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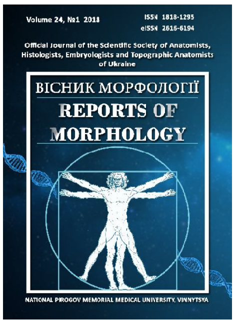

Effect of the Forkal on histological changes of the rat's mandible bone tissue in the area of the traumatic defect at the pathology of the hepatobiliary system

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The leading place in the structure of general injuries and among facial injuries occupy fractures of the upper and lower jaws. An important factor in the occurrence of complications is the microbial factor, but the concomitant pathology, such as hepatobiliary diseases, is commonly associated with about 70% of the population. The purpose of the work was to study the features of reparative regeneration of the defect of the mandible in the pathology of the hepatobiliary system on the background of the administration of Forkal in the animal experiment. An experimental study was conducted on 100 white male Wistar rats weighing 240-270 g, aged from 5 to 6 months. During the work, the rats were divided into 5 groups: control (20 rats, in which histological changes of the bone tissue of the mandible of healthy rats with mandibular injury at the site of defect were investigated); experimental No. 1 (20 rats in which histological changes of mandibular bone tissue were studied at the site of defect at obstructive hepatitis, which was obtained by ligation and intersection of the common bile duct); experimental No. 2 (20 rats in which histological changes of bone tissue of the mandible were examined at the site of the defect in toxic hepatitis, which was obtained by administering per os four carbon monoxide); experimental No. 3 (20 rats in which histological changes of the bone tissue of the mandible were examined at the site of defect in obstructive hepatitis, which were obtained by ligation and intersection of the common bile duct, and then added Forkal); experimental No. 4 (20 rats in which histological changes in the bone tissue of the mandible of rats at the site of the defect in toxic hepatitis were studied, which was obtained by introducing per os four carbon monoxide, and subsequently added to Forkal). All rats were injured in the mandible with a standardized defect. In the future, we observed the histological signs of healing the area of the perforation defect. It was established that regeneration of the area of the defect of the mandible is worsening in the conditions of the experimental pathology of the hepatobiliary system: the rate of recovery of the specific volume of fibroreticular tissue during obstructive hepatitis is slowed down by 2.6 times and 3.4 times in the course of toxic hepatitis. With the use of Forkal in conditions of experimental pathology of the hepatobiliary system, the rate of regeneration of the defect site of the mandible improves and accelerates. Thus, in order to accelerate the rate of recovery of the specific volume of fibroreticular tissue for patients with mandible trauma and associated pathology of the hepatobiliary system, it is advisable to use Forkal.

Keywords: *rat, maxillofacial area, perforated defect of mandible, regeneration, morphometric analysis, Forkal.*

Introduction

An increase in the number of fractures of the mandible and facial injuries remains one of the topical issues of jaw-facial traumatology the problem of the etiopathogenesis of complications. Fractures of the upper and lower jaw occupy a leading place among facial injuries and in the structure of general injury. Among lesions of the jaw-facial area they occur in 75-87% of cases [2, 9, 10, 15, 16, 17, 19, 20]. Injuries of jaw-facial area make up about 15-38% among all hospitalized [2, 9, 20]. Along with the increase in the total number of injuries, an increase in the frequency of jaw-facial injuries and their complications is observed, which is especially relevant with a steady increase in the number of patients with concomitant pathology [1, 3, 5, 6, 7, 8, 11, 12, 19, 20]. An important factor in the occurrence of complications, of course, is the microbial factor, but the concomitant pathology plays an important role. Infection, above all, leads to the development of pathological local and general changes, which in the future causes the development of complications. Most commonly observed: bone marrow suppuration, posttraumatic osteomyelitis, false joint, pathological motion of bone fragments, secondary hemorrhage, post-traumatic sinusitis or neuritis, bite violation [2, 17, 9, 12, 15, 20].

Analyzing this problem one of the neglected factors should be considered - the presence of diseases of the hepatobiliary system, the pathology of which occurs in about 70% of the population [1, 3, 13, 17]. The marked problem, with a certain coincidence, may have a major impact on the healing conditions of soft tissue of the jaw-facial area and bones of the facial skeleton, especially in the case of posttraumatic complications.

Post traumatic regeneration of the bone wound occurs due to the ability of the living organism to restore the tissue, primarily through the formation of connective tissue matrix, resulting in the ossification of the previous tissue structure is restored [3, 4, 8, 18]. An important task of jaw-facial surgery to improve the conditions for regurgitation of jaw fractures is to prevent or reduce the risk of developing complications that may occur with fractures of the bones of the facial skeleton.

Healing of fractures of the mandible on the background of concomitant pathology depends on the functional state of the bone itself and the body as a whole. The trauma of the lower jaw triggers a mechanism that requires two components: the first one is cells that can proliferate and differentiate in the osteogenic direction, and secondly, cells that survive trauma and synthesize osteoinductive products. No reports of experimental studies of the features of regeneration of the tissues of the maxillofacial area in the background of the pathology of the liver were found.

The purpose of the study is an experimental study of the features of reparative regeneration of the defect of the mandible in the pathology of the hepatobiliary system on the background of receiving Forkal.

