THE EFFECT OF USING EXERCISES ASSOCIATED WITH ISCHEMIA AND HYPEREMIA ON SOME IMMUNOGLOBULINS (IGM - IGG) AND WHITE BLOOD CELLS (WBC) IN THE REHABILITATION AND TREATMENT OF ANKLE SPRAIN INJURY LATERAL SIDE OF SWIMMERS

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Abstract

The purpose of this paper is to identifying the effect of using exercises associated with ischemia and hyperemia on some immunoglobulins (IgM - IgG) and white blood cells (WBC) in the rehabilitation and treatment of ankle sprain injury on the lateral side of swimmers. The researchers adopted the experimental approach in the style of one group. The researchers identified the research sample, which is represented by the swimmers of the National Center for the Care of Sports Talent in Baghdad Governorate, who were injured in the ankle joint, the lateral side of the second degree, which numbered (8) injured swimmers a specialized committee affiliated with the Department of Sports Medicine in Baghdad, for clinical examination and to ensure the proper functioning of the heart, kidneys and respiratory system, did this after diagnosing the injury and knowing its severity and medical history. One of the most important results reached by the researcher is that : The results showed that the exercises in the style of ischemia and hebrima have a positive effect in the treatment and rehabilitation of the lateral lateral sprain of the ankle joint in swimmers, and there is a clear increase in immunoglobulins (IgM - IgG) when the injury occurs directly in the research sample as a result of the defensive role it plays by increasing the activation of the cells of the immune system, which leads to the formation of a strong line of defense against the injury that the player may be exposed to. One of the most important recommendations recommended by the researchers is that : Emphasizing the use of therapeutic rehabilitative exercises using the method of ischemia and hyperemia within the vocabulary of the rehabilitative curricula, and relying on the anatomical and mechanical foundations when preparing them for their significant role in the treatment of injury, and necessity of relying on chemical variables when evaluating the rehabilitation curricula for injuries because they give accurate information about the real condition of the injury.

Keywords: Ischemia. Hyperemia.Immunoglobulin (IgG). Immunoglobulin(IgM). White blood cells (WBC)

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Introduction

Injuries are considered one of the obstacles that stand in the way of the athlete continuing to exercise his activities normally, and among these injuries is the joint injury. The ankle joint is one of the important joints that bears a great responsibility in carrying the weight of the body and in the process of moving, the movement from the feet to the upper limbs and controlling the strength required for the kinetic performance. The foot is also the base of the body's balance, and any injury in it weakens the body's balance. Ankle joint sprain is one of the most common injuries that the joint is exposed to, as it occurs in a large way, due to the fact that the foot is the basic base on which the body rests and provides it with movement, as the ankle sprain injury rate is about 85% of the total injuries that it is exposed to, whether for athletes Or for non-athletes, and every five cases there are four of which occur with the lateral ligament of the ankle joint. The exercises for ischemia and hyperemia are a modern method for sports training, and they are done by closing the artery in the working muscle for a certain period ranging from (3-4) minutes, as the level of oxygen decreases within the muscle tissues and the passage of arterial blood flow (oxygenated blood) to the cells is impeded, which leads to The occurrence of a condition (ischemia), i.e., training with hypoxia, and this process is accompanied by an increase in the accumulation of lactic acid in the muscles and the expansion of blood vessels, and when the condition of ischemia is completed, that is, when the artery is opened and the arterial blood is allowed to pass naturally, which leads to the occurrence of a condition (hyperemia) that increases during it Blood flow to the cells, as the blood circulation supplies the muscles with oxygen and removes waste products from the cellular interaction that cause the arteries to widen, in addition to getting rid of lactic acid by oxidizing it and turning some of it into other compounds. In order to increase the effect of this type of training, some artificial means are used that increase the length of the two periods (ischemia and hyperemia) by placing pressure around the muscular limbs that need to be affected by narrowing the limb leading to the exercise during periods of performance in order to increase the intensity and duration of the occurrence of muscle ischemia and to reduce the amount of The blood flows to and from the muscles, after that the pressure method used around the muscle end is expanded during the intervals of rest, so that the condition of (hyperemia) occurs increasingly, as the blood rushes in a large amount to the muscles that have been affected by the condition (ischemia). Through the experience of the researchers being teachers of swimming, training physiology and injury rehabilitation, and their follow-up to the training units for swimmers at the National Center for the Care of Swimming Talent, they noticed that they were exposed to different types of sports injuries, especially the ankle joint injury on the lateral side.

