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Содержание:

Koval H., Chopiak V., Kamyshnyi A. mRNA TLR2 and TLR4 EXPRESSION IN THE ENDOMETRIUM TISSUE IN WOMEN WITH ENDOMETRIOSIS ASSOCIATED WITH INFERTILITY	7
Зильфян А.А. РЕЗУЛЬТАТЫ И ЭФФЕКТИВНОСТЬ ИМПЛАНТАЦИИ КЕРАРИНГ С ПОМОЩЬЮ ФЕМТОСЕКУНДНОГО ЛАЗЕРА У ПАЦИЕНТОВ С КЕРАТОКОНУСКОМ.....	12
Ratiani L., Gamkrelidze M., Khuchua E., Khutsishvili T., Intskirveli N., Vardosanidze K. ALTERED MICROCIRCULATION IN SEPTIC SHOCK.....	16
Лучицкий В.Е. СИНДРОМ ТЕСТИКУЛЯРНОГО ДЕФИЦИТА У МУЖЧИН С САХАРНЫМ ДИАБЕТОМ 2 ТИПА И ОЖИРЕНИЕМ	25
Искакова С.С., Уразаев О.Н., Бекмухамбетов Е.Ж., Дворацки Г., Дворацка М. ИЗМЕНЕНИЯ КОЛИЧЕСТВА ТРЕС (T-CELL RECEPTOR EXCISION CIRCLES) У БОЛЬНЫХ САХАРНЫМ ДИАБЕТОМ 2 ТИПА	29
Моисеенко И.О., Приступа Л.Н., Гарбузова В.Ю., Погорелова О.С., Ополонская Н.А. РАСПРЕДЕЛЕНИЕ ГЕНОТИПОВ ПО С825Т ПОЛИМОРФИЗМУ ГЕНА Р3-СУБЪЕДИНИЦЫ G-ПРОТЕИНА У БОЛЬНЫХ АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ В ЗАВИСИМОСТИ ОТ СТЕПЕНИ ОЖИРЕНИЯ.....	36
Квирквелия Н.Б., Хизанишвили Н.А. ДИАГНОСТИЧЕСКИЕ ВАРИАЦИИ X-СЦЕПЛЕННОЙ МЫШЕЧНОЙ ДИСТРОФИИ С КОНТРАКТУРАМИ.....	40
Gegelashvili M., Meca A., Schwartz S.J. RELIGIOUS EXCLUSIVITY AND PSYCHOSOCIAL FUNCTIONING	45
Жвания М.А. ЮВЕНИЛЬНЫЙ ДЕРМАТОМИОЗИТ И КАЛЬЦИНОЗ	56
Soliman A.T., Adel A., Soliman N.A., Elalaily R., De Sanctis V. PITUITARY DEFICIENCY FOLLOWING TRAUMATIC BRAIN INJURY IN EARLY CHILDHOOD: A REVIEW OF THE LITERATURE	62
Ковалева Е.М., Похилько В.И., Чернявская Ю.И., Цвиренко С.М., Белорус А.И. ПРЕДИКТИВНАЯ МОДЕЛЬ РАЗВИТИЯ РАННИХ БАКТЕРИАЛЬНЫХ ИНФЕКЦИЙ У ПРЕЖДЕВРЕМЕННО РОЖДЕННЫХ ДЕТЕЙ.....	71
Арвеладзе Г.А., Геладзе Н.М., Хачапуридзе Н.С., Бахтадзе С.З., Капанадзе Н.Б. МИТОХОНДРИАЛЬНАЯ ДИСФУНКЦИЯ: СОВРЕМЕННЫЕ АСПЕКТЫ ТЕРАПИИ (ОБЗОР)	78
Karalashvili L., Kakabadze A., Vyshnevskaya G., Kakabadze Z. ACELLULAR HUMAN AMNIOTIC MEMBRANE AS A THREE-DIMENSIONAL SCAFFOLD FOR THE TREATMENT OF MUCOGINGIVAL DEFECTS.....	84
Avetikov D., Loza K., Starchenko I., Loza E., Marushchak M. EXPERIMENTAL-MORPHOLOGICAL SUBSTANTIATION OF EXPEDIENCY TO USE THE SKIN GLUE «DERMABOND» FOR POSTOPERATIVE WOUND CLOSURE	90

EXPERIMENTAL-MORPHOLOGICAL SUBSTANTIATION OF EXPEDIENCY TO USE THE SKIN GLUE «DERMABOND» FOR POSTOPERATIVE WOUND CLOSURE

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According to the latest statistics, published in modern scientific journals, pathological scarring occur in 10% of the total population of the world [1]. Therefore, an optimal aesthetic scar was and remains a major problem in plastic and maxillofacial surgery [2].

