Biological activity of the mummy. Publication 7: Impact on the course and outcome of acute myocardial infarction

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Acute diseases of the cardiovascular system require urgent allopathic therapy according to generally accepted schemes, and, if necessary, resuscitation measures. After the relief of acute manifestations and against the background of constant therapy with allopathic drugs, effective and safe drugs of natural origin are increasingly prescribed in order to improve the condition, minimize the side effects of allopathic treatment, prevent complications and reduce the dose of allopathic drugs used.

In the 60s-80s of the XX century, numerous experimental (on various laboratory animals) studies were carried out to study the possibility of using the organo-mineral complex of mummy, in particular, its effect on postinfarction regeneration, lipid, carbohydrate-phosphorus and mineral metabolism in acute infarction myocardium and postinfarction period.

I. Application for myocardial infarction

The work of K.Yu. Yuldashev and S.K. Saidkarimova (1978) [22].

The studies were carried out on male chinchilla rabbits weighing 2.5–3 kg. Myocardial infarction was reproduced under barbamil anesthesia by ligation of the anterior descending branch of the left coronary artery. The animals were sacrificed by introducing air into the ear vein on the 3rd and 15th days after the start of the experiment. Experimental animals received mummy orally in a dose200 mg / kg. Myocardial infarction was diagnosed using electrocardiography andvisually at autopsy. Three zones were studied: necrosis, perinecrotic and distant [22].

In the course of morphological studies, a positive effect of mummy on the structure of regeneration of the infarcted heart was revealed. The features of the morphogenesis of myocardial infarction associated with the formation of a zone of necrosis in the basin of the ligated coronary artery, with its organization by connective tissue and the development of compensatory hypertrophy of the peri-infarction zones did not change during the treatment of mummy. Under the influence of mummy, a significant acceleration of the processes of connective tissue replacement of the necrosis zone was observed. By the 10th day of research, the regeneration of ischemic infarction was completed [22].

Thus, during the experiment, it was shown that mummy has a beneficial effect on the course of experimental myocardial infarction: it normalizes the disturbed links of metabolism, promotes early recovery of the affected cardiac tissue [22].

II. Application in the postinfarction period

Row research is dedicated to experimental study influence mummy on postinfarction regeneration of the heart muscle. Analysis of bibliographic data indicates that the studies were carried out on male chinchilla rabbits with a model of myocardial infarction caused by surgical dressing under barbamil anesthesia and novocaine anesthesia of the descending branch of the left coronary artery [3, 13].

Shilajit was administered orally at a dose of 200 mg / kg once a day for 30 days. The animals were sacrificed on the 1st, 3rd, 10th, 15th and 30th days of the experiment. The studies were carried out in those animals in which myocardial infarction was determined visually and electrographically on the anterolateral heart wall. The studies were carried out in three zones: infarction, peri-infarction and distant [3, 13].

S.K. Saidkarimov et al. (1978) with morphological, histochemical, morphometric, luminescent and electron microscopic study of the infarcted heart, it was found that the structure of myocardial infarction is the same in the control and experimentalgroups. However, the results of morphometric and electronoscopic studies have shownthat in the experimental group of animals by the 10th day of the experiment, the infarction zone was replaced with mature connective tissue. In animals of the control group, scar formation lasted until 15–20 days of the experiment [13].

Ischemic myocardial infarction in animals of the experimental group was organized by mature fibroblasts with a relatively small number of blood capillaries. Luminescence microscopy of the connective tissue of the scar showed a small number of cells rich in RNA. Mostly cells containing DNA were found, which indicates the complete differentiation of connective tissue and the absence of low-differential cells [13]. At the same time, in control animals, loose connective tissue with a large number of blood vessels, immature fibroblasts, lymphocytes, and RNA-rich cells was detected in the infarction zone on the 15–20th day of the experiment [13]. The ultrastructure of cardiomyocytes in animals of the experimental group also indicated a more rapid onset of structural adaptation, manifested hypertrophy and hyperplasia of intracellular organelles of cardiomyocytes, in particular, mitochondria, sarcoplasmic reticulum and myofibrils. That is, mummy contributed to the enhancement of interluminar capillary exchange and stimulation of the acceptor abilities of cardiomyocytes [13].

The results of structural, functional and metabolic analysis of the course of regeneration of an infarcted heart showed that mummy improves impaired coronary circulation and myocardial metabolism; increases the reduced contractility of the heart; stimulates reparative regeneration. All this testifies to the positive therapeutic effect of mummy in occlusion of the coronary artery [13].

The most informative data on the effect of mummy on the regenerative process in the myocardium were obtained by V.V. Weisbrot et al. (1978) at 10th and 15th days of the experiment [3].

Morphological analysis of the structure of postinfarction regeneration at all analyzed levels (tissue, cellular and subcellular) on the 10-15th day of the experiment (with stimulation of mummy-asil) revealed a significant acceleration (on average by 5 days) of the processes of connective tissue replacement of the infarction zone and formation compensatory-restorative reactions of "intact" myocardium. No new or specific morphogenic effects of mummy on the regenerating heart muscle were found. This indicates a general nonspecific positive effect of mummy on the normalization of general metabolic processes and a wide range of its use [3].

