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HERNIAS
OF THE ABDOMINAL WALL

Study guide

Ministry of Education and Science of Ukraine
Ministry of health of Ukraine
Sumy State University
Educational and Scientific Medical Institute

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Recommended for publication
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This study guide contains information about basic principles of diagnostics and treatment of patients with abdominal wall hernias.

For English-speaking students of higher educational institutions of III–IV levels of accreditation and postgraduates: internists, surgeons, family physicians.

CONTENT

INTRODUCTION

The publication of this tutorial is caused by providing of the new Master's training program for the discipline "Surgery".

Surgery is very important for all physicians. It starts at the IY-th academic year after finishing fundamental disciplines such as pathologic anatomy, pathologic physiology, pharmacology, topographic anatomy, operative surgery and initial clinical disciplines: general surgery, propaedeutics of internal diseases. Surgery forms the basic knowledge for successful study of the special branches of internal diseases.

The general purpose is: assimilation of theoretical and practical knowledges about etiology, pathogenesis, typical clinical manifestations, and methods of diagnosing, conservative treatment, operative treatment, rehabilitation of patients with abdominal wall hernias for higher educational institutions of III–IV levels of accreditation and postgraduates: internists, surgeons, family physicians.

Concrete purposes are:

– interpretation of etiology, pathogenesis, classifications, typical clinical manifestations of the abdominal wall hernias;

– formation of algorithms of diagnosing, conservative and operative treatment, postoperative treatment and rehabilitation;

– differential diagnostics of abdominal wall hernias;

– evaluation of the results of lab. tests and additional methods of investigations in patients with abdominal wall hernias;

– identification of the indications for laparoscopic and open techniques.

1. PATHOMORPHOLOGY, CLASSIFICATION

Hernia of the abdominal wall or external hernia is such surgical disease, which is characterized by protrusion of the visceral organs from the place of their physiological placement through the natural canals or defects of the abdominal and pelvic wall. Uncomplicated abdominal wall hernias do well. However, hernias with associated strangulation have an associated mortality rate of 10 %. Abdominal wall hernias are common, with a prevalence of 1.7 % for all ages and 4 % for those aged over 45 years.

Each abdominal hernia consists of hernia's gate, hernia's sac and hernia's contents *(fig. 1)*. Hernia's sac is formed by the parietal peritoneum and can contain any organ from abdominal cavity, but mostly – small intestine and omentum. Sometimes it contains other organs: large intestine, urinary bladder, ovary and appendix. The main parts of the hernia sac are neck, body and fundus. Through the hernia's gate peritoneum is protruding.

The *sliding* hernia occurs when the hernia's sac is partially formed by the wall of an organ without peritoneal covering (e. g., posterior cecum, ovary, bladder, sigmoid).
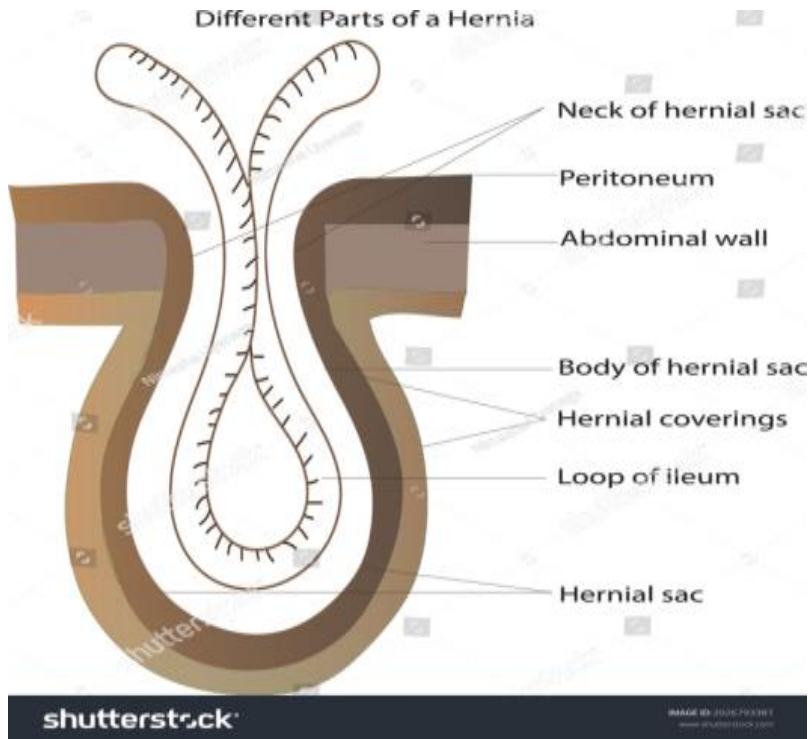
Figure 1 – Pats of a hernia
(https:// image.shutterstock.com)

Etiology of hernias:
Hernias are divided into two main groups:

- congenital;
- acquired.

Contributes factors: weakness of the abdominal wall (anatomical; congenital; connected with sex, age, weight loss, injury, postoperative scar, pregnancy).

Causes factors: increased abdominal pressure (hard physical activity, chronic cough, chronic constipation, obstructive uropathy and ascites).

Classification:

1. According to the anatomical localization:

- inguinal (indirect and direct) hernia;
- midline hernia;
- femoral hernia;
- umbilical, paraumbilical hernia;
- lumbar hernia;
- obturator hernia;
- Spigelian line hernia;
- ischiorectal hernia.

2. According to the clinical presentations:

- complete and incomplete;
- reducible (when the contents of the hernia sac can be returned to their normal anatomic domain) and nonreducible;
- traumatic;
- postoperative;
- complicated and noncomplicated.

3. Hernia's complications:

- incarceration;
- strangulation;

- contain's inflammation;
- contain's trauma;
- contain's malignization.

Abdominal wall anatomy.

The skin of the lower anterior abdominal wall is innervated by anterior and lateral cutaneous branches of the ventral rami of the seventh through 12th intercostal nerves and by the ventral rami of the first and second lumbar nerves. These nerves course between the lateral flat muscles of the abdominal wall and enter the skin through the subcutaneous tissue.

The first layers encountered beneath the skin are Camperis and Scarpais fasciae in the subcutaneous tissue. The major blood vessels of this superficial fatty layer are the superficial inferior and superior epigastric vessels, the intercostal vessels, and the superficial circumflex iliac vessels (which are branches of the femoral vessels).

The external oblique muscle is the most superficial of the great flat muscles of the abdominal wall. This muscle arises from the posterior aspects of the lower eight ribs and interdigitates with both the serratus anterior and the latissimus dorsi at its origin.

The posterior portion of the external oblique muscle is oriented vertically and inserts on the crest of the ileum. The anterior portion of the muscle courses inferiorly and obliquely toward the midline and the pubis.

The muscle fibers themselves are of no interest to the inguinal hernia surgeon until they give way to form its aponeurosis, which occurs well above the inguinal region.

The obliquely arranged anterior inferior fibers of the aponeurosis of the external oblique muscle fold back on themselves to form the inguinal ligament, which attaches laterally to the anterior superior iliac spine. In most persons, the medial insertion of the inguinal ligament is dual: one portion of the ligament inserts on the pubic tubercle and the pubic bone, whereas the other portion is fan-shaped and spans the distance between the inguinal ligament proper and the pectineal line of the pubis. This fan-shaped portion of the inguinal ligament is called the lacunar ligament. It blends laterally with Cooperis ligament.

The more medial fibers of the aponeurosis of the external oblique muscle divide into a medial crus and a lateral crus to form the external or superficial inguinal ring, through which the spermatic cord (or the round ligament) and branches of the ilioinguinal and genitofemoral nerves pass.

The rest of the medial fibers insert into the linea alba after contributing to the anterior portion of the rectus sheath.

Beneath the external oblique muscle is the internal abdominal oblique muscle. The fibers of the internal abdominal oblique muscle fan out following the shape of the iliac crest, so that the superior fibers course obliquely

upward toward the distal ends of the lower three or four ribs while the lower fibers orient themselves inferomedially toward the pubis to run parallel to the external oblique aponeurotic fibers. These fibers arch over the round ligament or the spermatic cord, forming the superficial part of the internal (deep) inguinal ring.

Beneath the internal oblique muscle is the transversus abdominis. This muscle arises from the inguinal ligament, the inner side of the iliac crest, the endoabdominal fascia, and the lower six costal cartilages and ribs, where it interdigitates with the lateral diaphragmatic fibers.