Therefore, the researchers decided to use exercises associated with ischemia and hyperemia to rehabilitate and treat ankle sprain injury on the lateral side of swimmers, contrary to the traditional methods used in treatment and rehabilitation, as it must be closely linked with the relevant chemical variables, the most important of which are immunoglobulins (IgM - IgG) and white blood cells (WBC), which, by studying it, can determine the speed of its recovery and its return to its normal state before the injury occurred.

The importance of the research lies in the fact that it is a new scientific attempt, according to the knowledge of the researchers, and for the first time in Iraq (Baghdad), with a number of exercises associated with ischemia and hyperemia that carry the possibility of rehabilitation and treatment of the ankle sprain on the lateral side of swimmers according to some chemical variables represented by immunoglobulins (IgM - IgG) and pellets White blood cell count (WBC) by using the compression method to serve injured swimmers, coaches and all those working in the field of rehabilitation and training.

Research Objective

- Identify the effect of using exercises associated with ischemia and hyperemia on some immunoglobulins (IgM - IgG) and white blood cells (WBC) in the rehabilitation and treatment of ankle sprain injury on the lateral side of swimmers.

Research Methodology and Field Procedures

Research methodology

The methodology is that intellectual organization overlapping in the scientific study, or it is the intellectual steps that the researcher possesses to solve a specific problem" (Malek Alshok, A. 2008), so the researchers adopted the experimental approach in the style of one group, "since experimentation is a method for discovering causal relationships between phenomena" (Abedalsatar M & Hanoon W, 2009), using the method of pre, Intermediate and post-tests for their suitability to the nature of the problem.

Community and sample research

"The objectives that the researcher sets for his research and the procedures that he will use will determine the nature of the sample that he will choose" (Abedalsatar M & Hanoon W, 2009). The researchers identified the research sample, which is represented by the swimmers of the National Center for the Care of Sports Talent in Baghdad Governorate, who were injured in the ankle joint, the lateral side of the second degree, which numbered (8) injured swimmers. This was done after diagnosing the injury and knowing its severity and medical history by a specialized committee affiliated with the Department

of Sports Medicine in Baghdad, for clinical examination and to ensure the proper functioning of the heart, kidneys and respiratory system (Table 1).

Methods, tools and devices used in the research

"They are the means through which the researcher can collect data and solve the problem to achieve the goals of the research, whatever those tools are like data, samples, and devices" (Siham Hassan 2009: 121).

- The locally manufactured compressor.
- Diger device for measuring the pulse rate in the foot, made in England.
- Senter fuge separator at a speed of (5000 rpm/min).
- Spectrophotometer (French made).
- Restameter device for measuring height and weight.
- Computer (Laptop) type Lenovo.
- A support device with handles.
- Medical syringes (5 ml). Medical cotton and sterile materials.
- Plain blood preservation tubes and tubes contain a preservative (ETDA).
- Chemicals (katat) to detect immunoglobulins (IgM - IgG) and white blood cells (WBC)
- Pasteur pipette for the purpose of drawing blood plasma and serum from tubes after separation.
- Small stick + elastic rope.
- A low sheet of compressed foam, 1 x 1 m wide.
- Personal interviews.
- Assistant work team staff.

Field Research Procedures

Determine the study variables

The researchers worked through modern scientific sources to identify the chemical variables that are highly compatible with the study and the field treatments related to them and study them to solve the research problem and they were as follows:

Chemical variables include:

- White blood cells (WBC).
- Immunoglobulins (IgM – IgG)

Compressive method for the occurrence of ischemia and hyperemia

The researchers (Ahmed Hassan and Fadel Kamel, 2019) designed a compressive method to obstruct the passage of arterial blood. The compressive method consists of a rubber bag that is (35) cm long and (18) cm wide. The bag contains two openings. At the end of it is a pressure gauge to measure the air pressure inside the bag. The rubber bag is located inside a cloth bag, its length is (75) cm and its width is (20) cm. The bag is surrounded from the outside by a belt made of leather that is installed around the bag when the bag is inflated with air, by converting the pressure the air is inward towards the thigh in the area where the femoral artery passes. The belt is (85) cm long and (15) cm wide. It is lined from the inside with a piece of sponge on one side, in order to protect the skin (thigh) as well as to balance the air pressure around the thigh on both sides.