III. The effect of mummy on some electrocardiographic parameters

3.1. Influence of mummy on electrocardiographic parameters of warm-blooded animals

A.I. Leskov et al. (1965) it was found that the mummy has practically no effect onthe cardiovascular system of experimental animals (cats) [6].

Intravenous administrationexperiencedanesthetized animals medinal, filtered solution of mummy in doses 10–50 mg / kg did not change the level of arterialpressure, heart rate and respiration, pulse wave amplitude.

Administration of the drug into the duodenum in doses 100, 200 and 500 mg / kg are also not changed the level of blood pressure, heart rate and respiration. 2-3 hours after the introduction of mummy in a dose500 mg / kg there was an increase in the amplitude of the pulse wave by 20-30% of the baseline. Increasing the dose of the drug to1000 mg / kg contributed to a decrease in breathing in2-3 times [6].

During the experiment, it was shown that intravenous administration of mummy at a dose 5 mg / kghad an inconsistent effect on coronary blood flow: there was both an increase in the volumetric flow rate of coronary blood flow (maximum by 43%) and its decrease (up to 13%) [6]. At the same dose, there were no ECG changes, there was an increase (by 10–20%) or a slowdown (by 9%) of the heart rate. The systolic indicator remained almost unchanged or, in some cases, there was a tendency to decrease it. The P wave voltage increased slightly (by 17–40%). In a number of experiments, a decrease in the voltage of the ECG teeth was noted within the first hour after administration, followed by an increase in a day. When administered parenterally, mummy in a dose250 mg / kgthere were similar changes in the ECG [6].

Electrocardiographic studies A.Sh. Shakirova (1965-1968), carried out onin dogs with long bones fracture, evidence of an improvement in the electrical activity of the heart after oral administration of the drug mumiyo [18–20].

In the course of the study, it was found that the time of atrioventricular conduction (duration of the P-Q interval) ranged from 0.08 to 0.12 s and almost did not change with oral administration of the mumiyo preparation; no dynamic changes in the intraventricular conduction of the heart were observed (its time ranged from 0.03 to 0.05 s) [18–20]. Research of functions of the heart N.A. Shelkovsky et al. (1965) were carried out at 10 series of adult dogs [21]. Laboratory animals under light morphine ether anesthesia were injected intraarterially and intravenously with a solution of mummy extract (40–20–10–5–1%) in an amount of 1 ml / kg of animal weight [21].

With the intravenous administration of large doses of mummy (40 and 20%, sometimes 10% solutions) in all animals immediately after administration, and in some even at the time of administration, there was a slowdown in intraventricular conduction, turning into ventricular flutter. As a result, death occurred very quickly, accompanied by the phenomena of a progressive drop in blood pressure to zero. Later, after 3-5 minutes, respiratory arrest was observed [21].

Intravenous administration of low doses of mummy (1% solution) had a pronounced effect on the activity of the heart muscle. From the side of the electrocardiogram, there was a rapid change in the size of all teeth, occasionally with a slight displacement of the ST interval; in some cases, the T1,2 wave was slightly below the isoline. These changes persisted throughout the entire experiment (90 minutes). With intravenous administration of a 5% solution of mummy extract, a pronounced electrical alternation of the QRS complex was observed [21].

Intra-arterial administration of large doses of 40 and 20% solutions of mummy extract never led to the death of animals and was accompanied by a slight increase in the amplitude of all teeth on the ECG [21].

Thus, intravenous administration of mummy extract leads to impaired ventricular conduction, which is most pronounced at high drug concentrations [21]. The effect of mummy on the bioelectric activity of the myocardium was studied by Yu.N. Nuraliev (1977) in experiments onguinea pigs [9, 10, 11].

Studies have shown that single and multiple oral administration of the drug in doses 25-1000 mg / kg contributed to the change in heart rate. So, when introducingmummy in a dose 100 mg / kg, through 30, 60, 120 minutes after administration, there was an increase in the number of heart contractions by 10-30 beats compared with the initial values. Administration of the drug to the dose1000 mg / kg was accompanied by extrasystole and a slowing of the heart rate.

With intra-abdominal administration of mummy in doses 1000-2500 mg / kg it sharply increased toxic effects on the heart. In 40-60 minutes after the introduction, the heart rate decreased by 20-40%, and after 3-4 hours the number of heartbeats decreased by 50-60%, which was accompanied by a sharp disturbance in the myocardial conduction system. The T wave was originally enlarged. After 6 hours, the T wave was absent, there was a violation of the QRS complex, ventricular premature beats, pronounced bradycardia, cardiac block and complete cardiac arrest [10, 11].

Thus, in the studied doses, when administered orally, mummy does not have a toxic effect on the cardiovascular system. With intra-abdominal administration of mummy in doses of 1000–2500 mg / kg, the toxicity of the drug is observed, coronary blood flow and intraventricular conduction are disturbed [10, 11]. The effect of mummy-asil on electrocardiographic parameters in experimental myocardial infarction was studied by T.R. Khalikov et al. (1978) [17].