The medial aponeurotic fibers of the transversus abdominis contribute to the rectus sheath and insert on the pecten ossis pubis and the crest of the pubis, forming the falx inguinalis. Infrequently, these fibers are joined by a portion of the internal oblique aponeurosis.

Aponeurotic fibers of the transversus abdominis also form the structure known as the aponeurotic arch. It is theorized that contraction of the transversus abdominis causes the arch to move downward toward the inguinal ligament, thereby constituting a form of shutter mechanism that reinforces the weakest area of the groin when intra-abdominal pressure is raised. The area beneath the arch varies. Many authorities believe that a high arch, resulting in a larger area from which the transversus abdominis is by definition absent, is a predisposing factor for a direct inguinal hernia. The transverse aponeurotic

arch is also important because the term is used by many authors to describe the medial structure that is sewn to the inguinal ligament in many of the older inguinal hernia repairs.

The rectus abdominis forms the central anchoring muscle mass of the anterior abdomen. It arises from the fifth through seventh costal cartilages and inserts on the pubic symphysis and the pubic crest. It is innervated by the seventh through 12th intercostal nerves, which laterally pierce the aponeurotic sheath of the muscle.

The semilunar line is the slight depression in the aponeurotic fibers coursing toward the muscle. In a minority of persons, the small pyramidalis muscle accompanies the rectus abdominis at its insertion. This muscle arises from the pubic symphysis. It lies within the rectus sheath and tapers to attach to the linea alba, which represents the conjunction of the two rectus sheaths and is the major site of insertion for three aponeuroses from all three lateral muscle layers.

The line of Douglas (i.e., the arcuate line of the rectus sheath) is formed at a variable distance between the umbilicus and the inguinal space because the fasciae of the large flat muscles of the abdominal wall contribute their aponeuroses to the anterior surface of the muscle, leaving only transversalis fascia to cover the posterior surface of the rectus abdominis.

The innervation of the anterior wall muscles is multifaceted.

The seventh through 12th intercostal nerves and the first and second lumbar nerves provide most of the innervation of the lateral muscles, as well as of the rectus abdominis and the overlying skin. The nerves pass anteriorly in a place between the internal oblique muscle and the transversus abdominis, eventually piercing the lateral aspect of the rectus sheath to innervate the muscle therein.

The external oblique muscle receives branches of the intercostal nerves, which penetrate the internal oblique muscle to reach it.

These important nerves lie in the space between the internal oblique muscle and the external oblique aponeurosis. They may divide within the psoas major or between the internal oblique muscle and the transversus abdominis.

The ilioinguinal nerve may communicate with the iliohypogastric nerve before innervating the internal oblique muscle. The ilioinguinal nerve then passes through the external inguinal ring to run parallel to the spermatic cord, while the iliohypogastric nerve pierces the external oblique muscle to innervate the skin above the pubis.

The cremaster muscle fibers, which are derived from the internal oblique muscle, are innervated by the genitofemoral nerve. There can be considerable variability.

The blood supply of the lateral muscles of the anterior wall comes primarily from the lower three or four intercostal arteries, the deep circumflex iliac artery, and the lumbar arteries. The rectus abdominis has a complicated blood supply that derives from the superior epigastric artery (a terminal branch of the internal thoracic [internal mammary] artery), the inferior epigastric artery (a branch of the external iliac artery), and the lower intercostal arteries. The lower intercostal arteries enter the sides of the muscle after traveling between the oblique muscles; the superior and the inferior epigastric arteries enter the rectus sheath and anastomose near the umbilicus.

The endoabdominal fascia is the deep fascia covering the internal surface of the transversus abdominis, the iliacus, the psoas major and minor, the obturator internus, and portions of the periosteum. It is a continuous sheet that extends throughout the extraperitoneal space and is sometimes referred to as the wallpaper of the abdominal cavity.

The transversalis fascia is particularly important for inguinal hernia repair because it forms anatomic landmarks known as analogues or derivatives.

The most significant of these analogues for hernia surgeons are the iliopectineal arch, the iliopubic tract, the crura of the deep inguinal ring, and Cooperis ligament.

The iliopubic tract is the thickened band of the transversalis fascia that courses parallel to the more superficially located inguinal ligament. It is attached to

the iliac crest laterally and inserts on the pubic tubercle medially. The insertion curves inferolaterally for 1 to 2 cm along the pectineal line of the pubis to blend with Cooperis ligament, ending at about the midportion of the superior pubic ramus. Cooperis ligament is actually a condensation of the periosteum and is not a true analogue of the transversalis fascia.

Hesselbachis inguinal triangle is the site of inguinal hernias. The inguinal ligament forms the base of the triangle, the edge of the rectus abdominis forms the medial border, and the inferior epigastric vessels form the superolateral border.

Between the transversalis fascia and the peritoneum is the preperitoneal space. In the midline behind the pubis, this space is known as the space of Retzius; laterally, it is referred to as the space of Bogros.

The preperitoneal space is very important for surgeons because many of the inguinal hernia repairs (see below) are performed in this area.
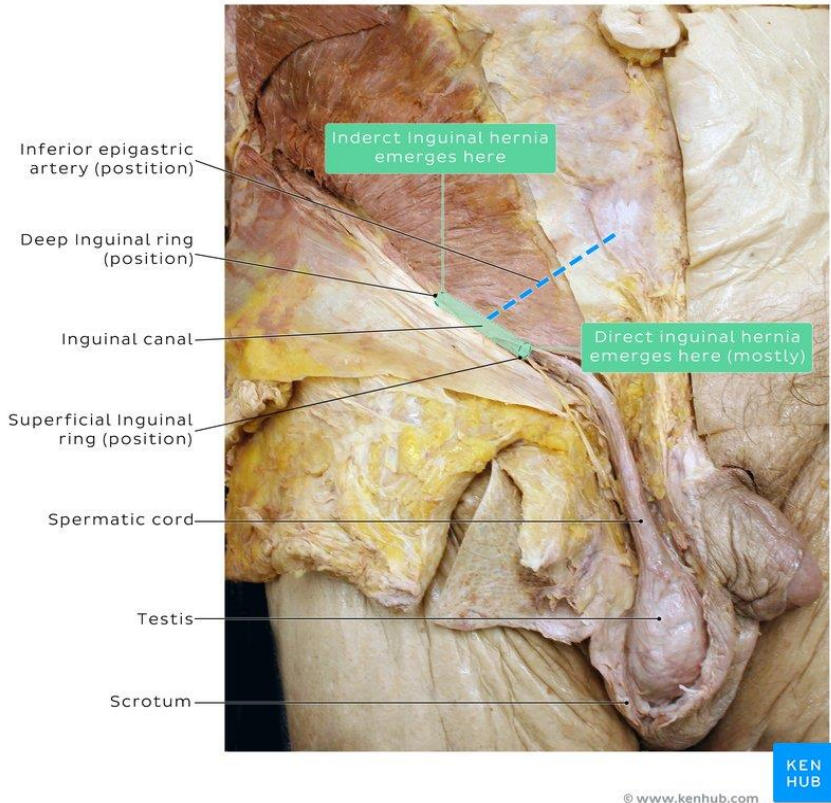
Figure 2 – The inguinal canal (https://www.kenhub.com)

The inguinal canal borders are:

- The roof is formed by muscles (internal oblique and transversus abdominis).
- The anterior wall is derived from aponeuroses (internal and external oblique aponeuroses).
- The floor is formed by ligaments (inguinal and lacunar ligaments).

- The posterior wall is formed by the conjoint tendon and transversalis fascia.

Deep inguinal ring (Anulus inguinalis profundus). It is an oval defect in the transversalis fascia, which is widest along the vertical axis of the opening. The defect is significantly larger in males than in females, as it is meant to accommodate the passage of the testes into the scrotal sac.

Superficial inguinal ring. The lateral crus is thicker than the medial one, as the former is reinforced by the inguinal ligament. The medial crus inserts at the pubic crest, while the lateral crus attaches to the pubic tubercle. There is also grooving of the lateral crus (not observed in females) that provides an atraumatic area for the spermatic cord to lay. The base of the triangular opening falls along the pubic crest. While there is variability in the size of the ring among individuals, it is also markedly larger in males than in females in order to accommodate testicular descent.

