral lymphadenopathy 58%. In the initial stage of the disease, with an asymptomatic course in stages 0, I-II Rai or A and B Binet, specific treatment is not carried out, clinical and hematological control is prescribed (watch and wait tactics) every 3 months. The use of regimens with Rituximab allows to achieve positive dynamics and establish clinical and hematological remission.

References

1. Corcimar I. Leucemia limfocitară cronică. Hematologie. Centrul Editorial – Poligrafic Medicina, Chişinău, 2007, p. 208 – 212 https://library.usmf.md/sites/default/files/2020-07/Corcimar%20I.%20Hematologie%202007_Optim

ized.pdf

2. Leucemia limfocitară cronică la adult. Protocol Clinic Național, Chişinău, 2020 c. 5-20 <https://msmps.gov.md/wp-content/uploads/2021/02/PCN-65-Leucemie-limfocitara-cronica.pdf>

3. Cancer Stat Facts: Leukemia — Chronic Lymphocytic Leukemia (CLL) U.S. Department of Health and Human Services - National Cancer Institute <https://seer.cancer.gov/statfacts/html/clyl.html>

4. Chronic lymphocytic leukaemia/small lymphocytic lymphoma treatment with rituximab and high-dose methylprednisolone, revisited - Ana Vagos Mata-Cancer Medicine Volume 10, Issue 24 p. 8768-8776, 2021

<https://onlinelibrary.wiley.com/doi/10.1002/cam4.4374>

5. Chronic lymphocytic leukaemia: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up - B. Eichhorst, T. Robak, Department I Internal Medicine.

6. Pathogenesis of chronic lymphocytic leukemia and the development of novel therapeutic strategies. Yoshikane Kikushige, Journal of clinical and experimental hematopathology Vol. 60 No.4, page146-158, 2020 https://www.jstage.jst.go.jp/article/jslrt/60/4/60_20036/_pdf/-char/en

7. Chronic lymphocytic leukemia prognostic models in real life: still a long way off. Stefano Molica, Vol. 14, No 2, page137-14, 2021 Department Hematology-Oncology, Azienda Ospedaliera Pugliese-Ciaccio, Catanzaro, Italy. <https://www.tandfonline.com/doi/epub/10.1080/17474086.2021.1876558?needAccess=true>

8. Oxford Handbook of Clinical Haematology, Drew Provan, Trevor Baglin, The essential rapid reference for all haematologists page 158-163 [provan_drew_baglin_trevor_dokal_inderjeet_eds_oxford_handboo.pdf](https://www.oxfordhandbook.com/view/article/1080/17474086.2021.1876558?needAccess=true)

9. Chronic lymphocytic leukaemia Michael Hallek, Tait D Shanafelt, Barbara Eichhorst, 2018 ctp. 39-41

[hallek_michael_eichhorst_barbara_catovsky_daniel_eds_chronic.pdf](https://www.oxfordhandbook.com/view/article/1080/17474086.2021.1876558?needAccess=true)

10. Treatment Approaches to Chronic Lymphocytic Leukemia With High-Risk Molecular Features, 2021 van der Straten, Hengeveld, Kater, Langerak and Levin. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8695615/#>

PSYCHOLOGICAL SCIENCES

POSSIBILITIES OF BIOFEEDBACK TRAINING FOR THE ORGANIZATION OF REHABILITATION MEASURES, TAKING INTO ACCOUNT THE PSYCHOPHYSIOLOGICAL INDICATORS OF HIGH-CLASS ATHLETES

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ВОЗМОЖНОСТИ ТРЕНИНГА БИОУПРАВЛЕНИЯ ДЛЯ ОРГАНИЗАЦИИ ВОССТАНОВИТЕЛЬНЫХ МЕРОПРИЯТИЙ С УЧЕТОМ ПСИХОФИЗИОЛОГИЧЕСКИХ ПОКАЗАТЕЛЕЙ СПОРТСМЕНОВ ВЫСОКОГО КЛАССА

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Abstract

The aim of the work is to assess the psychophysiological characteristics that reflect the adaptive mechanisms of elite athletes and describe the possibilities of using game biofeedback training to organize recovery activities. Psychophysiological methods were used with hardware stimuli presentation and registration of speed and accuracy responses, alternating with monitoring in resting state (BOSLAB system manufactured by COMSIB company). Based on the results of testing the athlete's psychophysiological state, options for classifying participants on the basis of response to stress / recovery were proposed. Proper recovery of athletes is considered to be an essential factor in achieving high results in sports, as well as one of the important aspects in maintaining the health of athletes.

