THE PROBLEM OF WOUND COMPLICATIONS IN ABDOMINAL WALL ENDOPROSTHESIS REPLACEMENT IN VENTRAL HERNIAS

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The analysis of the data reported in literature has shown the use of synthetic endoprosthesis in herniology to have decreased the recurrence rate of hernias, but resulted in the increased frequency of wound complications, which are observed when different endoprostheses are used or have various locations in tissues. Wound complications occur both in open and laparoscopic operations. There have been considered the most common complications, such as seroma, infiltrate, etc., and estimated different risk factors of hernia development — obesity, the characteristics of performing operations, and hernia size, the number of recurrences. Special attention has been paid to fluid accumulations (seromas) in the anterior abdominal wall tissues after endoprosthetic repair. There have been mentioned current techniques to prevent wound complications: the reduction of operative intervention traumatism, new wound drainage types; physicochemical methods having an impact on the wound process course; the techniques based on the correction of immunological disorders, the use of cell technologies.

Key words: ventral hernia; endoprosthesis replacement; prevention of wound complications.

The use of mesh polymer endoprostheses in the treatment of ventral hernias has decreased the recurrence rate, though resulted in the increase of wound complication rate [1–3]. The complications occur when different endoprostheses (polypropylene, polytetrafluorethylene) are used or have various locations in tissues [4–7]. The most common complications are seroma, infiltrate, prolonged wound exudation, rarely — an abscess, marginal necrosis, subcutaneous fat infarction, fistulas, an implant cyst, granulomas.

The attitude of researchers to wound complications after prosthetic hernioplasty is controversial. The most authors pay attention only to wound abscess, while such complications as an infiltrate, seroma, hematoma, and suture sinuses are rarely considered. The main agents of infectious complications in endoprosthetic replacement are recognized bacteria vegetative on the anterior abdominal wall skin [8]. Contamination occurs due to pathogenic microorganisms entering from subcutaneous fat along ligatures of a mesh implant [9]. There is an opinion that complications in tension-free hernioplasty do not relate to synthetic material, but result from a wide surgical release of cutaneous-subcutaneous flaps, when a number of great perforating vessels coming from the trunks of epigastric arteries are transected [10].

The human body response to synthetic implants is understudied. The question of the tissue response to polypropylene depending on plaiting/weaving type, mesh cell size, the thickness and structure of endoprosthesis remains unclear [11–13].

According to some researchers [14] an infiltrate in wound area appears due to local inflammatory response of the body to an implant as a foreign body, and the response is usually aseptic. Other authors [15] consider the presence of fluid accumulations to cause cellular tissue inflammatory infiltration. Such a response of cellular tissue has an effect on the condition of prethrombotic readiness of blood coagulation system and is one of the predisposing factors of thromboembolic complications.

Some researchers link the problem of suture sinuses in abdominal wall endoprosthesis replacement for ventral hernias only to the use of polyethers (lavsan, capron) as suture material, and to solve the problem they suggest using the same suture material to fix polypropylene implant [16].

The causes of the formation of seromas and their role are assessed differently in different studies. Seroma is fluid accumulation in the anterior abdominal wall tissues resulted from exudation in potential space or cavity after surgery. The formation of seromas is a nonspecific inflammatory response to prosthesis and mechanical or chemical injury of tissues. The frequency of seromas can vary due to the technique determining their presence. According to clinical findings, the frequency is not high, and can reach 100% if ultrasound (US) investigation is used. Small amount of fluid in the implant area is found almost in all patients on day 5-7. In addition, fluid is found not only in spaces coming in direct contact with the mesh but also in subcutaneous fat or peritoneal fat, for example, if an implant is situated between the layers of the sheaths of the rectus muscle [17].

According to other findings [18], the main cause of seroma formation is the presence of a wound cavity and a mesh in it as a foreign body. Moreover, any physical efforts
Studies have shown that fluid accumulations after endoprosthesis replacement have significant differences in pressure necessary for fluid passage. Thus, techniques that produce pressure gradient have been used to reduce seroma formation. However, these techniques are not effective in all cases, and further research is needed to improve the treatment of seromas.