Materials and methods

An experimental study was carried out on 100 white male rats of the Vistar line aged from 5 to 6 months and weights in the range of 240-270 g. The animals were in the general diet, had free access to water, food and standard conditions of stay in cages of vivarium of National Pirogov Memorial Medical University, Vinnytsya.

A large number of models of fracture of the mandible in laboratory animals are known, but not all of these techniques can satisfy the necessary objectification and standardization of the fracture, which will not allow an objective assessment [3, 8, 17, 18, 19]. In the experiment, we used the technique of creating a defect of the mandible of rats by surgical boron with a diameter of 1 mm, with a speed of rotation of up to 10000 turnovers per minute, which allowed to obtain a standard post-traumatic defect and objectively monitor the regeneration processes [17].

In the study, all the rats were divided into 5 groups:

control (20 rats) - examined the histological changes of the bone tissue of the mandible of healthy rats with trauma of the mandible at the site of defect;

experimental number 1 (20 rats) - examined the histological changes of the bone tissue of the mandible of rats with trauma of the mandible at the site of the defect in obstructive hepatitis, which were obtained by ligation and intersection of the common bile duct;

experimental number 2 (20 rats) - examined the histological changes in the mandibular bone tissue of rats with trauma of the mandible at the site of the defect in toxic hepatitis, which was obtained by introducing per os four carbon monoxide (CCl_4);

experimental number 3 (20 rats) - examined the histological changes of the bone tissue of the mandible of rats with trauma of the mandible at the site of the defect in obstructive hepatitis, obtained by ligation and intersection of the common bile duct, which were added on the day of jaw trauma and subsequent 2 weeks before with food Forkal (200 mg/kg of rat mass);

experimental number 4 (20 rats) - examined the histological changes of the bone tissue of the mandible of rats with mandibular trauma at the site of the defect in toxic hepatitis that was obtained by administering per os CCl_4, which were added on the day of jaw trauma and subsequent 2 weeks before with food Forkal (200 mg/kg of rat mass).

Forkal is a drug containing the active ingredient of calcitriol, which is an active metabolite of vitamin D3, which affects the metabolism of calcium and stimulates the activity of osteoblasts of the bones of the skeleton. It is formed in the kidneys from its predecessor, 25-hydroxycholecalciferol. With normal functioning of the body 0.5-1 micrograms of calcitriol per day is produced. Forkal promotes the absorption of calcium in the distal intestinal tract, increases its reabsorption in the kidneys and enhances the mineralization of bones. Forkal suppresses parathyroid hormone secretion, reduces pain in the bones and muscles.

In the course of an experimental study, we established the features of regeneration of bone defects. Quantitative evaluation of histological changes was carried out using morphometric techniques. After the manufacture of histological preparations, 5 characteristics were taken into account: the specific volume of fibroreticular tissue in the center of bone regeneration (%), specific volume of blood vessels (%), specific volume of bone beams in the bone regeneration center (%), the number of osteoblasts in a certain area in the bone regeneration cell, specific volume of the bone marrow in the bone regeneration cell (%). The research was conducted on 7, 14, 30, 60 days of the study.

The results of the experiment were processed using commonly used methods to determine the validity of differences by Student. The average arithmetic values of the studied parameters (M) and their relative average statistical errors (±m) were calculated using the package "Statistica 10".

Results

The data obtained in a result of the study is shown in Table 1. It was found that the specific volume of fibroreticular tissue at the center of bone regeneration on 7 day is dominant over other elements and is about 91.41%. The number of osteoblasts per unit area of bone beams is increased. The specific volume of blood vessels on the 7 day of the experiment in the center of regeneration of the bone reaches 3.502%, moreover these blood vessels located almost exclusively in the area of fibroreticular tissue. It is noteworthy that on 7 day there are no formed bone marrow elements, although in fibroreticular tissue there is a significant presence of cells, which according to morphology should be called lymphoid cells. They have circular shape, round nuclei and a narrow rim of the cytoplasm. Such cells can either be lymphocytes or stem (polypotent) cells, from which later elements of the bone marrow are formed.

In the analysis of the data presented in Table 1, it should be noted that the specific volume of fibroreticular tissue at the center of bone regeneration in the dynamics of the experiment without external influence decreases and for 60 day is 12.40±0.22%.

Bone beams become well visible when stained with hematoxylin and eosin, their specific volume up to 14 day increases by more than 5 times compared to 7 day of the experiment. By 30 day, the specific volume of beams is still increasing and at 60 day of the experiment is more than 72.0%, that is, bone beams in this period are already the bigger part of the elements of the zone of bone regeneration.

Data on the specific volume (%) of fibroreticular tissue in the center of bone regeneration of experimental animals in the ligation of the common bile duct in the dynamics of the experiment without the use of correctional agents are given in Table 1.

The analysis of the data showed that the specific volume of fibroreticular tissue in the bone regeneration center for 7 day is dominant over other elements and is more than 90%. It should be noted that the increased number of osteoblasts per unit area of bone beams. The analysis of the data presented in Table 1 shows that on the 60 day of the experiment, the specific volume of fibroreticular tissue in the bone regeneration center at the ligation of the common bile duct decreases, compared with 7 day, almost threefold. At the same time in the center of bone regeneration at the ligation of the common bile duct decreases the specific volume of blood vessels. At the 60 day of the experiment, the blood vessels were localized not only in the fibroreticular tissue, but also in the bone marrow that was already formed, although at the 30 day of the experiment, the formed bone marrow elements in the cell of regeneration of the bone were not found in the animals of the experimental group number 1.

