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## The use of nanomodified polypropylene mesh with an antiseptic in patients with inguinal hernias during Lichtenstein surgery

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### Abstract

Aloplasty of inguinal hernias (IH), of using modified polypropylene mesh antiseptic and an by carbon nanotubes, both this is accompanied by a fairly high frequency of postoperative complications from the postoperative wound.

In our view, the use of a nanomodified polypropylene mesh modified by carbon nanotubes and an antiseptic of polyhexamethyleneguanidme chloride the results of surgical treatment of IH.

**Aim** – to improve the results of surgical treatment of inguinal hernias modified polypropylene mesh antiseptic and an by carbon nanotubes.

**Materials and methods.** The analysis of surgical treatment of 144 patients with IH of has been performed. Depending on the type of mesh used during surgical treatment, patients were divided into 2 groups. In 72 (50%) of Group I patients, using modified polypropylene mesh antiseptic and an by carbon nanotubes. In the 2nd group, 72 (50%) patients using classic polypropylene mesh.

**Results and discussion.** Statistically significant results were obtained in patients of Group I compared to Group II: seroma was in 4 (5.6±1.2%) in Group II compared to 2 (2.8±0.4%) in Group I (p<0.05), respectively, the suppuration of the postoperative wound – 4 (5.6±0.4%) to 1 (1.4±0.6%) (p<0.05). The terms of stay of patients of group II on inpatient treatment – 11,2±2,2 days group II – 7,3±1,3 days.

Long-term results: ligature fistulas of the anterior abdominal wall were detected in 3 (5.4±0.4%) patients of group II, in patients of group I of the ligature fistulas were not detected (p<0.05), meshoma – in 1 (1.8±0.3%) of patients in group II, in group I there was no stir (p>0.05). Chronic pain in the abdominal wall in 6 – 8 months after surgery was observed in 3 (5.4±0.4%) patients in group II and in 1 (1.8±0.5%) group I (p>0.05), recurrences of hernia were found in 3 (5.4±0.4%) patients of group II, in group I – in 1 (1.8±0.3%) (p<0.05).

**Conclusion.** Surgical treatment of IH using modified polypropylene mesh antiseptic and an by carbon nanotubes the use of the classical polypropylene mesh, namely, reducing the frequency of seroma from 5.6±1.2% in the II group of patients to 2.8±0.4% in group I, respectively, suppurations of postoperative wounds – from 5.6±0.4% to 1.4±0.6%, inflammatory infiltrates – from 5.6±0.4% to 1.4±0.6%, ligaturial fistulas of the anterior abdominal wall – from 5.4±0.4% to 0%, meshoma – from 1.8±0.3% to 0%, chronic postoperative pain – from 5.4±0.4% to 1.8±0.5%, recurrence of hernia—from 5.4±0.4% to 1.8±0.3%.

**Key words:** inguinal hernia stomach; modified polypropylene mesh; postoperative wound complications.

**Introduction.** Hernias of the anterior abdominal wall and, in particular, inguinal abdominal hernia (PGH) are one of the most frequent surgical pathologies for which planned surgical interventions are performed [1]. Despite the rapid development of modern herniology, the problem of surgical treatment of patients with PCV remains relevant. The essence of the problem is that a large number of patients relapse after surgical treatment of a simple uncomplicated inguinal hernia, and even more often after treatment of a large hernia [2, 3]. According to Y.P. Feleshtynskyi (2011), the recurrence rate remains high - from 30 to 35% [4]. Domestic and foreign authors [5, 6] suggest to reduce the frequency of hernia recurrence to use materials that are maximally adapted to the tissues of the body, do not produce allergens, are able to counteract mechanical action at the junctions of tissues, and are affordable. But the use of classic polypropylene mesh during surgery leads to a high frequency of complications from the postoperative wound, such as seroma (30.8 - 60.4%),