The nature and type of postoperative scar depends on various factors. Belousov A.E. studied the effect of general and local factors on the quality of scars. He divided all local factors into two groups. The first group factors depend on the surgeon and the second one are independent of the surgeon. General factors are attributed to heredity, age and immune status of the victim [4].

1. Factors beyond the control of the surgeon (traumatic wounds): the nature of the damage, its scope, location, nature of blood flow in the walls of the wound, the presence of pollution, etc.
2. Factors, which are determined by the surgeon (surgical wound): method of surgical wound closure, its location relative to the field lines of the skin, methods and quality of drainage.

There are many publications and dissertations devoted to the impact of different methods of the wound edges approximation and suturing on their healing, but there is still a significant number of unsatisfactory results [7,8].

Quite important local factor is the trauma of suturing. Needles, like a scalpel, cut through not only the epidermis and dermis, but also a variety of skin appendages. The processes of restoring the integrity of damaged tissues begin to develop there. However, the tissue repairing associated with connective components is imperfect. As a result, a normal reaction of tissue on the local action of a foreign body (ligatures) is often taken for infection at the site of the seam. These reactions are usually called "stitch" (ligature) abscesses. Moreover, in such cases, shifted epithelium of the injured skin appendages can form small keratinized cysts. Clinically, they appear as small, dense, white or yellow-white papules, often taken for miliary or epidermoid cysts. These formations are usually reversing between 10 and 25 days, followed by replacement of scar tissue. "Stitch" abscesses tend to disappear, but miliary cysts may remain.

Until the middle of XX century, surgical thread problem has not caused much interest. Only from 50's XX century

revealed that the quality, chemical composition and structure of the material filaments influence on tissue reaction on its implantation, and ultimately, often on the result of the operation. It is proved that the nature and type of scar depends on processes occurring in the wound in the early postoperative period, which, in turn, greatly influences the type of used suture material [4].

We aimed to investigate the morphological features of healing of postoperative wounds in the early stages of reparative process in the experiment, depending on the used type of the wound closure.

Material and methods. The experiment included 20 male rats, weighing 180-200 g. All rats were anesthetized by a single intraperitoneal injection of sodium thiopental. After the shaving operative field, 2 cm full-thickness incision wound was made on the anterior surface of the abdomen in the longitudinal direction. As suture material for wound closure in the 1st experimental group (10 rats) we used surgical filament "Polyamide 4-0". In the 2nd experimental group (10 rats) wounds were closed by using skin glue "Dermabond".

All of the animals were taken out of the experiment on day 3 after surgery by administering a lethal dose of sodium thiopental. Directed biopsy of skin wound for histological examination was performed. Biopsy specimens were fixed in 12% neutral formalin, dehydrated and embedded in paraffin by standard methods [6]. From the paraffin blocks were made 5-7 mm thick sections that were stained with hematoxylin-eosin and examined under the microscope.

We determined the density and the ratio of cellular elements of different classes in the wound area, using the method of standard space ($S = 10000 \mu m^2$). The processing of the results was performed by standard statistical methods [3, 5].

Results and their discussion. The examination of skin wounds in animals of group 1: in all cases there was swelling and mild redness of the skin around the scar. The scar lines with node stitches were uneven nature through penalty wound edges nodal seams. The postoperative wounds were covered with crusts in 10 cases. Also, we observed postoperative wounds fester in all cases.

During the examinations under the microscope we observed forming scar, wedge-shaped, which consisted of granula-

tion tissue and extended throughout the thickness of the skin, subcutaneous tissue and partly to muscles. There was a high density of cellular elements - 46.9 ± 0.53 in $10000 \text{ } \mu\text{m}^2$. Mostly, there were cells of macrophage-monocytic series, plasma cells and lymphocytes. Sometimes, the cells with grainy basophilic cytoplasm were found in perivascular spaces. The presence of above cells is common for the early stages of reparative process. The quantity of such cells was up to $71.9 \pm 0.74\%$ of all cellular elements of the forming scar. All other cells $28.1 \pm 0.74\%$ were elements of fibroblastic series, mainly young fibroblasts - cells with elongated oval or rounded nucleus and basophilic cytoplasm (Fig. 1).

