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Use of nanomodified polypropylene net in surgical treatment of umbilical hernias combined with diastasis of straight muscles

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Abstract

Aloplasty of umbilical hernias (UH) with diastasis of rectus abdominis (DRA) 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 polyhexamethyleneguanidine chloride the results of surgical treatment UH of DRA.

Aim – to improve the results of surgical treatment of umbilical hernias with diastasis of rectus abdominis.

Materials and methods. The analysis of surgical treatment of 118 patients with UH of DRA of has been performed. Depending on the type of mesh used during surgical treatment, patients were divided into 2 groups. In 59 (50%) of Group I patients, using modified polypropylene mesh antiseptic and an by carbon nanotubes. In the 2nd group, 59 (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 12 (20.3±1.2%) in Group II compared to 2 (3.4±0.3%) in Group I (p<0.05), respectively, the suppuration of the postoperative wound – 2 (3.4±0.3%) to 0% (p<0.05). The terms of stay of patients of group II on inpatient treatment – 12,3±2,2 days group II – 7,5±1,5 days.

Long-term results: chronic pain in the abdominal wall in 6 – 8 months after surgery was observed in 2 (3.4±0.3)% patients in group II and in 1 (1.8±0.3%) group I (p>0.05), recurrences of hernia were found in 6 (5.9±0.5%) patients of group II, in group I – in 1 (0.9±0.2)% (p<0.05).

Conclusion. Surgical treatment of UH of DRA using modified polypropylene mesh antiseptic and an by carbon nanotubes the use of the classical polypropylene mesh, namely, reducing the frequency of seroma from 20.3±1.2% in the II group of patients to 3.4±0.3% in group I, respectively, suppurations of postoperative wounds – from 3.4±0.3% to 0%, inflammatory infiltrates – from 3.4±0.3% to 0%, chronic postoperative pain – from 3.9±0.4% to 0%, recurrence of hernia–from 5.9±0.5% to 0.9±0.2%.

Key words: umbilical hernia; diastasis of abdominal muscles; nanomodified polypropylene mesh; postoperative wound complications.

Introduction. Anterior abdominal wall hernias and umbilical hernia (UH) in particular are a leading surgical pathology which needs planned operative interferences. Operations on UH are in the third place among hernia defect's plasty. Despite the fast development of modern herniology, the problem of UH surgical treatment remains actual. Umbilical hernias occur more often among women in comparison with men, and also it is useful to note that in more than half cases they are combined with the abdominal rectus muscle's diastasis, this type of combination often leads to the hernias' relapse. According to Pheleshtinskii (2011), the frequency of the relapse still remains very high – from 6 to 8 %. Therefore, while using the nanomodified polypropylene mesh, the frequency of hernias' relapse significantly reduces. Foreign and domestic authors suggest using a "tensionfree" technology (plasty without tension) with the materials, that are maximally adapted to the organism's tissues, which do not produce allergens, are able to resist the mechanical act at the junction of tissues and affordable in price. But it is worth noting, that using a classical polypropylene mesh during the operation leads to the high complication rate from the side of post-operative wounds, such as seroma (20 – 25%), the purulence of post-operative wound (3-4%), the purulent infiltration (2 – 3%) and chronical pain (3 – 4%). One of the reasons of

post-operative wounds complications is a development of anterior abdominal wall tissues aseptic inflammation, as a result of their contact with the classical polypropylene mesh. A long-term aseptic inflammation of subcutaneous base, muscles, aponeurosis and fascia slows down the process of polypropylene mesh's germination with the connective tissue, which leads to its corrugation, and in case of infection's joining – to the mesh migration and hernia relapse. In our opinion, using the nanomodified propylene mesh with the antiseptic polyhexamethylene guanidine chloride will give an opportunity to improve the results of UH operative treatment.

Purpose of the work is to improve the results of abdominal hernias' surgical treatment, which are combined with the abdominal rectus muscle's diastasis, using the nanomodified polypropylene mesh.

Materials and methods

There was analysed the laparoscopic surgical treatment of 118 patients aged from 30 to 75 in the period from 2014 to 2019. They have been diagnosed with umbilical hernia combined with the abdominal rectus muscle's diastasis and undergone the alloplasty of umbilical hernias. There were 65 (55.1%) women, 53 (44.9%) men. Concomitant diseases were revealed at 85.6% of patients. It is useful to note, that majority had cardiovascular pathology and 16 patients were suffering from the nutritional obesity of II-III stage.

The special preoperative preparation on an outpatient-basis was given to all patients during (10,0±3,4) days, which comprised: 1) raising the reserves from the side of cardiopulmonary activity 2) correction therapy of concomitant diseases 3) prophylaxis of thromboembolic complications 4) prophylaxis of infectious complications of postoperative wound, 5) utter bowel's cleansing. For the cleansing of bowel and decreasing its volume the slag-free diet with the elimination of bread, flour and potato dishes was recommended to the patients and laxatives ("Regulax", "Dufalac") and cleansing enemas were prescribed. In this way it is possible to achieve the complete bowel's cleansing, decreasing it's volume and hernia's protrusion and also decreasing the patient's bodyweight. Some patient's irreducible hernias became reducible. "Fortrans" was prescribed according to the 12-hours scheme before the operative intervention.

