NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Quality in Sport. eISSN 2450-3118.

Journal Home Page
https://apcz.umk.pl/QS/index

GRELOWSKA, Aleksandra, OŁUBIEC, Adrian, OTO, Aleksandra, EJSNER, Rafał, KACZMAREK, Julia, BARCZYŃSKA, Katarzyna, BŁAŻUK, Michał, POZNAŃSKA, Nela, and SYS, Tomasz. Common and Rare Complications of Lichtenstein Inguinal Hernioplasty. Quality in Sport. 2026;54:69928. eISSN 2450-3118. https://doi.org/10.12775/QS.2026.54.69928

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. This is according to the Annex to the announcement of the Minister of Higher Education and Science dated 05.01.2024, No. 32553. The journal has a Unique Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).
The authors declare that there is no conflict of interest regarding the publication of this paper.
Received: 17.03.2026. Revised: 23.03.2026. Accepted: 23.03.2026. Published: 2.04.2026.

Common and Rare Complications of Lichtenstein Inguinal Hernioplasty

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ABSTRACT

Inguinal hernia repair remains one of the most frequently performed surgical procedures globally, with approximately 20 million operations conducted annually. While the Lichtenstein tension-free technique using polypropylene mesh is considered the "gold standard" due to its low recurrence rates and high safety profile, the procedure is still associated with a spectrum of potential complications. The most common among these include localized hematomas, seromas, surgical site infections and chronic pain. Furthermore, surgical manipulation within the spermatic cord may result in significant testicular complications. Certain outcomes, such as mesh migration or late-onset infections, may arise many years following the initial intervention. The primary strategy for mitigating these issues lies in the meticulous selection and execution of appropriate operative techniques. Rehabilitation includes early mobilization to the restoration of full physical activity. This study aims to provide a comprehensive review of the diverse range of complications associated with Lichtenstein inguinal hernioplasty.

Purpose. This study aims to characterize Lichtenstein's tension-free inguinal hernioplasty with synthetic mesh, with a particular emphasis on the analysis of common and rare postoperative complications, as well as their respective therapeutic management and preventive strategies.

Materials and methods. A review of current literature was conducted using PubMed and GoogleScholar databases for studies investigating complications after Lichtenstein tension-free hernia repair using keywords.

Results. The most common complications occur with an incidence ranging from 5% to 15% and include hematomas, seromas, surgical site infection, acute urinary retention and chronic pain. Following the procedure, rare testicular complications may arise, such as ischemic orchitis,

testicular atrophy and necrosis. Late-onset complications include mesh migration, prosthetic infection and pubic symphysis osteomyelitis.
Keywords: Lichtenstein tension-free hernia repair, mesh repair complication, rare complications, testicular complications, late-onset complications

1. Introduction

Inguinal hernia repair is one of the most frequently performed surgical procedures worldwide, with an estimated 20 million patients undergoing the operation annually [1]. Inguinal hernias account for 75% of all abdominal wall hernias. The lifetime risk of developing an inguinal hernia is approximately 27% in men and 3% in women [2]. Due to the inherent risk of incarceration and the presence of clinical symptoms, elective surgical intervention is generally the standard of care. The first tension-based repair was developed by Bassini in 1887, subsequently refined by surgeons such as Halsted and Shouldice. However, tension techniques are characterized by a high recurrence rate (approximately 15%) [3] and increased postoperative pain. The introduction of polypropylene mesh in the 1960s facilitated the development of tension-free methods, reducing recurrence rates to below 1% in specialized centers [3]. The technique developed by Irving Lichtenstein remains the gold standard for inguinal hernia repair and is recommended as the primary approach by the American College of Surgeons [4]. Given the proximity of delicate vascular and neural structures within the inguinal canal, hernia reduction requires meticulous tissue dissection. While the Lichtenstein procedure is considered safe, surgical manipulation of the spermatic cord, wound healing processes and the host's inflammatory response to synthetic mesh can lead to various complications [5,6]. The following sections of this study will discuss the most common and rare complications, which are frequently overlooked in the existing literature.