Experimental animals (rabbits) were divided into 3 groups: I - untreated withexperimental myocardial infarction; II - experimental group of animals that received mummy in a dose200 mg / kg orally once a day; III (control) - intact [17]. The results of the study showed deformity and ST deviation from the isoline characteristic of myocardial infarction, associated with impaired coronary blood flow. The T wave was flattened or negative, which indicates a metabolic disorder in the myocardium. The force of ventricular contractions decreased. In the rabbits of the experimental group, the ST shift from the isoline was noted, but it was less pronounced than in the control animals. Sharp ST deformity was observed in 50% of control and 15% of experimental animals, a positive T wave, respectively, in 50 and 80%.

In 15% of control animals, on the 15th day after occlusion of the coronary artery, pronounced ST deformity was found, in 25% - negative or flattened T wave. The force of atrial contractions reached the level of intact animals. These changes indicate a violation of the coronary circulation with symptoms of pronounced dystrophic changes and an increase in heart failure.

Long-term administration of mummy helped to normalize the heart rate of the ventricles. ST and T wave deformity against the background of mummy was observed only in 8% of cases [17].

The revealed changes were qualified by the authors as a positive effect of mummy in occlusion of the coronary artery due to the improvement of impaired coronary circulation and myocardial metabolism [17]. The results of this study are in full agreement with the works of S.K.Saidkarimov et al. (1978) [13].

Electrocardiographic studies by N.M. Madzhidova et al. (1980) were carried out on groups IV of rabbits [7].Group I consisted of animals with left ligationdescending coronary artery on the 3rd day of the pathological process. II - animals withexperimental myocardial infarction, received within 3 days after surgery mummy at a dose of 200 mg / kg. III - animals on 15th day of myocardial infarction. IV - animals that receivedwithin 15 days from the day of myocardial infarction, mummy at a dose of 200 mg / kg. In all animals, ECG was recorded before ligation of the left coronary artery (control) and before slaughter [7].

In rabbits Group I (in 16 cases) on an ECG taken on the 3rd day of the pathological process, an increase in heart rate was revealed by an average of 20 beats per minute. Deep, wide Q, ST segment elevation and its transition to negative T in II, III A and F leads were found in 9 cases. Significant prolapse (depression) of the ST segment and its transition to negative T was observed in 5 cases, and positive and flattened - in 4 [7]. In rabbitsII groupthere was a slight positive dynamics on the ECG, compared with the previous group: the ST segment displacement was less pronounced and more rare. The number of positive T cases increased [7].

Positive changes in the ECG under the influence of mummy in the acute period of experimental myocardial infarction served as the basis for studying the effect of mummy on the further course of the pathological process. A comparative study of the ECG of rabbits with experimental myocardial infarction, who received and did not receive mumiyo for 15 days, showed a noticeable difference in the course of the pathological process [7].

In rabbits that did not receive mummy, ST segment displacement was observed in 16% of cases, negative T - in 80%, lengthening of the QT interval - in 60%, cardiac arrhythmias (atrial, ventricular extrasystoles) - in 21% [7].

In rabbits that received mummy, there were positive changes, expressed in the disappearance of the zone of ischemic damage, that is, normalization of the ST segment, in all cases; the disappearance of the ischemic zone - in 46% of cases; shortening of the QT interval - in 24% [7].

ECG changes under the influence of mummy can be explained by the positive effect of the drug on the microcirculation system and myocardial metabolism. Long-term administration of mummy in myocardial infarction contributes to the normalization of coronary circulation and myocardial metabolism, which is accompanied by the restoration of contractile function and heart rate [7].

Morphological analysis of the structure of postinfarction regeneration at the tissue and cellular levels revealed an acceleration (on average by 5 days) of the process of connective tissue replacement of the infarction zone and the formation of compensatory-adaptive reactions of the intact myocardium on the 10-15th day of the experiment. At the same time, no new or specific morphogenic effects of the drug on the regenerating heart muscle were found, which indicates a general nonspecific positive effect on the normalization of general metabolic processes [7].

3.2. The effect of mummy on the electrocardiographic parameters of cold-blooded animalsThe results of a study of the effect of mummy on the heart of cold-blooded animals are very interesting and informative.

The object of research by K.Kh. Khaidarova et al. (1965) served as a thick purified extract mummy obtained from samples of raw materials from the Zeravshan Ridge (Gozzon village near Lake Iskander-Kul) [16].

The studies were carried out on the isolated (according to the Straub method) heart of cold-blooded animals at dilutions of 1: 400. During the experiment, no visible changes in the amplitude and heart rate were found [16].

Research by V.I. Kozlovskaya et al. (1972), carried out on an isolated (according to the methodStraube) the heart of cold-blooded animals, made it possible to establish a relationship between the dosage of the drug mummy and the strength of its effect on the cardiovascular system [5].

Mumiyo in a dose 0.1 mg / ml did not affect heart function. At a dose of 1-10 mg / ml - stimulated itactivity, which was accompanied by an increase in the amplitude and number of heart contractions. Dose50 mg / ml, there was a noticeable decrease in the amplitude and a decrease in heart rate. Vdose 100 mg / ml drug stopped cardiac activity [5]. The results of this study are in full agreement with the works of N.A. Shelkovsky et al. [21].