Some authors consider seroma formation to be related to the type of implant used. In vitro studies have shown that implants with anti-adhesive properties can reduce seroma formation. However, the effectiveness of these implants varies depending on the type of implant and the patient's condition.

The rate of seroma formation is higher in patients with obesity and diabetes mellitus. Other factors that increase the risk of seroma formation include age, gender, and tobacco use. Additionally, the type of procedure and surgical technique can affect the rate of seroma formation. In general, the rate of seroma formation is lower in laparoscopic procedures compared to open procedures.

Treatment of seromas involves conservative measures, such as rest, immobilization, and compression. In some cases, a needle aspiration or surgical drainage may be necessary. The choice of treatment depends on the size and location of the seroma, as well as the patient's overall health and condition.

Research suggests that reducing fluid accumulation in the postoperative wound is important to reduce the risk of seroma formation. Techniques such as negative pressure wound therapy and the use of anti-adhesive coatings on implants can help to reduce fluid accumulation and seroma formation. Further research is needed to develop more effective techniques for preventing seroma formation in patients undergoing endoprosthesis replacement.
Laboratory values, which statistically significantly affect the frequency of seromas are reduced concentrations of total protein, albumin, and high concentration of IL-1-RA (antagonists of interleukin-1 receptors) in blood serum. The study of the fluid in drainages after endoprosthetic repair to determine the predictors of seroma formation have showed only pH value (decrease) of wound discharge to be a seroma risk factor. Moreover, seroma and exudates of drainages are noted to differ statistically significantly in the content of some laboratory values [38].

H. Kaafarani et al. [39] studied risk factors of seroma formation in both open endoprosthetic repair, and laparoscopy. The peculiarities of the operation performance are of crucial importance: technique (open or laparoscopic), medical setting, where an operation is performed, wound drainage techniques and the characteristics of a hernia itself (the number of previous abdominal surgeries), while comorbidity is a less important factor.

Currently, the most authors consider that the prevention of wound complications in endoprosthesis repair should be based on effective drainage of the zone of hernioplasty and an implant. Timely extravasate removal is the basic prevention method of wound abscess [40–43].

Y.R. Mirzabekyan [44] emphasizes the wound drainage techniques after endoprosthetic repair, and criticizes Redon’s method, when drainage of “bellows” type is used, since this device does not maintain control over the amount of vacuum, and leaves open the possibility of the discharge reflux and the contact of sterile internal drainage lumen with external environment in emptying of the reservoir. There has been suggested low-vacuum active drainage of the wound using special systems, which maintain uniform and continuous vacuum along the whole length of the drainage combined with leakproofness and sterility.

According to other literature reports [31, 45] different variants of wound drainage after hernioplasty have no effect on the frequency of wound complications.

E.N. Chebyshева, B.Sh. Gogiy [46] studied the efficiency of drainage in abdominal wall replacement for ventral hernias according to ultrasound findings. Dynamic study after drainage removal showed no free fluid and fluid accumulations only in 44% of patients. 27.4% of patients were found to have fluid formations or free fluid above the mesh prosthesis that required puncture, 28.6% of patients were also observed to have small fluid accumulations, from 4 to 20 mm in size, along the previous drainages.

There is an opinion that the drainage is the entry of infection, though has no effect on inflammatory response resulted from operational injury [17, 47].

One of the main preventive methods of infectious complications in surgical management of the anterior abdominal wall hernias is preventive antibiotics. A number of researchers prove the advantages of using biologically active (antimicrobial) suture material [48], and there is some evidence for prospective use of polypropylene endoprosthesis from mono-filament fibers covered by biopolymer with cephalosporine antibiotic impregnated [49].

Currently, the problem of using synthetic materials in infected tissues is controversial. The most researchers consider that polypropylene endoprosthesis is not to be removed in case of infection, and implantation is possible in a strangulated hernia with intestinal area or greater omentum necrosis, acute intestinal obstruction, serous peritonitis. Contradiction is the phlegmon of hernia sac and the anterior abdominal wall [50–52].

V.V. Parshikov et al. [53] in their experimental study investigated the process of implant infection and stated bacterial biofilm to form on the surface of macroporous synthetic endoprostheses under bacterial contamination in vitro within 48 h. The process of mesh infection depends on the material, endoprostheses type, its surface microrelief, and microbial strain. Special endoprostheses able to resist biofilm formation are required to perform the operations using synthetic materials under infection.

