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MODERN METHODS OF PROSTHETIC REPAIR OF VENTRAL HERNIAS (LITERATURE REVIEW)

Dusiyarov M.M.
Ph.D. Associate Professor of the Department of General Surgery
Samarkand State Medical University
Xujabaev S.T.
MD Associate Professor of the Department of General Surgery
Samarkand State Medical University

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Abstract:
According to the literature review, abdominal hernia repair is one of the most frequently performed operations worldwide. Almost all hernia plastic surgery currently performed uses some form of prosthetic materials, in particular, mesh. A huge number of meshes are implanted every year, therefore, many hernia repair products are currently on the market. This has also caused increased interest among surgeons in the relevant characteristics of the mesh, such as material, structure, price, susceptibility to infections and the body's response to the mesh.

Keywords: Ventral hernias, prosthetic plastic surgery, general surgery

INTRODUCTION. Despite the improvement of hernioplasty over the past two decades in terms of general technique, the results, according to many experts, remain unsatisfactory. Postoperative hernias sutured with a primary suture have a recurrence rate from 12% to 54%, whereas the recurrence rate of mesh surgery can reach 36%. In addition, the introduction of a foreign body such as a prolenic mesh can lead to serious adverse effects such as pain, infection, fistula, intestinal damage and intestinal adhesions [7].

Some reports report improved results of laparoscopic repair of a postoperative hernia, in which the recurrence rate is very low - 4.3%, and there are fewer wound complications compared with the open technique[11]. There is not enough evidence to confirm the advantage of one plastic surgery method over another. It is still unclear whether one plastic surgery method is superior to another, and it is not known whether one plastic surgery method is more suitable for certain types of hernias compared to another. The clinical recommendations of the Society for Surgery of the Digestive Tract (SSAT 2018) have shown that hernias of less than 3 cm can be eliminated primarily without the use of a prosthetic mesh, as well as any hernias that require extensive dissection of tissues, for example, when separating components. This method is then suitable for open plastic surgery, but any other types of hernias that do not fall into the above category can be considered, where possible, for laparoscopic plastic surgery [14]. In addition, the data currently available consider the best recovery method with different outcomes, such as recurrence rate, associated costs, postoperative complications, and long-term outcomes.

Abdominal hernia repair is one of the most frequently performed operations worldwide. Almost all hernia plastic surgery currently performed uses some form of prosthetic materials, in particular, mesh. A huge number of meshes are implanted every year, therefore, many hernia repair products are currently on the market. This has also caused increased interest among surgeons in the relevant characteristics of the mesh, such as material, structure, price, susceptibility to infections and the body's response to the mesh.

Interestingly, although high-resolution imaging techniques such as MSCT and MRI can visualize certain meshes, which are currently widely used in laparoscopic repair of ventral and postoperative hernias, until now the problem of radiological visibility of meshes has attracted surprisingly little attention. Since manufacturers currently do not provide information about the radiopaque properties of their mesh material, both surgeons and radiologists either do not have information on this issue, or are forced to obtain it from their own experience. All these factors have prompted radiologists to pay more attention to the radiopaque properties of the meshes currently used in hernia surgery.

The visibility of grids ranges from invisible (e.g. Ultrapro and Vypro, both Ethicon companies) to barely discernible (Surgipro, Covidien; Marlex, BardDavol; Prolene, Ethicon; Parietex, Covidien); Parietene, Covidien; and Proceed, Ethicon), to easily visible (Composix and Ventralex, both from BardDavol), up to

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always visible (Dualmesh, Gore). Visibility - the property of being detected by high-resolution imaging methods - is determined by two factors: mainly the specific properties of the mesh itself and, to a lesser extent, the inflammatory reactions of the host caused by implanted prostheses.

The most important properties of the mesh that determine its radiological visibility are the density, structure and thickness of the material from which it is made. The density of the material from which the mesh is made plays a crucial role. Materials with a density close to that of human tissues are not visible because they are isoattenuated with respect to surrounding tissues. Polypropylene and polyester meshes have a density similar to that of adjacent muscles, and because of this they are usually either invisible or poorly visible. The density of foamed polytetrafluoroethylene is much higher than that of polypropylene or polyester. Consequently, meshes containing foamed polytetrafluoroethylene material are clearly visible using MSCT as a linear hyperabsorbing structure.

The structure or composition of the grid is another important factor. In the production of many nets, the main materials can be woven or knitted, as well as non-woven or non-woven. For technical reasons, including edge stability and elasticity, the vast majority of polypropylene and polyester nets are knitted. As for the radiopaque properties of grids, as a rule, a large mass means greater visibility.

