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Morphological Changes when Hemoben is Used in Bleeding from Acute Wounds of the Face-Jaw Area

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Abstract: One of the main issues of modern medicine, surgery, traumatology, urology, gynecology, neurosurgery, oncology, otorhinolaryngology, maxillofacial surgery is to stop the mine flow during and after surgery. In recent years, the number of local mining equipment has been increasing. This raises the question of whether these agents should be chosen based on their efficacy and safety. The value of a local anti-mine agent is limited in most studies to the study of its hemostatic effectiveness, that is, its main criterion is the question of stopping primary and secondary mining. But when using these drugs for cleaning wounds, studying the effect of the drug on soft tissues on the surface of the wound will help to positively resolve the issue of primary wound burns.

Currently, due to the increasing exposure to anti-inflammatory substances in modern medicine, the development of new effective types of them is becoming an urgent issue. In this matter, local hemostatic drugs are of great importance. Local hemostatic drugs are used both for diffuse bleeding and for bleeding from large vessels. Today, there are various locally used hemostatic agents with different chemical compositions. Various chemical substances and their mixtures are used for their production. When checking the effectiveness of these substances, their safety level, ease of use, price and other factors are taken into account.

Despite the large number of local mine suppressants, among them there are very few drugs that can be used universally.Therefore, the creation of highly effective local mine deterrents is an actual issue.

Keywords: Experimental animals. Blood flow from the wound, hemoben, morphological changes in the wound

1. Introduction

One of the main tasks is to effectively stop the mining flow in injuries and operations. Massive and poorly controlled bleeding seriously affects the general condition of the patient and is considered one of the factors that negatively affect wound healing (4,6.9). Pharmacological methods of mining can be conditionally divided into two. The first is systemic anesthesia, i.e. intravenous administration of anesthetics, and the next is local anesthetics, when a special anesthetic is applied to the surface of a local wound.

Despite the large number of local mine suppressants, among them there are very few drugs that can be used universally.Therefore, the creation of highly effective local mine deterrents is an actual issue.

One of the main tasks of medicine is to create drugs that do not have a harmful effect on the body. Of great interest is the use of cellulosic material in the production of mine retardants. One of the advantages of cellulose

is that it is obtained from a plant, and when it is made into a medicine, it is considered to have antiseptic properties. In the preparation of drugs from cellulose, its source is unlimited, and it is very important in the preparation of cheap drugs.

Aim of the research:

Morphological study of tissues around the wound after stopping mining by sprinkling Hemoben powder on bleeding wounds of different depths in the soft tissue of the face-jaw area of animals.

2. Materials and methods

The experiment was conducted on Chinchilla rabbits weighing 2.5-3.0 kg.

Rabbits were divided into four groups for the experiment:

1. There are 6 intact rabbits

2. Drainage from an untreated acute wound - 6.

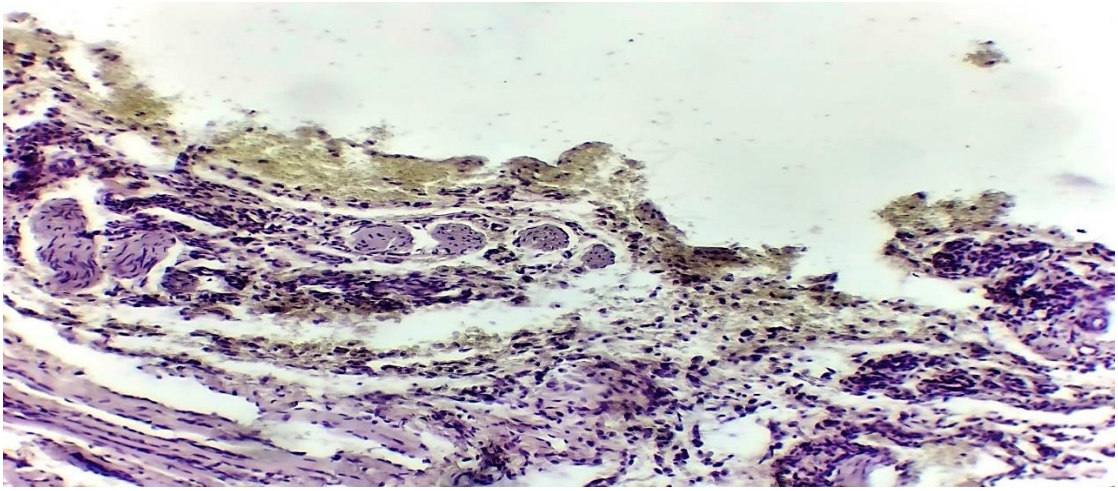
3. Ashing of Hemoben in drainage from superficial wounds 6.

4. Ashing of Hemoben in the discharge from a wound with damaged skin in the epidermis and dermis-6.

5. Morphological changes in the mine clot due to the addition of hemoben to the mine drop.

After the hairs in the experimental area were scraped off under intravenous anesthesia of the rabbits, wounds were made in the submandibular and submandibular areas using a sharp scalpel. After the necessary medicinal treatment, the wounds were sutured using silk sutures, an aseptic bandage was applied, and traditional medicinal treatments were prescribed.

Microscopic examination of the experimental wounds of the first group shows that the bottom of the wound and the surrounding tissues bled out, and the surface of the wound is covered with blood. Erythrocytes have not lost their granular and pigmented appearance. Transfused blood, including erythrocytes, retained the appearance of small yellow-red granules without clotting. If the epidermis and dermis of the skin in the face-maxillary region are damaged and a bleeding wound is formed deep into the muscle layer, the bottom of the wound consists of muscle tissue, blood loss is determined, i.e. , an accumulation of erythrocytes, is scattered without the formation of clots on its surface (Fig. 2).



1- fig. Experimental acute wound of the face-jaw area, day 3, hemorrhages on the surface of the wound and surrounding tissues. Paint: G-E. Floor: 10x10.

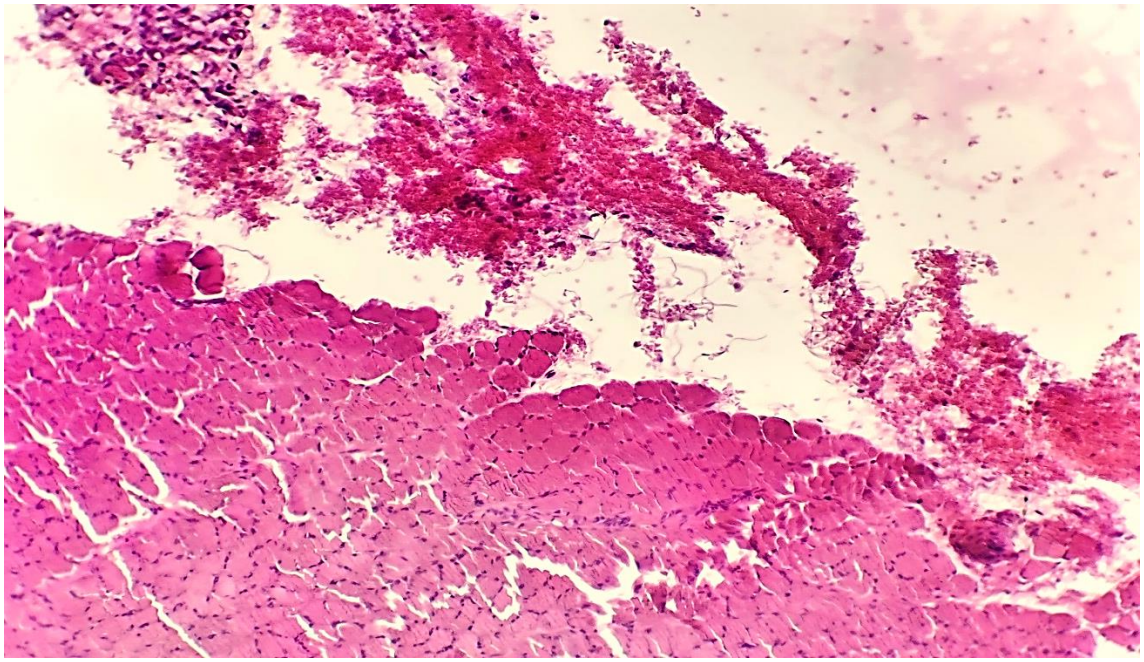


Figure 2. A deep wound of the soft tissues of the face-jaw area, the drug was not applied. The bottom of the wound consists of a muscle layer, on the surface of which is a collection of uncoagulated blood - erythrocytes.

