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Yulia CHULAK

PhD, MD, Lecturer at the Department of General dentistry, International Humanitarian University, Fontanska road, 23a, Odesa, Ukraine, 65009 (univesitydentalclinicmgu@gmail.com)

ORCID: 0009-0009-6020-3241

SCOPUS: 57223286534

Leonid CHULAK

Doctor of Medical Sciences, Professor, Honorable Scientist of Ukraine, Head of the Department of General dentistry, International Humanitarian University, Fontanska road, 23a, Odesa, Ukraine, 65009 (chulak1952@icloud.com)

ORCID: 0009-0003-7011-3625

SCOPUS: 57223302579

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USE OF AMARANTH OIL AT THE HARD PALATE TRAUMATA

Actuality. The present time is defined as the time of the “injury epidemic”, which is associated with an increase in the frequency of man-made disasters, local military conflicts, the complication and intensification of technological processes. Trauma treatment, that is, correction of the wound healing process, is carried out with the use of numerous pharmacological, physiotherapeutic and other means. Less attention is paid to their influence on the state of functional systems. Recently, wound specialists have been paying more and more attention to the use of natural remedies of plant origin in the injuries’ treatment, as the latter do not cause allergic side effects and can be used for a long time. One of such natural remedies is amaranth. It contains mono- and polyunsaturated fatty acids, phospholipids, squalene, vitamin E.

The purpose of the work is to analyze efficacy of different means and variants of AO use in healing of the hard palate damages.

Materials and methods. The experiment was performed in 72 white rats of the Wistar line of autobred breeding.

Research results. The authors based on the analysis of the course of the wound process in case of hard palate trauma in 72 experimental animals (rats), evaluated the specifics of the effect of amaranth oil when it is applied locally and internally. The results of the research established that the use of amaranth oil accelerates positive changes in the tissues of the hard palate in the area of injury in both variants of its use. But the internal use of amaranth oil reduces manifestations of irritation of the periosteum and dystrophic changes in the underlying bone, and in the tissues of the mucous membrane causes a decrease in the coarsening of fibrous fibers and damage to the multilayered non-keratinizing epithelium.

Conclusion. The amaranth oil when applied to the wound process, accelerates its completion, and its internal administration, apparently, due to systemic effects, makes the termination more complete.

Key words: hard palate, morphological change, amaranth oil.

Юлія ЧУЛАК

кандидат медичних наук, викладач кафедри загальної стоматології, Міжнародний гуманітарний університет, Фонтанська дор., 23а, м. Одеса, Україна, 65009 (univesitydentalclinicmgu@gmail.com)

ORCID: 0009-0009-6020-3241

SCOPUS: 57223286534

Леонід ЧУЛАК

доктор медичних наук, професор, заслужений діяч науки і техніки України, завідувач кафедри загальної стоматології, Міжнародний гуманітарний університет, Фонтанська дор., 23а, м. Одеса, Україна, 65009 (chulak1952@icloud.com)

ORCID: 0009-0003-7011-3625

SCOPUS: 57223302579

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ЗАСТОСУВАННЯ АМАРАНТОВОЇ ОЛІЇ ПРИ ТРАВМАХ ТВЕРДОГО ПІДНЕБІННЯ

Актуальність. Теперішній час визначається як час «епідемії травматизму», яка пов’язана зі збільшенням частоти техногенних катастроф, локальних військових конфліктів, ускладненням та інтенсифікацією технологічних процесів. Лікування

травми, тобто корекція процесу загоєння рани, проводиться із застосуванням численних фармакологічних, фізіотерапевтичних та інших засобів. Менше уваги приділяється їх впливу на стан функціональних систем. Останнім часом у лікуванні травм ранологи все більше уваги приділяють використанню натуральних засобів рослинного походження, оскільки останні не викликають алергічних побічних ефектів і можуть використовуватися тривалий час. Одним з таких природних засобів є амарант. Містить моно- і поліненасичені жирні кислоти, фосфоліпіди, сквален, вітамін Е.