Specific volume of bone beams up to 14 day of

Table 1. Morphometric indices of regenerative tissues of the mandible at the defect site in the dynamics of the experiment at the ligation of the common bile duct without correction and under conditions of correction by Forkal (n=60).

Morphometric indices	Research groups	Day of experiment			
		7	14	30	60
Specific volume (%) of fibroreticular tissue	Control	91.41±0.940	56.30±0.711	48.22±0.510	12.40±0.220
	experimental group №1	92.10±0.880	84.50±0.731*	74.63±0.580*	32.80±0.241*
	experimental group №3	92.21±0.831	76.40±0.701	64.00±0.511**	22.21±0.211**
Specific volume (%) of blood vessels	Control	3.211±0.051	2.012±0.051	1.613±0.051	0.521±0.011
	experimental group №1	3.712±0.081	3.411±0.090*	3.202±0.051*	1.701±0.021*
	experimental group №3	3.801±0.061	3.202±0.081	3.101±0.061	1.201±0.021**
Specific volume (%) of bone beams	Control	1.801±0.042	12.92±0.84	48.01±0.191	72.20±0.680
	experimental group №1	1.431±0.051	5.601±0.141*	14.81±0.160*	53.40±0.641*
	experimental group №3	1.521±0.061	6.912±0.511**	28.21±0.151**	59.82±0.611**
The average number of osteoblasts of bone beams in the bone regeneration center on an area of 100 μm^2	Control	3.502±0.041	5.702±0.151	2.001±0.061	1.001±0.050
	experimental group №1	3.801±0.081	3.502±0.101*	3.301±0.061*	2.802±0.041*
	experimental group №3	3.701±0.091	4.501±0.121**	2.603±0.051**	1.101±0.021**
Specific volume (%) of bone marrow	Control	0	0	1.602±0.041	3.801±0.050
	experimental group №1	0	0	0	2.301±0.061*
	experimental group №3	0	0	0	2.703±0.041

Note: * - significantly relative to the control group ($p<0.05$); ** - significantly relative to the experimental group №1 ($p<0.05$).

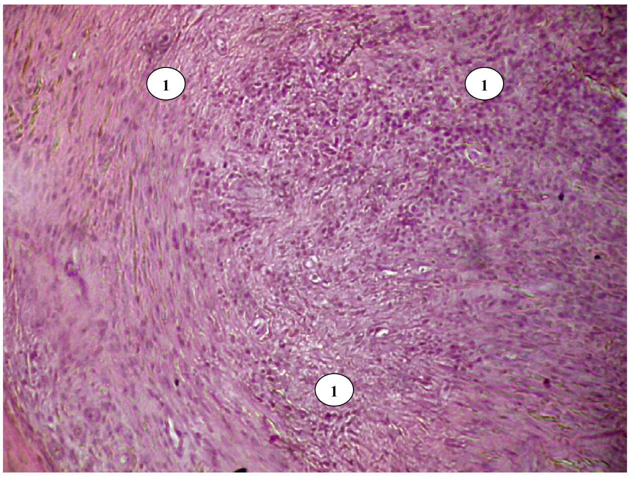

Fig. 1. Replacement by fibroreticular tissue (1) solid tissues of the rat's mandible at the site of its perforation when the ligation of the common bile duct done at the 7 day of the experiment. Experimental group №1. Hematoxylin-eosin. Lens x10, eyepiece x20.

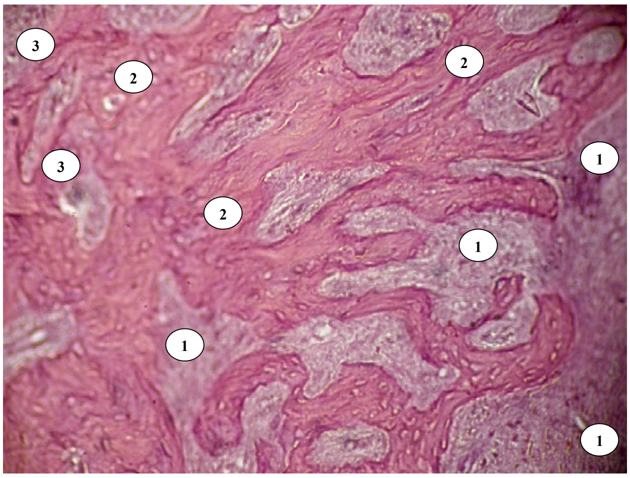

Fig. 2. Solid tissues of the rat's mandible at the site of its perforation when the ligation of the common bile duct done at the 60 day of the experiment. Experimental group №1. 1 - fibroreticular tissue. 2 - bone beams. 3- bone marrow. Hematoxylin-eosin. Lens x10, eyepiece x20.

experiment in rats of experimental group number 1, increases by more than 4 times, compared to 7 day, and up to 30 day of the experiment continues to increase and on 60 day is more than 50%, that is, bone beams in this period are already the bulk of the elements of the zone of bone regeneration (Fig. 1, 2).

