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WOUND HEALING PLASTERS FOR THE TREATMENT OF BURN WOUNDS

The article presents the results of an experiment to study the therapeutic effect of domestic wound patches developed on the basis of carbonized rice husks and sodium tetraborate, as well as to identify the best permeable material for further use in the treatment of burns. It was found that the patches have a pronounced effect in the treatment of thermal burns in animals. The processes of healing and epithelialization of burn wounds in experimental animals using wound healing patches occurred much faster compared to other analogues, and complete wound healing with scarring occurred after 20 and 14 days, respectively. Carbon sorbent and sodium tetraborate, which is part of the patches as a powerful antiseptic, bactericidal and antifungal agent, promote rapid healing of burns by actively sorbing the wound secreted and preventing the formation of purulent exudate.

Keyword: burn, wound healing plasters, carbonization, rice husk, sodium tetraborate

Introduction. According to the statistics of the world health organization, burns take the 3rd place among other injuries, their number increases especially sharply in case of natural disasters, military conflicts [1, 2]. It is known that among the burned patients with superficial and limited deep burns predominate, amounting to 75-80%. Such lesions do not lead to the development of burn disease, but require effective conservative topical treatment that would stimulate regeneration processes in the wound defect zone [3, 4]. The urgency of the problem of local drug therapy of purulent burn wounds is due to the low efficiency of traditional treatments, against the background of the appearance of infectious agents with multiple antibiotic resistance and reduced body resistance [1,2]. The most important element in the treatment of burn wounds is the selection of dressings corresponding to the healing phases, particularly problematic for the treatment of burns with abundant fluid release, often complicated by secondary processes, toxic damage by tissue necrosis products and, as a consequence, unsatisfactory results of treatment [3]. In case of burns on the human skin may be education, which can allocate a different liquid. Modern dressings for local treatment of burn wounds should have a complex and multi-directional effect: have the necessary level of sorption capacity; ensure the outflow of wound contents; regardless of the nature of bacterial contamination reliably and quickly suppress and remove from the wound surface microbial bodies, as well as their waste products. Maintaining an optimal wound environment is absolutely necessary for the normal functioning of cells and the course of recovery processes [4, 5]. In various phases of the pathological process should be used appropriate tasks of treatment dressing material. Thus, the plaster material used in the treatment of purulent-inflammatory processes should, thanks to the structure of its material, have the ability to absorb and irreversibly retain wound exudate, contributing to the removal of microorganisms, toxins and tissue decay products, as well as stimulate the rejection of dead tissue. The task of dressings in the treatment of "clean" burn wounds is reliable protection from mechanical damage and secondary contamination, as well as stimulation of healing processes [6, 7, 8].

The most effective therapeutic and prophylactic agent is a series of carbon sorbents that provide wound cleansing through selective sorption of toxins, proteins and microorganisms (applique tissue forms, powdered, nonwoven). Therefore, the need for highly effective sorbents, characterized not only by high selectivity, speed, sorption capacity and completeness of extraction of substances from various media, but also by simultaneous bactericidal-healing treatment, has recently become particularly urgent [9].

In this regard, the study of the processes of sorption of wound discharge by carbon nanoporous materials with a high healing effect is of undoubted interest for the treatment of burns.

This fact necessitates the creation and comprehensive study of new drugs for the local treatment of burn wounds. In this regard, it is relevant to develop and implement new innovative wound healing dressings (patches) with high efficiency antiseptic, bactericidal and antifungal action.

Materials and methods.

When performing the tasks of the work, the synthesis of a new sorbent with a high pore volume was carried out and on its basis the technology of obtaining new dressings was developed. The research methodology includes the processes of rice husk carbonization under isothermal conditions and their demineralization. The synthesized material has an optimal pore structure in the macro-meso-and nanoscale region. This determines the speed of action of dressings in relation to sorption and healing properties.

Physical and chemical properties were studied using modern research methods using international standards and state Standards. Analytical studies were conducted in certified and accredited laboratories of Republican State Enterprise on the Right of Economic Use "Institute of combustion problems", KazNU Al-Farabi, and preclinical tests conducted in the " research Institute of biology and biotechnology". Preclinical studies include the identification of wound healing effect of the dressing material and a comparative analysis of the results of histological and hematological methods of research. This study of the therapeutic effect of dressings is regulated by the requirements of the technical regulation of the Republic of Kazakhstan "Requirements for the safety of medical equipment and medical devices" dated January 21, 2013 No. 15 [10]. The reliability of the results of preclinical studies is guaranteed by the observance by the laboratory of the rules for preclinical (nonclinical) studies in the Republic of Kazakhstan, approved by the Ministry of Health of the Republic of Kazakhstan dated November 12, No. 697 (as amended on May 15, 2015) [11] and dated November 19, No. 745 of 2009 [12], as well as conducting research in accordance with the State Standard of the Republic of Kazakhstan "Good laboratory practice. The main provisions" [13].