2. Anatomy of the inguinal canal

The inguinal canal originates at the deep inguinal ring superior to the inguinal ligament and courses medially and inferiorly through the layers of the abdominal wall, terminating at the superficial inguinal ring. Its length ranges from four to six centimeters [7]. The canal is composed of four walls: the anterior wall is formed by the aponeurosis of the external abdominal oblique muscle; the superior wall by the inferior margins of the internal oblique and transversus abdominis muscles; the inferior wall by the inguinal ligament; and the posterior wall by the transversalis fascia - the weakening of which is the direct cause of hernia formation [8]. In males, the inguinal canal houses the spermatic cord, which contains the testicular,

deferential and cremasteric arteries, the testicular sympathetic plexus, as well as the vas deferens, pampiniform plexus, lymphatic vessels and the cremaster muscle. The vas deferens has a thick muscularis layer, making it easily palpable during physical or intraoperative examination, while the pampiniform venous plexus surrounds the testicular artery. In females, the inguinal canal contains the round ligament of the uterus along with Sampson's artery, which may be a source of profuse hemorrhage [9] and lymphatic vessels. In both sexes, the ilioinguinal nerve, the iliohypogastric nerve and the genital branch of the genitofemoral nerve also course through the canal. Indirect inguinal hernias pass through the deep inguinal ring, whereas direct hernias protrude medially to the inferior epigastric vessels, directly through the posterior wall in the area known as Hesselbach's triangle [7,10]. This triangle is bounded medially by the rectus sheath, laterally by the inferior epigastric vessels and inferiorly by the inguinal ligament.

3. Surgical Technique of the Lichtenstein Inguinal Hernioplasty

A primary role in the pathogenesis of inguinal hernias is attributed to the dysfunction of collagen metabolism and the ratio of type I to type III collagen [11]. This leads to the impairment of fibrous connective tissue and the failure of tension-based repairs, where already damaged tissues are sutured together. The discovery of this correlation shifted surgical focus toward tension-free repair methods utilizing synthetic meshes [12]. The procedure begins with an oblique inguinal skin incision of approximately 5-6 centimeters. Following the division of the subcutaneous tissue and the aponeurosis of the external abdominal oblique muscle, the latter should be incised while bypassing the superficial inguinal ring to avoid damaging the nerves exiting at that location. Subsequently, the aponeurotic flaps must be dissected and the spermatic cord should be isolated and retracted using a drain [13]. A small hernia sac may be reduced into the peritoneal cavity, whereas larger sacs should be opened and ligated [14]. The most critical technical principles of the Lichtenstein method involve the use of a mesh of appropriate size (approximately 7.5 × 15 centimeters) in a "footprint" shape, with an overlap of about 2 centimeters over the pubic symphysis. Prior to fixation, the mesh is slit to allow the passage of the spermatic cord, creating two tails that are crossed beneath the cord [13]. The mesh is then secured with a continuous suture to the internal oblique aponeurosis and the inguinal ligament, ensuring sufficient laxity to account for changes in body position and subsequent mesh shrinkage. Crucial to the procedure is the identification of three nerves: the ilioinguinal nerve, the iliohypogastric nerve and the genital branch of the genitofemoral nerve [3,13].

4. Common Postoperative Complications

Common postoperative complications occur with an incidence of approximately 5–15% and are primarily associated with the wound healing process and the tissue's inflammatory response to surgical trauma and the polypropylene mesh foreign body. These issues frequently result in prolonged convalescence and an extended absence from professional activities [15].

Hematomas and seromas represent the most frequent early complications following hernia repair. Hematomas occur in approximately 6-9% of patients, typically resulting from inadequate hemostasis of the subcutaneous tissue or the spermatic cord vessels, particularly in patients with coagulopathies or those receiving anticoagulant therapy [16]. Seromas are observed in 2-12% of patients and develop due to fluid accumulation within the space previously occupied by the dissected hernia sac or as a reactive response to the synthetic mesh material [17]. For minor accumulations, clinical observation is recommended as they often resolve spontaneously within several weeks; furthermore, invasive intervention may introduce pathogens leading to mesh infection. However, if these collections cause significant pain, skin tension, or are exceptionally large, aspiration using an 18G needle may be considered [16].