The average data of morphometric indices of solid tissues of the mandible at the site of its defect in animals of the experimental group number 2 with toxic hepatitis in the dynamics of the experiment without drug correction are given in Table 2 and Fig. 3, 4.

Under conditions of correction of bone regeneration using a Forkal in the ligation of the common bile duct (experimental group 3), beginning from the 7 day of the experiment, including up to 60 day (Fig. 5, 6), the following changes, which in general can be regarded as acceleration of the rate of bone regeneration are noted (Table 1).

The use of Forkal in animals of the experimental group number 4 for the purpose of correction of bone regeneration in the zone of its defect in toxic hepatitis significantly changes the picture, compared with the indicators of experimental group number 2. Dynamics of healing at 30, 60 day is

Table 2. Morphometric indices of regenerative tissues of the mandible at the defect site in the dynamics of the experiment at toxic hepatitis without correction and under conditions of correction by Forkal (n=60).

Morphometric indices	Research groups	Day of experiment			
		7	14	30	60
Specific volume (%) of fibroreticular tissue	Control	91.43±0.941	56.32±0.711	48.21±0.511	12.40±0.220
	experimental group №2	92.01±0.842	88.70±0.761*	79.90±0.590*	41.01±0.500*
	experimental group №4	92.11±0.671	73.21±0.731**	61.21±0.521**	24.80±0.241**
Specific volume (%) of blood vessels	Control	3.201±0.050	2.001±0.050	1.603±0.051	0.501±0.011
	experimental group №2	3.201±0.081	3.003±0.080*	2.701±0.04*	2.001±0.030*
	experimental group №4	3.302±0.081	3.101±0.060	3.001±0.051	1.002±0.011**
Specific volume (%) of bone beams	Control	1.801±0.041	12.91±0.841	48.01±0.190	72.21±0.681
	experimental group №2	1.401±0.071	3.801±0.161*	11.32±0.121*	48.41±0.652*
	experimental group №4	1.402±0.061	6.402±0.560**	28.91±0.161**	62.81±0.620**
The average number of osteoblasts of bone beams in the bone regeneration center on an area of 100 μm^2	Control	3.511±0.041	5.711±0.151	2.001±0.0602	1.001±0.051
	experimental group №2	3.703±0.051	3.602±0.101*	3.502±0.072*	2.802±0.050*
	experimental group №4	3.501±0.080	4.603±0.140**	2.411±0.041**	1.001±0.020**
Specific volume (%) of bone marrow	Control	0	0	1.601±0.041	3.802±0.051
	experimental group №2	0	0	0	1.602±0.021*
	experimental group №4	0	0	0	2.411±0.051**

Note: * - significantly relative to the control group ($p<0.05$); ** - significantly relative to the experimental group №2 ($p<0.05$).

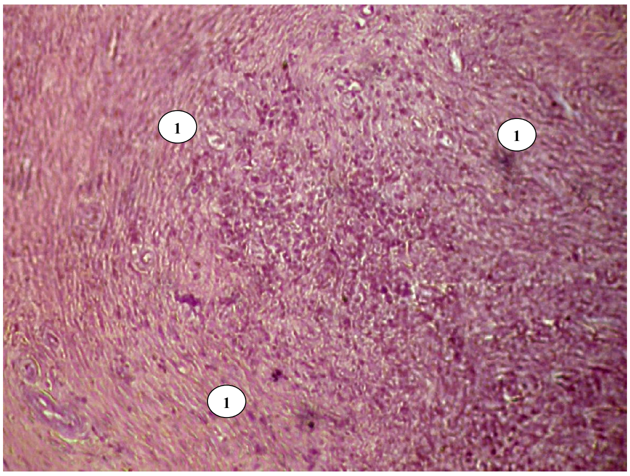

Fig. 3. Solid tissues of the rat's mandible at the site of its perforation with toxic hepatitis at the 7 day of the experiment. Experimental group №2. 1 - fibroreticular tissue. Hematoxylin-eosin. Lens x10, eyepiece x20.

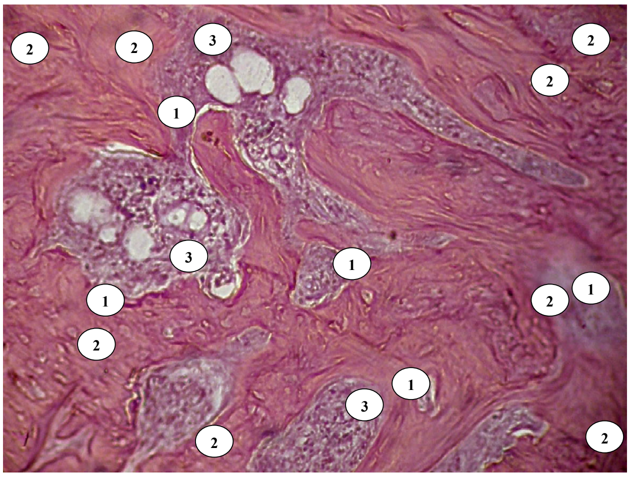

Fig. 4. Solid tissue of the rat's mandible at the site of its perforation with toxic hepatitis at the 60 day of the experiment. Experimental group №1. 1 - fibroreticular tissue. 2 - bone beams. 3- bone marrow. Hematoxylin-eosin. Lens x10, eyepiece x20.

