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Research Article

MORPHOLOGICAL RESULTS WITH THE APPLICATION OF A XENOGRAFT IN EXPERIMENTAL TYMPANOPLASTY

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ABSTRACT

To date, there is no consensus on the question of which tissues are more appropriate to use for tympanic membrane plastic surgery. We decided to study the use of xenograft from sheep pericardium in tympanoplasty in rabbits in an experiment with chronic dry mesotympanitis. Experimental morphological studies using a xenograft were carried out in 28 rabbits. In the experiment, a positive result was obtained in 25 (89.3%), negative in 3 (10.7%) rabbits.

KEYWORDS

Xenograft, tympanoplasty, temporal muscle fascia, flap.

INTRODUCTION

Despite the significant progress made in reconstructive and restorative surgery of the middle ear over the past two to three decades, the problem of surgical restoration of the integrity of the tympanic membrane

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is still relevant. No less important is the problem of choosing an effective plastic material for the formation of the neotympanic membrane.

Most otosurgeons prefer the autofascia of the temporal muscle, which is similar in nature to the tympanic membrane and convenient to use [9]. However, it, like all soft tissue grafts, often atrophies, which results in a recurrence of perforation or turns into a flabby scar, which significantly reduces the functional effect of the operation [11]. For this reason, in recent years, more rigid, usually multi-layered grafts have been used, which provide better morphological results.

However, due to the use of several heterogeneous tissues, the formed neotympanic membrane differs from the natural one in its physical and acoustic properties, which inevitably affects the functional result of myringoplasty.

Thus, the current state of the problem of reconstructive and restorative surgery of the middle ear, in particular the plastics of tympanic membrane defects, dictates the urgent need for further search for both more adequate transplants and improvement of methods of surgical interventions.

Achievements in reconstructive surgery and tissue conservation have found their expression in the use of flaps - homotransplants, mainly from connective tissue [1] (pericardium, aortic valve, dura mater, sclera, cornea, etc.). The most popular is the preserved dura mater, which has low antigenicity, good revascularization, resistance to infections, and quickly interacts with the receptive bed [4,8].

So V.I. Rodin et al.[5] using the preserved dura mater, they achieved closure of the tympanic membrane defect in 93% of patients, but according to M. Tos [7], the dura mater is quite rigid, dense and thick material, and this is one of its main drawbacks. Allografts were also used for myringoplasty: the dura mater of an adult and fetus [6], the tympanic membrane of an adult and fetus. Allografts can be transmitters of such dangerous infections as AIDS, hepatitis, syphilis, as well as genetic diseases.

Many years of clinical experience with the use of these grafts in surgical interventions on the middle ear revealed a number of disadvantages: rejection of the plastic material, recurrence of perforation in the neotympanic membrane, the need for additional operations to collect the graft, which negatively affects the anatomical and functional results of surgical treatment of patients . Therefore, in modern otosurgery, the development of new highly effective grafts for tympanic membrane defect repair is an urgent and important problem.

Recently, many foreign authors have used xenografts for myringoplasty [10,11]. In our republic, R.O. Mukhamadiev created a xenograft [2] from the pericardium of sheep (author's certificate No. 002-03/145 dated March 28, 2003), which was used by the author extrasclerally for various pathologies of the organ of vision. The xenograft attracts attention due to the availability and almost unlimited supply of plastic material.

The purpose of our study is to experimentally substantiate the effectiveness of the use of a xenograft from the sheep pericardium in tympanoplasty.

MATERIAL AND METHODS

Experimental and morphological studies were carried out on 28 rabbits using a xenograft from sheep pericardium with dry mesotympanitis on the right ear

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(main group). The control group consisted of the same rabbits (left ear), in which dry mesotympanitis was modeled. Morphological features of xenograft engraftment in experimental animals we made on the 3rd, 7th, 14th, 21st days, 1 month and 3 months after the operation. In the period from 3 days to 3 months after the operation, the animals were euthanized by air embolism and subjected to post-mortem examination. The extracted xenograft was studied macro- and microscopically. The pieces were fixed in 10% neutral formalin solution. After washing in running water, dehydration was carried out in alcohol and chloroform, and then they were filled with paraffin and wax. Histological sections were stained with hematoxylin-eosin. Collagen fibers were detected by the Vann-Gieson method.

