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## Inguinal hernias – the review of literature

### Przepukliny pachwinowe – przegląd literatury

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#### Słowa kluczowe

przepuklina pachwinowa, epidemiologia, patogeneza, plastyka przepukliny pachwinowej

#### Conflict of interest

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#### INTRODUCTION

Inguinal hernia repair is one of the most common procedure performed all over the world in adults. The lifetime risk of developing an inguinal hernia has been estimated at 27% for men and 3% for women (1). In general, due to easy recognition as an palpable mass in the groin region patients seek for doctor's consultation. Usually, it is not a life-threatening condition that may be successfully treated with the surgical manipulation. The emergency operation is necessary in cases of strangulation due to the possible complications such as intestinal necrosis, diffuse peritonitis and septic shock. The "wait and watch" strategy may be applied when it refers to minimally symptomatic or totally asymptomatic patients.

#### S u m m a r y

Among all surgical diseases, inguinal hernias are one of the most commonly encountered in the clinical practice of general surgeons all over the world. Although this topic has been under investigation for a long time, every year brings new information concerning the best approaches to the patients with this pathology.

Patients usually seek medical attention because of palpable mass in groin region and pain or discomfort that may appear at rest or during physical activities. Severe pain usually indicates hernia strangulation and needs immediate surgery. In other cases, hernia repair should be performed on electively in order to reduce clinical symptoms improving quality of patient's life and avoid complications. The hernia repair surgery may be performed as open (mesh or non-mesh techniques) or laparoscopic procedure.

In this study, a review of available data and literature on the epidemiology and pathogenesis of inguinal hernia has been conducted, as well as the clinical evaluation and the surgical treatment.

#### S t r e s z c z e n i e

Śród wszystkich schorzeń chirurgicznych, przepukliny brzuszne są jednymi z najczęściej spotykanych w praktyce klinicznej chirurgów ogólnych na całym świecie. Temat ten od wielu lat stanowi punkt zainteresowania naukowców i z każdym rokiem przybywa nam informacji odnośnie jak najlepszego zaopatrywania pacjentów z powyższym schorzeniem.

Pacjenci zazwyczaj zgłaszają się do lekarza z powodu wyczuwalnego uwypuklenia w obrębie pachwiny oraz bólu i dyskomfortu, który może pojawiać się w spoczynku bądź podczas wykonywania aktywności fizycznej. Ostry ból zazwyczaj wskazuje na uwięźnięcie przepukliny i wymaga pilnego zaopatrzenia chirurgicznego. W pozostałych przypadkach operacje powinny być wykonywane jako zabiegi planowe, co eliminuje objawy kliniczne, poprawiając jakość życia pacjentów oraz pozwala uniknąć poważnych komplikacji. Operacje naprawcze przepuklin mogą być przeprowadzone przy pomocy technik otwartych (z użyciem bądź bez używania siatek) lub laparoskopowych.

Niniejsza praca stanowi przegląd dostępnych danych oraz piśmiennictwa na temat epidemiologii i patogenezy przepuklin pachwinowych oraz oceny klinicznej i postępowania chirurgicznego z pacjentami, u których została zdiagnozowana.

#### REVIEW

##### Epidemiology and risk factors

Groin hernias account for up to 75% of all abdominal wall hernias, with the incidence of 97% for inguinal hernia and 3% for femoral hernia. Inguinal hernias are most likely to appear in men (90.2% males vs 9.8% females), whereas 70.2% of femoral hernias appear in women (2). The risk factors for hernia formation may be divided into patient-related and external risk factors. Higher incidence of inguinal hernia is associated with older age, male gender, coexistence of hiatal hernia in men, lower body mass index and Caucasian race (3). Inverse relationship between obesity and lower risk of hernia may be a result of limitations in physical examination in obese patients. Moreover, the visceral

fat may act as a barrier against protrusion of the hernia sack (4, 5). Recent studies suggest that smoking may be associated with the increased risk for hernia development due to the changes in collagen metabolism (6, 7). On the other hand, some studies showed negative link between tobacco use and inguinal hernia formation, which still remains unexplained (8, 9). Other patient-related factors identified as a potential risk for the formation of groin hernia include positive family history, chronic obstructive pulmonary diseases, abdominal aortic aneurysm, patent processus vaginalis and connective tissue disorders (10-12). Patients with increased serum levels of matrix metalloproteinase 2 (MMP-2) and matrix metalloproteinase tissue inhibitor 2 (TIMP-2) comparing to general population are also at higher risk of developing hernia (13). External risk factors are identified with cumulative exposures to daily lifting activities (total load, frequent heavy lifting) and prolonged standing and walking (14).