Experimental work with experimental animals was carried out in the laboratory of the Department of Biophysics and Biomedicine, Faculty of Biology and Biotechnology, KazNU. al-Farabi. During the experiment, the principles of scientific ethics and a humane attitude to animals were observed in accordance with international recommendations.

During the study, wound healing patches developed at the Zhalyn LLP Scientific production and Technical Center were used as healing agents (Figure 1).

The composition of the healing patch includes sorbent obtained from carbonized rice husks, sodium tetraborate and permeable material viscose-spunlace.

The healing plasters consists of a layer of permeable material impregnated with sorbent and sodium tetraborate. As the permeable material used viscose in a single layer, as a sorbent - carbonized rice husk in the amount of 1-2 g sodium Tetraborate used as an antiseptic with antibacterial and antifungal activity.

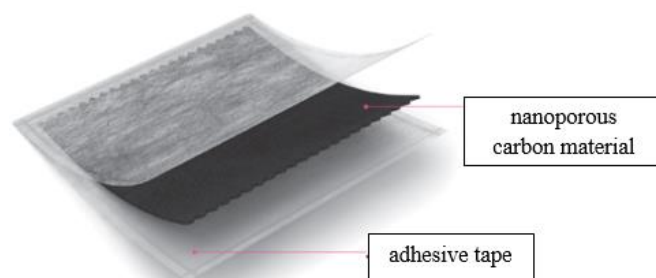


Figure 1 - Wound healing patch

Thermal burn modeling is possible only on a living organism, for which laboratory animals were used [14, 15].

Relatively small animals, such as mice, rats, have a number of advantages. The short life cycle and low maintenance costs of small animals make them quite convenient biological model for the experiment. Due to the mass availability of animals of the same generation, it is possible to select large groups with the same age and metric data. This allows you to apply burns with greater accuracy relative to the surface area of the body. The object of the study during the experimental work on the study of the therapeutic effect and the selection of materials for testing wound healing patch were small animals with an average body weight of 150-200 g. the Animals were kept in vivarium and were of the same sex and age.

Methods of the experiment.

Prior to modeling of burn injury in the left thigh of experimental animals, skin areas were shaved with a blade. Under ether anesthesia, burns were applied to the surface of the skin of animals with an area of 6-6.5 cm². For the spraying burns flames used cotton wool, gauze napkins, moistened with some alcohol. This method creates the situation where a person receives burns during the burning clothes. Burning cotton wool or gauze wipes moistened with alcohol on the animal's skin, a burn of the III a degree was simulated. The amount of alcohol was calculated taking into account the area of the burn. Taking into account that flame lesions are frequent and most severe, it was advisable to use this thermal agent. After applying burns as analgesic drugs used for pain and naklofen in ampoules. Patches in the experimental groups were changed every 2 days. Wound healing was observed with the help of the following parameters: scab formation, narrowing of the wound surface, presence or absence of purulent exudate in the wounds, epithelialization of wounds.

Experimental result.

The results showed that the wound patch has a pronounced

It should be noted that the experimental work shows that the patch impregnated with a sorbent from carbonized rice husk provides effective "vertical drainage" and creates favorable conditions for a speedy transition to the regeneration phase. The use of sodium tetraborate allows the use of the patch as a prevention and treatment of purulent wounds.

Healing patch has a number of advantages over analogues:

1. Effectively removes excess wound exudate and its toxic components;
2. Provides adequate gas exchange between wound and atmosphere;
3. Prevents heat loss;
4. Prevents secondary wound infection and contamination of environmental objects;
5. It does not contain toxic compounds [7,9].

During the work the animals were divided into 2 groups. In group I, a patch-1 was used to treat a burn wound, and in group II, a patch-2 was used. These patches are almost identical, both impregnated with sorbent from carbonized rice husks and sodium tetraborate. A distinctive feature is the thickness of the permeable material used. The permeable material of the patch-1 is viscose-Spunlace with a thickness of 55 g/m², and for the patch-2 viscose-Spunlace with a thickness of 60 g / m² was used as a permeable material.