IV. Influence on some biochemical parameters in myocardial infarction

4.1. Effect of mummy on lipid metabolism

Analysis of bibliographic data indicates that free fatty acids are of great importance for energy metabolism in the myocardium. Their accumulation in the zone of myocardial infarction is due to the fact that the heart extracts plasma fatty acids from fat stores in direct proportion to their arterial concentration. In the myocardium, they are consumed by the infarcted tissue, but to a lesser extent than by healthy tissue, and, therefore, they accumulate more than are oxidized.

In addition to free fatty acids, the heart uses other lipid fractions and products of their conversion from the flowing blood to cover energy needs: triglycerides, lipoproteins, phospholipids. Triglycerides in the heart muscle perform various functions: they are involved in maintaining the structural integrity of the cell; deposited in the form of fatty drops; together with proteins and phospholipids are used by myocardial tissue for oxidative processes. Phospholipids are involved in the structural organization of biomembranes; have an activating effect on the catalytic properties of a number of enzymes.

Thus, factors influencing the metabolic fate of fatty acids, phospholipids and triglycerides are of great diagnostic and therapeutic importance in ischemic myocardium.

In this regard, some authors have studied the effect of mummy on lipid metabolism (content of total lipids, phospholipids, free fatty acids and triglycerides) of the heart muscle in experimental myocardial infarction [2, 22].

The studies were carried out on male rabbits of the chinchilla breed (weighing 2.5–3 kg) with a model of myocardial infarction caused by surgical dressing under barbamil anesthesia and novocaine anesthesia of the descending branch of the left coronary artery [2, 22].

Shilajit was administered orally at a dose of 200 mg / kg once a day for 30 days. The animals were sacrificed on the 1st, 3rd, 10th, 15th and 30th days after the operation. The studies were carried out in those animals in which myocardial infarction was determined visually and electrographically on the anterolateral wall of the heart. Three zones were studied: necrosis, perinecrotic and distant [2, 22] and blood serum extracted from the left ventricular cavity [2]. The control was the myocardium of the anterior wall of the left ventricle of intact rabbits [2]. Research by K.Yu. Yuldashev andS.K. Saidkarimov (1978) it was shown that onOn the 3rd day of myocardial infarction in animals of the control group, there was a decrease in the content of total lipids in two zones: in the infarction zone to 2.38 ± 0.04 g% (P <0.01) and perinecrotic - to 2.57 ± 0, 04 g% (P <0.05). V in the distant zone, the content of total lipids increased to 2.92 ± 0.05 g% (P <0.2), while the norm was 2.82 ± 0.12 g%.

In animals of the experimental group, an increase in the level of total lipids was observed only in the zone of necrosis up to 2.99 ± 0.08 g% (P <0.0001). The content of free fatty acids in the control group of animals on the 3rd day of the experiment increased: in the infarction zone up to 65.66 ± 2.61 mg% (P <0.001); perinecrotic - 64.00 ± 0.98 mg% (P <0.001); in the distant, the content was close to the norm of 49.58 ± 2.55 mg% [22].

In animals of the experimental group, the content of free fatty acids on the 3rd day of myocardial infarction increased only in the infarction zone to 74.50 ± 4.18 mg% (P <0.05); in the rest of the zones, no significant changes were found [22].

The content of phospholipids (the norm is 1681.9 ± 62.47 mg%) in the control group of animals on the 3rd day of the experiment decreased in the infarction zone to 1449.0 ± 38.43 mg% (P <0.01); no significant changes were found in the perinecrotic and distant zones [22].

The phospholipid content in animals of the experimental group on the 3rd day of the experiment increased: in the infarction zone up to 1878.7 ± 98.11 mg% (P <0.001) and in the perinecrotic zone up to 1845.2 ± 79.93 mg% (P <0.001) ; no changes were observed in the remote zone [22]. Contenttriglycerides (normal 1062.0 ± 71.8 mg%) in the control group of animals on the 3rd day of the course of myocardial infarction increased only in the necrosis zone to 1356.2 ± 53.1 mg% (P <0.01). In the rest of the zones, no statistically significant changes were noted [22].

The triglyceride content in animals of the experimental group on the 3rd day of the experiment did not change in all three zones of myocardial infarction [22].

On the 15th day after myocardial infarction, both control and experimental animals did not show significant changes in lipid metabolism (with the exception of the content of free fatty acids), that is, mummy did not have a significant effect on lipid metabolism. The content of free fatty acids in control animals increased in all zones of infarction. In animals of the experimental group, the content of free fatty acids in the zone of infarction, peri-infarction and in the distant zone was statistically significantly reduced.

Changes in the ischemic myocardium on the 15th day of myocardial infarction in animals the experimental group were less pronounced [22]. Research by N. S. Bashirova et al. (1978 g.) indicate that mummy, especially in the early stages of myocardial infarction, has a positive effect on lipid metabolism [2].

During the experiment, it was found that in animals of the control group with experimental myocardial infarction after 3 days of the experiment, the content of total lipids in the infarction zone decreased by 15.6%; in peri-infarction - by 8.9%; in the distant, their content was close to normal.