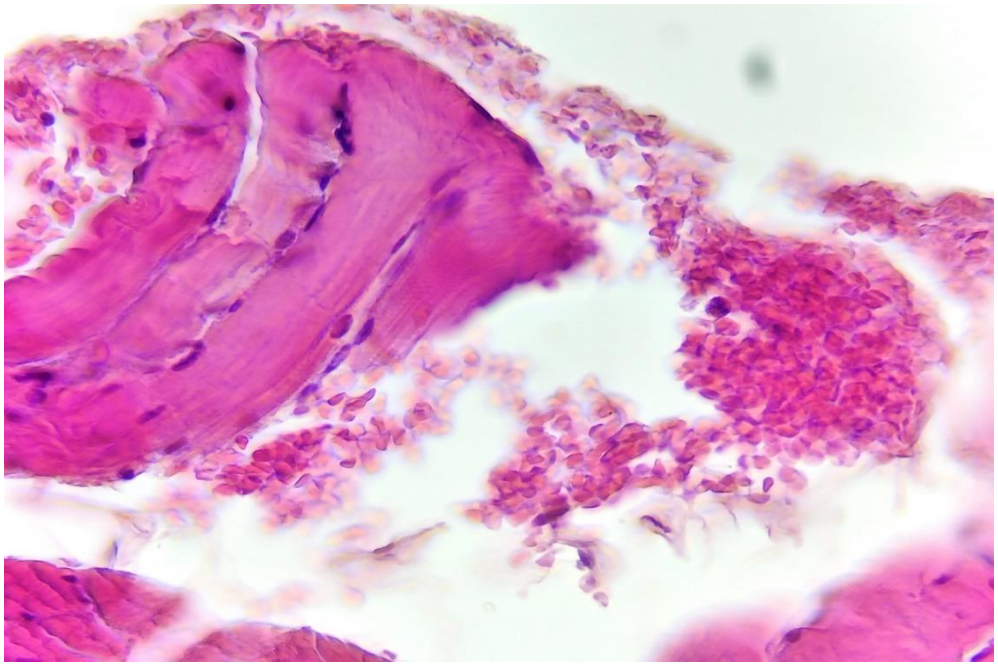


Figure 3. Scattered placement of blood erythrocytes on the surface of a wound deep to the skeletal muscle without clotting. Paint: G-E. Floor: 10x40.

When studied under a microscope lens, it becomes clear that the bottom of the wound consists of skeletal muscle tissue, muscle bundles, between them and on the surface of the blood erythrocytes are scattered without clotting (Fig. 3)

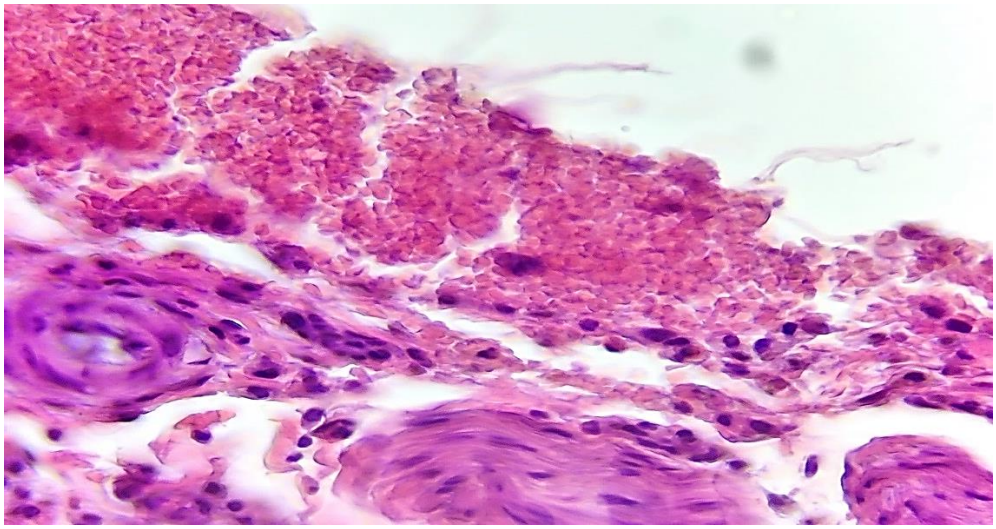
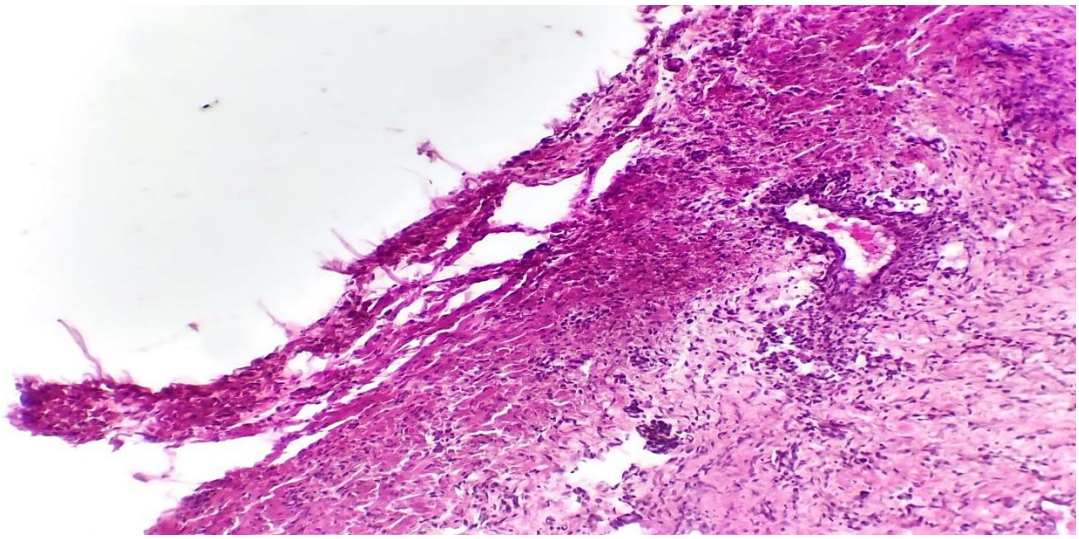


Figure 4. A deep-seated ulcer of the soft tissues of the face-jaw area up to the bony membrane, without coagulation of the shed blood, scattered erythrocytes. Paint: G-E. Floor: 10x40.



5- fig. Microscopic view of an untreated wound after 10 days. At the bottom of the wound, non-coagulated blood cells are seen along with the inflammatory infiltrate. Paint: G-E. Floor: 10x10.

As a result of the experiments, melodies were revealed

Examinations show that blood has been poured into the bottom of the wound and the surrounding tissues, and the surface of the wound is covered with blood, blood has been poured into the muscle

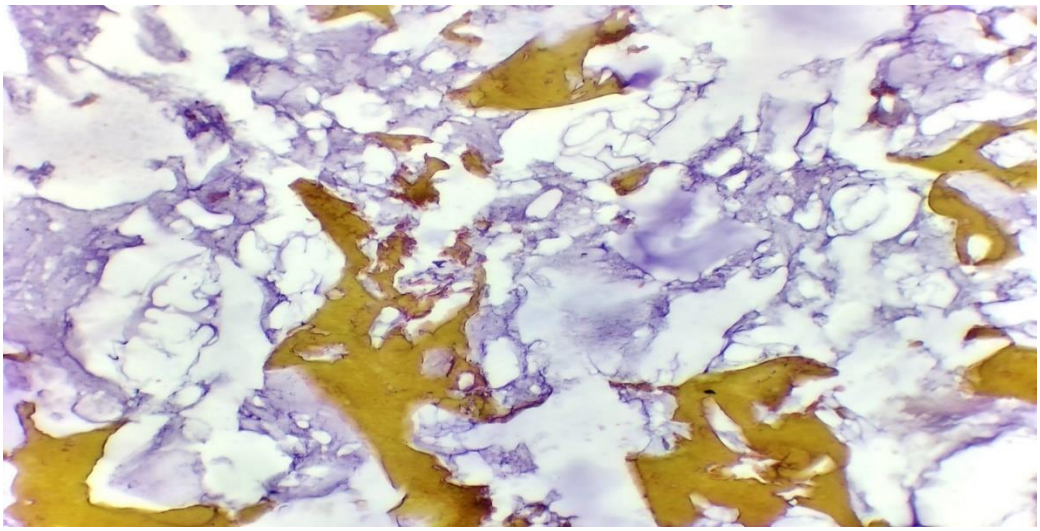
tissue of the bottom of the wound, that is, a collection of erythrocytes is scattered on the surface of the wound without clotting. When studied with a large lens of a microscope, the bottom of the wound is skeletal muscle tissue, muscle tufts are identified, and their between and on the surface of blood erythrocytes, it is observed that they are scattered without clotting

To study the effect of the Hemoben drug on mining

Microscopic changes in the clot after instillation of hemoben into the non-coagulated bone were studied.

When a drop of blood coagulated under the influence of Hemoben was studied under a microscope, it was found that the proteins in the blood plasma liquid were denatured in a short period of time under the influence of the

drug and formed a light purple thin fibrillar network, the fibrillar protein has a dense and homogeneous structure in some areas, and in other places it consists of a vacuolated thin fibrillar network (6 - fig). It is observed that the Hemoben drug binds blood cells, including erythrocytes, in a drop of blood, and creates a light brown product. It is determined that this brown product contains fine granular pigmentation originating from erythrocytes (Fig. 7).