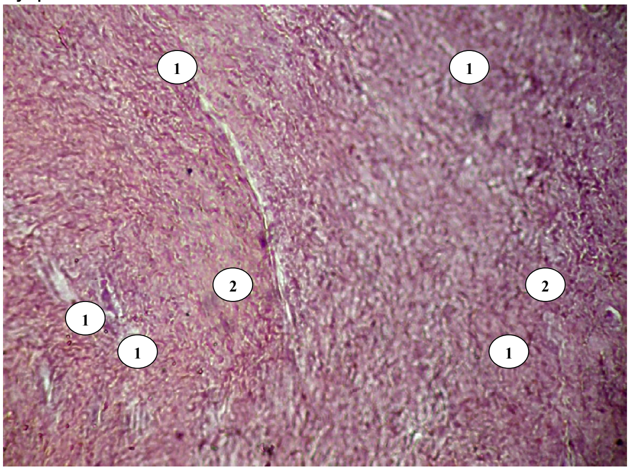

Fig. 5. Solid tissues of the rat's mandible at the site of its perforation during the ligation of the common bile duct on the 7 day of the experiment, under the conditions of the correction of Forkal, replaced by fibroreticular tissue - 1. Hematoxylin-eosin. Lens x10, eyepiece x20.

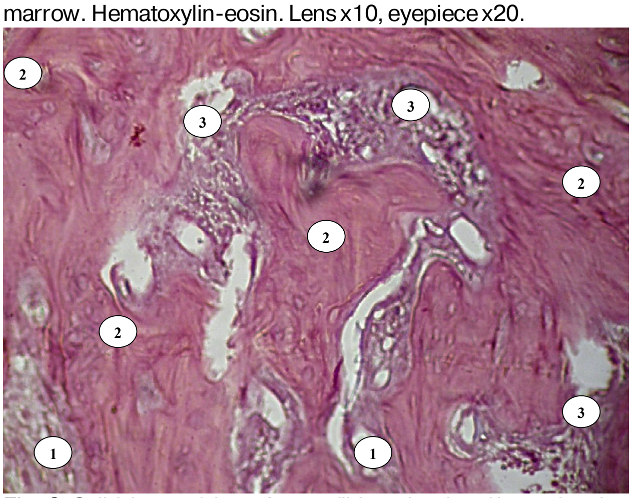

Fig. 6. Solid tissue of the rat's mandible at the site of its perforation when the bile duct is ligated on 60 day of the experiment under the conditions of the Forkal correction. 1 - fibroreticular tissue. 2 - bone beams. 3- bone marrow. Hematoxylin-eosin. Lens x10, eyepiece x20.

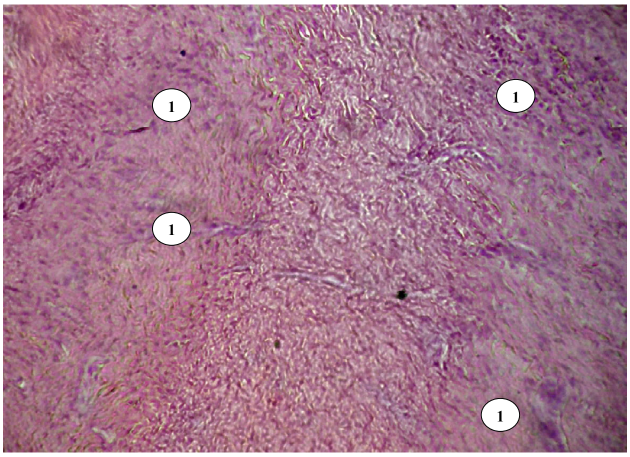

Fig. 7. Replacement by fibroreticular tissue (1) solid tissues of the rat's mandible at the site of its perforation with toxic hepatitis at the 7 day of the experiment under Forkal correction conditions. Hematoxylin-eosin. Lens x10, eyepiece x20.

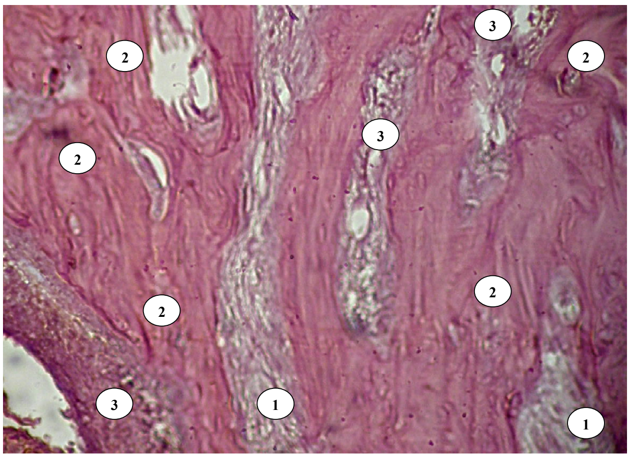

Fig. 8. Solid tissues of the rat's mandible at the site of its perforation with toxic hepatitis at the 60 day of the experiment under the conditions of Forkal correction. 1 - fibroreticular tissue. 2 - bone beams. 3- bone marrow. Hematoxylin-eosin. Lens x10, eyepiece x20

depicted in Fig. 7, 8. Morphometric indices obtained during the study of animals of the experimental group number 4 are given in Table. 2.