### Anatomy

The knowledge of the anteroinferior abdominal wall anatomy is essential for proper understanding of inguinal hernia and its repair. The abdominal wall in groin region is composed of peritoneum, transversalis fascia, internal and external oblique muscles, subcutaneous tissue and skin. Among the structures involved in hernias formation the anatomical area known as myopectineal orifice is considered to have a crucial role. The myopectineal orifice was first described by Dr Henri Fruchaud in 1956 as an area containing natural openings that was additionally weakened during the evolutionary process of human beings (15). This part of abdominal wall is supported only by two thin layers made of the transversalis fascia and the tendinous insertion of transversalis muscle. The orifice is known to be divided into three anatomical triangles: femoral, lateral and medial, that are potential sites for groin hernias formation. The lateral triangle is defined by inguinal ligament inferiorly, the deep inferior epigastric vessels medially and the internal oblique muscle superiorly. The medial triangle, also known as Hesselbach's Triangle or Hesselert's Triangle, is supported by the fibers of internal oblique muscle superiorly, the rectus abdominis muscle medially, the inguinal ligament inferiorly and deep inferior epigastric vessels laterally. The femoral triangle is bordered by Cooper's (iliopectineal) ligament inferiorly, inguinal ligament and iliopubic tract superiorly and iliopsoas muscle laterally. The inguinal ligament divides the orifice into two halves. The suprainguinal area of myopectineal orifice contains the internal inguinal ring that allows the passage of spermatic cord in men and the round ligament in women. Whereas, the subinguinal region is opening for the femoral canal and allows the transition of femoral vessels and nerve from abdomen to the lower limb and inversely (fig. 1) (16).

### Definition and classification

Groin hernia is defined as a protrusion of abdominal content through the area of weakness in groin region.

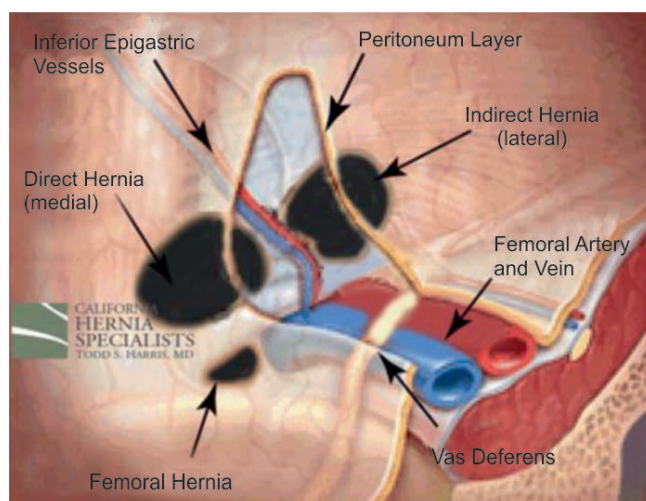


Fig. 1. Anatomy of inguinal region (source: californiaherniaspecialists.com)

Many different classifications have been described so far, with the Nyhus classification, being the most widely used, especially in the United States. According to anatomy, the Nyhus classification divides groin hernias into femoral and inguinal, which are subdivided into direct (medial) and indirect (lateral) based on their anatomical position towards the inferior epigastric vessels (17). The femoral hernia protrudes into the femoral canal through the fascia transversalis, medially to the femoral vein and below the inguinal ligament. A direct inguinal hernia protrudes through the transversalis fascia within the Hesselbach's triangle, medially to the inferior epigastric vessels. Whereas, an indirect inguinal hernia comes out through the internal inguinal ring and is located laterally to the inferior epigastric vessels. Lateral hernia may extend into the scrotum in men or labium majus in women (tab. 1).

Tab. 1. Nyhus classification (1993)

Type of hernia	Anatomical defect
Type 1	Indirect inguinal hernia with a normal ring Sac in the canal
Type 2	Indirect hernia with an enlarged internal ring but the posterior wall is intact; inferior deep epigastric vessels not displaced, sac not in scrotum
Type 3a	Direct hernia with a posterior floor defect only
Type 3b	Indirect hernia with enlargement of internal ring and posterior floor defect
Type 3c	Femoral hernia
Type 4	Recurrent hernia A – direct; B – indirect; C – femoral and D – combinations of A-B-C

The Nyhus classification was modified in 1998 by Stoppa, who added the aggravating factors dividing them into local (i.e. recurrence and size of hernia), general (i.e. activity, age, obesity, bladder or prostate pathology and pulmonary disease) and final factors involving particular surgical image such as risk for the infection or technical difficulties.