RESULTS AND DISCUSSION

On the 3rd day after tympanoplasty in the zone and circumference of the xenograft, dyscirculatory changes were noted in the form of plethora of vessels of the microcirculatory bed, diapedetic hemorrhage in the perivascular zone, expansion of postcapillary venules, and marginal location of white blood cells. Directly in the circumference of the transplanted pericardium, these changes were accompanied by hemorrhages, loosening and fibrinoid necrosis of the outer membrane of the pericardium. The fibrous structures of the middle membranes of the pericardium were subjected to edema, loosening and moderate swelling. The above morphological and functional changes in the soft tissues of the middle ear indicate the development of acute discirculatory, edematous-destructive changes in the surgical injury and xenograft.

On the 7th day after tympanoplasty in the zone and circumference of the xenograft, dyscirculatory changes turn into response inflammatory processes in the form of hyperemia of the vessels of the microcirculatory bed, thinning of their walls and migration of both polynuclear and mononuclear leukocytes into the perivascular zones. An inflammatory infiltrate is formed on the border of the pericardium and the surrounding tissue. On the part of the xenograft, loosening and destruction of its outer shell in the form of fibrinoid necrosis, in which activated lymphoid and macrophage cells appear, was noted. In the middle membrane of the pericardium, against the background of loosening and homogenization of fibrous structures, the appearance of active cells, both of the proper pericardial and reactive origin, was noted.

On the 14th day after tympanoplasty, fusion of the tissue structures of the pericardium with the surrounding soft tissue and the bone base is noted along the edges of the xenograft. At the same time, the tissue structures of the pericardium are completely destroyed and mixed with the surrounding structural elements of both soft and bone tissue. From the side of the skin of the external auditory canal, there was also a complete fusion of the pericardium with the structural elements of the skin. Only in the areas of the surgical incision, the appearance of a small proliferative infiltration, consisting of granulation tissue and inflammatory cells, is observed.

21 days after tympanoplasty. There was a decrease in the volume of destructive changes in the composition of the xenograft. Maturation and differentiation of young histiocytic cells of inflamed pericardial foci into mature histiocytes and fibrocytes were observed with the development of fibrous structures, which, merging with the fibrous elements of the pericardium, form dense and thick fibrillar structures. On the part of the bone tissue, the appearance of a thin layer similar to the periosteum, consisting of cellular-fibrous

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connective tissue, was determined. On the part of the skin of the external auditory canal, the formation of a mature connective tissue from the inflammatory-granulation tissue and its fusion with the fibrous tissue of the hypodermis and dermis was also noted.

One month after the experiment, the development of regressive phenomena in the composition of tympanoplasty and surrounding tissues was noted in the form of the disappearance of inflammatory cells, maturation and differentiation of cambial histiocytic cells into mature histiocytes and fibrocytes. Moreover, such a regressive differentiation of connective tissue cells was accompanied by a decrease in their number. The number of thin-walled vessels also decreased with stabilization of hemodynamic and edematous phenomena. Fibrous structures in the composition of the newly formed connective tissue and pericardium also decreased in volume, turned into separate bundles, which were tightly and closely connected on one side with bone tissue, and on the other with the dermis of the skin.

3 months after tympanoplasty of the pericardium in the surgical field, we saw the complete disappearance of all types of general pathological, inflammatory and regenerative changes. There was a complete fusion of the pericardial tissue with the surrounding tissues and microscopically, both in composition and in maturity, did not differ from the local connective tissue. Only the preservation of small areas with moderately differentiated fibrocytic cells and signs of angiomatosis was observed.

Macroscopic changes in the xenograft were assessed using an otoscope and a microscope. According to the results of experimental studies, it was noted: complete rejection of the graft 1 (3.57%) 3-day, prolapse of the graft in the tympanic cavity 1 (3.57%) 14-day, incomplete healing of the graft 1 (3.57%) 21-day. In the rest of the experimental animals, a positive macroscopic result was obtained, that is, the healing rate of the xenograft from the sheep pericardium during myringoplasty was 89.3%.

Conclusion. A positive macroscopic result of the healing of a xenograft from the pericardium of a sheep during tympanoplasty was obtained in 89.3% of rabbits. When analyzing the above microscopic data, it can be noted that in the early stages in the zone and circumference of the xenograft, reactive pathomorphological changes of a protective and restorative nature develop in the form of discirculation, edema, and loosening of tissue structures. These changes in the nearest terms of the experiment turn into an inflammatory-recovery process in the form of the formation of inflammatory granulation tissue at the border of the xenograft with subsequent fusion with the tissue elements of the pericardium, and from the side of the external auditory canal it is covered with skin.

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