Discussion

Taking into account the obtained indicators, the presence of individual bone beams on the 7 day of the study is due, of course, not to their new creation, but to the remnants of the former bone beams that were previously located on the site of the traumatic defect before the injury. A large number of osteoblasts in the bone beams indicates that the old bone beams also participate in bone regeneration processes at the defect site, which coincides with the point of view of Davydenko I.S. [4].

Along with this, in the dynamics of the experiment in the cell of regeneration of the bone decreases the specific volume of blood vessels. It should be noted that in the control group rats up to 60 day these blood vessels are located not only in the fibroreticulum layer, but also in the bone marrow, which is already present up to 30 day and is even more pronounced and formed at 60 day.

The number of osteoblasts of bone beams in the bone regeneration center at an area of 100 μm^2 decreases at a relatively slow pace. It should be noted that at 14 day (compared to the 7 day of the experiment) there is no probable decrease in the average number of osteoblasts of bone beams in the center of bone regeneration per unit area ($p>0.05$), but there is only a tendency to decrease, but for 30 day, compared to 7 day, changes are already statistically significant ($p<0.05$). A similar picture can be noticed for 60 day of the experiment, when the average number of osteoblasts of bone beams in the center of bone regeneration in the area has the smallest value. In animals of the control group, explicit bone marrow elements are present only in the histological materials of the fracture site of the mandible in rats at 30 and 60 day of the experiment. It should be noted that in the bone marrow dominate hematopoietic elements at different stages of development with domination of lymphoid-type cells, single thin-walled slit-like blood vessels and individual lymphocytes. Analyzing the obtained parameters, the high activity of the regenerative elements involved in the construction of a new bone tissue and the replacement of the bone defect was found to be quite high.

The increased concentration of osteoblasts per unit area of bone beams in bone beams shows that old bone beams also participate in bone regeneration processes at the defect site, similar to data of Tashchyan A.Ye. with co-authors [19]. The specific volume of blood vessels on the 7 day of the experiment in the center of regeneration of the bone does not reach even 4%, and these blood vessels are located almost exclusively in the area of fibroreticular tissue. It is noteworthy that at 7 day, in rats of the first experimental group, with obstructive hepatitis, which was obtained by ligation and intersection of the common bile duct, there are no observed bone marrow elements, although the fibroreticular tissue is marked by the presence of cells that, according to morphology, should called lymphoid cells. It is precisely from them that the elements of the bone marrow are formed in the future.

In rats of experimental group number 1, the average number of osteoblasts of bone beams in the center of bone regeneration on an area of 100 μm^2 decreases at a slow pace. At the 14 day, compared to the 7 day of the experiment, there was no probable decrease in the average number of osteoblasts of bone beams in the center of bone regeneration per unit area ($p>0.05$), except that there was only a tendency to decrease, but at 30 day, compared with 7 day, changes, though not expressed, but were statistically significant ($p<0.05$). At the 60 day of the experiment, the average number of osteoblasts of bone beams in the bone regeneration center per unit area has the smallest value among all periods of the experiment. In the conditions of ligation of the common bile duct in the experiment, the presence of bone marrow elements was determined only in histological materials of rats for 60 day. It is noteworthy that in the bone marrow the hematopoietic elements were dominated at different stages of development with the dominance of lymphoid-type cells, isolated thin-walled slit-like blood vessels and individual lymphocytes.

In toxic hepatitis, in the dynamics of the experiment without medication correction, the indicators reflect the dynamics of changes characterizing regenerative processes in the bone, and the dynamics in general is very similar to that described for the experiment with the ligation of the common bile duct. The difference is that in the course of time the specific volume of fibroreticular tissue and blood vessels decreases gradually, the average number of osteoblasts of bone beams decreases in the bone regeneration center per unit area, but, at the same time, the specific volume of bone beams increases. In toxic hepatitis, the rate of decrease in the specific volume of fibroreticular tissue is less than in the ligation of the common bile duct, while at the end point of the experiment (60 day), this figure remains significantly higher. Concerning the specific volume of blood vessels, the situation was similar. The above changes confirm Levitsky A.P. viewpoint [6] on the importance of the influence of the hepatobiliary system on the functioning of the organism as a whole and Levitsky A.P. with co-authors [8] on the teeth-jaw system.

In the analysis of the obtained indicators, it is noticeable that the specific volume of bone beams, on the contrary, is greater in the presence of toxic hepatitis than when the ligation of the common bile duct at each point of the experiment, including 60 day. However, with toxic hepatitis, the average number of osteoblasts of bone beams in the center of bone regeneration per unit area shows a similar dynamics, as in the ligation of the common bile duct. Statistically significant differences have not been established.

It is important to note that the specific volume of bone marrow at the 60 day of the experiment with toxic hepatitis is on average less than that of the common bile duct ligation.

The dynamics of regenerative processes in rats' bones, both in toxic and in obstructive hepatitis, were similar, but differed in the rate of decrease in the specific volume of fibroreticular tissue in toxic hepatitis, which confirms the negative influence of hepatobiliary system disorders on the exchange of calcium and vitamin D and coincides with the data of Moroz L.V. with co-authors [14].