Exploratory experience

The exploratory experiment is considered "a mini-experiment of the basic experiment, and the same conditions and circumstances in which the main experiment are as possible must be met in order for its results to be taken into account" (Aldulaimi, N, 2009), so the researchers conducted the exploratory experiment on Sunday 2/1 /2022 on two injured athletes from outside the research sample. The aim of this experiment was to identify how to use the compression device and fix it on the thigh area to obtain a case of ischemia (ischemia of the arterial blood connecting the lower extremities) and then the occurrence of the condition of hyperima after removing the compression device from the thigh The injured athlete, and the definition of the assisting work team on the nature of the work and other obstacles that the researcher may encounter, as well as conducting rehabilitative exercises designed to treat the inverted sprain injury of the ankle joint associated with the case of ischemia and hyperemia using the pressure method and its suitability for the research sample, as well as the safety of the devices and tools used with the exercises Rehabilitation and standing on the accuracy of the procedures and knowing the extent of their suitability and readiness of the injured to conduct rehabilitative exercises.

Pre, intermediate and post-tests

Due to the fact that the sample is not ready and not available, but it is obtained according to the cases that come to the hospital or through specialized clinics and sports clubs, and thus the tests were conducted periodically and continuously over the duration of the tests and according to the injuries, and thus the application of the curriculum has also continued during a different period And close and unevenly on the members of the research sample and under the direct supervision of the researchers.

Therefore, the researchers conducted the first pre-test on Friday 7/1/2022, the first intermediate test on Saturday 29/1/2022, and the first post-test on Saturday 2/19/2022.

Pre-tests

Pre-tests were conducted on the research sample as follows:

Taking a blood sample of (5cc) from the injured at rest, in the elite laboratory for pathological analyzes in Baghdad, as samples are taken from the forearm area of venous blood and the injured person is in the sitting position, as blood samples are placed in special blood preservation tubes with an amount of (2.5cc). To extract the values of (immunoglobulins (IgM - IgG) while a blood sample is placed in tubes containing a preservative (EDTA) in an amount of (2.5cc) to extract the values of white blood cells (WBC) numbered according to the sequence of the injured, as the number expresses the name of the injured, with the help of a specialized chemist In this field, all temporal and spatial conditions must be fixed in order to standardize them in the intermediate and distance tests and to avoid any error.

Therapeutic rehabilitation approach for physical exercises associated with ischemia and hyperemia

The prepared rehabilitative curriculum included performing physical exercises for ischemia and hyperemia in the rehabilitation of ankle joint injuries, which consisted of exercises without weight, exercises using body weight, medical balls, rubber ropes, and exercises using an iron bar. The purpose of these exercises is to strengthen the muscles of the ankle joint and lengthen their strength as well as increase the range movement and attempt to return its range of motion to the normal range and in all directions of movement. All members of the research sample (8) injured athletes underwent a rehabilitative program with three therapeutic training units per week, and the program lasts for 6 weeks using exercises associated with ischemia and hyperemia using the pressure method, which lasts from 3 to 5 minutes during a period of 6 weeks and is used during the main section only. The researcher relied in dividing the time of the therapeutic units on the extent of improvement in the degree of injury.

Intermediate tests

Intermediate tests were conducted on the research sample after a period of 3 weeks of applying the rehabilitation approach associated with ischemia and hyperemia as follows: Measuring the biochemical research variables during rest as mentioned previously in the pre-tests with the same procedures and the same temporal and spatial conditions. The purpose of conducting intermediate tests is to ensure that the sample members are not exposed to unexpected side complications, as well as to see the extent of improvement in the degree of infection.

Post-tests

Post-tests were conducted on the research sample after a period of 3 weeks of the intermediate test and a period of 6 weeks of applying the rehabilitation approach associated with ischemia and hyperemia as follows: Measuring the

Table 1: Shows the specifications of the research sample.

No.	Variables	Measuring unit	Mean	Std. Deviations	Median	Skewness
1	Length	Cm	187.8	5.10	178.5	1.21
2	Mass	Kg	71.50	4.3	72	0.50
3	Age	Year	21.12	1.76	20	0.12

biochemical research variables during rest as mentioned previously in the pre-tests with the same procedures and the same temporal and spatial conditions.