Surgical site infection (SSI) occurs in approximately 2-4% of patients, despite elective inguinal hernia repair being classified as a clean procedure [17]. Superficial infections manifest within 30 days of surgery, involving the skin and subcutaneous tissues, with clinical signs including pain, erythema, edema and purulent discharge [18]. Aufenacker et al. conducted a multicenter, double-blind, randomized controlled trial which demonstrated no significant difference in infection rates between patients administered cefuroxime and those given a placebo, thereby suggesting that antibiotic prophylaxis may be unnecessary in low-risk patients [17]. Mesh infections account for less than one-quarter of all surgical site infections. While initial symptoms mirror those of a standard SSI, persistent symptoms accompanied by systemic signs and a lack of response to antibiotic therapy should raise suspicion of mesh involvement. In most such cases, reoperation and mesh explantation are required [19].

Acute urinary retention affects approximately 1-6% of patients [16]. This complication most commonly occurs in elderly male patients with prostatic hypertrophy following spinal anesthesia. The standard treatment involves short-term bladder catheterization [20].

Chronic post-herniorrhaphy pain is classified as pain persisting for 3 to 6 months postoperatively that exceeds the normal healing period and has no other identifiable cause. The incidence of chronic pain ranges from 1% to as high as 37%, averaging 12% and typically diminishes over time [21]. A critical etiological factor is the intraoperative injury to the ilioinguinal, iliohypogastric or the genital branch of the genitofemoral nerve. Due to the

neuropathic nature of this pain, pharmacological management often utilizes anticonvulsants such as gabapentin or pregabalin [22]. Subsequent therapeutic steps may include nerve blocks using lidocaine, corticosteroids and hyaluronic acid or surgical neurectomy [23]. Preventive measures center on the meticulous intraoperative identification of the nerves and the use of local field anesthesia [22].

5. Rare Testicular Postoperative Complications

Rare postoperative complications occur in less than 1% of patients. Although they do not constitute the majority of clinical issues, their severity poses a significant threat to both general health and male fertility. While polypropylene mesh repairs offer numerous advantages - including the absence of tension, accelerated recovery and reduced recurrence rates - they may be associated with mechanical compression of the spermatic cord contents. Direct contact between the prosthetic material and vascular structures can trigger a postoperative inflammatory response and subsequent fibrosis, leading to the constriction of arteries and veins [24]. Consequently, complications following hernia repair may impair the function of the testes and the vas deferens, potentially resulting in male infertility [25]. These rare phenomena include ischemic orchitis, testicular atrophy and necrosis.

Ischemic orchitis typically manifests 2-3 days postoperatively. Clinical presentations include pain, edema and tenderness of the testicle and spermatic cord, often accompanied by systemic symptoms such as fever, leukocytosis and elevated C-reactive protein levels. Ischemic orchitis may resolve spontaneously, but it can also progress to testicular atrophy or necrosis. Diagnostic protocols should utilize Doppler ultrasonography, which may reveal diminished flow in the testicular artery and an increased resistive index, both of which are indicative of testicular ischemia. Management requires emergency surgical intervention to release the vessels compressed by the mesh and to debride any necrotic tissue. Orchidectomy may be necessary if testicular necrosis is confirmed. In cases of untreated inflammation, symptoms such as swelling and tenderness may persist for several weeks, gradually evolving into testicular atrophy [24].

