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# METHOD FOR INGUINAL HERNIA TREATMENT WITH XENOPERICARDIUM

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**ABSTRACT** — Our experimental study shows the possibility of using a xenopericardial plate as a prosthesis in patients with inguinal hernias.
The method of hernioplasty proposed by us is tension-free prosthetic technique.
The advantage of the proposed method is the low probability of recurrence of a hernia in the area of the inner inguinal ring by strengthening both the posterior and anterior walls of the inguinal canal. Due to the fact that the spermatic cord, m. transversus abdominis and m. obliquus internus abdominis are in contact with the smooth antiadhesive surface of the xenopericardial plate, there is no formation of rough cicatricial fusion and no dysfunction of these structures. As an experiment, this method was tested on thirty Wistar rats with implantation of a prosthesis in the tissue of the anterior abdominal wall. Morphological and morphometric assessment of the tissue in the area of implantation shows that the formation of connective tissue around the implanted hernioprosthesis is very active. The final stage of the experiment (after 3 months) has revealed that the rough side of xenopericardial plate is tightly fixed to the underlying tissues. The xenopericardial plate contacting the tissues with the smooth side does not cause the formation of connective tissue, which protects this area from adhesions in the postoperative period.

**KEYWORDS** — pericardium, inguinal hernia, tension-free prosthetic technique, morphological reaction.

## INTRODUCTION

Despite the fact that the basic principles of the treatment of inguinal hernias have been known since the 19th century the improvement of these methods of treatment is a relevant topic of scientific research. Inguinal hernia is diagnosed in about 5% of the male working-age population. This circumstance testifies to the economic losses of the state and gives the problem a social orientation [1, 2].

Initially, techniques based on the use of the patient's own tissues for hernia repair were proposed and widely used. The basis for a large number of hernia repair methods is the Bassini technique. Analyzing the complications that develop after this operation, a large percentage of hernia recurrences was noted. The cause of recurrence is the tension of the tissues sutured during plastic surgery, as well as their morpho-functional inferiority [3].

At present, the use of tension-free prosthetic techniques is considered optimal [4]. These methods involve the use of hernia prosthetic materials. A positive point is the absence of tension between the sutured tissues and ischemia in the plastic zone as a result. Nevertheless, a new group of so-called *prosthesis-associated* complications was identified during the process of gaining experience in the use of synthetic implants

A large number of currently used techniques demonstrate the need to find an optimal material for hernia repair. This material should have the already known advantages of the implant and should be free of the disadvantages associated with foreign body reactions.

## MATERIAL AND METHODS

The team of Penza State University Department of Surgery developed a method for hernia repair of the inguinal canal using a xenopericardial plate (patent RU 2392 874 C1).

Technically, the proposed method is most similar to the repair of the inguinal canal according to Lichtenstein. The method consists in the formation of the posterior wall of the inguinal canal with a polypropylene mesh, which is attached to the inguinal and Cooper's ligaments and to the common aponeurosis of the internal oblique and transverse abdominal muscles. A special hole is created in the polypropylene mesh for the passage of the spermatic cord. The edges of the hole are subsequently sutured to the inguinal ligament.

Despite its great popularity, the Lichtenstein method is not ideal and has a number of disadvantages. One of them is the formation of a rough scar at the junction of the prosthesis with the surrounding tissues. Also, due to the presence of a hole in the mesh, a recurrence of a hernia with compression of the spermatic cord and the development of testicular atrophy and subsequent infertility is possible. The operation in such cases is complicated by the separation of the elements of the spermatic cord from the prosthetic mesh, since due to their close proximity, fusion occurs with subsequent deformation and disruption of the functioning of the vas deferens and testicular vessels. The developed method is carried out as follows.

First, hernia repair is performed according to generally accepted requirements. An 8 cm incision is made 2–2.5 cm higher and parallel to the inguinal ligament. Upon completion of manipulations with the hernia sac, the transverse fascia is visualized and the space behind the transverse abdominal muscle is prepared, separating the latter from the transverse fascia to a depth of 2.5–3 cm, for the location of the first leaf of the endoprosthesis. Then the xenopericardial plate, 15 by 15 cm in size, is bent in half to form two sheets of 7.5 by 15 cm so that the smooth surface of the implant faces the inside of the bent implant sheet.

The first implant leaf is modeled over the formed space behind the transverse muscle. Two ligatures are fixed along the upper edge of the modeled first implant leaf. Ligatures are passed through the transverse and internal oblique muscles from back to front along the upper edge of the prepared space to the anterior surface of the internal oblique muscle and tied. This ensures that the top edge of the first leaf is secured. After that, a hole is formed in the first sheet of the implant. The hole must match the inner opening of the inguinal canal through which the spermatic cord is passed. Then the lower edge common for both sheets (fold zone) is fixed with single interrupted sutures to the groin and, partially, to the Cooper's ligament. At the same time, the medial edge of the first leaf overlaps the area of the pubic tubercle, entering the anterior wall of the sheath of the rectus abdominis muscle, to which it is fixed with additional sutures.

Then the upper edge of the second sheet of the implant is fixed to the aponeurosis of the external oblique muscle of the abdomen from the inside with single interrupted sutures, passing the threads from the inside to the outside. At the end of the reconstruction, the dissected aponeurosis of the external oblique abdominal muscle is sutured over the second sheet of the implant, forming the external opening of the inguinal canal according to generally accepted requirements (Fig. 1–4).