Statistical methods: The search data was processed through the Statistical Package for the Social Sciences (SPSS).

- Arithmetic mean.
- Standard deviation.
- Mediator.
- Torsion coefficient.
- Coefficient of difference.
- Percentage.
- Analysis of variance F test for corresponding samples.
- LSD's Law for Finding Differences in Arithmetic Media.

Results and Discussion

Presenting the results of the arithmetic mean values and standard deviations of immunoglobulins (IgM - IgG) and white blood cells (WBC) in the test (pre, Intermediate and post) of the research sample (Table 2).

Presenting the results of the analysis of variance test for immunoglobulins (IgM - IgG) and white blood cells (WBC) between the three tests (pre, Intermediate and post) in the research sample (Tables 3 & 4).

Discussion

Tables 3 and 4 show that there are significant differences between the three tests and in favor of the post-test in the number of white blood cells (WBC) being the lowest arithmetic mean between the three tests (pre, Intermediate and post) in the research sample.

The researchers attribute that the number of white blood cells is high in the research sample in the pre-test as a result of a sprained ankle joint, as white blood cells play a major and active role in addressing and eliminating pathogens as the first line of defense and the basis against diseases, as everything that enters the body is harmful to it and everything One of its types has special tasks and functions that devour and swallow pathogens with sweeping and removal of dead damaged cells to get rid of them outside the body with an important role to restore infected tissues and cells as the number of white blood cells increases upon infection, and rushes towards the site of infection as different methods are used to eliminate the causes Infection from tissue damage or harmful microbes (Salama. 2002) , due to an increase in (WBC) the devouring ability of these pellets to remove what is left behind by performing the exercises from the remnants of the fear of the cells after the completion of the performance, and because the white blood cells are the first line of defense in the human body, thus increasing the body's immunity (Ali Alkufi, H.2015).

confirms that "white blood cells represent the body's main line of defense against diseases, as they identify foreign bodies or foreign microbes that attack the body, whether from bacteria or viruses, and produce anti-defense means against them" (Al-Husseini. 2001).

The reason for the increase in this variable (WBC) comes as a result of the occurrence of infection, which is one of the main blood cells in addition to the red cell and platelets. The main function of white cells is to defend the body against infectious diseases, and it is part of the immune system, and it is the cells of the immune system whose function is to defend the body against all infectious diseases and substances that stimulate the immune system. There are several different types of white blood cells, but they are all formed from a multipotent stem cell In the bone marrow known as hematopoietic stem cell (Sherri W. 2000). However, after a period of using the therapeutic rehabilitative approach and physical exercises associated with ischemia and hyperemia, the number of white blood cells begins to decrease as a result of the return of damaged tissues to their normal state and the body's lack of need for a defensive state as a result of healing the injury. White blood cells perform their primary function in defending the body against infection that results from it, as they are divided into several types, each type of which performs its own functions in prevention and resistance to infection, and the importance of these cells appears if a person is exposed to a specific injury as a result of the entry of any foreign body into the body (Al-Shennawi and Qassem. 2002). In addition to the therapeutic rehabilitative exercises associated with ischemia

Table 2: Shows the arithmetic means and standard deviations of the variables under study in the three tests (pre, Intermediate, and post) for the research sample.

No	Variables		Pre-test		Intermediate tests		Post-test	
			Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1	Chemical variables	White Blood Cells (WBC)	9500	0.499	7600	0.322	6433	0.341
2		Immunoglobulin IgM Mg/dl	200.350	8.402	185.861	2.444	169	1.600
3		Immunoglobulin IgG Mg/dl	1290.55	8.334	1033.15	44.810	905.870	9.412

Table 3: Shows the analysis of variance between the three tests (pre-intermediate-post) for chemical indicators.

Variables	Sum Squares	Degree of freedom	Mean of squares	F value calculated	Level Sig
White Blood Cells (WBC)	37.877	2	18.870	170.992	0.000*
Error limit	1.441	14	0.110		
Immunoglobulin IgM Mg/dl	4750.050	2	2381.433	111.877	0.000*
Error limit	291.490	14	21.110		
Immunoglobulin IgG Mg/dl	612022.94	2	30200.80	430.053	0.000*
error limit	9920.860	14	706.890		
* Significance					

Table 4: Shows the value of the differences in the arithmetic mean in the chemical indicators and the value of the least significant difference (L.S.D) for the three tests (pre-intermediate-post).

