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A TISSUE REACTION TO COMBINED HERNIA PROSTHESIS AT DIFFERENT POSTOPERATIVE PERIODS

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ABSTRACT — Our experimental study shows a morphological response of the anterior abdominal wall to implantation of a combined (bovine pericardium graft and polyester mesh) hernia prosthesis. For this purpose, fifteen chinchillas were operated on. A combined prosthesis was implanted intra-abdominally, where the pericardium graft adjoined the internal organs with the smooth side, while the synthetic material was facing the peritoneum. Morphological and morphometric assessment of the tissue in the area of implantation of the prosthesis was carried out. Morphology of tissues samples was evaluated in 2 weeks, in 1 month and in 2 months after surgery. Our study revealed that the combined prosthesis implanted in the anterior abdominal wall causes an acute inflammatory response, which progresses within a month after the surgery. However, the signs of inflammation reduced at the end of the second month of the experiment. A new connective tissue grew actively into the implant from the side of the polyester mesh. The pericardium graft adjacent to the abdominal cavity with the smooth side did not cause formation of connective tissue. Thus, the combined hernia prosthesis has protected the abdominal cavity from adhesions in the postoperative period.

KEYWORDS — pericardium, polyester mesh, morphological reaction.

RELEVANCE

Currently, hernias of the anterior abdominal wall occupy one of the first places in the field of surgical diseases [1, 2]. Application of synthetic materials for reconstruction of the anterior abdominal wall made a revolution in hernia repair and is considered the gold standard for treatment of patients with central hernias. About 1 million implants of mesh prostheses are produced annually in the world. In some countries, more than 90% of all surgical interventions are performed using synthetic mesh prostheses [3, 4].

There are many studies comparing hernioplasty techniques. It is believed that the most effective

method is intra-abdominal surgery [5]. An intra-abdominal implantation of hernia prosthesis is supposed to minimize surgical trauma, but to date there is no unanimous recommendation on the best prosthesis for intra-abdominal hernia repairs [6]. Synthetic prostheses with anti-adhesive coating are conventionally used, but they are expensive and not manufactured in Russia.

The use of xenopericardial animals (pigs, calves) for prostheses of heart valves and blood vessels has long been a practice in cardiovascular surgery [7]. Studies have been conducted in which hernioplasty was performed using a xenopericardial graft. This biological material has several advantages over traditional mesh implants.

In addition, there are studies in which it is shown that polyester mesh prostheses cause a less pronounced inflammatory response than polypropylene ones. However, polyester nets, when sewn into the abdominal wall, undergo sacking [8]. The combination of such a mesh with a xenopericardial graft allows us to solve this problem.

The purpose

of this experimental study was to study the patterns of morphological reaction of the tissues of the anterior abdominal wall to implantation of a combined (xenopericardial graft and polyester mesh) hernia prosthesis.

MATERIALS AND METHODS

The experiment was conducted on fifteen chinchilla rabbits weighing up to 3.5 kg. The studies were carried out in accordance with the requirements of the "European Convention for the Protection of Vertebrate Animals, used for experiments or other scientific purposes" (Strasbourg, 1986). Permission was obtained from the local Ethics Committee of the Medical Institute of Penza State University.

The combined prosthesis was made from a bovine pericardium sheet ("Kardioplant", Penza, Russia) and a polyester mesh (Covidien, Sofradim, France). The prosthesis was implanted intraabdominally. In this case, the xenopericardial graft adjoined the internal organs with the smooth side, and the synthetic material was facing the peritoneum. Animals were removed from the experiment after 2 weeks, 1 month and 2 months after the start of the study. Morphological and

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morphometric assessment of the state of tissue in the area of implantation was conducted.

RESULTS

The combined hernia prosthesis when implanted in the anterior abdominal wall causes a rather pronounced inflammatory reaction which amplifies within a month after the operation. By the second month of the experiment, signs of inflammation were reduced. In this case, new connective tissue grows actively into the implant from the side of the polyester mesh. The xenopericardial graft is anchored to the abdominal wall with the smooth side and does not promote spontaneous endothelialization, thus protecting the abdominal cavity from adhesions in the postoperative period.

