

Pathogenesis of Recurrent Ventral Hernia

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Annotation: The causes of recurrent hernias after primary hernioplasty are varied. They are divided into general predisposing factors associated with disruption of reparative processes and a decrease in the general nonspecific reactivity of the body; producing factors that weaken the abdominal wall and affect intra-abdominal pressure; local factors associated with the operation; and indirect factors caused by wound complications (3,10,18,23).

Keywords: Recurrent ventral hernia, hernioplasty, herniogenesis, autoplasty, alloplasty, xenoplasty.

Relevance. The causes of recurrent hernias after primary hernioplasty are varied. They are divided into general predisposing factors associated with disruption of reparative processes and a decrease in the general nonspecific reactivity of the body; producing factors that weaken the abdominal wall and affect intra-abdominal pressure; local factors associated with the operation; and indirect factors caused by wound complications (3,10,18,23).

To prevent recurrence of the hernia after surgery, it is important to ensure healing of the postoperative wound by primary intention (1,2,12,14,17,21). Napolitano L.M. et al. (2004) emphasized that the incidence of hernia recurrence decreases with adequate pain relief, careful preparation of tissue around the hernia defect, protection of fatty tissue from injury during surgery, and tension-free suturing. An important factor is the method of hernioplasty: auto-, allo- and xenoplasty reduce the frequency of relapses by 3 times compared to plastic surgery with one's own tissues. An important role is played by suture materials (strong, non-hygroscopic threads), which do not cause changes in tissue. Prevention of persistent intestinal paresis, hypostatic pneumonia, exacerbation of chronic bronchitis, early activation of the patient and exclusion of early physical activity after surgery reduce the risk of relapse of PIH in the long term (4,6,13,19).

Among the causes of recurrence of postoperative hernias, the leading role is played by congenital disorders of collagen metabolism (7,11,16,20) and infectious complications in the area of the postoperative wound (9,17). Pascual G. et al. (2012) believe that the main factors are mechanical, explaining that after surgery the length of the wound increases by 30% compared to the original, which causes lateral stress in the spaces between the sutures. This leads to protrusion of preperitoneal fat through the gaps between the sutures and the gradual formation of a hernial orifice. In the early postoperative period, increased intra-abdominal pressure is associated with intestinal paresis, cough and vomiting (20).

Impaired function of the anterior abdominal wall muscles and nerve damage also contribute to the formation of recurrent hernias (15), as confirmed by cases of hernia formation after closed abdominal trauma (1). An important role in herniogenesis is played by tissue tension in the surgical area. This tension leads to atrophy and weakening of the tissues of the abdominal wall, which contributes to the cutting of sutures. During the formation of PVG, according to V.I. Belokoneva et al. (2015) the anterior and lateral abdominal muscles lose one of the fixation points, which leads to muscle contraction, the development of contracture and the replacement of muscle fibers with connective and fatty tissue. These significant changes impair the function of the abdominal wall muscles, which must be taken into account when choosing a method for closing a defect in the abdominal wall (8,22).

Excess body weight also contributes to the formation of hernias. A hanging skin-subcutaneous "apron", the weight of which can reach 5-8 kg, creates a constant static load on the aponeurosis. Factors contributing to hernia formation include chronic constipation, previous herniotomies, diabetes mellitus, chronic bronchitis, emphysema, anemia, hypo- and dysproteinemia, age over 60 years, midline incisions, laparostomies in patients with peritonitis, acute intestinal obstruction and pancreatic necrosis (8,11). A significant role in the formation of hernias is played by defects in surgical technique, insufficient hemostasis, inadequate wound drainage, violation of asepsis rules and purulent-inflammatory complications (5,20).

It has been established that the development of PIH is associated with the type of surgical approach used during the primary operation. The highest risk of hernia formation is observed with pararectal and oblique subcostal approaches according to Kocher (6,10).

Postoperative ventral hernias most often occur within the first three years after surgery, with most patients presenting within the first year (13). According to Timmermans L et al (2019), hernias occurring in the first six months after surgery are often associated with technical defects during surgery. While the development of hernias in the first year after surgery is associated with complications in the surgical wound, in the subsequent two years, comorbidities and other factors become the main factors (17). The reasons for the formation of PIH more than 10 years after surgery are still not well understood.

Among the problems in herniology, the causes of recurrent hernias after the use of prosthetic hernioplasty methods remain the least studied, despite their high frequency, which ranges from 5 to 66% (2,5).

The introduction of prosthetic methods of hernioplasty using synthetic prostheses has reduced the frequency of relapses by 20-50% (5). The success of these operations largely depends on the quality of the prostheses used. Researchers are constantly searching for the "ideal prosthesis" that must meet stringent requirements (1,3,19). Synthetic prostheses should not soften under the influence of tissue fluids, cause inflammation, rejection, allergic reactions or sensitization, and should not have carcinogenic properties. They must be chemically inert, durable, suitable for factory production and retain their properties during sterilization. Synthetic mesh prostheses are classified by material, pore size, degree of hydrophilicity, and the presence or absence of an anti-adhesive barrier (6,19).