Variables	Tests	differences in the arithmetic mean	Level Sig	Support to
White Blood Cells (WBC)	Pre- intermediate	1.900	0.000*	Intermediate
	Pre-post	3.067	0.000*	post
	Intermediate- post	1.167	0.000*	post
Immunoglobulin IgM Mg/dl	Pre- intermediate	14.489	0.000*	Intermediate
	Pre-post	31.35	0.000*	post
	Intermediate- post	19.875	0.000*	post
Immunoglobulin IgG Mg/dl	Pre- intermediate	-257.4	0.000*	Intermediate
	Pre-post	-384.68	0.000*	post
	Intermediate- post	-127.28	0.000*	post
* significance				

and hyperemia, they were effective in reducing the number of white blood cells, as the increase in pulling the tendons and then the ligaments led to raising the pressure causing the increase in the number of white blood cells, and the use of therapeutic exercises led to an increase in blood flow to the affected area and then raising Excreta and residues of infection, which also reduced the number (Al-Mandalawi and Al-Shatti. 1987) (Figure 1).

Tables 3 and 4 show that there are significant differences between the three tests and in favor of the post test, immunoglobulin (IgM) being less arithmetic mean between the three tests (pre, Intermediate and post) in the research sample. The immunoglobulin (IgM) percentage increased in the pre-measurement, while the percentage in the post-measurement decreased significantly. The researchers attribute the increase of this variable (IgM) to the fact that this variable plays a role in providing protection within the tissue fluids or body secretions when infection occurs to the affected part or organ. As for the telemetry, it is due to its natural state, and this was confirmed by " as he believes that this variable is mainly confined to the vascular system, so it has importance in providing protection within the tissues or secretions of the body. It works in one way or another in providing protection within the fluids of the tissues or secretions of the body, but upon recovery from the injury, this variable returns to the normal situation because the member who has recovered does not need it". (Al-Makawi. (1998).

As the use of the rehabilitative approach with physical exercises associated with ischemia and hyperemia by using the compression method, which is characterized by being commensurate with the nature of the injury and its role in treating the ankle joint and returning it to its normal condition, which led to a decrease in the percentage of immunoglobulin (IgM), and the effect is greater when using ischemia and hyperemia associated with these exercises. Ischemia works during exercise during a period of 3-5 minutes to prevent arterial blood from reaching the target organ, which is the ankle joint. During this period, it depends on the available food stocks to try to cover what the joint needs while performing exercises to compensate for the damaged tissues as a result of injury, and then the joint resistance increases. As a result of the lack of ischemia, and after the end of the exercise, the pressure device is lifted, and then the state of hyperemia (perfusion) occurs, and then large amounts of blood reach the tissues of the target organ, which is the ankle joint, so that the blood loaded with food reaches in double quantities and reaches the farthest point within the damaged tissues of the joint, which contributes to Healing of the ankle joint injury, which leads to a decrease in the level of immunoglobulin (IgM). Immunoglobulin (IgM) occupies the second place in terms of concentration in the blood serum. This immunoglobulin is responsible for the primary immune response, as well as units (IgM) that also act as receptors for lymphocyte antigen. Constructivism (Al-Shennawi. (2003).). In addition, "the players suffer from a slight decrease in the concentrations of immunoglobulins during high-intensity training." (Zwayan, L., & Makhlif, S., 2018) (Figure 2).

Tables 3 and 4 show that there are significant differences between the three tests in favor of the immunoglobulin (IgG) post-test. Being the lowest arithmetic mean among the three tests (pre, Intermediate, and post) for the research sample.