DISCUSSION

The study showed that the combination of a xenopericardial graft and a polyester mesh as a single hernia prosthesis leads to the development of a sufficiently pronounced inflammatory response in the tissues of the abdominal wall.

In the early stages — 2 weeks after surgery, inflammatory infiltration is mainly detected in the area of the polyester network, later lymphocytes and neutrophilic leukocytes spread into the thickness of the xenopericardial graft. A month after the start of the experiment, inflammation in the area of operation reaches its maximum intensity, after that it gradually decreases.

The formation of connective tissue around the implantation is very active. Initially, a large number of fibroblasts and, accordingly, connective tissue fibers are formed at the border of the intrinsic tissues of the abdominal wall and the polyester mesh.

Then the fibers and capillaries of the granulation tissue grow into the mesh cells, approaching the xenopericardial graft. The development of the inflammatory reaction and the growth of connective tissue around the combined prosthesis has a number of features compared to separately used mesh implants [7, 8].

At the final stage of the experiment (after 2 months), the preparations show a fairly dense connective tissue fused with a polyester mesh. In this case, the formation of connective tissue from the xenopericardial graft does not occur. In this way, the use of combined prostheses can help in solving the problem of adhesion formation after hernioplasty, which is repeatedly described in the literature [9, 10].

CONCLUSION

The use of our combined prosthetic option for implantation into the abdominal wall enables to avoid

a number of complications that often arise with other types of prostheses.

REFERENCES:

1. **SHESTAKOV A. L., IVANCHIK I. YA., TSARENKO E. V., ET AL.** Long-term results and quality of life of patients after prosthetic hernioplasty for postoperative ventral hernias. *Annals of Surgery* 2010; (6): 56–60.
2. **BELOKONEV V. I., PUSHKIN S. YU., KLYUYEV K. E., ET AL.** Structure, frequency and causes of recurrent abdominal hernias. Materials of the 8th conference "Topical issues of herniology". Moscow 2011: 24–25.
3. **FRANKLIN ME, GONZALEZ JJ, GLASS JL:** Use of porcine small intestinal submucosa as a prosthetic device for laparoscopic repair of hernias in contaminated fields: 2-year follow-up. *Hernia*. 2004, 8: 186–189.
4. **BACHMAN S, RAMSHAW B.** Prosthetic material in ventral hernia repair: how do I choose? *Surg Clin North Amer*. 2008; 88 (1): 101–112.
5. **CESANA D, OLMI S, CROCE E.** Laparoscopic inguinal hernia repair IPOM: feasibility and advantages. *Hernia* 2011; (2): 49.
6. **CHISTYAKOV D. B., MOVCHAN K. N., MOROZOV YU. M. ET AL.** Experience in the organization of treatment of patients with abdominal hernias in the Department of modern surgical technologies of a multi-specialty hospital in megapolis. *Bulletin of the North-Western state medical University. I. I. Mechnikova* 2015; 7 (3): 11.
7. **KLINGE, U., CONZE, J., KRONES, C.J. ET AL.** Incisional Hernia: Open Techniques. *World J. Surg.* 29, 1066–1072 (2005). <https://doi.org/10.1007/s00268-005-7970-2>
8. **ZYULKIN G. A.** Justification and evaluation of the effectiveness of polyester implants in hernioplasty of postoperative ventral hernias: Dis. ... *Cand. med. sciences*. Penza, 2012: 109 p.
9. **KIM H, BRUEN K, VARGO D:** Acellular dermal matrix in the management of high-risk abdominal wall defects. *Am J Surg.* 2006, 192: 705–709. 10.1016/j.amjsurg.2006.09.003. doi:10.1016/j.amjsurg.2006.09.003
10. **CHISTYAKOV D. B., MOVCHAN K. N., YASHCHENKO A. S.** Risks of formation of adhesions during intraabdominal implantation in the abdominal wall of mesh prostheses made of ambiguous materials with different bioinert properties. *Bulletin of the Russian Military Medical Academy* 2016; (2): 6.