suppuration of the postoperative wound (4.8 - 6.4%), ligature fistula (1, 2 - 3.0%), meshoma (0.06 - 1.60%) [7, 8, 9]. It should be noted that one of the causes of postoperative wound complications is the development of aseptic inflammation of the tissues of the abdominal wall as a result of their contact with the classic polypropylene mesh. Long-term aseptic inflammation of the subcutaneous base, muscles, aponeurosis, and fascia inhibits the process of germination of the classic polypropylene mesh with connective tissue, which leads to its shrinkage, and in the case of infection, to migration of the mesh and recurrence of the hernia [10]. In our opinion, the use of a modified polypropylene mesh with antiseptic polyhexamethyleneguanidine chloride and carbon nanotubes will improve the results of surgical treatment of PAH.

**Purpose of the work** to improve the results of surgical treatment of inguinal hernias modified polypropylene mesh antiseptic and an by carbon nanotubes.

### **Materials and methods**

An analysis of operative treatment for the period from 2015 to 2019 was conducted for 144 patients with PG between the ages of 35 and 65 who underwent alloplasty of umbilical abdominal hernias. There were 85 (59%) men, 59 (41%) women. Associated pathology was found in 81.2% of patients. It should be noted that in the majority (65.4%) it was cardiovascular pathology and 19 patients suffered from alimentary obesity II-III degree.

All patients underwent special preoperative preparation on an outpatient basis for an average of  $(10.0 \pm 1.2)$  days, which included: 1) increasing the reserves of cardiopulmonary activity, 2) prevention of thromboembolic complications, 3) corrective therapy of concomitant diseases, 4) prevention of infectious complications from the postoperative wound, 5) maximum bowel cleansing. To clean the intestines and reduce its volume, patients were recommended a slag-free diet excluding bread, flour and potato dishes, and prescribed laxatives ("Regulax", "Dufalak") and cleansing enemas. Thanks to which it is possible to achieve maximum cleansing and reduction of the volume of the intestines and hernial protrusion, as well as a reduction in the patient's body weight. In some patients, unreparable hernias became repairable. On the eve of the surgical intervention, 12 hours before the operation, Fortrans was prescribed according to the scheme.

The effectiveness of preoperative preparation was controlled by monitoring the function of the cardiovascular system and the function of external respiration. Antibacterial prophylaxis was carried out using third-generation cephalosporins (cefosulbin) in combination with metronidazole. In order to prevent thromboembolism of the pulmonary

artery, low molecular weight heparins were used, as well as compression underwear for the lower limbs during the operation and for 1 month in the postoperative period.

Depending on the mesh implant used during the operation, the patients were divided into two groups, which were comparable in terms of age, sex ratio, and size of the PAH.

In 72 (50%) patients of group I, a modified polypropylene mesh implant was used [11, 12, 13]. During surgical treatment of an inguinal hernia, a dissection of the skin and subcutaneous fatty tissue was performed 2 cm above and parallel to the inguinal fold, after which the hernial sac was isolated near the base, which was tied and cut off. After that, the modified mesh implant was sutured to the inguinal ligament, to the aponeurosis above the pubic bone and the internal oblique muscle of the abdomen, as well as proximal to the internal inguinal ring. Hernioplasty was completed by suturing the aponeurosis of the external oblique muscle above the spermatic cord. After thorough hemostasis, the subcutaneous fat tissue along the line of connection of anatomical structures was drained with two polyvinyl chloride tubes. The postoperative wound was sutured layer by layer with polypropylene threads made of polypropylene modified with carbon nanotubes and polyhexamethyleneguanidine chloride antiseptic.

In group II, 72 (50%) patients used a classic polypropylene mesh implant.