Below the iliopubic tract are the critical anatomic elements from which a femoral hernia may develop. The iliopectineal arch separates the vascular compartment that contains the femoral vessels from the neuromuscular compartment that contains the iliopsoas muscle, the femoral nerve, and the lateral femoral cutaneous nerve. The vascular compartment is invested by the femoral sheath, which has three subcompartments: the lateral, containing the femoral artery and the femoral branch of

the genitofemoral nerve; the middle, containing the femoral vein; and the medial, which is the cone-shaped cul-de-sac known as the femoral canal. The femoral canal is a 1 to 2 cm blind pouch that begins at the femoral ring and extends to the level of the fossa ovalis. The femoral ring is bordered by the superior pubic ramus inferiorly, the femoral vein laterally, and the iliopubic tract (with its curved insertion onto the pubic ramus) anteriorly and medially. The femoral canal normally contains preperitoneal fat, connective tissue, and lymph nodes (including Cloquetis node at the femoral ring), which collectively make up the femoral pad. This pad acts as a cushion for the femoral vein, allowing expansion such as might occur during a Valsalva maneuver, and serves as a plug to prevent abdominal contents from entering the thigh. A femoral hernia exists when the blind end of the femoral canal becomes an opening through which a peritoneal sac can protrude.

The femoral canal is located in the anterior thigh within the femoral triangle. The gate to the femoral canal is located at its superior border, known as the femoral ring. The femoral ring is closed by a connective tissue layer – the femoral septum. This septum is pierced by the lymphatic vessels exiting the canal.

- Medial border – lacunar ligament.
- Lateral border – femoral vein.
- Anterior border – inguinal ligament.

- Posterior border – pectineal ligament, superior ramus of the pubic bone, and the pectineus muscle
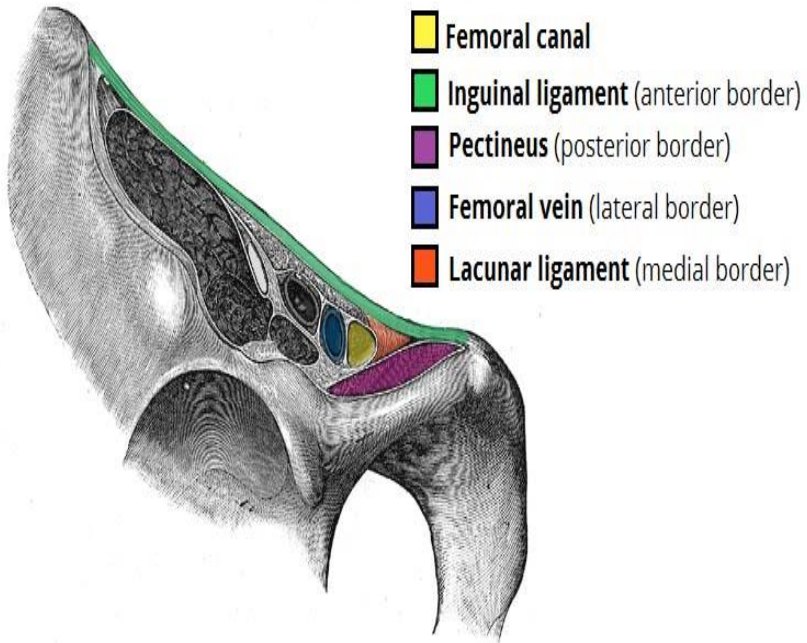

Femoral canal
Inguinal ligament (anterior border)
Pectineus (posterior border)
Femoral vein (lateral border)
Lacunar ligament (medial border)

Figure 3 – The femoral canal
(https://teachmeanatomy.info)

The femoral canal contains:
- Lymphatic vessels – draining the deep inguinal lymph nodes.
- Deep lymph node – the lacunar node.

- Empty space.
- Loose connective tissue.

The empty space allows distension of the adjacent femoral vein, so it can cope with increased venous return, or increased intra-abdominal pressure.
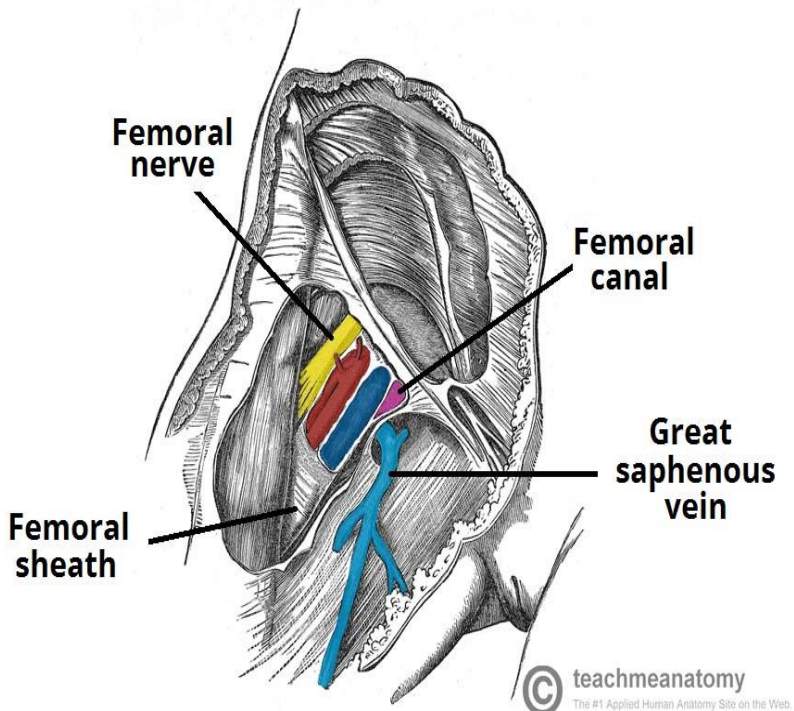

Figure 4 – The femoral triangle contents
(https://teachmeanatomy.info)

The *white line* (linea alba) is a fibrous structure. It runs from the xiphoid process down to the pubic symphysis. The name means as it is composed mostly of collagen connective tissue, which has a white appearance. The white line is formed by the fusion of the aponeuroses of the muscles of the anterior abdominal wall. It separates the left and right rectus abdominis muscles. The *umbilical ring* is a dense fibrous ring surrounding the umbilicus. The *Spigelian line* (linea semilunaris) is a curved tendinous intersection found on either side of the rectus abdominis muscle. It extends from the cartilage of the ninth rib to the pubic tubercle. It is formed by the aponeurosis of the internal oblique muscle at its line of division to enclose the rectus muscle.

2. CLINICAL SIGNS AND DIAGNOSTICS

History and physical examination remain the best means of diagnosing hernias. The review of systems should carefully seek out associated conditions, such as ascites, constipation, chronic obstructive pulmonary disease and cough.

1. The Cooper sign. The inguinal hernia is defined over and outside of the tubercle pubic, and the femoral hernia – below and medially from it.

2. The "cough push" sign. You ask patient to caught and detect by hand "answer" of hernia content. In strangulated hernia it´s absent.

Diagnostics

Inguinal hernia. The diagnosis of hernia is usually made because a patient, parent, or physician sees a bulge in the inguinal region or scrotum. This bulge may be intermittent as the herniating viscus may or may not enter the space depending on intra-abdominal pressure.

In infants, the only symptom of a hernia may be increased irritability, especially with a large hernia. Hernias in older children and adults may be accompanied by a dull ache or burning pain, which often worsens with exercise or straining (e.g., coughing).

Examination of an adult is best performed from the seated position with the patient standing. One visualizes the inguinal canal areas for the bulge. Frequently, a

provocative cough is necessary to expose the hernia. The cough is repeated as the examiner invaginates the scrotum and feels for an impulse. The diameter of the internal ring is assessed.

In a sliding inguinal hernia, a portion of viscus or its mesentery constitutes part of the hernia sac. The bladder can be seen medially in the hernia sac, while portions of the colon (cecum on the right side, sigmoid on the left side) may be part of any hernia sac. In females, the ovary or fallopian tubes may become part of the wall of the hernia sac and must be carefully preserved during repair.

If the visceral contents of a hernia sac do not easily reduce into the peritoneal cavity, the hernia is incarcerated. If the contents cannot be reduced at all, the hernia is irreducible. In chronic hernias, adhesions may impair reduction.

Some hernias, such as obturator, femoral, or lumbar hernias, should be considered as causes of bowel obstruction. Intense pain is suggestive of strangulation with ischemic bowel. Torsion of the bowel on entry into the sac may lead to precipitous symptoms, while a more gradual onset of pain arises from progressive lymphatic, venous, and then finally arterial compromise secondary to occlusion at the neck of the sac.

Spigelian hernias present with local pain and signs of obstruction from incarceration. This pain increases with contraction of the abdominal musculature.