Мета роботи – проаналізувати ефективність різних засобів і варіантів застосування АО в лікуванні ушкоджень твердого піднебіння.

Матеріали та методи. Експеримент проведено на 72 білих щурах лінії Вістар автобредного розведення.

Результати дослідження. Автори на основі аналізу перебігу ранового процесу при травмі твердого піднебіння у 72 експериментальних тварин (щурів) оцінили особливості дії амарантової олії у разі місцевого та внутрішнього застосування. За результатами досліджень встановлено, що застосування амарантової олії прискорює позитивні зміни в тканинах твердого піднебіння у зоні ураження у разі обох варіантів її застосування. Але внутрішнє застосування амарантової олії зменшує прояви подразнення окістя і дистрофічні зміни в підлеглий кістці, а в тканинах слизової оболонки викликає зменшення огрубіння фіброзних волокон і пошкодження багаточарового незрозовілого епітелію.

Висновок. Амарантова олія під час нанесення на рановий процес прискорює його завершення, а його внутрішнє введення, мабуть, за рахунок системної дії робить його завершення більш повним.

Ключові слова: тверде піднебіння, морфологічна зміна, амарантова олія.

Actuality. The present time is defined as the time of the “injury epidemic”, which is associated with an increase in the frequency of man-made disasters, local military conflicts, the complication and intensification of technological processes (Lindholm & Searle, 2016).

A wound, i.e. tissue damage as a result of a traumatizing effect, and is eliminated by the body during the process of healing. This process is a complex, multiphase one, in its implementation not only the structures of the affected area, but also various functional systems of the body take part. Thus, the deployment and duration of the initial stages of healing are related with the influence of blood components on the subendothelial layer of vessel walls (Chulak et al., 2021), with the activity of the complement, the activity of the angiogenesis process in the affected area, and the intensity of cell proliferation processes in this area (Bordoni & Zanier, 2014).

Trauma treatment, that is, correction of the wound healing process, is carried out with the use of numerous pharmacological, physiotherapeutic and other means. At the same time, attention is focused on their influence directly in the injury zone. Less attention is paid to their influence on the state of functional systems (Hsiao, et al., 2021).

Recently, wound specialists have been paying more and more attention to the use of natural remedies of plant origin in the injuries treatment, as the latter do not cause allergic side effects and can be used for a long time (Sattar et al., 2024, Baraniak & Kania-Dobrowolska, 2022; Gupta et al., 2023).

One of such natural remedies is amaranth. It contains mono- and polyunsaturated fatty acids, phospholipids, squalene, vitamin E (Chulak & Badiuk, 2023; Chulak et al., 2021). The last two components largely determine the positive effect of amaranth oil (AO). However, in the available literature, we did not find data that would evaluate the effectiveness of AO application depending

on the means of its use – local (wound tampon) or general (internal administration).

The purpose of the work is to analyze efficacy of different means and variants of AO use in healing of the hard palate damages.

Materials and methods. The experiment was performed in 72 white rats of the Wistar line of autobred breeding.

Keeping and working with animals was carried out in accordance with the requirements of Directive 2010/63/EU and European Council of 22.09.2010 on the protection of animals used for scientific purposes (Official Journal U 276.20.10.2010-r 003-0.079) and the order of the Ministry of Education, Science, Youth and Sports of Ukraine No. 249 dated 01.03.2012 (Official Gazette of Ukraine 06.04.2012, No. 24 (C82). P. 942, Act Code 60909/2012). According to the work task, the animals were ranked into 4 groups:

Group I counted 9 rats kept under the conditions of animal facility and were not exposed to any influence; the results of their research served as a control.

Group II was composed of 21 rats in which, under ether anesthesia, the soft tissues of the hard palate were separated with a spatula. The separated area equals to 0.5 x 0.7 cm. The observation of the course of the uncorrected wound process was performed.

Group III was composed of 21 rats that in a day after inflicting an injury on the hard palate, a tampon with AO was applied to the injured area for 10 minutes. The procedure was made under ether anesthesia.