It should be noted, that most of the fibroblasts were in the depth of postoperative scar, whereas when macrophages and lymphocytes localized mainly in its surface sections.

Fig. 1. The basal layer of scar formed on day 3 after the imposition of nodal joints sutures (1st experimental group of animals), H&E, x280

1 - lymphocytes; 2 - adult fibroblasts; 3 - young fibroblasts

We could detect squamous epithelium above the granulation tissue in five cases. This finding indicated the beginning of the process of the wound defect epithelization. A complete epithelization has been find in two observations, when epithelium completely covered the wound defect. Partial (incomplete) epithelization was discovered in three cases. In those cases, epithelium was detected only in the peripheral parts of the wound defect; while in the central parts of the wound surface eosinophilic structureless mass has been found. Such a pattern indicates incomplete wound cleaning process (Fig. 2).

Constantly, we detected circulatory disorders, localized in the dermis on the periphery of the forming scar. Such disorders included a plethora of arterial and venous microvessels, small perivascular hemorrhages, some small clots in the capillaries. Sometimes, we met piecemeal congestion of lymphocytes and macrophages diasionally,

mainly near the small blood vessels in the reticular layer of the dermis. We found the remains of suture material, which looked like almost homogeneous, eosinophilic fragments of various sizes, surrounded by inflammatory infiltration, with a predominance of neutrophils in the last and macrophages.

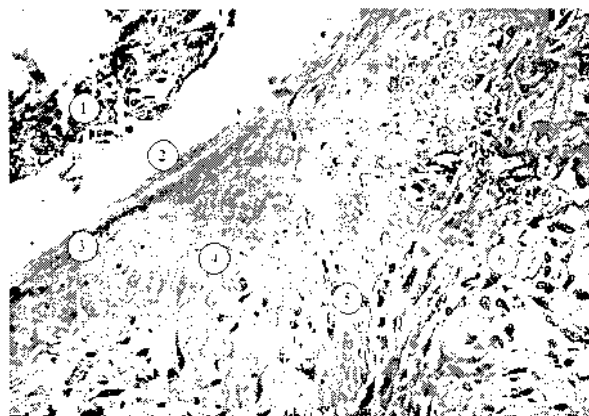


Fig. 2. The structure of the scar formed on day 3 after the imposition of nodal sutures (1 experimental group of animals), H&E, x280

1 - tissue detritus; 2 - the stratum corneum; 3 - granular layer; 4 - basal layer; 5 - acanthotic cord; 6 - granulation tissue

The examination of skin wounds in animals of group 2: in all cases there was equal linear scar, no effects of edema and hyperemia in the surrounding tissues, while, as in the previous group, such signs were detected.

Microscopic study show results similar to the previous group. We determined granulation tissue that covered the entire thickness of the skin and hypodermis. However, the density of cellular elements was significantly lower than in the previous experimental group and averaged 35.0 ± 0.60 $10000 \text{ } \mu\text{m}^2$. The number of lymphocytes and macrophages $61.1 \pm 0.82\%$ was predominant among the total number of granulation tissue cells. However, the relative number of fibroblasts was significantly higher than in the previous group and was $38.9 \pm 0.82\%$.

In compare with the previous group we observed higher number of newly formed blood microvessels in the forming scar. It may be the evidence of faster tissue regeneration under the skin glue (Fig. 3).

The results of epithelization were also not like in the previous group. The epithelium covered the wound defect almost completely in eight cases. Incomplete epithelization was observed in two cases.

It should be noted that there was the lack of tissue detritus in the area of postoperative scar. That indicated about a complete cleaning of the wound.