Interparietal hernias between the layers of the abdominal wall present in a similar manner. A mass may be just superior and lateral to the external ring, and the scrotum may not contain a testis.

Internal supravesical hernias may have obstructive symptoms of the intestinal tract or those resembling a urinary tract infection.

An umbilical hernia presents as a central, midabdominal bulge. Altered sensorium and obesity enhance the danger of incarceration. Hypertrophic, hyperpigmented, skin is testimony to high pressure on the skin. The size of the fascial defect and whether it is circular provide management clues.

Diastasis recti or a widened linea alba has no clinical significance and does not require operative repair. However, there may be small openings in the linea alba through which preperitoneal fat can protrude. These epigastric hernias occur in children as well as in adults, suggesting that the defects are congenital.

The name paraumbilical hernia applies when this defect is adjacent to the umbilicus. These *midline hernias* present as lumps anywhere along the linea alba and tend to cause sudden severe pain with exercise.

Postoperative hernias are observed at the sites of scars after previous surgical interventions.

Clinical signs of hernia's strangulation:
- acute pain;
- incarceration;
- meteorism;
- vomiting.

3. SURGICAL TREATMENT

3.1. Inguinal herniorrhaphy

Nonprosthetic repair. Local anesthesia is entirely adequate, especially when combined with intravenous infusion of a rapid-acting, short-lasting, amnesic and anxiolytic agent such as propofol. This is the approach most commonly employed in specialty hernia clinics.

The various inguinal herniorrhaphies have a number of initial technical steps in common.

Step 1. Initial incision. Traditionally, the skin is opened by making an oblique incision between the anterior superior iliac spine and the pubic tubercle. For cosmetic reasons, however, many surgeons now prefer a more horizontal skin incision placed in the natural skin lines. In either case, the incision is deepened through Scarpais and Camperis fasciae and the subcutaneous tissue to expose the external oblique aponeurosis. The external oblique aponeurosis is then opened through the external inguinal ring.

Step 2. Mobilization of cord structures. The superior flap of the external oblique fascia is dissected

away from the anterior rectus sheath medially and the internal oblique muscle laterally. The iliohypogastric nerve is identified at this time; it can be either left in situ or freed from the surrounding tissue and isolated from the operative field by passing a hemostat under the nerve and grasping the upper flap of the external oblique aponeurosis. Routine division of the iliohypogastric nerve along with the ilioinguinal nerve is practiced by some surgeons but is not advised by most.

The cord structures are then bluntly dissected away from the inferior flap of the external oblique aponeurosis to expose the shelving edge of the inguinal ligament and the iliopubic tract. The cord structures are lifted "en masse" by the fingers of one hand at the pubic tubercle so that the index finger can be passed underneath to meet the thumb or the fingers of the other hand. Mobilization of the cord structures is completed by means of blunt dissection, and a drain is placed around them for retraction during the procedure.

Step 3. Division of cremaster muscle. Complete division of the cremaster muscle has been common practice, especially with indirect hernias. The purposes of this practice are to facilitate identification of the sac and to lengthen the cord for better visualization of the inguinal floor. Almost always, however, adequate exposure can be obtained by opening the muscle longitudinally, which

reduces the chances of damage to the cord and prevents testicular descent. Accordingly, the latter approach should be considered best practice unless there are extenuating circumstances.

Step 4. High ligation of sac. The term high ligation of the sac is used frequently in discussing hernia repair; its historical significance has ingrained it in the descriptions of most of the older operations. For our purposes in this chapter, high ligation of the sac should be considered equivalent to reduction of the sac into the preperitoneal space without excision. The two methods work equally well and are highly effective. Some surgeons believe that sac inversion results in less pain (because the richly innervated peritoneum is not incised) and may be less likely to cause adhesive complications. Sac eversion in lieu of excision does protect intra-abdominal viscera in cases of unrecognized incarcerated sac contents or sliding hernia.

Step 5. Repair of inguinal canal. Methods of repairing the inguinal floor differ significantly among the various repairs and are described separately.

Step 6. Closure. Closure of the external oblique fascia serves to reconstruct the superficial (external) ring. The external ring must be loose enough to prevent from a strangulation of the cord. A dilated external ring is sometimes referred to as an industrial hernia, because over the years it has occasionally been a problem during preemployment physical examinations. Scarpais fascia and the skin are closed to complete the operation.

Details of some specific repairs.

Bassini repair *(fig. 5).* After performing the initial dissection and the reduction or ligation of the sac, Bassini began the reconstruction of the inguinal floor by opening the transversalis fascia from the internal inguinal ring to the pubic tubercle, thereby exposing the preperitoneal fat, which was bluntly dissected away from the undersurface of the superior flap of the transversalis fascia. This step allowed him to properly prepare the deepest structure in his famous "triple layer".
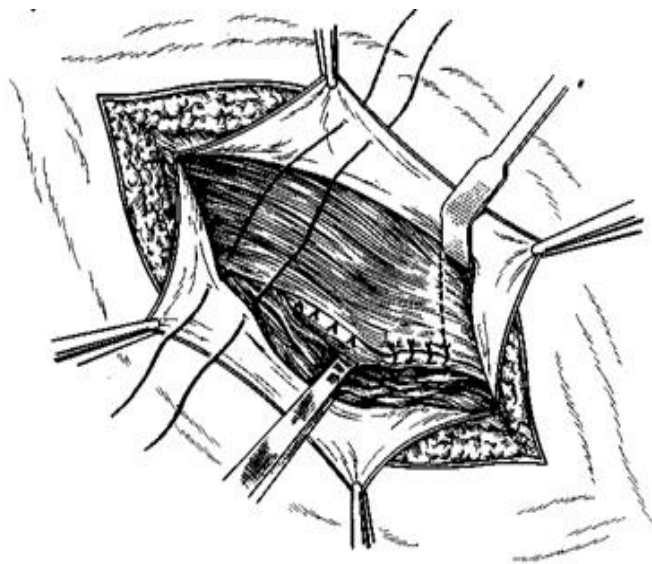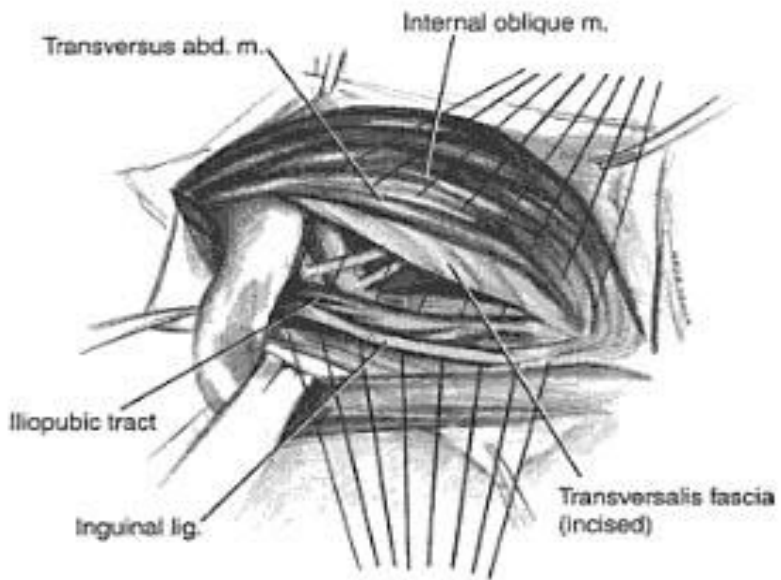
Figure 5 – Inguinal Bassini repair (https://surgerynote)

The first stitch in Bassini's repair includes the triple layer superiorly and the periosteum of the medial side of the pubic tubercle, along with the rectus sheath. In current practice, however, most surgeons try to avoid the periosteum of the pubic tubercle so as to decrease the incidence of osteitis pubis. The repair is then continued laterally, and the triple layer is secured to the reflected inguinal ligament (Poupartis ligament) with nonabsorbable sutures. The sutures are continued until the internal ring is closed on its medial side. A relaxing incision was not part of Bassini's original description but now is commonly added.

Concerns about injuries to neurovascular structures in the preperitoneal space as well as to the bladder led many surgeons, especially in North America, to abandon the opening of the transversalis fascia. The unfortunate consequence of this decision is that the proper development of the triple layer is severely compromised. In lieu of opening the floor, a forceps (e. g., an Allis clamp) is used to grasp tissue blindly in the hope of including the transversalis fascia and the transversus abdominis. The layer is then sutured, along with the internal oblique muscle, to the reflected inguinal ligament as in the classic Bassini repair.