The incidence of testicular atrophy is less than 0.5% following primary hernia repair but increases to 5% in recurrent cases [26]. An atrophic testicle is typically painless, non-tender and significantly reduced in size. This condition is currently attributed to acute thrombosis of the pampiniform venous plexus rather than primary acute arterial injury, given the collateral blood supply provided to the testis via the inferior epigastric, vesical, prostatic and scrotal arteries [24]. This hypothesis is further supported by the presence of typical thrombotic symptoms and the relative rarity of gangrene. Generally, there is no effective treatment for

established testicular atrophy. The renowned hernia researcher Halsted observed that excision of the spermatic cord was associated with a markedly higher rate of postoperative ischemic orchitis [27]. However, a comprehensive explanation for these complications remains elusive. A 1971 study by Heifetz et al. indicated that even after intentional occlusion of the spermatic cord, ischemic orchitis failed to manifest in approximately one-third of cases [28]. The repair of large scrotal hernias and recurrent hernias carries a particularly high risk of ischemic orchitis and atrophy.

Intraoperatively, a necrotic testis can be distinguished from reversible ischemic orchitis by the absence of bleeding, which confirms infarction. A necrotic testis must be removed, as it may lead to infertility through the induction of antisperm autoimmunity. Notably, the incidence of unilateral vas deferens obstruction in subfertile men with a history of pediatric inguinal hernia repair has been reported to be as high as 27.8% [28]. In cases of atrophy, the seminiferous tubules responsible for spermatozoa production are usually absent, which can be a direct cause of infertility. However, an atrophic testis smaller than 2 centimeters may still secrete adequate levels of testosterone due to the preservation of Leydig cells, which only lose function in cases of profound atrophy [25].

The vas deferens may be compressed, perforated or transected during surgery due to cord manipulation or excessively tight mesh placement. While transection may be identified intraoperatively, compression or crush injuries are often only diagnosed later during infertility evaluations. The incidence of such injuries ranges from 0.1% to 0.53% [25]. Common consequences include the formation of spermatic granulomas and epithelial dysfunction. Bilateral testicular impairment may occur through the formation of antisperm autoantibodies (ASA) and a decrease in contralateral testicular blood flow mediated by sympathetic vasospasm [29]. These injuries can lead to oligospermia and azoospermia. In such instances, microsurgical reconstruction via vasovasostomy should be attempted.

6. Rare Complications

During inguinal hernia repair, injury to the iliac artery or vein may occur, potentially leading to the subsequent development of a retroperitoneal hematoma. This is an extremely rare but potentially fatal complication, particularly in patients receiving anticoagulant therapy. Fujikawa et al. described such a complication in a 68-year-old patient managed with warfarin and bridged with heparin, who presented with pain and swelling of the left flank on the second postoperative day. Computed tomography confirmed the diagnosis of a retroperitoneal hematoma. The patient was managed conservatively with bed rest, intravenous fluid

resuscitation, packed red blood cell transfusions and analgesics. Warfarin was discontinued and protamine was administered. The patient was subsequently discharged in good clinical condition [30].

7. Late-Onset mesh-related complications

Despite the use of modern materials, a polypropylene mesh remains a foreign body that persists within the organism for a prolonged period. Late-onset complications are often a consequence of the structural and chemical properties of the mesh, which may eventually lead to material migration.

The migration of a mesh or a "mesh plug" into the urinary bladder is a rare phenomenon. This complication may manifest between 3 months and 25 years postoperatively, resulting from chronic mechanical pressure exerted by the mesh on the bladder wall, particularly in cases of malpositioning or subclinical infection [31]. The risk is further elevated in indirect inguinal hernia repairs where the mesh is sutured directly to the transversalis fascia. This condition should be suspected when a patient with a history of inguinal hernioplasty presents with recurrent, treatment-resistant urinary tract infections, hematuria, pyuria, polyuria or dysuria, as well as bladder calculi. Diagnosis is typically confirmed via computed tomography and cystoscopy, which can visualize the migrated mesh within the bladder wall. Management necessitates surgical intervention, involving either partial cystectomy or bladder-sparing mesh excision [31].