In the early postoperative period, treatment measures included the correction of disorders of the cardiovascular and respiratory systems, stimulation of intestinal functions. All patients were prescribed "Dikloberl" in a dose of 3 ml intramuscularly for 7 days after the operation to reduce the inflammatory reaction of the abdominal wall to mesh implantation. In order to prevent stress ulcers of the gastrointestinal tract, "Kvamatel" was prescribed according to the scheme. Antibacterial therapy with the use of cefosulbin 1 g twice a day was continued in all patients, since all of them had an increased risk of infectious complications from the wound. In order to prevent pulmonary embolism, low-molecular-weight heparins were used for 7-9 days.

Statistical calculations were carried out using the integrated system STATISTICA® 5.5 (STAT+SOFT® Snc, USA), with the use of a licensed program (AXX 910A374605FA).

## **Results and discussion**

The results of surgical treatment of PPH in patients of groups I and II were evaluated by studying and comparing immediate and long-term postoperative complications (figure).

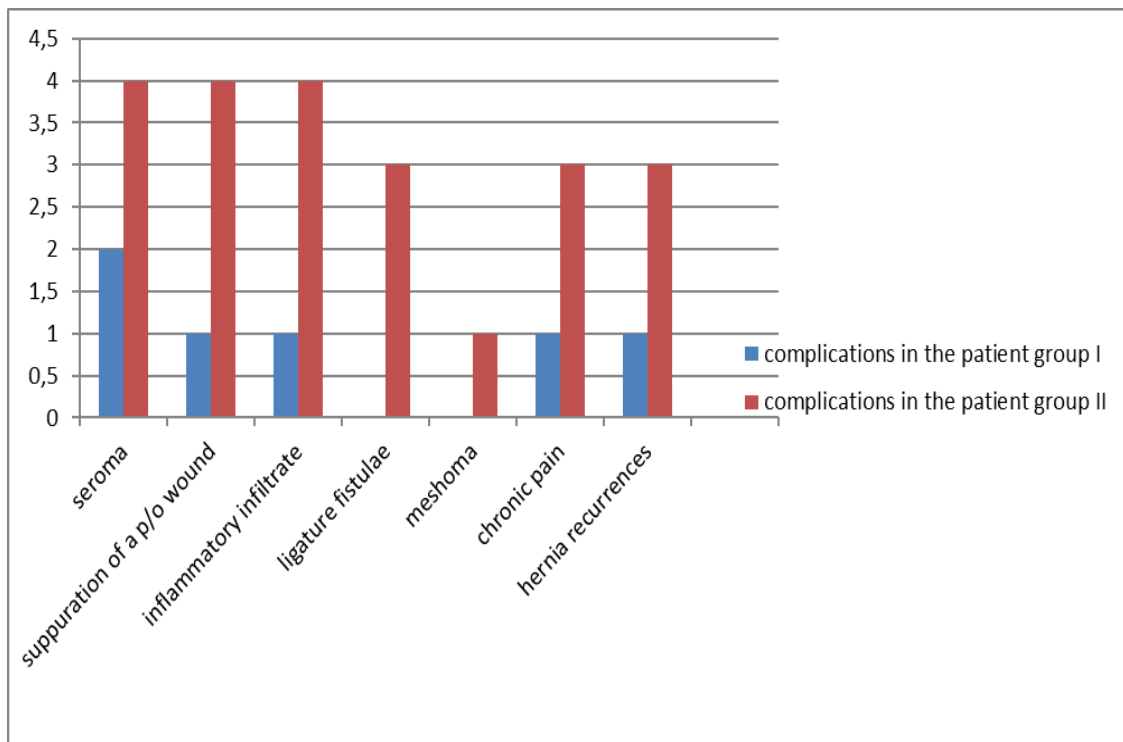


Figure. Immediate and remote results surgical treatment of patients with inguinal ernias of the abdomen

*Immediate results of treatment.* Statistically significantly better results were obtained in patients of group I in contrast to group II ( $p < 0.05$ ): a decrease in seroma formation was observed from 4 ( $5.6 \pm 1.2$ ) to 2 ( $2.8 \pm 0.4$ )%, suppuration of the postoperative wound from 4 ( $5.6 \pm 0.4$ ) to 1 ( $1.4 \pm 0.6$ )% and inflammatory infiltrate from 4 ( $5.6 \pm 0.4$ ) to 1 ( $1.4 \pm 0.6$ )%. The duration of inpatient treatment in group I was ( $7.3 \pm 1.3$ ) days, in group II – ( $11.2 \pm 2.2$ ) days.