Shouldice repair (fig. 6). The repair is started at the pubic tubercle by approximating the iliopubic tract laterally to the undersurface of the lateral edge of the rectus abdominis. The suture is continued laterally,

approximating the iliopubic tract to the medial flap, which is made up of the transversalis fascia, the internal oblique muscle, and the transversus abdominis. Eventually, four suture lines are developed from the medial flap. The continuous suture is extended to the internal ring, where the lateral stump of the cremaster muscle is picked up to form a new internal ring. Next, the direction of the suture is reversed back toward the pubic tubercle, approximating the medial edges of the internal oblique muscle and the transversus abdominis to Poupartis ligament, and the wire is tied to itself and then to the first knot. Thus, two suture lines are formed by the first suture. A second wire suture is started near the internal ring, approximating the internal oblique muscle and the transversus abdominis to a band of external oblique aponeurosis superficial and parallel to Poupartis ligament. This third suture line ends at the pubic crest. The suture is then reversed, and a fourth suture line is constructed in a similar manner, superficial to the third line.
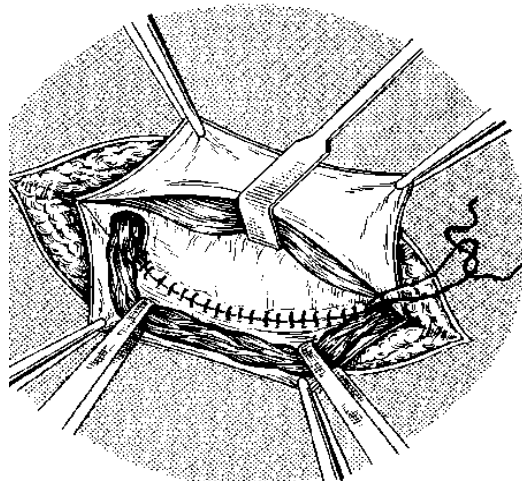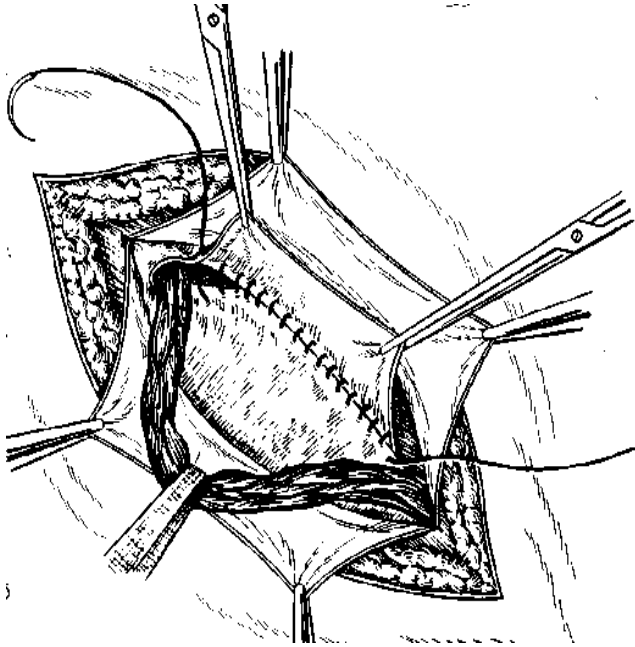
Figure 6 – Inguinal Shouldice herniorrhaphy
(https://surgerynote)

McVay Cooperis ligament repair. This operation is similar to the Bassini repair, except that it uses Cooperis ligament instead of the inguinal ligament for the medial portion of the repair.

Interrupted sutures are placed from the pubic tubercle laterally along Cooperis ligament, progressively narrowing the femoral ring; this constitutes the most common application of the repair – namely, treatment of a femoral hernia. The last stitch in Cooperis ligament is known as a transition stitch and includes the inguinal ligament. This stitch has two purposes: to complete the narrowing of the femoral ring by approximating the inguinal ligament to Cooperis ligament, as well as to the medial tissue, and to provide a smooth transition to the inguinal ligament over the femoral vessel so that the repair can be continued laterally (as in a Bassini repair). Given the considerable tension required to bridge such a large distance, a relaxing incision should always be used. In the view of many authorities, this tension results in more pain than is noted with other herniorrhaphies and predisposes to recurrence. For this reason, the McVay repair is rarely chosen today, except in patients with a femoral hernia or patients with a specific contraindication to mesh repair.

Girard repair. In these operations it is proposed to attach the edges of the internal oblique muscle and transverse muscle of abdomen to the inguinal ligament over the spermatic duct. The aponeurosis of the external

oblique muscle sutured by second layer of the suture. Excess of the aponeurosis is fixed to the muscle in the form of duplication.

Spasokukotsky repair. Proposed to suture the edges of the internal oblique muscle and transverse muscle of abdomen with aponeurosis of the external oblique muscles by single-layer interrupted suture.

Martynov repair. Proposed the fixation to the Poupartis ligament the internal edge of the external oblique muscle aponeurosis without muscles. External edge of the aponeurosis is sutured over internal in the form of duplication.

Kimbarovsky repair. Based on the principles of joining similar tissues, proposed special suture: Sutures placed on 1 cm from the edge of the external oblique abdominal muscle aponeurosis, grasped the part of the internal oblique and transverse muscle of abdomen. After that, aponeurosis is sutured one more time from behind to the front and attached to the Poupartis ligament.

Kukudganov repair. Proposed to restore back wall of inguinal interval. Sutures are placed between the Couperis ligament, direct abdominal muscle and aponeurosis of the transversal muscle.

Postempsky repair. Proposed the closure of inguinal interval with the lateralization moving of spermatic duct. The plastic narrowing of internal inguinal ring of to 0,8 cm is the important stage of this modification.

Alloplastic repair of inguinal hernia.
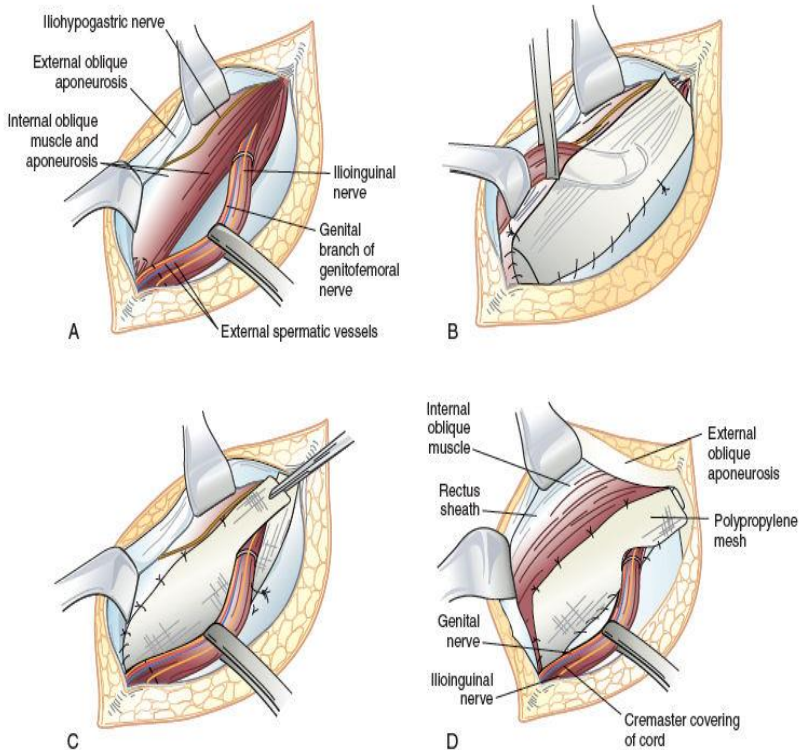*Lichtenstein repair (fig. 7).*

Figure 7 – Inguinal Lichtenstein herniorrhaphy
(https://www.surgicalcore.org)

The first five steps of a Lichtenstein repair are very similar to the first five steps of a conventional anterior nonprosthetic repair, but there are certain technical points that are worthy of emphasis. The external oblique

aponeurosis is generously freed from the underlying anterior rectus sheath and internal oblique muscle and aponeurosis in an avascular place from a point at least 2 cm medial to the pubic tubercle to the anterior superior iliac spine laterally. Blunt dissection is continued in this avascular place from the area lateral to the internal ring to the pubic tubercle along the shelving edge of the inguinal ligament and the iliopubic tract. As a continuation of this same motion, the cord with its cremaster covering is swept off the pubic tubercle and separated from the inguinal floor. Besides mobilizing the cord, these maneuvers create a large space beneath the external oblique aponeurosis that can eventually be used for prosthesis placement. The ilioinguinal nerve, the external spermatic vessels and the genital branch of the genitofemoral nerve all remain with the cord structures.