The results of the study are shown in table 1.

Table 1 - Indicators of therapeutic effect patch-1 and patch-2

Group of animals	Wound healing, burn surface area (mm)						
	01.07.19y	04.07.19y	07.07.19y	10.07.19y	13.07.19y	16.07.19y	19.07.19y
I-burn + patch-1	67	50	33	20	13	8	6
II-burn + patch-2	69	46	32	14	7	0	0

As a result of researches it is established that the best effect has an anti-burn plaster-2 (II experimental group). Complete healing and scarring of the burn wound of the experimental animal with the use of this bandage occurred 14 days after the application of the thermal burn. The formation of purulent exudate and swelling of the wound was not observed. The wound was dry, so the bandage did not stick to the wound. Wound healing occurred by secondary tension. The process of epithelialization from the wound edges was observed and the area of the wound surface was measured. A pronounced scar

has formed. Based on the result, it can be concluded that sodium tetraborate added to the patch prevented the formation of purulent exudate in the burn wound (figure 2).

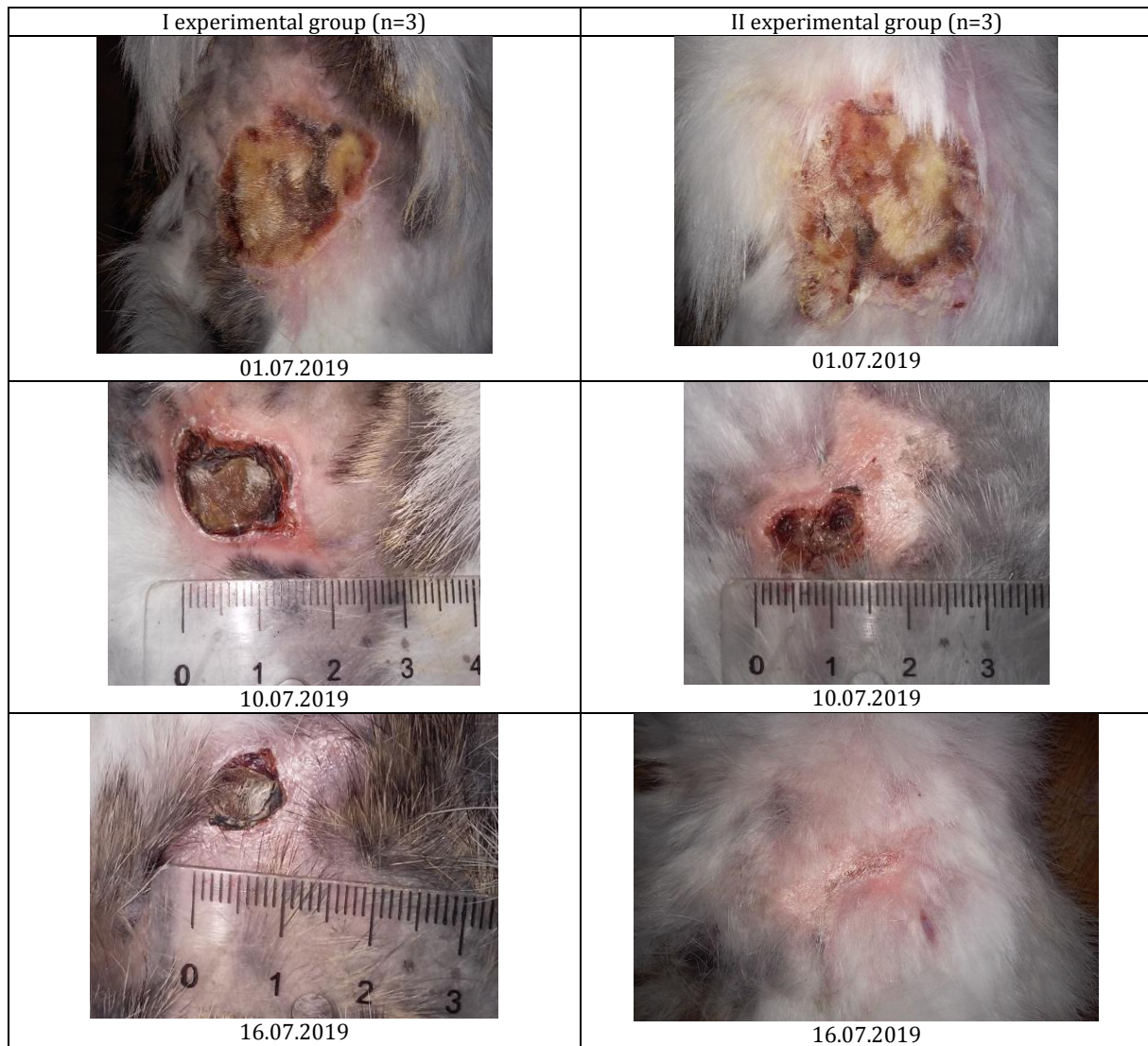


Figure 2 - Burn wound healing Process of experimental animals of groups I and II

In group I, where the patch-1 was used as a healing agent, the healing process of the burn wound was slower compared to the indicators of group II. Complete healing of the burn wound did not occur during the experimental period. Nevertheless, the wound was dry, the patch did not stick to the wound during the dressing procedures. Purulent exudate was not formed. The process of epithelialization from the wound edges was observed and the area of the wound surface was measured. Wound healing occurred by secondary tension.

Summary. Based on the above results of the study, it can be concluded that both types of anti-burn patches can be used in the treatment of burn lesions. Sorbent from carbonized rice husks and sodium tetraborate, which are part of the patches contribute to rapid healing of burns by actively sorbing the wound secreted and preventing the formation of purulent exudate with sodium tetraborate as a powerful antiseptic, bactericidal and antifungal agent. And the most suitable permeable material for burn patches is viscose-Spunlace with a thickness of 55 g / m², since the use of this type of permeable material in the course of experimental work allowed the most rapid achievement of complete epithelialization of the burn wound in experimental animals.