Аннотация

Работа направлена на оценку психофизиологических параметров, отражающих адаптивные механизмы спортсменов высокого класса и описание возможностей использования тренинга игрового биоуправления для организации восстановительных мероприятий. Использовались психофизиологические методики с аппаратным предъявлением стимулов и регистрацией ответных реакций на скорость и точность, чередующиеся с мониторингом в состоянии отдыха (АПК «БОСЛАБ», производство ООО «КОМСИБ»). На основе результатов тестирования психофизиологического состояния спортсмена предложены варианты классификации участников по признаку реагирования на стресс / восстановления. Качественное восстановление спортсменов представляется существенным фактором достижения высоких результатов в спорте, а также одним из актуальных направлений в вопросах сохранения здоровья атлетов.

Keywords: elite sport, game biofeedback technology, response/recovery, psychophysiological testing, recovery measures.

Ключевые слова: спорт высших достижений, технология игрового биоуправления, реагирование / восстановление, психофизиологическое тестирование, восстановительные мероприятия.

Введение: Важнейшей основой психофизиологии спорта является учение о физиологических (функциональных) резервах организма, знание которого позволяет спортивным специалистам грамотно оценивать состояние атлета и решать задачи по сохранению здоровья и поддержанию профессионализма спортсменов. Все эти задачи наиболее эффективно решаются с использованием автоматизированных психофизиологических методик, позволяющих контролировать состояние основных систем организма до, во время и после физических нагрузок.

В планировании и разработке современных программ восстановления используется технология адаптивного биоуправления, основанная на развитии навыков саморегуляции. Этот подход задействует собственные ресурсы спортсмена по восстановлению работоспособности, достижению состояния релаксации или наоборот активации и концентрации внимания (в зависимости от поставленной задачи). Как показали несколько метаанализов и систематических обзоров, использование биологической обратной связи по ВСР, обычно включающей серию сеансов с практикующим врачом в течение нескольких недель и часто завершаемые домашней практикой, приводят к снижению симптомов стресса и тревоги (Lehrer, Kaur, et al., 2020), симптомов депрессии (Pizzoli et al., 2021), фибромиалгии (Repeau, 2020), усилению исполнительных функций (Tinello et al., 2021), и улучшению спортивных результатов (Pagaduan, Chen, Fell, & Xuan Wu, 2020; Pagaduan, Chen, Fell, & Xuan Wu, 2021) [1-6]. Однако, несмотря на растущее использование биологической обратной связи по сердечному ритму, остаются вопросы относительно основных механизмов этого метода.

Целью исследования является определение особенностей реагирования на стрессовые воздействия с учетом психофизиологических показателей и описание возможностей использования тренинга игрового биоуправления для организации восстановительных мероприятий спортсменов высокого класса.

Материалы и методы: в исследовании приняли участие 67 спортсменов, входящих в состав национальных сборных России.

Протокол исследования: сеанс психофизиологического стресс-тестирования был представлен сессиями, моделирующими ситуации стресса, чередующимися с сессиями отдыха, что позволяло оценить реакцию спортсменов на стресс и степень восстановления после него. До и после стресс-тестов для диагностики функционального состояния использовалась методика «Вариационная кардиоинтерваломерия» (ВКМ).

Результаты:

1. На основе экспертной оценки специалистов-психофизиологов были выделены типовые профили реагирования на основе динамики длительности RR-интервалов.

1.1 Оптимальный профиль реагирования/восстановления (оптимальное реагирование/оптимальное восстановление). Во время выполнения стресс-тестов участники снижали длительность RR - интервалов (сессии 2,4 и 6), что является оптимальной ответной реакцией организма на стресс, и увеличивали длительность кардиоинтервалов на сессиях отдыха (3 и 5 сессии) и заключительном фоновом мониторинге (сессия 7) до полного восстановления – до значений исходного фонового мониторинга (сессия 1) и выше.

1.2. Профиль частичного (неполного) восстановления (оптимальное реагирование/частичное (неполное) восстановление). Во время выполнения стресс – тестов участники снижали длительность RR-интервалов (сессии 2,4 и 6), что является оптимальной ответной реакцией организма на стресс, но восстановление после стресс-тестов наблюдается полностью или частично только на одной или двух сессиях отдыха (сессии 3 и 5) и/или фона (сессия 7), при этом исходных фоновых значений RR – интервалов достичь не удастся.