For indirect hernias, the cremaster muscle is incised longitudinally, and the sac is dissected free and reduced into the preperitoneal space. Theoretically, this operation could be criticized on the grounds that if the inguinal floor is not opened, an occult femoral hernia might be overlooked. To date, however, an excessive incidence of missed femoral hernias has not been reported. In addition, it is possible to evaluate the femoral ring via the space of Bogro's through a small opening in the canal floor.

Direct hernias are separated from the cord and other surrounding structures and reduced back into the

preperitoneal space. Dividing the superficial layers of the neck of the sac circumferentially – which, in effect, opens the inguinal floor – usually facilitates reduction and helps maintain it while the prosthesis is being placed. This opening in the inguinal floor also allows the surgeon to palpate for a femoral hernia. Sutures can be used to maintain reduction of the sac, but they have no real strength in this setting; their main purpose is to allow the repair to proceed without being hindered by continual extrusion of the sac into the field, especially when the patient strains.

Placement of prosthesis. A mesh prosthesis is positioned over the inguinal floor. For an adult, the prosthesis should be at least 15 cm × 8 cm. The medial end is rounded to correspond to the patients particular anatomy and secured to the anterior rectus sheath at least 2 cm medial to the pubic tubercle. A continuous suture of either nonabsorbable or long-lasting absorbable material should be used. Wide overlap of the pubic tubercle is important to prevent the pubic tubercle recurrences all too commonly seen with other operations. The suture is continued laterally in a locking fashion, securing the prosthesis to either side of the pubic tubercle (not into it) and then to the shelving edge of the inguinal ligament. The suture is tied at the internal ring.

Creation of shutter valve. A slit is made at the lateral end of the mesh in such a way as to create two tails, a wider one (approximately two thirds of the total width)

above and a narrower one below. The tails are positioned around the cord structures and placed beneath the external oblique aponeurosis laterally to about the anterior superior iliac spine, with the upper tail placed on top of the lower. A single interrupted suture is placed to secure the lower edge of the superior tail to the lower edge of the inferior tail effect, creating a shutter valve. This step is considered crucial for preventing the indirect recurrences occasionally seen when the tails are simply reapproximated. The same suture incorporates the shelving edge of the inguinal ligament so as to create a domelike buckling effect over the direct space, thereby ensuring that there is no tension, especially when the patient assumes an upright position.

Securing of prosthesis. A few interrupted sutures are placed to attach the superior and medial aspects of the prosthesis to the underlying internal oblique muscle and rectus fascia. On occasion, the iliohypogastric nerve, which courses on top of the internal oblique muscle, penetrates the medial flap of the external oblique aponeurosis. In this situation, the prosthesis should be slit to accommodate the nerve. The prosthesis can be trimmed in situ.

3.2. Femoral herniorrhaphy

There are some methods of surgical treatment of the femoral hernia, where the plastic repair is performed intraperitoneally from the side of thigh through the inguinal canal.

The Bassini method is attributed to "femoral". It is performed through an incision, that passes under inguinal fold. After removal of hernial sac the hernial opening is closed by suturing of lig. inguinal (1) to the pectineal ligament (2) without pressure of femoral vein (3) *(fig. 8)*. The Rudgi-Parlavecho method *(fig. 9)*. Ends of the transversus and internal oblique muscles and inguinal ligament sutured to the periosteum of pubic bone.
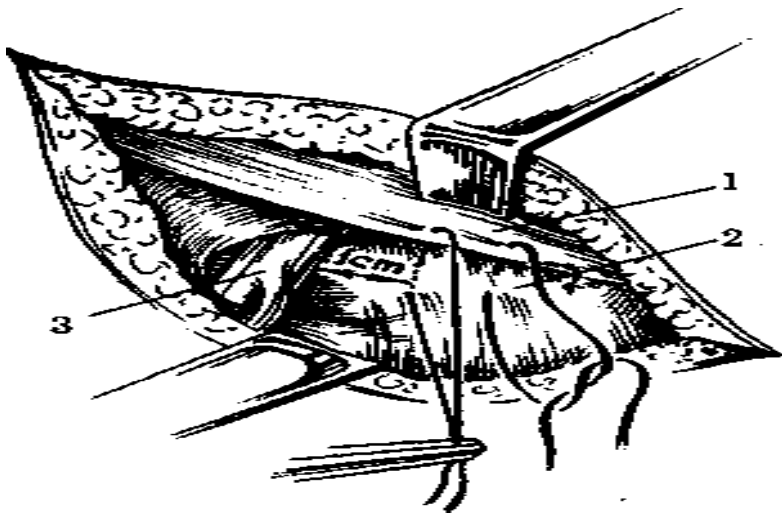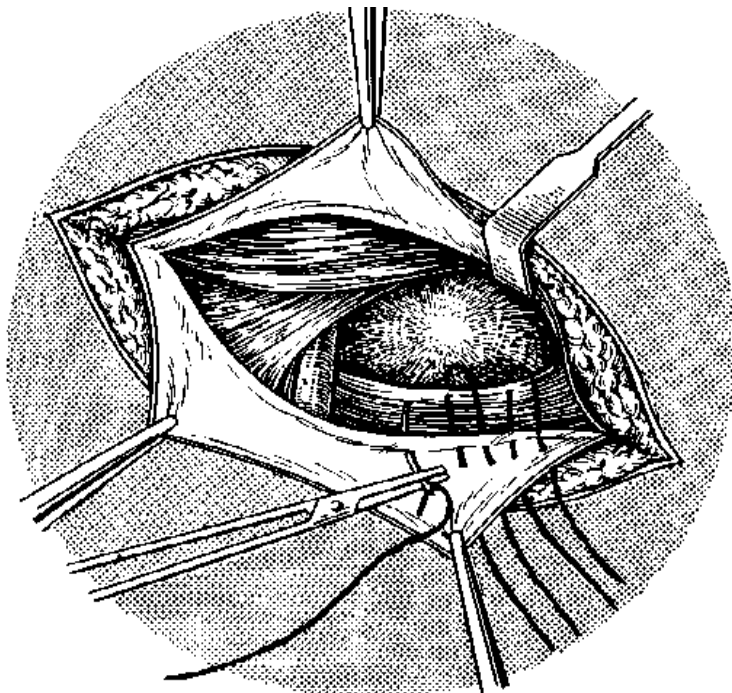

Figure 8 – Bassini method (https://surgerynote)

Figure 9 – Rudgi-Parlavec homethod (https://surgerynote)

3.3. Umbilical herniorrhaphy

An umbilical hernia is the result of improper healing of an umbilical scar, which leads to a fascial defect that is covered by skin. If the defect is to one side, it is called a paraumbilical hernia; this variant is more common in adults. The vast majority of umbilical hernias presenting in children are congenital, whereas 90 % of those diagnosed in adults are acquired. These hernias are eight times more common in black children than in white ones.

The onset of umbilical or paraumbilical hernia in older patients is usually sudden, and the defect tends to be relatively small. In these patients, it is important to look for an underlying cause of increased intra-abdominal pressure (e. g., ascites or an intraabdominal tumor).

The differential diagnosis of an umbilical hernia should include so-called "caput medusa", a condition in which varicosities extend radially from the umbilicus as a consequence of portal hypertension.

Another condition to be considered is the so-called Sister Mary Joseph node, which is a metastatic deposit of intra-abdominal cancer at the umbilicus. The cancer cells reach this area via lymphatic vessels in the falciform ligament.

Other periumbilical masses that might be confused with an umbilical hernia are umbilical granulomas, omphalomesenteric duct remnant cysts, and urachal cysts.