6- fig. A drop of blood coagulated under the influence of hemoben, plasma proteins in the form of a fibrillar network, blood cells combined with hemoben, formed a light brown product. Paint: G-E. Floor: 10x10

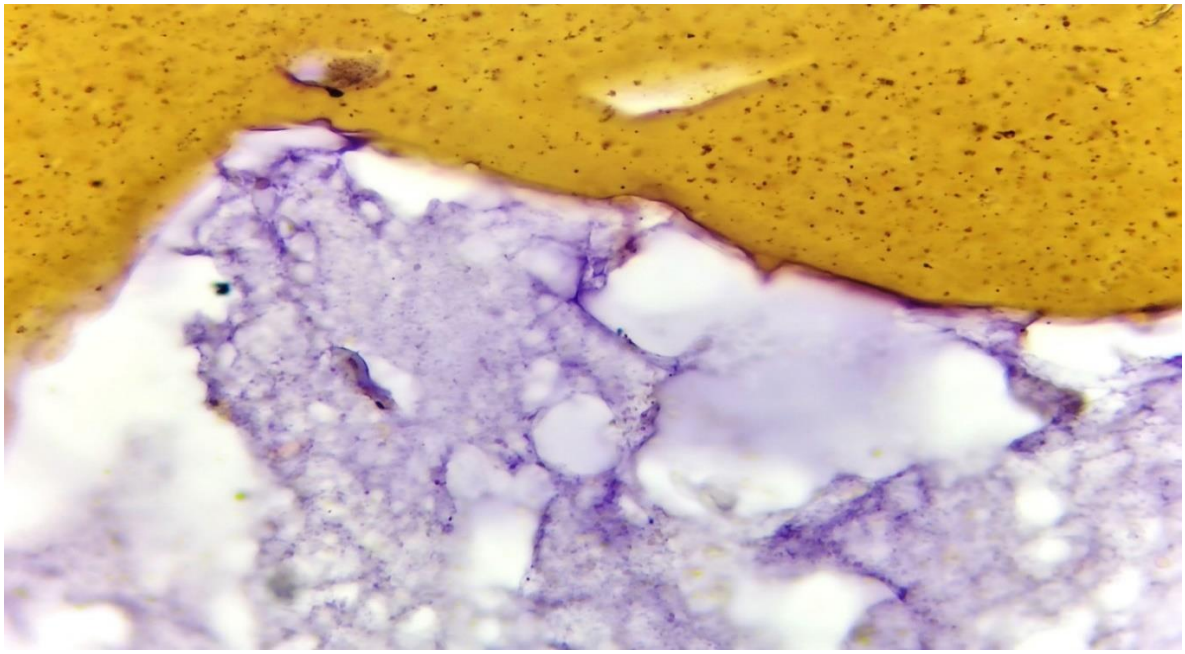


Figure 7. The brown product contains hemoglobinogenic pigmentation, with fibrillar protein finely vacuolated. Paint: G-E. Floor: 10x40

In the next group of patients, when an experimental wound appears on the skin of the face-jaw area, when a part of the dermis is damaged and removed, the deep areas of the dermis, i.e., the connective tissue and countless blood vessels in it, rupture, and blood flows from the surface of the wound. In order to stop the flow of blood, it was found that when hemoben, a new blood clot preparation, was applied to the wound surface, the blood coagulated and solidified for 1-2 minutes. Microscopic examination of the tissues of the wounded, blood-

stopped areas of the skin revealed that tissue structures, white blood cells, red blood cells, and plasma proteins coagulate under the influence of hemobene on the surface of the damaged dermis, forming destructible products of various sizes. As it deepens from the surface of the wound, it is observed that the fibrous structures of the dermis are disorganized, swollen, homogenized, and chaotically located (Fig. 8). As a result, it is determined that the connecting cells between the fibers are also chaotically located. Almost all blood vessels of the dermis are in a state of spasm, morphologically, the wall is thickened due to swelling, and the cavity is narrowed.

When studied under the microscope lens, it was found that the dermal tissue was damaged in the superficial wound of the skin of the face-jaw area, and the surface of the wound was covered by various disintegrated tissue structures. It is observed that these tissue structures are mainly composed of fibrous structures, interstitium and fragmented cells. Among the tissue structures, it is determined that the components of the blood flowing from the blood vessels, that is, white blood cells, red blood cells, and plasma proteins have coagulated separately, joined together in some areas, and formed large clots (Fig. 9). In the areas close to the surface, it is determined that connective tissue cells are activated and a small number of inflammatory cells have appeared. The deeper the dermal tissue penetrates, the more fibers there are and the fewer cells there are. It is determined that the fibrous structures are swollen, swollen and disordered.

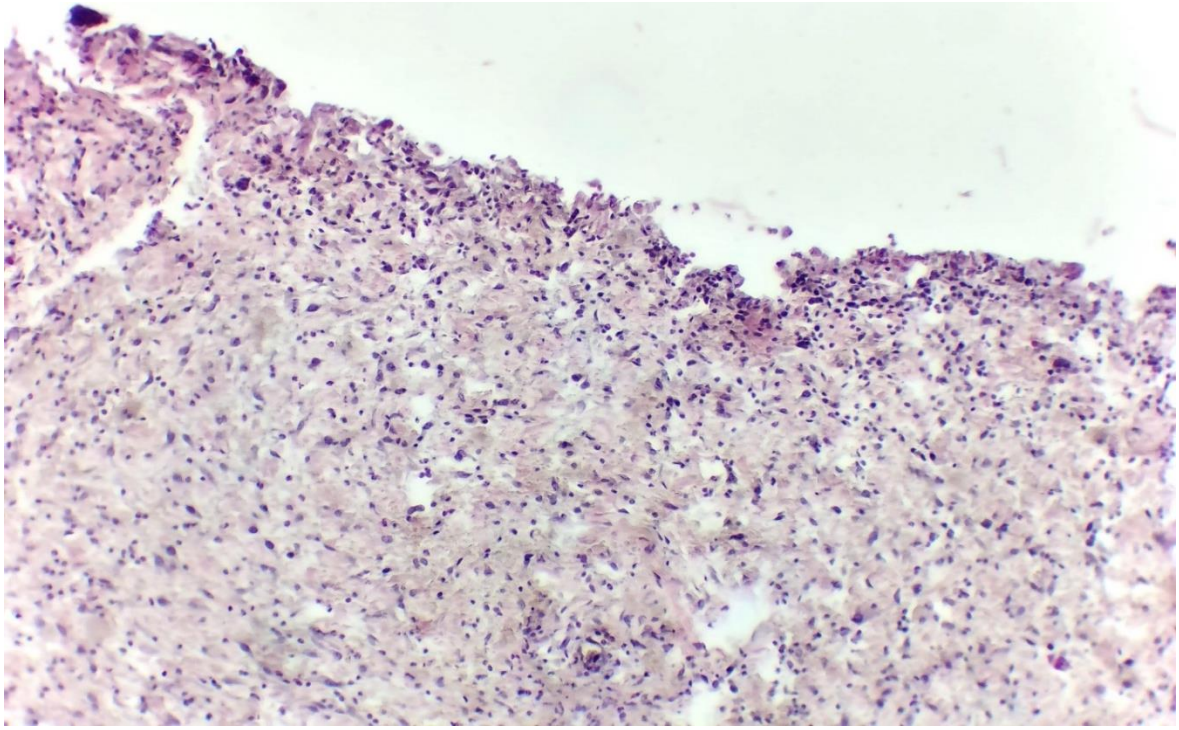


Figure 8. On the 3rd day, hemoben was applied to the skin of the face-jaw region of the animals, blood cells coagulated separately and clots formed on the surface of the wound. Paint: G-E. Floor: 10x10.