Similarly, the migration of polypropylene mesh or plugs into the gastrointestinal tract is a rare, chronic process that may occur between 10 days and 26 years after the primary surgery. The risk increases in cases of large indirect inguinal hernias where the bowel segments maintain direct contact with the prosthetic material [31]. Symptoms are often nonspecific and may remain undiagnosed for extended periods, frequently being confirmed only during exploratory surgery. In left-sided repairs, migration into the sigmoid colon may present with hematochezia and localized pain. Conversely, right-sided migration typically involves the small intestine or the cecum, potentially leading to intestinal obstruction. Treatment requires surgical resection of the affected tissues followed by anastomosis, occasionally necessitating a temporary colostomy [32]. Kouakou et al. (2018) reported a case of an entero-cutaneous fistula developing from a hernia mesh, resulting in the discharge of fecal matter. The management involved mesh explantation and ileocolectomy. Six months later the hernia was successfully repaired using the tension-based Bassini technique [33].

Mesh infections are categorized into early-onset (within 30 days postoperatively) and late-onset, occurring months or years after the procedure. While early infections are typically the result of perioperative contamination, late-onset deep mesh infections are usually caused by bacteria forming a biofilm on the mesh surface. This biofilm protects the pathogens from both antimicrobial agents and the host immune system, failing to address the nidus of infection. Clinical manifestations include chronic pain, tenderness, erythema and edema, sometimes accompanied by fistulous tracts with purulent discharge. In a retrospective study by Chen et al. the incidence of such infections was 0.3% (8 out of 2,666 cases) with cultures yielding Staphylococcus aureus, Enterobacter cloacae and Pseudomonas aeruginosa. Ultrasonography and magnetic resonance imaging are valuable diagnostic tools. Standard treatment involves targeted antibiotic therapy based on cultures, followed by the surgical removal of the mesh, fibrotic adhesions and involved lymph nodes. Notably, one patient in the study was successfully managed conservatively through abscess drainage and antibiotics [34].

Pubic symphysis osteomyelitis is an extremely rare complication following inguinal hernia repair, occurring when an infection spreads from the mesh to the periosteum of the pubic tubercle. Symptoms include severe lower back and perineal pain that exacerbates during ambulation, pubic symphysis tenderness and a wide-based gait. Imaging studies, such as X-ray, CT, or MRI are essential for diagnosis, typically revealing bony erosion and destruction with periostitis. Laboratory findings often show leukocytosis along with elevated C-reactive protein and erythrocyte sedimentation rate (ESR). Management is prolonged, requiring a six-week course of antibiotics and, in some cases, surgical debridement of the infected bone tissue [35].

8. Strategies for the Prevention of Postoperative Complications in Lichtenstein Hernioplasty

While certain postoperative complications occur regardless of patient predisposition, surgeons can implement subtle technical refinements to minimize adverse outcomes. Messias et al. outlined specific recommendations for the Lichtenstein procedure that significantly enhance long-term surgical results [13]. Although the meticulous identification of the ilioinguinal nerve, the iliohypogastric nerve and the genital branch of the genitofemoral nerve may extend the operative time by several minutes, their preservation is crucial in protecting the patient from chronic postoperative pain. Precise dissection of the inguinal region is mandatory, as complications such as hematomas, seromas and infections are recognized independent risk factors for the development of chronic pain. The subcutaneous tissue should be stratified with caution, as it houses the ilioinguinal and iliohypogastric nerves. Whenever possible, nerve

manipulation should be restricted and the protective fascia of the internal oblique muscle should be preserved to prevent direct contact between the nerves and the prosthetic mesh. Furthermore, maintaining the deep fascia of the cremaster muscle (in males) or the round ligament of the uterus (in females) during spermatic cord dissection safeguards the genital branch of the genitofemoral nerve. In the event of complete intraoperative nerve transection, the nerve should be excised as proximally as possible, ligated with absorbable sutures and implanted within the fibers of the internal oblique muscle. The spermatic cord should be dissected using forceps - avoiding vigorous manual manipulation - and retracted with a Penrose drain [13].