Most of the defects are small and can therefore be closed by simple suturing. Alternatively, *Mayo* technique ('horizontal' stitching of aponeurosis) ore *Sapezko* technique ('vertical' stitching of aponeurosis) may be used *(fig. 10)*.
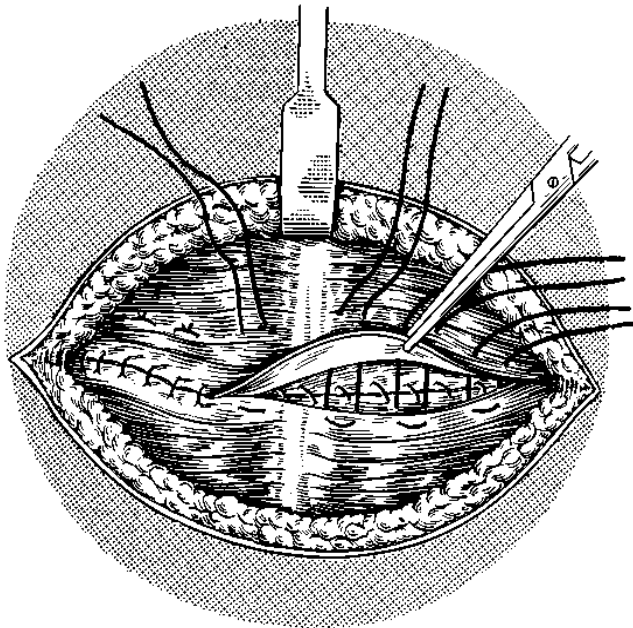

Figure 10 – Mayo technique (https://surgerynote)

A subumbilical semilunar incision is made, the hernia sac is opened, the contents of the sac are reduced

into the abdomen, and the sac is excised. The fascial defect is then bridged with prosthesis without fear of contact with the intra-abdominal viscera. The prosthesis is sutured circumferentially to the defect; alternatively, it can be sutured to the undersurface of the posterior rectus sheath and the linea alba above the peritoneal closure. If the peritoneum cannot be kept intact beneath the defect, omentum should be tacked to the peritoneum circumferentially to isolate the abdominal viscera from the prosthesis at least to some degree.

3.4. Postoperative hernia herniorrhaphy

Simple nonprosthetic repair.

Simple nonprosthetic repair of postoperative hernia is reserved for only the least complicated defects, because in large series of unselected patients, the recurrence rate ranges from 25 % to 55 %.

If there is a solitary defect 3 cm or less in diameter, primary closure with nonabsorbable suture material is appropriate.

Some surgeons use a Mayo "vest-over-pants" repair. Various advancement and darn procedures have also been described.

A more substantial repair for these defects was popularized by Ramirez. In this operation, known as the component separation technique, fascial places are incised between muscle groups, so that, in effect, the abdominal wall is lengthened by allowing the muscle to separate on either side of a defect. The hernia can then be repaired primarily with less tension on the repair. This procedure is especially useful at contaminated hernia sites.

A similar procedure is the keel operation of Maingot, which was popular in the middle of the 20th century. The anterior rectus sheath is incised longitudinally, and the medial edge is allowed to rotate behind the rectus abdominis. This, in effect, lengthens the posterior rectus sheath, allowing it to be closed under less

tension. The lateral edges of the incised rectus sheath on each side are then approximated to each other.

Onlay prosthetic repair.

In this technique, a prosthetic onlay is placed over any of a wide variety of simple repairs. Large series of selected patients have documented acceptable results with onlay prosthetic repair, but most surgeons feel that this technique offers little advantage over the simple repair that the prosthesis overlies.

Prosthetic bridging repair.

Prosthetic bridging repair became popular in the 1990s, in keeping with the tension-free concept for inguinal herniorrhaphy.

When a hernia defect is bridged with a mesh prosthesis, every attempt should be made to isolate the material from the intraabdominal viscera to prevent erosion and subsequent fistula formation or adhesive bowel obstruction. This can be accomplished by means of a peritoneal flap constructed from the peritoneal sac or omentum. When contact with intra-abdominal organs cannot be avoided, expanded polytetrafluoroethylene (e-PTFE) should be strongly considered for the prosthesis. Most authorities feel that complications are less likely with e-PTFE, though this has not been unequivocally shown to be the case.

Combined fascial and mesh closure.

The issue of contact between the intra-abdominal viscera and the prosthesis has been further addressed by

techniques that combine features of the component separation technique with the tension-free concept. The posterior fascia is closed primarily, but the anterior fascia is allowed to remain open, so that there is no tension at all. The anterior fascia is then bridged with a prosthesis.

Sublay prosthetic repair.

Sublay prosthetic repair, sometimes referred to as the retromuscular approach, is characterized by the placement of a large prosthesis in the space between the abdominal muscles and the peritoneum.

The posterior rectus sheath is opened on each edge of the hernia defect and dissected away from the undersurface of the recti or a distance of 10 to 15 cm. The posterior rectus sheaths are approximated to each other primarily. A large mesh prosthesis (composed of e-PTFE if the approximation of the posterior rectus sheath is inadequate) is then placed in this space outside he repaired posterior sheath but beneath the recti. The mesh is secured in this position with several sutures that are placed with a suture passer through small stab incisions at the periphery of prosthesis and tied in the subcutaneous tissue above the fascia.

4. POSTOPERATIVE COMPLICATIONS

1. Recurrence of the hernia after repair is estimated to occur in 3–10 % of patients.

2. Temporary urinary retention with difficulty urinating is common.

3. Wound infection occurs in 1–3 % of patients postoperatively.

4. Injury:

– to the ilioinguinal, iliohypogastric, and genital branch of the genitofemoral nerves rarely occurs and may result in paresthesias in their distribution of innervation;

– to the structures of the spermatic cord rarely occurs.

5. Seroma and hematoma.

TESTS

(one answer is correct)

1. The contributes factor of hernias is:
a) hard physical activity;
b) weight loss;
c) chronic cough;
d) chronic constipation.

2. The causes factor of hernias is:
a) congenital weakness of the abdominal wall;
b) weight loss;
c) chronic cough;
d) pregnancy.

3. The sliding hernia occurs when:
a) patient has congenital weakness of the abdominal wall;
b) the hernia's sac is absent;
c) the hernia's sac is formed by the strangulated bowel;
d) the hernia's sac is partially formed by the wall of an organ without peritoneal covering.

4. Classification of hernias of the abdominal wall according to localization doesn't include:
a) diaphragmatic hernia;
b) midline hernia;

c) femoral hernia;

d) umbilical hernia.

5. Classification of hernias complications doesn't include:

a) incarceration;

b) strangulation;

c) sliding hernia;

d) inflammation.

6. Main method in diagnostic procedure is:

a) X – ray examination;

b) ultrasound;

c) lab. studies;

d) anamnestic and clinical examination.

7. Clinical manifestations of strangulated hernia is:

a) acute pain;

b) incarceration;

c) vomiting;

d) all answers are correct.

8. Differential sing between incarcerated and strangulated hernias is:

a) "cough push" sing;

b) Blumberg sing;

c) cramp-like abdominal pain;

d) all answers are correct.

9. Final method of differential diagnostic between incarcerated and strangulated hernias is:
a) laparocentesis;
b) ultrasound;
c) herrniotomy;
d) X-ray examination.

10. Treatment of the patients with strangulated hernias is:
a) conservative;
b) surgical;
c) surgical in young patients, conservative in elderly;
d) symptomatic treatment.

11. Optimal term for operation in patients with strangulated hernia is:
a) 2 hours;
b) 12 hours;
c) 24–48 hours;
d) 72 hours.

12. The limits of resection of small bowel in patients with strangulated hernia are:
a) nonviability part + 40 cm before + 20 cm late;
b) nonviability part + 20 cm before + 10 cm late;

c) only nonviability part;

d) surgeon has to detect individually.

13. Optimal surgical procedure in patients with strangulated hernia and nonviability of sigmoid colon is:

a) nonviability part + 40 cm before + 20 cm late;

b) resection of sigmoid colon + colostomy;

c) resection of sigmoid colon + primary anastomosis;

d) surgeon has to detect individually.

14. Differential sing of the sliding inguinal hernia is:

a) cramp-like abdominal pain;

b) incarceration;

c) dysuria;

d) all answers are correct.

15. Optimal surgical procedure in inguinal hernia is:

a) Bassini repair;

b) Lichtenstein repair;

c) Postempsky repair;

d) MacVay repair.

16. Optimal surgical procedure in femoral hernia is:

a) Bassini repair;

b) Lichtenstein repair;

c) Postempsky repair;

d) MacVay repair.

17. Optimal surgical procedure in umbilical hernia is:

a) Bassini repair;

b) Lichtenstein repair;

c) Postempsky repair;

d) Mayo repair.

18. Optimal surgical procedure in postoperative hernia is:

a) simple nonprosthetic repair;

b) "onlay" repair;

c) "sublay" repair;

d) all answers are correct.