There are four main options for the location of the prosthesis during prosthetic hernioplasty: "on lay", "in lay", "sub lay" and intra-abdominal position. With the "on lay" method, when the prosthesis is placed on the stitched edges of the aponeurosis, complications such as seromas, hematomas, infiltrates, ligature fistulas and wound suppuration are possible (2,5,22). Adequate drainage and proper wound management can significantly reduce complications. The use of vacuum drainage helps prevent the accumulation of exudate and blood in the wound, helps bring the edges of the wound closer together and eliminates the wound cavity, and also allows you to manage the healing process. Haltmeier T. et al (2013) noted a 2.4-fold reduction in the number of wound suppurations when using vacuum drainage. Infection of the prosthesis during "on lay" requires its removal, although Malbrain et al. (2013) allow its persistence even in infected tissues. Tension repair with local tissues with reinforcement with a prosthesis in the "on lay" position increases the frequency of hernia recurrences by 28.3% (14). Studies have shown that seromas do not arise due to the presence of a prosthesis, but due to damage to the subcutaneous tissue during mobilization of the hernial sac (4,13); seromas in the subcutaneous tissue are associated with impaired blood supply to the mobilized edges of the skin. Ischemia of adipose tissue leads to aseptic and then to infected necrosis of the subcutaneous tissue. Thus, it is not the prosthesis itself, but the technique of performing the operation that causes complications. Donnelly JP et al. (2019) believes that abdominoplasty should be a mandatory component of prosthetic hernioplasty if indicated.

The "in lay" method involves closing the abdominal wall defect with a prosthesis placed in the hernial orifice without suturing it, which preserves or slightly reduces the volume of the abdominal cavity.

Egea AM et al. (2010) consider such operations to be palliative. The frequency of hernia recurrence with “in lay” ranges from 3 to 44% (11).

With the “sub lay” method, the prosthesis is located under the aponeurosis, in contact with the peritoneum, greater omentum, membranes of the hernial sac and intestinal loops. The recurrence rate for “sub lay” reaches 12% (9), and the rate of local complications varies from 20 to 45.8% (4,10). Studies by Gray SH et al. (2018) did not find a significant difference in the rate of postoperative complications and relapses between the “on lay” and “sub lay” methods.

Intra-abdominal placement of the prosthesis is undesirable, since contact of the synthetic material with the intestine leads to the formation of adhesions and the development of adhesive disease, including the formation of intestinal fistulas in the long term (12,13). To prevent such complications, some authors suggest using fibrin glue or gels based on carboxymethylcellulose and hyaluronic acid (16,19); some modern synthetic prostheses, such as polytetrafluoroethylene, behave well when in contact with internal organs.

With various types of prosthetic hernioplasty in patients with large and giant postoperative ventral hernias, the frequency of purulent complications ranges from 2 to 6%, which is slightly higher than with other “clean” operations (15,18). Reasons for this include ischemic disturbances in the subcutaneous fat graft during its mobilization from the underlying aponeurosis (23). The main perforating vessels are located in the projection of the trunks of the epigastric vessels along the lateral edge of the rectus abdominis muscles. Their intersection when mobilizing a skin flap more than half the width of the rectus abdominis muscle leads to ischemia of the subcutaneous tissue and skin edges (7).

Other factors that contribute to infection of a postoperative wound during hernia repair are the presence of a “dormant” infection around old ligatures, the creation of large spaces when separating the anatomical structures of the abdominal wall, obesity, immunosuppression, a significant volume and duration of the operation (12,21), as well as suturing technique when closing abdominal wall defects. Sergent F et al. (2020) classify wound complications in patients after surgery for PIH into three groups: conditionally clean (without a history of suppuration), contaminated (with a history of purulent process) and infected (with a purulent focus at the time of admission).

In the long term, the most significant complication is recurrence of the disease. This may be caused by mesh displacement and the formation of a defect in the abdominal wall, not reinforced by the mesh, with the peritoneum re-extruding through the defect in this area. Displacement of the mesh is possible due to its partial or complete separation due to violation of the fixation technique and other reasons (9,10). Relapses can be caused by concomitant diseases, anatomical features of the structure of the anterior abdominal wall, and violations of the rules for managing the postoperative period. Early physical activity and pregnancy after anterior abdominal wall surgery increase the risk of recurrent PIH.

Factors that do not depend on the quality of surgical technique include non-compliance with the recommended regimen after surgery, early return to physical activity before the formation of a strong scar holding the mesh, and concomitant pathology, accompanied by an increase in intra-abdominal pressure in the early stages after surgery.

According to the Center for Disease Control and Prevention (USA), surgical infection develops in 12% of patients after “clean” hernia repairs and in 34% after potentially infected ones (12). Infection of the prosthesis is the most serious complication after hernia repair, which can develop within a year after implantation. Infection of the prosthesis after open hernia repair is observed in 6-10% of patients, and with laparoscopic hernioplasty - in 3.6%. In 82% of cases, *S. aureus* is found in the wound, in 17% - gram-negative microorganisms, such as *Proteus* and *Klebsiella*. The use of coarse and lightweight polypropylene meshes helps eliminate infection, while microporous polytetrafluoroethylene meshes are almost impossible to eliminate infection, which requires removal of the prosthesis (6).

Conclusion. Analysis of the literature shows that in the pathogenesis of recurrent hernias after repair with local tissues and prosthetic methods, there are both common and different factors. In local tissue repairs, the main factor is tissue tension, which is also present in prosthetic repairs, especially in the “on lay” and “sub lay” positions. Significant differences in pathogenesis lie in the fact that the prosthesis is a source of chronic inflammation in the tissues, causing its biodegradation, wrinkling, displacement and separation from the place of fixation. This determines the characteristics of the course of recurrent hernias after prosthetic hernioplasty methods, which require special approaches to their treatment.

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