The immunoglobulin (IgM) has increased in the pre-measurement as a result of a sprained injury in the ankle joint, which results in internal bleeding resulting from rupture of the tissues and blood vessels. In this case, the blood goes out of its normal course, forming a foreign body (antigen) that leads to a defect in the blood vessels. The site of the injury, which leads to the reduction or cessation of the functioning of the organ in its performance of the movement, and this is what appears in the form of a tumor, a change in the color of the skin, the inability to perform, and pain during pressure at the site of the injury, which leads to the inability of the person to perform; Which reduces the effectiveness of performance, and here is the role of immunoglobulin (IgM), which is one of the dominant immunoglobulins in the blood serum, representing about 75% of the concentration of the rest of the immunoglobulins (Al-Shennawi and Qassem . 2002). The researchers attribute the reason for the increase in this variable (IgG) in the pre-measurement to the increased activation of the cells of the immune system, which leads to the formation of a strong defense line against the injury that the player may be exposed to. "When the complementary immune system is activated, the efficiency of this protein increases by destroying foreign bodies." (Refaat. 2008). As for the reason for its lack in the telemetry as a result of the use of therapeutic rehabilitative exercises associated with ischemia and hyperemia, which had a major role in treating the sprained ankle joint during a period of 6 weeks and its return to normal, which led to the return of (IgG) to its normal state also after this protein was eliminated On foreign bodies, by uniting the foreign body with the infected body, then destroying and eliminating it (Refaat. 2008). In addition, the player's knowledge of the scientific information related to his injury leads to diagnosis and treatment so that the player returns to the condition he was in before the injury occurred. This is the main and primary goal of the therapeutic side of sports medicine in the field of athletes' injuries (Zaher. 2008) (Figure 3).

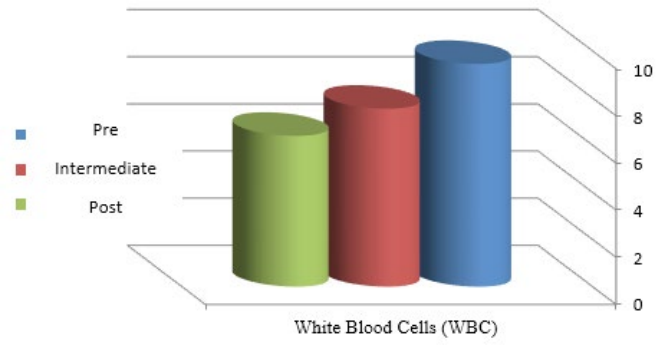

Figure 1: Shows the arithmetic mean of white blood cells (WBC) in the three tests (pre, intermediate, and post) for the research sample.

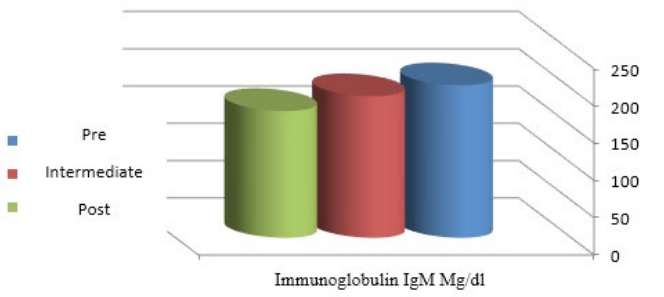

Figure 2: shows the computational mean of immunoglobulin (IgM). In the three tests (pre, intermediate and post) for the research sample.

Conclusions and Recommendations

Conclusions

- The results showed that the exercises in the style of ischemia and hebrima have a positive effect in the treatment and rehabilitation of the lateral lateral sprain of the ankle joint in swimmers.
- There is a clear increase in immunoglobulins (IgM - lgG) when the injury occurs directly in the research sample as a result of the defensive role it plays by increasing the activation of the cells of the immune system, which leads to the formation of a strong line of defense against the injury that the player may be exposed to.
- There is a rise in white blood cells (WBC) when the infection occurs directly in the research sample for its main and effective role in addressing and eliminating the causes of infection and everything that enters the body to harm it by devouring and swallowing the pathogens with vacuuming and

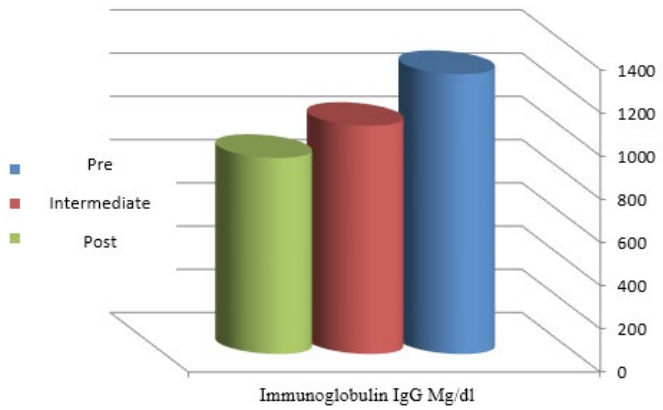

Figure 3: Shows the arithmetic mean of immunoglobulin (IgM) in the three tests (pre, intermediate, and post) for the research sample.

removing dead damaged cells to get rid of them outside the body with an important role To restore the affected tissues and cells, and then it begins to gradually decrease, as the tissues return to their normal position.