There have been suggested various physicochemical methods to have an impact on the wound in perioperative period to prevent wound complications and improve the endoprostheses integration processes in tissue: the use of low-intensity laser radiation through drainage in an implant area [54, 55]; the use of infrared laser to expose the anterior abdominal wall in the operation wound area through bandage [56]; local usage of ozone and sodium hypochloride [57]; the wound management of low-energy air plasma stream in NO-therapy mode [58]. A number of researchers pay attention to immunological disorders and their correction in such patients [59–61].

V.V. Zhebrovsky et al. [59] consider one of the directions of prophylaxis of inflammatory complications in hernioplasty to be combating endogenous toxemia, and against its background – the correction of immune alterations. The result of enterogenous toxemia is the release of inflammatory mediators with the development of local and systemic inflammatory responses in the form of wound abscesses, postoperative pneumonia, urogenic complications, peritonitis, abdominal sepsis and other complications. The authors think it necessary to use enterosorption, selective intestinal decontamination and immunomodulatory agents in preoperative preparation.

Now there have been carrying out the investigations on the study of endoprostheses integration in tissues in order to optimize the wound process and accelerate the intergrowth of mesh prostheses, as well as to reduce the complications in postoperative period. Y.S. Vinnik et al. [22] in their experimental study prove the advantages of using polypropylene endoprosthesis covered by biodegraderating biopolymer over polypropylene and composite endoprostheses. They suggest using autologous embryonal fibroblasts in abdominal wall repair [50, 63], the technology of intraoperative covering of mesh endoprostheses by autologous protein-platelet membranes, for production of which patients’ plasma is used [18].

One of the traditional directions of the prophylaxis of wound complications is the reduction of traumatic operative intervention.

There have been suggested original techniques of prosthetic hernioplasties without mobilization of subcutaneous fat from aponeurosis. S.G. Grigoriev et al. [64] have developed the hernioplasty technique without hernia sac removal. It consists in the following: the
anterior wall of the hernia sac only is opened to enter the abdominal cavity; intrabdominal plasty is used, and the implant surface is covered by the walls of the hernia sac. V.V. Parshikov et al. [65] suggest an original technique of sutureless fixation of an endoprosthesis. After opening the hernia sac they perform mobilization of hernia orifice from the side of the abdominal cavity with no treatment from wound-side and without separating cellular tissue from aponeurosis. An endoprosthesis is fixed in abdominal wall tissues using the strips cut beforehand along the perimeter of an endoprosthesis passing them through the abdominal wall using a special trocar.

In literature there are reports showing the significance of tissue dissection techniques to prevent wound complications. The use of an ultrasound scalpel compared to traditional high-frequency coagulation enables to reduce the volume of wound discharge along drainages and the intensity of pathological changes in adjacent tissues. Moreover, the use of high-frequency knife for dissection and hemostasis increases the postoperative complication rate with the increase of a patient' body mass [66]. The experiment has proved the advantages of high-intensity laser radiation and ultrasound energy in tissue dissection before electrosurgical effect [67].

One of the directions of wound complication prophylaxis is also new techniques of fixation of subcutaneous flaps and eradication of residual cavities in cellular tissue. Some researchers fix subcutaneous fat when suturing the wound to the endoprosthesis location zone [68–70]. They suggest original ways of fixation of subcutaneous fat (new types of sutures) [71, 72], the use of various glue compositions to anchor subcutaneous flaps — fibrin glue [73] and medical polymer nanoglu [74].

It is recommended to use talc when closing wounds with significant detachment of subcutaneous flaps after hernioplasty [75]. There are reports on the efficiency of using special "vacuum" dressings, which prevent the formation of seromas after the treatment of incisional ventral hernias [76].

Thus, the analysis of literature shows that the problem of wound complications in endoprosthetic repair of ventral hernias still remains unsettled. The efficiency of various preventive techniques of wound complications in abdominal wall repair is questionable. It is necessary to improve well-known and develop new endoprostheses, which would draw a minimum response of the body in good integration in tissue and high strength to avoid recurrences.

References


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