The presence of above risk factors upgrade the hernia type by one in comparison to Nyhus system (18). As there is many different classifications available and there has been no consensus on the dominance of any of them, The European Hernia Society (EHS) decided to review all systems and simplify them. Their proposal is the classification that includes the anatomic location (L – lateral, M – medial, F – femoral) and the size of the hernia orifice based on the finger index as reference. In addition, every hernia may be described as primary (P) or recurrent (R) (19). Additionally, hernias may be classified as reducible or irreducible. A reducible hernia occurs when the sac is pushed back to the abdominal cavity with doctor’s manipulation or spontaneously, whereas irreducible cannot be fully reduced (tab. 2).

**Tab. 2.** EHS Groin Hernia Classification

EHS Groin Hernia Classification	Primary/Recurrent				
	0	1	2	3	x
L (lateral)					
M (medial)					
F (femoral)					

0 – no hernia detectible; 1 – < 1.5 cm (one finger); 2 – < 3 cm (two fingers); 3 – > 3 cm (more than two fingers); x – not investigated

**Clinical evaluation**

The most common symptom of this pathology is hernia or groin pain, although it may be absent in more than 30% of patients. Studies show that patients with an indirect hernia are more likely to present with pain than those with a direct hernia (20). Only 1.5% of patients described their pain as severe at rest, and 10.2% during movements (21). The sudden appearance of severe pain usually indicates strangulation and is an emergency case. Other symptoms that may be observed include increased peristalsis, tenesmus, genital or abdominal pain, nausea and vomiting. The positive correlation between the presence of inguinal hernia and lower urinary tract symptoms has also been observed (22). About 7% of patients remain asymptomatic (23). For symptomatic patients usually no pre-operative imaging investigation is necessary, because the physical examination is diagnostic. The physical examination is based on groin palpation in standing and supine position with digital exploration of inguinal canal. The palpation should be performed in relaxed position and also in the situation of increased intraabdominal pressure. Therefore, the patients should be asked to cough or to perform the Valsalva maneuver. The physical examination usually reveals a visible mass in the groin region that is easily palpable (fig. 2, 3).

Performance of the ultrasonography, computed tomography or magnetic resonance imaging should be considered in cases of occult inguinal hernia. Ultrasonography, being the non-invasive and widely available method of imaging, usually is the first choice test. The characteristic ultrasound finding for inguinal her-



**Fig. 2.** Right-sided inguinal hernia (source: own material)



**Fig. 3.** Left-sided inguinal hernia (source: own material)

nia is an abnormal intrabdominal content (fat, bowel or both) of variable echogenicity in the groin region (24). The proof for the ultrasound’s quality is its high-level specificity (0.9980) and sensitivity (0.9758) reported in recent studies (25). If the results of ultrasonography do not reveal any abnormalities, magnetic resonance imaging should be performed in order to make the final diagnosis, as it remains the most sensitive method in the diagnostic process of occult inguinal hernia (26). The differential diagnosis for inguinal hernia should be considered in two ways: possible causes of groin pain and probable sources of scrotal or groin masses. The potential diagnostic possibilities are listed in the table below (27) (tab. 3).

**Surgical management**

The aim of hernia repair is to reduce clinical symptoms, improve quality of life and prevent from adverse complications. Strangulated hernias are indications for

**Tab. 3.** Differential diagnosis of inguinal hernia

Potential causes of groin pain	Potential causes of groin/scrotal mass
<ul style="list-style-type: none"> <li>• Appendicitis</li> <li>• Adhesions</li> <li>• Inflammatory bowel diseases</li> <li>• Urinary tract infection</li> <li>• Hip pathology</li> <li>• Pelvic pathology</li> </ul>	<ul style="list-style-type: none"> <li>• Epididymitis</li> <li>• Hematoma</li> <li>• Lymphadenopathy</li> <li>• Lipoma</li> <li>• Metastatic neoplasia</li> <li>• Hydrocele</li> <li>• Femoral arterial aneurysm</li> <li>• Inguinal adenitis</li> </ul>

an emergency surgery. What is more, all symptomatic hernias should be operated electively. The question is how to deal with the asymptomatic patients? The European Hernia Society guidelines for hernia treatment accept watchful waiting for men with minimally symptomatic or asymptomatic inguinal hernia (28).