- The case of ischemia and hyperemia associated with the prepared therapeutic rehabilitative exercises had a positive effect on shortening the rehabilitation and treatment period, which was at a rate of (6) weeks and at the rate of (3) units per week when applying the curricula compared to the traditional rehabilitative exercises.

Recommendations

- Emphasizing the use of therapeutic rehabilitative exercises using the method of ischemia and hyperemia within the vocabulary of the rehabilitative curricula, and relying on the anatomical and mechanical foundations when preparing them for their significant role in the treatment of injury.
- Necessity of relying on chemical variables when evaluating the rehabilitation curricula for injuries because they give accurate information about the real condition of the injury.
- Rehabilitation curricula should be based on exercises whose range of motion is similar to the anatomical structure of the joint, which helps speed up the treatment of the injury.
- Taking into account the results reached when preparing the rehabilitation curricula to accelerate, treat and rehabilitate players after injury.
- Conducting other future studies using special exercises associated with ischemia and hyperemia for other individual or team games, especially for athletes with injuries to the upper extremities of the body.

References

Bahaa El-Din Ibrahim Salama. (2002). Sports Health and Physiological Determinants of Sports Activity, Dar Al-Fikr Al-Arabi, pp. 266-267.

Ayman Al-Husseini. 2001. The human body is a machine of wonders and secrets, The Qur'an Library, Cairo, p. 63.

Sherri W. (2000). Human physiology and anatomy Laboratories. p 185.

Farha Al-Shennawi and Medhat Qassem. (2002). The immune system between health and sports, Alam Al-Kitab, pp. 26-27.

Qasim Al-Mandalawi and Mahmoud Al-Shatti. (1987).Sports Training and Records, University of Mosul, Dar Al-Kutub for Printing and Publishing, p. 123.

Saad Eddin Al-Makawi. (1998). Immunity is the body's defensive strategy, Manshaat Al-Ma'arif, p. 62.

Farha Al-Shennawi. (2003). Your immune system protects you from microbes and diseases, Dar Al-Hilal for Publishing and Distribution, Issue 29, pp. 33-34.

Farha Al-Shennawi and Medhat Qassem .(2002). A previously mentioned source, AD, p. 55.

Amir Muhammad Refaat.(2008). The effect of phyto compounds on some immune variables in athletes, Master's thesis, Faculty of Physical Education, Tanta University, p. 36.

Abd al-Rahman Abd al-Hamid Zaher. (2008) . Encyclopedia of Sports Injuries and Their First Aid, Al-Kitab Center for Publishing, pp. 25-27.

Malek Alshok, A. (2008). Impact exercises especially in the development of speed and its relationship with the completion of (200 m) freestyle. *Journal of Physical Education*, *20*(2), 259–271. https://doi.org/10.37359/JOPE.V20(2)2008.772

Abedalsatar M & Hanoon W. (2009). The special drills for fatness and their effect in developing some basic skills in basket ball for age (17- 18). jope [Internet]. 2009 Jun. 28 [cited 2023 May 3];21(2):363-82. Available from: https://jcope.uobaghdad.edu.iq/index.php/jcope/article/view/728

Aldulaimi, N. (2009). The effects of Individual & Collective competition pattern on improving the spike and block skills and their retention in volleyball of the students. *Journal of Physical Education*, *21*(2), 213–238. https://doi.org/10.37359/JOPE.V21(2)2009.723

Ali Alkufi, H. (2015). The effect of physical exercises in special (McHc) and (HcT) Describe the types of white blood cells to the players tennis. *Journal of Physical Education*, *27*(4), 419–428. https://doi.org/10.37359/JOPE.V27(4)2015.683

Zwayan, L., & Makhlif, S. (2018). Mental Relaxation Exercises and Their Effect On Some Immune System Components of Women's Football. *Journal of Physical Education*, *30*(2), 366–378. https://doi.org/10.37359/JOPE.V30(2)2018.370

Sherri W. (2000)."Human physiology and anatomy Laboratorie.