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Alloplasty for Open Tracheal Defects

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Abstract:
This article studies the use of alloplasty in open tracheal defects. Today, early innovative diagnosis and prevention of tracheal defects is one of the most urgent problems in medicine.

Keywords: trachea, defects, methods of plasty.

Introduction

Plastic reconstructive surgery has always experienced an acute shortage of materials suitable for replenishing tissue defects of a living organism. This primarily refers to the need to replace defects of hollow organs formed as a result of traumatic injuries and diseases. Attempts to use artificial materials foreign to the organism for plastic surgery purposes were unsatisfactory and gave only temporary effect. Glass, noble metals, stainless steel, rubber, and plastic were used in the first alloplastic operations on the respiratory tract [1]. The monolithic structure of such materials prevented tissues from sprouting into their thickness, as a result of which they shifted and traumatized the surrounding tissues, caused excessive growth of granulations, supported infection, formed bedsores, and caused bleeding [2]. The chemical instability of some of them led to the gradual decomposition of their structure with the release of chemical elements into the surrounding tissues and to the development of a prolonged inflammatory process, as a result of which the foreign body was sooner or later rejected. Based on experimental and clinical experience, the properties that ideal artificial materials for airway plasty should possess were formed: the presence of cells that promote rapid

sprouting of the material by regenerating tissues; implantability into the recipient's tissues under the conditions of infected environment; chemical inertness, invariability under the influence of tissue fluids, absence of inflammatory and allergic reaction to implantation, non-carcinogenicity; elasticity and strength that ensure maintenance of the lumen of the airway. Tantalum [3], marlex [1], proplast [4], plastipor [5], hydroxyapatite [6], titanium nickelide, and dacron have been proposed at different times among artificial materials for creating the framework of the larynx and trachea. Marlex mesh [1] has been most widely used for laryngotracheoplasty as a strengthening material. Nevertheless, in recent years, interest in Marlex has decreased due to the frequent development of complications. When using Marlex, patients are often concerned about pain in the implantation area, wound suppuration with fistula formation and sequestration of the prosthesis, extrusion of the mesh in the late postoperative period through the skin or into the lumen of the airways, and arterial bleeding from large vessels.

Since the middle of the 20th century, polypropylene-based meshes have been used to close various tissue defects, including laryngeal and tracheal defects. There are many polypropylene endoprostheses on the world market, differing in fiber thickness, size and shape of cells, porosity and other properties. Yagudin R.K. and his co-authors have developed their own polypropylene prosthesis - basic knitted mesh "Esfil" with the thickness of filament from 0,10 to 0,15 mm and surface porosity 43,9-55,5%, which is used for alloplasty of laryngotracheostomy. All modern mesh prostheses are considered inert. However, histological data obtained by studying prostheses removed for various reasons months and years after implantation show that in the spaces between the polymer fibers and the recipient's tissues there is a persistent inflammatory reaction. The material is encapsulated by a thick capsule without fixation and sprouting of connective tissue, which does not exclude the implant migration. Reducing the thickness of the endoprosthesis leads to a closer contact with the surrounding tissues, facilitates the sprouting of connective tissue, and the smaller volume of the foreign material introduced into the wound reduces the reactive inflammation with the corresponding decrease in the number of complications.

The hysteresis elastic behavior of the body tissues determines the criteria for the choice of implantation materials, which by their physical and mechanical properties should have certain characteristics and meet the requirements of biomechanical compatibility. Nowadays the most perspective artificial material for medical purposes, satisfying the above mentioned requirements, is titanium nickelide and alloys on its basis. The efficiency of titanium nickelide use is connected with its unique properties - to comply with the law of lag of biological tissues, to show high elastic properties, to change its shape under temperature and stress changes. Titanium nickelide has unique biochemical and biomechanical compatibility with the tissues of the organism and in this connection it is able to exist in the organism for a long time keeping its functional features. Implants on the basis of bioadaptive titanium nickelide are widely used in reconstructive-

restorative clinical and experimental laryngotracheal surgery, as titanium nickelide alloys are able to deform up to 6% of the initial value under the conditions of body temperature.

Porous implants with shape memory in combination with skin-muscular flaps Darmakov V.V. et al. (2006) used in 39 patients to eliminate various laryngotracheal defects. Mukhamedov M.R. et al. (2006) perfected the one-stage reconstruction of the laryngeal skeleton of the original form by the endoprosthesis from porous titanium nickelide in 148 patients with malignant tumors of the head and neck. Full epithelization of the implant surface came in 3 months after the surgical intervention, and in 6 months the mucous membrane on the endoprosthesis surface did not differ from the mucous membrane of the remaining part of the larynx. The authors obtained good functional results: vocal function was preserved in 93.3%, respiratory function - in 88.3%, protective function - in 96.6% of patients.

F.B. Khlebnikova et al. (2006) used porous-permeable endoprostheses made of titanium nickelide to replace defects of the cartilaginous framework of the larynx in 53 cases. Porous-permeable plates, mesh reinforced with porous plates, nickelide-titanium tissue in combination with granulated titanium nickelide were used. Rejection of the prosthesis was observed only in three cases (5.6%). Voice formation was preserved in all patients, there were no swallowing disorders.

S.S. Reshulsky et al. (2018) combined the methods: in group I 15 (30%) used a plate made of porous titanium nickelide, in group II 12 (24%) patients used rib autochartilage, in group III 9 patients (18%) used rib allochartilage and group IV consisting of 14 patients (28%) used polytetrafluoroethylene-based heteromaterial [149]. In group I patients in whom porous titanium nickelide was used, healing by primary tension was 80% of cases. In 3 patients (20%), healing occurred by secondary tension, in two cases the implant came out of the muscle bed, which required its removal. In one case the wound discharge in the area of the bed was drained three times under ultrasound control by means of fine-needle aspiration puncture. The authors observed the best result of surgical wound healing in group II of patients, where their own tissues were used. The healing by primary tension in patients amounted to 91.7%. In 4 (44.4%) patients of group III healing by secondary tension with rejection of the material on 7-10 days after the operation was fixed. This was accompanied by both local reactions in the form of hyperemia, edema, soft tissue pain, and systemic manifestations of inflammation. Ultimately, this complication led to allograft lysis and tracheal fistula formation.

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