The processes of healing and epithelialization of burn wounds in experimental animals using anti-burn patches occurred much faster compared to other analogues, and complete wound healing with scarring occurred in 20 and 14 days, respectively. Based on the results of the experimental study, it can be concluded that the proposed patches can be used in practice for the treatment of burn diseases.

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КҮЙІК ЖАРАЛАРЫН ЕМДЕУГЕ АРНАЛҒАН ЖАРАЛАРДЫ ЕМДЕЙТІН ПЛАСТЫРЛАР

Түйін: Мақалада көмірленген күріш қауызы мен натрий тетраборатының негізінде жасалған ішкі жаралардың терапиялық әсерін зерттеуге арналған тәжірибе нәтижелері келтірілген, сонымен қатар күйіктерді емдеуде әрі қарай қолдануға болатын ең жақсы өткізілетін материал анықталған. Жануарлардың термиялық күйіктерін емдеуде пластырлардың айқын әсері бар екендігі анықталды. Тәжірибелік жануарларда күйік жараларын емдеу және жараларды емдеуге арналған пластырларды қолдану эпителизация басқа аналогтармен салыстырғанда анағұрлым тез жүрді, ал жараларда тыртықтың пайда болуымен толықтай емдеу сәйкесінше 14 күннен 20 күнге кейін өтті. Пластырлардың құрамына кіретін көміртегі сорбенті және натрий тетрабораты күшті антисептикалық, бактерицидтік және антифункционалды агенттер күйіктердің тез емделуіне ықпал егеді, бөлінген жараны белсенді түрде сорып, іріңді экссудаттың пайда болуына жол бермейді.

Түйінді сөздер: күйік, жараны емдейтін пластырлар, көміртектену, күріш қауызы, натрий тетрабораты.

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РАНА ЛЕЧЕБНЫЕ ПЛАСТЫРИ ДЛЯ ЛЕЧЕНИЯ ОЖГОВЫХ ФОНОВ

Резюме: В статье представлены результаты эксперимента по изучению терапевтического эффекта внутренних раневых пластырей, разработанных на основе карбонизированной рисовой шелухи и тетрабората натрия, а также для определения лучшего проницаемого материала для дальнейшего использования при лечении ожогов. Было установлено, что пластыри оказывают выраженный эффект при лечении термических ожогов у животных. Процессы заживления и эпителизации ожоговых ран у экспериментальных животных с использованием пластырей для заживления ран происходили значительно быстрее по сравнению с другими аналогами, а полное заживление ран с образованием рубцов происходило через 20 и 14 дней соответственно. Углеродный сорбент и тетраборат натрия, которые входят в состав пластырей в качестве мощного антисептического, бактерицидного и противогрибкового средства, способствуют быстрому заживлению ожогов, активно сорбируя выделяемую рану и предотвращая образование гнойного экссудата.

Ключевые слова: ожог, ранозаживляющие пластыри, карбонизация, рисовая шелуха, тетраборат натрия