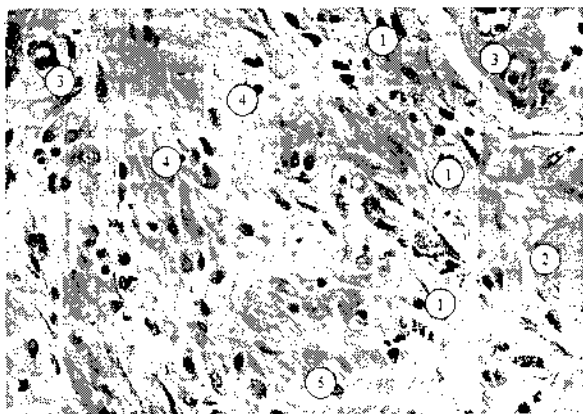


Fig. 3. The basal seal ion of the scar formed on day 3 after surgery using skin glue (II experimental group), H&E, x280

1 - fibrocytes; 2 - adjacent muscles; 3 - blood microvessels; 4 - lymphocytes; 5 - macrophage

Conclusions:

According from our experiment, the usage of skin glue creates better conditions for wound healing:

1. Accelerates wound cleansing of tissue detritus.
2. Helps to accelerate the maturation of granulation tissue in the connective tissue.
3. Improves vascularization of the forming scar.
4. Creates a better condition of surrounding tissues for wound epithelization.

Thus, to achieve a more aesthetic scar, we recommend applying skin glue instead of using nodal joints.

Also, we are planning to work out the method of intraskin suturing for better wound closing with the skin glue.

The work is a part of research of the department of surgical dentistry and maxillofacial surgery, plastic and reconstructive surgery of the head and neck "Optimization of conservative and surgical treatment of patients having defects and deformation of maxillofacial area", № state registration № 0110U004629.

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SUMMARY

EXPERIMENTAL-MORPHOLOGICAL SUBSTANTIATION OF EXPEDIENCY TO USE THE SKIN GLUE «DERMABOND» FOR POSTOPERATIVE WOUND CLOSURE

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We aimed to investigate the morphological features of healing of postoperative wounds in the early stages of reparative process in the experiment, depending on the used type of the wound closure.

It is proved that the nature and type of the scar depends on the processes that occur in the wound at the early postoperative stage, which in turn greatly affects the form of suture material used.

The experiment included 20 male rats, weighing 180-200 g. All rats were anesthetized by a single intraperitoneal injection of sodium thiopental. After the shaving operative field, 2 cm full-thickness incision wound was made on the anterior surface of the abdomen in the longitudinal direction. As suture material for wound closure in the 1st experimental group (10 rats) we used surgical filament "Polyamide 4-0". In the 2nd experimental group (10 rats) wounds were closed by using skin glue "Dermabond".

According from our experiment, the usage of skin glue creates better conditions for wound healing. Thus, to achieve a more aesthetic scar, we recommend applying skin glue instead of using nodal joints.

Keywords: post-operative scarring, wound healing, morphology of wounds, skin glue, microscopic study.

РЕЗЮМЕ

ЭКСПЕРИМЕНТАЛЬНО-МОРФОЛОГИЧЕСКОЕ ОБОСНОВАНИЕ ЦЕЛЕСООБРАЗНОСТИ ПРИ- МЕНЕНИЯ КОЖНОГО КЛЕЯ «ДЕРМАБОНД» ПРИ ЗАКРЫТИИ ПОСЛЕОПЕРАЦИОННЫХ РАНЕВЫХ ДЕФЕКТОВ КОЖИ

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Украина*

Целью исследования явилось изучение морфологических свойств заживления постоперационных ран на ранних ступенях репаративного процесса в эксперименте, в зависимости от типа ушивания раны.

Доказано, что характер и вид рубца зависят от процессов, которые происходят в ране на раннем послеоперационном этапе, на которые, в свою очередь, в значительной степени влияет вид использованного шовного материала.

Эксперимент проведен на 20 крысах-самцах массой 180-200 г. Всем животным при обезболивании тиопенталом натрия проводили полнослойные прямолинейные разрезы длиной в 2 см на передней поверхности живота в продольном направлении. В качестве шовного материала для закрытия послеоперационной раны животным I экспериментальной группы (10 крыс) применяли хирургические нити «Полиамид №4». Животным II экспериментальной группы (10 крыс) был нанесен кожный клей «Дермабонд».

Данные морфологического исследования показали, что применение кожного клея в эксперименте создает лучшие условия для заживления послеоперационной раны. Таким образом, для достижения более эстетичного нормотрофического рубца авторы рекомендуют нанесение кожного клея вместо применения узловых швов.