

## TREATMENT OF FULL-LAYER SKIN DEFECTS USING DECELLULARIZED PIG SKIN DERMAL MATRIX

O.O. Kulianda<sup>1</sup>, O.I. Kulianda<sup>2</sup>, O.V. Denefil<sup>1</sup>

<sup>1</sup> I. Horbachevsky Ternopil National Medical University, Ternopil, Ukraine

<sup>2</sup> Cne «Kyiv City Clinical Hospital № 17», Kyiv, Ukraine

### Abstract

The choice of treatment methods for complex skin defects poses certain technical and medical difficulties related to the choice of material for filling the wound defect and its antigenic compatibility. A promising direction in the treatment of skin defects is the use of decellularized (cellulless) pig skin, the composition and structure of which is as close as possible to the patient's dermis.

**The aim** of the study was to analyze the clinical case of a patient with a basal cell carcinoma in the right wing of the nose, who was treated with full-layer skin defects using a decellularized dermal matrix from pig skin.

**Material and methods of investigation.** Patient P., 94 years old, with a basal cell carcinoma in the area of the right wing of the nose, underwent treatment. As a material applied directly to the wound, a flap of acellular dermal matrix (ADM) of pig skin with preservation of the native structure was used.

**Results.** 6 weeks before the visit to the dermatologist, the patient developed a pea-sized papule on the skin in the area of the wing of the nose, which increased in size and became painful on palpation. When examining the skin in the area of the right wing of the nose, a tumor-like formation was observed, 1x1 cm in size, flesh-colored, with peeling on the surface and vascularization, firm consistency, painful. Regional lymph nodes are not enlarged. The formation is clearly separated from healthy skin. The oncologist made a diagnosis: basal cell carcinoma. The tumor was removed, resulting in a full-layer skin defect measuring 1x1.5 cm with connection to the nasal cavity. Acellular dermal matrix was used to close the defect on the 3rd day after surgery. The flap was placed so that it did not cover the skin around the wound. With the help of "Levomykol" ointment, a moist chamber was created over the dermal flap. The dressing was changed every 2-3 days. On the 14th day, the flap peeled off, a granulating wound with signs of marked marginal epithelization formed in its place. The bottom of the wound was located almost at the same level as the intact skin. On the 21st and 26th day, active marginal epithelization of the wound and wound healing under the scab were noted. The bandage was not used during this period. On the 32nd day, the wound closed.

**Conclusions.** Decellularized dermal matrix of pig skin when closing a full-layer postoperative skin defect creates optimal conditions for reparative wound regeneration. The effectiveness of its use is due to the presence of a collagen matrix in it, from which the nuclear elements of cells have been removed, which does not lead to immune aggression. The clinical case proves the expediency of using the decellularized dermal matrix of pig skin in the treatment of full-layer skin defects of various genesis.

**Key words:** skin defects; decellularized dermal matrix.

**Introduction.** The choice of treatment methods for skin defects complex in their configuration and anatomical-physiological location poses certain technical and medical difficulties related to the choice of material for filling the wound defect and its antigenic compatibility. As previous experimental and clinical studies have shown, the use of decellularized (cellless) pig skin is a promising direction in the treatment of skin defects of various etiologies. The main advantages of such biological material are the composition and structure of pig dermis, which are as close as possible to the patient's dermis [1, 2]. In order to use such skin as a substitute, it is necessary to carefully remove all immunogenic factors that can lead to rejection of the xenogenic material [3, 4]. At the same time, it is necessary to preserve the native structure and composition of the dermis. The methods used to achieve these goals have, as a rule, opposite effects: extremely aggressive removal of immunogenic components can destroy the structure and composition of the tissue, while more gentle methods can preserve the immunogenicity of the tissue. Currently, physical and chemical methods of decellularization are proposed, which allow preserving the structure and properties of xenogenic transplants [5, 6]. The conducted studies showed that the acellular skin matrix supports the penetration of fibroblasts, does not delay neovascularization and epithelization in the absence of an immune response [7]. It has also been shown that the cosmetic and functional results after the use of xenogeneic dermal grafts for the treatment of skin defects are significantly superior to the results after autodermoplasty with a perforated flap, and they also contribute to faster healing of donor wounds due to the fact that thinner autodermal grafts are required [8, 9].

**The aim** of the study was to analyze the clinical case of a patient with a basal cell carcinoma in the area of the right wing of the nose, who was treated with full-layer skin defects using a decellularized dermal matrix from pig skin.

**Material and methods of investigation.** Patient P., 94 years old, with a basal cell carcinoma in the area of the right wing of the nose, underwent treatment. A flap of acellular dermal matrix (ADM) of pig skin with preservation of the native structure was used as a covering material that was applied directly to the wound. The process of making ADM consisted in a combination of physical and chemical effects on the dermis. Dermis with a thickness of 1.0-1.3 mm was collected from pigs under the age of 1 year from the back and

partially from the side parts of the trunk. Achieving the maximum acellularity of the dermal matrix was carried out step by step and included four stages of skin treatment: freezing-thawing process, dehydration with glycerin, osmotic stress, washing out the remaining cells with detergent. After that, the skin was subjected to freeze-drying [10]. The prepared skin preparations were stored in a packages in sterile conditions.