The cremasteric fibers are incised transversely at the level of the deep inguinal ring to identify an indirect hernia sac or a spermatic cord lipoma. A cord lipoma, which is a protrusion of extraperitoneal fat, is present in 20-70% of patients. Failure to excise it is the leading cause of "pseudo-recurrence" following Lichtenstein repair, as the residual lipoma may mimic a persistent hernia [36]. Excision of the cremaster muscle itself should be avoided, as it is associated with a higher risk of testicular complications, ischemic orchitis and postoperative pain. Additionally, the femoral canal should be assessed for a concomitant femoral hernia - either through the hernia sac or Bogros' space - particularly in female patients. If a femoral hernia is identified, the mesh should be modified with a triangular extension on its inferior margin [13].

In cases of indirect hernias, the sac should be freed from the cord and reduced without ligation to minimize postoperative discomfort. For direct hernias, the transversalis fascia should be reinforced with a continuous absorbable suture or a purse-string suture to restore anatomical integrity. The polypropylene mesh should be "footprint-shaped" and sufficiently large (approximately 7.5 × 15 cm), featuring a greater medial curvature to fit between the inguinal ligament and the rectus sheath and a lesser lateral curvature [13].

Available meshes vary in pore size, weight, tensile strength and elasticity. Lightweight meshes (< 40 g/m²) are characterized by a reduced inflammatory response and a decreased foreign body sensation. Porosity allows for fibroblastic ingrowth, therefore the use of large-pore, lightweight meshes with a tensile strength exceeding 16 N/m² is considered optimal [13]. Correct fixation is essential to prevent mesh migration or folding. The medial border should be secured with two absorbable sutures: one in the rectus abdominis sheath and the other in the internal oblique aponeurosis at the level of the deep inguinal ring. These sutures must be tied loosely to prevent tissue necrosis and chronic pain. The mesh is subsequently anchored to the inguinal ligament using a continuous non-absorbable suture, with the needle passed up to four

times. The mesh tails should overlap and a slight redundancy in the fixed mesh ensures that movement does not create tension in the inguinal region or compress the spermatic cord [13].

9. Postoperative functional rehabilitation: returning to full physical activity

Postoperative rehabilitation is equally vital for achieving full functional recovery. During the first two weeks, patients should avoid heavy lifting and limit physical activity to short walks. By the fourth week, walking duration may be extended to 30 minutes. Scar mobilization, isometric abdominal exercises and stretching may be initiated. From the fifth week, core stabilization exercises can begin with a gradual increase in load-bearing up to 10-15 kg. Patients may typically return to full pre-operative physical activity after eight weeks [36].

10. Conclusion

Inguinal hernia repair utilizing polypropylene mesh remains the gold standard for this procedure, maintaining a high safety profile. However, like any surgical intervention, it is not without inherent risks. Common postoperative complications, such as hematomas and seromas, typically require clinical observation and are transient in nature. Conversely, surgical site infections and acute urinary retention necessitate prompt and effective causative treatment. In the prevention of chronic post-herniorrhaphy pain, the most critical factor is the meticulous dissection of tissues during the initial procedure.

Rare complications - including ischemic orchitis, testicular atrophy, necrosis, infertility and retroperitoneal hematoma - occur with significantly lower frequency but exert a profound impact on the patient's quality of life. To mitigate these risks, a thorough command of regional anatomy and an awareness of technical refinements, stemming from surgical experience, are essential. Late-onset complications such as mesh migration into the bladder or gastrointestinal tract, fistula formation, late infections and pubic symphysis osteomyelitis may manifest many years after the primary surgery. Consequently, obtaining a detailed patient history is paramount, as it can guide the clinician in linking nonspecific symptoms to a correct diagnosis.

In contemporary practice the surgeon must perform the Lichtenstein hernioplasty with absolute precision at every stage, as this determines both clinical success and patient satisfaction. The continued evolution of prosthetic materials and the advancement of intraoperative imaging techniques, such as intraoperative ultrasonography, will further serve to reduce the incidence of complications in the future.

Disclosure

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All authors have read and agreed to the published version of the manuscript

Funding: This research received no external funding

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable

Conflicts of Interest:The authors declare no conflict of interest

Declaration of generative AI and AI-assisted technologies in the writing process: In preparing this work, the authors used Gemini to improve the language quality and grammar correction only. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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