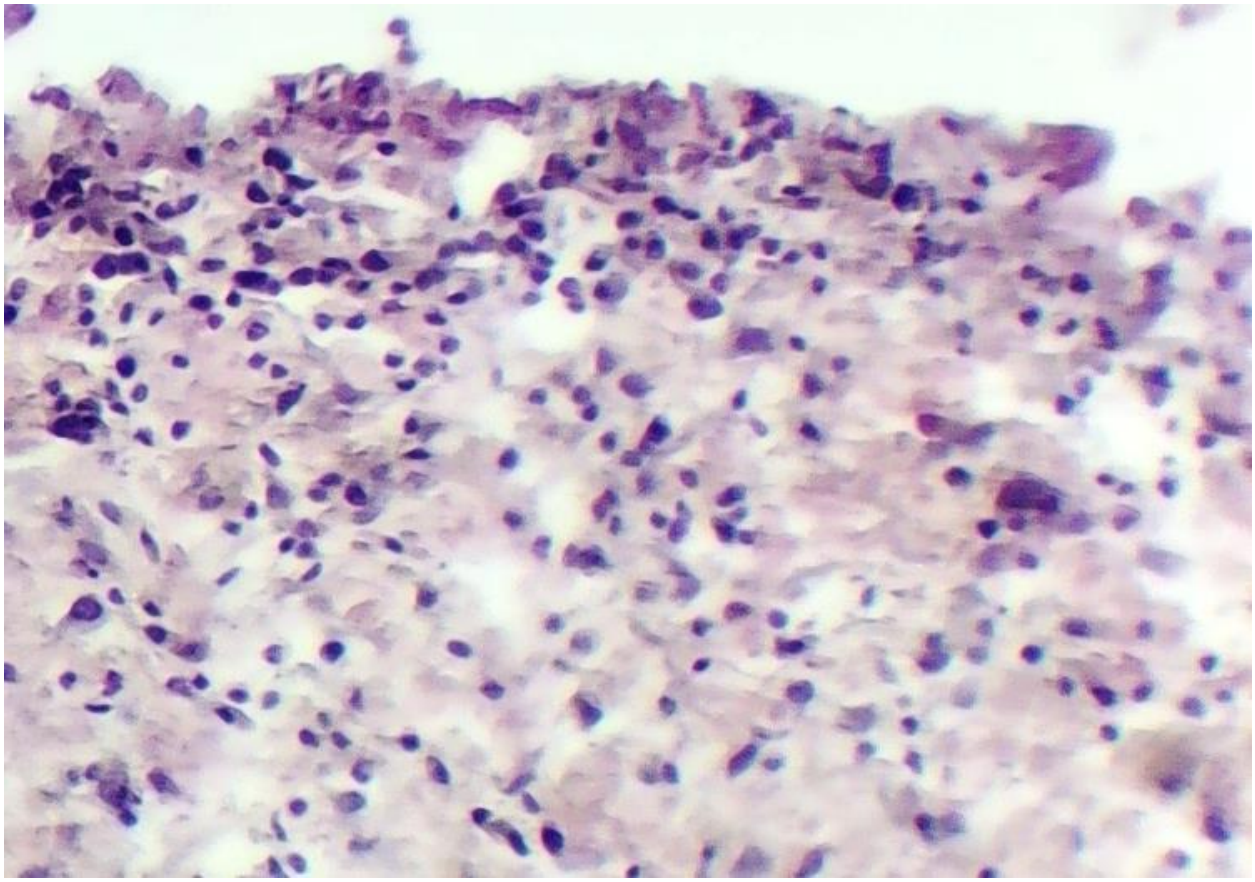


Figure 9. On the surface of the wound, tissue fragments, blood cells have coagulated and turned into clots. Paint: G-E. Floor: 10x100.

When a superficial wound appeared on the skin of the face-jaw area, and the bleeding from it was stopped with the help of hemoben, the tissue of the deep layers of the skin was studied under a microscope, and the following data were obtained. It is observed that the hypodermis under the dermis, the fat layer, and the layer of muscle cells of the skin are severely swollen, and the blood vessels, bundles of connective tissue, and smooth muscle layers are deformed and thinned. It was found that the most developed layer of the swelling process is the hypodermis layer under the dermis (Fig. 10). It is determined that the muscle layer and the fatty tissue under the skin are relatively slightly swollen. During this 3-day period of the experiment, the lower half of the dermis layer, where the wound was formed, thickened due to the proliferation and increase of connective tissue cells and the appearance of inflammatory infiltrate. It is determined that the disintegration of the fibrous structures between the proliferating and increased connective tissue cells is mixed with the interstitial substance and creates a homogeneous structureless substance.

When studied under the microscope lens, it is observed that swelling and disorganization processes have developed in the tissue structures located deep under the wound. In the hypodermis, it is observed that the connective tissue cells have switched to proliferative activity, are hypertrophied and hyperchromized histotopographically (Fig. 11). It is determined that the skin is separated from the connective tissue around the skeletal muscles with a swelling, the muscle fibers are slightly swollen and deformed.

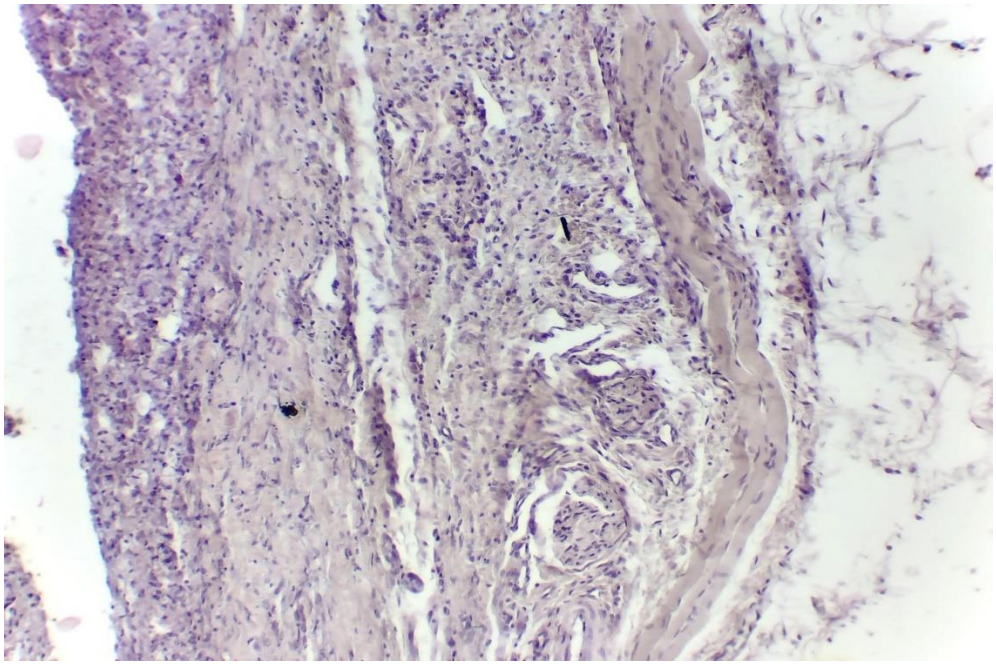


Figure 10. Animals with a superficial wound on the skin of the face-jaw area, on the 3rd day, hemoben was smeared, and the tissues located deep from the wound were swollen. Paint: G-E. Floor: 10x10.

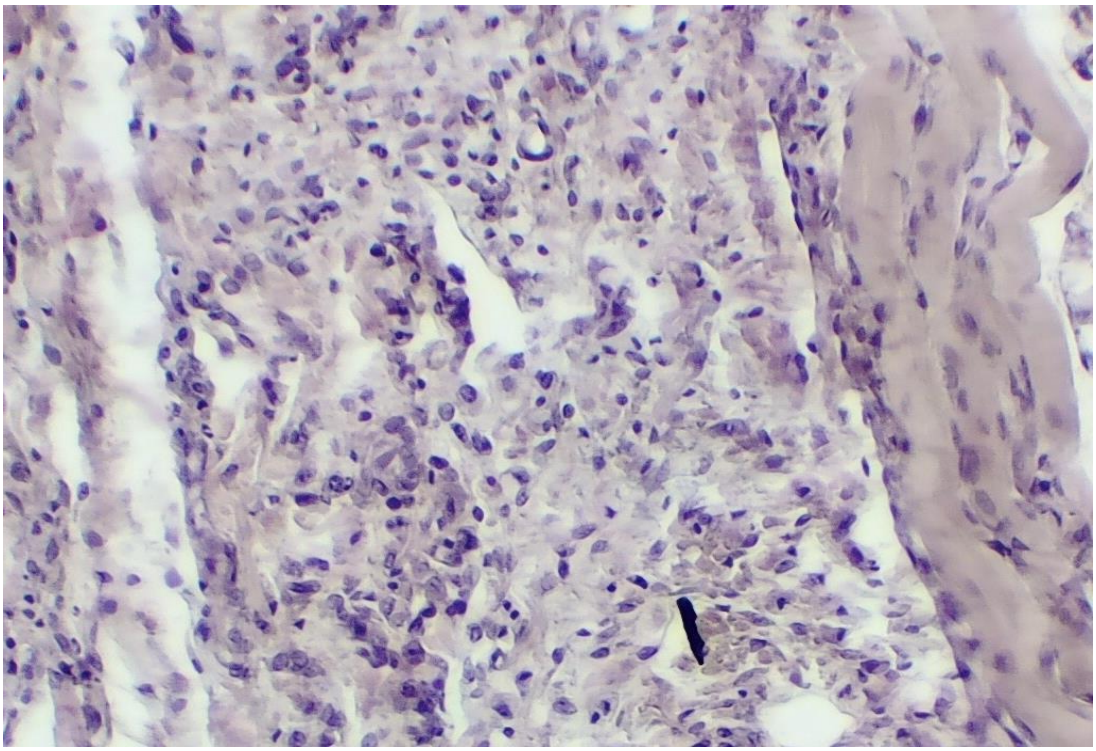


Figure 11. Tissue structures under the wound are swollen and disorganized. Paint: G-E. Floor: 10x40.