In animals of the experimental group, during this period, the content of total lipids increased by 25.6% in the zone of necrosis; in other zones, their content remained unchanged [2]. In the blood of control animals, the content of total lipids decreased by 38%. In animals of the experimental group, the content of the latter in the blood increased by 67.6% [2]. In animals of the control group, after 3 days of the experiment, the amount of free fatty acids in the zone of infarction and peri-infarction increased by 32.5%, and in the distant one, their content approached the value characteristic of a healthy myocardium [2]. The effect of mummy on the infarcted heart of the animals of the experimental group was accompanied by an increase in the content of free fatty acids in the infarction zone by 13.5%. In other areas, no changes were noted [2].

The phospholipid content in control animals after 3 days of the experiment in the infarction zone decreased to 87.41 ± 1.18 mg% (in intact animals, their level was 108.33 ± 1.32 mg%). In the peri-infarction area, a downward trend was also observed. In animals of the experimental group, the phospholipid content decreased to 103.4 ± 0.89 mg%. The content of triglycerides on the 3rd day of the experiment in the control group of animals increased only in the zone of necrosis to 1356.2 ± 53.1 mg% (P <0.01) at the norm of 1062.0 ± 71.8 mg%. In the rest of the zones, no statistically significant changes were noted [2]. The content of triglycerides in animals of the experimental group on the 3rd day of the experiment did not change in all three zones of myocardial infarction [2].

On the 15th day of the course of myocardial infarction in animals of the experimental group, the content triglycerides increased in the infarction zone by 44.3% and remained unchanged in the peri-infarction and distant zones [2].

4.2 Influence of mummy on mineral metabolism

Studies on the effect of mummy on the level of trace elements in experimental myocardial infarction are very interesting [22].

K.Yu. Yuldashev and S.K. Saidkarimov (1978) showed that on3rd day of the course of myocardial infarction in the zones of necrosis, perinecrotic and distant in the control andan increase in the level of iron was observed in the experimental groups of animals. The content of copper in animals of the control group in the zone of necrosis decreased. In the perinecrotic and distant zones of herthe content was, respectively, 961 μg% and 449 μg% [22].

The copper content in animals of the experimental group on the 3rd day of myocardial infarction in all zones increased sharply (in the necrosis zone it was 859 μg%, perinecrotic - 1100 μg%, distant - 1030 μg%) [22]. On the 15th day of myocardial infarction, the control animals showed a sharp increase in the iron content in the necrosis zone, along with the normalization of its content in the perinecrotic and distant zones. Experienced animalsthe group showed a normalization of the level of iron in the necrosis focus against the background of an increase in itscontent in other areas. The content of copper in animals of the control group decreased in the zone of necrosis, and increased in the perinecrotic and distant zones. Experienced animalsgroup, the copper content decreased in the focus of necrosis against the background of a slight increase in it inperinecrotic and distant zones [22].

The authors explain the detected changes as follows. In the acute period of the course of myocardial infarction around the zone of necrosis, there are profuse hemorrhages, hyperemia and, consequently, an increase in the iron content as a result of tissue infiltration with erythrocytes. To compensate for functions in the focus of necrosis, areas distant from it begin to hyperfunction. Probably, in order to maintain the function of the heart, oxidative-metabolic processes are enhanced in the hyperfunctioning area, where iron, being a part of the cytochrome system, plays an important role [22].

An increase in the content of iron and copper under the influence of mummy in experimental myocardial infarction is a beneficial effect, because these trace elements are part of redox enzymes and contribute to the enhancement of the oxidative process. In addition, copper is involved in the mobilization of carbohydrates; therefore, an increase in its content in the affected areas under the influence of mummy can be regarded as an adaptive reaction of the body [22]. M.F. Fazylov and T.R. Khalikov (1978) all experimental male rabbitschinchilla weighing 1.8-3.2 kg were divided into three groups: I - intact rabbits (17); II -control animals with experimental myocardial infarction (17); III - experimental animals withexperimental myocardial infarction, who received mummy at a dose of 200 mg / kg [15].

The content of copper and iron was determined: in the heart muscle in various zones (necrosis, perinecrotic and distant), liver and blood. The saturation of iron transferrin and the activity of ceruplasmin were determined in blood serum [15].

The iron content in the blood of animals of the control group on the 3rd day of the experiment did not change significantly. In the cardiac muscle in the area of necrosis, there was a tendency to an increase in its content; in the perinecrotic and distant zones, the level of iron increased sharply. This is probably due to either hemorrhage in violation of hemodynamics in these areas, or the movement of iron from the depot (liver) [15].

The copper content in animals of the control group on the 3rd day of myocardial infarction in the necrosis focus decreased sharply; perinecrotic - increased; in the area distant from the infarction did not undergo a noticeable change. Hypercupremia was observed in the blood against the background of increased activity of ceruplasmin. The increase in copper content in the perinecrotic area is explained by the participation of copper in redox reactions for the destruction of excess amounts of biogenic amines [15].

The iron-binding capacity of transferrin in animals of the control group is The 3rd day of the experiment decreased [15]. The iron content in the blood and liver of the experimental group of animals by 3 and the day of the experiment increased. In the heart muscle in the area of necrosis, a sharp increase in the level of iron was observed, compared with the control group. In the perinecrotic area, the iron content was slightly lower than in control animals, but higher than in intact animals. The mummy had no effect on the level of iron in the area remote from the infarction. These changes in the level of iron in different zones of the heart during myocardial infarction under the influence of mummy, according to the researchers, are explained by the improvement in hemodynamics and the enrichment of the damaged organ with iron by increasing the iron-binding capacity of transferrin [15].

