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Advantages of using a nanomodified mesh with an antiseptic in the surgical treatment of abdominal hernia

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Abstract

Surgical treatment of open operations for abdominal hernias (AH) using classic techniques of allogeneoplasty (sublay, onlay) is often accompanied by an increase in intra-abdominal pressure (IBP) and a decrease in the volume of the abdominal cavity, which in the postoperative period leads to abdominal compartment syndrome (ACS) In 2 ,4 - 3.6% of cases and mortality in 1.2 - 3.4% of observations. This requires a special method of closing a large defect of the abdominal wall, which would not increase ICP. The use of improved techniques contributes to the creation of the optimal volume of the abdominal cavity and improves the results of treatment, in particular, the frequency of ACS decreases. But it should be noted that the use of combined operations with a classic polypropylene mesh 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%).

Aim – to improve the results of surgical treatment of abdominal hernias (AG) when using a nanomodified polypropylene mesh with an antiseptic.

Materials and methods. An analysis of surgical treatment of 400 patients with GJ was carried out. Depending on the type of mesh implant used during surgical treatment, patients were divided into two groups. 200 (50%) patients of group I underwent surgery using a nanomodified polypropylene mesh with an antiseptic, in group II, 200 (50%) patients underwent surgery using a classic polypropylene mesh.

Results and discussion. Statistically significantly better results were obtained in patients of group I compared to group II. Thanks to the fact that in patients of group I, a nanomodified polypropylene mesh implant with an antiseptic was used, it was possible to achieve a reduction in the frequency of seroma by 4.2 times, suppuration of the postoperative wound by 8 times, inflammatory infiltrate by 10 times, and the occurrence of ligature fistulas of the anterior abdominal wall by 12.5 times, meshomas in 7.5 times. The long-term results of surgical treatment of AG also confirm the advantages of operations for abdominal hernias using nanomodified polypropylene mesh with an antiseptic compared to the use of classic polypropylene mesh, which is associated with a decrease in the frequency of wound infectious complications, migration and shrinkage of the mesh and prevents recurrence of AG. The duration of inpatient treatment in group I was (7.0±1.0) days, in group II – (12.0±2.2) days.

Conclusion. Surgical treatment of abdominal hernias using a nanomodified polypropylene mesh with an antiseptic is more effective compared to the use of a classic polypropylene mesh, as evidenced by a decrease in the frequency of seroma from (30.5±1.2) to (7.3±0.5)%, suppuration postoperative wound - from (9.8±0.5) to (1.2±0.2)%, inflammatory infiltrate - from (12.2±0.6) to (1.2±0.2)%, ligature fistulae of the anterior abdominal wall - from (6.5±0.5) to (0.5±0.1)%, meshomas - from (3.9±0.3) to (0.5±0.1) %, chronic postoperative pain - from (8.0±0.6) to (1.3±0.2)%, hernia recurrence - from (9.3±0.6) to (1.3±0.2)%.

Key words: abdominal hernia; nanomodified polypropylene mesh; postoperative wound complications.

Introduction. Surgical treatment of open operations for abdominal hernias (AH) using classic techniques of allogeneoplasty (sublay, onlay) is often accompanied by an increase in intra-abdominal pressure (IBP) and a decrease in the volume of the abdominal cavity, which in the postoperative period leads to abdominal compartment syndrome (ACS) In 2 ,4 - 3.6% of cases and mortality in 1.2 - 3.4% of observations [1, 2]. This requires a special method of

closing a large defect of the abdominal wall, which would not increase ICP. The use of improved techniques contributes to the creation of the optimal volume of the abdominal cavity and improves the results of treatment, in particular, the frequency of ACS decreases [3, 4, 5]. But it should be noted that the use of combined operations with a classic polypropylene mesh 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%) [6, 7]. 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 polypropylene mesh by the connective tissue, which leads to its shrinkage, and in the case of infection, to the migration of the mesh and recurrence of the hernia. In our opinion, the use of nanomodified polypropylene mesh with antiseptic polyhexamethyleneguanidine chloride in combination with improved surgical techniques will improve the results of surgical treatment of AG.

Purpose of the work – to improve the results of surgical treatment of abdominal hernias (AG) when using a nanomodified polypropylene mesh with an antiseptic.

Materials and methods

An analysis of surgical treatment was carried out for the period from 2014 to 2019. 250 patients with postoperative large-sized abdominal hernias aged 30 to 70 years using the "sublay" technique and with postoperative giant-sized abdominal hernias during the operation to separate the anatomical components of the abdominal wall, 150 patients with large and small abdominal umbilical hernias, patients diagnosed with a large umbilical hernia underwent sublay surgery, and patients diagnosed with a small umbilical hernia underwent preperitoneal alloplasty. In general, an analysis of surgical treatment of 400 patients with abdominal hernias was carried out. Concomitant diseases with a predominance of chronic cardiovascular pathology were found in 124 (31.1%) patients, II-III degree obesity - in 210 (52.4%), chronic bronchitis - in 15 (3.7%), diabetes - in 32 (7.9%), chronic venous insufficiency of the lower extremities - in 19 (4.9%).