1.3. Профиль ареактивности (отсутствие реакции на стресс). Во время выполнения стресс-тестов участники показали отсутствие какой-либо реакции на стресс - состояние ареактивности, так как не было ответной реакции на стресс, проблематично оценить и восстановление.

2. Возможности тренинга игрового биоуправления для организации восстановительных мероприятий спортсменов высокого класса.

Полученная классификация типовых профилей реагирования/восстановления позволяет персонализировать методы и средства психофизиологической поддержки спортсменов высокого класса, что позволит в дальнейшем повысить эффективность программ восстановительных мероприятий. В основе таких программ заложено поэтапное освоение и применение навыков саморегуляции: вначале ознакомление и освоение различных методик регуляции, затем развитие специфических спортивных навыков саморегуляции, а в дальнейшем повышение эффективности полученных навыков и перенос их в реальную жизнь. Перспективным инструментом для достижения осознанного контроля над произвольными физиологическими реакциями является технология игрового биоуправления.

Во время занятий участник погружается в смоделированную на мониторе виртуальную среду, представленную игровым сюжетом, получая при этом биологическую обратную связь по физиологическому регистрируемому сигналу. От участника требуется постоянный осознанный контроль (мониторинг) и анализ своего состояния и соответствующего поведения, что является совокупным результатом индивидуальных психических, эмоциональных, физических реакций при выполнении задач тренинга. Как правило, ситуация соревнования вызывает у участника игры увеличение пульса и повышение симпатического тонуса, а способность

расслабиться, повысив парасимпатический тонус, позволяет контролировать автоматические реакции и восстанавливать вегетативный баланс.

Выбранный метод БОС должен позволить участнику «увидеть» свой психофизиологический ответ на стрессовую ситуацию, оценить его, сформировать новую, более эффективную стратегию реагирования на стресс и восстановления после него, позволяющую сохранить собственное психическое и физическое здоровье.

Заключение: Экспериментально показано, что опыт и эффективность спортсмена напрямую связана с уровнем развития навыков саморегуляции. Утверждается, что навыки саморегуляции не менее важны для ситуаций после выступления – то есть эти навыки следует развивать, не только для достижения пика формы, но и для ускорения восстановления. Технология биоуправления сегодня является одним из наиболее перспективных методов обучения/развития навыков саморегуляции, а также коррекции функционального состояния организма человека. Разработка и внедрение новых психофизиологических технологий повышения эффективности тренировочного и восстановительного процесса является необходимым условием для построения типовых программ восстановительных мероприятий медико-психологического обеспечения спортсменов высокого класса.

References

1. Lehrer, P. M., Kaur, K., Sharma, A., Shah, K., Huseby, R., Bhavsar, J., & Zhang, Y. (2020). Heart rate

variability biofeedback improves emotional and physical health and performance: A systematic review and meta analysis. *Applied Psychophysiology & Biofeedback*, 45, 109–129

2. Pizzoli, S. F. M., Marzorati, C., Gatti, D., Monzani, D., Mazzocco, K., Pravettoni, G. (2021). A meta-analysis on heart rate variability biofeedback and depressive symptoms. *Scientific Reports*, 11(1), 6650. <https://doi.org/10.1038/s41598-021-86149-7>

3. Reneau, M. (2020). Heart rate variability biofeedback to treat fibro-myalgia: An integrative literature review. *Pain Management Nursing*, 21(3), 225–232. <https://doi.org/10.1016/j.pmn.2019.08.001>

4. Tinello, D., Kliegel, M., & Zuber, S. (2021). Does heart rate variability biofeedback enhance executive functions across the lifespan? A systematic review. *Journal of Cognitive Enhancement*. <https://doi.org/10.1007/s41465-021-00218-3>

5. Pagaduan, J., Chen, Y.-S., Fell, J. W., & Xuan Wu, S. S. (2020). Can heart rate variability biofeedback improve athletic performance? A systematic review. *Journal of Human Kinetics*, 73, 103–114. <https://doi.org/10.2478/hukin-2020-0004>

6. Pagaduan, J., Chen, Y. S., Fell, J. W., & Xuan Wu, S. S. (2021). A preliminary systematic review and meta-analysis on the effects of heart rate variability biofeedback on heart rate variability and respiration of athletes. *Journal of Complementary and Integrative Medicine*. <https://doi.org/10.1515/jcim-2020-0528>

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