By the 5th day of the experiment, it is observed that the bottom of the wounded area of the skin is slightly deformed, covered with inflammatory infiltrate and small connective tissue tufts. It is determined that the connective tissue surrounding the wound and its tube is thickened due to the expansion of blood vessels, proliferation of cells, diffuse and focal inflammatory infiltrate (Fig. 12). In this case, it is determined that the wall of arterial blood vessels in the dermal tissue is thickened due to swelling and swelling, and the wall of venous blood vessels, on the contrary, is thinned. When studied under a microscope lens, it was found that a

chronic inflammatory infiltrate of both diffuse and focal form appeared in the deep dermal tissue of the wound. In particular, it is observed that the inflammatory infiltrate mainly consists of lymphoid and histiocytic cells (Fig. 13). Eosinophilic cells are found among the inflammatory infiltrate.

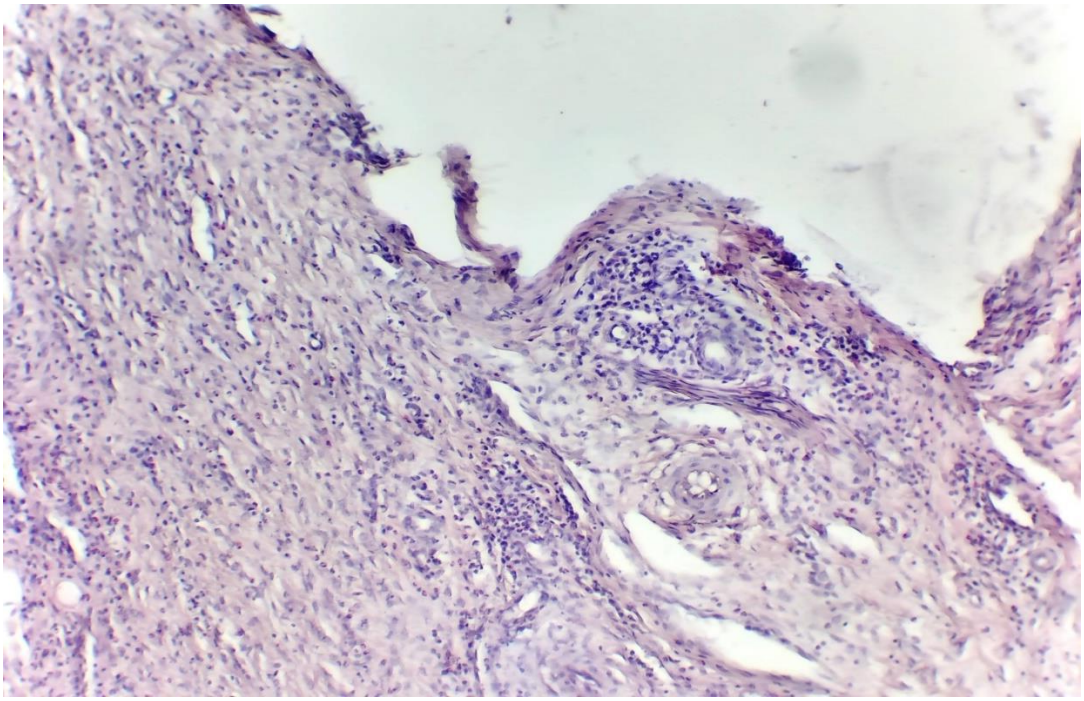
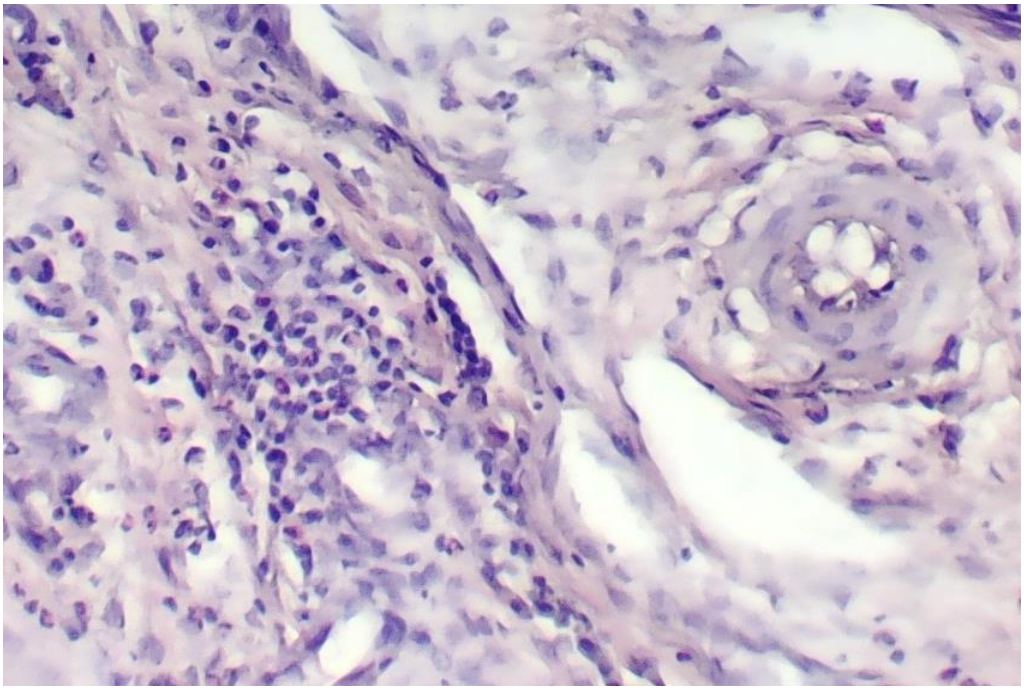


Figure 12. Animals with a superficial wound of the skin of the face-jaw area, on the 5th day, hemoben was smeared, and the tissues located deep from the wound were swollen and inflamed. Paint: G-E. Floor: 10x10.



13- Fig. Thickening of the wall of arteries in the dermis due to swelling, appearance of focal lymphoid infiltration around veins. Paint: G-E. Floor: 10x40.

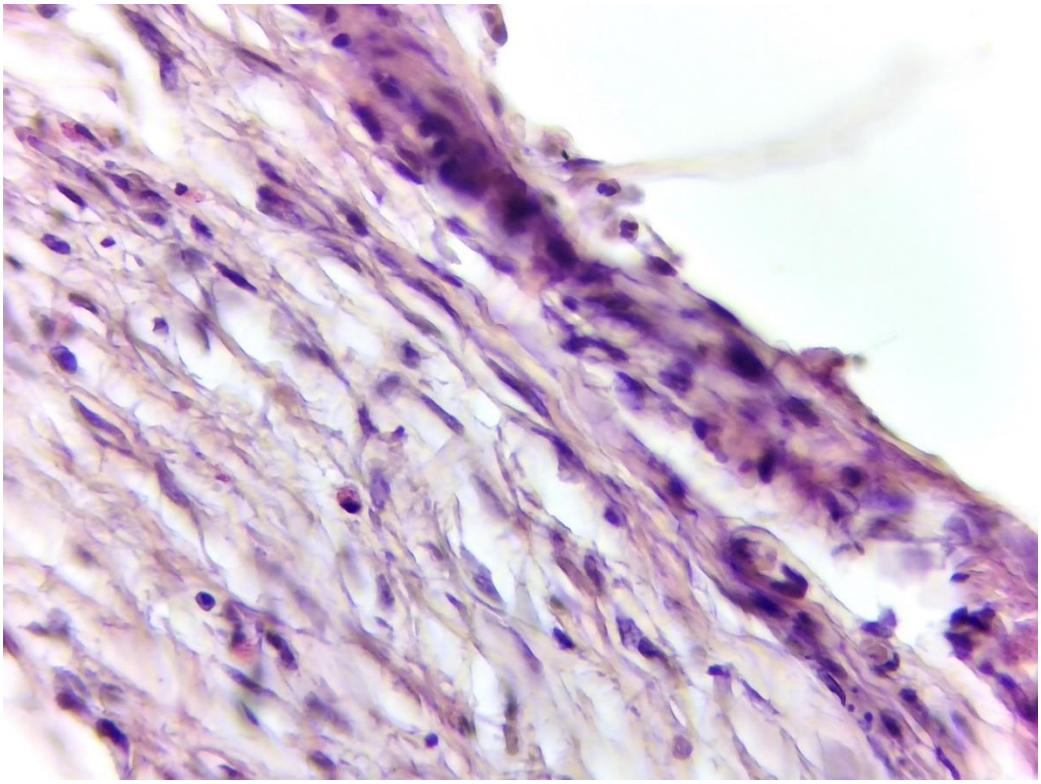


Figure 14. On the 10th day of the experiment, the disintegrated tissue structures on the surface of the wound disappeared, replaced by a dense tissue. Paint: G-E. Floor: 10x40.