All patients underwent special pre-operative preparation on an outpatient basis for an average of (10.0±3.4) days, which included: 1) adaptation of the cardiovascular and respiratory systems and an increase in ICP, 2) an increase in the reserves of cardiopulmonary activity, 3) corrective therapy of accompanying diseases, 4) prevention of thromboembolic complications, 5) prevention of infectious complications from the postoperative wound, 6)

maximum cleansing of the intestines. 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. In this way, it is possible to achieve maximum cleaning and reduction of the volume of intestines and hernial protrusion, as well as reduction of the patient's body weight. Abdominal circumference decreases by an average of 14-16 cm, and in some patients inoperable hernias become operable. On the eve of the surgical intervention, 12 hours before the operation, Fortrans was prescribed according to the scheme. Adaptation of the respiratory and cardiovascular systems to increased ICP was carried out with the help of a dosed bandage compression of the abdomen and a special complex of respiratory gymnastics. The abdomen was dosed with a bandage based on the patient's well-being. Bandage compression was performed only in patients with correctable postoperative hernias, as it can lead to entrapment in non-correctable hernias.

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) for 2 hours. before surgery. In order to prevent thromboembolic complications, "Clexan" was used in a dose of 40 mg subcutaneously for 12 hours. before the operation and once a day after the operation for 7-9 days, as well as compression underwear for the lower limbs during the operation and for 1 month in the postoperative period.

Depending on the type of mesh implant used during the surgical treatment of abdominal hernia, the patients were divided into two groups, which were comparable in terms of age, gender ratio, and AG size.

In 200 (50%) patients of group I, surgery was performed for abdominal hernias using a nanomodified polypropylene mesh with an antiseptic [8, 9].

In group II, 200 (50%) patients underwent surgery for abdominal hernia using a classic polypropylene mesh.

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 1g twice a day was continued in all patients, since all of them had an increased risk of infectious complications from the

wound. Prevention of thromboembolic complications was carried out with clexan in a dose of 40 mg 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 GJ in patients of groups I and II were evaluated by studying and comparing immediate and long-term postoperative complications (table).

Immediate results of treatment. An increase in IAP to (11.5±2.2) mmHg was observed in 2 (1%) patients in group I, and in 5 (2.5%) patients in group II, which was accompanied by the occurrence of ACS I degree, which was eliminated by conservative measures.

Statistically significantly better results were obtained in patients of group I: seroma, suppuration of the postoperative wound and inflammatory infiltrate were detected much less frequently than in group II ($p<0.05$). It should be noted that seroma occurred 2 times less often in patients with small umbilical hernias compared to large umbilical hernias. The duration of inpatient treatment in group I was (7.0±1.0) days, in group II – (12.0±2.2) days.

The long-term results were studied by the method of repeated examinations and questionnaires in 160 patients of group I and 160 patients of group II within 1 to 5 years. Chronic pain in the area of the abdominal wall during 6-8 months after the operation was observed in 13 (8.0%) patients of group II and in 2 (1.3%) patients of group I ($p>0.05$), which was eliminated by the method of prescribing physiotherapeutic procedures and nonsteroidal anti-inflammatory drugs.

Thus, significantly better immediate and long-term results were obtained in patients of group I. Regarding the general complication, in particular ACS, which arose as a result of intra-abdominal hypertension of the first degree and was comparable in patients of the two groups and was eliminated after the restoration of intestinal peristalsi.

Thanks to the fact that in patients of group I, a nanomodified polypropylene mesh implant with an antiseptic was used, it was possible to achieve a reduction in the frequency of seroma by 4.2 times, suppuration of the postoperative wound by 8 times, inflammatory infiltrate by 10 times, and the occurrence of ligature fistulas of the anterior abdominal wall by 12.5 times , meshomas in 7.5 times. Such a significant reduction in the frequency of complications from the postoperative wound is due to the properties of the polypropylene mesh, which is modified with carbon nanotubes and the antiseptic polyhexamethyleneguanidine chloride, namely, it 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 infection, while the classic polypropylene mesh does not have such properties.

Table - Immediate and remote results surgical treatment of patients with abdominal hernias

Complication	**Group I**	**Group II**
Immediate results	**n=200**	**n=200**
IAP	2	5
Seroma	14	60*
Postoperative wound suppuration	2	19*
Inflammatory infiltrate	2	23*
Remote results	**n=160**	**n=160**
Ligature fistulae of the anterior abdominal wall	1	12*
Meshoma	1	7
Chronic pain	2	14
Recurrence of hernias	2	17*

ACS – abdominal compartment syndrome

*The difference compared to group I is statistically significant ($p<0.05$).

The long-term results of surgical treatment of AG also confirm the advantages of operations for abdominal hernias using nanomodified polypropylene mesh with an antiseptic compared to the use of classic polypropylene mesh, which is associated with a decrease in the frequency of wound infectious complications, migration and shrinkage of the mesh and prevents recurrence of AG.

Conclusions

Surgical treatment of abdominal hernias using a nanomodified polypropylene mesh with an antiseptic is more effective compared to the use of a classic polypropylene mesh, as evidenced by a decrease in the frequency of seroma from (30.5±1.2) to (7.3±0.5)%, suppuration postoperative wound - from (9.8±0.5) to (1.2±0.2)%, inflammatory infiltrate - from (12.2±0.6) to (1.2±0.2)%, ligature fistulae of the anterior abdominal wall - from (6.5±0.5) to (0.5±0.1)%, meshomas - from (3.9±0.3) to (0.5±0.1) %, chronic postoperative pain - from (8.0±0.6) to (1.3±0.2)%, hernia recurrence - from (9.3±0.6) to (1.3±0.2)%.

Perspectives of the further researches

Based on further research, new approaches to the surgical treatment of abdominal hernias will be developed using new types of domestically produced nanocomposite mesh

implants with antimicrobial properties, 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 provide a significant economic effect.

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