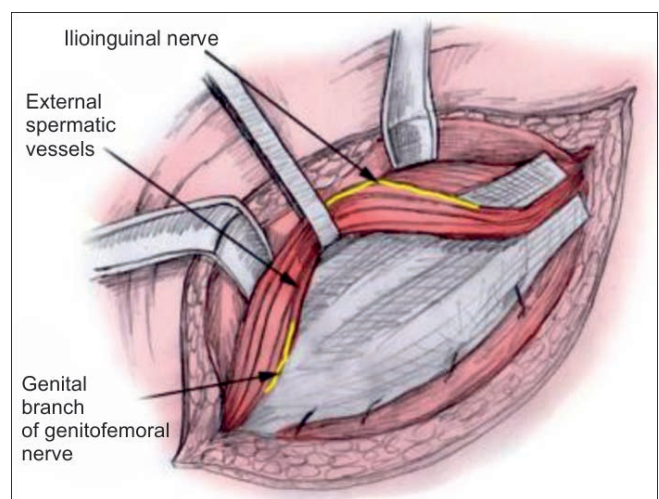
The surgical management of inguinal hernia is based on the repair of the posterior wall of the inguinal canal. There are two ways of performing hernia repair procedure: open or laparoscopic intervention. The meta-analysis shows that although endoscopic technique lasts longer (65.7 vs 55.5 min using the Lichtenstein repair), it has more advantages such as lower complications rate and significantly shorter convalescence period in comparison to the open technique (29, 30).

**OPEN TECHNIQUES**

The open techniques are based on either pure tissues approximation or tension free mesh repair. The first effective inguinal hernia repair technique was described in 1887 by Edoardo Bassini. In this method, conjoint ligament and aponeurosis of the transverse abdominal muscle are sutured by single stitches to the inguinal ligament. The spermatic cord is placed above the reconstructed posterior wall of inguinal canal. Due to the fact, that the Bassini method had high recurrence rate, it was the basis for the creation of Shouldice method (31). In this technique, the transversalis fascia is incised from the internal ring to the pubic crest and subsequently these two layers are placed on each other. This method uses two continuous sutures, going back and forth, which supplies four lines of sutures. According to studies, Shouldice herniorrhaphy is the best non-mesh technique in terms of recurrence rate, that was estimated at 3.6% (32).

Tension free hernioplasty is the method based on reinforcing the inguinal floor by insertion of a sheet of mesh. It maybe performed by either anterior or posterior approach. The most popular open-mesh technique is the Lichtenstein method that was introduced in 1978 and usually uses the anterior approach to insert one-layer polypropylene mesh as a strengthening material. The lateral edge of the mesh is sutured to the inguinal ligament, while the medial is stitched to the aponeurosis of internal oblique muscle and transversalis muscle. Proximal end of the mesh is incised in order to form two layers that embrace the spermatic cord and secure the deep inguinal ring (33). Proper fixation of

the mesh is essential to avoid mesh dislocation and reduce the postoperative chronic pain, therefore different types of mesh fixation has been investigated. The current available methods for mesh fixation include sutures, tacks or staples, self-fixing mesh and fibrin. Data comparing suture and glue mesh fixation show that tissue glue fixation is predominant in terms of operative time and post-operative pain (34, 35). The self-gripping mesh also is superior to conventional suture in Lichtenstein technique when it comes to performance time, but there is no differences in pain or other post-operative complications (36, 37). So far, there is no consensus about the best technical option for mesh fixation, therefore, it depends on the hospital's possibilities and surgeon's personal preferences. Another tension free hernia repair is Rutkow's mesh plug repair. The technique uses the umbrella shaped plug of Marlex that is inserted into the internal ring (fig. 4).



**Fig. 4.** Open mesh – repair (source: medscape.com)

**ENDOSCOPIC TECHNIQUES**

The development of videoscopic surgery brought new methods for hernia repair. Nowadays there are three techniques for laparoscopic management available: transabdominal preperitoneal repair (TAPP), intraperitoneal onlay mesh repair (IPOM) and totally extraperitoneal repair (TEP). In TEP method the mesh is inserted directly into the preperitoneal space, whereas in the TAPP technique the preperitoneal space is reached through the peritoneal cavity. The updated guidelines from the HerniaSurge Group recommend that the choice of the techniques between TAPP and TEP should be based on the surgeon's skills, education and experience as they both have comparable outcomes (38). The potential postoperative complications include seroma and hematoma formation, urinary retention, neuralgias, testicular pain and swelling, mesh or wound infection and recurrence of the hernia. The most common and serious long-term complication after surgical management of hernia repair is chronic pain, that

may refer to up to 16% of patients. The definition of chronic, post-operative pain has been defined as pain lasting at least 3 months. The potential pathogenesis includes preoperative nerves damage or possible suturing the nerves during the surgical manipulation. It may also be caused by the inflammation process around the mesh or so called “meshoma”, which is a condition when the mesh material shrinks and the nerves are trapped into it (39).

## CONCLUSIONS

Despite the fact, that groin hernias have been the object of investigations for many years, it is still an attractive topic for many researchers and clinicians. The up to date knowledge on the pathogenesis, surgical management and possible complications is needed to improve the patient's quality of life, reduce the recurrence rate and perform the best possible surgical inguinal hernia repair.

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