By the 10th day of the experiment, due to the effect of the Hemoben drug applied to the surface wound on the skin of the face-jaw area and to stop the bleeding, the above-mentioned fragmented tissue pieces and coagulated clots formed from blood cells on the surface of the wound were relatively absorbed and absorbed into the connective tissue structures. is determined to be gone. As a result, the surface of the wound is stained dark due to the absorption of tissue fragments, hemoben-induced blood cells and blood plasma proteins, and it is observed that inclusions with hematoxylin and eosinophilic substance in a homogeneous state have appeared (Fig. 14). Therefore, it can be predicted that the healing process of tissues and cells on the surface of the wound with blood stopped with the help of Hemoben is observed to be significantly accelerated. It was determined that the connective tissue of the dermis located at the bottom of the wound and around it has an orderly structure compared to previous periods, that is, its fibrous structures are directed and located in one direction. It is observed that the cells are also differentiated, become elongated, and decrease in number, but inflammatory cells remain among them.

In this series of experiments, when the skin of the face-jaw area was completely transplanted, a wound appeared with the underlying fat and muscle tissue exposed, hemoben was applied to stop the bleeding, and the tissues were examined microscopically. In contrast to the wound in the first series, it was found that the surface of the wound was covered with a necrotic and inflammatory infiltrative mass from the 3rd day of the experiment, as the tissue was removed deeply. It was observed that the fat and skeletal muscle tissue under the wound were severely swollen and diffusely inflamed (Fig. 15). It is determined that the blood vessels in the tissue are enlarged and full, and blood is poured around some of them in the diapedesis method.

When examining the surface of the wound and covering it with necrotic masses and the composition of the inflammatory infiltrate, it is known that blood cells and plasma proteins coagulated and formed clots under the influence of hemoben in the composition of necrosis and infiltrate and combined with the interstitial substance of the tissue (Fig. 16). It can also be shown that under the influence of hemobene, an intermediate substance and a protein substance in the inflammatory infiltrate formed at the bottom of the wound, coagulation and the

formation of a pale eosinophilic homogeneous mass occur. Deeply located connective tissue and vessels are reactive, edema and inflammation are observed around them.

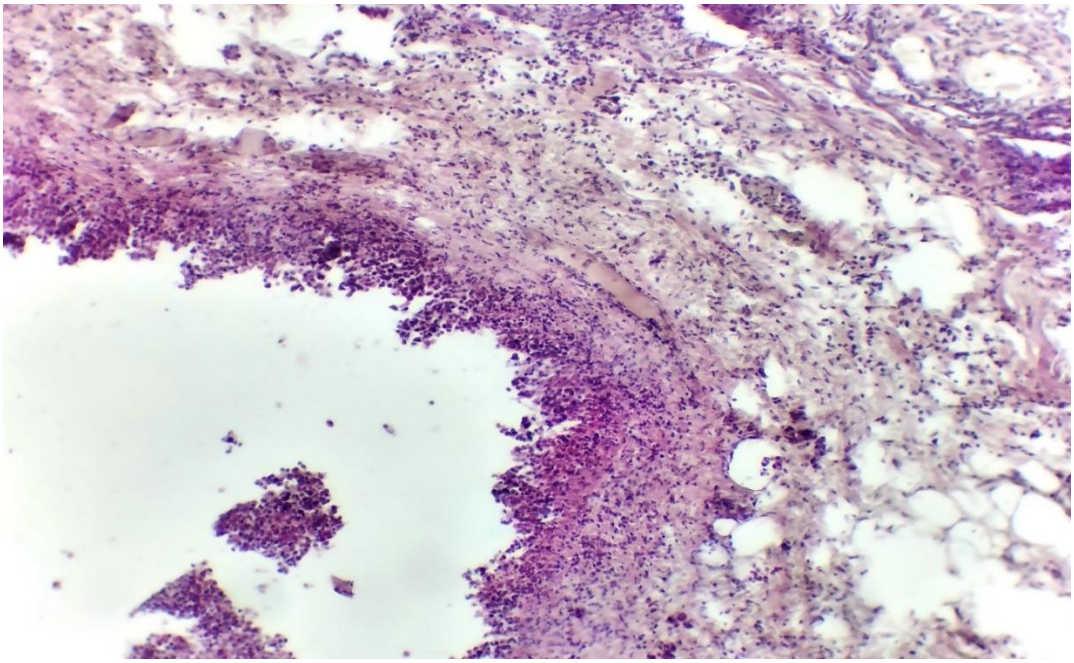


Figure 15. A deep wound of the skin of the face-jaw area, on the 3rd day, hemoben was applied, the surface of the wound was covered with necrosis and inflammation, the deep tissues were swollen and inflamed. Paint: G-E. Floor: 10x10.

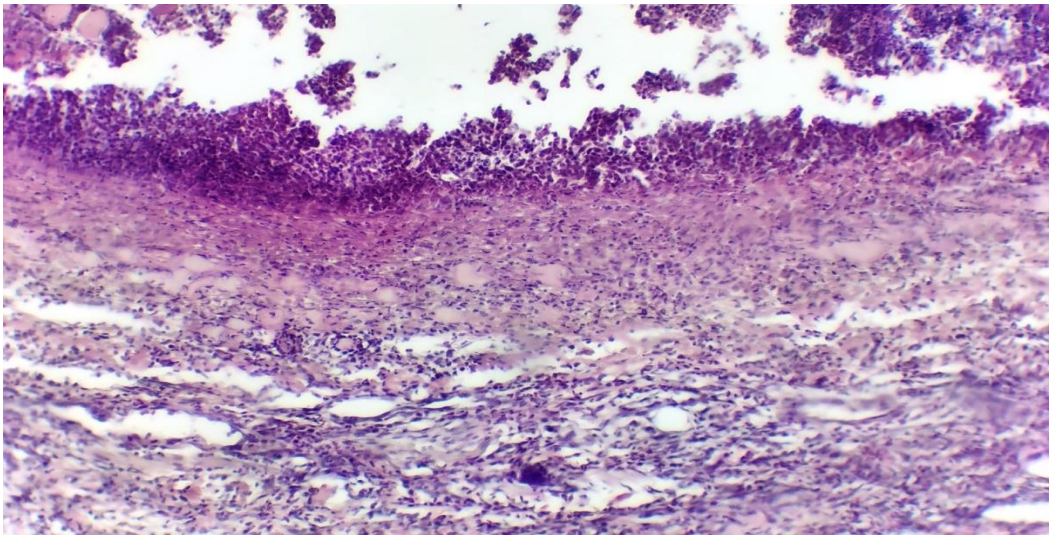


Figure 16. The bottom of the deep wound, on the 3rd day, was covered with necrosis and inflammatory infiltrate, under the influence of hemoben, blood cells coagulated and formed clots. Paint: G-E. Floor: 10x40.

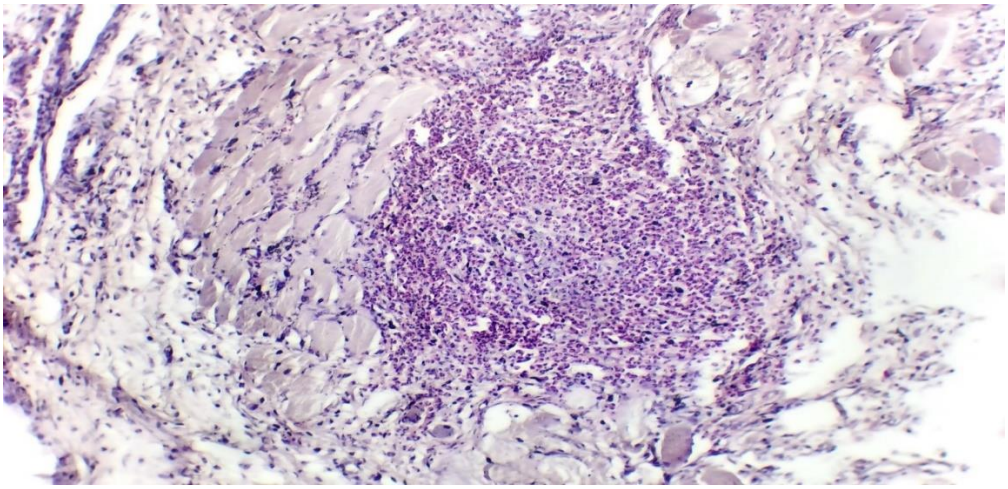


Figure 17. On the 5th day of the experiment, after hemoben was applied, the appearance of focal lympho-histiocytic cell infiltrate adjacent to skeletal muscles. Paint: G-E. Floor: 10x10.

By the 5th day of the experiment, a deep wound of the face-jaw region, that is, a wound in which the epidermis and dermis were completely removed, and the underlying fat tissue and muscle fibers were preserved, was examined microscopically. it is determined that an inflammatory infiltrate has formed. In this case, morphologically, it is observed that the chronic inflammatory infiltrate is similar to granulomatosis with a focus in the area near the skeletal muscle (Fig. 17). It is observed that around these inflammatory infiltrate cells, i.e. fat infiltrates and spreads from one side to the skeletal muscle side from the other side. When this lymphohistiocytic inflammatory infiltrate is studied under a microscope, it becomes clear that a large number of eosinophils are present in the infiltrate (Fig. 18). Therefore, it can be concluded that the large amount of eosinophils in the inflammatory infiltrate confirms the development of the immunopathological process in the tissue, including the exacerbation of the allergic process. To find out, the infiltration of both lymphocytes and eosinophils between the autologous tissue around the cell cluster indicates the development of an immunopathological process in relation to the autologous tissue.