IV group consisted of 21 rats. This group of animals were injected with 0.3 ml of AO into the oral cavity every day against the background of the hard palate trauma.

The duration of the experiment was 3, 7 and 10 days.

At the end of the experiment the rats were removed from it under ether anesthesia. A part of the damaged upper jaw mucous membrane was removed. The

extracted material was fixed in a 5% formalin solution for 48 hours, then washed with tap water and placed in a 5% nitric acid solution for decalcification. The decalcification lasted 7–10 days. After decalcification the pieces of tissue were washed with tap water, passed through alcohols of increasing concentration and embedded in celloidin according to the usual method. Sections of 8–9 μm thick were made from the blocks obtained and stained with hematoxylin-eosin. The obtained preparations were examined with the help of light microscope, the changes in the main plate of the mucous membrane of the palate, the epithelium and the underlying bone were evaluated.

Results and their discussion. A study of the rats' hard palate tissues with an uncorrected process established the following. On the 3rd day after the injury in the periosteum of the underlying bone swelling of the periosteum cells, the formation of "inflows" from these cells; the appearance of fibrous fibers in the outer plate of the bone; the presence of "melting trabecula" in substantia spongiosa ossis and the accumulation of lymphocytes in the cells were observed. In the future, manifestations of bone irritation and inflammation decrease (a few lymphoid elements are observed in the cells), "influxes" of cells disappear in the periosteum, and single fibrous fibers remain in the outer plate of the bone, as in the control.

At the beginning of the experiment (3 days after the injury) a conglomerate of interstitial, dark eosinophilic substance, thickened fibrous fibers in a moderate amount, spasmodic small vessels is observed between the base plate of the mucous membrane and the bone. This conglomerate is infiltrated with lymphoid elements. Later (7–10 days) it almost disappears, but disorganized thickened fibrous fibers, small vessels (in moderate quantity), small inclusions of interstitial substance remain. On the 10th day, some bundles of fibrous fibers form folds.

On the 3rd day after the injury, folds of fibrous plates, which occur in control animals, are not detected in the lamina propria of the separated mucous membrane; bundles of fibrous fibers are arranged in a disorderly manner, the fibers themselves are thickened, few vessels have partly increased blood flow, partly are spasmodic. There is lymphoid infiltration and inclusions of eosinophilic interstitial substance, quite few and small in size.

Subsequently, these changes decrease and on the 10th day after the injury, the fibrous fibers are partly thin, partly thickened, but located mainly parallel to the length of the plate. Their edematous disturbance is not determined, the vessels are few in number, of moderate blood filling, lymphoid infiltration is not determined, small folds are formed from the fibrous plate.

At the beginning of the experiment, the multi-layered non-keratinizing epithelium is characterized by a decrease, and in some places, the smoothing of the papillae into the underlying plate. The basal layer of the epithelium is thin, single-rowed in some areas. Nuclei are small, dark. The intermediate layer is of different thickness throughout the sample, the nuclei of its cells are oval, dark. There is no surface layer in some areas. Later (7 days after the injury), the height and frequency of the papillae of the epithelium is restored. The basal layer mostly corresponds to the control data, although there are areas where it is single-rowed. The surface layer of the epithelium is also restored. The thickness of the intermediate layer remains uneven throughout the preparation, although the density of cells in it corresponds to the control data.

The study of changes in the traumatized area of rats that received external treatment of the traumatized area with AO against the background of a hard palate injury revealed the following.

On the third day after the injury (one tampon application of AO) in the periosteum of the injury zone, there is a swelling increase in its cells.

There are isolated "influxes" of these cells, short fibrous fibers are found in the outer plate of the bone, "melting trabecular" are found in substantia spongiosa ossis but there are few of them. Lymphocytes are detected in the cells of the spongy bone, but they are visually less than in the case of an uncorrected wound process.

On the 7th day after the injury, when AO tampons are used, the swelling of some cells in the periosteum remains, their "influxes" are not determined; fibrous fibers are found, but they are thinner than in the previous line of observations. In the cells of the spongy part of the bone, lymphoid elements are single, melting trabecula are not detected. At the end of the experiment, no signs of inflammation or dystrophy were detected in the bone under the trauma zone, the histologic pattern of the bone was the same as in the control.