The content of copper in the blood and liver of the experimental group of animals on the 3rd day of the experiment increased against the background of a decrease in the activity of ceruplasmin. In the heart muscle in the necrotic area, the copper content increased to 859 μg%, in the perinecrotic area - up to 1100 μg%, in the distant one - up to 1030 μg%. An increase in the level of copper in the blood and tissues, apparently, has a compensatory value aimed at normalizing the oxidation of biogenic amines and the synthesis of high-energy phosphorus compounds [15].

On the 15th day of the course of myocardial infarction, the animals of the control group showed a high level of iron in the necrotic area. In the liver, a sharp decrease in the iron content was observed, along with a tendency to an increase in its content in the blood against the background of a stable decrease in the iron-binding capacity of transferrin [15]. In all areas of the heart studied (on the 15th day of the experiment), the iron content decreased in comparison with that on the 3rd day of the experiment, but it was slightly higher than in the animals of the intact group [15].

The content of copper in the blood of control animals on the 15th day of the course of myocardial infarction decreased, while the activity of ceruplasmin remained increased [15]. In the heart muscle in the area of necrosis, the copper content remained low; perinecrotic - increased to 1000 μg%; in the distant, it increased to 599 μg%. In the liver, the copper content decreased to 302.3 μg%. The increase in copper content in the perinecrotic and distant regions of the heart is probably due to the movement of copper from the liver depot [15].

The iron content in the blood of the experimental group of animals on the 15th day of the development of myocardial infarction decreased to 23 mg%. In the cardiac muscle in the zone of necrosis, the iron content approached the norm (6.8 mg%), but was lower in comparison with the animals of the control group. In perinecrotic and distant areas, the contentiron waselevated, and the iron-binding capacity of transferrin was not significantly altered.

The concentration of copper in the blood of the experimental group of animals on the 15th day from the day of ligation of the coronary artery increased to 352.5 μg%, in the liver - up to 554 μg%. In the heart muscle in the area of necrosis, the copper content was 205 μg%, in the perinecrotic and distant areas, respectively, 454 and 750 μg%. The activity of ceruloplasmin in the blood serum was almost 3 times lower than that in control animals [15].

Thus, the introduction of mummy in myocardial infarction in rabbits contributes to a noticeable normalization of the content and redistribution of iron and copper in the heart.

4.3. Effect of mummy on carbohydrate-phosphorus metabolism

The objects of research by K.Yu. Yuldashev and S.K. Saidkarimova (1978) had rabbits-chinchilla males weighing 2.5–3 kg. Myocardial infarction was reproduced under barbamil anesthesia by ligation of the anterior descending branch of the left coronary artery. The animals were sacrificed by introducing air into the ear vein on the 3rd and 15th days after the start of the experiment. Experimental animals received mummy orally in a dose200 mg / kg. Myocardial infarctiondiagnosed by electrocardiography and visually at autopsy. Three zones were studied: necrosis, perinecrotic and distant [22].

Glycogen was determined in the heart muscle, pyruvic, milk, adenosine triphosphoric (ATP), adenosidiphosphoric (ADP) and creatine phosphoric acids. RNA, DNA, mucopolysaccharides were histochemically determined [22].

As a result of the research, it was shown that on the 3rd day of myocardial infarction in animalsin the control group, there was a noticeable decrease in glycogen levels (normal 506.0 ± 158.6 mg%) in the necrosis zone up to 161 ± 21.3 mg% (up to 32.2% [13]), perinecrotic - 221 ± 30.5 mg% (up to 44% [13]); distant - 423 ± 63.2 mg% (up to 85% [13]). The content of pyruvic acid (norm 1.008 ±

0.16 mg%) increased: in the necrosis zone up to 1.493 ± 0.197 mg%, perinecrotic - 1.241 ± 0.167 mg%, distant - 0.97 ± 0.111 mg%. The content of lactic acid (norm 167.0 ± 14.4 mg%) also increased: in the zone of necrosis up to 208.0 ± 36.1 mg%, perinecrotic - 179.0 ± 25.9 mg%, distant - 208.0 ± 20.6 mg%. These changes indicate a switch in carbohydrate metabolism indicators from aerobic to anaerobic (glycolytic) type of metabolism. A decrease in glycogen content in all three zones during myocardial infarction can be considered as an indicator of the degree of hypoxia at the cellular level [22].

The content of high-energy phosphorus compounds (ATP, ADP, AMP) on the 3rd day of myocardial infarction in animals of the control group in the necrosis zone markedly decreased (2 times) [13] and amounted to 48%, 44% and 45%, respectively [22]. The content of creatine phosphoric acid decreased by 90% [22] (almost 10 times [13]), while the level of free inorganic phosphorus remained unchanged [22]. In the perinecrotic zone, the content of high-energy phosphorus compounds (ATP, ADP, AMP and creatine phosphoric acid) decreased by 48%, 40%, 25% and 35%, respectively. In the remote zone, these indicators did not change significantly [13].