In particular, on the 14 day of the experiment, the specific volume of fibroreticular tissue in the bone regeneration center, when corrected by the Forkal, in the rats of experimental group 3, on the average, is significantly lower ($p<0.05$) than in the experiment without the use of correctional drugs. This pattern persists until the end of the experiment, that is, up to 60 day. That is, with the use of a Forkal, a more rapid decrease in the specific volume of bone precursor tissue is observed.

At the same time, regarding the specific volume of blood vessels, it cannot be asserted about the rate of growth and decrease of this indicator, up to the 60 day of the experiment with the use of Forkal. But the specific volume of bone beams in the application of Forkal compared to the experiment without regeneration correction, although it begins to grow from the 14 day, but the greatest effect from the action of Forkal is marked on the 30 day of the experiment and lasted until 60 day of the experiment.

It should be noted that the use of Forkal at the ligation of the common bile duct did not lead to earlier formation of bone marrow elements, although the specific volume of bone marrow at 60 day of the experiment with the use of a Forkal is slightly higher than without the use of correctional agents.

So, in general, it can be stated that on the 60 day of the experiment, when the ligation of the common bile duct was applied, the use of a Forkal led to a more profound maturation of the bone tissue at the place of perforation than without correction.

A clearly expressed regularity is noted with respect to the number of osteoblasts of bone beams in the bone regeneration center with the use of a Forkal at the ligation of the common bile duct. In particular, the number of these cells on the 14 day does not decrease, but on the contrary increases, and only later stimulation of osteoblast growth (at 30 and 60 day) is slowing down. This may mean that the use of a Forkal in the ligation of the common bile duct can stimulate the proliferation of osteoblasts of bone beams in the center of bone regeneration, which is likely to largely explain the increase in the specific volume of bone beams themselves at the 14 day of the experiment, although the number of osteoblasts at 30 and 60 days of the experiment is reduced, which positively characterizes the processes of maturation of the bone beams themselves.

Comparing with the data of the control group, the specific volume of bone beams and bone marrow at 60 day is significantly higher in the experimental group 3 animals at the correction of the Forkal.

When comparing bone regeneration in the model of obstructive and toxic hepatitis without treatment, it was found that up to 60 day, the proportion of bone beams and bone marrow is significantly higher in the group of obstructive hepatitis.

In particular, starting from the 14 day, at toxic hepatitis more rapidly decreases the specific volume of fibroreticular tissue and this pattern is maintained until the end of the experiment, moreover on the 60 day the effect becoming particularly pronounced. At the same time, the effect of Forkal on the specific volume of blood vessels in toxic hepatitis becomes noticeable only on 60 day.

But the effect of Forkal on increasing the specific volume of bone beams in toxic hepatitis is already observed on 14 day. At the same time, this effect is felt until the end of the experiment.

The average number of osteoblasts of bone beams in the center of bone regeneration per unit area during toxic hepatitis temporarily increases by 14 day, and subsequently decreases, similarly to the ligation of the common bile duct. It is important that Forkal at toxic hepatitis on 60 day increases the specific volume of bone marrow, which accelerates healing.

Thus, the use of a Forkal for correction of regenerative processes in toxic hepatitis is sufficiently effective, the rate of regeneration is increasing, and at the end of the experiment (at 60 day), the bone tissue in the place of the former defect looks more mature than in the experiment without correction.

In the future, we consider it expedient to continue the study of the effect of therapeutic agents on regeneration of the defect of the mandible in the pathology of the hepatobiliary system.

Conclusions

1. Experimental pathology of the hepatobiliary system negatively affects the regeneration of the segment of the defect of the mandible, which is manifested by a decrease in the rate of recovery of the specific volume (%) of fibroreticular tissue by 2.6 times at obstructive hepatitis and toxic hepatitis - by 3.4 times.

2. With the experimental pathology of the hepatobiliary system, the regeneration of the area of the defect of the mandible is improved and accelerated with the use of Forkal.

3. In patients with injuries of the mandible when identifying the pathology of the hepatobiliary system, it is advisable to use Forkal.

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ВПЛИВ ФОРКАЛУ НА ГІСТОЛОГІЧНІ ЗМІНИ КІСТКОВОЇ ТКАНИНИ НИЖНЬОЇ ЩЕЛЕПИ ЩУРІВ У ДІЛЯНЦІ ТРАВМАТИЧНОГО ДЕФЕКТУ ПРИ ПАТОЛОГІЇ ГЕПАТОБІЛІРНОЇ СИСТЕМИ