**Results and discussion.** From the anamnesis of the patient P., it is known that after a prolonged (within a week) illness, against the background of acute respiratory viral infection, a papule the size of a pea, which was the color of skin, formed on the skin in the area of the wing of the nose. The patient associates the appearance of the nodule with long-term traumatization of the skin due to a runny nose. The papule increased in size and became painful during palpation. After 6 weeks, from the moment the papule appeared, the patient consulted a dermatologist. When examining the skin in the area of the right wing of the nose, a tumor-like formation, 1x1 cm in size, flesh-colored, with peeling on the surface, and pronounced visual vascularization was observed. On palpation, the node was firm and painful (Fig. 1). Regional lymph nodes are not enlarged. The formation is clearly separated from healthy skin. The patient was referred to an oncologist. The diagnosis was established: basal cell carcinoma in the area of the right wing of the nose. Surgical treatment is recommended. A week later, the tumor was removed. After the removal of the basal cell carcinoma of the nasal wing, a full-layer skin defect measuring 1x1.5 cm was formed with a connection to the nasal cavity (Fig. 2). In order to close the defect on the 3rd day after surgery, acellular dermal matrix was used, which was placed in the postoperative skin defect. The flap was placed in such a way that it did not cover the skin around the wound. With the help of "Levomekol" ointment, a moist chamber was created above the dermal flap (Fig. 3).



Рис. 1. Basal tumor in the area of the right wing of the nose.

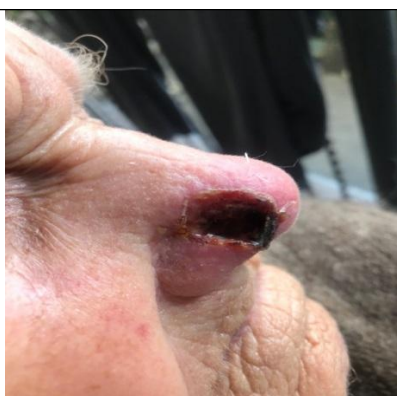


Рис. 2. Appearance of the wound on the 3rd day after tumor removal.



Рис. 3. The wound is closed with a dermal flap, 6 days.



Рис. 4. Dermal flap on the wound. 10 days

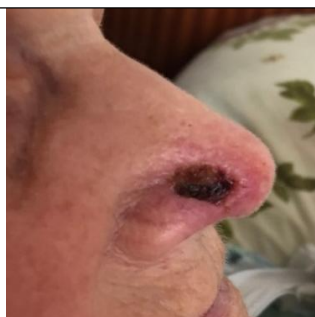


Рис. 5. Appearance of the wound after removal of the dermal flap. 14 days.



Рис. 6. Wound after 21 days.



Рис. 7. Condition of the wound on the 26th day.



Рис. 8. The result of treatment on the 32nd day.

During the treatment, the bandage was changed every 2-3 days. The flap itself gradually became thinner and changed its color (Fig. 4). On the 14th day, the flap peeled off on its own, and a granulating wound with signs of marked marginal epithelization formed in

its place (Fig. 5). The bottom of the wound was located almost at the same level as the intact skin.

On the 21st (Fig. 6) and 26th day (Fig. 7) of observation, we noted active marginal epithelization of the wound and wound healing under the scab. During this period, the wound was treated without the use of bandages. Later, the wound closed due to marginal epithelization (Fig. 8).

Recently, in addition to research on the creation of synthetic frameworks, a lot of attention has been paid to the development of the technology of decellularization of tissues and whole organs. It is believed that tissue cleaned of cells loses its immunogenicity and can be used for allo- and even xenogeneic transplantation. At the same time, acellular tissues have an extracellular matrix structure similar to the native one, and primarily collagen fibers, amorphous intercellular substance and even signaling molecules are preserved to a lesser extent. Against the background of the latest achievements in the field of biomaterial science and cell technologies, the direction of using structured dermal matrix of various origins is actively developing. However, in this field there are many unsolved problems related to the choice of scaffold material, obtaining different cell lines, recellularization of matrices, vascularization of the obtained structures, and many others.

Tissue-engineered organs that have previously undergone decellularization must be free of donor cells, including cellular components such as cytoplasm and nuclei. Their presence in the extracellular matrix can contribute to the violation of cellular biocompatibility in vitro and cause adverse reactions in vivo during subsequent recellularization.

Decellularization contributes to the fact that the intracellular matrix (ICM) of some species does not cause immune rejection in others. With proper removal of cellular antigens that cause immune rejection without damaging the ICM, the resulting scaffold can be a powerful source of signals and promote constructive tissue remodeling after damage. "Constructive remodeling" means that the ICM framework contributes to the formation of an area of appropriate tissue at the site of implantation instead of scar tissue formation [11,12,13].

Given the great demand for reconstructive frame mechanisms in medicine, approaches and methods for creating tissue-engineered bio-implants are being actively developed.

Biological implants consisting of a decellularized collagen matrix are obtained from human (allograft) or animal (pig, bovine xenograft) donor material. The ability of these materials to stimulate the processes of neovascularization and regeneration, as well as to be integrated into the chain of physiological metabolism, determines the balance of reparative

processes without pronounced phenomena of inflammatory reactions, while excluding the development of immunological rejection, which theoretically has an advantage over synthetic prostheses.

**Conclusions.** Decellularized dermal matrix of pig skin when closing a full-layer postoperative skin defect creates optimal conditions for reparative wound regeneration. The effectiveness of its use is due to the presence of a collagen matrix in it, from which the nuclear elements of cells have been removed, which does not lead to immune aggression. The clinical case proves the expediency of using the decellularized dermal matrix of pig skin in the treatment of full-layer skin defects of various genesis.

#### Limitations

First of all, this is a retrospective study and the patient is single. That is why we deem it reasonable to conduct further research on this subject with an involvement of larger patient samples. Second, the patient is old, and it is impossible to investigate the influence of these conditions on the long-term prognosis. Third, we did not have a chance to observe the 3-year event-free survival in female patients with diagnosed basalioma due to a small number of cases.

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