On the 3rd day of myocardial infarction, in the animals of the experimental group, an increase in the content of glycogen in the necrotic and near-necrotic zone occurred against the background of a decrease in the rate of glycolysis. An increase in the level of ATP, ADP and creatine phosphoric acid in these zones of the heart was accompanied by an increase in the oxidative and phosphorylating capacity of the mitochondria of the infarcted heart [13].

On the 15th day of the experiment, the animals of the experimental group showed an increase in the level ofglycogen, pyruvate, lactic acid and high-energy phosphorus compounds. Moreover, theirthe content in the studied areas reached the norm, which indicates a favorable effect of mummy on the course of myocardial infarction [22].

The introduction of mummy within 15 days from the day of coronary artery occlusion led to an increase in carbohydrate-phosphorus metabolism in the heart muscle of rabbits. This indicates an increase in the intensity of oxidative processes under the influence of mummy-asil and its beneficial effect on the course of myocardial infarction [22].

A statistically significant increase in the level of ATP, ADP, AMP and creatine phosphoric acid in various zones of the heart during myocardial infarction served as additional confirmation of the ongoing normalization in energy exchange under the action of the drug. T.R.Khalikov et al. (1978) experimental animals (male rabbits of the chinchilla breedweighing 2-2.5 kg) were divided into 3 groups: I - animals with untreated experimentalmyocardial infarction (33); II - experimental group of animals that received mummy in a dose 200 mg / kg orally once a day (36); III (control) - intact animals (10) [17].

In the course of the research, it was shown that on the 3rd day of myocardial infarction in animals with untreated experimental myocardial infarction (Group I), a decrease in the level of glycogen was observed (in the necrosis zone up to 32.2%, perinecrotic zone - 44%, distant - 85%) and an increase in the content of pyruvic and lactic acids. These changes in the parameters of carbohydrate metabolism, according to the researchers, are associated with the switching of the aerobic type of metabolism, characteristic of a healthy heart, to glycolytic in response to tissue hypoxia in all zones of the heart. The increased content of pyruvic and lactic acids in the heart muscle can be both the result of increased endogenous formation and the result of absorption from coronary blood or slow release into the blood [17].

In animals with untreated experimental myocardial infarction (I group) in the zone of necrosis the level of ATP was 48%, ADP - 44%, AMP - 45%, and the content of creatine phosphoric acid decreased by 90%. In the perinecrotic zone, the level of ATP decreased by 48%, ADP - by 40%, AMP - by 25%, creatine phosphoric acid - by 35%. No significant changes in these indicators were found in the remote area [17].

In the experimental group of animals on the 3rd day of myocardial infarction, compared with untreated (Group I), the glycogen content increased in the necrosis zone and perinecrotic zone against the backgroundan increase in the level of lactic acid [17].

Increase in the content of ATP, ADP and creatine phosphoric acid in various zones of the heart experimental group of animals on 3rd day of myocardial infarction indicates the normalization of metabolism energy under the influence of mummy. It is possible that mummy promotes the stimulation of oxidative processes in the heart muscle, and changes in the parameters of carbohydrate metabolism are non-specific [17].

In animals with untreated experimental myocardial infarction (I group) on On the 15th day, some normalization of the glycogen level took place (in the necrosis zone - 93%, in the near-necrotic - 98%, in the distant - 80%). The level of high-energy phosphorus compounds in the necrosis zone was further reduced: ATP - by 32%, ADP - by 35%, AMP - by 20%. In the near-necrotic and distant zones, no sharp changes were revealed, which may be a consequence of a compensatory increase in the number of mitochondria in this part of the myocardium [17].

In the animals of the experimental group, on the 15th day of myocardial infarction, an increase in the level of creatine phosphoric acid was noted, which indicates a favorable effect of mummy on the course of myocardial infarction and is the result of the normalization of oxidative processes with an improvement in coronary blood flow.

Thus, long-term administration of mummy in myocardial infarction is accompanied by the normalization of coronary circulation and myocardial metabolism, which leads to the restoration of the contractile function and heart rate. All this can be regarded as a positive effect of the drug on the course and outcome of myocardial infarction.

V. Conclusion

The results of our information and analytical research were summarized in Table 1.

On the basis of numerous experimental studies, it has been shown that Shilajit preparations have a beneficial effect on the course of myocardial infarction: they accelerate tissue regeneration, normalize some disturbed metabolic links, which leads to a much earlier recovery of the affected cardiac tissue compared to control. Long-term administration of mummy in myocardial infarction is accompanied by the normalization of coronary circulation and myocardial metabolism, which leads to the restoration of the contractile function and heart rate. Under the influence of mummy in the post-infarction period, the process of connective tissue replacement of the infarction zone and the formation of compensatory-adaptive reactions of the myocardium are accelerated. The drug has a general nonspecific positive effect on the normalization of general metabolic processes. Thus, mummy extract is a promising substance for use in the complex therapy of myocardial infarction. However, in order to introduce mummy preparations into clinical practice, it is necessary to conduct experimental and clinical studies on standardized samples of dry mummy extract for all of the listed indications. In this case, special attention should be paid to the choice of the dose of dry mummy extract in each specific case.