The efficiency of preoperative preparation was controlled by means of cardiovascular and external breathing functions' monitoring. Antibacterial prophylaxis was carried out using the third-generation cephalosporin (Cephosulbin) in combination with Metronidazole. With the aim of pulmonary thromboembolism complications' prophylaxis were used low molecular

heparins as well as the compressional underwear for lower extremities during the operation and 1 month in the postoperative period.

Depending on the type of meshy implant used, patients were divided into two groups and compared by the age, sex correlation and size of umbilical hernia combined with the abdominal rectus muscle's diastasis, where the width of diastasis was 5-12 cm.

The nanomodified propylene meshy implant was used among the 59 (50%) patients of the first group. During the surgical treatment of umbilical hernia the "sublay" technique with the deployment of meshy implant in the retro muscular space was used. There was performed the longitudinal surgical access from the xiphoid scion to the pubic coalescence on the full length of abdominal wall's defect and abdominal rectus muscle's diastasis. The hernial sac was set apart with the desection of abdomen's white line and with the mobilization of aponeurotic edges from the subcutaneous basis. The hernial sac and it's separate pockets were cut, the scrupulous revision of abdominal cavity was performed. Identified coalescences of intestinal loops were cut. The full or partial removal of hernia sac was performed. After this, the aponeurotic vaginas of abdominal rectus muscles were cut on the edge of abdominal wall's defect along the white line. Aponeurotic vaginas of rectus muscles were cut from the both sides. Aponeurotic vaginas were cut from the xiphoid scion to the pubic coalescence. Then the posterior walls of abdominal rectus muscles' aponeurotic vaginas were mobilized from the muscles to the lateral sides on the full length of rectus muscles. Neurovascular bundles on the lateral sides were saved as much as it was possible. During the mobilization of retro muscular space in the hypogastrium behind the arcuate line the posterior aponeurotic wall of rectus muscles disappeared and the peritoneal space opened. After this the posterior walls of abdominal rectus muscles' aponeurotic vaginas were sewed together with separate sutures (prolen 0). Then the retro muscular space was measured and the patch from the nanomodified polypropylene meshy implant was cut out. The width of implant was 14-16 cm and the legth was 25-30 cm. The overlap of hernial defect and the abdominal rectus muscles' diastasis by 5-6 cm in all directions was mandatory. The straightened mesh was fixed circularly to the posterior walls of the abdominal rectus muscles' aponeurotic vaginas, and from below the arcuate line to the transversal fascia and parietal peritoneum with separate sutures (prolen 2.0.). After this 1 drainage was deployed for the vacuum draining. Then the anterior walls of aponeurotic vaginas of rectus muscles were sewed with the muscles. Separate sutures were used (prolen 1.0).

Subcutaneous cellular tissue was drained along the line of anatomic structures' conjunction by dint of 2 polychlore phenyl tubes. Postoperative wound was sewed together

layer by layer with the polypropylene strings made of polypropylene, which were modified with carbon nanotubes and antiseptic polyhexamethylene guanidine chloride.

The classical polypropylene meshy implant was used among the 59 (50%) patients of the second group.

During the early postoperative period therapeutic measures included disturbances correction from the side of cardiovascular and respiratory systems, bowel's function stimulation. "Dicloberl" dosed 3 ml was prescribed to use intramuscularly to all patients for 7 days for abdominal wall's inflammation reaction on the mesh's implanting decreasing. With the aim of the gastrointestinal tract's stress ulcer's prophylaxis "Quamatel" was prescribed according to the scheme. Antibacterial therapy including Cephosulbin 1g twice per day, was continued, as all of them had the increased risk of the wound infectious complications occurrence. Thromboembolic complications prophylaxis was carrying out with "Clexane" dosed 40 mg during 7 – 9 days.

During the statistical calculations the integral system STATISTICA® 5.5 (STAT+SOFT® Snc, USA), using the license program (AXX 910A374605FA) was used.

Results and discussion

The results of umbilical hernias' surgical treatment, combined with the abdominal rectus muscle's diastasis among the patients of I and II groups were estimating by studying and comparing the direct and remote postoperative complications.

The direct results of treatment. According to the statistics significantly better results were received among the patients of the group I unlike the group II ($p < 0,05$): decreasing of seroma's formation was observed from 12 ($20,3 \pm 1,2$) to 2 ($3,4 \pm 0,3$)%, purulence of post-operative wound from 2 ($3,4 \pm 0,3$) to 0% and purulent infiltration from 2 ($3,4 \pm 0,3$) to 0%. The duration of stationary treatment in the group I took ($7,5 \pm 1,5$) days, in the group II it took ($12,3 \pm 2,2$) days.