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Провідне місце в структурі загального травматизму та серед травм обличчя займають переломи верхньої та нижньої щелеп. Важливим чинником виникнення ускладнень є мікробний фактор, але при цьому важливе місце займає супутня патологія, наприклад захворювання гепатобіліарної системи, патологія котрої зустрічається близько у 70% населення. Метою роботи стало вивчення в експерименті на тваринах особливостей репаративної регенерації дефекту нижньої щелепи при патології гепатобіліарної системи на фоні прийому Форкалу. Експериментальне дослідження було проведено на 100 білих щурах-самцях лінії Вістар масою 240-270 г, віком від 5 до 6 місяців. У процесі роботи щурі були поділені на 5 груп: контрольна (20 щурів, у котрих досліджували гістологічні зміни кісткової тканини нижньої щелепи здорових щурів з травмою *нижньої щелепи у місці нанесення дефекту; дослідна №1 (20 щурів, у яких досліджували гістологічні зміни кісткової тканини нижньої щелепи щурів у місці нанесення дефекту при обтураційному гепатиті, котрий отримували шляхом перев'язки та пересічення загального жовчного протоку; дослідна №2 (20 щурів, у яких досліджували гістологічні зміни кісткової тканини нижньої щелепи щурів у місці нанесення дефекту при токсичному гепатиті, котрий отримували шляхом введення per os чотирьох хлористого вуглецю; дослідна №3 (20 щурів, у яких досліджували гістологічні зміни кісткової тканини нижньої щелепи щурів у місці нанесення дефекту при обтураційному гепатиті, котрий отримували шляхом перев'язки та пересічення загального жовчного протоку, а потім додавали Форкал; дослідна №4 (20 щурів, у яких досліджували гістологічні зміни кісткової тканини нижньої щелепи щурів у місці нанесення дефекту при токсичному гепатиті, котрий отримували шляхом введення per os чотирьох хлористого вуглецю, а у подальшому додавали Форкал. Всім щурам наносили травму нижньої щелепи з утворенням стандартизованого дефекту. У подальшому спостерігали за гістологічними ознаками загоєнням ділянки перфораційного дефекту. Встановлено, що регенерація ділянки дефекту нижньої щелепи погіршується в умовах експериментальної патології гепатобіліарної системи: швидкість відновлення питомого об'єму фіброретикулярної тканини при обтураційному гепатиті уповільнюється в 2,6 рази та в 3,4 рази в умовах токсичного гепатиту. При застосуванні Форкалу в умовах експериментальної патології гепатобіліарної системи швидкість регенерації ділянки дефекту нижньої щелепи покращується та прискорюється. Таким чином, з метою прискорення швидкості відновлення питомого об'єму фіброретикулярної тканини для пацієнтів із травмою нижньої щелепи та супутньою патологією гепатобіліарної системи доцільно використовувати Форкал.*

Ключові слова: *щур, щелепно-лицева ділянка, перфораційний дефект нижньої щелепи, регенерація, морфометричний аналіз, Форкал.*

ВЛИЯНИЕ ФОРКАЛА НА ГИСТОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ КОСТНОЙ ТКАНИ НИЖНЕЙ ЧЕЛЮСТИ КРЫС В ОБЛАСТИ ТРАВМАТИЧЕСКОГО ДЕФЕКТА ПРИ ПАТОЛОГИИ ГЕПАТОБИЛИАРНОЙ СИСТЕМЫ

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Ведущее место в структуре общего травматизма и среди травм лица занимают переломы верхней и нижней челюстей. Важным фактором возникновения осложнений является микробный фактор, но при этом важное место занимает сопутствующая патология, например заболевания гепато-билиарной системы, патология которой встречается около 70% населения. Целью работы стало изучение в эксперименте на животных особенностей репаративной регенерации дефекта нижней челюсти при патологии пищеварительной системы на фоне приема Форкала. Экспериментальное исследование было проведено на 100 белых крысах-самцах линии Вистар массой 240-270 г, в возрасте от 5 до 6 месяцев. В процессе работы крысы были разделены на 5 групп: контрольная (20 крыс, у которых исследовали гистологические изменения костной ткани нижней челюсти здоровых крыс с травмой нижней челюсти в месте нанесения дефекта; исследовательская №1 (20 крыс, у которых исследовали гистологические изменения костной ткани нижней челюсти крыс в месте нанесения дефекта при обтурационном гепатите, который получали путем перевязки и пересечения общего желчного протока; исследовательская №2 (20 крыс, у которых исследовали гистологические изменения костной ткани нижней челюсти крыс в месте нанесения дефекта при токсическом гепатите, который получали путем введения per os четырех хлористого углерода; исследовательская №3 (20 крыс, у которых исследовали гистологические изменения костной ткани нижней челюсти крыс в месте нанесения дефекта при обтурационном гепатите, который получали путем перевязки и пересечения общего желчного протока, а затем добавляли Форкал; исследовательская №4 (20 крыс, у которых исследовали гистологические изменения костной ткани нижней челюсти крыс в месте нанесения дефекта при токсическом гепатите, который получали путем введения per os четыреххлористого углерода, а в дальнейшем добавляли Форкал. Всем крысам наносили травмы нижней челюсти с образованием стандартизированного дефекта. В дальнейшем наблюдали за гистологическими признаками заживлением участка перфорационного дефекта. Установлено, что регенерация участка дефекта нижней челюсти ухудшается в условиях экспериментальной патологии гепато-билиарной системы: скорость восстановления удельного объема фиброретикулярной ткани при обтурационном гепатите замедляется в 2,6 раза и в 3,4 раза в условиях токсического гепатита. При применении Форкала в условиях экспериментальной патологии гепато-билиарной системы скорость регенерации участка дефекта нижней челюсти улучшается и ускоряется. Таким образом, с целью ускорения скорости восстановления удельного объема фиброретикулярной ткани у пациентов с травмой нижней челюсти и сопутствующей патологией гепато-билиарной системы целесообразно использовать Форкал.

Ключевые слова: *крыса, челюстно-лицевая область, перфорационный дефект нижней челюсти, регенерация, морфометрический анализ, Форкал.*