The thickness of the mesh is also very important. An increase in the thickness of the mesh will be associated with an improvement in the X-ray imaging of this product (i.e., the thicker the mesh, the better the visualization). Thus, a 1.5 mm thick homogeneous expanded polytetrafluoroethylene mesh (Dualmesh PLUS, Gore) is more visible than a 1 mm thick homogeneous expanded polytetrafluoroethylene mesh (Dualmesh or Dualmesh PLUS). As expected, the latter are much better visible than grids containing the same material, but in a much thinner form (Composix, Intramesh T1, Cousin, VentralexHerniaPatch, BardDavol and AIR Composite, CABS).

Since pure polypropylene and polyester meshes are usually not recommended for intraperitoneal administration, all polypropylene and polyester meshes currently used for laparoscopic plastic surgery of ventral and postoperative hernias are coated or impregnated with a protective membrane or film to minimize the formation of adhesions, intestinal erosion or the development of intestinal fistulas (ParietexComposite, Sofradim; Proceed; TiMesh, Biomet; C-QUR, AtriumMedical; Intramesh W3, Cousin; Dynamesh, FEG Textiltechnik; Sepramesh IP, Bard Davol; Ventralight ST, Bard Davol; and Ventralex ST, Bard Davol). When using these so-called composite grids, the visibility of the non-X-ray contrast mesh may be affected by the X-ray contrast properties of the barrier coating. However, these coatings are extremely thin and, apparently, have practically no effect on the non-contrast properties of the integral product. For example, the thickness of the applied titanium layer in TiMesh ranges from 30 to 50 nm. Alternatively, other composite meshes cover the visceral side of the main polypropylene mesh with another thin expanded polytetrafluoroethylene mesh that serves as a protective barrier (Composix, Ventralex, Intramesh T1 and Dulex, all from BardDavol). Since foamed polytetrafluoroethylene is clearly visible using MSCT and MRI, the degree of visibility will correlate with the thickness of the component made of foamed polytetrafluoroethylene.

Implantation of all prosthetic materials causes a specific host response in the form of various inflammatory reactions consisting of a cascade of events (coagulation, inflammation, angiogenesis, epithelialization, fibroplasia, matrix deposition and contraction) that lead to collagen deposition and connective tissue formation. This inflammatory reaction of the host and the penetration of collagen will also take place in the product (mesh) and will depend on the amount and weight of the implanted prosthetic material. This varies depending on the different grids: from moderate (foamed polytetrafluoroethylene) to moderate (light mesh) and to extreme (heavy polypropylene mesh). High-resolution imaging techniques can detect subtle changes associated with an inflammatory response that may indirectly indicate the presence of an "invisible" mesh. In general, this "indirect visibility" of the meshes correlates with the degree of inflammatory response of the host caused by the mesh. However, these radiological changes are more subtle, and so far clinicians have not received any assessment of clinically significant parameters for radiological assessment of post-surgical problems. This is true because the interpretation of these studies requires a very well-informed radiologist [2] and, as a rule, the results are not associated with a high degree of agreement between researchers [3]. In addition, the interpreting radiologist is often not familiar with all the clinical information related to the surgical history of patients.

From a clinical point of view, the grids currently used can be divided into several groups based on their visibility or radiopaque properties in high-resolution radiological studies. The new classification scheme

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should be provided with instructions for use for all products so that both surgeons and radiologists better understand the properties of the prosthesis to be implanted or to be recognized during X-ray examination. That is, the product will be labeled according to one of the following classifications: always visible, inaccurately visible, indirectly identifiable, poorly visible or invisible.

The only grids that are always visible are Dualmesh and Dualmesh PLUS due to the high density of the material (polytetrafluoroethylene foam), its uniform structure (non-woven and non-woven) and its thickness (1, 1.5 or 2 mm). This function allows you to measure the mesh dimensions, position and overlap of the fascial defect very accurately and reliably.

Novitsky YW (2017) attempted to define the ideal mesh for laparoscopic repair of ventral and postoperative hernia as "inert, easy to handle and having a structure that facilitates ingrowth into the abdominal wall, while avoiding adhesions on the visceral surface" [10]. In another study, considerations were considered for choosing the optimal mesh to be used for ventral hernia repair [4]. None of these studies attached importance to the radiopaque properties of mesh products or the materials from which they were made.

Another characteristic that should be chosen as the "ideal" property of the mesh is that it should be radiologically visible. The possibility of mesh visualization can become the basis for a better understanding of potential complications after laparoscopic repair of ventral and postoperative hernias, such as relapses [15], mesh protrusion, mesh shrinkage [6] and their consequences. mechanisms. It can also be very useful in planning subsequent abdominal surgeries in patients with laparoscopic repair of ventral and postoperative hernias. This will allow the surgeon to possibly avoid incision of the implanted mesh or even contact with it [12]. The disadvantages of invisible grids are typical for studies requiring marking the edges of the grid with titanium or metal clips, impregnating the edges of the grid with barium, and applying dots to the grid with superparamagnetic iron oxides [9]. Modern concepts of treatment of patients with ventral hernia consist in a combination of various methods of hernioplasty. Hernia parameters and surgical and anesthetic risk significantly affect the choice of prosthetics method.