The remote results of treatment were studied by repeated examination and questionnaire among 51 patients of group I, and among 51 patients of group II in time from 1 to 5 years. Chronical pain in the abdominal wall's region during 6 – 8 months after the operation was observed at 2 ($3,9 \pm 0,4$)% patients of the group II and at 1 ($1,8 \pm 0,3$)% patient of the group I, which was eliminated in the way of prescribing the physiotherapeutic procedures and non-steroidal anti-inflammatory drugs. Hernia's relapse arose among 1 ($0,9 \pm 0,2$)% patient of group I unlike the 6 ($5,9 \pm 0,5$)% patients of group II ($p < 0,05$).

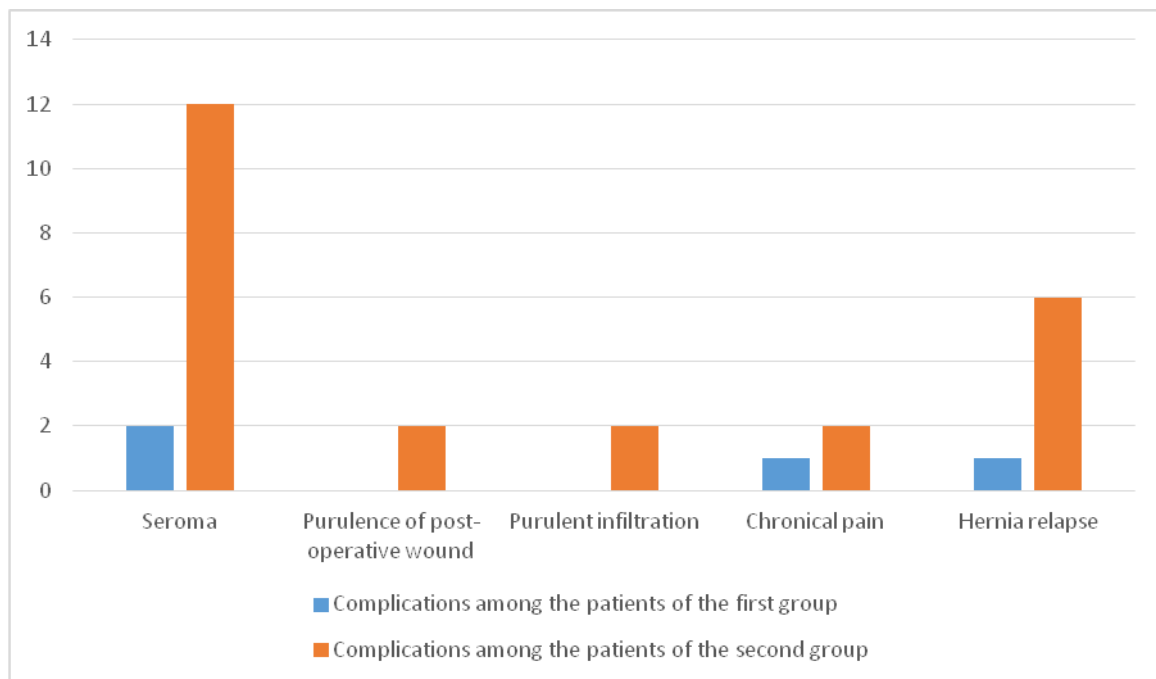


Fig. Direct and remote results of the surgical treatment of patients with umbilical hernias combined with abdominal rectus muscles' diastasis

Thereby, notably better results of laparoscopic surgical treatment were received in patients of group II. Due to nanomodified polypropylene meshy implant used for group I it was possible to achieve the reduction of seroma frequency occurrence in 6 times, purulence of post-operative wound in 2 times, purulent infiltration in 2 times. It is useful to note, that such a significant reduction of complications frequency is due to characteristics of nanomodified polypropylene mesh with the antiseptic polyhexamethylene guanidine chloride, specifically it owns the high sorption, hygroscopic and antiseptic effects whereby it helps to reduce the intensity of abdominal wall's tissues' aseptic inflammation, serous liquid's exudation and the risk of infection, while the classic polypropylene mesh has not such aforementioned characteristics. Remote results of surgical treatment also confirmed the advantages of using the nanomodified polypropylene mesh with the antiseptic polyhexamethylene guanidine chloride compared to using the classical polypropylene mesh, which is associated with the reducing of wound infectious complications' frequency, mesh migration and corrugation and prevents the umbilical hernia relapse.

Conclusions

The surgical treatment of umbilical hernias combined with the abdominal rectus muscle's diastasis based on the nanomodified polypropylene mesh is more effective compared to using the classical polypropylene mesh. That was proved by the reduction of

seroma frequency from $(20,3 \pm 1,2)$ to $(3,4 \pm 0,3)\%$, purulence of post-operative wound from $(3,4 \pm 0,3)$ to 0%, purulent infiltration from $(3,4 \pm 0,3)$ to 0%, chronic postoperative pain – from $(3,9 \pm 0,4)$ to $(1,8 \pm 0,3)\%$, hernia relapse – from $(5,9 \pm 0,5)$ до $(0,9 \pm 0,2)\%$.

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