Table 1

INFLUENCE OF MUMMY ON THE CARDIOVASCULAR SYSTEM

№ п/п	Автор исследования, библиографическая ссылка	Год	Характеристика объекта исследования				Результаты исследований
			Название препарата и его концентрация	Способ и дозы введения	Опытные животные	Место отбора проб	
1.	К.Ю. Юлдашев и С.К. Саидкаримов [22]	1978	мумиё-асиль	перорально 200 мг/кг	кролики-самцы породы шиншилла весом 2,5–3 кг	не указано	Ускоряет процессы соединительнотканного замещения зоны некроза, нормализует некоторые нарушенные звенья обмена веществ. Повышает: уровень *общих липидов* в зоне некроза; содержание *свободных жирных кислот* в зоне инфаркта; *фосфолипидов* в зоне инфаркта и периинекротической зоне. Нормализует содержание железа в очаге некроза на фоне его увеличения в остальных зонах. Снижает уровень меди в очагах некроза на фоне увеличения её содержания в перинекротической и отдаленной зонах.
2.	С.К. Саидкаримов с соавт. [13]	1978	мумиё-асиль	перорально 200 мг/кг	кролики-самцы породы шиншилла весом 2,5–3 кг	не указано	Улучшает коронарное кровообращение и метаболизм миокарда, повышает сократительную способность сердца, стимулирует репаративную регенерацию.
3.	В.В. Вайсброт с соавт.	1978	мумиё-асиль	перорально 200 мг/кг	кролики породы шиншилла весом 2,5–3 кг	не указано	Оказывает общее неспецифическое положительное влияние на нормализацию процессов общего метаболизма.
4.	А.И. Лесков с соавт. [6]	1965	мумиё	внутривенно – 5,10–50 мг/кг; в двенадцатиперстную кишку – 100, 200, 500, 1000 мг/кг	кошки	не указано	Не изменяет уровень артериального давления, ритм сердца и дыхания. В дозе 1000 мг/кг вызывает урежение дыхания. В дозе 5 мг/кг внутривенно окаывает непостоянное влияние на коронарный кровоток.
5.	А.Ш. Шакиров [18–20]	1965–1968	мумиё-асиль	перорально	собаки		Улучшает электрическую активность сердца.
6.	Н.А. Шелковский с соавт. [21]	1965	экстракт мумиё	внутриартериально и внутривенно 40%, 20%, 10%, 5% и 1% раствор в количестве 1 мл/кг	собаки	не указано	Внутривенное введение больших доз в виде 40%, 20%, иногда 10% растворов сопровождается замедлением внутрижелудочковой проводимости с переходом в трепетание желудочков. Внутривенное введение небольших дозы (1% раствора) оказывает заметное влияние на деятельность сердечной мышцы снижается вольтаж всех зубцов ЭКГ. Внутривенное введение 5% растворов сопровождается выраженной альтерацией комплекса QRS. Внутриартериальное введение 40% и 20% растворов сопровождается некоторым увеличением всех зубцов ЭКГ.
7.	В.И. Козловская [5]	1972	мумиё	местно – 0,1 мг/мл, 1–10 мг/мл, 50 мг/мл, 100 мг/мл	изолированное сердце холоднокровных	не указано	Препарат в дозе 0,1 мг/мл не влияет на работу сердца. В дозе 1–10 мг/мл – увеличивает амплитуду и количество сердечных сокращений. В дозе 50 мг/мл – уменьшает амплитуду и частоту сердечных сокращений. В дозе 100 мг/мл – прекращает работу сердца.
8.	К.Х. Хайдаров с соавт. [16]	1965	густой очищенный экстракт мумиё	не указано	изолированное сердце холоднокровных	Зеравшанский хребет	Не обнаружены изменения амплитуды и частоты сердечных сокращений.
9.	Ю.Н. Нуралиев [9, 10, 11]	1977	экстракт мумиё	перорально и внутри-брюшинно в дозах 25–1000 мг/кг, 100 мг/кг, 2500 мг/кг	морские свинки	не указано	Пероральное введение в дозе 25–1000 мг/кг изменяет сердечный ритм. В дозе 100 мг/кг увеличивает число сердечных сокращений. В дозе 1000 мг/кг замедляет сердечный ритм и вызывает экстрасистолию. Внутрибрюшинное введение в дозах 1000–2500 мг/кг нарушает коронарный кровоток и внутрижелудочковую проводимость.
10.	Т.Р. Халиков с соавт. [17]	1978	мумиё-асиль	перорально в дозе 200 мг/кг	кролики	не указано	Улучшает коронарное кровообращение и метаболизм миокарда. Нормализует энергетический обмен.
11.	Н.М. Маджидов с соавт. [7]	1980	мумиё-асиль	перорально в дозе 200 мг/кг	кролики	не указано	Положительно влияет на систему микроциркуляции и метаболизма миокарда; способствует нормализации коронарного кровообращения; восстанавливает сократительную функцию и частоту сердечных сокращений.
12.	Н.С. Баширова с соавт. [2]	1978	мумиё	перорально в дозе 200 мг/кг	кролики-самцы весом 2–2,5 кг	не указано	Оказывает положительное влияние на липидный обмен, особенно на ранних сроках инфаркта миокарда.
13.	М.Ф. Фазылов и Т.Р. Халиков [15]	1978	мумиё	перорально в дозе 200 мг/кг	кролики	не указано	Способствует нормализации уровня и перераспределению железа и меди в сердце.

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