HolmdahlV. etal. (2019) conducted a randomized controlled trial on giant PVG plastic surgery using a synthetic mesh or a full-layer skin flap[8].Plastic surgery of giant PVG often requires complex surgery, and the results of traditional methods using synthetic mesh as reinforcement are unsatisfactory, with a high frequency of relapses and complications. The hypothesis of the authors was that a full-layer skin graft (FTSG) is an alternative reinforcing material for plastic giant PVG. FTSG was compared with conventional materials that are currently used as reinforcement in the plastic of giant PVG. 52 patients were included in the study: 24 received FTSG and 28 synthetic meshes. After 1 year of follow-up, four relapses (7.7%) were detected, two in each group. There were no significant differences in pain, patient satisfaction, or aesthetic outcome between the groups.

A.S. Ermolov and co-authors (2019) optimized surgical tactics in patients with giant PVG by analyzing the immediate and long-term results of modern hernioplasty methods. Up to 50% of surgical interventions on abdominal organs are complicated by PVG [5]. The mortality rate in interventions for giant PVG reaches 2.3%. According to various data, the recurrence rate ranges from 10 to 60%. Repeated surgical interventions for recurrent ventral hernias increase the recurrence rate by another 10% [1]. There are many risk factors for recurrence - age, gender, genetic characteristics, concomitant diseases, intraoperative hernia parameters and surgical procedure.

At the Institute of Emergency Medicine and the medical unit of the Ministry of Internal Affairs. Sklifosovsky operated on 680 patients with PVH over a 15-year period (445 (65.4%) women, 235 (34.6%) men). The average age of the patients was 63.2±14.2 years. Sublay herniation was performed in 490 (72%) patients without severe concomitant pathology and a relative volume of hernial protrusion of up to 18%. The submuscular insertion technique was used in 95 (14%) patients with severe concomitant pathology and persons over 50 years of age or with a relative volume of hernial protrusion of more than 18%. The hybrid technology was used in 12 patients with severe concomitant diseases, European-qualified W2 hernias or recurrent hernias, significant adhesions in the abdominal cavity or hernial sac.

Early postoperative wound complications occurred in 27 (5.5%) patients in the form of hematoma (n=12, 2.5%), infiltration (n=7, 1.4%), wound suppuration (n=8, 1.6%). Other complications were observed in 6 (1.2%) patients: pneumonia, pulmonary embolism, intestinal obstruction. There were no deaths. Relapses in the long-term period were detected in 18 (3.7%) patients. The axillary-insertion herniation technique was accompanied by early postoperative

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wound complications in 5 (5.1%) patients, including hematoma (n=3, 3.2%), infiltration (n=1, 1%), wound suppuration (n=1, 1%). There was no mortality. No other early postoperative complications were observed. Relapses were detected in 5 (5.2%) patients. Preoperative intra-abdominal pressure was 7-10 mmHg in all patients with tissue deficiency. This value did not exceed 12 mmHg after surgery due to the creation of a "preset diastasis". An analysis of the early and long-term results of hybrid anterior abdominal wall surgery revealed no recurrence, local and systemic complications. Persistent Minor diastasis between the rectus muscles reinforced with a mesh implant was observed in 3 (25%) of 12 patients.

With the increasing use of mesh for PVG plastics, a wide range of different meshes are currently available for consideration [13].In general categories, they consist of synthetic, composite, absorbable, biological and hybrid meshes. The group of synthetic meshes includes products made of polypropylene, polyester and polytetrafluoroethylene (PTFE).In addition, synthetic meshes can be classified according to the density of the mesh structure into light, medium and heavy meshes, as well as based on the size of their pores.Composite meshes are meshes in which a barrier coating is applied to one side of the mesh to minimize the formation of adhesions on the visceral side.This coating can be made of either a permanent material such as PTFE or a absorbable material.

In recent years, there has been an increase in the number of biological nets available for abdominal wall hernia repair.Biological nets usually consist of materials derived from humans, pigs, or cattle.They undergo a process in which the material is decellularized and further processed.The rationale for the use of biological nets is that they can act as a framework for the ingrowth of native tissue.In addition, there are absorbable synthetic meshes whose properties are similar to those of biological meshes, but with theoretically less risk, since they are not derived from animals or humans.

The choice of mesh for a ventral hernia depends on many factors, including both the properties of the mesh and its location, for example, whether it will be placed intraperitoneal, preperitoneal or retro-rectally.The guiding principle is to avoid placing uncoated polypropylene mesh intraperitoneally, where it may be in direct contact with internal organs.In addition, the type of hernia defect is another factor, for example, whether the wound is clean compared to clean contaminated or contaminated, and also whether the plastic is performed with a bridge or with a support.In general, light or biological nets should be avoided to close the defect due to the increased recurrence rate.

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