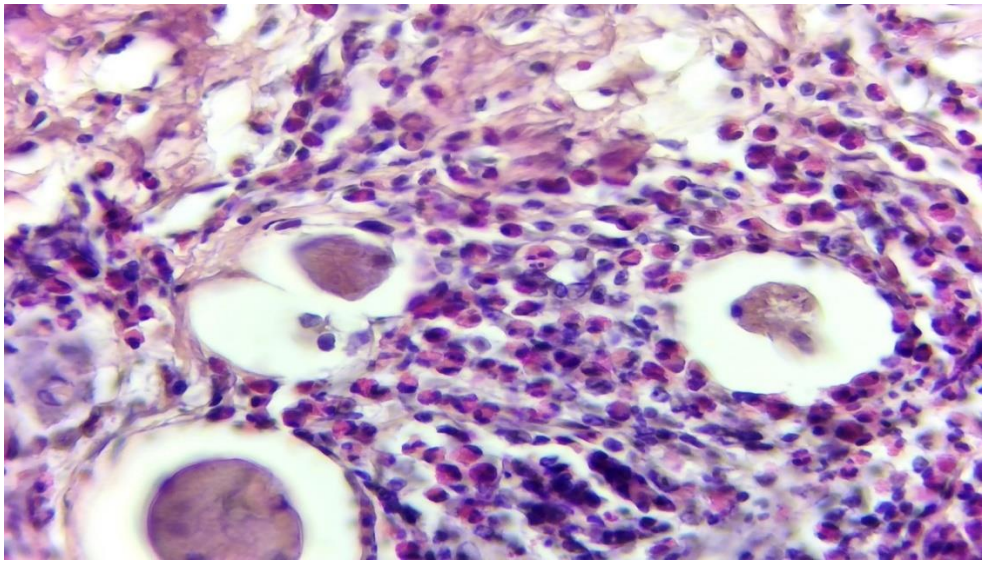


Figure 18. On the 5th day of the experiment, the abundance of eosinophils in the cell infiltrate. Paint: G-E. Floor: 10x40.

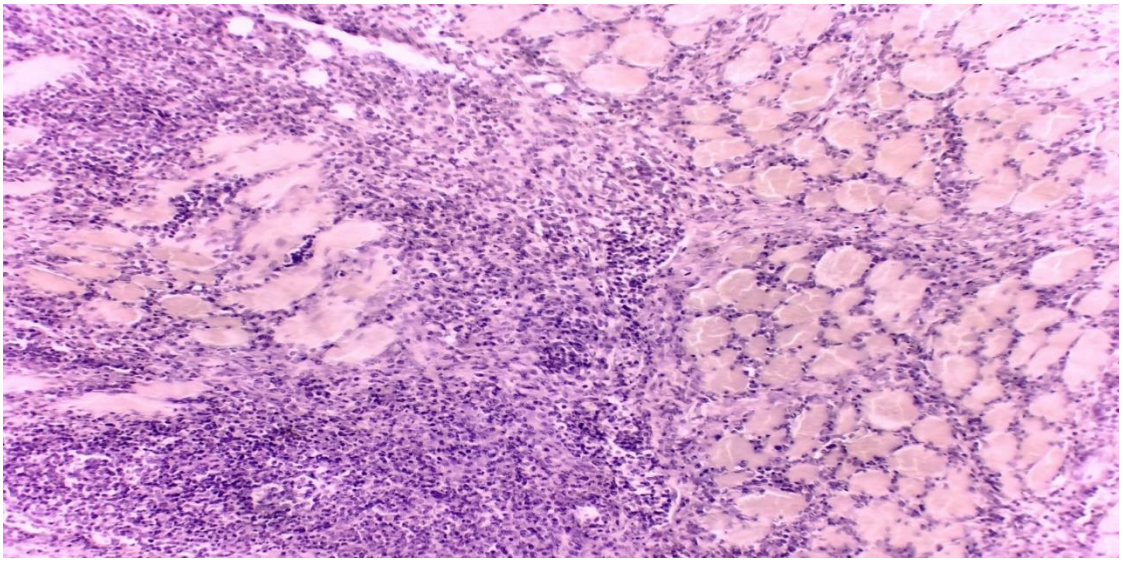


Figure 19. Deep wound of the face-jaw area, 10th day, hemoben was applied. Deep skeletal muscles are densely surrounded by inflammatory infiltrate. Paint: G-E. Floor: 10x10.

By the 10th day of the experiment, it is determined that the inflammatory process developed around the deep wound of the face-jaw area has turned into a chronic proliferative form of inflammation and has diffusely grown into all surrounding tissues, including muscle, connective and fatty tissues. In this case, it is observed that each strand and each fiber of the muscle tissue is surrounded by inflammatory infiltrate, as a result, the muscle fibers are deformed, become different sizes, and atrophy. It is determined that the connective tissue between the muscle bundles has expanded due to the increase in the volume of the inflammatory infiltrate in it (Fig. 19). It is determined that there is a large number of lymphoid cells in the inflammatory infiltrate and they are located in individual clusters. When studied with a large lens of a microscope, it became clear that skeletal muscle fibers were thinned, each deformed, myofibrils were torn, myolysis occurred, the histotopography of nuclei changed, and some of them were destroyed. Intermuscular connective tissue is expanded due to inflammatory infiltrate and densely filled with inflammatory cells (Fig. 20). The inflammatory infiltrate contains a large number of eosinophils, and it is determined that the inflammatory cells are deformed and destroyed to varying degrees.

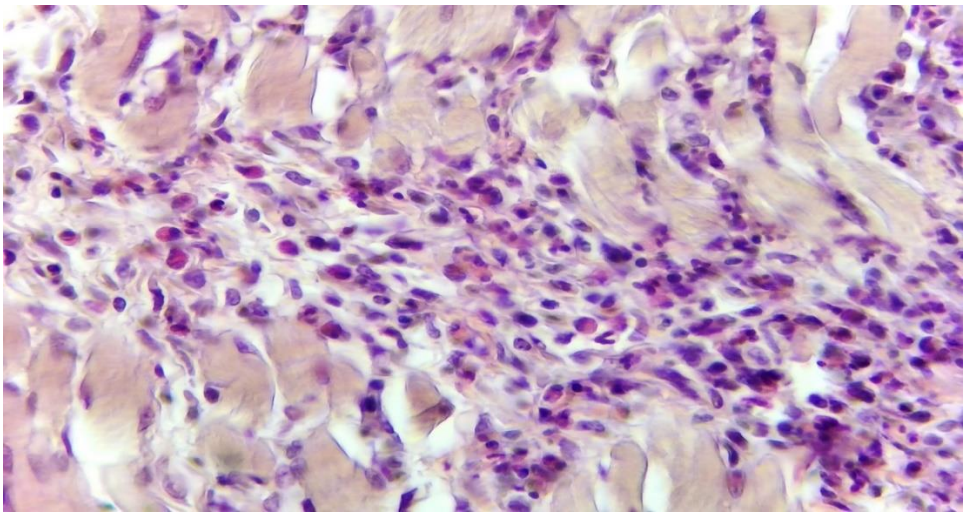


Figure 20. Inflammatory infiltrate between skeletal muscles and a large number of eosinophils in it. Paint: G-E. Floor: 10x40.

3. Conclusion

As a result of the conducted experiments, the tunes were identified:

Examinations show that the wound bed and surrounding tissues are covered with blood and the surface of the wound is covered with blood, the muscle tissue of the wound bed contains blood that has been poured on the surface of the wound, that is, a collection of erythrocytes is scattered without clotting. When studied under the microscope lens, the bottom of the wound is skeletal muscle tissue, muscle bundles, and between them and on the surface, it is observed that the blood erythrocytes are scattered without clotting.

The experiment showed that when the animals created a superficial wound defect on the skin of the face-jaw area, and the blood flowing from it was stopped with the drug Hemoben, the blood cells and plasma proteins coagulated under the influence of the drug, and the tissue fragments that appeared on the wounded surface of the tissue were denatured and turned into clots under the influence of the drug. observed. Over time, it was found that the pieces of destroyed tissue and coagulated blood cells on the surface of the wound were absorbed, replaced by a dense connective tissue consisting of a homogeneous substance with hematoxylin and eosinophilic inclusions. When animals develop a superficial wound defect on the skin of the face-jaw area, and the blood flowing from it is stopped with the drug Hemoben, under the influence of the drug, blood cells and plasma proteins coagulate and become clotted, and the tissue fragments that appear on the wounded surface of the tissue are also denatured and turn into clots under the influence of the drug. Over time, pieces of destroyed tissue and clotted blood cells on the surface of the wound are absorbed, and it is determined that a dense connective tissue consisting of a homogeneous substance with hematoxylin and eosinophilic inclusions has appeared in its place.

4. References

[1] Zatevakhin I.I., Kirienko A.I., Sazhin A.V. (ed.). Emergency Abdominal Surgery: A Methodological Guide for the Practicing Physician. Moscow: Medical Information Agency; 2018.