*Remote results.* It was studied by the method of repeated examinations and questionnaires in 56 patients of group I and in 56 patients of group II in terms of 1 to 5 years. Chronic pain in the area of the abdominal wall during 6-8 months after the operation was observed in 3 ( $5.4 \pm 0.4$ )% of patients of group II and in 1 ( $1.8 \pm 0.5$ )% of group I ( $p > 0, 05$ ), which was eliminated by prescribing physiotherapeutic procedures and nonsteroidal anti-inflammatory drugs. Hernia recurrence occurred in 1 ( $1.8 \pm 0.3$ )% of patients of group I, in contrast to 4 ( $5.4 \pm 0.4$ )% of patients of group II ( $p < 0.05$ ), ligature fistulas of the anterior abdominal wall occurred in 3 ( $5.4 \pm 0.4$ )% of patients of group II and meshoma in 1 ( $1.8 \pm 0.3$ )% of patients ( $p < 0.05$ ), in contrast to group I where such complications were not observed.

It should be noted that much better immediate and long-term results were obtained in patients of group I. Because a modified polypropylene mesh implant was used in patients of group I, it was possible to reduce the frequency of seroma by 2 times, suppuration of the

postoperative wound by 4 times, and inflammatory infiltrate by 4 times times, occurrence of ligature fistulas of the anterior abdominal wall 3 times, meshomas 1 time. Thus, such a significant reduction in the frequency of complications from the postoperative wound is due to the properties of the modified polypropylene mesh with carbon nanotubes and the antiseptic polyhexamethyleneguanidine chloride, namely, this mesh has a high sorption, hygroscopic and antiseptic effect, thanks to which it is possible to reduce the intensity of aseptic inflammation of the tissues of the abdominal wall, the exudation of serous fluid and the risk of infection, while the classic polypropylene mesh does not have such properties.

The long-term results of operative treatment of PAH also confirm the advantages of using a modified polypropylene mesh with carbon nanotubes and an antiseptic polyhexamethyleneguanidine chloride compared to the use of a classic polypropylene mesh, which is associated with a decrease in the frequency of wound infection complications, migration and shrinkage of the mesh and prevents recurrence of PAH.

### **Conclusions**

Operative treatment of abdominal inguinal hernias using a modified polypropylene mesh is much more effective compared to the use of a classic polypropylene mesh, as evidenced by a decrease in the frequency of seroma from  $(5.6 \pm 1.2)$  to  $(2.8 \pm 0.4)\%$ , suppuration of the postoperative wounds - from  $(5.6 \pm 0.4)$  to  $(1.4 \pm 0.6)\%$ , inflammatory infiltrate - from  $(5.6 \pm 0.4)$  to  $(1.4 \pm 0.6)\%$ , ligature fistulas of the anterior abdominal wall - from  $(5.4 \pm 0.4)$  to  $0\%$ , meshomas - from  $(1.8 \pm 0.3)$  to  $0\%$ , chronic postoperative pain - from  $(5.4 \pm 0.4)$  to  $(1.8 \pm 0.5)\%$ , hernia recurrence - from  $(5.4 \pm 0.4)$  to  $(1.8 \pm 0.3)\%$ .

### **Perspectives of the further researches**

On the basis of further research, new approaches to the surgical treatment of abdominal hernias will be developed using new types of nanocomposite mesh implants with antimicrobial properties of domestic production, which will reduce the number of postoperative complications and recurrences of hernias and improve the quality of life of patients in the postoperative period and will give a significant economic effect.

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