19. More frequent postoperative complication in patients with "gigantic" hernias is:

a) pulmonary embolism;

b) abdominal compartment syndrome;

c) wound infection;

d) systemic fat embolism.

20. More frequent postoperative complication after simple nonprosthetic repair is:

a) seroma;

b) wound infection;

c) recurrence of the hernia;

d) systemic fat embolism.

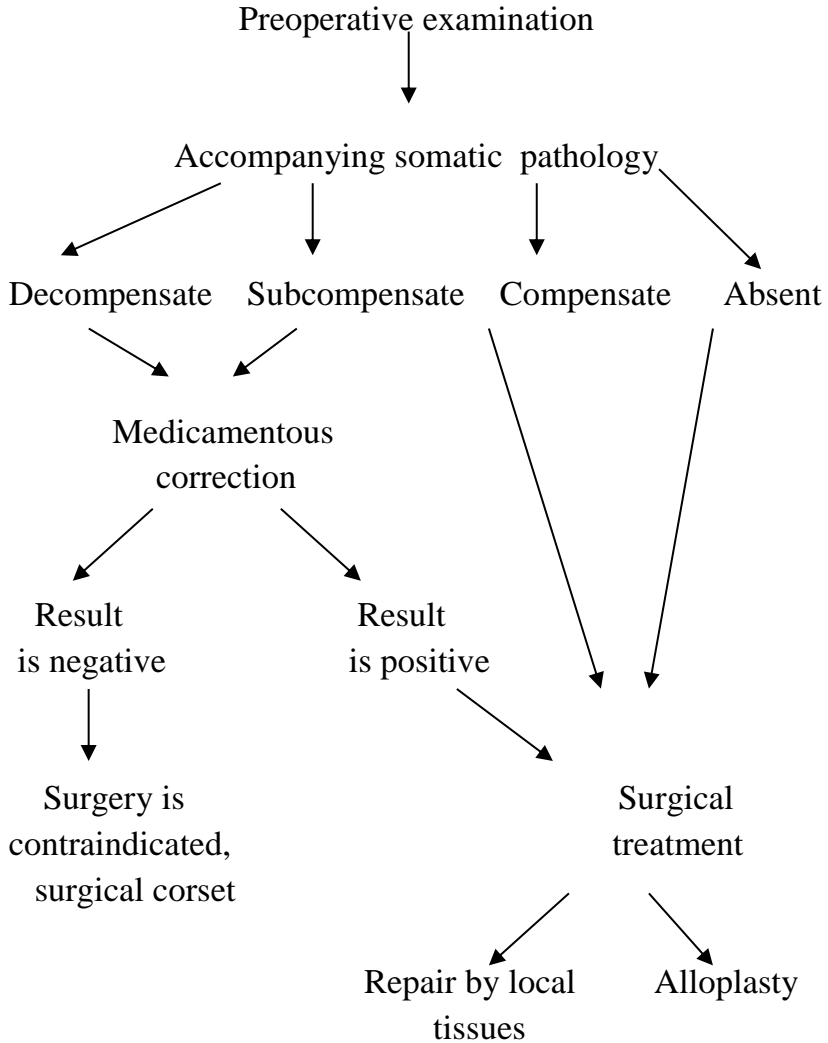**21. More frequent postoperative complication after prosthetic "onlay" repair is:**

a) seroma;

b) wound infection;

c) recurrence of the hernia;

d) lymphorrhea.

Standards of answers

1 – b; 2 – c; 3 – d; 4 – a; 5 – c; 6 – d; 7 – d; 8 – a; 9 – c; 10 – b; 11 – a; 12 – a; 13 – b; 14 – c; 15 – b; 16 – a; 17 – d; 18 – c; 19 – b; 20 – c; 21 – d.
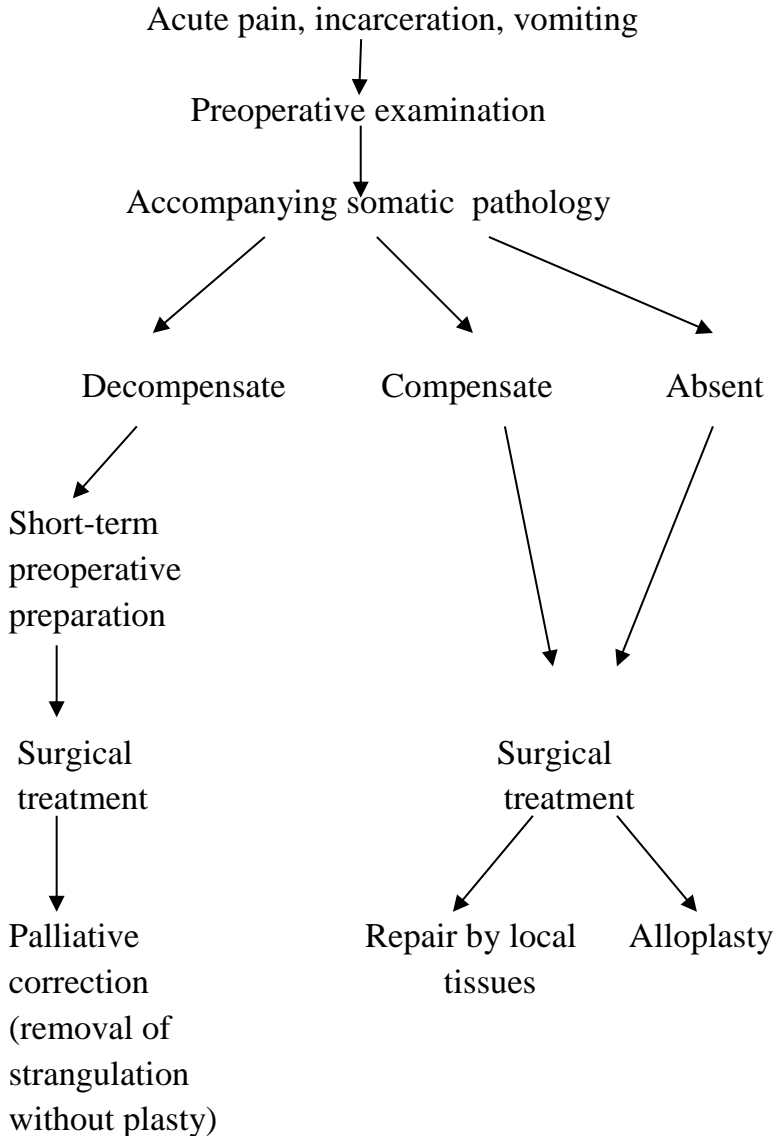
ADDITION A
Algorithm of treatment of hernias

Preoperative examination

↓

Accompanying somatic pathology

Decompensate   Subcompensate   Compensate   Absent

Medicamentous
correction

Result
is negative

Result
is positive

Surgery is
contraindicated,
surgical corset

Surgical
treatment

Repair by local
tissues

Alloplasty

ADDITION B

Algorithm of treatment of the strangulated *hernia*

Acute pain, incarceration, vomiting

↓

Preoperative examination

↓

Accompanying somatic pathology

Decompensate　　　Compensate　　　Absent

Short-term
preoperative
preparation

↓

Surgical
treatment

↓

Palliative
correction
(removal of
strangulation
without plasty)

Surgical
treatment

Repair by local　　　Alloplasty
tissues

THE LIST OF LINKS

1. Laparoscopic inguinal herniorrhaphy, TAPP: https://www.youtube.com/watch?v=Udt9biv_C00.
2. Laparoscopic inguinal herniorrhaphy, TEP: https://www.youtube.com/watch?v=yg6SDOClyZM.
3. Postoperative hernia "Onlay" prosthetic repair https://www.youtube.com/watch?v=yCzzzqzN2-0.
4. Postoperative hernia "Sublay" prosthetic repair https://www.youtube.com/watch?v=5XRJ7hSWsFY.
5. Postoperative hernia laparoscopic repair https://www.youtube.com/watch?v=7TMdSTGzDss.

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SUBJEKT INDEX

Електронне навчальне видання

Ситнік Олександр Леонідович,
П'ятикоп Геннадій Іванович,
Пак Василь Якович

ГРИЖІ ЧЕРЕВНОЇ СТІНКИ

Навчальний посібник
(Англійською мовою)

Навчальний посібник містить інформацію про основні принципи діагностики та лікування хворих на грижі передньої черевної стінки

Для англомовних студентів закладів вищої освіти ІІІ–ІV рівнів акредитації, лікарів-інтернів, хірургів та сімейних лікарів.