[2] Polytrauma Guideline Update Group. Level 3 guideline on the treatment of patients with severe/multiple injuries. Eur J Trauma Emerg Surg. 2018;44:3–271. PMID: 29654333 https://doi.org/10.1007/s00068-018-0922-y

[3] Goncharov A.V., Samokhvalov I.M., Suvorov V.V., Markevich V.Yu.,Pichugin A.A., Petrov A.N. Problems of staged treatment of victims with severe concomitant injuries in the conditions of the regional trauma system. Polytrauma.2017;4:6–15.

[4] Duchesne J, Inaba K, Ali Khan M. Damage Control in Trauma Care. An Evolving Comprehensive Team Approach. Switzerland: Springer International Publishing; 2018. https://doi.org/10.1007/978-3-319-72607-6

[5] Pape HC, Peitzman AB, Rotondo MF, Giannoudis PV. Damage Control Management in the Polytrauma Patient. Second Edition. Switzerland: Springer International Publishing; 2017. https://doi.org/10.1007/978-3-319-52429-0

[6] Spahn D, Bouillon B, Cerny V, Duranteau J, Filipescu D, Hunt B, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. Crit Care. 2019;23(1):98. PMID: 30917843 https://doi.org/10.1186/s13054-019-2347-3

[7] Bobovnik S.V., Bulanov A.Yu., Grigoriev E.V., Zabolotskikh I.B.,Lebedinsky K.M., Sinkov S.V., etc. The protocol of resuscitation and intensive care in acute massive blood loss, Clinical guidelines, All-Russian public organization “Federation of anesthesiologists and resuscitators”; 2018 https://congress-med.ru/assets/files/2018/2018-rossijskie-rekomendaczii-poneotlozhnoj-pomoshhi-pri-ostroj-krovopotere.pdf

[8] Lo E., Deane S. Diagnosis and classification of immune-mediated thrombocytopenia. Autoimmun. Rev. 2014; 13(4-5): 577-83. DOI: 10.1016/j.autrev.2014.01.026

[9] Audia S., Mahåvas M., Samson M., Godeau B., Bonnotte B. Pathogenesis of immune thrombocytopenia. Autoimmun. Rev. 2017; 16(6): 620-632. DOI: 10.1016/j.autrev.2017.04.012

[10] Lambert M.P., Gernsheimer T.B. Clinical updates in adult immune thrombocytopenia. Blood. 2017; 129(21): 2829-2835. DOI: 10.1182/blood-2017-03-754119

[11] Forest S.K., Hod E.A. Management of the platelet refractory patient. Hematol. Oncol. Clin. North Am. 2016; 30(3): 665-677. DOI: 10.1016/j.hoc.2016.01.008

[12] Kaufman R.M., Djulbegovic B., Gernsheimer T., Kleinman S., Tinmouth A.T., Capocelli K.E., Cipolle M.D., Cohn C.S., Fung M.K., Grossman B.J., Mintz P.D., O'Malley B.A., Sesok-Pizzini D.A., Shander A., Stack G.E., Webert K.E., Weinstein R., Welch B.G., Whitman G.J., Wong E.C., Tobian A.A.; AABB. Platelet transfusion: A clinical practice guideline from the AABB. Ann. Intern. Med. 2015; 162(3): 205-213. DOI: 10.7326/M14-1589

[13] Gurion R., Siu A., Weiss A.R., Masterson M. Use of recombinant factor VIIa in a pediatric patient with initial presentation of refractory acute immune thrombocytopenic purpura and severe bleeding. J. Pediatr. Pharmacol. Ther. 2012; 17(3): 274-280. DOI: 10.5863/1551-6776-17.3.274

[14] Misgav M., Shenkman B., Budnik I., Einav Y., Martinowitz U. Differential roles of fibrinogen and von Willebrand factor on clot formation and platelet adhesion in reconstituted and immune thrombocytopenia. Anesth. Analg. 2011; 112(5): 1034-1040. DOI: 15.1213/ANE.0b013e318212fffc

[15] Weisel J.W., Litvinov R.I. Fibrin formation, structure and properties. Subcell. Biochem. 2017; 82: 405-456. DOI: 1007/978-3-319-49674-0_

[16] Lewis K.M., Spazierer D., Urban M.D. et al. Comparison of regenerated and non-regenerated oxidized cellulose hemostatic agents. Eur Surg 2013; 45: 4: 213—220.

[17] Mair H., Kaczmarek I., Oberhoffer M., Groetzner J., Daebritz S., Reichart B. Surgicel Nu-Knit hemostat for bleeding control of fragile sternum. J Thorac Cardiovasc Surg 2005; 130: 2: 605—606.

[18] Mair H., Schutz A., Lamm P., Reichart B. Control of bledding from fragile sternum with a resorbable hemostyptic. Ann Thorac Surg 2001; 71: 2: 759—760.

[19] Matsushita T., Masuda S., Inoue T. Early experience with combined use of two plant-based hemostatic agents. Ann Thorac Surg 2010; 90: 327—328.

[20] Murphy J.J., Glantz W., Schoenberg H.W. The healing of renal wounds. III. A comparison of electrocoagulation and suture ligation for hemostasis in partial nephrectomy. J Urol 1961; 85: 882—883.

[21] Öllinger R., Mihaljevic A.L., Schuhmacher C. et al. A multicentre, randomized clinical trial comparing the Veriset™ haemostatic patch with fibrin sealant for the management of bleeding during hepatic surgery. HPB 2013; 15: 7: 548—558.

[22] Pernet M. Antibacterial effect of oxidized regenerated cellulose. Ann Chir 1983; 37: 700—701.

[23] Querimi B., Baumann P., Husing J. et al. Collagen hemostat significantly reduces time to hemostasis compared with cellulose: COBBANA, a single-center, randomized trial. Am J Surg 2013; 205: 6: 636—641.
[24] Ryšavá J., Dyr J.E., Homola J. et al. Surface interactions of oxidized cellulose with fibrin (ogen) and blood platelets. Sensor Actuat BChem 2003; 90: 1: 243—249.
[25] Sabel M., Stummer W. Haemostasis in spine surgery. The use of local agents: Surgicel and Surgifoam. Eur Spine J 2004; 13: 1: 97—101.
[26] Samudrala S. Topical Hemostatic Agents in Surgery: A Surgeon's Perspective. AORN J 2008; 88: 3: S1—S11.
[27] Seyednejad H., Imani M., Jamieson T., Seifalian A.M. Topical haemostatic agents. Brit J Surg 2008; 95: 10: 1197—1225.
[28] Spangler D., Rothenburger S., Nguyen K. et al. In Vitro Antimicrobial Activity of Oxidized Regenerated Cellulose Against Antibiotic-Resistant Microorganisms. Surg Infect 2003; 4: 3: 255—262.
[29] Stilwell R.L., Whitmore E.J., Saferstein L.G. Calcium-modified oxidized cellulose hemostat. US Patent 5483913, 1996.
[30] Stilwell R.L., Marks M.G., Saferstein L., Wiseman D.M. Oxidized cellulose: chemistry, processing and medical applications. In: Domb A.J., Kost J., Wiseman D.M., eds. Handbook of biodegradable polymers. Amsterdam: Harwood Acad Publ 1997; 291—306.
[31] Spotnitz W.D., Burks S. Hemostats, Sealants, and adhesives: components of the surgical toolbox. Transfusion 2008; 48: 7: 1502—1516.
[32] Takacs I., Wegmann J., Horwath S. et al. Efficacy of Different Hemostatic Devices for Severe Liver Bleeding: A Randomized Controlled Animal Study. Surg Innov 2010; 17: 4: 346—352.
[33] Tavlasoglu M., Durukan A.B., Kurkluoglu M. et al. Comparison of sternal intramedullary bleeding prevention strategies in cardiac surgery. Turk J Med Sci 2013; 43: 695—699.
[34] Wang C., Gu T.X., Yu L. et al. Role of oxidized regenerated cellulose in the hemostasis of severe sternal osteoporosis during cardiopulmonary bypass. J Clinical Rehabilit Tissue Eng Res 2011; 15: 25: 4739—4742.
[35] Wang H.S., Kirsch W., Zhu Y.H. et al. Hemostatic agents derived from chitin and chitosan. J Macromol Science-Pol R 2005; 45: 4: 309—323.
[36] Wiseman D.M., Gottlick-Iarkowski L., Kamp L. Effect of different barriers of oxidized regenerated cellulose (ORC) on cecal and sidewall adhesions in the presence and absence of bleeding. J Invest Surg 1999; 12: 3: 141—146.
[37] Wu Y., Jinmei He J., Cheng W. et al. Oxidized regenerated cellulosebased hemostat with microscopically gradient structure. Carbohydr Polym 2012; 88: 3: 1023—1032.
[38] Xe J., Wang F., Wu Y. et al. Preparation of the water-soluble chitosancoated oxidized regenerated cellulose gauze. Cellulose 2011; 18: 6: 1651—1659.