The zone between the bone and the separated mucosa of the palate corresponds to the description of this zone in rats with an uncorrected wound process. In the future (7 days of observation), in this zone there is a complete adherence of the main plate to the bone, small foci of the interstitial substance, a fairly large number of thin fibrous fibers, small vessels. Unlike the uncorrected wound process, they were moderately blood filled. At the end of the experiment (10 days after the injury), the fibrous fibers of the lamina propria are arranged, that is, a fibrous lamina is formed with existing folds. As in control. lymphoid infiltration in the lamina propria was not observed after 7 days of the experiment.

On the 3rd day after the injury in the rats of this experimental group the number of papillae in the non-keratinizing epithelium is visually reduced and there is a thinning (in some areas to one row of cells) of the basal layer. An intermediate layer has a visually sparse arrangement of cells. The surface layer is intact. Already on the 7th day of observation, the non-keratinizing epithelium looks the same as in control rats.

Rats of the third group (internal administration of AO on the background of palate's trauma) were characterized by significant differences in structural changes compared to the other two experimental groups of animals.

On the third day of the experiment, there are practically no swollen cells in the periosteum of the underlying bone, there are small, isolated "influxes", most cells with a dark, flat nucleus. There is a very small number of lymphoid elements in the cells of the spongy part of the bone, "melting" trabecula are almost undetectable. In the outer plate of the bone fibrous fibers are single and very thin.

On the 7th day of the experiment and thereafter, the appearance of the subordinate bone coincides with the control data. The presence of separate "melting" trabecula in the spongiosa ossis on the 7th day of the experiment can be considered the peculiarity of this group.

The zone of mucosal separation in rats of this group is characterized by the presence of a homogeneous interstitial substance interspersed with thin fibrous fibers collected in bundles. Small blood vessels of moderate blood filling are quite common. Lymphoid elements are gathered around the vessels. The own mucosal plate on the 3rd day of the experiment is characterized by an increased number of fibroblasts with oval, slightly enlarged nuclei. The fibrous plate itself is smoothed, bundles of fibers are dispersed in it. There is an accumulation of lymphocytes. Later (7 days), lymphoid elements are not identified, the fibrous plate is quite uniform, and on the 10th day folds are identified in it.

Adhesion of the own plate to the bone on the 7th day occurs in rather long sections, and on the 10th day of the experiment it is complete.

As for the multi-layered epithelium, on the 3rd day of the experiment the rats of this group have isolated shallow papillae, areas of a homogeneous basal layer, thinning of the cells of the intermediate layer over rather long areas, and small areas where the surface layer is absent. On the 7–10th day the frequency of papillae in the multi-layered epithelium, the multi-rowed basal layer, and the surface layer are restored.

Thus, the results of our research proved that an uncorrected wound process in the hard palate is accompanied by manifestations of an inflammatory reaction in the underlying bone; changes in fibrous fibers and spasm of blood vessels in the own mucosal plate, accumulation of interstitial substance in the injury zone, dystrophic changes in the multilayered epithelium. These changes are determined on the 3rd day after the injury and subsequently they decrease, remaining in the form of final manifestations at the end of the experiment.

In the groups where AO was used, the inflammatory changes in the bone were less defined already on the 3rd day of the experiment and disappeared with local application on the 10th day, and with internal application, the final manifestations were smaller already on the 7th day, that is, internal application is more effective in overcoming inflammatory reactions

The course of the wound process in the main plate of the mucous membrane when using amaranth was also accelerated, compared to the uncorrected inflammatory process. With internal use of AO recovery of the lamina propria and multilayered epithelium was complete on the 10th day of the experiment.

Conclusion. That is amaranth oil when applied to the wound process, accelerates its completion, and its internal administration, apparently, due to systemic effects, makes the termination more complete.

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Chulak Yu.L. – research idea, translation, information search;

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Email address for correspondence:

chulak1952@icloud.com