The advantage of the proposed method is the low probability of recurrence of a hernia in the area of the inner inguinal ring by strengthening both the posterior and anterior walls of the inguinal canal. Due to the fact that the spermatic cord, m. transversus abdominis and m. obliquus internus abdominis are in contact with the smooth antiadhesive surface of the xenopericardial plate, there is no formation of rough cicatricial fusion and no dysfunction of these structures. As an experiment, this method was tested on thirty Wistar rats with implantation of a prosthesis in the tissue of the anterior abdominal wall. 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.

There were no complications in the postoperative period in rats.

Animals were removed from the experiment after 2 weeks, 1 month and 3 months after the start of the study. Conducted morphological and morphometric assessment of the state of tissue in the area of implantation of the prosthesis.

## RESULTS AND DISCUSSION

The study showed that the xenopericardial plate 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 prothesis, then lymphocytes and neutrophilic leukocytes spread into the thickness of the xenopericardial plate. A month after the start of the experiment, inflammation in the area of operation reaches its maximum intensity, then its regular decrease occurs.

The formation of connective tissue around the implanted hernioprosthesis 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 prothesis (Table 1).

Then the fibers and capillaries of the granulation tissue grow into the mesh cells, approaching the xenopericardial plate. 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.

The final stage of the experiment (after 3 months) shows that the rough side of xenopericardial plate is tightly fixed to the underlying tissues.

The xenopericardial plate facing the tissues with the smooth side does not cause the formation of connective tissue, which protects this area from adhesions in the postoperative period.

## CONCLUSION

Thus, the data of experimental studies allow us to conclude that the proposed method for the treatment of inguinal hernias using a xenopericardial plate makes it possible to strengthen both walls of the inguinal canal. This method minimizes the incidence of recurrent hernia. The antiadhesive side of the prosthesis facing the spermatic cord prevents the formation of rough cicatricial adhesions between the elements of the spermatic cord and the implant, thereby preventing the risk of impairment of its trophism and function.

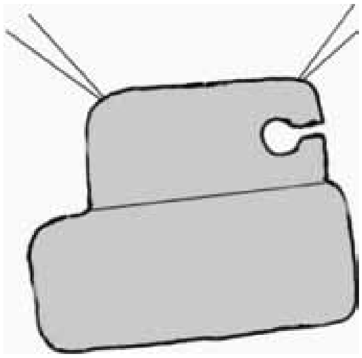

***Fig. 1.** Figure of carved out endoprosthesis*

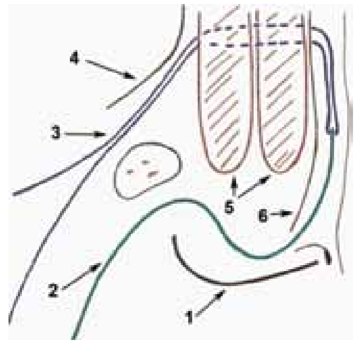


***Fig. 2.** Scheme of fixation of the posterior leaflet of the endoprosthesis: 1 — inguinal ligament; 2 — endoprosthesis; 3 — fixing ligature; 4 — aponeurosis of the external oblique muscle of the abdominal wall; 5 — internal oblique and transverse muscles; 6 — fascia transversalis*

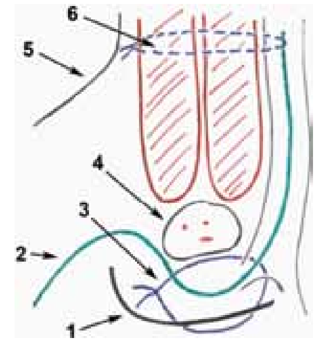


***Fig. 3.** Scheme of fixation of the endoprosthesis to the inguinal ligament: 1 — inguinal ligament; 2 — endoprosthesis; 3 — ligature fixing the endoprosthesis to the inguinal ligament; 4 — spermatic cord; 5 — aponeurosis of the external oblique muscle; 6 — ligature fixing the posterior leaf of the endoprosthesis*

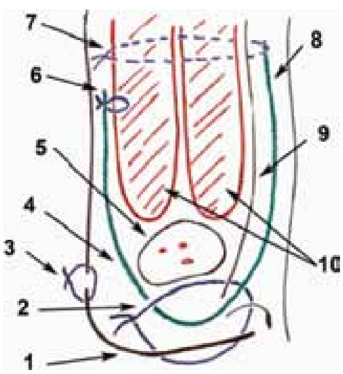


***Fig. 4.** The final view of the operation. New inguinal canal is formed: 1 — inguinal ligament; 2 — ligature fixing the endoprosthesis to the inguinal ligament; 3 — ligature on the aponeurosis of the external oblique abdominal muscle; 4 — anterior leaflet of the endoprosthesis; 5 — spermatic cord; 6 — ligature fixing the anterior leaflet of the endoprosthesis; 7 — ligature fixing the posterior leaf of the endoprosthesis; 8 — posterior leaf of the endoprosthesis; 9 — fascia transversalis; 10 — internal oblique and transverse abdominal muscles*

***Table 1.** The number of connective tissue cells in the area of implantation of the xenopericardial plate (cells in the field of view)*

| | 3 month | | |
|---|---|---|---|
| | Min | Max | M±m |
| Fibroblasts | 130 | 172 | 151,01±9,67 |
| Fibrocytes | 74 | 93 | 79,43±5,32 |
| The ratio of fibroblasts and fibrocytes | | | 1,9 |

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